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Application Number: 17203292 Document Date: 03/16/2021

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Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/AIA/424 (04-14)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Jonathan O'TOOLE	Nonprovisional Application Number (if known):	
Title of Invention:	BREAST PUMP SYSTEM		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently $0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.

2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.

3. The applicable box is checked below:

I. ☑ Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, **or** the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.

II. ☐ Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Mark D. Simpson/	Date 2021-03-16
Name (Print/Typed) Mark D. Simpson	Practitioner Registration Number 32942

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☑ *Total of 1 forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	373499.00057
	Application Number	
Title of Invention	BREAST PUMP SYSTEM	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jonathan		O'TOOLE	

Residence Information (Select One) US Residency ● Non US Residency Active US Military Service

City	London	Country of Residence [i]	GB

Mailing Address of Inventor:

Address 1	c/o Chiaro Technology Limited
Address 2	63-66 Hatton Garden

City	London	State/Province	
Postal Code	EC1N 8LE	Country [i]	GB

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Adam		ROLLO	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	London	Country of Residence [i]	GB

Mailing Address of Inventor:

Address 1	c/o Chiaro Technology Limited
Address 2	63-66 Hatton Garden

City	London	State/Province	
Postal Code	EC1N 8LE	Country [i]	GB

Inventor 3 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	373499.00057
	Application Number	
Title of Invention	BREAST PUMP SYSTEM	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Andrew		CARR	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	London	Country of Residence [i]	GB

Mailing Address of Inventor:

Address 1	c/o Chiaro Technology Limited		
Address 2	63-66 Hatton Garden		
City	London	State/Province	
Postal Code	EC1N 8LE	Country [i]	GB

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	78905		
Email Address	patents@saul.com	Add Email	Remove Email

Application Information:

Title of the Invention	BREAST PUMP SYSTEM		
Attorney Docket Number	373499.00057	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	44	Suggested Figure for Publication (if any)	1

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	373499.00057
	Application Number	
Title of Invention	BREAST PUMP SYSTEM	

Publication Information:

☐	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐	**Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	78905		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	17181057	2021-02-22
Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
17181057	Continuation of	16009547	2018-06-15

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	373499.00057
	Application Number	
Title of Invention	BREAST PUMP SYSTEM	

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
1709561.3	GB	2017-06-15	1DE1

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
1709564.7	GB	2017-06-15	B3B5

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
1709566.2	GB	2017-06-15	D6F6

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
1809036.5	GB	2018-06-01	D82C

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	373499.00057
	Application Number	
Title of Invention	BREAST PUMP SYSTEM	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	373499.00057
	Application Number	
Title of Invention	BREAST PUMP SYSTEM	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	CHIARO TECHNOLOGY LIMITED		
Mailing Address Information For Applicant:			
Address 1	63-66 Hatton Garden		
Address 2			
City	London	**State/Province**	
Country	GB	Postal Code	EC1N 8LE
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	373499.00057
	Application Number	
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Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Mark D. Simpson/			Date (YYYY-MM-DD)	2021-03-16
First Name	Mark D.	Last Name	Simpson	Registration Number	32942

Additional Signature may be generated within this form by selecting the Add button. Add

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	373499.00057
	Application Number	
Title of Invention	BREAST PUMP SYSTEM	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

BREAST PUMP SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation of U.S. Application No. 17/181,057, filed on February 22, 2021, which is a U.S. Application No. 16/009,547, filed on June 15, 2018, which is based on, and claims priority to, GB Application No. 1709561.3, filed June 15, 2017; GB Application No. 1709564.7, filed on June 15, 2017; GB Application No. 1709566.2, filed on June 15, 2017; and GB Application No. 1809036.5, filed on June 1, 2018, the entire contents of each of which being fully incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The field of the invention relates to a breast pump system; one implementation of the system is a wearable, electrically powered breast pump system for extracting milk from a mother.

A portion of the disclosure of this patent document contains material, which is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure, as it appears in the Patent and Trademark Office patent file or records, but otherwise reserves all copyright rights whatsoever.

2. Description of the Prior Art

The specification of the present disclosure is broad and deep. We will now describe the prior art in relation to key aspects of the present disclosure.

Prior art related to breast pump systems

A breast pump system is a mechanical or electro-mechanical device that extracts milk from the breasts of a lactating woman.

A typical breast pump design is as shown in WO 96/25187 A1. A large suction generating device is provided, which is freestanding. This is attached by air lines to one

or two breast shields which engage with the user's breasts. A pressure cycle is applied from the suction generating device, via the air lines, to the breast shields. This generates a pressure cycle on the user's breasts to simulate the suction generated by a feeding child.

The suction generating device is a large component that connects to mains power to operate the pumps therein. Milk collection bottles are provided to store the expressed breast milk. In the system of WO 96/36298 A1 separate bottles are provided attached to each breast shield. A single bottle with tubing connecting to each breast shield may also be used. But for a mother to use this discretely, such as in an office environment, specialised bras must be used. In particular, breast-pumping bras which have a central slit, for the nipple tunnel of the breast shield to extend through, are typically used. The breast shield is held within the bra, with the suction generating device and milk bottle outside the bra.

The fundamental breast pump system has not significantly evolved from this approach, only minor technical improvements have been made.

However, these systems present a number of significant disadvantages. As the suction generating device is a large freestanding unit connected to mains power, the user may feel tethered to the wall. The known devices typically also require a specific user posture and undressing to function normally. This is obviously difficult for a user to do discretely, such as in an office setting. The known devices are also typically noisy, uncomfortable, and hard to clean.

Fully integrated wearable breast pump systems have begun to enter the market, such as described in US 2016 0206794 A1. In such pump systems, the suction source, power supply and milk container are contained in a single, wearable device; there is no need for bulky external components or connections. Such devices can be provided with a substantially breast shaped convex profile so as to fit within a user's bra for discrete pumping, as well as pumping on-the-go without any tethers to electrical sockets or collection stations. The internal breast shield is naturally convex to fit over a breast.

In US 2016 0206794 A1, when viewed from the front, the breast pump device has a 'tear-drop' rounded shape, fuller at its base than at its top. But it uses collapsible bags as

milk collection devices. As the collection bag systems are collapsible, it can be difficult for a user to extract all of their milk from the bag, due to the small cut opening that is needed and the capillary action between the bonded plastic sheets that form the bag. This waste can be disheartening for the user, as this is food for their child. The bags are also not re-usable, so the user is required to purchase and maintain a stock of these. As well as presenting a recurring cost, if the user runs out of stock they are unable to use the product until more bags are purchased.

Furthermore, as a result of the collapsible bags, a complex and somewhat noisy pumping arrangement is necessary. In particular, the breast shield connects to a tube which is provided with compression units which "step" the expressed milk through the tube to the collection bag. This uses the breast milk as a hydraulic fluid to generate suction on the breast. In order to carry this out, a complex sequenced pulsing arrangement must be implemented.

In addition to these systems being particularly complex and wasteful, only a relatively small bag can be used. In US 2016 206794, approximately 110 ml (4 fluid ounces) of milk can be collected before the bag must be changed. While this may be sufficient for some users, others may produce much more milk in a session.

A further integrated wearable breast pump system is shown in US 2013 0023821 A1. In the third embodiment in this document, the breast pump system includes a motor driven vacuum pump and power source. An annular (or punctured disc) membrane is provided, with the flow path of the milk going through the centre of the annulus. The membrane is housed in separate housing and is sealed at its inner and outer edges. The breast shield has a small protrusion to engage with these housing components. However, the design of this breast pump system results in a number of problems. The use of an annular membrane, with the fluid flow path running through the opening of the annulus is undesirable as it results in a large and bulky device. There is therefore a need for improved integrated breast pump systems.

Prior Art related to liquid measurement systems

In the context of breast pump systems, it is useful to measure the quantity of expressed milk. One way to do this is to have a clear container for the breast pump, through which

the level of expressed milk inside the container can be seen. However, viewing the milk bottle is not always possible, for example in a breast pump that collects milk while being worn inside a maternity bra.

An existing apparatus for detecting the level of liquid inside a container of a breast pump is that disclosed in US 2016/296681. In this apparatus, a sensing mechanism is provided at the top of a container, which detects droplets of liquid, specifically breast milk, entering the container. By detecting these droplets entering the container, the apparatus can determine the quantity of liquid which enters the container. In this apparatus, an accurate indication of the level of liquid in the container is reliant on the sensing mechanism being able to accurately record every droplet entering the container.

Particularly at times when liquid enters the container at a high flow rate, this accuracy cannot be guaranteed, leading to significant cumulative errors. An accurate indication of the level of liquid in the container in this apparatus is also reliant on the sensing mechanism always being on during the pumping process, so that power consumption of the sensing mechanism is correspondingly high.

In view of the above, there is the need for an improved way to determine the level of liquid inside a container connected to a breast pump.

Prior Art related to bra clips

Many specialised bras (or brassieres) exist for maternity use and that facilitate nursing and/or breast pumping for milk collection, without the need to remove the bra itself. In a traditional nursing bra, this is achieved with the use of an at least partially detachable cup, which can be unhooked for feeding and/or pumping.

Further specialised bras are known which are provided with cut-out portions or slits which substantially align with the wearer's areola and nipple. Traditional breast pump systems comprise an elongate breast shield which extends away from the breast towards an external bottle and source of suction. The breast shield is arranged to extend through the cut-out portion or slit, with the collection bottle and pumping apparatus placed outside of the bra. These systems require the user to remove or unbutton any over-garments, and are uncomfortable when not pumping.

Integrated, wearable breast pump systems have begun to enter the market, such as previously noted US 2016 0206794 A1. In such pumps, the suction source, power supply and milk container are all in a single, wearable device, as noted above, without the need for bulky external components or connections. Such devices can be provided with a substantially breast shaped profile so as to fit within a user's bra for discrete pumping, as well as pumping on-the-go without any tethers to electrical sockets or collection stations.

Maternity (or nursing) bras such as disclosed in US 4,390,024 A have partially detachable cups, with several hooks provided along the bra strap for attaching the cups to the strap. The cups can then be attached to different hooks in order to adjust the bra strap length. However, these attachment points are fixed. Additionally, this bra has been designed to accommodate the change in breast size before and after the feeding/pumping process. It is not designed to accommodate a breast pump. Accordingly, there is a need for a better system to accommodate integrated wearable breast pumps.

SUMMARY OF THE INVENTION

The invention is a wearable breast pump system including: a housing shaped at least in part to fit inside a bra; a piezo air-pump fitted in the housing and forming part of a closed loop system that drives a separate, deformable diaphragm to generate negative air pressure, that diaphragm being removably mounted on a breast shield.

BRIEF DESCRIPTION OF THE FIGURES

Aspects of the invention will now be described, by way of example(s), with reference to the following Figures, which each show features of various implementations of the invention including optional features that may be utilised:

Figure 1 is a front view of an assembled breast pump system.

Figure 2 is a rear view of the assembled breast pump system of Figure **1**.

Figure 3 is a front view of a partially disassembled breast pump system.

Figure 4 is a rear view of the partially disassembled breast pump system of Figure 3.

Figure 5 is a front view of a further partially disassembled breast pump system.

Figure 6 is a rear view of the further partially disassembled breast pump system of Figure 5.

Figure 7 is a front view of the breast pump system of Figure **1**, with the outer shell translucent for ease of explanation.

Figure 8 is a further front view of the breast pump system of Figure **1**, with the front of the outer shell removed for ease of explanation.

Figure 9 is a schematic view of a nipple tunnel for a breast shield.

Figure 10 is a schematic of a pneumatic system for a breast pump system.

Figure 11 is a schematic of an alternative pneumatic system for a breast pump system.

Figure 12 is a schematic of a further alternative pneumatic system for a breast pump system.

Figure 13 is a graph depicting measured pressure in the breast pump system of Figure **12** over time.

Figure 14 shows schematics for breast shield sizing and nipple alignment.

Figure 15 shows a screenshot of an application running on a device connected to the breast pump system.

Figure 16 shows a screenshot of an application running on a device connected to the breast pump system.

Figure 17 shows a screenshot of an application running on a device connected to the breast pump system.

Figure 18 shows a screenshot of an application running on a device connected to the breast pump system.

Figure 19 shows a screenshot of an application running on a device connected to the

breast pump system.

Figure 20 shows a screenshot of an application running on a connected device.

Figure 21 shows a screenshot of an application running on a connected device.

Figure 22 shows a screenshot of an application running on a connected device.

Figure 23 shows a screenshot of an application running on a connected device.

Figure 24 shows a screenshot of an application running on a connected device.

Figure 25 shows a screenshot of an application running on a connected device.

Figure 26 shows a diagram of a breast pump sensor network,

Figure 27 shows a sectional view of a device being used to determine the level of liquid in a container;

Figure 28 shows a sectional view of the device and the container from Figure 27 being used at a different orientation.

Figure 29 shows a sectional view of the device and the container from Figure 27 being used whilst undergoing acceleration.

Figure 30 shows a sectional view of the device from Figure 27 being used as part of a breast pump assembly.

Figure 31 shows a sectional view of a device connected between a container and its lid, and which is operable to determine the level of liquid inside the container.

Figure 32 depicts a prior art design for a maternity bra;

Figure 33 depicts a clip and clasp being fitted to a maternity bra.

Figure 34 depicts an alternative clip for adjustment of a maternity bra.

Figure 35 depicts the alternative clip of Figure 34.

Figure 36 depicts an alternative clip for adjustment of a maternity bra.

Figure 37 depicts an alternative clip for adjustment of a maternity bra.

Figure 38 depicts an alternative clip for adjustment of a maternity bra.

Figure 39 depicts adjustment of the maternity bra of Figure 37.

Figure 40 shows a configuration with two piezo pumps mounted in series.

Figure 41 shows a configuration of two piezo pumps mounted in parallel.

Figure 42 shows a plot of the air pressure generated as a function of time by two piezo pumps mounted in series and mounted in parallel respectively.

Figure 43 shows a plot of the air pressure generated as a function of time by two piezo pumps mounted in a dual configuration.

Figure 44 shows a figure of a pump including two piezo pumps in which each piezo pump is connected to a heat sink.

DETAILED DESCRIPTION

We will now describe an implementation of the invention, called the Elvie™ pump, in the following sections:

Section A: The Elvie™ Breast Pump System

Section B: An IR System

Section C: A Bra Clip

Section D: Piezo Pumps and Wearable Devices

Section A: The Elvie™ Breast Pump System

1. Elvie™ Breast Pump System Overview

An implementation of the invention, called the Elvie™ pump, is a breast pump system that is, at least in part, wearable inside a bra. The breast pump system comprises a breast shield for engagement with the user's breast, a housing for receiving at least a portion of the breast shield and a detachable rigid milk collection container attachable, in use, to a lower face of the housing and connected to the breast shield for collecting milk expressed by the user, with a milk-flow pathway defined from an opening in the breast shield to the milk collection container. The housing inside also includes a pump for generating a negative pressure in the breast shield, as well as battery and control electronics Unlike other wearable breast pumps, the only parts of the system that come into contact with milk in normal use are the breast shield and the milk container; milk only flows through the breast shield and then directly into the milk container. Milk does not flow through any parts of the housing at all, for maximum hygiene and ease of cleaning.

With reference to Figure 1 and Figure 2, the assembled breast pump system 100 includes a housing 1 shaped to substantially fit inside a bra. The housing 1 includes one or more pumps and a rechargeable battery. The breast pump system includes two parts that are directly connected to the housing 1: the breast shield 7 and a milk container 3. The breast shield 7 and the milk container 3 are directly removable or attachable from the housing 1 in normal use or during normal dis-assembly (most clearly shown in Figure 5). All other parts that are user-removable in normal use or during normal dis-assembly are attached to either the breast shield 7 or the milk container 3. The breast shield 7 and milk container 3 may be removed or attached for example using a one click or one press action or a push button or any other release mechanism. Audible and/or haptic feedbacks confirm that the pump is properly assembled.

The modularity of the breast pump allows for easy assembly, disassembly and replacement of different parts such as the breast shield and milk collection container. This also allows for different parts of the pump to be easily washed and/or sterilised. The breast shield and bottle assembly, both of which are in contact with milk during

pumping, may therefore be efficiently and easily cleaned; these are the only two items that need to be cleaned; in particular, the housing does not need to be cleaned.

The housing **1**, breast shield 7 that is holding a flexible diaphragm, and milk container 3 attach together to provide a closed-loop pneumatic system powered by piezoelectric pumps located in the housing 1. This system then applies negative pressure directly to the nipple, forms an airtight seal around the areola, and provides a short path for expressed milk to collect in an ergonomically shaped milk container 3.

The different parts of the breast shield system are also configured to automatically self-seal under negative pressure for convenience of assembly and disassembly and to reduce the risk of milk spillage. Self-sealing refers to the ability of sealing itself automatically or without the application of adhesive, glue, or moisture (such as for example a self-sealing automobile tire or self-sealing envelopes). Hence once the breast pump system is assembled it self-seals under its assembled condition without the need to force seals into interference fits to create sealed chambers. A degree of interference fitting is usual however, but is not the predominating attachment mechanism. Self-sealing enables simple components to be assembled together with a light push: for example, the diaphragm just needs to be placed lightly against the diaphragm housing; it will self-seal properly and sufficiently when the air-pump applies sufficient negative air-pressure. The diaphragm itself self-seals against the housing when the breast shield is pushed into the housing. Likewise, the breast shield self-seals against the milk container when the milk container is pushed up to engage the housing. This leads to simple and fast assembly and dis-assembly, making it quick and easy to set the device up for use, and to clean the device after a session.

Self-sealing has a broad meaning and may also relate to any, wholly or partly self-energising seals. It may also cover any interference seals, such as a press seal or a friction seal, which are achieved by friction after two parts are pushed together.

Whilst one particular embodiment of the invention's design and a specific form of each of the parts of the breast pump system is detailed below, it can be appreciated that the overall description is not restrictive, but an illustration of topology and function that the design will embody, whilst not necessary employing this exact form or number of

discrete parts.

The breast pump system 100 comprises a housing 1 and a milk collection container (or bottle) 3. The housing 1 (including the one or more pumps and a battery) and the container 3 are provided as a unit with a convex outer surface contoured to fit inside a bra. The milk collection container 3 is attached to a lower face 1A of the housing 1 and forms an integral part of the housing when connected, such that it can be held comfortably inside a bra. While the breast pump 100 may be arranged to be used with just the right or the left breast specifically, the breast pump 100 is preferably used with both breasts, without modification. To this end, the outer surfaces of the breast pump 100 are preferably substantially symmetrical.

Preferably, the width of the complete breast pump device (housing 1 and milk container 3) is less than 110 mm and the height of the complete breast pump device is less than 180 mm.

Overall, the breast pump system 100 gives discrete and comfortable wear and use. The system weighs about 224 grams when the milk container is empty, making it relatively lighter as compared to current solutions; lightness has been a key design goal from the start, and has been achieved through a lightweight piezo pump system and engineering design focussed on minimising the number of components.

The breast pump system 100 is small enough to be at least in part held within any bra without the need to use a specialized bra, such as a maternity bra or a sports bra. The rear surface of the breast pump is also concave so that it may sit comfortably against the breast. The weight of the system has also been distributed to ensure that the breast pump is not top heavy, ensuring comfort and reliable suction against the breast. The centre of gravity of the pump system is, when the container is empty, substantially at or below the horizontal line that passes through the filling point on the breast shield, so that the device does not feel top-heavy to a person while using the pump.

Preferably, when the container is empty, the centre of gravity is substantially at or below the half-way height line of the housing so that the device does not feel top-heavy to a user using the pump.

The centre of gravity of the breast pump, as depicted by Figure 1, is at around 60mm high on the centreline from the base of the breast pump when the milk container is empty. During normal use, and as the milk container gradually receives milk, the centre of gravity lowers, which increases the stability of the pump inside the bra. It reduces to around 40mm high on the centreline from the base of the breast pump when the milk container is full.

The centre of gravity of the breast pump is at about 5.85mm below the centre of the nipple tunnel when the milk container is empty, and reduced to about 23.60mm below the centre of the nipple tunnel when the milk container is full. Generalising, the centre of gravity should be at least 2mm below the centre of the nipple tunnel when the container is empty.

The breast pump 100 is further provided with a user interface 5. This may take the form of a touchscreen and/or physical buttons. In particular, this may include buttons, sliders, any form of display, lights, or any other componentry necessary to control and indicate use of the breast pump 100. Such functions might include turning the breast pump 100 on or off, specifying which breast is being pumped, increasing or decreasing the peak pump pressure. Alternatively, the information provided through the user interface 5 might also be conveyed through haptic feedback, such as device vibration, driven from a miniature vibration motor within the pump housing 1.

In the particular embodiment of the Figures, the user interface 5 comprises power button 5A for turning the pump on and off. The user interface 5 further comprises pump up button 5B and pump down button 5C. These buttons adjust the pressure generated by the pump and hence the vacuum pressure applied to the user's breast. In preferable embodiments, the pump up button 5B could be physically larger than the pump down button 5C. A play/pause button 5D is provided for the user to interrupt the pumping process without turning the device off.

The user interface 5 further comprises a breast toggle button 5E for the user to toggle a display of which breast is being pumped. This may be used for data collection, e.g. via an application running on a connected smartphone; the app sends data to a remote server, where data analysis is undertaken (as discussed in more detail later), or for the user to keep track of which breast has most recently been pumped. In particular, there may be a

pair of LEDs, one to the left of the toggle button 5E and one to the right. When the user is pumping the left breast, the LED to the right of the toggle button 5E will illuminate, so that when the user looks down at the toggle it is the rightmost LED from their point of view that is illuminated. When the user then wishes to switch to the right breast, the toggle button can be pressed and the LED to the left of the toggle button 5E, when the user looks down will illuminate. The connected application can automatically track and allocate how much milk has been expressed, and when, by each breast.

The breast pump system also comprises an illuminated control panel, in which the level of illumination can be controlled at night or when stipulated by the user. A day time mode, and a less bright night time mode that are suitable to the user, are available. The control of the illumination level is either implemented in hardware within the breast pump system itself or in software within a connected device application used in combination with the breast pump system.

As depicted in Figure 1, the housing **1** and milk collection container 3 form a substantially continuous outer surface, with a generally convex shape. This shape roughly conforms with the shape of a 'tear-drop' shaped breast. This allows the breast pump 100 to substantially fit within the cup of a user's bra. The milk collection container 3 is retained in attachment with the housing **1** by means of a latch system, which is released by a one-click release mechanism such as a push button 2 or any other one-handed release mechanism. An audible and/or haptic feedback may also be used to confirm that the milk collection container 3 has been properly assembled.

The European standard EN 13402 for Cup Sizing defines cup sizes based upon the bust girth and the underbust girth of the wearer and ranges from AA to Z, with each letter increment denoting an additional 2 cm difference. Some manufacturers do vary from these conventions in denomination, and some maternity bras are measured in sizes of S, M, L, XL, etc. In preferred embodiments, the breast pump 100 of the present invention corresponds to an increase of between 3 or 4 cup sizes of the user according to EN 13402.

A plane-to-plane depth of the breast pump can also be defined. This is defined as the distance between two parallel planes, the first of which is aligned with the innermost

point of the breast pump 100, and the second of which is aligned with the outermost point of the breast pump 100. This distance is preferably less than 100 mm.

Figure 2 is a rear view of the breast pump 100 of Figure 1. The inner surface of the housing 1 and milk collection container 3 are shown, along with a breast shield 7. The housing 1, milk collection container 3 and breast shield 7 form the three major subcomponents of the breast pump system 100. In use, these sub-components clip together to provide the functioning breast pump system 100. The breast shield 7 is designed to engage with the user's breast, and comprises a concave inner flange 7A which contacts the breast. To allow the breast pump 100 to be used on either of the user's breasts, the breast shield 7 is preferably substantially symmetrical on its inner flange 7A.

The inner flange 7A is substantially oval-shaped. While the inner flange 7A is concave, it is relatively shallow such that it substantially fits the body form of the user's breast. In particular, when measured side-on the inner-most point of the flange 7A and the outer-most point may be separated by less than 25 mm. By having a relatively shallow concave surface, the forces applied can be spread out over more surface area of the breast. The flatter form also allows easier and more accurate location of the user's nipple. In particular, the flange 7A of the breast shield 7 may extend over the majority of the inner surface of the housing 1 and milk collection container 3. Preferably, it may extend over 80% of this surface. By covering the majority of the inner surface, the breast shield is the only component which contact's the wearer's breast. This leaves fewer surfaces which require thorough cleaning as it reduces the risk of milk contacting a part of the device which cannot be easily sterilized. Additionally, this also helps to disperse the pressure applied to the user's breast across a larger area.

The breast shield 7 substantially aligns with the outer edge 1B of the housing 1. The milk collection container 3 may be provided with an arcuate groove for receiving a lower part of the breast shield 7. This is best shown in later Figures. In the assembled arrangement of Figures 1 and 2, the inner surface of the breast pump 100 is substantially continuous.

The breast shield 7 comprises a shield flange for engaging the user's breast, and an elongate nipple tunnel 9) aligned with the opening and extending away from the user's

breast. Breast shield nipple tunnel 9 extends from a curved section 7B in the breast shield 7. In preferable embodiments the nipple tunnel 9 is integral with the breast shield 7. However, it is appreciated that separate removable/interchangeable nipple tunnels may be used. Curved section 7B is positioned over the user's nipple and areola in use. The breast shield 7 forms an at least partial seal with the rest of the user's breast around this portion, under the negative air pressure created by an air-pressure pump.

This breast shield nipple tunnel 9 defines a milk-flow path from the inner surface of the breast shield 7A, through the breast shield nipple tunnel 9 and into the milk collection container 3. The breast shield nipple tunnel 9 is preferably quite short in order to minimise the length of the milk-flow path in order to minimise losses. By reducing the distance covered by the milk, the device is also reduced in size and complexity of small intermediate portions. In particular, the breast shield nipple tunnel 9 may extend less than 70 mm from its start to end, more preferably less than 50 mm. In use, the nipple tunnel 9 is substantially aligned with the user's nipple and areolae. The nipple tunnel comprises a first opening 9A for depositing milk into the collection container and a second opening 19A for transferring negative air pressure generated by the pump to the user's nipple.

The shield flange 7A and nipple tunnel 9 may be detachable from the housing **1** together. The shield flange 7A and nipple tunnel 9 being detachable together helps further simplify the design, and reduce the number of components which must be removed for cleaning and sterilization. However, preferably, the nipple tunnel 9 will be integral with the breast shield 7, in order to simplify the design and reduce the number of components which must be removed for cleaning and sterilisation.

Figures 3 and 4 are of a partially disassembled breast pump 100 of the present invention. In these Figures, the breast shield 7 has been disengaged from the housing **1** and milk collection bottle 3. As shown in Figure 4, the housing **1** comprises a region or slot 11 for receiving the breast shield nipple tunnel 9 of the breast shield 7. The breast shield is held in place thanks to a pair of channels (9B) included in the nipple tunnel 9, each channel including a small indent. When pushing the housing **1** onto the breast shield 7, which has been placed over the breast, ridges in the housing (9C) engage with the channels, guiding the housing into position; a small, spring plunger, such as ball bearing in each

ridge facilitates movement of the housing on to the nipple tunnel 9. The ball bearings locate into the indent to secure the housing on to the nipple tunnel with a light clicking sound. In this way, the user can with one hand place and position the breast shield 7 onto her breast and with her other hand, position and secure the housing 1 on to the breast shield 7. The breast shield 7 can be readily separated from the housing 1 since the ball bearing latch only lightly secures the breast shield 7 to the housing 1.

Alternatively, the breast shield 7 may also be held in place by means of a clip engaging with a slot located on the housing. The clip may be placed at any suitable point on the shield 7, with the slot in a corresponding location.

The breast shield nipple tunnel 9 of the breast shield 7 is provided with an opening 9A on its lower surface through which expressed milk flows. This opening 9A is configured to engage with the milk collection bottle 3.

The breast pump 100 further comprises a barrier or diaphragm for transferring the pressure from the pump to the milk-collection side of the system. In the depicted example, this includes flexible rubber diaphragm 13 seated into diaphragm housing 19A. The barrier could be any other suitable component such as a filter or an air transmissive material. Diaphragm housing 19A includes a small air hole into the nipple tunnel 9 to transfer negative air pressure into nipple tunnel 9 and hence to impose a sucking action on the nipple placed in the nipple tunnel 9.

Hence, the air pump acts on one side of the barrier or diaphragm 13 to generate a negative air pressure on the opposite, milk-flow side of the barrier. The barrier has an outer periphery or surface, i.e. the surface of diaphragm housing 19A that faces towards the breast, and the milk-flow pathway extends underneath the outer periphery or surface of the barrier or diaphragm housing 19A. The milk-flow path extending under the outer periphery or surface of the barrier 19A allows for a simpler and more robust design, without the milk-flow pathway extending through the barrier. This provides increased interior space and functionality for the device.

As noted, the milk-flow pathway extends beneath or under the barrier 13 or surface of diaphragm housing 19A. This provides an added benefit of having gravity move the milk down and away from the barrier.

Preferably the milk-flow pathway does not pass through the barrier 32. This results in a simpler and smaller barrier design.

As noted, the diaphragm 13 is mounted on diaphragm housing 19A that is integral to the breast shield. This further helps increase the ease of cleaning and sterilisation as all of the components on the "milk" flow side can be removed.

The barrier **13** may also provide a seal to isolate the air pump from the milk-flow side of the barrier. This helps to avoid the milk becoming contaminated from the airflow or pumping side (i.e. the non-milk-flow side).

Alternatively, the only seal is around an outer edge of the barrier **13**. This is a simple design as only a single seal needs to be formed and maintained. Having multiple seals, such as for an annular membrane, introduces additional complexity and potential failure points.

As illustrated in Figures 3 and **4**, the barrier may include a flexible diaphragm 13 formed by a continuous circular disc shaped membrane which is devoid of any openings or holes. This provides a larger effective "working" area of the diaphragm (i.e. the area of the surface in contact with the pneumatic gasses) than an annular membrane and hence the membrane may be smaller in diameter to have the same working area.

The diaphragm **13** is arranged so that the milk-flow pathway extends below and past the outer surface or periphery of the diaphragm 13. This means that the milk-flow pathway does not extend through the diaphragm 13. In particular, the milk-flow pathway is beneath the diaphragm **13**. However, the diaphragm 13 may be offset in any direction with respect to the milk-flow pathway, provided that the milk-flow pathway does not extend through the diaphragm **13**.

Preferably, the diaphragm 13 is a continuous membrane, devoid of any openings. The diaphragm 13 is held in a diaphragm housing 19, which is formed in two parts. The first half **19A** of the diaphragm housing 19 is provided on the outer surface of the breast shield 7, above the breast shield nipple tunnel 9 and hence the milk-flow pathway. In

preferred embodiments, the first half 19A of the diaphragm housing 19 is integral with the breast shield. The second half 19B of the diaphragm housing is provided in a recessed portion of the housing 1. The diaphragm 13 self-seals in this diaphragm housing 19 around its outer edge, to form a watertight and airtight seal. Preferably, the self-seal around the outer edge of the diaphragm 13 is the only seal of the diaphragm 13. This is beneficial over systems with annular diaphragms which must seal at an inner edge as well. Having the diaphragm 13 mounted in the breast pump 100 in this manner ensures that it is easily accessible for cleaning and replacement. It also ensures that the breast shield 7 and diaphragm 13 are the only components which need to be removed from the pump 100 for cleaning. Because the diaphragm 13 self-seals under vacuum pressure, it is easily removed for cleaning when the device is turned off.

Figures 5 and 6 show a breast pump 100 according to the present invention in a further disassembled state. In addition to the breast shield 7 and diaphragm 13 being removed, the milk collection container 3 has been unclipped. Preferably, the milk collection container 3 is a substantially rigid component. This ensures that expressed milk does not get wasted, while also enhancing re-usability. In some embodiments, the milk collection container 3 may be formed of three sections: a front bottle potion, a rear bottle potion, and a cap. These three sections may clip together to form the milk collection container 3. This three-part system is easy to empty, easily cleanable since it can be dis-assembled, and easily re-usable. The milk collection container or milk bottle may be formed of at least two rigid sections which are connectable. This allows simple cleaning of the container for re-use. Alternatively, the container may be a single container made using a blow moulding construction, with a large opening to facilitate cleaning. This large opening is then closed with a cap with an integral spout 35 or 'sealing plate' (which is bayonet-mounted and hence more easily cleaned than a threaded mount spout). A flexible rubber valve 37 (or 'sealing plate seal') is mounted onto the cap or spout 35 and includes a rubber duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump; this ensures that negative air-pressure does not need to be applied to the milk container and hence adds to the efficiency of the system. The flexible valve 37 self-seals against opening 9A in nipple tunnel 9. Because it self-seals under vacuum pressure, it automatically releases when the system is off, making it easy to remove the milk container.

Preferably, the milk collection container resides entirely below the milk flow path defined by the breast shield when the breast pump system 100 is positioned for normal use, hence ensuring fast and reliable milk collection.

The milk collection container 3 has a capacity of approximately 5 fluid ounces (148 ml). Preferably, the milk collection container has a volume of greater than 120 ml. More preferably, the milk collection container has a volume of greater than 140 ml. To achieve this, the milk collection container 3 preferably has a depth in a direction extending away from the breast in use, of between 50 to 80 mm, more preferably between 60 mm to 70 mm, and most preferably between 65 mm to 68 mm.

The milk collection container 3 further preferably has a height, extending in the direction from the bottom of the container 3 in use to the cap or spout or sealing plate 35, of between 40 mm to 60 mm, more preferably between 45 mm to 55 mm, and most preferably between 48 mm to 52 mm. The cap 35 may screw into the milk collection bottle 3. In particular, it may be provided with a threaded connection or a bayonet and slot arrangement.

Further preferably, the milk collection container has a length, extending from the leftmost point to the rightmost point of the container 3 in use, of between 100 mm to 120 30 mm, more preferably between 105 mm to 115 mm, and most preferably between 107 mm to 110 mm.

This cap 35 is provided with a one-way valve 37, through which milk can flow only into the bottle. This valve 37 prevents milk from spilling from the bottle once it has been collected. In addition, the valve 37 automatically seals completely unless engaged to the breast shield 7. This ensures that when the pump 100 is dismantled immediately after pumping, no milk is lost from the collection bottle 3. It can be appreciated that this one-way valve 37 might also be placed on the breast shield 7 rather than in this bottle cap 35.

Alternatively, the milk bottle 3 may form a single integral part with a cap 35. Cap 35 may include an integral milk pouring spout.

In certain embodiments, a teat may be provided to attach to the annular protrusion 31A

or attach to the spout that is integral with cap 35, to allow the container 3 to be used directly as a bottle. This allows the milk container to be used directly as a drinking vessel for a child. The milk collection container may also be shaped with broad shoulders such that it can be adapted as a drinking bottle that a baby can easily hold.

Alternatively, or in addition, a spout may be provided to attach to the protrusion 31A for ease of pouring. A cap may also be provided to attach to the protrusion 31A in order to seal the milk collection bottle 3 for easy storage.

The pouring spout, drinking spout, teat or cap may also be integral to the milk collection container.

Further, the removable milk collection container or bottle includes a clear or transparent wall or section to show the amount of milk collected. Additionally, measurement markings (3A) may also be present on the surface of the container. This allows the level of milk within the container to be easily observed, even while pumping. The milk collection container or bottle may for example be made using an optically clear, dishwasher safe polycarbonate material such as Tritan™.

The milk collection container or bottle may include a memory or a removable tag, such as a tag including an NFC chip, that is programmed to store the date and time it was filled with milk, using data from the breast pump system or a connected device such as a smartphone. The container therefore includes wireless connectivity and connects to a companion app. The companion app then tracks the status of multiple milk collection containers or bottles to select an appropriate container or bottle for feeding. The tag of the bottle may also be programmed to store the expiry date of the milk as well as the quantity of the milk stored.

Figures 7 and 8 show front views of a breast pump system 100. The outer-surface of the housing 1 has been drawn translucent to show the components inside. The control circuitry 71 for the breast pump 100 is shown in these figures. The control circuitry in the present embodiment comprises four separate printed circuit boards, but it is appreciated that any other suitable arrangement may be used.

The control circuitry may include sensing apparatus for determining the level of milk in the container 3. The control circuitry may further comprise a wireless transmission device for communicating over a wireless protocol (such as Bluetooth) with an external device. This may be the user's phone, and information about the pumping may be sent to this device. In embodiments where the user interface comprises a breast toggle button 5E, information on which breast has been selected by the user may also be transmitted with the pumping information. This allows the external device to separately track and record pumping and milk expression data for the left and right breasts.

There should also be a power charging means within the control circuitry 71 for charging the battery 81. While an external socket, cable or contact point may be required for charging, a form of wireless charging may instead be used such as inductive or resonance charging. In the Figures, charging port 6 is shown for charging the battery 81. This port 6 may be located anywhere appropriate on the housing 1.

Figure 8 shows the location of the battery 81 and the pumps 83A, 83B mounted in series inside the housing 1. While the depicted embodiment shows two pumps 83A, 83B it is appreciated that the present invention may have a single pump. Preferably, an air filter 86 is provided at the output to the pumps 83A, 83B. In preferable embodiments, the pumps 83A, 83B are piezoelectric air pumps (or piezo pumps), which operate nearly silently and with minimal vibrations. A suitable piezo pump is manufactured by TTP Ventus, which can deliver in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free flow. The rear side of the second half of the diaphragm housing 19B in the housing 1 is provided with a pneumatic connection spout. The pumps 83A, 83B are pneumatically connected with this connection spout.

Operation of the breast pump 100 will now be described. Once the breast pump 100 is activated and a pumping cycle is begun, the pumps 83A, 83B generates a negative air pressure which is transmitted via an air channel to a first side of the diaphragm 13 mounted on the diaphragm housing 19A. This side of the diaphragm 13 is denoted the pumping side 13B of the diaphragm 13.

The diaphragm 13 transmits this negative air pressure to its opposite side (denoted the milk-flow side 13A). This negative pressure is transferred through a small opening in the

diaphragm housing 19A to the breast shield nipple tunnel 9 and the curved opening 7B of the breast shield 7 that contacts the breast. This acts to apply the pressure cycle to the breast of the user, in order to express milk. The milk is then drawn through the nipple tunnel 9, to the one way valve 37 that remains closed whilst negative pressure is applied. When the negative air pressure is released, the valve 37 opens and milk flows under gravity past the valve 37 and into milk container 3. Negative air pressure is periodically (e.g. cyclically, every few seconds) applied to deliver pre-set pressure profiles such as profiles that imitate the sucking of a child.

While the depicted embodiment of the breast pump 100 is provided with two pumps, the following schematics will be described with a single pump 83. It is understood that the single pump 83 could be replaced by two separate piezo air-pumps 83A, 83B as above.

Figure 9 depicts a schematic of a further embodiment of a breast shield nipple tunnel 9 for a breast pump 100. The breast shield nipple tunnel 9 is provided with an antechamber 91 and a separation chamber 93. A protrusion 95 extends from the walls of the breast shield nipple tunnel 9 to provide a tortuous air-liquid labyrinth path through the breast shield nipple tunnel 9. In the separation chamber 93 there are two opening 97, 99. An air opening 97 is provided in an upper surface 93A of the separation chamber 93. This upper surface 93 is provided transverse to the direction of the breast shield nipple tunnel 9. This opening 97 connects to the first side of the diaphragm housing 19A and is the source of the negative pressure. This airflow opening 97 also provides a route for air to flow as shown with arrow 96. It is appreciated that the tortuous pathway is not necessary and that a breast shield nipple tunnel 9 without such a pathway will work.

The other opening 99 is a milk opening 99. The milk opening 99 is provided on a lower surface 93B of the separation chamber 93 and connects in use to the container 3. After flowing through the tortuous breast shield nipple tunnel 9 pathway, the milk is encouraged to flow through this opening 99 into the container 3. This is further aided by the transverse nature of the upper surface 93A. In this manner, expressed milk is kept away from the diaphragm 13. As such, the breast pump 100 can be separated into a "air" side comprising the pump 83, the connection spout 85 and the pumping side 13B of the diaphragm 13 and a "milk-flow" side comprising the breast shield 7, the milk collection container 3 and the milk-flow side 13A of the diaphragm 13. This ensures that all of the

"milk-flow" components are easily detachable for cleaning, maintenance and replacement. Additionally, the milk is kept clean by ensuring it does not contact the mechanical components. While the present embodiment discusses the generation of negative pressure with the pump 83, it will be appreciated that positive pressure may instead be generated.

While the embodiments described herein use a diaphragm 13, any suitable structure to transmit air pressure while isolating either side of the system may be used.

The breast pump may further comprise a pressure sensor in pneumatic connection with the piezo pump. This allows the output of the pump to be determined.

Figure 10 shows a schematic of a basic pneumatic system 200 for a breast pump 100. In the system 200 milk expressed into the breast shield 7 is directed through the breast shield nipple tunnel 9 through the torturous air-liquid labyrinth interface 95. The milk is directed through the non-return valve 37 to the collection container 3. This side of the system forms the "milk-flow" side 201.

The rest of the pneumatic system 200 forms the air side 202 and is separated from contact with milk. This is achieved by way of a flexible diaphragm 13 which forms a seal between the two sides of the system. The diaphragm 13 has a milk-flow side 13A and an air side or pumping side 13B.

The air side 202 of the system 200 is a closed system. This air side 202 may contain a pressure sensor 101 in pneumatic connection with the diaphragm 13 and the pump 83. Preferably, the pump 83 is a piezoelectric pump (or piezo pump). Due to their low noise, strength and compact size, piezoelectric pumps are ideally suited to the embodiment of a small, wearable breast pump. The pump 83 has an output 83A for generating pressure, and an exhaust to the atmosphere 83B. In a first phase of the expression cycle, the pump 83 gradually applies negative pressure to half of the closed system 202 behind the diaphragm 13. This causes the diaphragm 13 to extend away from the breast, and thus the diaphragm 13 conveys a decrease in pressure into the breast shield 7. The reduced pressure encourages milk expression from the breast, which is directed through the tortuous labyrinth system 95 and the one-way valve 37 to the collection bottle 3.

While in the depicted embodiment the air exhaust 83B is not used, it may be used for functions including, but not limited to, cooling of electrical components, inflation of the bottle to determine milk volume (discussed further later) or inflation of a massage bladder or liner against the breast. This massage bladder may be used to help mechanically encourage milk expression. More than one massage bladder may be inflated regularly or sequentially to massage one or more parts of the breast. Alternatively, the air pump may be used to provide warm air to one or more chambers configured to apply warmth to one or more parts of the breast to encourage let-down.

The air side 202 further comprises a two-way solenoid valve **103** connected to a filtered air inlet 105 and the pump 83. Alternatively, the filter could be fitted on the pump line 83A. If the filter is fitted here, all intake air is filtered but the performance of the pump may drop. After the negative pressure has been applied to the user's breast, air is bled into the system 202 through the valve 103 in a second phase of the expression cycle. In this embodiment, the air filter 105 is affixed to this inlet to protect the delicate components from degradation. In particular, in embodiments with piezoelectric components, these are particularly sensitive.

The second phase of the expression cycle and associated switching of valve 103 is actioned once a predefined pressure threshold has been reached. The pressure is detected by a pressure sensor **101**.

In certain embodiments, if the elasticity and extension of the diaphragm 13 may be approximated mathematically at different pressures, the pressure measured by sensor 101 can be used to infer the pressures exposed to the nipple on the opposite side of the diaphragm 13. Figure 11 shows an alternative pneumatic system 300. The core architecture of this system is the same as the system shown in Figure 10.

In this system 300, the closed loop 202 is restricted with an additional three way solenoid valve **111**. This valve **111** allows the diaphragm 13 to be selectively isolated from the rest of the closed loop 202. This additional three way valve **111** is located between the diaphragm 13 and the pump 83. The pressure sensor 101 is on the pump 83 side of the three way valve **111**. The three way valve 111 is a single pole double throw (SPDT) valve,

wherein: the pole 111A is in pneumatic connection with the pump 83 and pressure sensor; one of the throws 11 is in pneumatic connection with the diaphragm 13; and the other throw 111C is in pneumatic connection with a dead-end 113. This dead-end 113 may either be a simple closed pipe, or any component(s) that does not allow the flow of air into the system 202. This could include, for example, an arrangement of one-way valves.

In this system 300, therefore, the pump 83 has the option of applying negative pressure directly to the pressure sensor 101. This allows repeated testing of the pump in order to calibrate pump systems, or to diagnose issues with the pump in what is called a dead end stop test. This is achieved by throwing the valve to connect the pump 83 to the dead end 113. The pump 83 then pulls directly against the dead end 113 and the reduction of pressure within the system can be detected by the pressure sensor 101.

The pressure sensor detects when pressure is delivered and is then able to measure the output of the pumping mechanism. The results of the pressure sensor are then sent to an external database for analysis such as a cloud database, or are fed back to an on-board microcontroller that is located inside the housing of the breast pump system.

Based on the pressure sensor measurements, the breast pump system is able to dynamically tune the operation of the pumping mechanism (i.e. the duty or pump cycle, duration of a pumping session, the voltage applied to the pumping mechanism, the peak negative air pressure) in order to ensure a consistent pressure performance across different breast pump systems.

In addition, the breast pump system, using the pressure sensor measurements, is able to determine if the pump is working correctly, within tolerance levels. Material fatigue of the pump is therefore directly assessed by the breast pump system. Hence, if the output of the pumping mechanism degrades over time, the breast pump system can tune the pumping mechanism operation accordingly. As an example, the breast pump system may increase the duration of a pumping session or the voltage applied to the pumping mechanism to ensure the expected pressures are met.

This ensures that the user experience is not altered, despite the changing output of the pump as it degrades over time. This is particularly relevant for piezo pumps where the output of the pump may vary significantly.

The microcontroller can also be programmed to deliver pre-set pressure profiles. The pressure profiles may correspond to, but not necessarily, any suction patterns that would mimic the sucking pattern of an infant. The patterns could mimic for example the sucking pattern of a breastfed infant during a post birth period or at a later period in lactation.

The profiles can also be manually adjusted by the user using a control interface on the housing of the breast pump system or on an application running on a connected device.

Additionally, the user is able to manually indicate the level of comfort that they are experiencing when they are using the system. This can be done using a touch or voice-based interface on the housing of the breast pump system itself or on an application running on a connected device.

The system stores the user-indicated comfort levels together with associated parameters of the pumping system. The pressure profiles may then be fine scaled in order to provide the optimum comfort level for a particular user.

The profiles or any of the pumping parameters may be calculated in order to correlate with maximum milk expression rate or quantity.

The pressure profiles or any of the pumping parameters may also be dynamically adjusted depending on the real time milk expression rate or quantity of milk collected. The pressure profiles or any of the pumping parameters may also be dynamically adjusted when the start of milk let-down has been detected.

Additionally, the system is also able to learn which parameters improve the breast pump system efficiency. The system is able to calculate or identify the parameters of the pumping mechanism that correlate with the quickest start of milk let-down or the highest volume of milk collected for a certain time period. The optimum comfort level for a particular user may also be taken into account.

Figure 12 shows a schematic for a system 400 for a breast pump 100 which can estimate the volume of milk collected in the collection container 3 from data collected on the air-side part 202 of the system 400.

The pump 83 is connected to the circuit via two bleed valves 126, 128. The first bleed valve 126 is arranged to function when the pump 83 applies a negative pressure. As such, this valve 126 is connected to a "bleed in" 127, for supplying atmospheric air to the system 202.

The second bleed valve 128 is arranged to function when the pump 83 applies a positive pressure. As such, this valve 128 is connected to a "bleed out" 129 for bleeding air in the system 202 to the atmosphere.

Although Section C describes the preferred embodiment for measuring or inferring the volume of milk collected in the milk collection container using IR sensors, an alternative method for measuring or inferring the volume of milk collected in the milk collection container using pressure sensors is described also below.

During a milking pump cycle, the pump 83 applies negative pressure on the air side 13B of the diaphragm 13 which causes its extension towards the pump 83. This increases the volume of the space on the milk side 13B of the diaphragm 13. This conveys the decrease in pressure to the breast to encourage expression of milk. A set of three non-return valves 121, 123, 125 ensure that this decrease in pressure is applied only to the breast (via the breast shield 7) and not the milk collection container 3. To measure the volume of milk collected in the container 3, the pump 83 is used instead to apply positive pressure to the diaphragm 13. The diaphragm 13 is forced to extend away from the pump 83 and conveys the pressure increase to the milk side 201 of the system 400. The three non-return valves 121, 123, 125 ensure that this increase in pressure is exclusively conveyed to the milk collection container 13.

The breast pump may further comprise: a first non-return valve between the milk flow side of the diaphragm and the breast shield, configured to allow only a negative pressure to be applied to the breast shield by the pump; a second non-return valve between the milk-flow side of the diaphragm and the milk collection container configured to allow only a positive pressure to be applied to the milk collection container by the pump; and a pressure sensor in pneumatic connection with the pressure-generation side of the diaphragm.

The resulting pressure increase is monitored behind the diaphragm 13 from the air-side 202 by a pressure sensor 101. Preferably, the pressure sensor 101 is a piezoelectric pressure sensor (piezo pressure sensor). The rate at which the pump 83 (at constant strength) is able to increase the pressure in the system 400 is a function of the volume of air that remains in the milk collection container 3. As air is many times more compressible than liquid, the rate at which pressure increases in the system 400 can be expressed as an approximate function of the volume of milk held in the collection container 3.

Thus by increasing the pressure in this fashion, the rate of pressure increase can be determined, from which the volume of milk held in the container 3 is calculable. Figure 13 shows repeated milking and volume measurement cycles as the collection container 3 is filled. To determine the rate of pressure increase the pump 83 was run for a fixed time. As pumping proceeds and the volume of air reduces in the system 400, the pump 83 is able to achieve a higher pressure. Each milking cycle is represented by a positive pressure spike 41. There is a clear upwards trend 43 in magnitude of positive pressures achieved as the collection container 3 is filled.

A method of estimating the pressure applied by a breast pump may comprise the steps of: selecting a pressure cycle from a pre-defined list of pressure cycles; applying pressure with the pump to stimulate milk expression; reading the output of the pressure sensor; and adjusting the applied pressure of the pump to match the pressure profile selected. This allows for repeatable application of force to the breast, even as the pump performance degrades.

Preferably the method further comprises the steps of: approximating the elasticity and extension of the diaphragm at the relevant pressure; and calculating an estimated applied pressure based upon the output of the pressure sensor and the approximated elasticity and extension of the diaphragm.

Alternatively, a method of estimating the milk collected by a breast pump may comprise the steps of: generating a positive pressure with the pump; transmitting the positive pressure via the diaphragm and second non-return valve to only the milk collection

container; measuring the increase in pressure by the pressure sensor in pneumatic connection with the diaphragm; estimating the volume of milk inside the milk collection container based upon the rate of increase of pressure. In this manner, the volume of milk can be estimated remotely.

In this manner, an estimate can be obtained for the volume of milk in the container 3 based upon the measured pressures.

Figure 13 also shows a dead end stop pump test 45 as described above. The negative spike shows the application of negative pressure directly to the pressure sensor **101**.

2. Breast shield sizing and nipple alignment

The correct sizing of the breast shield and the alignment of the nipple in the breast shield are key for an efficient and comfortable use of the breast pump. However breast shape, size as well as nipple size and position on the breast vary from one person to another and one breast from another. In addition, women's bodies often change during the pumping life cycle and consequently breast shield sizing may also need to be changed. Therefore, a number of breast shield sizes are available. Guide lines for correct nipple alignment are also provided.

With reference to Figure 14, three breast shield sizes are shown (A1, B1, C1). The substantially clear breast shield gives an unobstructed view of the breast and allows a user to easily confirm that she has the appropriate sized shield for her breast.

In order to determine the correct breast shield size and nipple alignment, the breast shield and the diaphragm are detached from the housing and placed on the breast with the sizing symbol facing upwards (with the diaphragm positioned below the nipple) and the nipple aligned in the centre of the fit lines (as shown in A2, B2, C2). The transparent breast shield allows the user to observe the nipple while adjusting the position of the breast shield in order to align the nipple correctly near the centre of the breast shield nipple tunnel. Prior to using the pump, the nipple is aligned correctly, and the breast shield is pushed into place ensuring the seal is correctly positioned on the breast shield. The fit lines should be directly aligned with the outside of the nipple. The correct

alignment is illustrated B2.

When the nipple is correctly aligned, the user then rotates the breast shield in order for the diaphragm to be positioned on top of the nipple. The user may then quickly assemble the rest of the breast pump (i.e. the housing and the milk container) on the breast shield via a one-click attachment mechanism confirming correct engagement, which may be performed one-handed. Nipple alignment may therefore be easily maintained. Audio and/or haptic feedback may also be provided to further confirm correct engagement.

3. Connected Device Application

Figures 15 to 20 show examples of screenshots of a connected device application that may be used in conjunction with the breast pump system as described above. The interface shown here is an example only and the same data may be presented via any conceivable means including animated graphics, device notifications, audio or text descriptions.

Figure 15 shows a homepage of the application with different functions provided to the user which can be accessed either directly while pumping or at a later time in order for example: to review pump settings or the history of previous pumping sessions.

Figure 16 shows a status page with details of remaining battery life, pumping time elapsed and volume of milk inside the milk container.

Figure 17 shows screenshots of a control page, in which a user is able to control different pump parameters for a single breast pump (A) or two breast pumps (B). The user may press on the play button to either start, pause, or resume a pumping activity. The user may also directly increase or decrease the rate of expression using the (+) or (-) buttons. When only one breast is being pumped (A), the user may also indicate if it is either the right or left breast that is being pumped. The user may also control the pump peak pressure or alternatively may switch between different pre-programmed pressure profiles such as one mimicking the sucking pattern of a baby during expression or stimulation cycle.

Figure 18 shows a page providing a summary of the last recorded pumping session.

Figure 19 shows a page providing a history of previous pumping sessions. The user may scroll down through the page and visualize the data related to specific pumping sessions as a function of time.

The application is also capable of providing notifications relating to pumping. Figure 20 shows a screenshot of the application, in which a user is provided a notification when the milk collection bottle is full. Other generated notifications may include warnings about battery life, Bluetooth connection status or any other wireless communication status, status of miss-assembly, excessive movement or lack of expression.

Figure 21 shows a further example with a screenshot of an application running on a connected device. The page shows the pumping status when a user is using a double pump mode of operation with a pump on each breast. The user is able to manually control each pump individually and may start, stop or change a pumping cycle, increase or decrease each pump peak pressure, or switch between different pre-program pressure profiles such as one mimicking the sucking pattern of a baby during an expression or stimulation cycle. The application also notifies the user when a milk collection container is nearly full as shown in Figure 22.

Figure 23 shows a status page with an alert notifying the user that the milk collection container of the pump on the right breast is full. A message is displayed that the pump session has paused and that the milk collection container should be changed or emptied before resuming pumping.

With reference to Figure 24, when the left and right pump are stopped or paused, the application displays the elapsed time since the start of each session (right and left), the total volume of milk collected in each bottle.

With reference to Figure 25, a page summarising the last session (with a double pump mode) is displayed.

In addition to the data provided to the user, and their interactions with the application, the app will also hold data that the user does not interact with. For example, this may include data associated with pump diagnostics. In addition to all functions and sources of

data discussed above, the application may itself generate metadata associated with its use or inputs, notes or files uploaded by the user. All data handled within the mobile application can be periodically transferred to a cloud database for analysis. An alternative embodiment of the breast pump system may include direct contact between the database and the pump, so that pumping data may be conveyed directly, without the use of a smartphone application.

In addition to providing data to the cloud, the application may also provide a platform to receive data including for example firmware updates.

4. Breast pump data analysis

The discreet, wearable and fully integrated breast pump may offer live expression monitoring and intelligent feedback to the user in order to provide recommendations for improving pump efficiency or performance, user comfort or other pumping/sensing variables, and to enable the user to understand what variables correlate to good milk flow.

Examples of variables automatically collected by the device are: time of day, pump speed, pressure level setting, measured pressure, pressure cycle or duty cycle, voltage supplied to pumps, flow rate, volume of milk, tilt,, temperature, events such as when let-down happens, when a session is finished. The user can also input the following variables: what side they have pump with (left or right or both), and the comfort level.

This is in part possible because the live milk volume measurement system functions reliably (as discussed in Section B). The breast pump system includes a measurement sub system including IR sensors that measures or infers milk flow into the milk container, and that enables a data analysis system to determine patterns of usage in order to optimally control pumping parameters. The generated data may then be distributed to a connected device and/or to a cloud server for analysis in order to provide several useful functions.

Figure 26 illustrates an outline of a smart breast pump system network which includes the breast pump system (100) in communication with a peripheral mobile device and application (270) and several cloud-based databases (268, 273). The breast pump system

(100) includes several sensors (262). Sensor data refers to a broad definition including data generated from any sensor or any other analogue/digital reading directly from the motherboard or any other component. However, within the embodiment detailed, these measurements include one or more of the following, but not limited to: milk volume measurements, temperature sensor readings, skin temperature sensing, pressure sensor readings, accelerometer data and user inputs through any physical device interface.

The device also contains a number of actuators, including, but not restricted to: piezoelectric pump(s), solenoid valve(s), IREDs and an LED display. Sensors and actuators within the device are coordinated by the CPU (263). In addition, any interactions, and data from these components, may be stored in memory (264).

Further to these components, the device also contains a communication chip, such as a Bluetooth chip (265) which can be used to communicate wirelessly with connected devices such as a peripheral mobile device (270). Through this connection any sensor data (267) generated in the breast pump can be sent to the connected device. This user data, along with any other metadata generated from a connected device app, can be provided to an online database which aggregates all user data (273). In addition, the communication chip will also allow the sending of user control data / firmware updates from the connected device to the breast pump system (266).

Raw data (271) collected from the measurement sub-system including sensors (262) may be analysed on a cloud database and the analysed data may be stored on the cloud (272). Through inferences provided by the analysed data, firmware updates (269) may be developed. These can be provided for download to the pump through, for example, an online firmware repository or bundled with the companion app in the connected device app store (268).

In addition, it should be appreciated that despite the sophistication of the proposed breast pump network, the breast pump still retains complete functionality without wireless integration into this network. Relevant data may be stored in the device's memory (264) which may then be later uploaded to the peripheral portion of the system when a connection is established, the connection could be via USB cable or wireless.

The measurement sub-system may analyse one or more of the following:

- the quantity of the liquid in the container above its base;
- the height of the liquid in the container above its base;
- the angle the top surface of the liquid in the container makes with respect to a baseline, such as the horizontal.

Based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase, a haptic and/or visual indicator indicates if the pump is operating correctly to pump milk. For example, the visual indicator is a row of LEDs that changes appearance as the quantity of liquid increases.

The visual indicator may provide:

- an estimation of the flow rate;
- an estimation of the fill rate;
- an indication of how much of the container has been filled.

As a further example, an accelerometer may infer the amount of movement or tilt angle during a pumping session. If the tilt angle excesses a threshold, the system warns or alerts the user of an imminent spillage, or provides the user with an alert to change position. Alternatively, the system may also stop pumping to prevent spillage, and once the tilt angle reduces below the threshold, pumping may resume automatically. By sensing the movement or title angle during a pumping session, the system may also derive the user's activity such as walking, standing or lying.

Many variables can affect milk expression and data analysis of these multiple variables can help mothers to achieve efficient pumping regimes and improve the overall user experience.

Therefore, the measurement sub-system measures or infers milk flow into the milk container and enables a user to understand what variables (e.g. time of day, pump setting) correlates to good milk flow. The amount of milk expressed over one or more sessions is recorded as well as additional metrics such as: time of day, pump setting, length of a single pumping session, vacuum level, cycle times, comfort, liquids consumed by the mother. Live data or feedback is then provided to the user to ensure the breast pump is

being used properly and to support the user in understanding the variables that would correspond to the specific individual optimum use of the breast pump.

Furthermore, live data can be used to automatically and intelligently affect specific pumping parameters in order to produce the most efficient pumping session. For example, if the rate of expression increases, the milking cycle might be adjusted accordingly to achieve a more efficient, or more comfortable pumping cycle.

The measurement sub-system also enables a data analysis system to determine patterns of usage in order to optimally control pumping parameters. Collected metrics are transferred through wireless connections between the pump, a connected device or app and a cloud database. Additionally, the application can also connect to other apps residing on the connected device, such as fitness app or social media app or any other apps. Further metrics may also include the behaviour or specific usage of the user associated with the connected device while using the pump (detection of vision and/or audio cues, internet usage, application usage, calls, text message).

Different aspects of pumping can be automatically changed based on dynamic sensor feedback within the breast pump device. The data analysis system is able to access real-time data of pumping sessions and may be used to perform one or more of the following functions, but not limited to:

- indicate whether the milk is flowing or not flowing,
- measure or infer the quantity and/or height of the liquid in the container above its base,
- give recommendations to the mother for optimal metrics for optimal milk flow,
- give recommendations to the mother for optimal metrics for weaning,
- give recommendations to the mother for optimal metrics for increasing milk supply (e.g. power pumping),
- give recommendations to the mother for optimal metrics if an optimal session start time or a complete session has been missed,
- automatically set metrics for the pumping mechanism, such as length of a single pumping session, vacuum level, cycle times.
- automatically stop pumping when the milk container is full,
- automatically adjust one or more pumping parameters to achieve an optimum

pumping session,

- automatically adjust one or more pumping parameters to achieve a comfortable pumping session,
- automatically change the pumping cycle from a programmed cycle to another different programmed cycle, such as from a stimulation cycle to an expression cycle.

In addition, sensor feedback might be used to improve the physical function of the breast pump system itself. For example, an array of piezoelectric pumps may be dynamically adjusted in response to their operating temperatures so as to optimise the total life of the component whist maintaining peak pressures.

Many additional embodiments may be described for these simple feedback systems, yet the premise remains: real-time sensor feedback is used to automatically and dynamically adjust actuator function. Each feedback program may feasibly include any number and combination of data sources and affect any arrangement of actuators.

The data generated can also be used to generate large datasets of pumping parameters, user metadata and associated expression rates, therefore allowing the analysis of trends and the construction of associations or correlations that can be used to improve pumping efficiency, efficacy or any function related to effective milk expression. The analysis of large user datasets may yield useful general associations between pumping parameters and expression data, which may be used to construct additional feedback systems to include on firmware updates.

Multiple data sources can be interpreted simultaneously and several different changes to pumping might be actuated to increase pumping efficiency, user experience or optimize pump performance.

Collected metrics may be anonymised and exported for sharing to other apps, community or social media platforms on the connected device, or to an external products and services, such as community or social media platform. By contrasting the performance of different users in the context of associated metadata, users may be grouped into discrete 'Pumper profiles' or communities, which may then be used to

recommend, or action the most appropriate selection of intelligent feedback systems to encourage efficient expression. For example, a higher peak pressure may be recommended for women who tend to move more whilst pumping, so as to achieve more efficient expression.

5

SECTION B: IR SYSTEM

This section describes the milk detecting system used in the Elvie™ pump.

With reference to Figures 27 and 28, there is shown a device 270 for use in detecting the level of liquid inside a container 275. The device 270 is formed of a housing 271 in which is located a sensing assembly 272 comprising a series of optical emitters 273 (an array of three optical emitters is used on one implementation) which are relative to, and each located at a distance from, an optical receiver 274. In operation of the device as will be described, each optical emitter 273 is operable to emit radiation which is received by the optical receiver 274. In an embodiment of the invention, the series of optical emitters are each located equidistant from the optical receiver 274.

The optical emitters 273 and the optical receiver 274 from the sensing assembly 272 are located in a portion 276 of the device 270 which faces the container 275 when the device is connected to the container 275. The portion 276 of the device 270 containing the optical emitters 273 and the optical receiver 274 comprises a window 277 of material which is transparent to optical radiation. In this way, each of the optical emitters 273 and the optical receiver 274 have a line of sight through the window 277 into the container 275 when the device 270 is connected thereto.

A controller 278 comprising a CPU 279 and a memory 280 is provided in the device 270 for controlling the operation of the sensing assembly 272. An accelerometer 281 is also provided in the housing 271, which is operatively connected to the controller 278. Operation of the device 270 when connected to the container 275 will now be described.

In a principal mode of operation, to determine the level L of liquid inside the container 275, the controller 278 instructs the optical emitters 273 to each emit radiation towards the surface of the liquid inside the container 275 at a given intensity. The optical receiver 274 receives the reflected radiation from each optical emitter 273 via the surface of the liquid and each of these intensities is recorded by the controller.

For each operation of the sensing assembly 272, the controller 278 records the intensities of radiation emitted by each of the optical emitters 273 as intensities IE1; IE2...IEn

(where n is the total number of optical emitters), and records the intensities of radiation received by the optical receiver 274 from each of the optical emitters 273 as received intensities IR1; IR2...IRn.

By comparing the emitted radiation intensities IE1; IE2...IEn with the received radiation intensities IR1; IR2...IRn, the controller 278 calculates a series of intensity ratios IE1:IR1; IE2:IR2...IEn:IRn, which are then used to determine the level of the liquid inside the container. At the most basic level, if the intensity ratio of IE1:IR1 is the same as IE2:IR2, given the optical emitters 273 are equidistant from the optical receiver 274, this indicates that the level of the liquid inside the container is parallel to the top of the bottle, as shown in Figure 27. In contrast, if these two intensity ratios are different, this indicates that the liquid level is at a different angle, such as that shown in Figure 28.

To accurately determine the level and the quantity of liquid inside the container 275, the controller 278 processes the recorded intensity ratios using a database located in the memory 280. The database contains an individual record for each container which is operable to connect with the device 270. Each record from the database contains a look-up table of information, which contains expected intensity ratios (IE1:IR1 and IE2:IR2) for the container 275 when filled at different orientations, and with different quantities of liquid.

By comparing the information from the look-up table with the recorded intensity ratios, the controller 278 calculates the level and quantity of liquid inside the container 275 and stores this information in the memory 280.

In situations where a container 275 to the device 270 contains no stored record in the database, the sensing assembly 272 can be used in a calibration mode to create a new record. In the calibration mode, the sensing assembly 272 is operated as the container is filled from empty, and as it is positioned at different orientations. At each point during the calibration mode, the controller 278 calculates the recorded intensity ratios (IE1:IR1 and IE2:IR2) and stores them in the record relating to the container 275. For each set of recorded intensity ratios, the user includes information in the record relating to the orientation and fill level of liquid inside of the container 275.

To improve the accuracy of the results obtained by the device 270 during its use, the controller 278 when recording each intensity ratio also records a parameter from the accelerometer 281 relating to the acceleration experienced by the device 270. For each recorded acceleration parameter, the controller 278 determines whether the parameter 278 exceeds a predetermined threshold acceleration parameter stored in the memory 280. The predetermined threshold is indicative of an excessive acceleration, which causes sloshing of liquid inside the container 275 connected to the device 270. In the event of a recorded acceleration parameter exceeding the predetermined threshold acceleration parameter, the controller 278 flags the recorded intensity ratios associated with the recorded acceleration parameter as being unreliable (due to sloshing).

Even without the use of the accelerometer 281, the controller 278 is nonetheless operable to determine whether a set of recorded intensity ratios occur during a period of excess acceleration. In this regard, for each set of intensity ratios recorded at a given time, the controller 278 checks whether any of these intensity ratios is of a predetermined order of magnitude different than the remaining recorded intensity ratios from the set. In the event that the controller 278 determines that this is the case, this indicates that the liquid inside the container has 'sloshed' as a result of the excess acceleration, as shown in Figure 29. In this event, the controller 278 flags the set of recorded intensity ratios as being unreliable.

It will be appreciated that instead of recording the relative intensities of radiation emitted by the optical emitters 273 with the radiation received by the optical emitter 274, the controller 278 could instead record the time taken for radiation emitted by each of the optical emitters 273 to be received by the optical receiver 274. In this arrangement, the look up table would instead contain time periods as opposed to intensity ratios.

In terms of the applications for the device 270, it will be appreciated that the device can be used in a wide variety of applications. One possible application is the use of the device 270 to determine the level of liquid located within a container 275, such as a baby bottle, used as part of a breast pump assembly. In this arrangement, the device 270 is associated with a breast pump 301 which assists with the expression of milk from a breast. The breast pump may be located in the housing 271 of the device 270 as shown in Figure 30, or it may be realisably connected to the housing 271.

Either way, the device 270 would be connectable to the container 275 such that milk expressed by the breast pump can pass from the pump via a channel 302 into the container 275.

The breast pump may be any type of breast pump system including any shapes of milk container or bottle and may comprise a pump module for pumping milk from a breast. The pump module being contained within the housing may comprise: a coupling, a container attachable to the housing via the coupling to receive milk from the pump, a sensing assembly within the housing and comprising at least one optical emitter operable to emit optical radiation towards the surface of the body of milk held in the container when the housing is connected to the container, an optical receiver for receiving the reflected radiation from the surface of the milk, and a controller electrically connected to the sensing assembly for receiving signals from the optical receiver and calculating the level of the milk inside the container based on the reflected radiation received by the optical receiver.

By determining the level of milk inside the container based on reflected radiation from the surface of the milk in the container, there is no need to monitor the individual droplets of milk entering the container, such that the sensing assembly can avoid errors associated with measuring these droplets. For example, because we take multiple reflection-based measurements once the container is filled, we can generate an average measurement that that is more accurate than a single measurement. But with systems that rely in counting individual droplets, that is not possible – further, systemic errors (e.g. not counting droplets below a certain size) will accumulate over time and render the overall results unreliable. Furthermore, by not needing to measure these droplets, the sensing assembly from the breast pump need not always be on during the pumping process, which saves power.

When at least two optical emitters are used, the sensing assembly from the breast pump may determine the level of milk inside the container more accurately and irrespective of the orientation of the liquid level inside the container.

Each optical emitter may be equidistant from the optical receiver in order for the

controller to easily calculate the level of the milk inside the container based on the reflected radiation originating from each optical emitter. The signals from the optical receiver preferably comprise information relating to the intensity of the radiation received by the optical receiver.

Each optical emitter may be operable to emit radiation at a different wavelength, or at a different time, than the other optical emitters. In this way, the controller can more easily process the signals from the optical receiver, and more easily distinguish between the radiation emitted by each of the optical emitters.

The optical emitter may emit radiation in the visible range of wavelengths. Alternatively, it may be UV or IR light. The emitted wavelength may be for example between 10nm and 1mm.

The sensing assembly may also comprise at least one accelerometer electrically connected to the controller. The controller may be configured to record an accelerometer parameter from the accelerometer and determine whether the accelerometer parameter exceeds a predetermined threshold. The predetermined threshold may be indicative of an excessive acceleration, which might cause sloshing of milk inside any container connected to the breast pump.

Another application for the device 270 is as a collar for detecting the level/quantity of liquid in a container 275, such as a baby bottle, via its lid 310. An example of the device 270 being used as such a collar is shown in Figure 31. In this arrangement, the device 270 is located between the container 275 and the lid 310, and comprises a first end 311 having a first coupling 312 for attaching the collar to the lid 310. The device comprises a second end 313 having a second coupling 314 for attaching the device 270 to the container 275. The second coupling may be a screw thread, shown in Figure 31, on the inside surface of the container 275. In this way, the distinctive bottom inside surface can be used by the sensing assembly 272 to more easily calibrate itself to the container 275 on which the distinctive bottom inside surface is located. The distinctive bottom may also be used to help identify which container 275 the device is connected to, and thus which record should be used from the database when the device 270 is used.

To further improve the accuracy of the sensing assembly 272, the controller 278 may also be configured to use the recorded information from the accelerometer 281, in situations where the record acceleration is below the predetermined threshold acceleration parameter, to calculate a more accurate liquid level and/or quantity of liquid located inside the container which is compensated for acceleration.

In one particular arrangement, the controller 278 may poll the accelerometer 281 prior to each operation of the sensing assembly 272 to verify that the device 270 is not currently undergoing excessive acceleration. In the event of the controller 278 determining excessive acceleration in the device 270, the controller 278 would continually re-poll the accelerometer, and not operate the sensing assembly 272, until the parameter from the accelerometer is determined as being below the predetermined threshold acceleration parameter stored in the memory 280.

It will also be appreciated that for each container record stored in the database, the container record may comprise a plurality of look up tables, wherein each look up table is associated with a particular liquid used in the container, and wherein each look up table contains its own set of intensity ratios. In this way, the device 270 can more accurately determine the level/quantity of different liquids used in a particular container 275.

As described herein, the sensing assembly 272 has been described as having a plurality of optical emitters 273. It will be appreciated however that the sensing assembly could operate using a single optical emitter 273 and plurality of optical receivers 274. In this arrangement, each record from the database would contain a plurality of ratios relating to the emitted radiation from the optical emitter 273 as received by each of the optical receivers 274. In use of the device 270, the controller 278 would then similarly record the emitted radiation from the optical emitter 273 as received by each of the optical receivers 274. In an alternate arrangement, there may be provided a plurality of optical emitters 273 and a plurality of optical receivers 274, wherein each optical emitter 273 is associated with a respective optical receiver 274. In its simplest arrangement, the sensing assembly 272 may comprise a single optical emitter 273 and a single optical receiver 274.

In certain configurations, the optical emitters 273 may together emit radiation having the same wavelength. In other configurations, the optical emitters 273 may each emit

radiation having a different wavelength. In this latter configuration, the optical receiver 274 would then be able to determine which optical emitter 273 is associated with any given received radiation, based on the wavelength of the received radiation.

The optical emitters 273 may also each emit radiation at different times, such to allow the controller 278 to more easily process the signals from the optical receiver 274, and more easily distinguish between the radiation emitted by each of the optical emitters 273.

In relation to the electrical connection between the controller 278 and the sensing assembly 272, it will be appreciated this electrical connection may be either a wired/wireless connection as required.

Although not shown in the Figures, the device 270 herein described is preferably powered by a battery or some other power source located in the device 270. In other embodiments, the device 270 may be powered using mains electricity.

In one configuration, it is also envisaged that rather than the controller 278 comparing the information from the look-up table with the recorded intensity ratios to calculate the level and quantity of liquid inside the container 275, the controller 278 could instead process the recorded intensity ratios through a liquid-level equation stored in the memory 280. In this configuration, the liquid-level equation could be a generalised equation covering a family of different containers, or could be an equation specific to a container having a given shape and/or type of liquid inside.

It will also be appreciated that in some applications of the device 270, the device could be used to detect the level of a solid, as opposed to a liquid, in a container. As used herein, the terms 'optical emitter' and 'optical receiver' are intended to cover sensors which can emit radiation in or close to the optical wavelength. Any type of radiation at or close to the optical wavelength is suitable provided that it does not have any harmful effects. The exact wavelength is not important in the context of the invention. Such sensors thus include those which can emit visible radiation (such as radiation having wavelengths in the region of 400nm-700nm), and/or those which can emit IR radiation (such as radiation having wavelengths in the region of 700nm-1mm and/or those which can emit UV radiation (such as radiation having wavelengths in the region of 10nm to

400nm).

Existing prior art for such a sensor module is the apparatus disclosed in RU2441367. In this apparatus, the container is an industrially sized milk tank, which only includes a single laser mounted at the top of the tank. Whilst this apparatus is suited for large-sized containers, which do not move in use, the apparatus is less-suited for applications where the container moves in use, or where the liquid level inside the container is non perpendicular to the laser beam shone into the container. In contrast, the sensor module described above can be used in a variety of different applications, is conveniently located within a housing, and which by virtue of it having at least two optical emitters, can determine the level of liquid even inside containers of irregular shapes, and which can determine the level of liquid inside a container irrespective of the orientation of the liquid level inside the container.

Further to the embodiments of the fluid measurement system in different contexts, it can be appreciated that different functions entirely may be possible using the same component structure. For example, it is known that certain molecules within breast milk absorb specific wavelengths of light at characteristic propensities. Whilst the proposed system uses multiplexed IREDs at the same wavelengths to perform proximity measurements, the same array of IREDs may instead be used to emit several different wavelengths of light and determine their absorption upon reflection. If appropriately calibrated, the system may be able to report on the presence or concentration of specific compounds in the expressed milk, such as fat, lactose or protein content.

In addition to this embodiment, it is feasible that the system might be applied to monitor the change in volume of any other container of liquid, given there is sufficient reflection of IR off its surface. These embodiments might include for example: liquid vessel measurement such as for protein shakes, cement or paint, or volume measurements within a sealed beer keg.

SECTION C: BRA CLIP

This section describes a bra clip that forms an accessory to the Elvie™ pump.

It relates to a system allowing a user to quickly and simply adjust the cup size of a maternity bra to allow discrete and comfortable insertion and use of an integrated wearable breast pump. As such, the user does not need a specialised adjustable bra; instead the present system works with all conventional maternity bras. The user also does not have to purchase any larger bras to wear while pumping.

As shown in Figure 32, a typical maternity bra 320 comprises a support structure made up of shoulder straps 321 which support the bra 320 on the wearer's shoulders, and a bra band 322 for extending around a user's ribcage, comprising two wings 323 and a central panel or bridge 324. The straps 321 are typically provided with adjustment mechanisms 325 for varying the length of the straps 321 to fit the bra 320 to the wearer. At the outermost end of each wing, an attachment region 326 is provided. Typically, hooks 327 and loops 328 are provided for securing the bra 320 at the user's back. However, any other suitable attachment mechanism may be used. Alternatively, the attachment region 326 may be provided at the front of the bra 320 in the bridge region 324, with a continuous wing 323 extending continuously around the wearer's back. Typically, a number of sets of loops 328 are provided to allow for variation in the tightness of the bra 320 on the wearer. While shown as having a separation in Figure 32, the wings 323 and bridge 324 may form a single continuous piece in certain designs. Likewise, while shown with a distinct separation in Figure 32, the shoulder straps 321 and the wings 323 may likewise form a single continuous piece.

The maternity bra 320 is further provided with two breast-supporting cups 329 attached to the support structure. The cups 329 define a cup size, which defines the difference in protrusion of the cups 329 from the band 322. The European standard EN 13402 for Cup Sizing defines cup sizes based upon the bust girth and the underbust girth of the wearer and ranges from AA to Z, with each letter increment denoting a 2 cm difference between the protrusion of the cups 329 from the band 322. Some manufacturers do vary from these conventions in denomination, and some maternity bras are measured in sizes

of S, M, L, XL, etc.

The cups 329 may be stitched to the bra band 321. At least one of the cups 329, is in detachable attachment with the corresponding strap 321. In particular, this is achieved at attachment point 330 where a hook 331 attached to the bra strap 321 engages with a clasp 331 attached to the cup 329. The hook 331 and the bra strap adjuster 325 are set such that in the closed position, the cup size of the bra 320 fits the wearer's breasts.

In Figure 32, the left cup 329 is shown attached to its attachment point 330, which the right cup 329 is unattached. In this manner, the wearer is able to detach the cup 329 to expose their breast for feeding or for breast pumping. Once this is completed, the cup 329 is reattached and the maternity bra 320 continues to function as a normal bra.

While in the depicted embodiments, a hook 331 is shown on the bra strap 321 and a clasp 332 is shown on the cup 329, it is appreciated that the provision of these may be reversed, or that alternative attachment mechanisms may be used.

A maternity bra therefore may comprise a support structure comprising shoulder straps and a bra band and a first and a second cup each attached to the support structure to provide a first cup size, at least one cup being at least partially detachable from the support structure at an attachment point.

In other embodiments, the detachable attachment point 330 may be provided at a different location, such as at the attachment between the bra band 322 and the cup 329. The mechanism for such an attachment point is the same as described above.

A clip has been designed such that it is configured to be attached to the support structure at a position away from the attachment point. This results in the original attachment point being usable, with the clip providing an alternative attachment point to give, in effect, an adjusted cup size.

Alternatively, the clip may also be attachable to the support structure at a plurality of non-discrete positions. This ensures essentially infinite adjustment of the clip position such that the perfect position for the user can be found.

The clip can also extend between an unextended and an extended state, and can attach to the support structure at the attachment point; the first cup size is providable when the at least partially detachable cup is attached to the clip when the clip is an unextended state; the second cup size is providable when the at least partially detachable cup is attached to the clip when the clip is in an extended state. An extendable clip like this allows quick switching between the two states in use.

Figure 33 depict a clip 335 according to the present invention, along with a clasp 332 shown in isolation from the bra cup 329 it is normally attached to. The clip comprises a first engagement mechanism and at least one second engagement mechanism(s). The clip is attachable in a releasable manner to the support structure at a first position via the first engagement mechanism and attachable in a releasable manner to one of the partially detachable cups via the second engagement mechanism to provide a second cup size different to the first cup size. The clip 335 is provided with a material pathway 336 which receives a portion of the bra strap 321. In the particular embodiment of these Figures, the clip 335 is substantially U-shaped, with a narrowing profile towards its open end. However, it is appreciated that any other suitable shape with a material pathway may be used, such as an S-shape or E-shape. The clip 335 is designed to be attached to the bra strap 321 in a releasable manner, with the slot 336 acting as a support engaging mechanism. The releasable manner means that the clip 335 may be simply removed from the bra 320 without causing any damage to the functioning of the bra 320. To enhance the ease of attachment, the clip 335 may be provided with outwardly extending wings 204 which help direct the bra strap 321 into the clip 335. The clip 335 is further provided with a hook 220 acting as a cup engaging mechanism which can engage with the clasp 332.

Figure 33 (c) shows the clip 335 being attached to a bra strap 321 in order to provide a second attachment point 337 for the clasp 332 to attach to, and hence to provide a second cup size for the bra 320. In this particular embodiment, the clip 335 is attached in a portion of strap 321A below the original attachment point 330 and hence the second attachment point 337 is likewise below the original attachment point. This results in a second cup size larger than the first cup size. In preferred embodiments, as shown in these Figures, the clip 335 engages with the support structure in a direction transverse to

the direction in which it engages with the cup.

Figure 33 (d) and (e) show how a wearer is able to move between the first and second cup sizes. In 33(d), the cup 329 is attached at the first attachment point 330 to provide a first cup size. The wearer then disengages the clasp 332 from the hook 331 at the hook 338 at the second engagement point 239. In this manner, the wearer is easily able to transition between the two cup sizes.

Figures 34 and 35 show an alternative design for a clip 340. This clip 340 is substantially "E-shaped", with a back portion 341 and first, second and 5 third prongs 342A, 342B, 342C extending transverse from this back portion 341. The three prongs 342A, 342B, 342C are spaced apart along the length of the back portion 341. The first and third prongs 342A, 342C are provided with attachment clips 343A, 343B.

These attachment clips 343A, 343B can engage with the clasp 332 of a bra to provide the second cup size. Depending upon the orientation of the clip 300, one or the other of the attachment clips 343A, 343B will be used to attach the clasp 332 of the bra. By providing these clips 343A, 343B on both of the first and the third prongs 342A, 342C the clip is easily reversible so it can be used on either side of the bra. Preferably the clip 340 is also symmetrical, to aid the reversibility of the clip 340.

Figure 35 shows the clip 340 attached to a bra. As can be seen, the first and third prongs 342A, 342C extend on the front side of the bra strap, with the second prong 342B extending on the rear side of the bra strap. In this manner, the clip 340 is attached to the strap. In preferable embodiments, a grip-enhancing member 344 such as a number of projections and/or roughened patches can be provided on the second prong 342B in order to strengthen this grip.

In alternative embodiments, the attachment clip could be provided on the second, centremost prong 342B. In such an arrangement, the centremost prong 342B would be on the outside of the bra, with the first and third prongs 342A, 342C on the inside.

The provision of the attachable clip allows maternity bras already owned by the wearer to be quickly transformed into bras with quick switchable double cup size options.

This allows the use of integrated wearable breast pumps which increase the user's required cup size. This allows more design freedom for the breast pump in terms of size and shape, while still allowing the user to discretely pump with the pump held within their bra. By allowing conversion of the user's existing maternity bras, they are not forced to purchase specially designed bras to wear with the pump. The bra is hence normally at the first engagement point 330 when the breast pump device is not being used. As shown in Figure 33, the clasp 332 is then engaged by the user to discretely switch between the two configurations, and the user then inserts the pump without any complex adjustment or removal of clothing.

Preferably, the clip will be relatively unobtrusive in size and shape and hence can be left in place when the bra is first put on and used when necessary. To this end, the clip is preferably machine washable without significant damage or degradation.

In some embodiments, the clip may be switchable between positions for engaging with each cup so that a single clip may be used on either side of the bra. To achieve this, the clip is preferably reversible. This may provide the user with a visual indication of which breast has produced milk most recently so switching can take place.

In a preferred embodiment, the first engagement mechanism engages with the support structure in a first direction and the second engagement mechanism engages with the cup in a second direction transverse to the first direction. This increases ease of attachment as with this structure the sideways engagement of the clip to the support structure ensures that the second attachment mechanism is correctly orientated for the cup.

The second engagement mechanism may be one or more of a hook or a snap or a clip. This ensures easy interfacing with the traditional hook and clasp systems already provided on maternity bras.

Preferably the clip further comprises two distinct second engagement mechanisms which can be used interchangeably dependent upon the orientation of the clip. This makes the clip easier to use as it can be quickly switched between each bra strap, and the user does not have to worry which way up to put the clip on.

Preferably, the clip comprises a material pathway with an opening for receiving a portion of the support structure as the first engagement mechanism for securing the clip to the bra. This ensures a quick and simple method for attaching the clip to the bra. In particular, the clip may substantially U-shaped, and the material pathway is between the arms of the U.

Preferably, the clip comprises three prongs extending from a central support, the three prongs arranged as a central prong and two outer prongs so as to receive the support structure on one side of the central prong and on the opposite side of each respective outer prong, at least one prong being provided with the second engagement mechanism. This ensures a strong attachment to the bra and a simple design.

Preferably, both outer prongs are each provided with a respective second engagement mechanism. This ensures that the clip is reversible for easier attachment to the bra.

A method of adjusting the cup size of a maternity bra is provided according to the present invention, comprising: providing a maternity bra comprising: a support structure comprising shoulder straps and a bra band; and a first and second cup each attached to the support structure to provide a first cup size, the at least one cup being detachable from the support structure at an attachment point, providing a clip comprising first and section engagement mechanisms, attaching the first engagement mechanism of the clip in a releasable manner to a first position of the support structure of the maternity bra, attaching one of the detachable cup to the second engagement mechanism of the clip in a releasable manner to provide a second cup size different to the first cup size.

This clip and method allow a user to quickly and simply adjust the cup size of a maternity bra to allow discrete and comfortable insertion and use of an integrated wearable breast pump.

Preferably, the method further comprises the step of inserting a breast pump into the detachable cup. The adjustment of the size of the bra allows the bra to support the breast pump against the user's breast for comfort and ease.

Preferably, the method further comprises the steps of: detaching the first engagement mechanism of the clip from the first position support structure of the maternity bra; attaching the first engagement mechanism of the clip in a releasable manner to a second position of the support structure of the maternity bra; and attaching the other of the detachable cups to the second engagement mechanism of the clip in a releasable manner to provide a second cup size different to the first cup size. This allows the user to use a single clip on either of the cups.

An alternative embodiment may be provided, with an extendable clip 360 as shown in Figure 36. In such an embodiment the clip is attached to the hook 331 on the strap 321 in a releasable manner, with the clasp 332 attached to an expandable portion of the clip. The clip is then able to expand between an unexpanded state where the clasp 332 is held in substantially the same position as the first attachment point 330 to provide the first cup size, and an expanded state, where the clasp 332 is held in a second position away from the first attachment point 330 to provide the second cup size.

For example, an elongate clip with first and second opposite ends may be provided. A first attachment point for attaching to the hook 331 is provided at the first end, and a second attachment point for attaching to the clasp 332 is provided at the second end. The elongate clip is hinged between the two ends, such that the clip can be folded between an elongate configuration to a closed configuration where the second end touches the first end. A clasp can be provided on the clip to hold the second end in this closed configuration. Thus, in the closed position the clasp 332 is held in substantially the same location as the first attachment point 330 to provide the first cup size, and in the open position the clasp is held away from the first attachment point 330 to provide the second cup size.

Other extendable clip embodiments are also possible, for example sliding clips or elastic clips.

Additional embodiments of a maternity bra adjuster are provided in Figures 37 and 38. The alternative proposed solution is a small adapter device, which comprises a first portion 370 including a clasp 373 and a second portion 372 including a hook 374, in which the first and second portions are separated by a small distance 371 in order to

provide two different adjustable sizes. The first portion includes a clasp 373 that is designed to attach to the hook on the bra strap 321. It may also include a top hook 375 positioned underneath the clasp, and a clip 376 on the rear side. The second portion includes a bottom hook 372.

The clasp 332 that is present on the cup 329 of the maternity bra, may then either engage with the top hook (321) to provide a first cup size, and engage with the bottom hook (332) to provide a second cup size that is different from the first cup size, as illustrated in Figure 39. The user may then discretely switch between a non pumping position, provided by the first cup size, and a second pumping position without any complex adjustment or removal of clothing needed, while using a wearable breast pump system (100).

The first portion and second portion may be made of plastic and may be separated by a stretchy material such as elastic or elastomeric material. The first portion may also include a clip on the rear side, the purpose of which is to allow the user to leave the clip attached to the bra for an extended time period.

Section D: Use of Piezo Pump in Wearables

As described in Section A, the breast pump system includes a piezo air pump, resulting in a fully wearable system that delivers a quiet, comfortable and discreet operation in normal use. This section gives further information on the piezo air pump.

In comparison with other pumps of comparable strength, piezo pumps are smaller, lighter and quieter.

Each individual Piezo pump weighs approximately 6gm and may, with material and design improvements, weigh less than 6gm.

In operation, the Elvie breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise; tests indicate that it makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.

Piezo pumps also have lower current draw, allowing for increased battery life. A piezo pump is therefore ideally suited for wearable devices with its low noise, high strength and compact size. Further, as shown in the breast pump system of Figures 7 and 8, more than one piezo pump may be used.

Whilst a breast pump system is largely described in previous sections, the use of piezo mounted either in series or in parallel can also be implemented in any medical wearable devices or any wearable device. The piezo pump may pump air as well as any liquid.

With reference to Figure 40, a diagram illustrating a configuration of two piezo pumps mounted in series is shown.

With reference to Figure 41, a diagram illustrating a configuration of two piezo pumps mounted in parallel is shown.

With reference to Figure 42, the air pressure generated as a function of time by two piezo pumps mounted in series and two piezo pumps mounted in parallel are compared. In

this example, the parallel configuration produces higher flow rate and achieves -100mmHg negative air pressure faster than the series configuration. In comparison, the series configuration produces lower flow rate and takes slightly longer to reach 100mmHg. However, the parallel configuration cannot achieve as high as a vacuum as the series configuration and plateaus at -140mmHg. In comparison, the series configuration is able to generate about -240mmHg.

A dual configuration is also implemented in which more than one piezo pump is configured such that they can easily switch between a parallel mode and a series mode. This dual configuration would suit wearable devices that would need to achieve either lower or higher pressure faster.

Figure 43 shows a plot of the air pressure generated as a function of time by two piezo pumps mounted in a dual configuration. In this dual configuration, the piezo pumps first start with a parallel mode in order to benefit from faster flow rate, and then switch to a series mode (as indicated by the switch-over point) when stronger vacuums are required, enabling to save up to 500ms on cycle time with elastic loads.

Additionally, a piezo pump may be used in combination with a heat sink in order to efficiently manage the heat produced by the wearable pump. This configuration may be used to ensure that the wearable device can be worn comfortably. The heat sink or heat sinks are configured to ensure that the maximum temperature of any parts of the breast pump system that might come into contact with the skin (especially prolonged contact for greater than 1 minute) are no more than 48°C and preferably no more than 43°C.

The heat sink may store the heat produced by a piezo pump in order to help diverting the heat produced to another location. This not only ensures that the wearable system can be worn comfortably, but also increases the lifetime of a piezo pump.

Figure 44 shows a picture of a wearable breast pump housing including multiple piezo pumps (440). The breast pump system is wearable and the housing is shaped at least in part to fit inside a bra. By applying a voltage to the piezo pumps, the pressure provided by the pumps increase. The generation of higher pressure by the piezo pumps also means higher heat produced that needs to be managed. Each piezo pump is therefore

connected to a heat sink (441), such as a thin sheet of copper. The heat sink has a long thermal path length that diverts the heat away from the piezo pump.

The use of a heat sink in combination with a piezo pump is particularly relevant when the wearable device is worn directly or near the body, and where the management of heat induced by the piezo pump is crucial.

A wearable device including a piezo pump may therefore include a thermal cut out, and may allow for excess heat to be diverted to a specific location. The heat sink may be connected to an air exhaust so that air warmed by the piezo pumps vents to the atmosphere. For example, the wearable system is a breast pump system and the heat sink stores heat, which can then be diverted to warm the breast shield of the breast pump system.

Use cases application include but are not limited to:

- Wound therapy;
- High degree burns;
- Sleep apnoea;
- Deep vein thrombosis;
- Sports injury.

APPENDIX: SUMMARY OF KEY FEATURES

In this section, we summarise the various features implemented in the Elvie™ pump system. We organize these features into six broad categories:

A. Elvie Breast Pump: General Usability Feature Cluster

B. Elvie Piezo Air Pump Feature Cluster

C. Elvie Milk Container Feature Cluster

D. Elvie IR System Feature Cluster

E. Elvie Bra Clip Feature Cluster

F. Other Features, outside the breast pump context

Drilling down, we now list the features for each category:

A. Elvie Breast Pump: General Usability Feature Cluster

Feature 1 Elvie is wearable and includes only two parts that are removable from the pump main housing in normal use.

Feature 2 Elvie is wearable and includes a clear breast shield giving an unobstructed view of the breast for easy nipple alignment.

Feature 3 Elvie is wearable and includes a clear breast shield with nipple guides for easy breast shield sizing.

Feature 4 Elvie is wearable and includes a breast shield that audibly attaches to the housing.

Feature 5 Elvie is wearable and includes a breast shield that attaches to the housing with a single push.

Feature 6 Elvie is wearable and not top heavy, to ensure comfort and reliable suction against the breast.

Feature 7 Elvie is wearable and has a Night Mode for convenience.

Feature 8 Elvie is wearable and includes a haptic or visual indicator showing when milk is flowing or not flowing well.

Feature 9 Elvie is wearable and collects data to enable the mother to understand what variables (e.g. time of day, pump speed etc.) correlate to good milk-flow.

Feature 10 Elvie is wearable and collects data that can be exported to social media.

Feature 11 Elvie is wearable and has a smart bottle that stores the time and/or date of pumping to ensure the milk is used when fresh.

Feature 12 A smart bottle that stores the time and/or date of pumping to ensure the milk is used when fresh.

Feature 13 Elvie is wearable and includes a sensor to infer the amount of movement or tilt angle during normal use.

Feature 14 Elvie includes a control to toggle between expressing milk from the left breast and the right breast.

Feature 15 Elvie includes a pressure sensor.

Feature 16 Elvie includes a microcontroller to enable fine tuning between pre-set pressure profiles.

Feature 17 Elvie enables a user to set the comfort level they are experiencing.

Feature 18 Elvie includes a microcontroller to dynamically and automatically alter pump operational parameters.

Feature 19 Elvie automatically learns the optimal conditions for let-down.

B. Elvie Piezo Air Pump Feature Cluster

Feature 20 Elvie is wearable and has a piezo air-pump for quiet operation.

Feature 21 Elvie has a piezo air-pump and self-sealing diaphragm

Feature 22 Elvie uses more than one piezo air pump in series.

Feature 23 Elvie is wearable and has a piezo air-pump, a breast shield and a diaphragm that fits directly onto the breast shield.

Feature 24 Elvie is wearable and has a piezo air-pump for quiet operation and a re-useable, rigid milk container for convenience.

Feature 25 Elvie has a piezo-pump for quiet operation and is a connected device.

Feature 26 Elvie uses a piezo in combination with a heat sink that manages the heat produced by the pump.

Feature 27 Elvie is wearable and gently massages a mother's breast using small bladders inflated by air from its negative pressure air-pump.

Feature 28 Elvie is wearable and gently warms a mother's breast using small chambers inflated by warm air from its negative pressure air-pump.

C. Elvie Milk Container Feature Cluster

Feature 29 Elvie is wearable and includes a re-useable, rigid milk container that forms the lower part of the pump, to fit inside a bra comfortably.

Feature 30 Elvie is wearable and includes a milk container that latches to the housing with a simple push to latch action.

Feature 31 Elvie is wearable and includes a removable milk container with an integral milk pouring spout for convenience.

Feature 32 Elvie is wearable and includes a removable milk container below the milk flow path defined by a breast shield for fast and reliable milk collection.

Feature 33 Elvie is wearable and includes a breast shield and removable milk container of optically clear, dishwasher safe plastic for ease of use and cleaning.

Feature 34 Elvie is wearable and includes various components that self-seal under negative air pressure, for convenience of assembly and disassembly.

Feature 35 Elvie is wearable and includes a spout at the front edge of the milk container for easy pouring.

Feature 36 Elvie is wearable and includes a milk container that is shaped with broad shoulders and that can be adapted as a drinking bottle that baby can easily hold.

D. Elvie IR System Feature Cluster

Feature 37 Elvie is wearable and includes a light-based system that measures the quantity of milk in the container for fast and reliable feedback.

Feature 38 The separate IR puck for liquid quantity measurement.

Feature 39 The separate IR puck combined with liquid tilt angle measurement.

E. Bra Clip Feature

Feature 40 Bra Adjuster.

F. Other Features that can sit outside the breast pump context

Feature 41 Wearable device using more than one piezo pump connected in series or in parallel.

Feature 42 Wearable medical device using a piezo pump and a heat sink attached together.

We define these features in terms of the device; methods or process steps which correspond to these features or implement the functional requirements of a feature are also covered.

We'll now explore each feature 1 – 42 in depth. Note that each feature can be combined with any other feature; any sub-features described as 'optional' can be combined with any other feature or sub-feature.

A. Elvie Breast Pump: General Usability Feature Cluster

Feature 1 Elvie is wearable and includes only two parts that are removable from the pump main housing in normal use

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) a breast shield;

(c) a rigid or non-collapsible milk container;

and in which the breast pump system includes only two parts that are directly removable from the housing in normal use or normal dis-assembly: the breast shield and the rigid, non-collapsible milk container.

Optional:

- The only parts of the system that come into contact with milk in normal use are the breast shield and the milk container.
- Milk only flows through the breast shield and then directly into the milk container.
- The breast shield and milk container are each pressed or pushed into engagement with the housing.
- The breast shield and milk container are each pressed or pushed into a latched engagement with the housing.
- The two removable parts are each insertable into and removable from the housing using an action confirmed with an audible sound, such as a click.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and nipple tunnel shaped to receive a nipple.

- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield slides into the housing using guide members.
- housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings, in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.
- Breast shield includes or operates with a flexible diaphragm that (a) flexes when negative air pressure is applied to it by an air pump system in the housing, and (b) transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- No other parts are removable from the breast shield, apart from the flexible diaphragm.
- The milk container attaches to a lower surface of the housing and forms the base of the breast pump system in use.
- The milk container mechanically or magnetically latches to the housing.
- The milk container is released by the user pressing a button on the housing.
- The milk container includes a removable cap and a removable valve that is seated on the lid.
- In normal use, the milk container is positioned entirely within a bra.

- No other parts are removable from the milk container, apart from the cap and the valve.
- All parts that are user-removable in normal use are attached to either the breast shield or the milk container.
- Audible or haptic feedback confirms the pump system is properly assembled for normal use with the milk container locked to the housing and the breast shield locked to the housing.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 2 Elvie is wearable and includes a clear breast shield giving an unobstructed view of the breast for easy nipple alignment

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a breast shield including a substantially transparent nipple tunnel, shaped to receive a nipple, providing to the mother placing the breast shield onto her breast a clear and unobstructed view of the nipple when positioned inside the nipple tunnel, to facilitate correct nipple alignment.

Optional:

- The breast shield is configured to provide to the mother a clear and unobstructed view of the nipple when the breast shield is completely out, of or separated from, the housing.
- The breast shield is configured to provide to the mother a clear and unobstructed view of the nipple when the breast shield is partially out of, or partially separated from, the housing.
- Entire breast shield is substantially transparent.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast.

- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.
- Breast shield includes or operates with a flexible diaphragm that (a) flexes when negative air pressure is applied to it by an air pump system in the housing, and (b) transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel includes on its lower surface an opening through which expressed milk flows.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- A milk container attaches to a lower surface of the housing and forms the base of the breast pump system in use.
- The milk container mechanically or magnetically latches to the housing.
- The milk container is released by the user pressing a button on the housing.

- The milk container includes a removable cap and a removable valve that is seated on the lid.
- In normal use, the milk container is positioned entirely within a bra.

Feature 3 Elvie is wearable and includes a clear breast shield with nipple guides for easy breast shield sizing

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a breast shield including a substantially transparent nipple tunnel shaped to receive a nipple, the nipple tunnel including guide lines that define the correct spacing of the nipple from the side walls of the nipple tunnel.

Optional:

- The guide lines run generally parallel to the sides of the nipple placed within the nipple tunnel.
- Breast shield is selected by the user from a set of different sizes of breast shield to give the correct spacing.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around the nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers in the housing locate into small indents in the breast shield.

- Breast shield latches into position against the housing using magnets.
- Breast shield includes or operates with a flexible diaphragm that (a) flexes when negative air pressure is applied to it by an air pump system in the housing, and (b) transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel includes on its lower surface an opening through which expressed milk flows.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 4 Elvie is wearable and includes a breast shield that audibly attaches to the housing.

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a breast shield that is attachable to the housing with a mechanism that latches with an audible click when the breast shield is slid on to or against the housing with sufficient force.

Optional:

- The breast shield is configured to slide onto or against the housing in a direction parallel to the long dimension of a nipple tunnel in the breast shield.

- Breast shield is removable from the housing with an audible click when the breast shield is pulled away from the housing with sufficient force.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around the nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.
- Breast shield includes or operates with a flexible diaphragm that (a) flexes when negative air pressure is applied to it by an air pump system in the housing, and (b) transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.
- The edge of the flexible diaphragm seals, self-seals, self-energising seals, or interference fit seals against the housing when the breast shield attaches to the housing.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel includes on its lower surface an opening through which expressed milk flows.

- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 5 Elvie is wearable and includes a breast shield that attaches to the housing with a single push

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a breast shield configured to attach to the housing with a single, sliding push action.

Optional:

- The breast shield is configured to slide onto or against the housing in a direction parallel to the long dimension of a nipple tunnel in the breast shield.
- The single push action overcomes a latching resistance.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into a nipple tunnel in the breast shield to position a diaphragm housing portion of the breast shield at the top of the breast.
- Housing is configured to slide onto the breast shield when the breast shield has been placed onto a breast using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.
- Breast shield includes or operates with a flexible diaphragm that (a) flexes when negative air pressure is applied to it by an air pump system in the housing, and (b)

transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.

- The edge of the flexible diaphragm seals, self-seals, self-energising seals, or interference fit seals against the housing when the breast shield attaches to the housing.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel includes on its lower surface an opening through which expressed milk flows.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- A milk container attaches to a lower surface of the housing and forms the base of the breast pump system in use.
- The milk container mechanically or magnetically latches to the housing.
- The milk container is released by the user pressing a button on the housing.
- The milk container includes a removable cap and a removable valve that is seated on the lid.
- In normal use, the milk container is positioned entirely within a bra.

Feature 6 Elvie is wearable and not top heavy, to ensure comfort and reliable suction against the breast

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism

(b) and a breast shield;

(c) a milk container;

and in which the centre of gravity of the pump system is, when the milk container is empty, substantially at or below (i) the half-way height line of the housing or (ii) the horizontal line that passes through a nipple tunnel or filling point on a breast shield, so that the device is not top-heavy for a woman using the pump.

Optional:

- The milk container is a re-useable milk container that when connected to the housing is positioned to form the base of the housing.
- In which the centre of gravity only moves lower during use as the milk container gradually receives milk, which increases the stability of the pump inside the bra.
- In which milk only passes downwards when moving to the milk container, passing through the nipple tunnel and then through an opening in the lower surface of the nipple tunnel directly into the milk container, or components that are attached to the milk container.
- System is configured so that its centre of gravity is no more than 60mm up from the base of the milk container also below the top of the user's bra cup.
- In which the pumping mechanism and the power supply for that mechanism are positioned within the housing to provide a sufficiently low centre of gravity.
- In which the pumping mechanism is one or more piezo air pumps, and the low weight of the piezo air pumps enables the centre of gravity to be substantially at or below (i) the half-way height line of the housing or (ii) the horizontal line that passes through the nipple tunnel or filling point on the breast shield.
- In which the pumping mechanism is one or more piezo air pumps, and the small size of the piezo air pumps enables the components in the housing to be arranged so that the centre of gravity is substantially at or below (i) the half-way height line of the housing or (ii) the horizontal line that passes through the nipple tunnel or filling point on the breast shield.
- In which the pumping mechanism is one or more piezo air pumps, and the low weight of the battery or batteries needed to power that piezo air pumps enables the centre of gravity to be substantially at or below (i) the half-way height line of

the housing or (ii) the horizontal line that passes through the nipple tunnel or filling point on the breast shield.

- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 7 Elvie is wearable and has a Night Mode for convenience

A breast pump system including:

(a) a housing including a pumping mechanism;

(b) an illuminated control panel;

(c) a control system that reduces or adjusts the level or colour of illumination of the control panel at night or when stipulated by the user.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Control system is implemented in hardware in the pump itself using a 'night mode' button.
- Control system is implemented in software within a connected device app running on the user's smartphone.
- Control system is linked to the illumination level on a connected device app., so that when the connected app is in 'night mode', the illuminated control panel is also in 'night mode', with a lower level of illumination, and when the illuminated control panel on the housing is in 'night mode', then the connected app is also in 'night mode'.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast. The pumping mechanism is one or more piezo air pumps, selected for quiet operation.

Feature 8 Elvie is wearable and includes a haptic or visual indicator showing when milk is flowing or not flowing well

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) a milk container that is configured to be concealed within a bra and is hence not visible to the mother in normal use;

(c) a visual and/or haptic indicator that indicates whether milk is flowing or not flowing into the milk container.

Optional:

- A haptic and/or visual indicator indicates if the pump is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase
- The visual indicator is a row of LEDs that changes appearance as the quantity of liquid increases.
- The haptic and/or visual indicator provides an indication of an estimation of the flow rate.
- The visual indicator provides a colour-coded indication of an estimation of the flow rate.
- The visual indicator provides an indication of how much of the container has been filled.
- The visual indicator is part of a user interface in a connected, companion application, running on a smartphone or other personal device, such as a smart watch or smart ring.
- The haptic indicator is part of a user interface in a connected, companion application, running on a smartphone or other personal device, such as a smart watch or smart ring.
- A sub-system measures or infers the quantity and/or the height of the liquid in the container.
- The sub-system measures or infers the quantity and/or the height of the liquid in the container by using one or more light emitters and light detectors to detect

light from the emitters that has been reflected by the liquid, and measuring the intensity of that reflected light.

- Sub-system includes or communicates with an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the sub-system to accurately measure or infer the quantity and/or the height of the liquid in the container.
- A sub-system measures or infers the angle the top surface of the liquid in the container makes with respect to a baseline, such as the horizontal.
- A haptic and/or visual indicator indicates if the amount of milk in the milk container has reached a preset quantity or level.
- A haptic and/or visual indicator indicates if there is too much movement of the breast pump system for viable operation.
- Milk container is attached to the lower part of the housing and forms the base of the breast pump system.
- Milk container is made of transparent material.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 9 Elvie is wearable and collects data to enable the mother to understand what variables (e.g. time of day, pump speed etc.) correlate to good milk-flow

A breast pump system including:

(a) a housing including a pumping mechanism;

(b) a milk container;

(c) a measurement sub-system that measures or infers milk flow into the milk container;

and in which the measurement sub-system provides data to a data analysis system that determines metrics that correlate with user-defined requirements for milk-flow rate or milk expression.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- User-defined requirement is to enhance or increase milk-flow.
- User-defined requirement is to reduce milk-flow.
- The data analysis system analyses data such as any of the following: amount of milk expressed over one or more sessions, rate at which milk is expressed over one or more sessions, profile of the rate at which milk is expressed over one or more sessions.
- The data analysis system determines metrics such as any of the following: pump speed, length of a single pumping session, negative air pressure or vacuum level, peak negative air pressure or vacuum level, pump cycle time or frequency, changing profile of pump speed over a single pumping session time of day.
- The data analysis system determines metrics such as any of the following: amount and type of liquids consumed by the mother, state of relaxation of the mother before or during a session, state of quiet experienced by the mother before or during a session, what overall milk expression profile the mother most closely matches.
- Data analysis system is local to the breast pump system, or runs on a connected device, such as a smartphone, or is on a remote server or is on the cloud, or is any combination of these.
- measurement sub-system measures or infers the quantity and/or the height of the liquid in the container above its base.
- Measurement sub-system measures or infers angle the top surface of the liquid in the container makes with respect to a baseline, such as the horizontal.
- Data analysis system gives recommended metrics for improving milk flow
- Data analysis system gives recommended metrics for weaning.
- Data analysis system gives recommended metrics for increasing milk supply (e.g. power pumping).
- Data analysis system gives recommended metrics if an optimal session start time or a complete session has been missed.

- Data analysis system leads to automatic setting of metrics for the pumping mechanism, such as pump speed, length of a single pumping session, vacuum level, cycle times, changing profile of pump speed over a single pumping session.
- Data analysis system enables sharing across large numbers of connected devices or apps information that in turn optimizes the milk pumping or milk weaning efficacy of the breast pump.
- Metrics include the specific usage of the connected device by a woman while using the pump (for example by the detection of vision and/or audio cues).
- The measurement sub-system measures or infers the quantity and/or the height of the liquid in the container.
- The measurement sub-system measures or infers the quantity and/or the height of the liquid in the container by using one or more light emitters and light detectors to detect light from the emitters that has been reflected by the liquid, and measuring the intensity of that reflected light.
- The measurement sub-system includes or communicates with an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the measurement sub-system to accurately measure or infer the quantity and/or the height of the liquid in the container.
- Milk container is a re-useable milk container that when connected to the housing is positioned to form the base of the housing.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 10 Elvie is wearable and collects data that can be exported to social media.

A breast pump system including:

(a) a housing including a pumping mechanism;

(b) a milk container;

(c) a data sub-system that collects and provides data to a connected device or remote application or remote server;

(d) and in which the collected data, in whole or in part, is used by a data analysis system that provides inputs to a social media or community function or platform.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- The data analysis system analyses metrics such as any of the following: amount of milk expressed over one or more sessions, rate at which milk is expressed over one or more sessions, profile of the rate at which milk is expressed over one or more sessions.
- The data analysis system analyses metrics such as any of the following: pump speed, length of a single pumping session, negative air pressure or vacuum level, peak negative air pressure or vacuum level, pump cycle time or frequency, changing profile of pump speed over a single pumping session time of day.
- The data analysis system analyses metrics such as any of the following: amount and type of liquids consumed by the mother, state of relaxation of the mother before or during a session, state of quiet experienced by the mother before or during a session, what overall milk expression profile the mother most closely matches.
- Data analysis system is local to the breast pump system, or runs on a connected device, such as a smartphone, or is on a remote server or is on the cloud, or is any combination of these.
- The social media or community function or platform organizes the collected data into different profiles.
- The social media or community function or platform enables a user to select a matching profile from a set of potential profiles.
- each profile is associated with a specific kind of milk expression profile, and provides information or advice that is specifically relevant to each milk expression profile.
- Information or advice includes advice on how to increase milk expression by varying parameters, such as time of milk expression, frequency of a milk

expression session, pump speed, length of a single pumping session, vacuum level, cycle times, changing profile of pump speed over a single pumping session and any other parameter that can be varied by a mother to help her achieve her milk expression goals.

- The application is connected to other applications residing on the connected device, such as a fitness app.
- The collected data includes data received from other connected apps.
- The collected data is anonymised before it is shared.
- The sub-system includes a wi-fi connectivity component for direct connectivity to a remote server.
- The milk container is a re-useable milk container that when connected to the housing is positioned to form the base of the housing.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 11 Elvie is wearable and has a smart bottle that stores the time and/or date of pumping to ensure the milk is used when fresh

A breast pump system including a pumping mechanism and a milk container and including:

(a) a housing including the pumping mechanism;

(b) a milk container;

(c) and in which the milk container or any associated part, such as a lid, includes a memory or tag that is automatically programmed to store the time and/or date it was filled with milk.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Memory or tag is programmed to store the quantity of milk in the milk container.
- Memory or tag stores the milk expiry date.

- Memory or tag stores a record of the temperature of the milk or the ambient temperature around the milk, and calculates an expiry date using that temperature record.
- System includes a clock and writes the time and/or date the milk container was filled with milk to the memory or tag on the milk container.
- Clock is in the housing.
- Clock is in the milk container.
- Milk container includes a display that shows the time and/or date it was filled with milk.
- Milk container includes a display that shows the quantity of milk that it was last filled with milk.
- Milk container includes a display that shows whether the left or right breast was used to fill the milk container.
- Memory or tag is connected to a data communications sub-system.
- Memory or tag is a remotely readable memory or tag, such as a NFC tag, enabling a user to scan the milk container with a reader device, such as a smartphone, and have the time and/or date that container was filled with milk, displayed on the reader device.
- Reader device shows the time and/or date a specific milk container was filled with milk.
- Reader device shows the quantity of milk that a specific milk container was last filled with.
- Reader device shows the time and/or date and/or quantity that each of several different milk containers were filled with.
- Reader device shows whether the left or right breast was used to fill the milk contained in a specific milk container.
- A sub-system measures or infers milk flow into the milk container.
- The sub-system measures or infers the quantity and/or the height of the liquid in the container.
- The sub-system measures or infers the quantity and/or the height of the liquid in the container by using one or more light emitters and light detectors to detect light from the emitters that has been reflected by the liquid, and measuring the intensity of that reflected light.

- Sub-system includes an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the sub-system to accurately measure or infer the quantity and/Ir the height of the liquid in the container.
- 'The sub-system is in the housing.
- Milk container is a re-useable milk container that when connected to the housing is positioned to form the base of the housing.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 12 A smart bottle that stores the time and/or date of pumping to ensure the milk is used when fresh.

A smart bottle or container that includes or is associated with a memory or a tag that is programmed to store the date and time it is filled using data from a pump or a connected device, such as a smartphone.

Optional:

- 'The container includes wireless connectivity and connects to a companion app.
- The memory or tag includes an NFC chip and is read using a NFC reader.
- The memory or tag stores also an expiry date.
- Memory or tag stores a record of the temperature of the milk or the ambient temperature around the milk, and calculates an expiry date using that temperature record.
- The memory or tag stores also the quantity of milk stored.
- System includes a clock and writes the time and/or date the milk container was filled with milk to the memory or tag on the milk container.
- Clock is in the housing.
- Clock is in the container.
- Milk container includes a display that shows the time and/or date it was filled with milk.
- Milk container includes a display that shows the quantity of milk that it was last filled with milk.

- Milk container includes a display that shows whether the left or right breast was used to fill the milk contained.
- Milk container includes a display that shows the expiry date.
- memory or tag is connected to a data communications sub-system.
- Memory or tag is a remotely readable memory or tag, such as a NFC tag, enabling a user to scan the milk container with a reader device, such as a smartphone.
- Reader device shows the time and/or date a specific milk container was filled with milk.
- Reader device shows the quantity of milk that a specific milk container was last filled with.
- Reader device shows the time and/or date and/or quantity that each of several different containers were filled with.
- Reader device shows whether the left or right breast was used to fill the milk contained in a specific milk container.
- Reader device shows the expiry date.
- Container includes wireless connectivity and connects to a companion application.
- An application tracks status of one or more smart containers and enables a user to select an appropriate smart container for a feeding session.
- The pump is wearable.
- The pump is in a housing shaped to fit inside a bra and the container is a milk container that is connected to the housing and is positioned to form the base of the housing.
- Container is used for liquids other than milk.

Feature 13 Elvie is wearable and includes a sensor to infer the amount of movement or tilt angle during normal use.

A breast pump system including:

(a) a housing;

(b) a milk container;

(c) the housing including a sensor, such as an accelerometer, that measures or determines the movement and/or tilt angle of the housing, during a pumping session and automatically affects or adjusts the operation of the system depending on the output of the sensor.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- If the tilt angle of the housing exceeds a threshold, then the system automatically affects the operation of the system by warning or alerting the mother of a potential imminent spillage (e.g. from milk flowing back out of a breast shield) using an audio, or visual or haptic alert, or a combination of audio, haptic and visual alerts.
- If the tilt angle of the housing exceeds a threshold, then the system automatically adjusts the operation of the system by stopping the pump to prevent spillage.
- When the tilt angle of the housing reduces below the threshold, the system automatically adjusts the operation of the system by causing pumping to resume automatically.
- If the tilt angle of the housing exceeds a threshold, then the system automatically affects the operation of the system by providing the mother with an alert to change position.
- The container includes an optically clear region.
- There are one or more light emitters and detectors positioned in the base of the housing, the light emitters and receivers operating as part of a sub-system that measures or infers the tilt angle of the milk in the container.
- The sub-system measures the quantity of liquid in the milk container and also takes the measured tilt angle of the housing into account.
- If the tilt angle is above a certain threshold, the system ignores the quantity of liquid measured.
- The sub-system derives or infers the mother's activity, such as walking, standing or lying activities, from the sensor.
- The milk container is a re-useable milk container that when connected to the housing is positioned to form the base of the housing.

- Sub-system stores a time-stamped record of movement and/or tilt angles of the housing in association with milk flow data.
- System includes a breast shield that attaches to the housing.
- System includes a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 14 Elvie includes a control to toggle between recording whether milk is being expressed from the left breast and the right breast.

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra;

(b) a control interface that the user can select to indicate or record if milk is being expressed from the left or the right breast.

Optional:

- Control interface is a physical interface on the housing.
- Control interface is a single button on the housing.
- Control interface is from an application running on a device, such as a smartphone or smart ring.
- Visual indicators on the housing indicate whether the breast pump system is being set up the left or the right breast.
- The visual indicator for the left breast is on the right-hand side of the housing, when viewed from the front; and the visual indicator for the right breast is on the left-hand side of the housing, when viewed from the front.
- The housing includes a button labeled to indicate the left breast and a button labeled to indicate the right breast, that are respectively illuminated to indicate from which breast the milk is being expressed.
- Breast pump system is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 15 Elvie includes a pressure sensor.

A breast pump system including (i) a pumping mechanism that applies negative air-pressure and (ii) an air pressure sensor configured to measure the negative pressure delivered by the negative air-pressure mechanism and (iii) a measurement sub-system that measures or infers milk flow or milk volume.

Optional:

- The system also includes a control sub-system that combines or relates the air-pressure measurements with the milk flow or milk volume measurements
- The control sub-system automatically adjusts the negative air-pressure to give the optimal milk flow or milk volume.
- The control sub-system automatically adjusts the negative air-pressure during a pumping session to give the optimal milk flow or milk volume within comfort constraints defined by the user.
- The air pressure sensor detects pressure created by the pumping mechanism.
- Sensor is a piezo air pressure sensor
- Air pressure sensor measures the negative air pressure during a normal milk expression session.
- Air pressure sensor measures the negative air pressure during a calibration session, and the system uses the results to vary the operation of the pumping mechanism so that it deliver consistent performance over time.
- Air pressure sensor measures the negative air pressure during a calibration session, and the system uses the results to vary the operation of the pumping mechanism so that different pumping mechanisms in different breast pump systems all deliver consistent performance
- Air pressure sensor measures the negative air pressure during a calibration session, and the system uses the results to determine if the pumping mechanism is working correctly, within tolerance levels.
- The operation of the pumping mechanism is varied by altering the duty or pump cycle.
- The operation of the pumping mechanism is varied by altering the voltage applied to the pumping mechanism.
- Pumping mechanism is a piezo air pump.

- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a flexible diaphragm that seals, self-seals, self-energising seals or interference fit seals against a diaphragm housing that forms part of a breast shield.
- Breast pump system is wearable and includes a housing that is shaped at least in part to fit inside a bra.
- Breast pump system includes a milk container and a measurement sub-system that automatically measures the quantity of milk in the milk container.
- The measurement sub-system includes one or more light emitters and one or more light detectors, operating as part of a sub-system that measures or infers the quantity of the milk in the container and/or the height of the milk in the container above its base, and in which the light detectors detect and measure the intensity of the light from the emitters that has been reflected from the surface of the milk.

Feature 16 Elvie includes a microcontroller to enable fine tuning between pre-set pressure profiles

A breast pump system including (i) a pumping mechanism that applies negative air-pressure and (ii) a microcontroller programmed to cause the pumping mechanism to deliver various pre-set pressure profiles and to permit the user to manually vary the pressure to a value or values that are in-between the values available from a pre-set pressure profile.

Optional:

- The user manually varies the pressure using a control interface on a housing of the breast pump system
- The user manually varies the pressure using a control interface on an application running on a wireless device such as a smartphone that is wirelessly connected to the breast pump system.
- The user manually varies the pressure by altering a control parameter of the pumping mechanism.
- The user manually varies the pressure by altering the duty cycle or timing of the

pumping mechanism.

- The user manually varies the pressure by altering the voltage applied to the pumping mechanism.
- The system includes an air pressure sensor configured to measure the negative air pressure delivered by the pumping mechanism.
- The air pressure sensor is a piezo air pressure sensor.
- Pumping mechanism is a piezo air pump.
- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a flexible diaphragm that seals, self-seals, self-energising seals or interference fit seals against a diaphragm housing that forms part of a breast shield.
- Pressure profile defines one or more maximum negative air pressure levels.
- Pressure profile defines one or more maximum negative air pressure levels, each for a pre-set time.
- Pressure profile defines one or more cycle time.
- Pressure profile defines peak flow rate.
- Breast pump system is wearable and includes a housing that is shaped at least in part to fit inside a bra.
- Breast pump system includes a milk container and a measurement sub-system that automatically measures the quantity of milk in the milk container.
- The measurement sub-system includes one or more light emitters and one or more light detectors, operating as part of a sub-system that measures or infers the quantity of the milk in the container and/or the height of the milk in the container above its base, and in which the light detectors detect and measure the intensity of the light from the emitters that has been reflected from the surface of the milk.

Feature 17 Elvie enables a user to set the comfort level they are experiencing

A breast pump system including (i) a pumping mechanism that applies negative air-pressure and (ii) a microcontroller programmed to control the pumping mechanism and to permit the user to manually indicate the level of comfort that they are experiencing when the system is in use.

Optional:

- The user manually indicates the level of comfort that they are experiencing using a touch or voice-based interface on a housing of the breast pump system
- The user manually indicate the level of comfort that they are experiencing using a touch or voice-based interface on an application running on a wireless device, such as a smartphone, that is wirelessly connected to the breast pump system.
- The system stores user-indicated comfort levels together with associated parameters of the pumping system.
- The system is a connected device and a remote server stores user-indicated comfort levels together with associated parameters of the pumping system.
- The parameters of the pumping system include one or more of: pumping strength, peak negative air pressure; flow rate; voltage applied to the pumping mechanism; duty or timing cycle of the pumping mechanism.
- System automatically varies parameters of the pumping system and then enables the user to indicate which parameters are acceptable.
- System includes an air pressure sensor that measures the negative air pressure delivered by the pumping mechanism.
- The air pressure sensor is a piezo air pressure sensor.
- Pumping mechanism is a piezo air pump.
- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a flexible diaphragm that seals, self-seals, self-energising seals or interference fit seals against a diaphragm housing that forms part of a breast shield.
- Breast pump system is wearable and includes a housing that is shaped at least in part to fit inside a bra.
- Breast pump system includes a milk container and a measurement sub-system that automatically measures the quantity of milk in the milk container.
- The measurement sub-system includes one or more light emitters and one or more light detectors, operating as part of a sub-system that measures or infers the quantity of the milk in the container and/or the height of the milk in the container above its base, and in which the light detectors detect and measure the

intensity of the light from the emitters that has been reflected from the surface of the milk.

Feature 18 Elvie includes a microcontroller to dynamically and automatically alter pump operational parameters

A breast pump system including (i) a pumping mechanism that applies negative air-pressure and (ii) a microcontroller programmed to automatically change one or more parameters of the pumping mechanism, and to automatically measure or relate milk expression data as a function of different values of one or more of these parameters.

Optional:

- The milk expression data includes one or more of the following: milk expression rate or quantity; comfort; optimal pumping mode; optimal pumping mode given remaining battery power.
- The system automatically calculates or identifies the parameters of the pumping mechanism that correlate with maximum milk expression rate or quantity and uses that set of parameters.
- The system automatically calculates or identifies the parameters of the pumping mechanism that correlate with maximum milk expression rate or quantity and uses that set of parameters if the comfort experienced by the user when those parameters are used is above a threshold.
- The system displays the parameters of the pumping mechanism that correlate with maximum milk expression rate or quantity to the user.
- The system displays the parameters of the pumping mechanism that correlate with maximum milk expression rate or quantity to the user and enables the user to manually select those parameters if they are acceptable.
- Parameters of the pumping mechanism includes pumping strength, peak negative air pressure; flow rate; voltage applied to the pumping mechanism; duty or timing cycle of the pumping mechanism.
- System includes an air pressure sensor that measures the negative air pressure delivered by the pumping mechanism.
- The air pressure sensor is a piezo air pressure sensor.

- Pumping mechanism is a piezo air pump.
- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a flexible diaphragm that seals, self-seals, self-energising seals or interference fit seals against a diaphragm housing that forms part of a breast shield.
- Breast pump system is wearable and includes a housing that is shaped at least in part to fit inside a bra.
- Breast pump system includes a milk container and a measurement sub-system that automatically measures the quantity of milk in the milk container.
- The measurement sub-system includes one or more light emitters and one or more light detectors, operating as part of a sub-system that measures or infers the quantity of the milk in the container and/or the height of the milk in the container above its base, and in which the light detectors detect and measure the intensity of the light from the emitters that has been reflected from the surface of the milk.

Feature 19 Elvie automatically learns the optimal conditions for let-down

A breast pump system including (i) a pumping mechanism that applies negative air-pressure and (ii) a microcontroller programmed to dynamically change one or more parameters of the pumping mechanism, and to automatically detect the start of milk let-down.

Optional:

- The microcontroller is programmed to dynamically change one or more parameters of the pumping mechanism, to enable it to learn or optimize the parameters relating to milk let-down.
- The system automatically calculates or identifies or learns the parameters of the pumping mechanism that correlate with the quickest start of milk let-down.
- The system automatically calculates or identifies or learns the parameters of the pumping mechanism that correlate with the quickest start of milk let-down and uses that set of parameters if the comfort experienced by the user when those

parameters are used is above a threshold or are otherwise acceptable to the user.

- The system displays the parameters of the pumping mechanism that correlate with the quickest start of milk let-down to the user.
- The system displays the parameters of the pumping mechanism that correlate with the quickest start of milk let-down and enables the user to manually select those parameters if they are acceptable.
- parameters of the pumping mechanism includes pumping strength, peak negative air pressure; flow rate; voltage applied to the pumping mechanism; duty or timing cycle of the pumping mechanism.
- System includes an air pressure sensor that measures the negative air pressure delivered by the pumping mechanism.
- The air pressure sensor is a piezo air pressure sensor.
- Pumping mechanism is a piezo air pump.
- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a flexible diaphragm that seals, self-seals, self-energising seals or interference fit seals against a diaphragm housing that forms part of a breast shield.
- Breast pump system is wearable and includes a housing that is shaped at least in part to fit inside a bra.
- Breast pump system includes a milk container and a measurement sub-system that automatically measures the quantity of milk in the milk container.
- The measurement sub-system includes one or more light emitters and one or more light detectors, operating as part of a sub-system that measures or infers the quantity of the milk in the container and/or the height of the milk in the container above its base, and in which the light detectors detect and measure the intensity of the light from the emitters that has been reflected from the surface of the milk.

B. Elvie Piezo Air Pump Feature Cluster

Feature 20 Elvie is wearable and has a piezo air-pump for quiet operation

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra;

(b) a piezo air-pump in the housing that is part of a closed loop system that drives, a separate, deformable diaphragm to generate negative air pressure.

Optional:

- The deformable diaphragm inside the housing is driven by negative air pressure generated by the piezo pump.
- Piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement.
- The closed system is separated from a 'milk' side by a flexible diaphragm.
- Deformable diaphragm is removably mounted against a part of a breast shield.
- Deformable diaphragm is a unitary or one-piece object that is removably mounted against a part of a breast shield.
- Deformable diaphragm is not physically connected to the piezo air-pump.
- Piezo air-pump is a closed loop air-pump that drives a physically separate and remote deformable diaphragm that removably fits directly onto the breast shield
- Deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 10 gm, and may weigh less than 6gm.
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.

- The piezo pump is fed by air that passes through an air filter.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 21 Elvie has a piezo air-pump and self-sealing diaphragm

A breast pump system including:

(a) a housing;

(b) a piezo air-pump in the housing that is part of a closed loop system that drives, a physically separate, deformable, self-sealing diaphragm, to generate negative air pressure.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement .
- The closed system is separated from a 'milk' side by the flexible diaphragm.
- Deformable diaphragm is removably mounted against a part of a breast shield.
- Deformable diaphragm is a unitary or one-piece object that is removably mounted against a part of a breast shield.
- Deformable diaphragm is not physically connected to the piezo air-pump.
- Piezo air-pump is a closed loop air-pump that drives a physically separate and remote deformable diaphragm that removably fits directly onto the breast shield.
- Deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing,

and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.

- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 10 gm, and may weigh less than 6gm.
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.
- The piezo pump is fed by air that passes through an air filter.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 22 Elvie uses more than one piezo air pump in series

A breast pump system including:

(a) a housing;

(b) multiple piezo air-pumps in the housing that drives a deformable diaphragm inside the housing to generate negative air pressure; in which the multiple piezo air-pumps can be operated at different times in series-connected and in parallel-connected modes.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Parallel connected mode is used during a first part of a pumping cycle to reach a defined negative air pressure more quickly than series connected mode would, and then the system switches to a series connected mode to reach a greater negative air pressure than series connected mode can reach.
- An actuator switches the system from parallel-connected piezo pump mode to series-connected piezo pump mode.

- Each piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- Each piezo air pump weighs less than 10 gm, and may weigh less than 6gm..
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.
- Each piezo pump is fed by air that passes through an air filter.
- Each piezo air pump forms part of a closed or closed loop system.
- Each piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.
- The piezo-air pumps are a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- The piezo air-pump is a closed loop negative air-pressure system that drives a physically separate and remote deformable, self-sealing diaphragm that removably fits directly onto the breast shield.

Feature 23 Elvie is wearable and has a piezo air-pump, a breast shield and a diaphragm that fits directly onto the breast shield

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra;

(b) a breast shield that attaches to the housing;

(b) a piezo air-pump in the housing that drives a deformable diaphragm that fits directly onto the breast shield.

Optional:

- Deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- Deformable diaphragm is removable from the diaphragm housing for cleaning.

- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- The piezo air-pump is a closed loop negative air-pressure system that drives a physically separate and remote deformable, self-sealing diaphragm that removably fits directly onto the breast shield.
- Piezo air pump is position at or close to the base of the housing.
- There are two or more piezo air pumps.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement.
- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 10 gm, and may weigh less than 6gm.
- In operation, the breast pump system makes less then 30dB noise at maximum. power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.The piezo pump is fed by air that passes through an air filter.
- The breast shield and milk container are each pressed or pushed into engagement with the housing.
- The breast shield and milk container are each pressed or pushed into a latched engagement with the housing.
- The breast shield and milk container are each insertable into and removable from the housing using an action confirmed with an audible sound, such as a click.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and a nipple tunnel shaped to receive a nipple.

- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield slides into the housing using guide members.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.

Feature 24 Elvie is wearable and has a piezo air-pump for quiet operation and a re-useable, rigid milk container for convenience

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra;

(b) a piezo air-pump in the housing;

(c) and a re-useable, rigid or non-collapsible milk container that when connected to the housing forms an integral part of the housing and that is also removable from the housing.

Optional:

- Piezo air pump forms part of a closed or closed loop system.
- Piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- The closed system is separated from a 'milk' side by a flexible diaphragm.

- A deformable diaphragm inside the housing is driven by negative air pressure generated by the piezo pump.
- The piezo air-pump is a closed loop negative air-pressure system that drives a physically separate and remote deformable, self-sealing diaphragm that removably fits directly onto the breast shield.
- The deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- The deformable diaphragm is removable from the diaphragm housing for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel in the breast shield includes an opening on its lower surface that is positioned through which expressed milk flows directly into the milk container.
- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 10 gm, and may weigh less than 6gm.
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.
- The milk container forms the base of the system.
- The milk container has a flat base so that it can rest stably on a surface.
- The milk container is removable from the housing.
- The milk container includes a clear or transparent wall or section to show the amount of milk collected.
- The milk container is sealable for storage.
- The milk container obviates the need for consumable or replaceable milk pouches.

Feature 25 Elvie has a piezo-pump for quiet operation and is a connected device

A breast pump system including

(a) a housing;

(b) a piezo air-pump in the housing;

(c) a milk container;

(d) a data connectivity module that enables data collection relating to the operation of the piezo air-pump and transmission of that data to a data analysis system.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Transmission is to an application running on a connected device such as a smartphone, or a server, or the cloud.
- The data collection and transmission relates to any other operational data of the system.
- Piezo air pump forms part of a closed or closed loop system.
- Piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- The piezo air-pump is a closed loop negative air-pressure system that drives a physically separate and remote deformable, self-sealing diaphragm that removably fits directly onto the breast shield.
- The closed system is separated from a 'milk' side by a flexible diaphragm.
- A deformable diaphragm inside the housing is driven by negative air pressure generated by the piezo pump.

- The deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- Deformable diaphragm is removable from the diaphragm housing for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel in the breast shield includes an opening on its lower surface that is positioned through which expressed milk flows directly into the milk container.
- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 10 gm, and may weigh less than 6gm.
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.
- A sub-system measures or infers the quantity and/or the height of the liquid in the container and shares that data with the data connectivity module.
- The sub-system measures or infers the quantity and/or the height of the liquid in the container by using one or more light emitters and light detectors to detect light from the emitters that has been reflected by the liquid, and measuring the intensity of that reflected light.
- Sub-system includes an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the sub-system to accurately measure or infer the quantity and/or the height of the liquid in the container.
- The data analysis system analyses metrics such as any of the following: amount of milk expressed over one or more sessions, rate at which milk is expressed over one or more sessions, profile of the rate at which milk is expressed over one or more sessions.
- The data analysis system analyses metrics such as any of the following: pump speed, length of a single pumping session, negative air pressure or vacuum level,

peak negative air pressure or vacuum level, pump cycle time or frequency, changing profile of pump speed over a single pumping session time of day.

- The data analysis system analyses metrics such as any of the following: amount and type of liquids consumed by the mother, state of relaxation of the mother before or during a session, state of quiet experienced by the mother before or during a session, what overall milk expression profile the mother most closely matches.

Feature 26 Elvie uses a piezo in combination with a heat sink that manages the heat produced by the pump.

A breast pump system including:

(a) a housing;

(b) a piezo air-pump in the housing that drives a deformable diaphragm inside the housing to generate negative air pressure;

(c) a heat sink to manage the heat produced by the piezo-air pump to ensure it can be worn comfortably.

Optional:

- The heat sink is configured to ensure that the maximum temperature of any parts of the breast pump system that might come into contact with the skin, especially prolonged contact for greater than 1 minute, are no more than 48°C and preferably no more than 43°C.
- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Heat sink is connected to an air exhaust so that air warmed by the piezo pumps vents to the atmosphere.
- Heat sink warms a breast shield.
- Piezo air pump forms part of a closed or closed loop system.
- Piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.

- There are two or more piezo air pumps, each connected to its own or a shared heat sink.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- The piezo air-pump is a closed loop negative air-pressure system that drives a physically separate and remote deformable, self-sealing diaphragm that removably fits directly onto the breast shield.
- The closed system is separated from a 'milk' side by a flexible diaphragm.
- A deformable diaphragm inside the housing is driven by negative air pressure generated by the piezo pump.
- The deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- The deformable diaphragm is removable from the diaphragm housing for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel in the breast shield includes an opening on its lower surface that is positioned through which expressed milk flows directly into the milk container.
- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 10 gm, and may weigh less than 6gm.
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.

Feature 27 Elvie is wearable and gently massages a mother's breast using small bladders inflated by air from its negative pressure air-pump

A breast pump system including:

(a) a housing;

(b) an air-pump in the housing that drives a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast;

(c) in which the air pump also provides air to regularly or sequentially inflate one or more air bladders or liners that are configured to massage one or more parts of the breast.

Optional:

- Air-pump is a piezo pump.
- Breast pump system is wearable and the housing is shaped at least in part to fit inside a bra.
- Bladders or liners are formed in a breast shield that attaches to the housing.

Feature 28 Elvie is wearable and gently warms a mother's breast using small chambers inflated by warm air from its negative pressure air-pump

A breast pump system including:

(a) a housing;

(b) an air-pump, such as a piezo pump, in the housing that drive a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast;

(c) in which the air pump also provides warm air to regularly or sequentially inflate one or more air chambers that are configured to apply warmth to one or more parts of the breast.

Optional:

- Breast pump system is wearable and the housing is shaped at least in part to fit inside a bra.
- The air chamber is a deformable diaphragm positioned on a breast shield that attaches to the housing.

C. Elvie Milk Container Feature Cluster

Feature 29 Elvie is wearable and includes a re-useable, rigid milk container that forms the lower part of the pump, to fit inside a bra comfortably

A wearable breast pump system configured including:

(a) a housing shaped at least in part with a curved surface to fit inside a bra and including a pumping mechanism;

(b) and a re-useable rigid or non-collapsible milk container that when connected to the housing forms an integral, lower part of the housing, with a surface shaped to continue the curved shape of the housing, so that the pump system can be held comfortably inside the bra.

Optional:

- The milk container forms the base of the system.
- The milk container has a flat base so that it can rest stably on a surface.
- The milk container is attached to the housing with a push action.
- The milk container includes a clear or transparent wall or section to show the amount of milk collected.
- The milk container is sealable for storage.
- The milk container obviates the need for consumable or replaceable milk pouches.
- The milk container includes an aperture, spout or lid that sits directly underneath an opening in a nipple tunnel of a breast shield, and expressed milk flows under gravity through the opening in the nipple tunnel and into the milk container.
- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a

breast shield, and milk flows under gravity through the opening into the milk container.

- The milk container is made using a blow moulding construction.
- The milk container has a large diameter opening to facilitate cleaning that is at least 3cm in diameter.
- The large opening is closed with a bayonet-mounted cap with an integral spout.
- A flexible rubber or elastomeric valve is mounted onto the cap or spout and includes a rubber or elastomeric duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump mechanism to ensure that negative air-pressure is not applied to the milk container.
- The pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 30 Elvie is wearable and includes a milk container that latches to the housing with a simple push to latch action

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a milk container that is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action.

Optional:

- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a breast shield, and milk flows under gravity through the opening into the milk container.
- Milk container, when connected to the housing, forms an integral, lower part of the housing and that is removable from the housing with a release mechanism that can be operated with one hand.

- Mechanism that releasably attaches or latches is a mechanical or magnetic mechanism.
- Mechanical mechanism includes flanges on the top of the milk container, or the sealing plate that seals the opening to the milk contained, that engage with and move past a surface to occupy a latched position over that surface when the milk container is pressed against the housing to lock into the housing.
- The housing includes a button that when pressed releases the milk container from the housing by flexing the surface away from the flanges so that the flanges no longer engage with and latch against the surface.
- Mechanism that attaches or latches the milk container into position does so with an audible click.
- The milk container forms the base of the system.
- The milk container has a flat base so that it can rest stably on a surface.
- The milk container is removable from the housing by releasing the latch and moving the housing off the milk container.
- The milk container includes a clear or transparent wall or section to show the amount of milk collected.
- The milk container is sealable for storage.
- The milk container obviates the need for consumable or replaceable milk pouches.
- The milk container includes an aperture that sits directly underneath an opening in a nipple tunnel of a breast shield, and expressed milk flows under gravity through the opening in the nipple tunnel and into the milk container.
- The milk container is made using a blow moulding construction.
- The milk container has a large diameter opening to facilitate cleaning that is at least 3cm in diameter.
- The large opening is closed with a bayonet-mounted cap with an integral spout.
- A flexible rubber or elastomeric valve is mounted onto the cap or spout and includes a rubber or elastomeric duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump to ensure that negative air-pressure is not applied to the milk container.

- The pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 31 Elvie is wearable and includes a removable milk container with an integral milk pouring spout for convenience

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a re-useable milk container that is connected to the housing with a surface shaped to continue the curved or breast-like shape of the pump, so that the pump can be held comfortably inside a bra and where the milk container includes a pouring spout for pouring milk.

Optional:

- Spout is integral to the milk container.
- Spout is integral to a removable lid to the milk container.
- Spout is positioned at or close to the front edge of the milk container.
- Spout is removable from the container, such as by clipping off the container.
- A teat is attachable to the spout.
- A flexible rubber or elastomeric valve is mounted onto the cap or spout and includes a rubber or elastomeric duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump to ensure that negative air-pressure is not applied to the milk container.
- The milk container forms the base of the system.
- The milk container has a flat base so that it can rest stably on a surface.
- The milk container is removable from the housing.
- The milk container includes a clear or transparent wall or section to show the amount of milk collected.
- The milk container is sealable for storage.

- The milk container obviates the need for consumable or replaceable milk pouches.
- The milk container includes an aperture that sits directly underneath an opening in a nipple tunnel of a breast shield, and expressed milk flows under gravity through the opening in the nipple tunnel and into the milk container through the pouring spout in the milk container.
- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a breast shield, and milk flows under gravity through the opening into the milk container.
- The milk container is made using a blow moulding construction.
- The milk container has a large diameter opening to facilitate cleaning that is at least 3cm in diameter.
- The large opening is closed with a bayonet-mounted cap with an integral spout.
- The pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 32 Elvie is wearable and includes a removable milk container below the milk flow path defined by a breast shield for fast and reliable milk collection

A wearable breast pump system including:

(a) a housing including a pumping mechanism, the housing being shaped at least in part to fit inside a bra;

(b) and a breast shield including a nipple tunnel shaped to receive a nipple, and including an opening that defines the start of a milk flow path;

(c) a re-useable milk container that when connected to the housing is positioned entirely below the opening or the milk flow path, when the breast pump is positioned or oriented for normal use.

Optional:

- The milk container includes an aperture that sits directly underneath the opening in the nipple tunnel in the breast shield, and expressed milk flows under gravity through the opening in the nipple tunnel and into the milk container through the pouring spout in the milk container.
- Milk flows from the opening directly into the milk container.
- Milk flows from the opening directly into the milk container.
- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against the opening in the breast shield, and milk flows under gravity through the opening into the milk container.
- Milk flows from the opening directly onto a valve that is attached to the milk container, the valve closing whilst there is sufficient negative air pressure in the volume of air between the valve and the breast shield opening, and then opening to release the milk into the container when the air pressure rises sufficiently.
- Milk flows from the opening directly onto a valve that is attached to a spout, that is in turn attached to the milk container.
- The milk container has a large diameter opening to facilitate cleaning that is at least 3cm in diameter.
- The large opening is closed with a bayonet-mounted cap with an integral spout.
- A flexible rubber or elastomeric valve is mounted onto the milk container cap or spout and includes a rubber or elastomeric duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump to ensure that negative air-pressure is not applied to the milk container, and milk flows towards and is retained by the duck bill valve whilst the valve is closed, and flows past the valve into the milk container when the negative air pressure is released and the valve opens.
- The breast shield and milk container are each pressed or pushed into engagement with the housing.
- The breast shield and milk container are each pressed or pushed into a latched engagement with the housing.
- The two removable parts are each insertable into and removable from the housing using an action confirmed with an audible sound, such as a click.

- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and a nipple tunnel shaped to receive a nipple.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield slides into the housing using guide members.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.

Feature 33 Elvie is wearable and includes a breast shield and removable milk container of optically clear, dishwasher safe plastic for ease of use and cleaning

A breast pump system including:

(a) a housing including a pumping mechanism;

(b) and a breast shield defining a region shaped to receive a nipple, the region defining the start of a milk flow path;

(c) a re-useable, rigid or non-collapsible milk container that when connected to the housing is positioned to form the base of the housing;

and in which the breast shield and the milk container are made substantially of an optically clear, dishwasher safe material.

Optional:

- The material is a polycarbonate material, such as Tritan™.

- breast pump system is wearable and the housing is shaped at least in part to fit inside a bra.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and a nipple tunnel shaped to receive a nipple.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield operates with a flexible diaphragm that flexes when negative air pressure is applied to it by an air pump system in the housing, and transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- The breast shield and milk container are each pressed or pushed into engagement with the housing.
- The breast shield and milk container are each pressed or pushed into a latched engagement with the housing.
- The breast shield and milk container are each insertable into and removable from the housing using an action confirmed with an audible sound, such as a click.
- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a breast shield, and milk flows under gravity through the opening into the milk container.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and a nipple tunnel shaped to receive a nipple.

- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield slides into the housing using guide members.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.

Feature 34 Elvie is wearable and includes various components that self-seal under negative air pressure, for convenience of assembly and disassembly

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including an air pumping mechanism;

(b) a breast shield;

(c) a diaphragm that flexes in response to changes in air pressure caused by the air pumping mechanism and that seals to the breast shield;

(d) a re-useable milk container that seals to the breast shield;

and in which either or both of the diaphragm and the re-useable milk container substantially self-seal under the negative air pressure provided by the pumping mechanism.

Optional:

- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a

breast shield, and milk flows under gravity through the opening into the milk container.

- The re-useable milk container includes a 1 way valve that self-seals against a conduit from the breast shield and allows milk to pass into the container but not spill out, and in which the valve (a) closes and (b) partly or wholly self-seals against the conduit under the negative air pressure provided by the pumping mechanism.
- The 1 way valve is attached to the milk container, or a lid or spout of the milk container with an interference fit and is readily removed in normal use for separate cleaning.
- The diaphragm partly or wholly self-seals to the breast shield under the negative air pressure provided by the pumping mechanism.
- The diaphragm partly or wholly self-seals to the housing under the negative air pressure provided by the pumping mechanism.
- The diaphragm is attached to the diaphragm housing using elastomeric or rubber latches and is readily removed in normal use for separate cleaning.
- The breast shield and milk container are each pressed or pushed into engagement with the housing.
- The breast shield and milk container are each pressed or pushed into a latched engagement with the housing.
- The breast shield and milk container are each insertable into and removable from the housing using an action confirmed with an audible sound, such as a click.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and a nipple tunnel shaped to receive a nipple.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield slides into the housing using guide members.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.

- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.

Feature 35 Elvie is wearable and includes a spout at the front edge of the milk container for easy pouring

A wearable breast pump system configured as a single unit and including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a milk container that forms an integral part of the housing;

(c) a re-useable pouring spout that is positioned at or close to the front edge of the milk container.

Optional:

- Milk container is a multifunctional bottle, operating as both a storage container to contain milk that is being expressed, as well as a refrigeratable and freezable storage bottle for that milk, as well as a bottle from which that milk can be drunk by a baby.
- Spout is integral to a removable lid to the milk container.
- Spout is removable from the container, such as by clipping off the container.
- A teat is attachable to the spout.
- By placing the spout at or close to the front edge of the milk container, the milk container fully empties more readily than where the spout is placed in the middle of the lid of a milk container.
- The spout sits generally under an opening in the breast shield spout or nipple tunnel through which expressed milk flows.
- The re-useable milk container includes a 1 way valve that self-seals against a conduit from the breast shield and allows milk to pass into the container but not spill out, and in which the valve (a) closes and (b) partly or wholly self-seals against the conduit under the negative air pressure provided by the pumping mechanism.

- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a breast shield, and milk flows under gravity through the opening into the milk container.

Feature 36 Elvie is wearable and includes a milk container that is shaped with broad shoulders and that can be adapted as a drinking bottle that baby can easily hold

A wearable breast pump system configured as a single unit and including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) a breast shield;

(c) a milk container that is removable from the housing and is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall.

Optional:

- Teat is attachable directly to the milk container.
- Pouring or drinking spout is integral to the milk container.
- The shoulders are at least 2cm in width, and the neck is no more than 1 cm in height, to enable a baby to readily grip and hold the container when feeding from the milk in the container.
- Spout/teat/straw resides near the edge of the container's rim.
- Milk container is a multifunctional bottle, operating as both a storage container to contain milk that is being expressed, as well as a refrigertable and freezable storage bottle for that milk, as well as a bottle from which that milk can be drunk by a baby.
- The re-useable milk container includes a 1 way valve that self-seals against a conduit from the breast shield and allows milk to pass into the container but not spill out, and in which the valve (a) closes and (b) partly or wholly self-seals

against the conduit under the negative air pressure provided by the pumping mechanism.

- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a breast shield, and milk flows under gravity through the opening into the milk container.
- Spout is integral to the milk container.
- Spout is integral to a removable lid to the milk container.
- Spout is positioned at or close to the front edge of the milk container.
- Spout is removable from the container, such as by clipping off the container.
- A teat is attachable to the spout.
- A flexible rubber or elastomeric valve is mounted onto the cap or spout and includes a rubber or elastomeric duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump to ensure that negative air-pressure is not applied to the milk container.
- The milk container forms the base of the system.
- The milk container has a flat base so that it can rest stably on a surface.
- The milk container is removable from the housing.
- The milk container includes a clear or transparent wall or section to show the amount of milk collected.
- The milk container is sealable for storage.
- The milk container obviates the need for consumable or replaceable milk pouches.
- The milk container includes an aperture that sits directly underneath an opening in a nipple tunnel of a breast shield, and expressed milk flows under gravity through the opening in the nipple tunnel and into the milk container through the pouring spout in the milk container.
- The milk container is made using a blow moulding construction.
- The milk container has a large diameter opening to facilitate cleaning that is at least 3cm in diameter.
- The large opening is closed with a bayonet-mounted cap with an integral spout.

D. Elvie IR System Feature Cluster

Feature 37 Elvie is wearable and includes a light-based system that measures the quantity of milk in the container for fast and reliable feedback

A system for milk volume determination, for use as part of a breast pump, or breast milk collecting device, including:

(a) a re-useable rigid or non-collapsible milk container;
(b) at least one light emitter, configured to direct radiation towards the surface of the milk;
(c) at least one light detector, configured to detect reflected radiation from the surface of the milk;

wherein the light emitters and detectors operate as part of a sub-system that measures the height of, or infers the quantity of, the milk in the container.

Optional:

The wearable breast pump system includes:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a breast shield;

(c) a re-useable rigid or non-collapsible milk container that when connected to the housing is positioned to form the base of the housing;

and in which the top of the container includes an optically clear region that is aligned below one or more light emitters positioned in the base of the housing.

- The sub-system measures or infers the quantity and/or the height of the liquid in the container by using one or more light emitters and light detectors to detect light from the emitters that has been reflected by the liquid, and measuring the intensity of that reflected light.
- Sub-system includes an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the sub-system to accurately measure or infer the quantity and/or the height of the liquid in the container.

- The sub-system measures or infers the quantity and/or the height of the liquid in the container and shares that data with a data connectivity module.
- Where the quantity or level exceeds a threshold, then the pumping mechanism automatically changes mode, e.g. from a stimulation mode to an expression mode.
- Where the quantity or level exceeds a threshold, then the pumping mechanism automatically stops.
- Milk-flow data is captured and stored.
- If milk-flow falls below a threshold, then a notification is provided to the mother.

Feature 38 The separate IR puck for liquid quantity measurement

A liquid-level measuring system for measuring the quantity of liquid in a container for a breast pump; the system including:

(a) one or more light emitters directing light at the surface of the liquid in the container;

(b) one or more light receivers configured to detect light from the light emitters that has been reflected from the liquid;

(c) a sub-system that infers, measures or calculates the quantity in the liquid using measured properties of the detected light;

(d) a collar or other fixing system that positions the system over the container.

Optional:

- The quantity of milk is measured as milk enters the container or as milk is removed from the container.
- Measured property includes the reflected light intensity

Feature 39 The separate IR puck combined with liquid tilt angle measurement

A liquid-level measuring system for measuring the tilt angle of liquid in a container; the system including:

(a) one or more light emitters directing light at the surface of the liquid in the container;

(b) one or more light receivers configured to measure properties of the light reflected from the liquid;

(c) a sub-system including an accelerometer that infers, measures or calculates the tilt angle of the liquid using measured properties of the detected light;

(d) a collar or other fixing system that positions the system over the container.

Optional:

- Measured property includes the reflected light intensity
- The quantity of liquid is measured as liquid enters the container or as liquid is removed from the container.
- Sub-system includes an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the sub-system to accurately measure or infer the quantity and/or the height of the liquid in the container.
- The sub-system measures or infers the quantity and/or the height of the liquid in the container and shares that data with a data connectivity module.

Generally applicable optional features

- Weight of the entire unit, unfilled, is under 250g and preferably 214g.
- Silver based bactericide is used on all parts that are not steam or heat sterilized in normal cleaning.
- Housing includes a rechargeable battery.
- System is self-contained.
- System is a closed loop system.
- Breast pump system is a self-contained, wearable device that includes an integral rechargeable battery, control electronics, and one or more air pumps operating as a closed system, driving a flexible diaphragm that in turn delivers negative air-pressure to the breast, to cause milk to be expressed.
- Housing has a generally rounded or convex front surface and has a generally tear-drop shape when seen from the front.

E. Bra Clip Feature Cluster

Feature 40 Bra Adjuster

A bra adjuster for a nursing or maternity bra, the nursing or maternity bra including a bra cup with a flap that can be undone to expose the nipple, and the flap attaching to the shoulder strap using a clasp, hook or other fastener attached to the flap, and a corresponding fastener attached to the shoulder strap;

and in which the bra adjuster is attachable at one end to the fastener attached to the flap, and at its other end to the fastener attached to the shoulder strap, and hence increases the effective bra cup size sufficiently to accommodate a wearable breast pump, and is also detachable from the flap and shoulder strap.

Optional:

- Bra adjuster is retained in position on the bra during normal wearing of the bra, even when the flap is attached directly to the shoulder strap, and is used to increases the effective bra cup size only when the wearable breast pump is used.
- Bra adjuster is extensible or elastic.
- Bra adjuster is of a fixed length.
- Bra adjuster includes a clip that the user can slide onto the bra strap to secure the bra adjuster in position.
- Bra adjuster is machine-washing washable.

F. Other Features that can sit outside the breast pump context

Feature 41 Wearable device using more than one piezo pump connected in series or in parallel

A wearable device including multiple piezo pumps mounted together either in series or in parallel.

Optional:

- The wearable device is a medical wearable device.
- The piezo pumps air or any liquid etc.
- The system can switch between a parallel mode and a series mode to arrive to lower or higher pressure quicker.

Feature 42 Wearable medical device using a piezo pump and a heat sink attached together.

A wearable medical device including a piezo pump and a heat sink attached together.

Optional

- The wearable device uses more than one piezo pump connected in series.
- The wearable device uses more than one piezo pump connected in parallel.
- Each piezo pump is connected to its own heat sink, or to a common heat sink.
- The or each heat sink is configured to ensure that the maximum temperature of any parts of the breast pump system that might come into contact with the skin, especially prolonged contact for greater than 1 minute, are no more than 48°C and preferably no more than 43°C
- The wearable device includes a thermal cut out.
- Excess heat is diverted to a specific location on the device that is selected to not be in prolonged contact with the skin of the user, in normal use.
- Use cases application:
    - Wound therapy
    - High degree burns
    - Sleep apnea
    - Deep vein thrombosis
    - Sports injury.
- Wearable medical device is powered/charged via USB.

Note

It is to be understood that the above-referenced arrangements are only illustrative of the application for the principles of the present invention. Numerous modifications and alternative arrangements can be devised without departing from the spirit and scope of

the present invention. While the present invention has been shown in the drawings and fully described above with particularity and detail in connection with what is presently deemed to be the most practical and preferred example(s) of the invention, it will be apparent to those of ordinary skill in the art that numerous modifications can be made without departing from the principles and concepts of the invention as set forth herein.

CLAIMS

1. A breast pump device that is configured as a self-contained, in-bra wearable device, and that includes:

(i) a housing that includes (a) a rechargeable battery; (b) a power charging circuit for controlling the charging of the rechargeable battery; (c) control electronics powered by the rechargeable battery; (d) an air pump powered by the rechargeable battery and generating negative air pressure; (e) a diaphragm configured to prevent milk from reaching the pump and seated in a diaphragm holder;

(ii) a breast shield made up of a breast flange and a nipple tunnel and that is configured to slide out from the housing together with the diaphragm, and the diaphragm is configured to be removable from a diaphragm holder for cleaning; and

(iii) a milk container that is configured to attach to the housing.

2. The breast pump device of Claim 1, in which the breast shield is substantially rigid.

3. The breast pump device of Claim 1, in which the breast shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast.

4. The breast pump device of Claim 1, in which the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast.

5. The breast pump device of Claim 1, in which the breast shield integrates the breast flange and nipple tunnel as a one-piece item.

6. The breast pump device of Claim 1, in which the breast flange and the nipple tunnel are a single, integral item with no joining stubs.

7. The breast pump device of Claim 1, in which the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.

8. The breast pump device of Claim 1, in which the breast shield is configured to slide in and out from the housing, together with the diaphragm that prevents milk from reaching the pump, on guide members in the breast shield.

9. The breast pump device of Claim 1, in which the housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.

10. The breast pump device of Claim 1, in which the breast pump device includes only two parts that are directly removable from the housing in normal use or normal dis-assembly: the breast shield and the milk container.

11. The breast pump device of Claim 1, in which the device includes a diaphragm that prevents milk from reaching the pump.

12. The breast pump device of Claim 11, in which the diaphragm is substantially circular and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing.

13. The breast pump device of Claim 11, in which the diaphragm is a membrane that is seated against a diaphragm holder that is formed as the recess in the rear surface of the housing, the diaphragm deforming in response to changes in air pressure caused by the air pump to create negative air pressure in the nipple tunnel.

14. The breast pump device of Claim 11, in which the diaphragm is removable from a diaphragm holder that sits above the breast flange and the nipple tunnel portion.

15. The breast pump device of Claim 1, in which the milk container is substantially rigid.

16. The breast pump device of Claim 1, in which the milk container is configured to attach to a lower part of the housing and to form a flat bottomed base for the device.

17. The breast pump device of Claim 1, in which the milk container has a surface shaped to continue a curved shape of the housing, so that the entire device can be held comfortably inside the bra.

18. The breast pump device of Claim 1, in which the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container.

19. The breast pump device of Claim 1, in which the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action.

20. The breast pump device of Claim 1, in which the milk container includes a cap that is removable from the milk container and a removable valve that enables milk to pass into the milk container in one direction.

21. The breast pump device of Claim 1, in which the top of the container includes an optically clear region that is aligned below one or more light emitters positioned in the base of the housing.

22. The breast pump device of Claim 1, in which the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall.

23. The breast pump device of Claim 1, in which the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container.

24. The breast pump device of Claim 1, in which the housing includes a wireless data communications system powered by the rechargeable battery.

25. The breast pump device of Claim 1, in which the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra, and a rear surface that is shaped to contact, at least in part, the breast shield.

26. The breast pump device of Claim 1, in which the housing includes a visual and/or haptic indicator that indicates whether milk is flowing or not flowing into the milk container.

27. The breast pump device of Claim 1, in which the housing includes a visual and/or haptic indicator that indicates if the pump is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the milk container above its base is increasing above a threshold rate of increase.

28. The breast pump device of Claim 1, in which the pump comprises a piezo air pump system.

29. The breast pump device of Claim 1, in which the pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow and is a lightweight air pump that enables the total mass of the breast pump system, unfilled with milk, to be less than 250gm.

30. The breast pump device of Claim 1, in which the breast pump device makes less than 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.

ABSTRACT

The invention is a wearable breast pump system including a housing shaped at least in part to fit inside a bra and a piezo air-pump. The piezo air-pump is fitted in the housing and forms part of a closed loop system that drives a separate, deformable diaphragm to generate negative air pressure. The diaphragm is removably mounted on a breast shield.

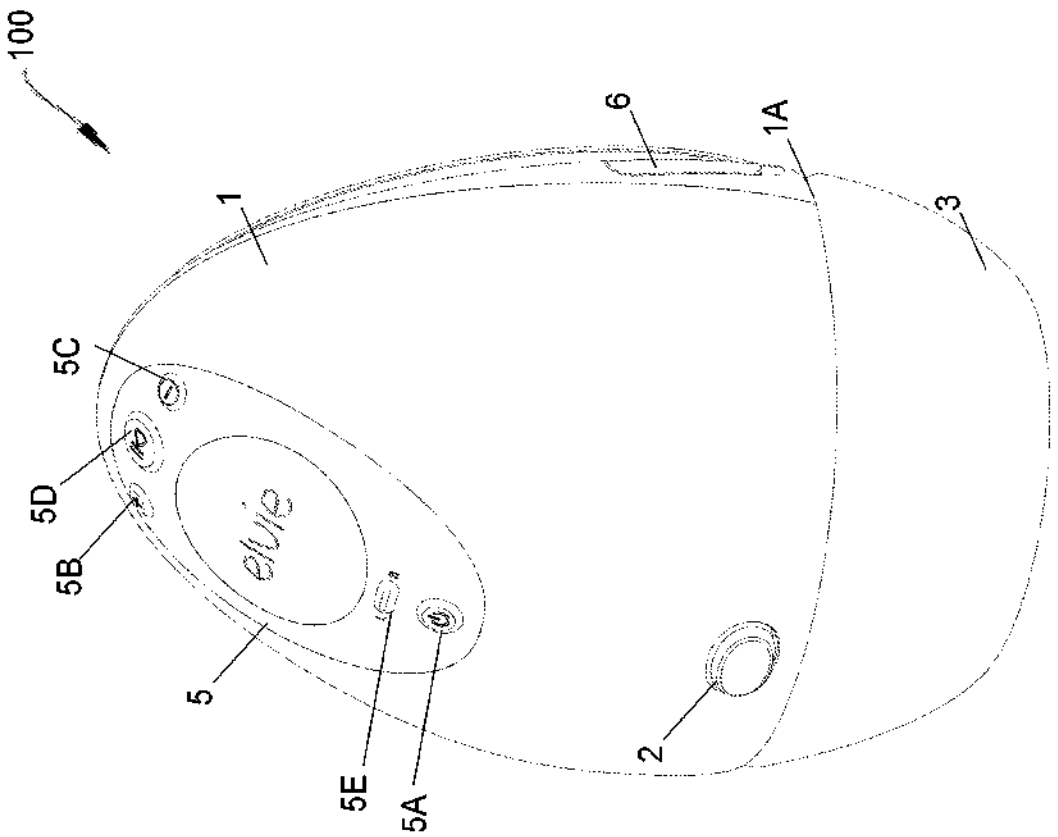


FIGURE 1

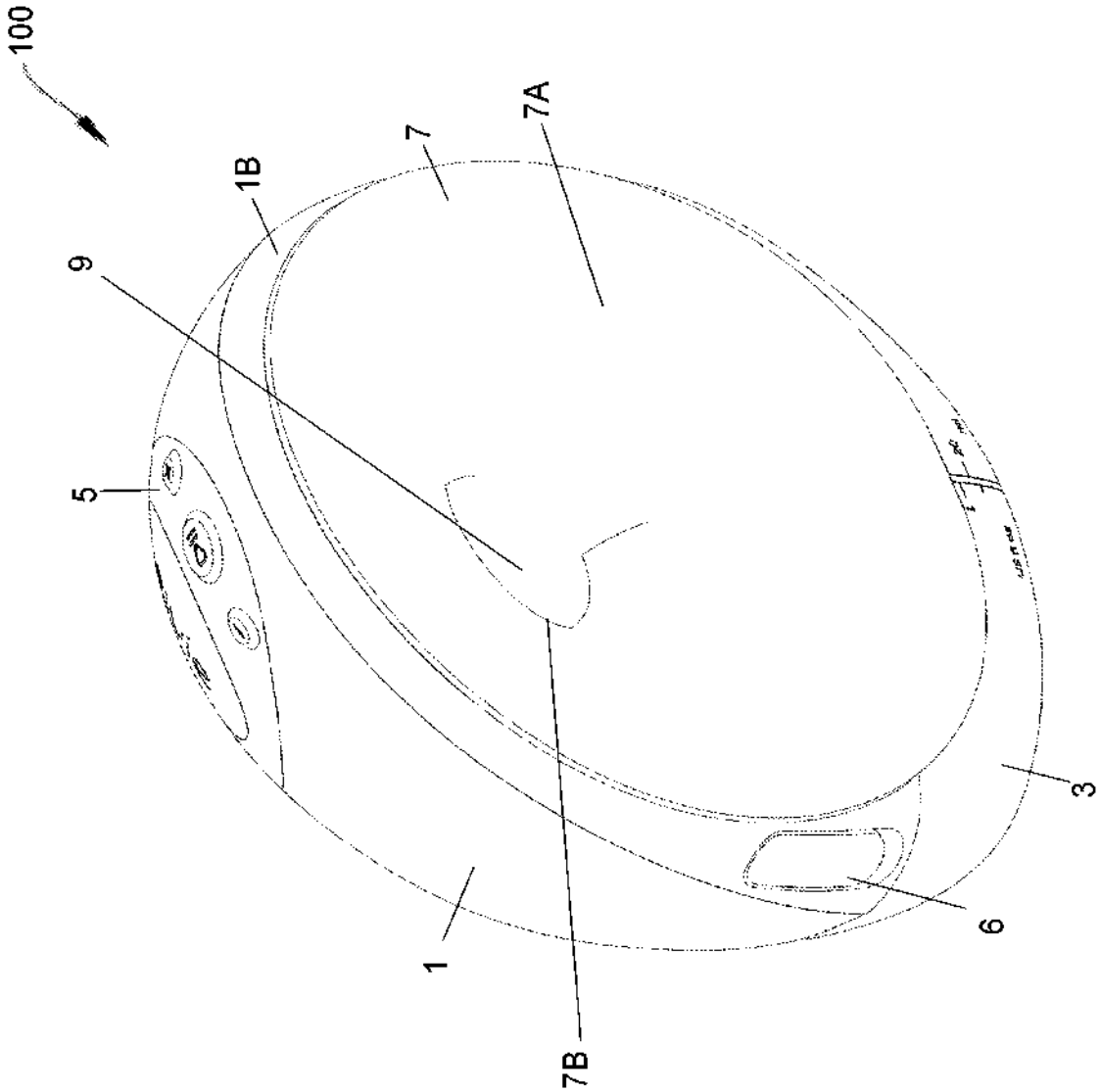


FIGURE 2

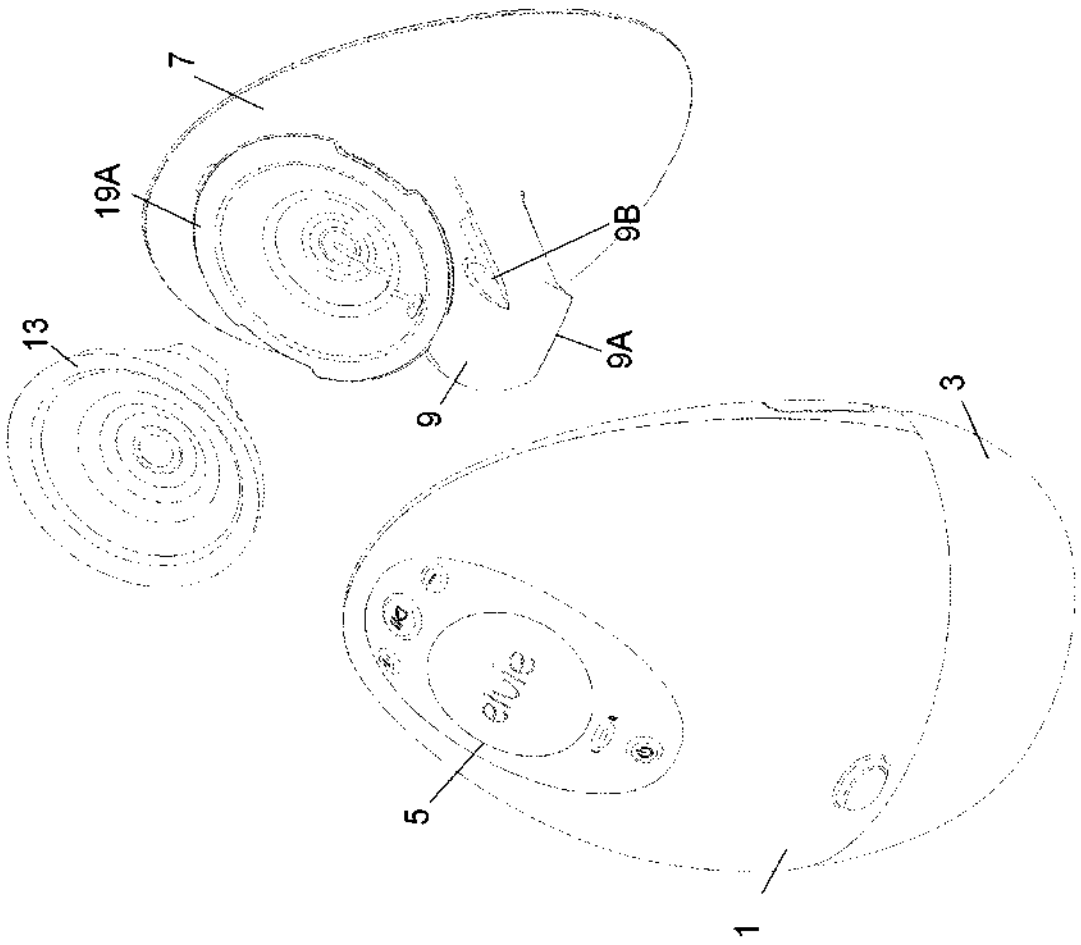


FIGURE 3

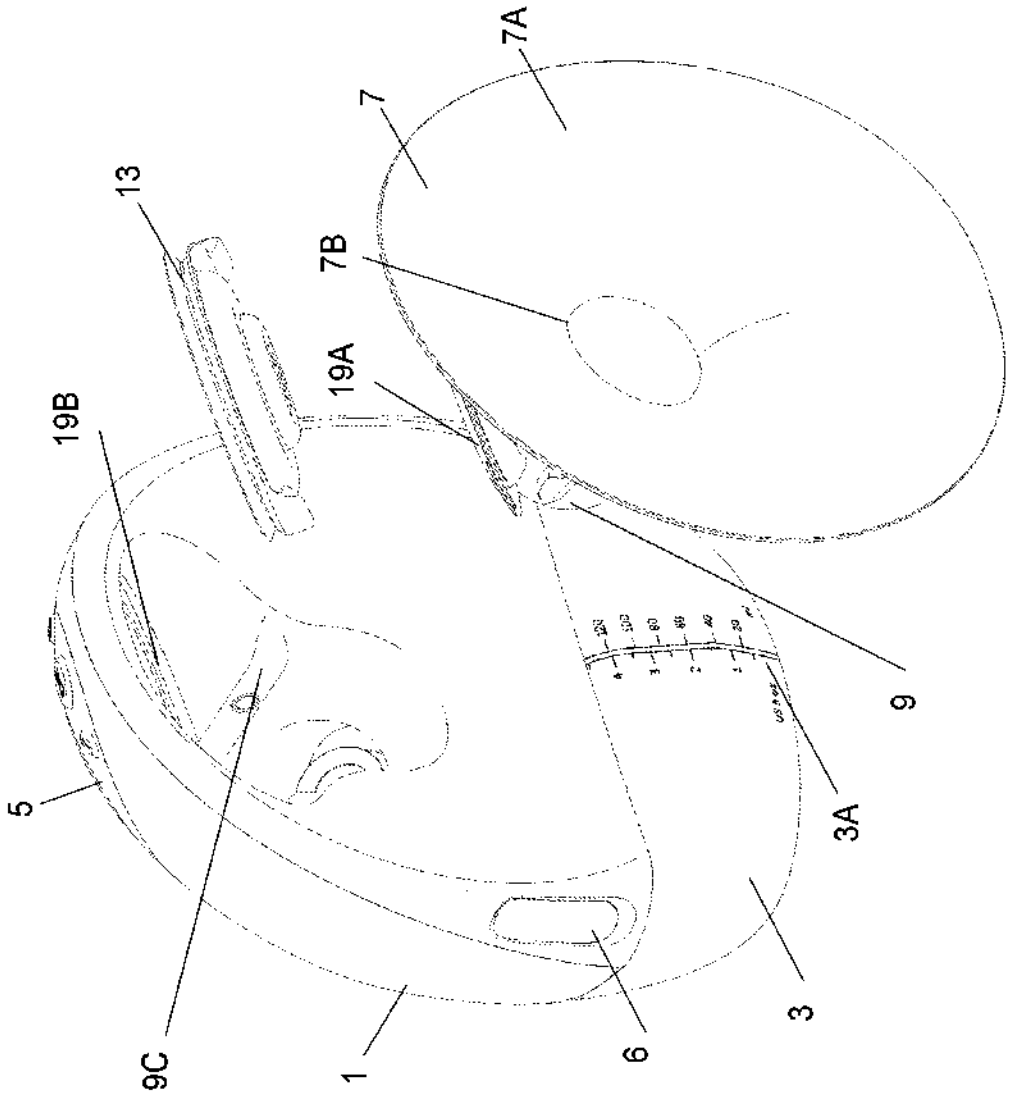


FIGURE 4

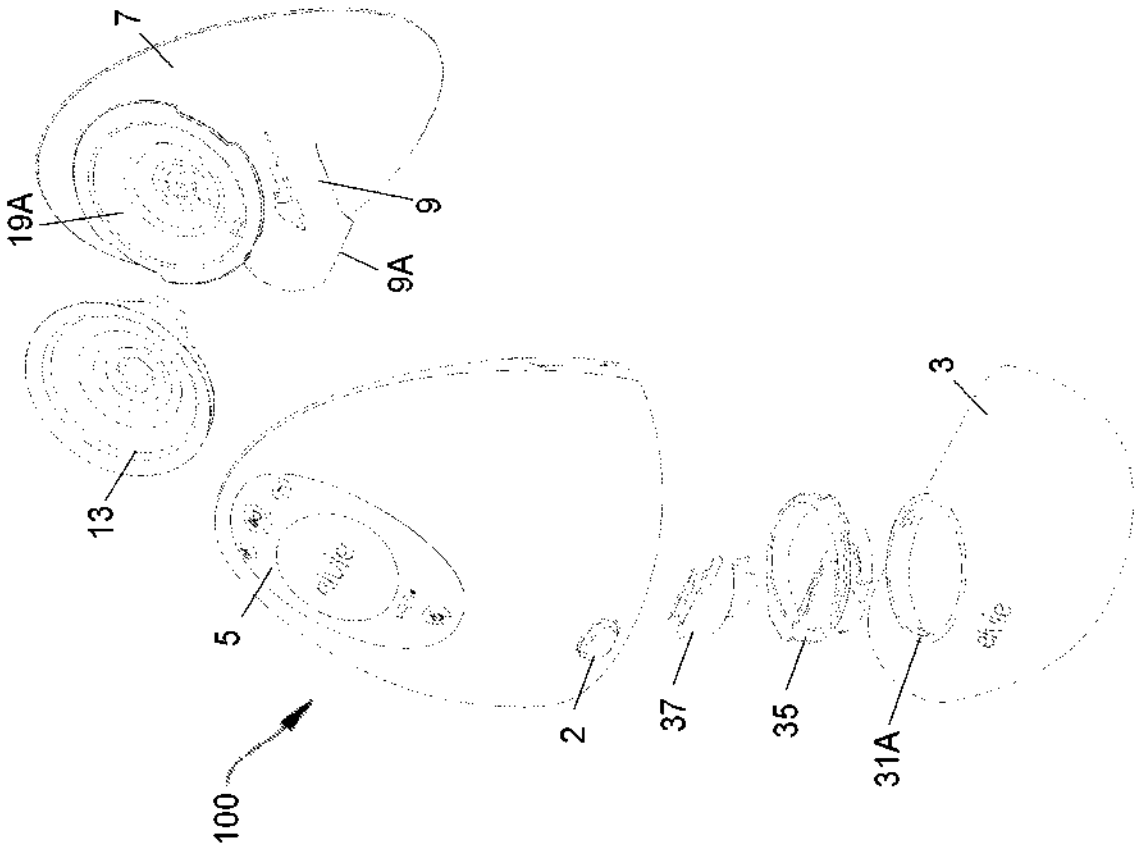


FIGURE 5

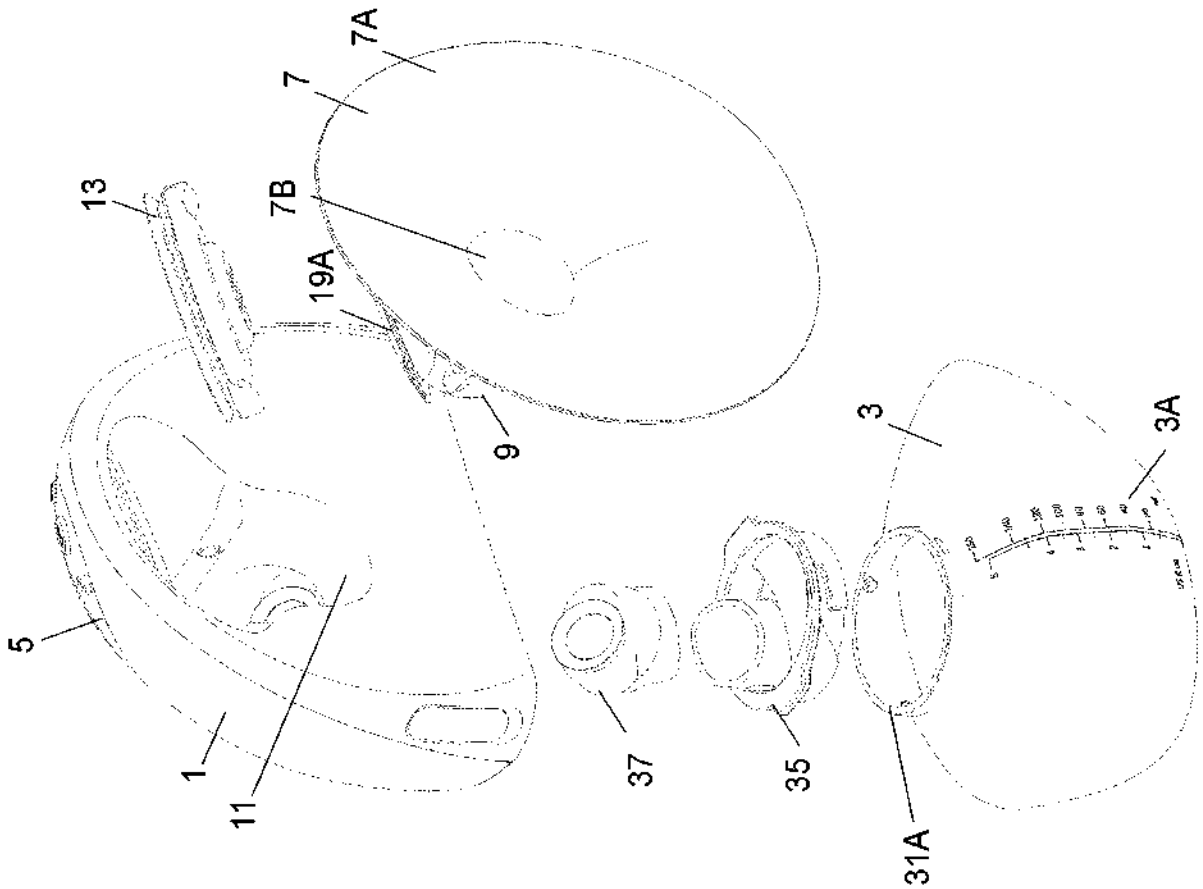


FIGURE 6

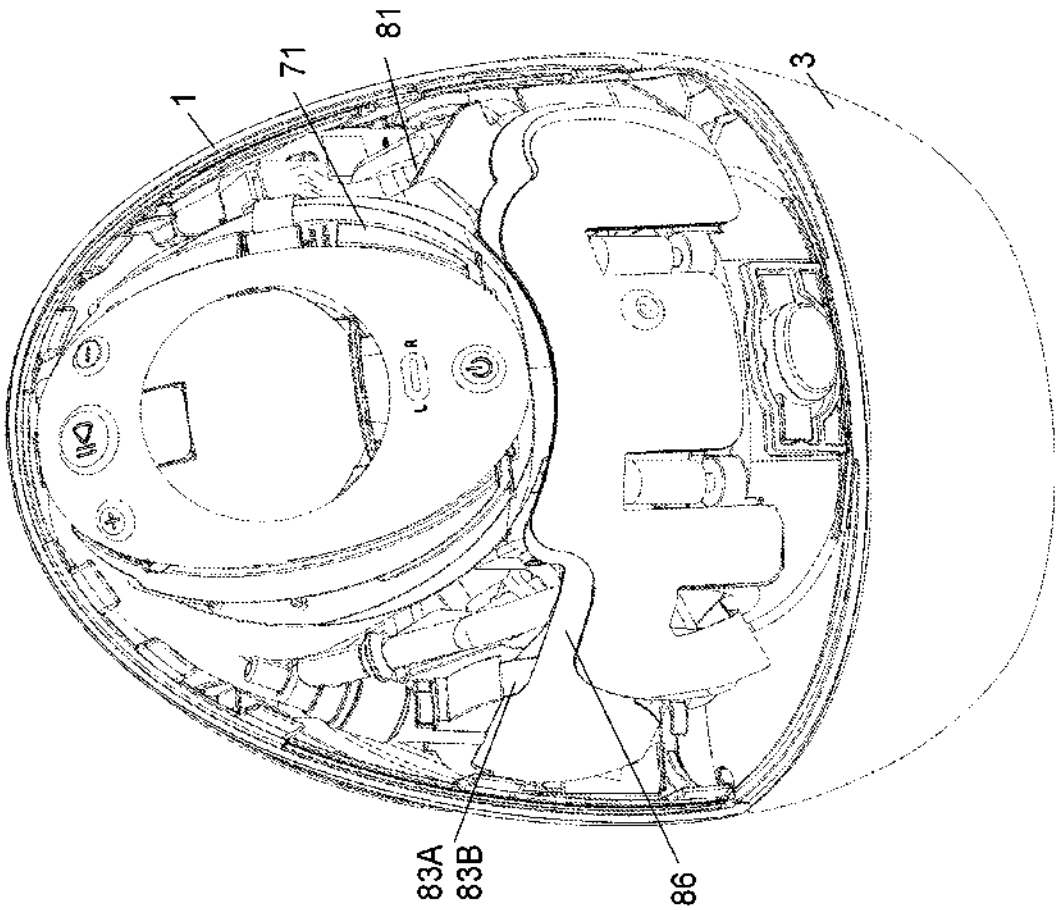


FIGURE 7

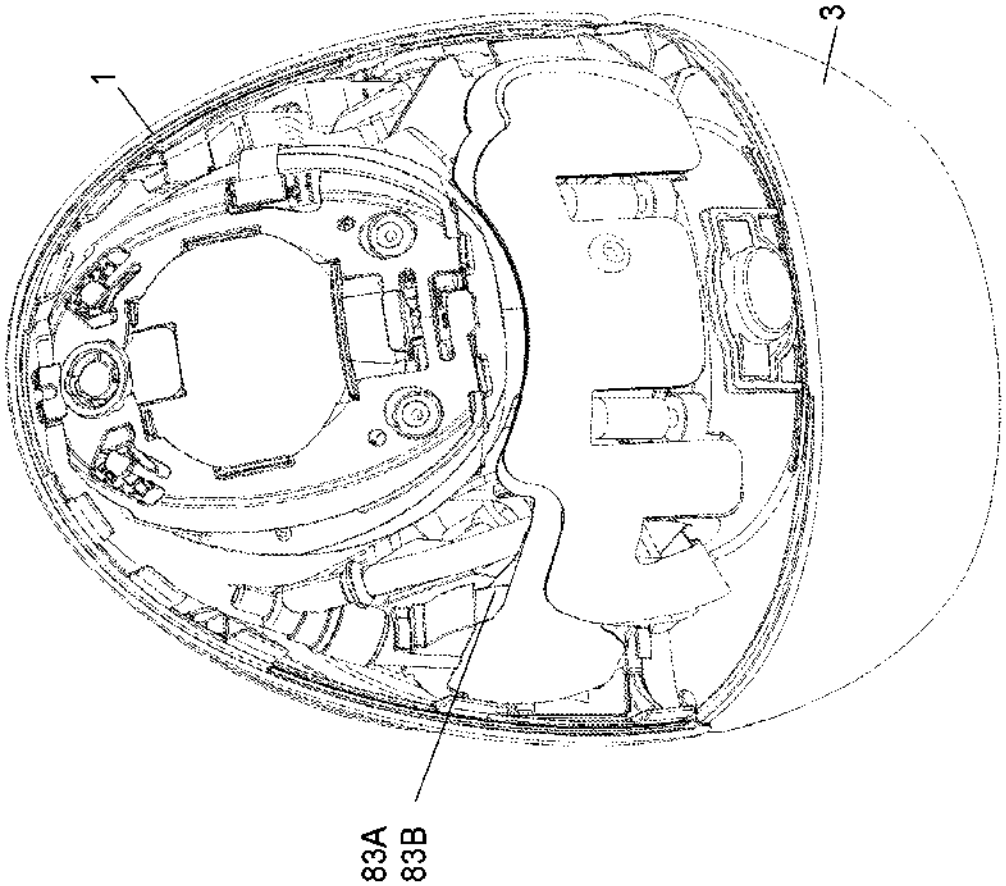


FIGURE 8

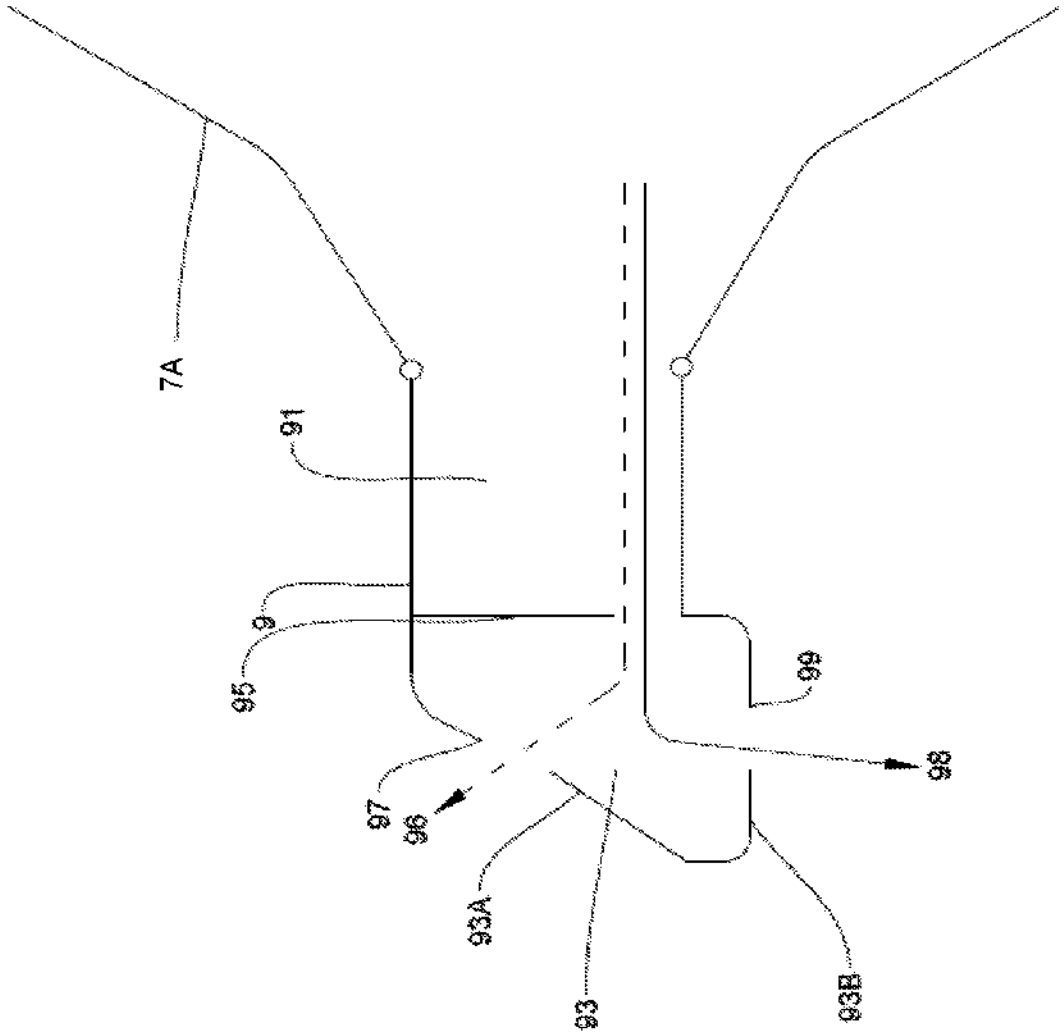


FIGURE 9

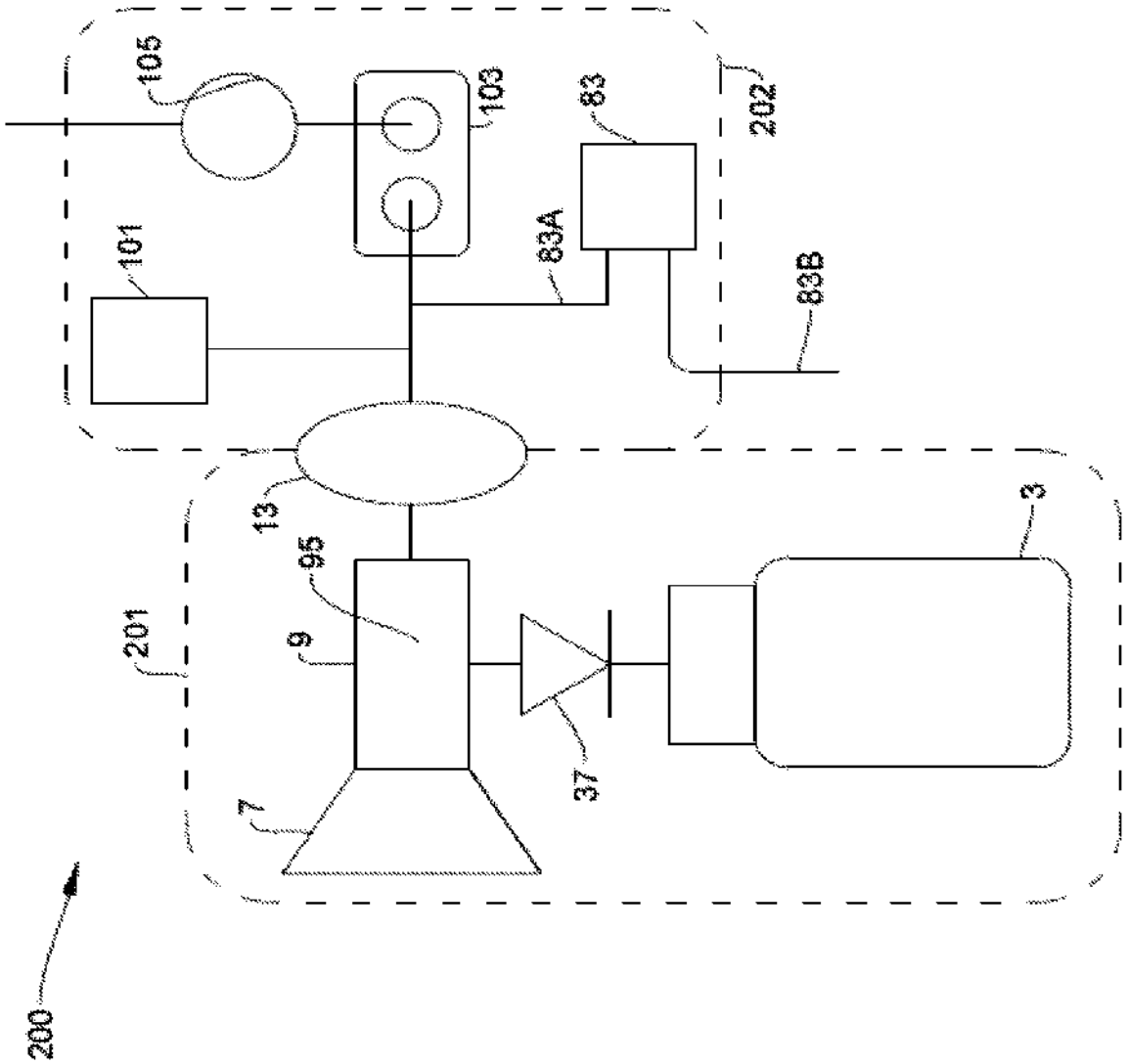


FIGURE 10

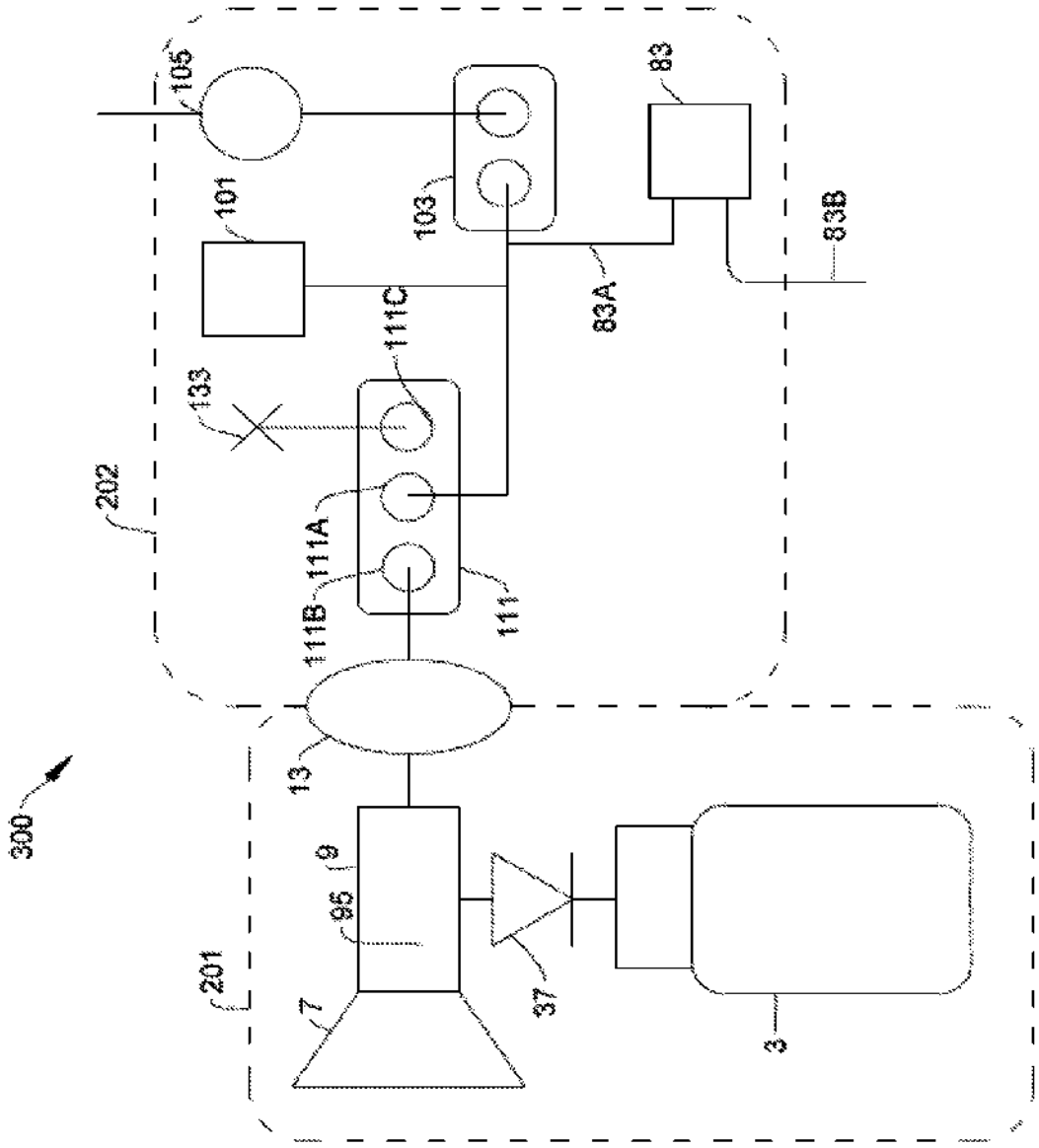

300
202
201
105
101
103
83
83A
83B
111C
133
111A
111B
111
13
9
95
7
37
3

FIGURE 11

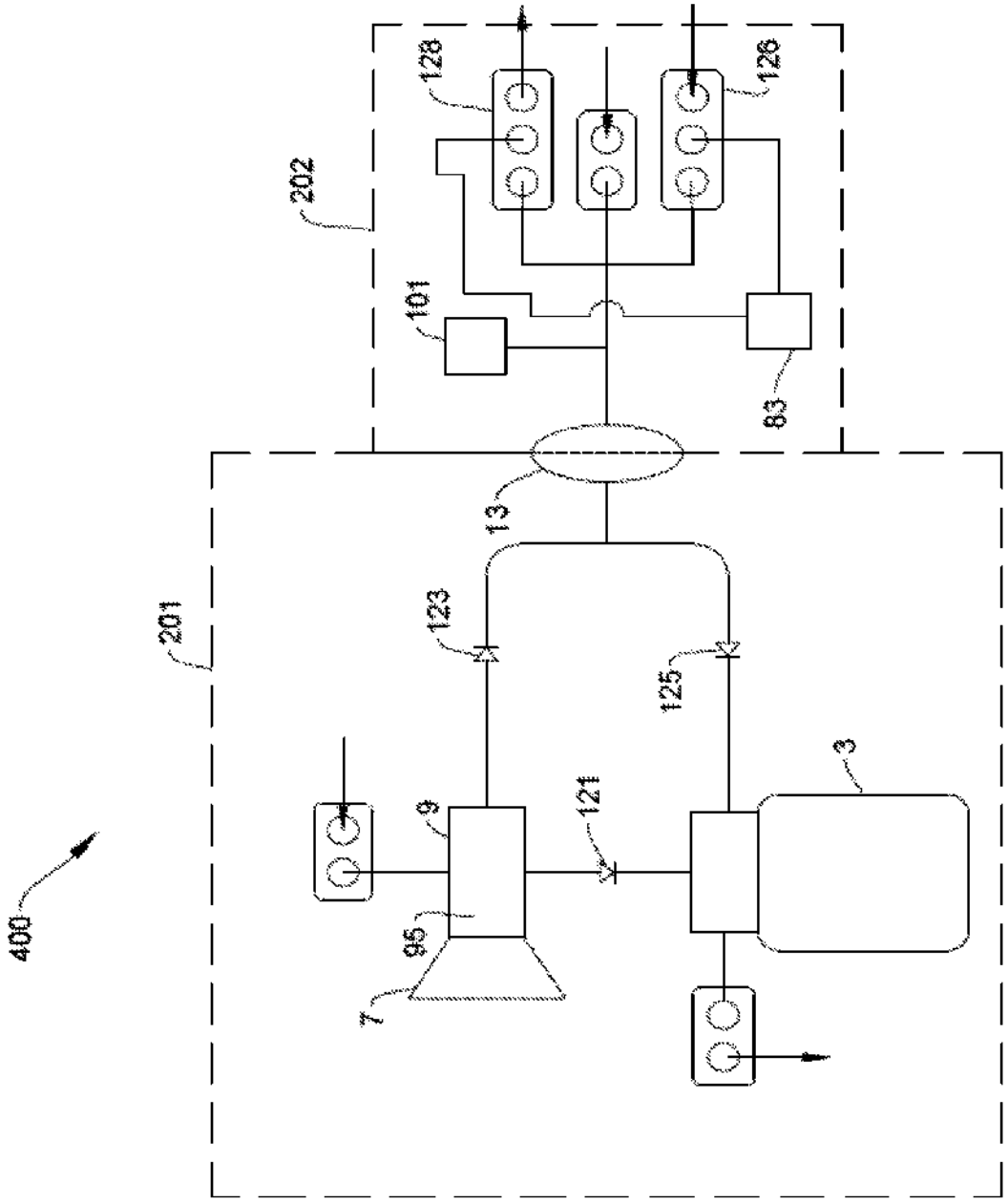


FIGURE 12

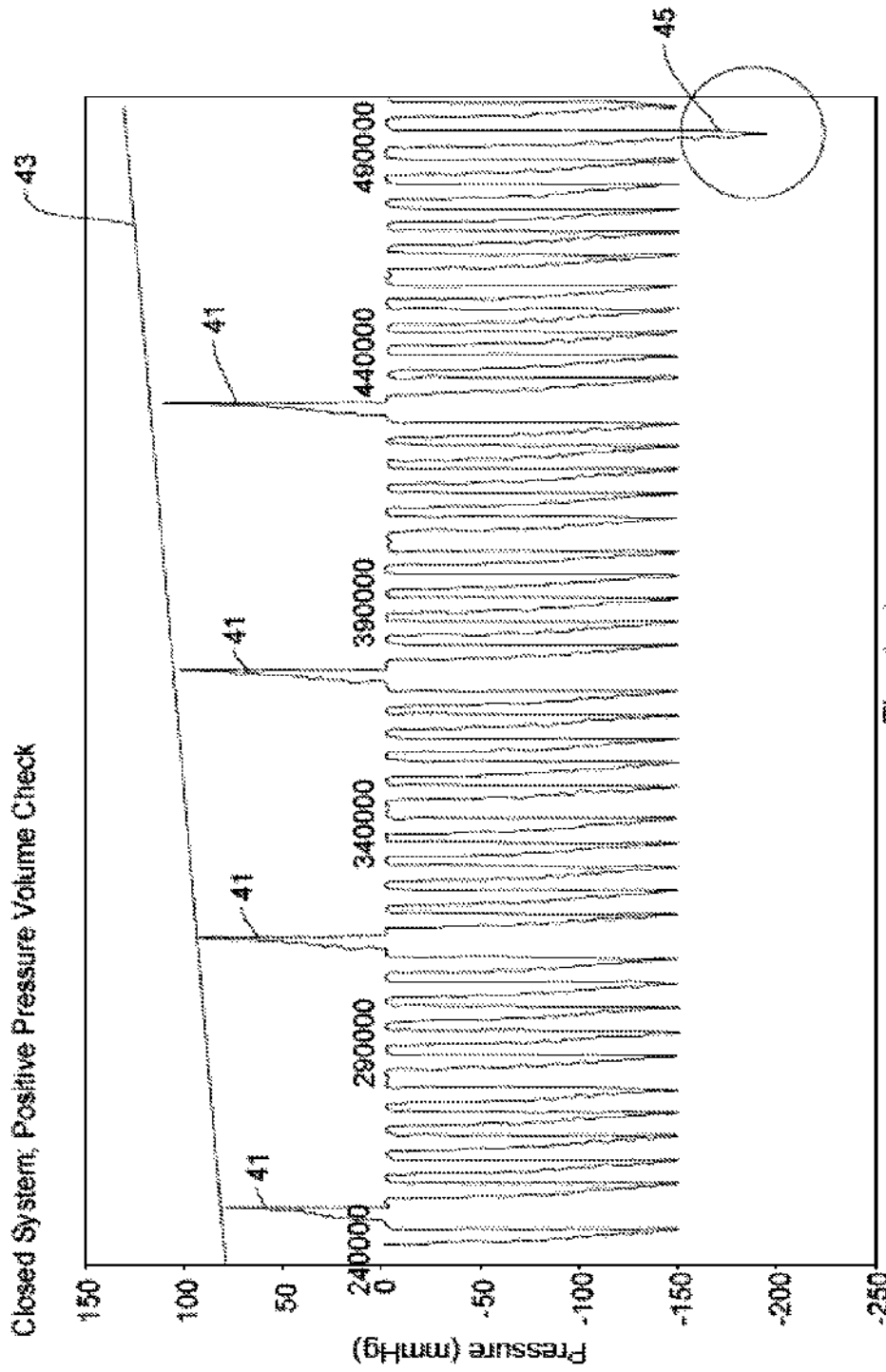

Closed System, Positive Pressure Volume Check
43
41
41
41
41
45
240000
290000
340000
390000
440000
490000
150
100
50
0
-50
-100
-150
-200
-250
Pressure (mmHg)
Time (ms)
Plot Area

FIGURE 13

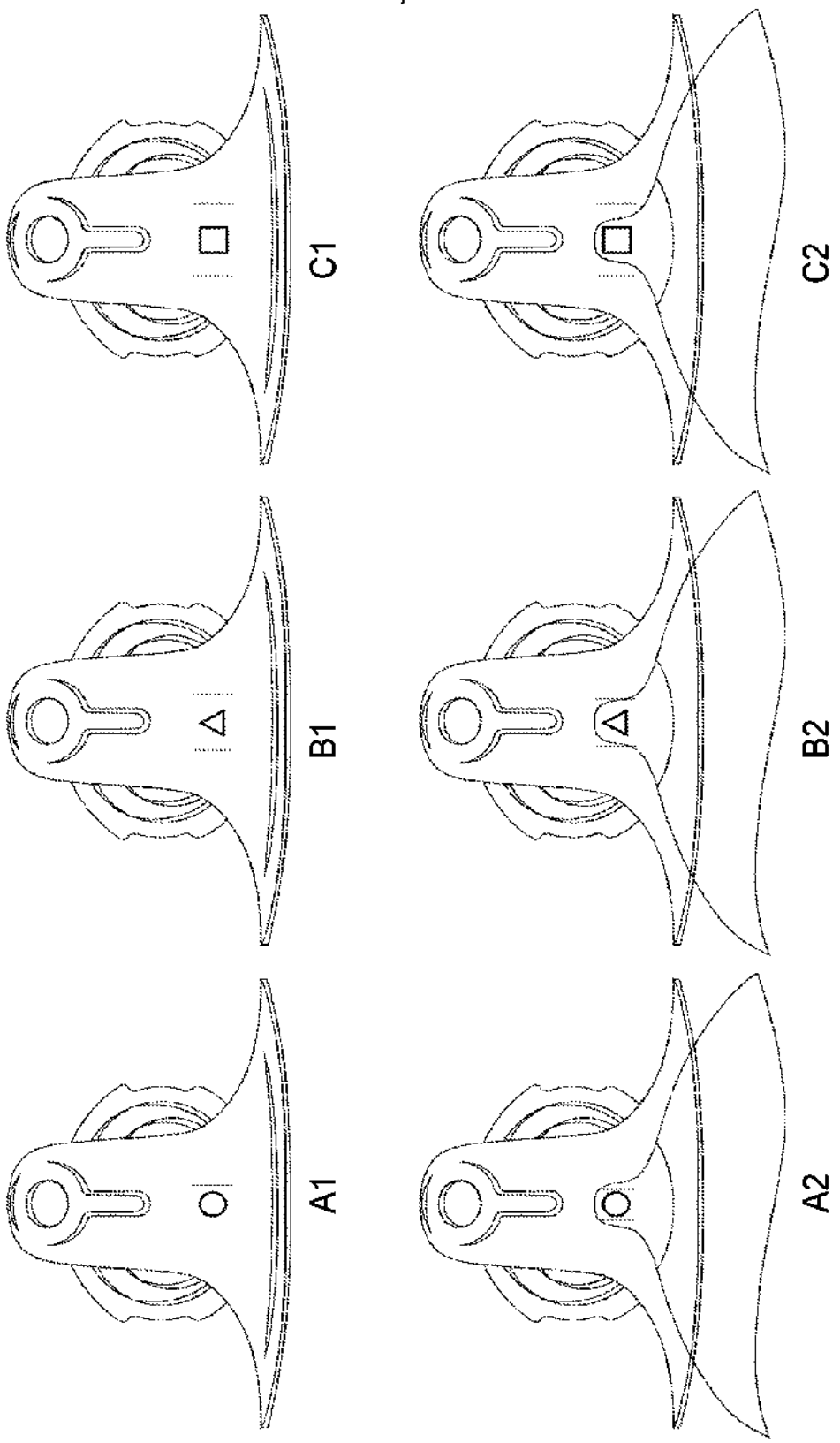


FIGURE 14

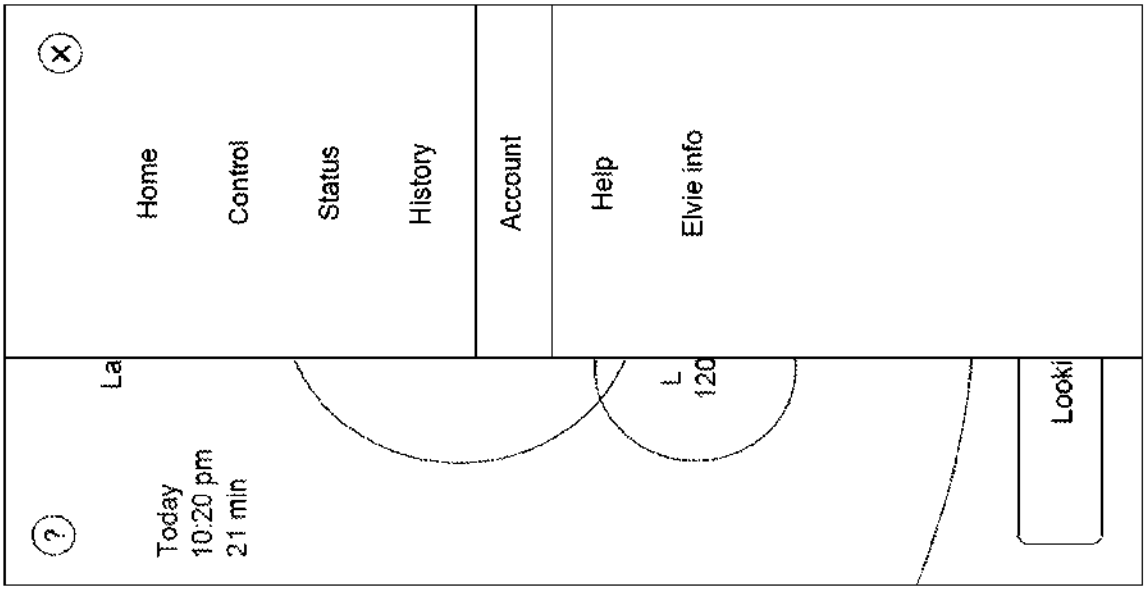

Home
Controi
Status
History
Account
Help
Elvie info
Today
10:20 pm
21 min
Looki

FIGURE 15

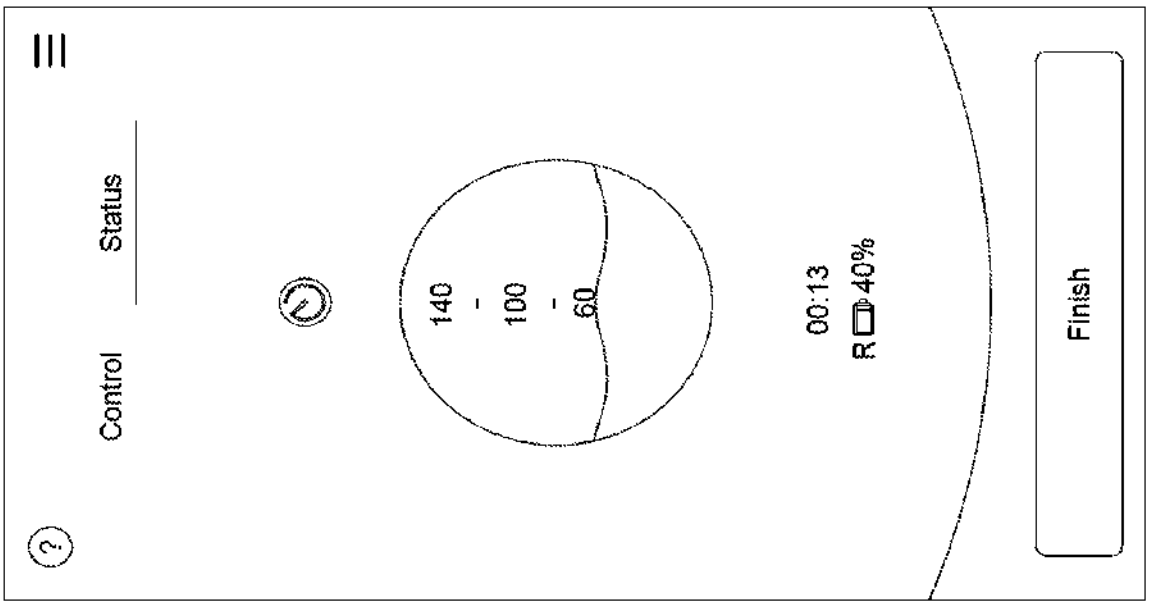


FIGURE 16

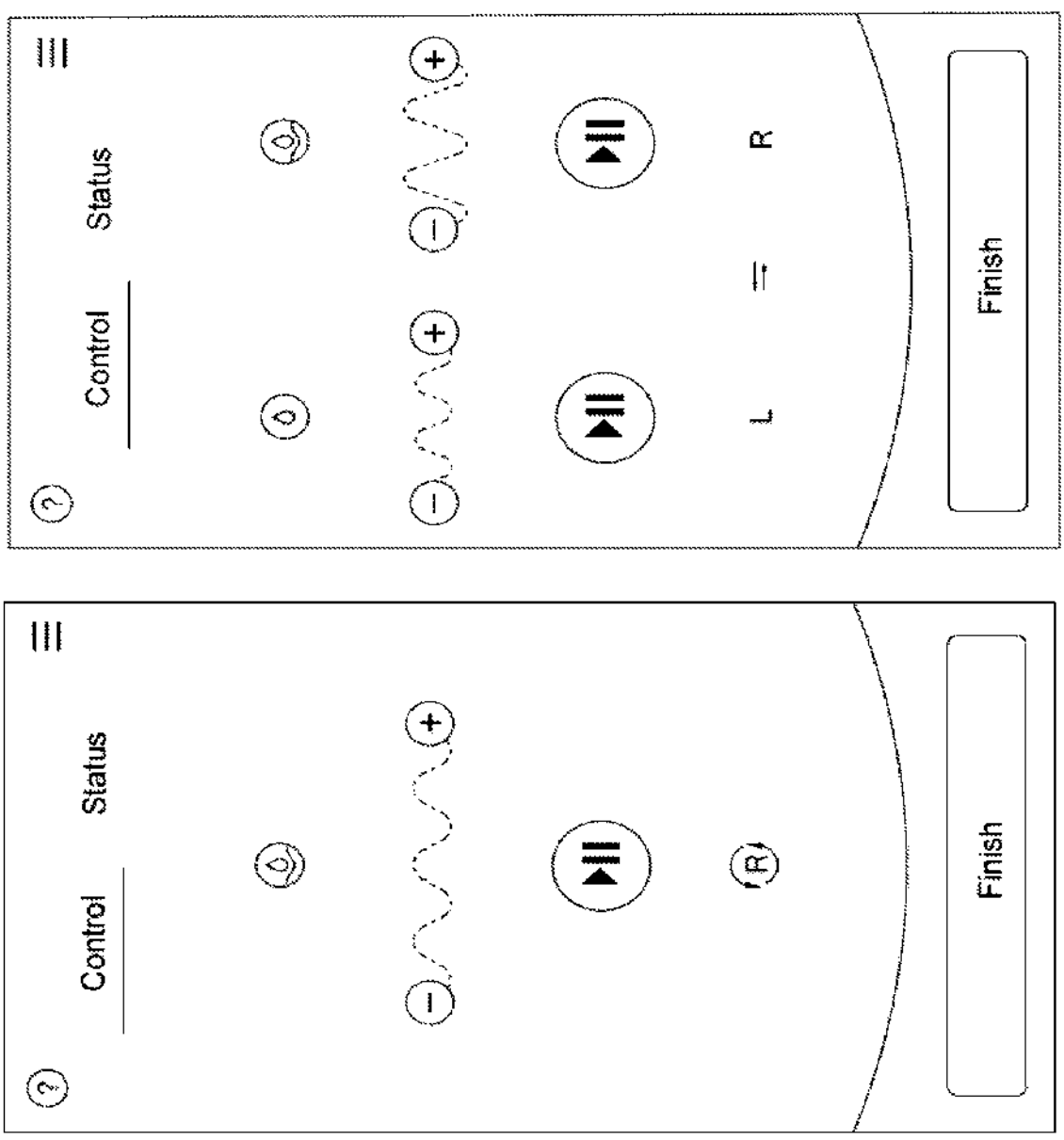


FIGURE 17

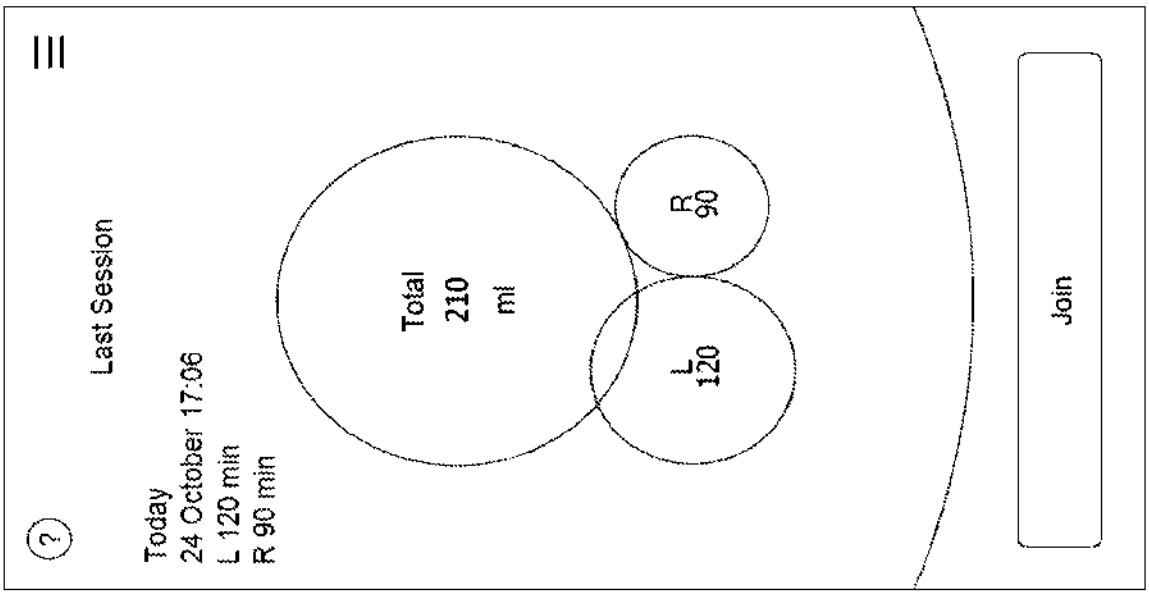

Last Session
Today
24 October 17:06
L 120 min
R 90 min
Total
210
mi
L
120
R
90
Join

FIGURE 18

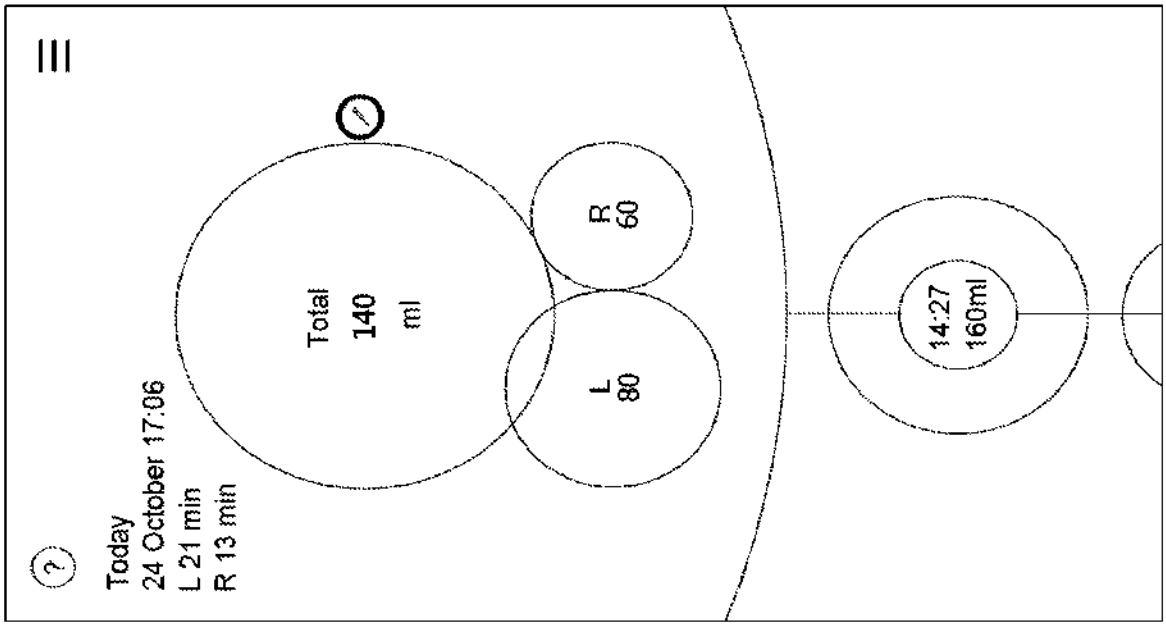

Today
24 October 17:06
L 21 min
R 13 min
Total
140
ml
L
80
R
60
14:27
160ml

FIGURE 19

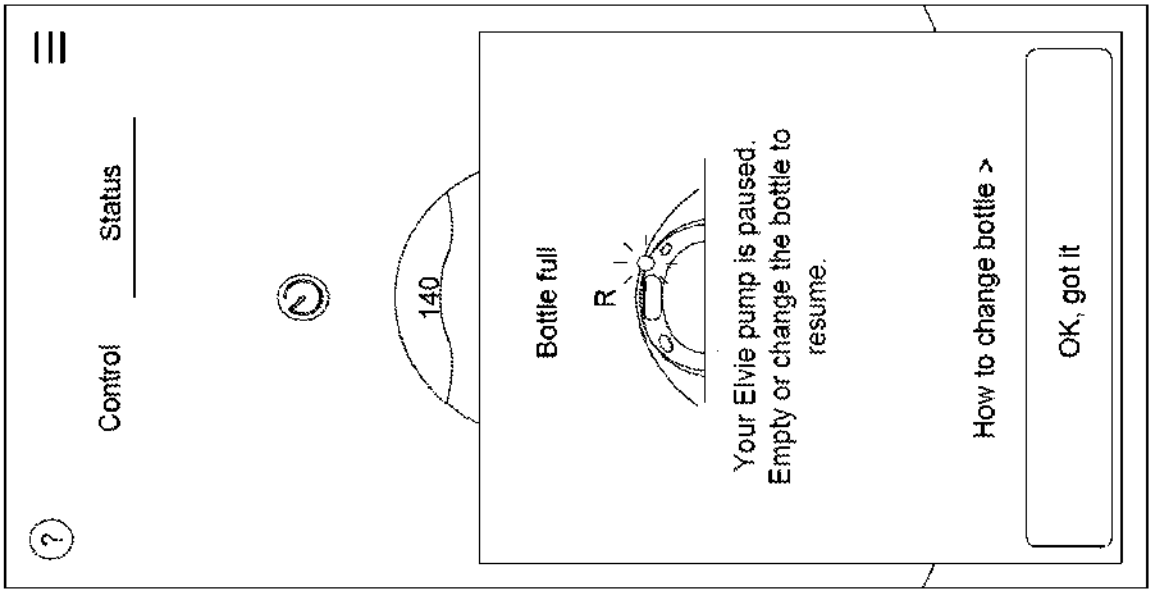

Control
Status
140
Bottle full
R
Your Elvie pump is paused.
Empty or change the bottle to resume.
How to change bottle >
OK, got it

FIGURE 20

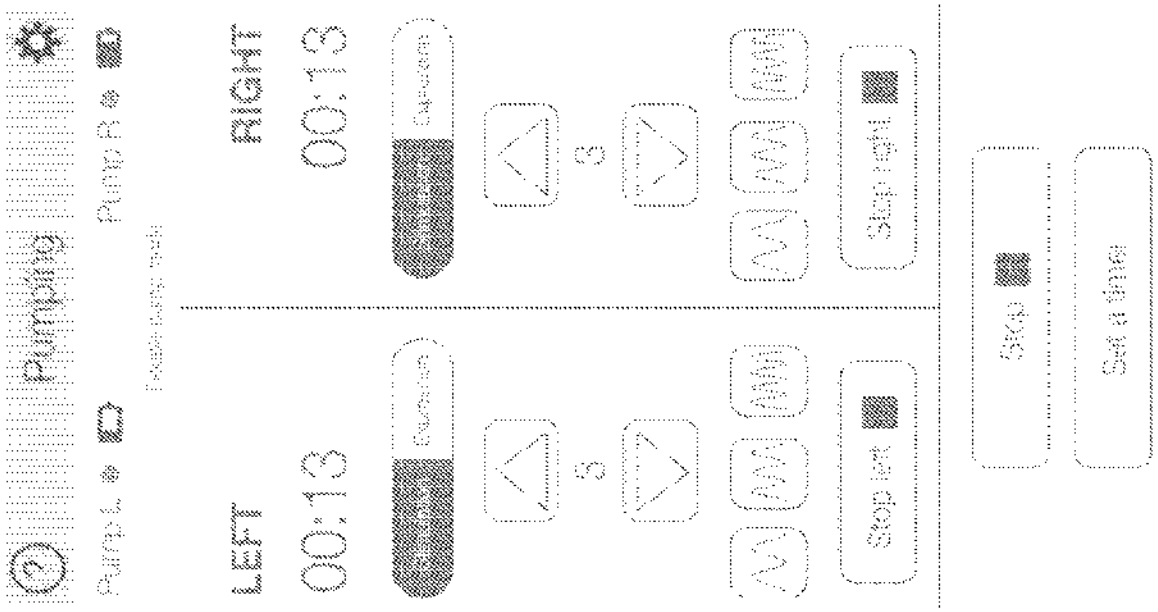

Pumping
Pump L
Pump R
LEFT
00:13
RIGHT
00:13
5
3
Stop left
Stop right
Stop
Set a timer

FIGURE 21

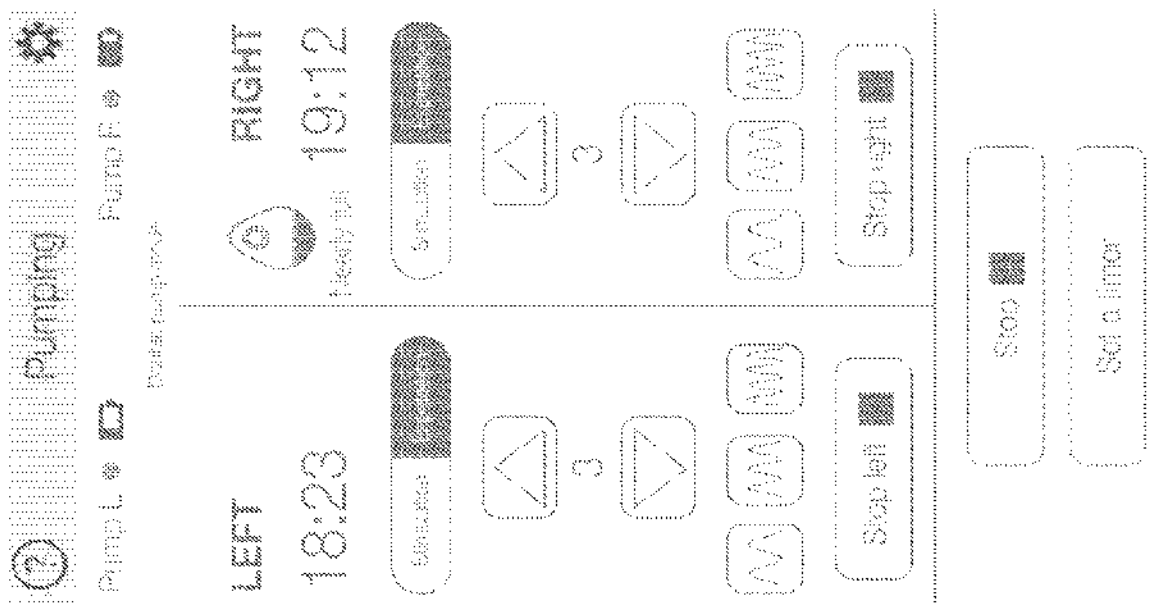

Pumping
Pump L
Pump R
LEFT
18:23
RIGHT
19:12
3
3
Stop left
Stop right
Stop
Set a timer

FIGURE 22

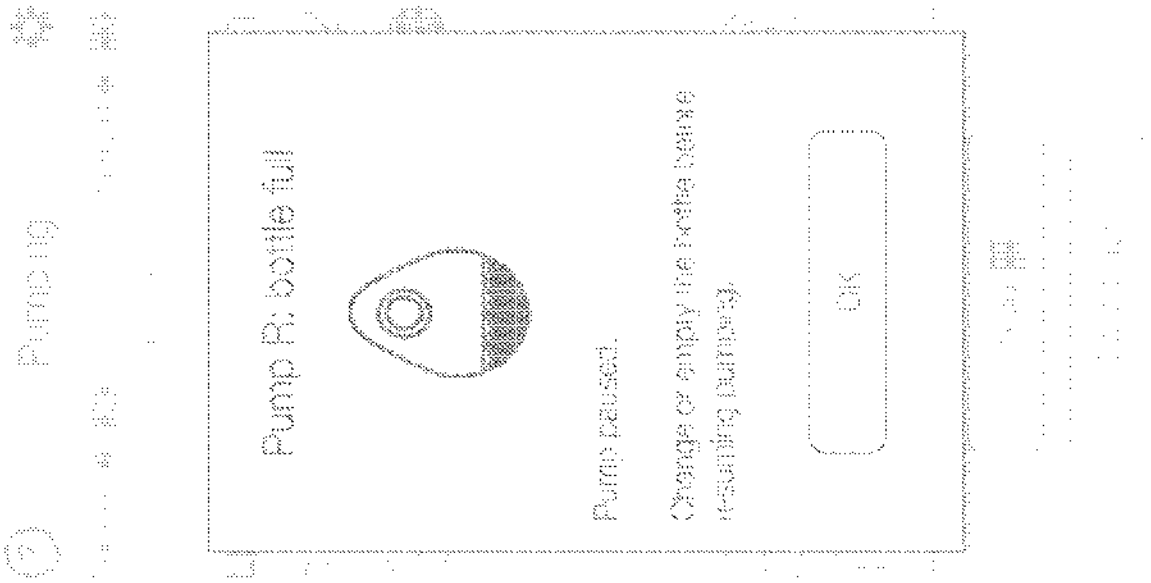


FIGURE 23

Stopped
Pump L
Pump R
LEFT
21:02
STOPPED
RIGHT
20:38
STOPPED
Total volume infused:
60 ml
Total volume infused:
65 ml
Resume left
Resume right
Return
End session

FIGURE 24

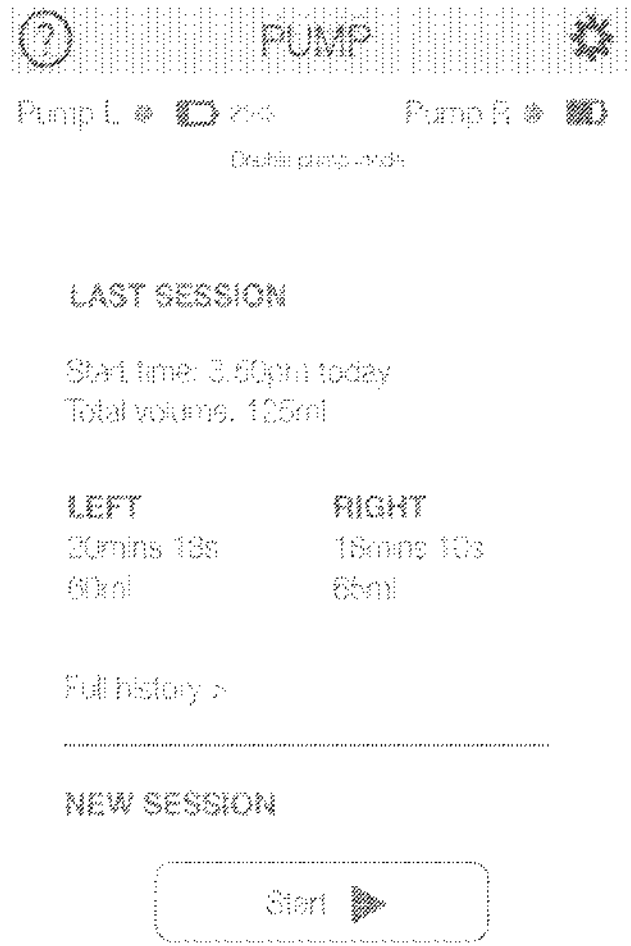

PUMP
Pump L
Pump R
LAST SESSION
Start time: 3.50pm today
Total volume: 125ml
LEFT
20mins 18s
60ml
RIGHT
18mins 10s
65ml
Full history >
NEW SESSION
Start

FIGURE 25

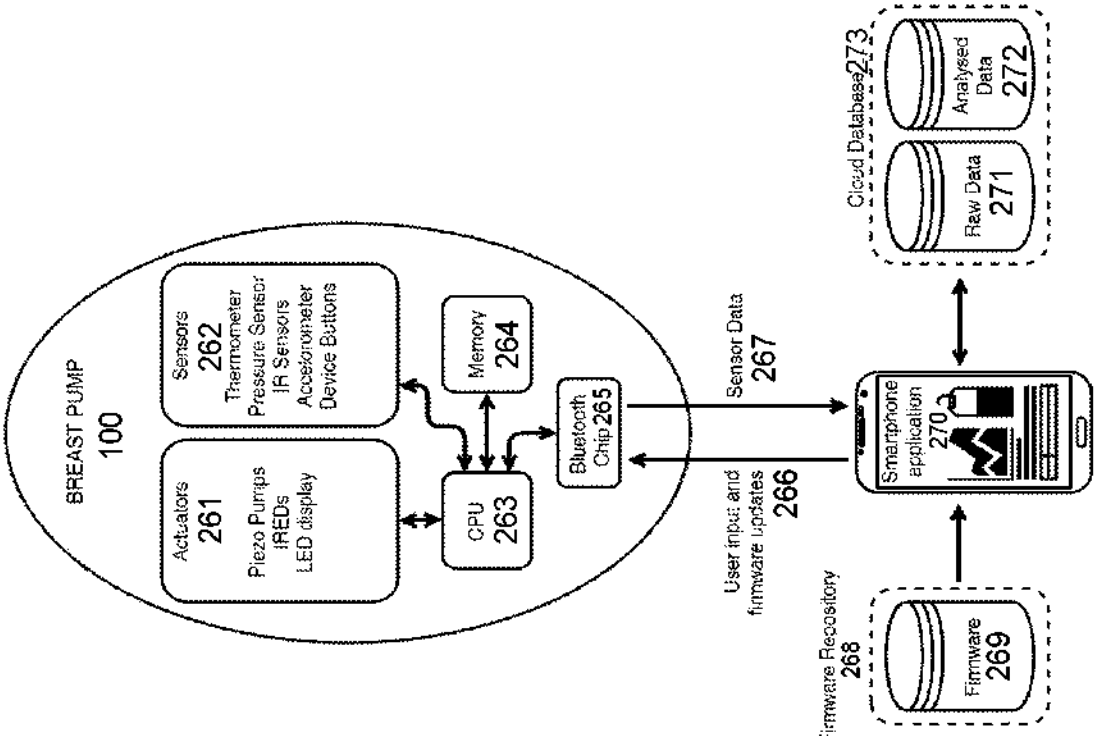

BREAST PUMP
100
Actuators
261
Piezo Pumps
IREDs
LED display
Sensors
262
Thermometer
Pressure Sensor
IR Sensors
Accelerometer
Device Buttons
CPU
263
Memory
264
Bluetooth
Chip 265
Sensor Data
267
User input and
firmware updates
266
Smartphone
application
270
Cloud Database 273
Raw Data
271
Analysed
Data
272
Firmware Repository
268
Firmware
269

FIGURE 26

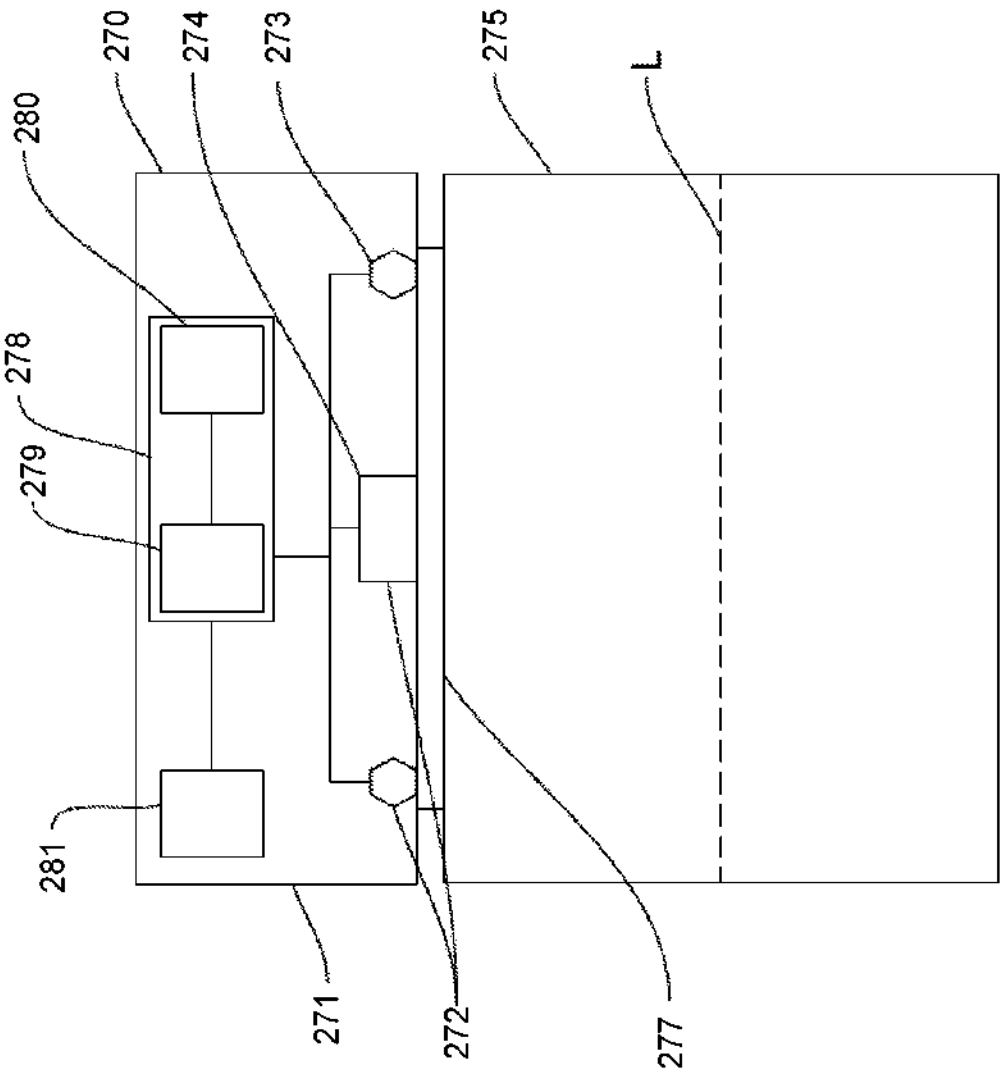


FIGURE 27

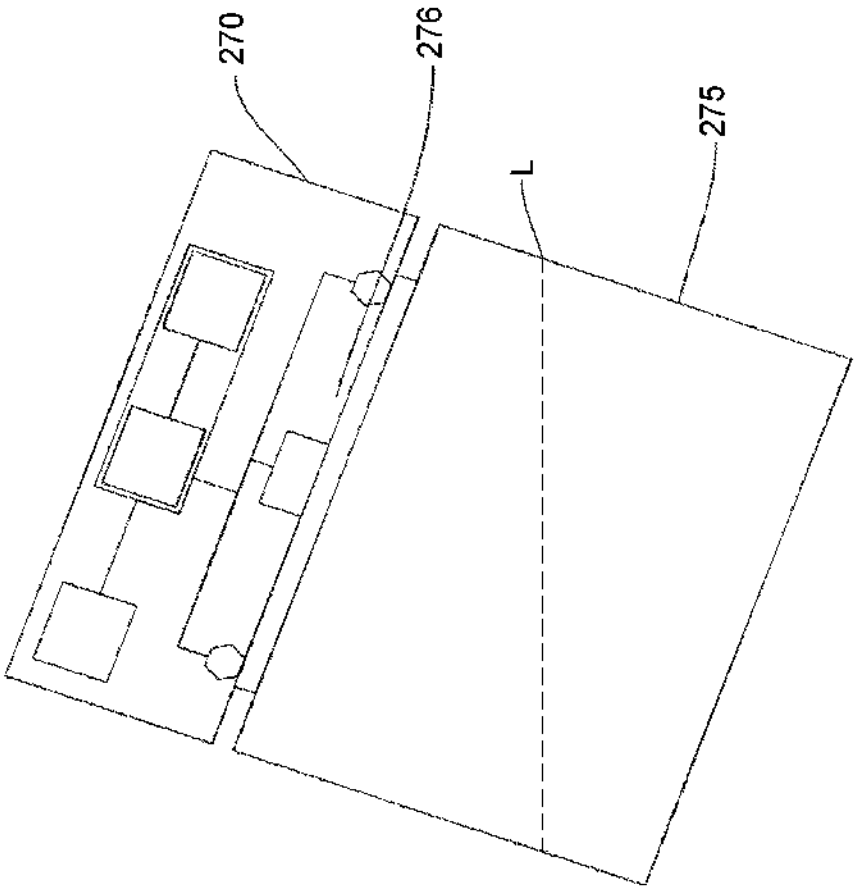


FIGURE 28

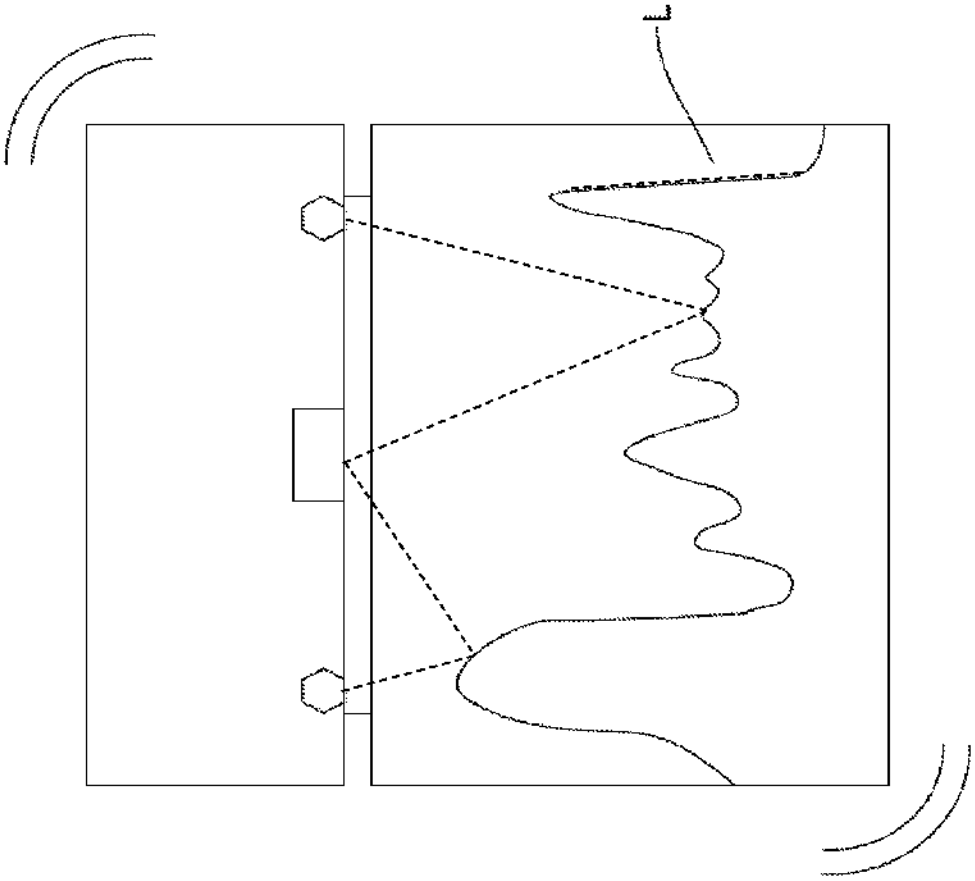


FIGURE 29

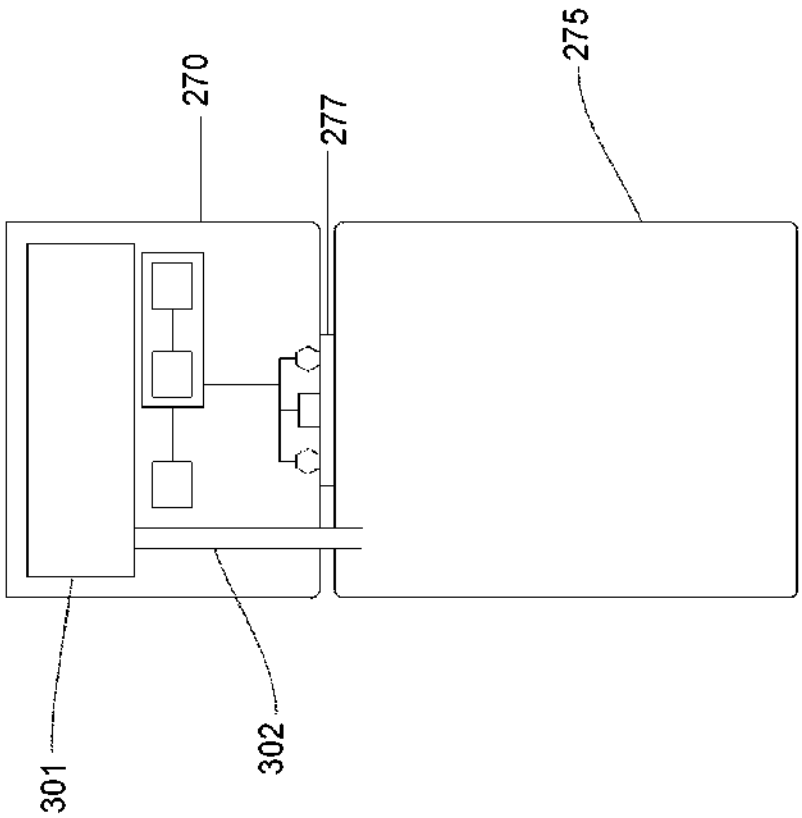


FIGURE 30

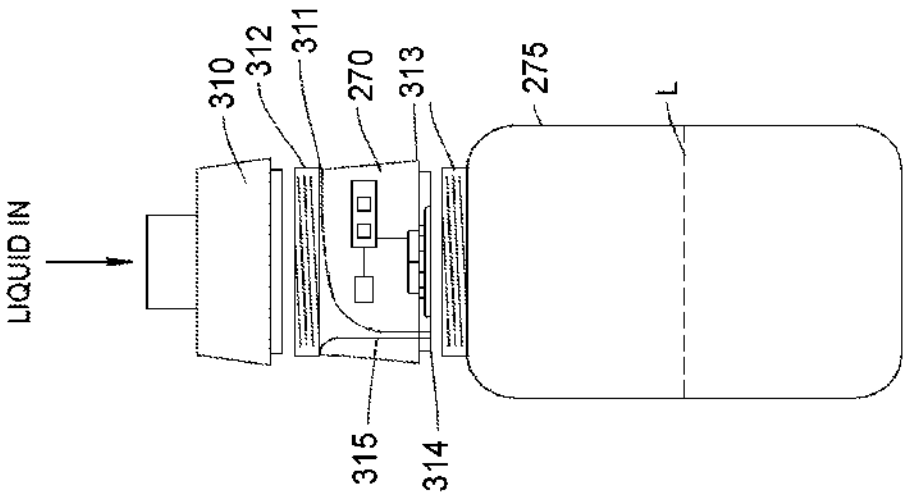


FIGURE 31

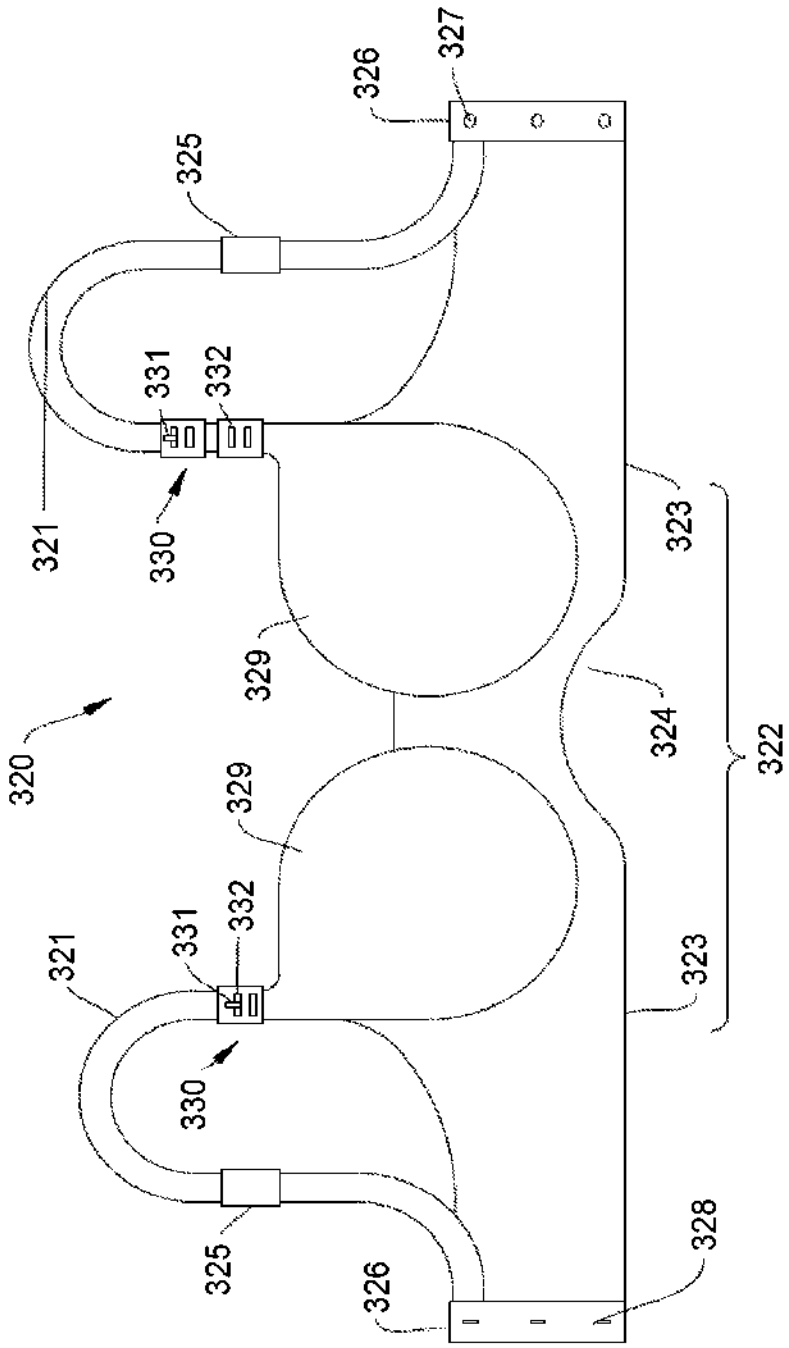
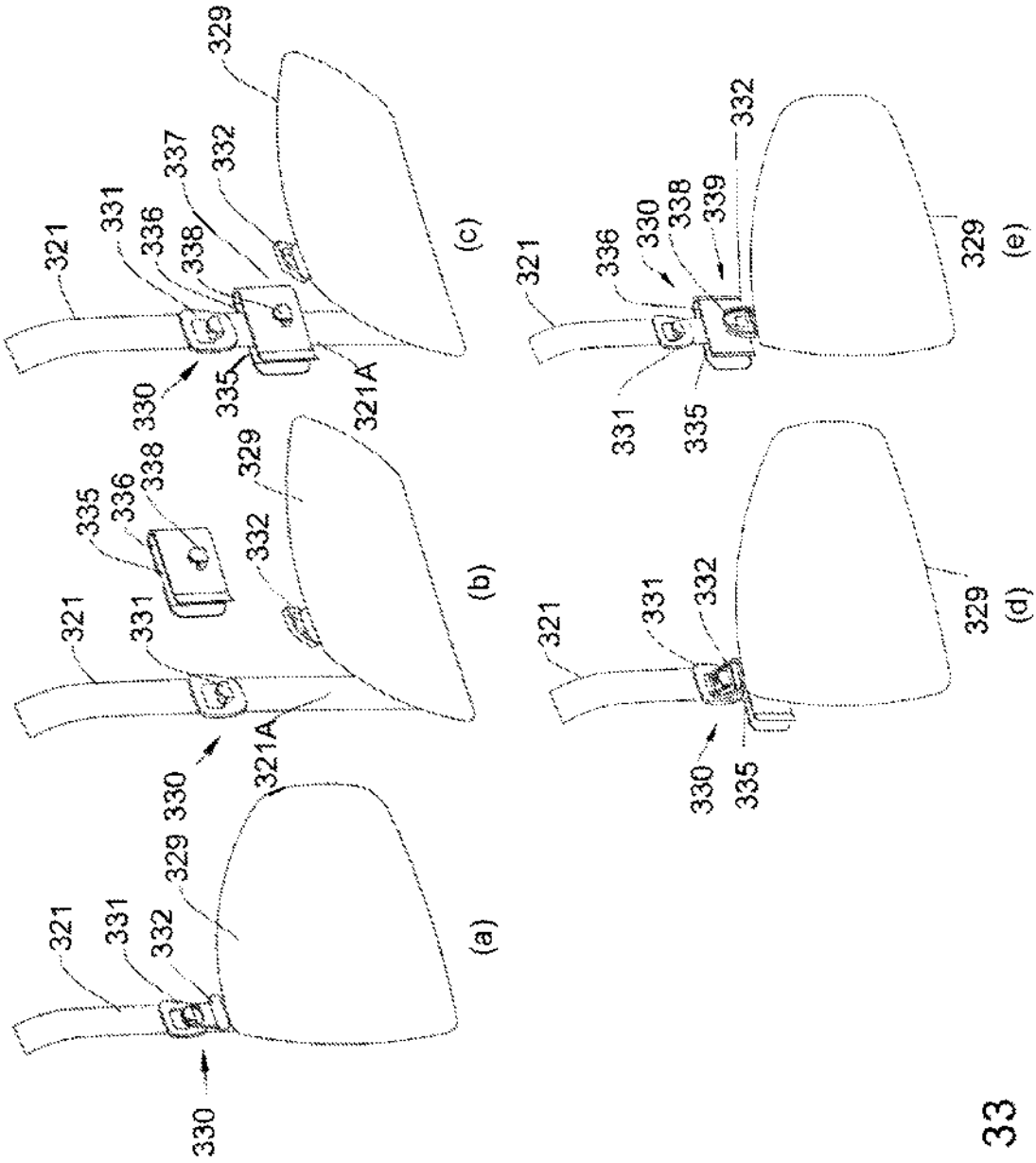


FIGURE 32



330
321
331
332
329
(a)
330
321
331
335
336
338
329
332
321A
(b)
330
321
331
336
338
337
332
329
335
321A
(c)
330
321
331
332
329
335
(d)
330
321
336
330
338
339
332
329
331
335
(e)

FIGURE 33

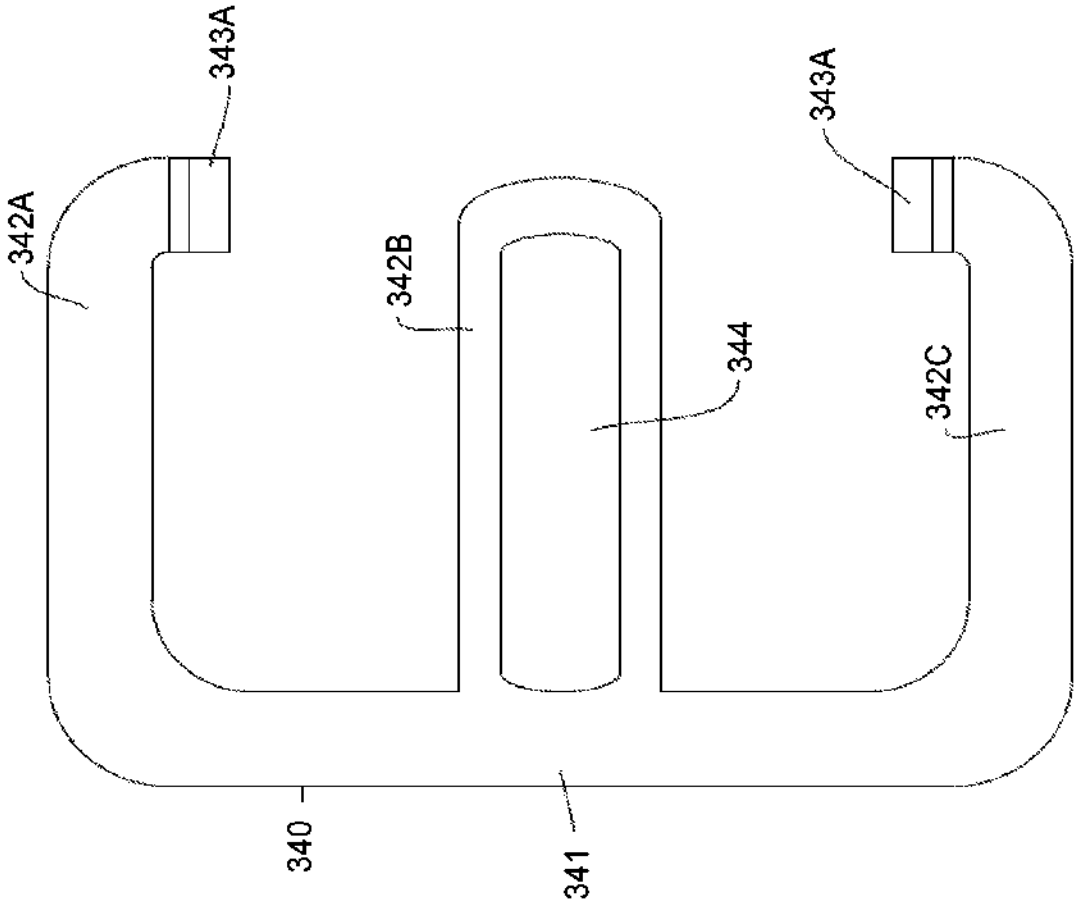


FIGURE 34

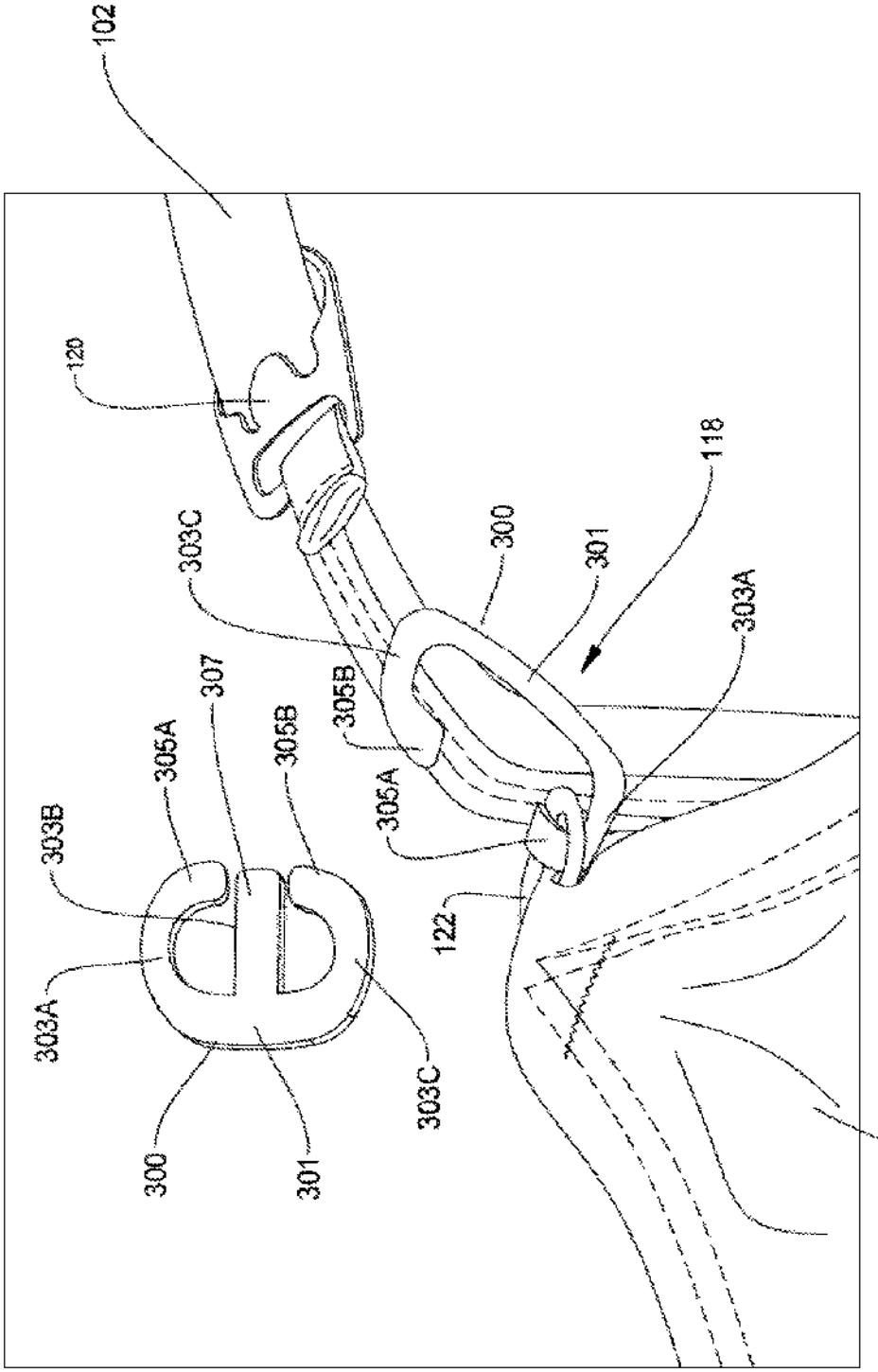

102
120
303C
300
301
118
303A
307
305B
305A
305A
305B
303B
122
303A
303C
300
301
116

FIGURE 35

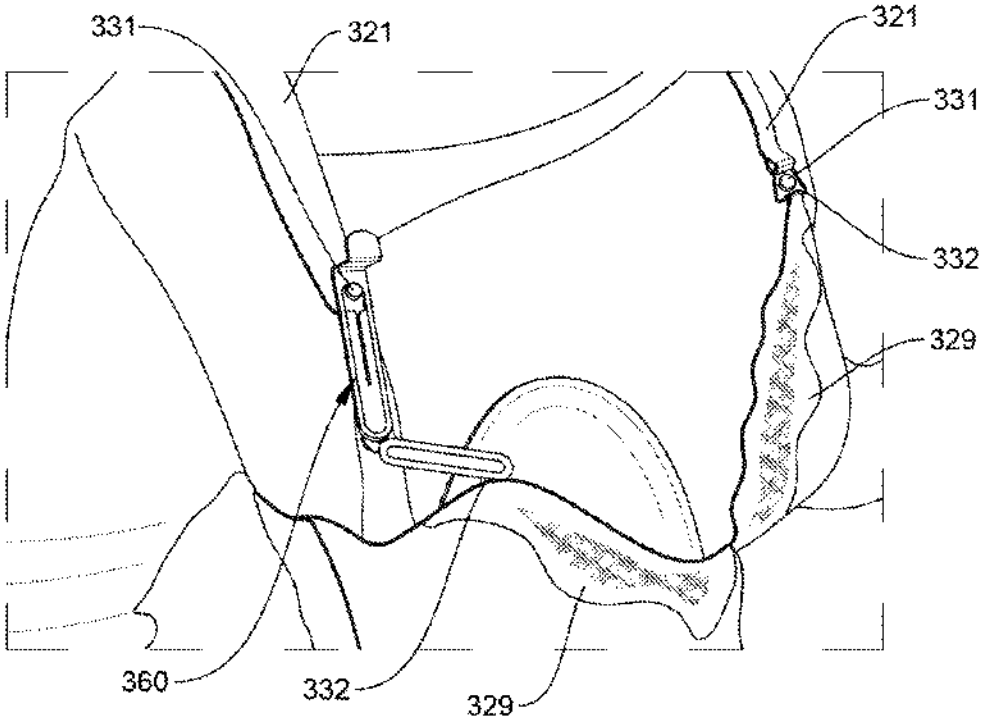


FIGURE 36

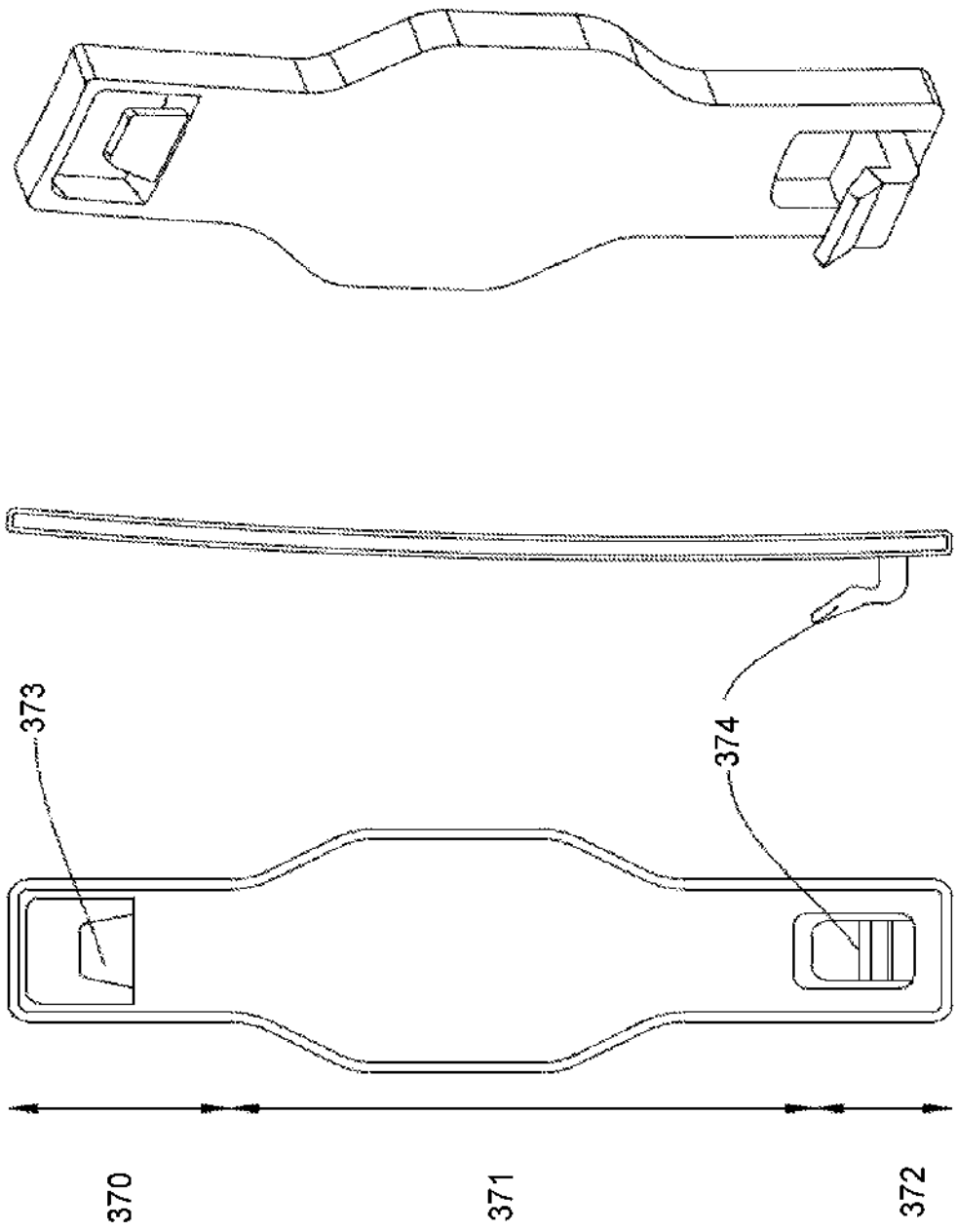


FIGURE 37

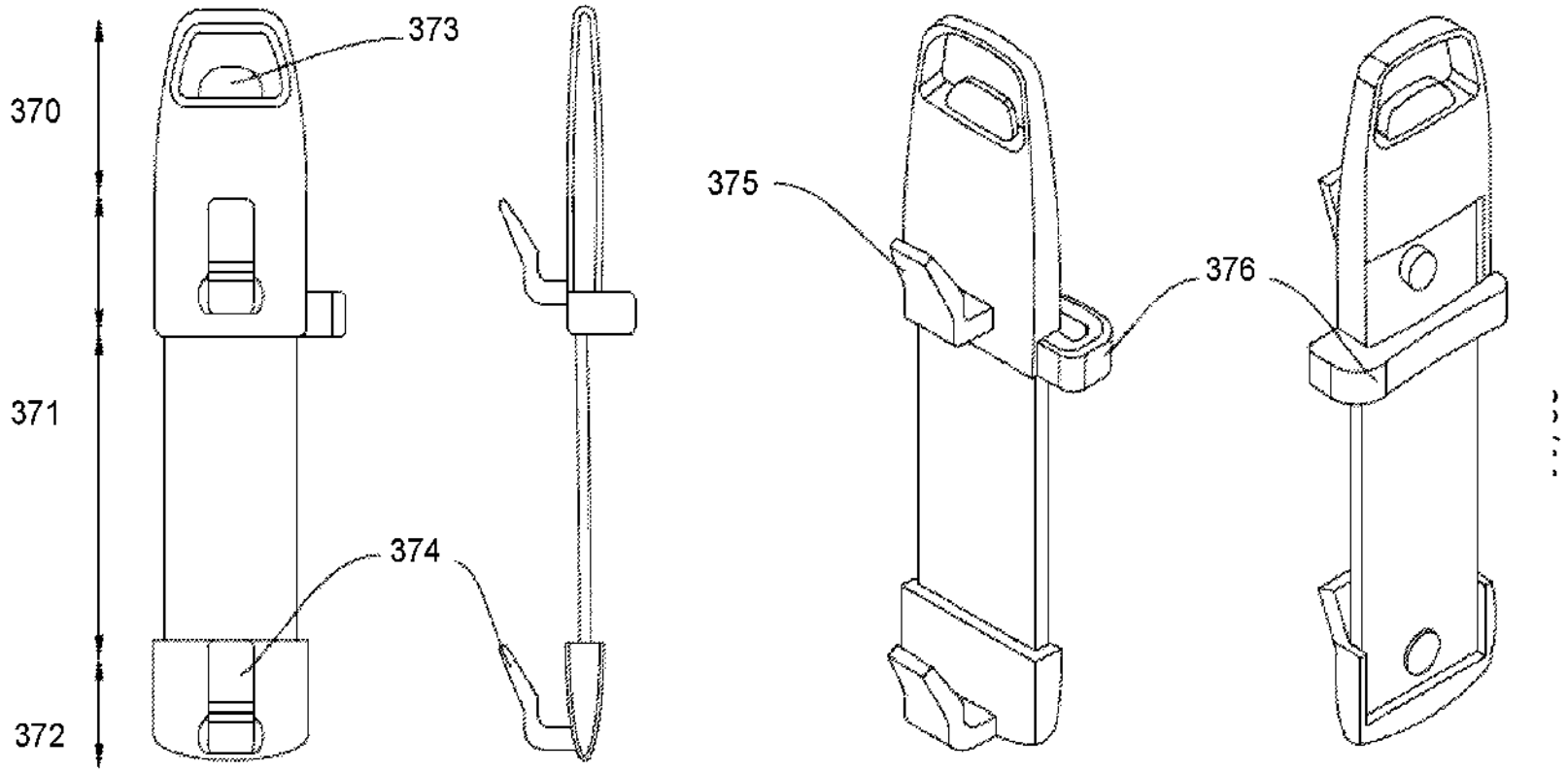


FIGURE 38

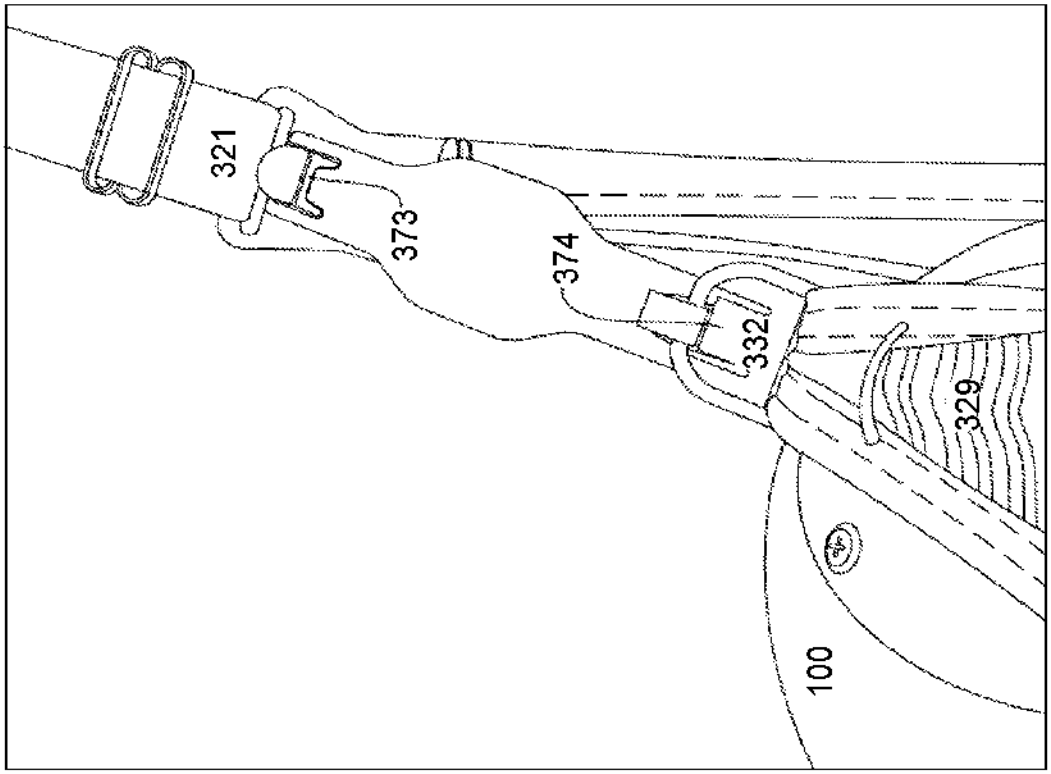


FIGURE 39

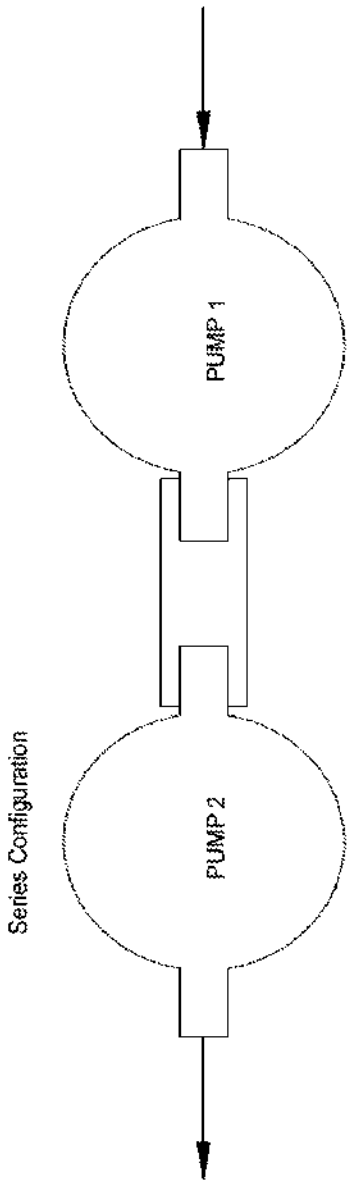


FIGURE 40

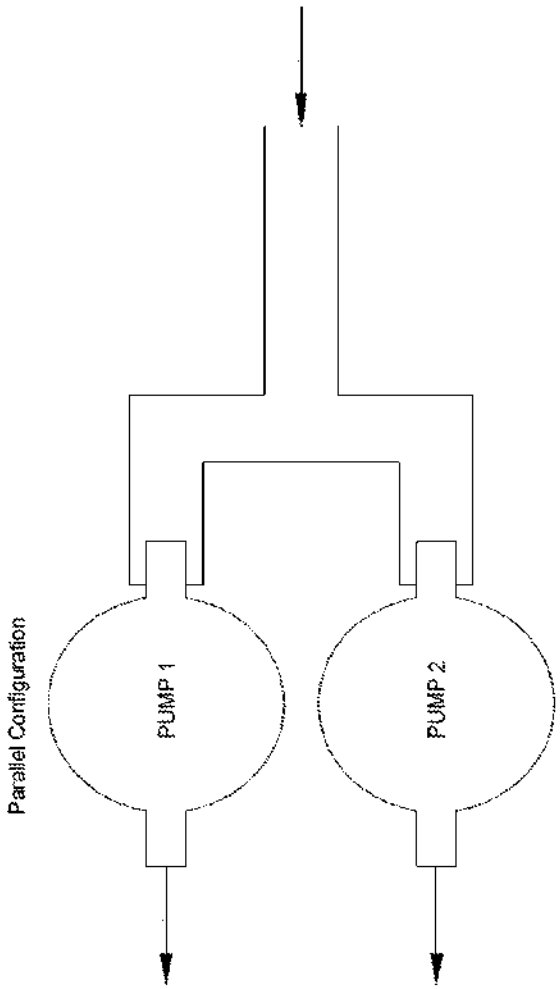


FIGURE 41

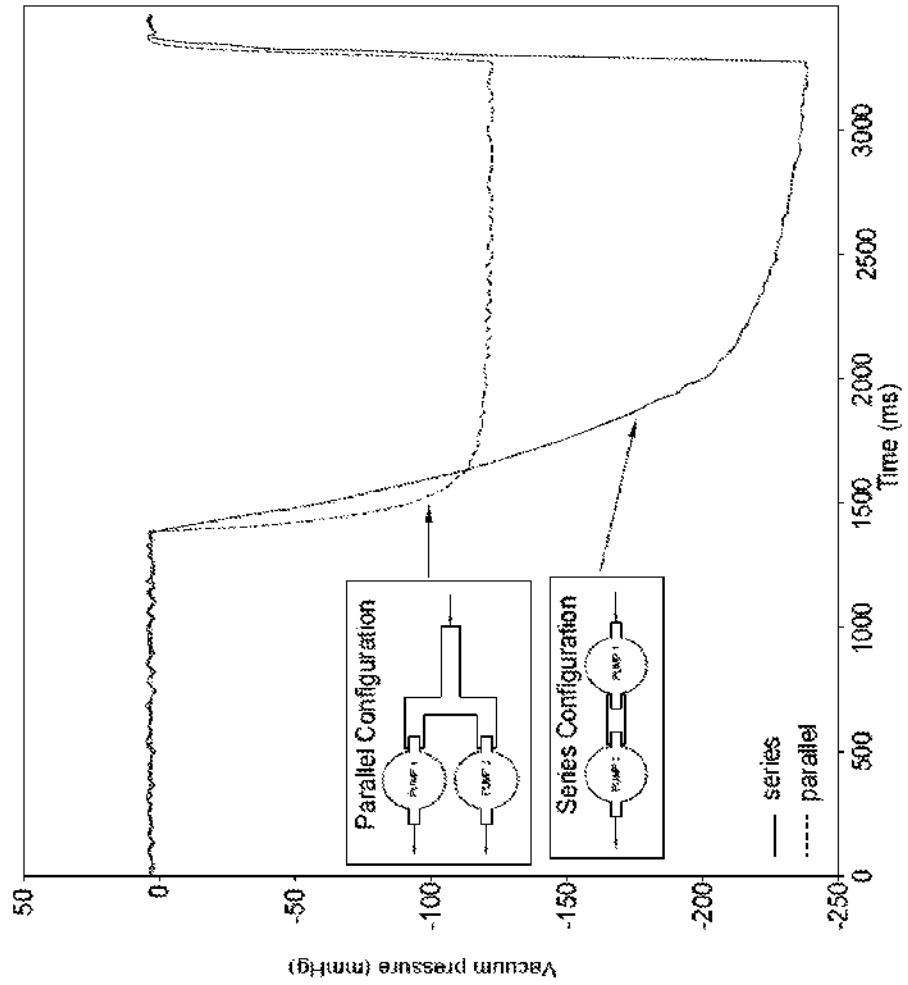

Vacuum pressure (mmHg)
50
0
-50
-100
-150
-200
-250
0
500
1000
1500
2000
2500
3000
Time (ms)
series
parallel
Parallel Configuration
Series Configuration

FIGURE 42

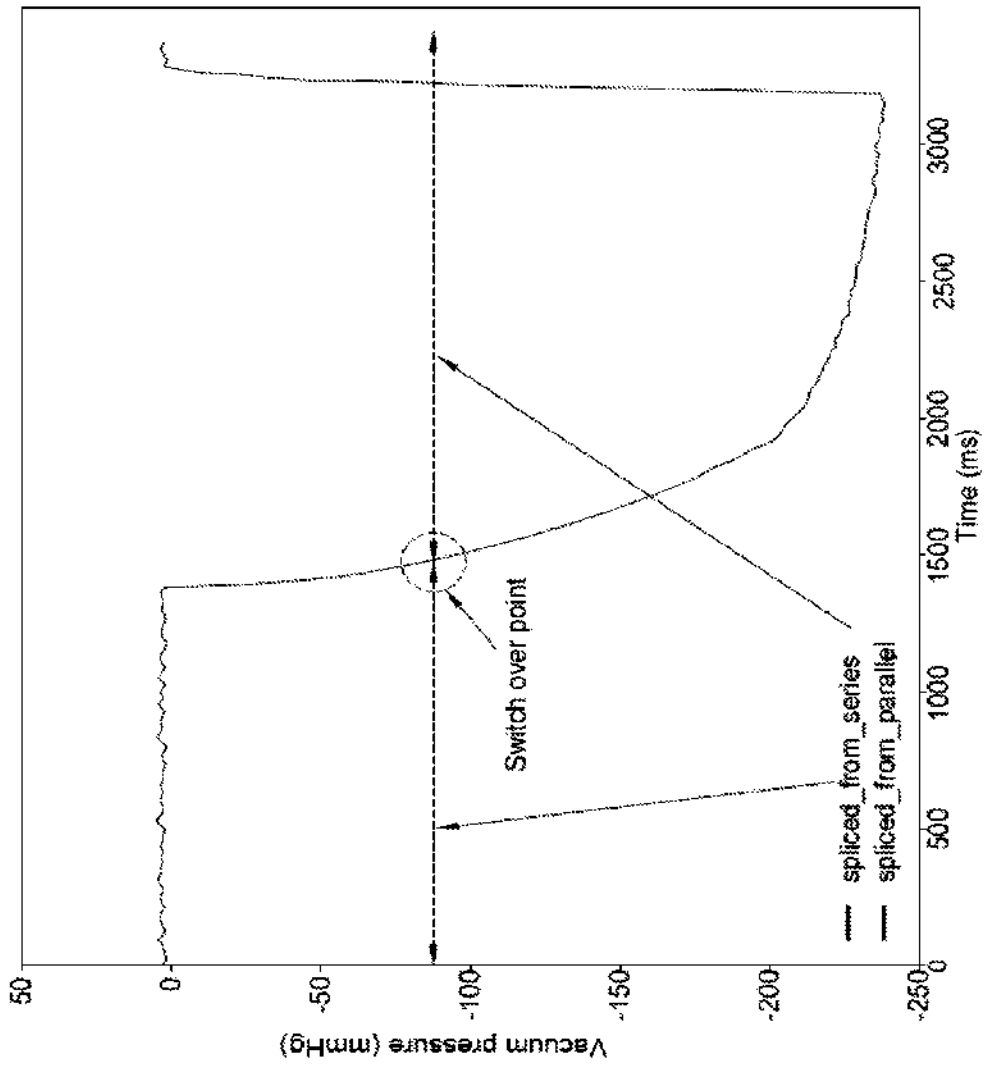

Vacuum pressure (mmHg)
50
0
-50
-100
-150
-200
-250
0
500
1000
1500
2000
2500
3000
Time (ms)
Switch over point
spliced_from_series
spliced_from_parallel

FIGURE 43

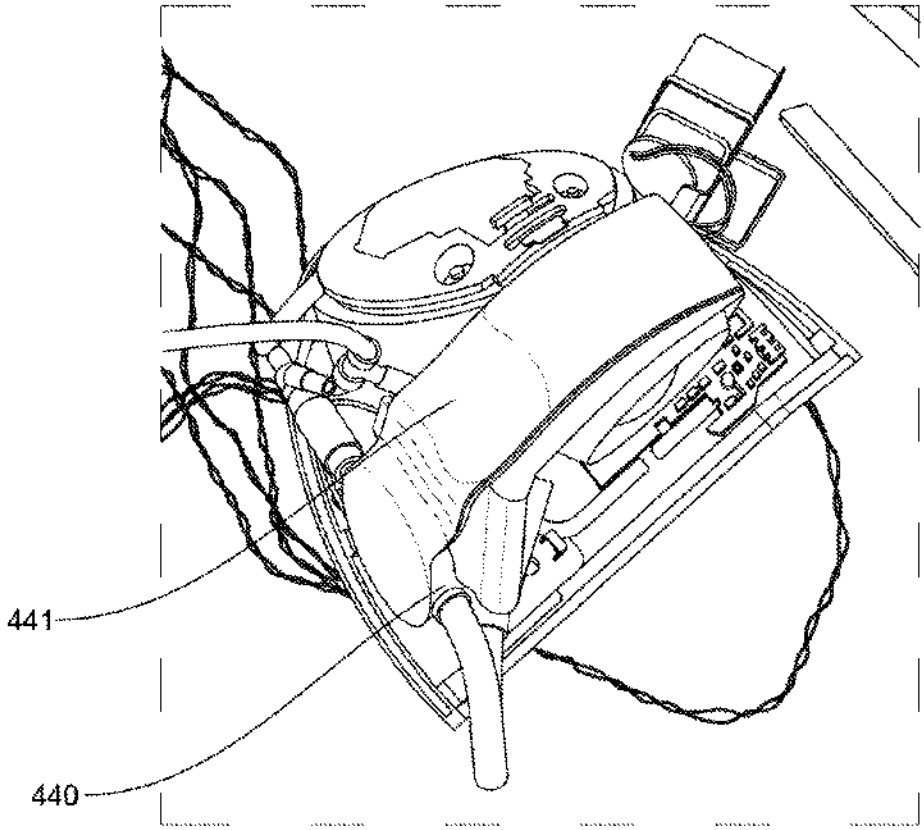


FIGURE 44

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	BREAST PUMP SYSTEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

- ☐ The attached application, or
- ■ United States application or PCT international application number 16/009,547 filed on 15 June 2018.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

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LEGAL NAME OF INVENTOR

Inventor: Jonathan O'TOOLE

Date (Optional): _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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LEGAL NAME OF INVENTOR

Inventor: Adam ROLLO Date (Optional): _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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- ☒ United States application or PCT international application number 16/009,547 filed on 15 June 2018.

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LEGAL NAME OF INVENTOR

Inventor: Andrew CARR Date (Optional): _____

Signature: _____

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Doc Code: PA..
Document Description: Power of Attorney

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I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 78905

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

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I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

CHIARO TECHNOLOGY LIMITED

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	18 JULY 2018
Name	ANDREA ZITNA		
Title	CHIEF REVENUE OFFICER		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

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PATENT **Docket No. 373499.00057**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTORS:	**Jonathan O'TOOLE et al.**	Confirmation No.
APPLICATION NO.	**TBD**	
FILED:	**Herewith**	Examiner:
CASE NO.	**373499.00057**	Group Art Unit:
TITLE:	**BREAST PUMP SYSTEM**	

FILED ELECTRONICALLY ON March 16, 2021

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUBMISSION OF INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR §§1.97 AND 1.98

Sir:

Submitted herewith for the above-identified application is an Information Disclosure Statement under 37 CFR §§1.97 and 1.98. Pursuant to 37 CFR §1.98(d)(1), Applicant has not provided copies of the foreign patent and non-patent literature cited in the accompanying Information Disclosure Statement ("IDS"), since copies of these publications were submitted in IDS's filed on June 15, 2018; December 7, 2018; or November 3, 2020, in grandparent Application No. 16/009,547, of which the parent of the present application is a continuation.

The Examiner is requested to initial a copy of the enclosed Form PTO-1449 and return a copy to applicant.

Respectfully submitted

March 16, 2021
Date

/Mark D. Simpson/
Mark D. Simpson, Esquire
Registration No. 32,942

SAUL EWING ARNSTEIN & LEHR LLP
Centre Square West
1500 Market Street, 38th Floor
Philadelphia, PA 19102-2189
Telephone: 215 972 7880
Email: Mark.Simpson@saul.com

38230424.1

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First Named Inventor	Jonathan O'Toole
Art Unit	
Examiner Name	
Attorney Docket Number	373499.00057

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	1	2849881	A	1958-09-02	ANDERSON	
	2	4390024	A	1983-06-28	WILLIAMS	
	3	4535627	A	1985-08-20	PROST, et al.	
	4	5474683	A	1995-12-12	BRYANT, et al.	
	5	5941847	A	1999-08-24	HUBER, et al.	
	6	5973770	A	1999-10-26	CARTER, et al.	
	7	6045529	A	2000-04-04	NUEESCH	
	8	6090065	A	2000-07-18	GILES	

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	First Named Inventor	Jonathan O'Toole
	Art Unit	
	Examiner Name	
	Attorney Docket Number	373499.00057

	9	6227936	B1	2001-05-08	MENDOZA	
	10	6328709	B1	2001-12-11	HUNG, et al.	
	11	6358226	B1	2002-03-19	RYAN	
	12	6383163	B1	2002-05-07	KELLY, et al.	
	13	6440100	B1	2002-08-27	PRENTISS	
	14	6461324	B1	2002-10-08	SCHLENSOG	
	15	6547756	B1	2003-04-15	GRETER, et al.	
	16	6579258	B1	2003-06-17	ATKIN, et al.	
	17	6663587	B2	2003-12-16	SILVER, et al.	
	18	6749582	B2	2004-06-15	BRITTO, et al.	
	19	7048519	B2	2006-05-23	FONG, et al.	

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	Filing Date	
	First Named Inventor	Jonathan O'Toole
	Art Unit	
	Examiner Name	
	Attorney Docket Number	373499.00057

	20	7201735	B2	2007-04-10	ATKIN, et al.	
	21	D548831	S	2007-08-14	CHARLEZ	
	22	7312554	B2	2007-12-25	VOGELEY	
	23	7314400	B2	2008-01-01	FILDAN, et al.	
	24	7662018	B1	2010-02-16	THOMPSON	
	25	7776008	B2	2010-08-17	RENZ, et al.	
	26	8057425	B1	2011-11-15	MYERS, et al.	
	27	8118772	B2	2012-02-21	DAO, et al.	
	28	8187227	B2	2012-05-29	LUZBETAK, et al.	
	29	8262606	B2	2012-09-11	GRETER, et al.	
	30	8282596	B2	2012-10-09	GRETER, et al.	

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	Filing Date	
	First Named Inventor	Jonathan O'Toole
	Art Unit	
	Examiner Name	
	Attorney Docket Number	373499.00057

	31	8376986	B2	2013-02-19	VAN, et al.	
	32	8702646	B2	2014-04-22	GARBEZ, et al.	
	33	8801495	B1	2014-08-12	GUINDON	
	34	8876760	B2	2014-11-04	BOSMAN, et al.	
	35	8926556	B2	2015-01-06	VAN EIJKELENBORG, et al.	
	36	9033913	B2	2015-05-19	KHALIL, et al.	
	37	9173587	B2	2015-11-03	VAN SCHIJNDEL, et al.	
	38	9345274	B1	2016-05-24	PRILL	
	39	9539377	B2	2017-01-10	MAKOWER, et al.	
	40	10039871	B2	2018-08-07	POLLEN, et al.	

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	Attorney Docket Number	373499.00057

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020193731	A1	2002-12-19	MYERS, et al.	
	2	20040056641	A1	2004-03-25	MYERS, et al.	
	3	20040074281	A1	2004-04-22	LOBDELL, et al.	
	4	20040267215	A1	2004-12-30	CHARLEZ, et al.	
	5	20050219302	A1	2005-10-06	VOGELEY, et al.	
	6	20060122575	A1	2006-06-08	WAKABAYASHI	
	7	20070051172	A1	2007-03-08	PERINET, et al.	
	8	20070051727	A1	2007-03-08	HOLLEY	
	9	20080177224	A1	2008-07-24	KELLY, et al.	
	10	20080262420	A1	2008-10-23	DAO, et al.	

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	Filing Date	
	First Named Inventor	Jonathan O'Toole
	Art Unit	
	Examiner Name	
	Attorney Docket Number	373499.00057

	11	20080275386	A1	2008-11-06	MYERS	
	12	20110004154	A1	2011-01-06	VAN, et al.	
	13	20110196291	A1	2011-08-11	VISCHER, et al.	
	14	20110274566	A1	2011-11-10	AMIROUCHE, et al.	
	15	20120277636	A1	2012-11-01	BLONDHEIM, et al.	
	16	20130023821	A1	2013-01-24	KHALIL, et al.	
	17	20140031744	A1	2014-01-30	CHEN	
	18	20140052056	A1	2014-02-20	GARBEZ, et al.	
	19	20140275857	A1	2014-09-18	TOTH, et al.	
	20	20140323962	A1	2014-10-30	KOOIJKER, et al.	
	21	20140378895	A1	2014-12-25	BARACK	

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	First Named Inventor	Jonathan O'Toole
	Art Unit	
	Examiner Name	
	Attorney Docket Number	373499.00057

	22	20150217036	A1	2015-08-06	POLLEN, et al.	
	23	20150217037	A1	2015-08-06	POLLEN, et al.	
	24	20150283311	A1	2015-10-08	ALVAREZ, et al.	
	25	20160000980	A1	2016-01-07	ALVAREZ, et al.	
	26	20160058928	A1	2016-03-03	NOWROOZI, et al.	
	27	20160058929	A1	2016-03-03	MEDVEDEV, et al.	
	28	20160082165	A1	2016-03-24	ALVAREZ, et al.	
	29	20160082166	A1	2016-03-24	GUTHRIE, et al.	
	30	20160151551	A1	2016-06-02	FELBER	
	31	20160158424	A1	2016-06-09	CHEN, et al.	
	32	20160166745	A1	2016-06-16	AALDERS	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Jonathan O'Toole
	Art Unit	
	Examiner Name	
	Attorney Docket Number	373499.00057

	33	20160206794	A1	2016-07-21	MAKOWER, et al.	
	34	20160220743	A1	2016-08-04	GUTHRIE, et al.	
	35	20160220745	A1	2016-08-04	GUTHRIE, et al.	
	36	20160256617	A1	2016-09-08	HANSEN	
	37	20160271305	A1	2016-09-22	KURIHARA, et al.	
	38	20160287767	A1	2016-10-06	SIMMONS, et al.	
	39	20160296681	A1	2016-10-13	GASKIN, et al.	
	40	20160310650	A1	2016-10-27	MAKOWER, et al.	
	41	20170021068	A1	2017-01-26	GASKIN, et al.	
	42	20170035951	A1	2017-02-09	TANAKA	
	43	20170043065	A1	2017-02-16	TAKEUCHI	

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	Application Number	
	Filing Date	
	First Named Inventor	Jonathan O'Toole
	Art Unit	
	Examiner Name	
	Attorney Docket Number	373499.00057

	44	20170072117	A1	2017-03-16	KURIHARA, et al.	
	45	20170072118	A1	2017-03-16	MAKOWER, et al.	
	46	20170095599	A1	2017-04-06	KONDO, et al.	
	47	20170143879	A1	2017-05-25	OKAGUCHI	
	48	20170220753	A1	2017-08-03	GUTHRIE, et al.	
	49	20180021490	A1	2018-01-25	CHANG, et al.	
	50	20180110906	A1	2018-04-26	BARACK	

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	1	3311982	DE	C2	1983-10-13	BATTELLE MEMORIAL INSTITUTE		
	2	9503280	EP	A2	1992-02-08	PIERBURG GMBH		

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	Application Number	
	Filing Date	
	First Named Inventor	Jonathan O'Toole
	Art Unit	
	Examiner Name	
	Attorney Docket Number	373499.00057

	3	9420158	WO	A1	1994-09-15	DEKA PRODUCTS LIMITED PARTNERSHIP		
	4	19750620	DE	A1	1999-06-02	SIEMENS AG, 80333 MUENCHEN, DE		
	5	1586340	EP	A2	2005-10-19	SEA PROFIT (HONG KONG) LIMITED		
	6	2005114116	WO	A1	2005-12-01	LANE, JOHN, DENNIS; ESPARZA, JOSEPH, LUIS; NICHOLS		
	7	2005114113	WO	A3	2006-03-02	ACCU-GAUGE LIMITED		
	8	1430918	EP	B1	2008-05-14	MEDELA HOLDING AG		
	9	2344380	RU	C1	2009-01-20	GOSUDARSTVENNOE OBRAZOVATEL'NOE UCHREZHDENIE VYSSH		
	10	2009134271	WO	A1	2009-11-05	UTC POWER CORPORATION		
	11	2473022	GB	B	2011-12-14			
	12	2441367	RU	C2	2012-02-10	OBSHCHESTVO S OGRANICHENNOJ OTVETSTVENNOST'JU 'NAU		
	13	2436277	EP	A1	2012-04-04	DREW, LORNA		

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	Application Number	
	Filing Date	
	First Named Inventor	Jonathan O'Toole
	Art Unit	
	Examiner Name	
	Attorney Docket Number	373499.00057

	14	2210628	EP	B1	2013-02-13	MEDELA HOLDING AG		
	15	2499248	GB	B	2014-04-02	ELIZABETH MORANA		
	16	1404393	EP	B1	2014-12-24	MEDELA HOLDING AG		
	17	2015081459	WO	A1	2015-06-11	CHEN, JUNBO		
	18	2015116749	WO	A1	2015-08-06	CORNING INCORPORATED		
	19	2015120321	WO	A1	2015-08-13	NAIA HEALTH, INC.		
	20	2015150225	WO	A1	2015-10-08	KONINKLIJKE PHILIPS N.V.		
	21	2015174330	WO	A1	2015-11-19	MURATA MANUFACTURING CO., LTD.		
	22	2016002606	WO	A1	2016-01-07	MURATA MANUFACTURING CO., LTD.		
	23	2016006494	WO	A1	2016-01-14	MURATA MANUFACTURING CO., LTD.		
	24	2016006496	WO	A1	2016-01-14	MURATA MANUFACTURING CO., LTD.		

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	Filing Date	
	First Named Inventor	Jonathan O'Toole
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	Attorney Docket Number	373499.00057

	25	2016007560	WO	A1	2016-01-14	NAYA HEALTH, INC.		
	26	2016010524	JP	A	2016-01-21	MURATA MFG CO LTD		
	27	2016014469	WO	A1	2016-01-28	EXPLORAMED NC7, LLC		
	28	2016014488	WO	A1	2016-01-28	EXPLORAMED NC7, LLC		
	29	105288759	CN	A	2016-02-03	SHANGHAI NORMAL UNIVERSITY		
	30	2016024558	WO	A1	2016-02-18	MURATA MANUFACTURING CO., LTD.		
	31	2016039083	WO	A1	2016-03-17	MURATA MANUFACTURING CO., LTD.		
	32	2016104673	WO	A1	2016-06-30	MURATA MANUFACTURING CO., LTD.		
	33	2077868	EP	B1	2016-07-27	MEDELA HOLDING AG		
	34	2016164853	WO	A1	2016-10-13	NAYA HEALTH, INC.		
	35	1263487	EP	B2	2016-11-23	MEDELA HOLDING AG		

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	Application Number	
	Filing Date	
	First Named Inventor	Jonathan O'Toole
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	Examiner Name	
	Attorney Docket Number	373499.00057

	36	2017061349	WO	A1	2017-04-13	MURATA MANUFACTURING CO., LTD.		
	37	2017108555	WO	A1	2017-06-29	KONINKLIJKE PHILIPS N.V.		
	38	2017139480	WO	A1	2017-08-17	EXPLORAMED NC7, INC.		

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	1	Whisper Wear Hands-Free Breast Pump, Model: WWPMP01, User Guide, pps. 1-20, Distributed with product at least as early as 2007 (see https://web.archive.org/web/20070621162539/http://www.whisperwear.com/pump_single.html)	

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	Application Number	
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	First Named Inventor	Jonathan O'Toole
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	Attorney Docket Number	373499.00057

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

✓ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Mark D. Simpson/	Date (YYYY-MM-DD)	2021-03-16
Name/Print	Mark D Simpson	Registration Number	32942

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Application Number:	
Filing Date:	
Title of Invention:	BREAST PUMP SYSTEM
First Named Inventor/Applicant Name:	Jonathan O'TOOLE
Filer:	Mark D. Simpson/Lynn White
Attorney Docket Number:	373499.00057
Filed as Small Entity	

Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	80	80
UTILITY SEARCH FEE	2111	1	350	350
UTILITY EXAMINATION FEE	2311	1	400	400
REQUEST FOR PRIORITIZED EXAMINATION	2817	1	2100	2100
Pages:				
UTILITY APPL SIZE FEE PER 50 SHEETS >100	2081	1	210	210
Claims:				
CLAIMS IN EXCESS OF 20	2202	10	50	500

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous-Filing:				
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**3710**

Electronic Acknowledgement Receipt	
EFS ID:	42197487
Application Number:	17203292
International Application Number:	
Confirmation Number:	9955
Title of Invention:	BREAST PUMP SYSTEM
First Named Inventor/Applicant Name:	Jonathan O'TOOLE
Customer Number:	78905
Filer:	Mark D. Simpson/Lynn White
Filer Authorized By:	Mark D. Simpson
Attorney Docket Number:	373499.00057
Receipt Date:	16-MAR-2021
Filing Date:	
Time Stamp:	17:00:26
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$3710
RAM confirmation Number	E20213FH01023833
Deposit Account	504364
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Warnings:					
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2	Application Data Sheet	ADS.PDF	1822783 68be7732d1947c456244bfd1f8f6e9296ce7 ab65	no	9
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	Specification	1	121
	Claims	122	125
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	Multipart Description/PDF files in .zip description				
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Application number: 1709564.7

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NP10 8QQ

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Patents Act 1977 *(Rule 12)*

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Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

Application number GB 1709564.7

1.	Your reference	**MJD/P153993GB00**
2.	Full name, address and postcode of the applicant or of each applicant	**CHIARO TECHNOLOGY LIMITED** **Second Floor 63-66 Hatton Garden** **London EC1N 8LE** **Greater London** **United Kingdom**
	Patents ADP number *(if you know it)*	**11287869002**
3.	Title of the invention	**A LIQUID LEVEL MEASUREMENT SYSTEM**
4.	Name of your agent *(if you have one)*	**Boult Wade Tennant**
	"Address for service" to which all correspondence should be sent. This may be in the European Economic area or Channel Islands (see warning note below) *(including the postcode)*	**Boult Wade Tennant** **Verulam Gardens** **70, Gray's Inn Road** **London WC1X 8BT** **United Kingdom**
	Patents ADP number *(if you know it)*	**42001**
5.	Priority declaration: Are you claiming priority from one or more earlier-filed patent applications? If so, please give details of the application(s)	

Country	Application number	Date of filing	PDAS Access Code

6.	Divisionals etc: Is this application a divisional application, or being made following resolution of an entitlement dispute about an earlier application. If so, please give the application number and filing date of the earlier application	Number of earlier UK application	Date of filing *(day / month / year)*
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Description: **12**

Claim(s): **3**

Abstract: **n/a**

Drawing(s): **4**

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10. If you are also filing any of the following, state how many against each item.

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Statement of inventorship and right to grant of a patent (Patents Form 7): **1**

Request for search (Patents Form 9A): **1**

Request for a substantive examination (Patents Form 10): **0**

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11. I/We request the grant of a patent on the basis of this application.

Signature: **/DRAPER, Martyn John/** Date: **15 Jun 2017**

12. Name, e-mail address, telephone, fax and/or mobile number, if any, of a contact point for the applicant

DRAPER, Mr Martyn
Email: boult@boult.com
Telephone: 020 7430 7500
Fax: 020 7430 7600

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A LIQUID LEVEL MEASUREMENT SYSTEM

BACKGROUND

The present invention relates to a sensing mechanism for detecting the level of liquid in a container. In a particular arrangement, the present invention relates to such a sensing mechanism when used along with a breast pump.

In the context of breast pumps, it is useful to measure the quantity of expressed milk. One way to do this is to have a clear container affixed to the breast pump, through which the level of expressed milk inside the container can be visibly determined. However, such visual determinations are not always possible, for example in a breast pump that collects milk while being worn inside a maternity bra.

An existing apparatus for detecting the level of liquid inside a container of a breast pump is that disclosed in US 2016/296681. In this apparatus, a sensing mechanism is provided at the top of a container, which measures droplets of liquid, specifically breast milk, entering the container. By measuring the properties of these droplets entering the container, the apparatus can determine the quantity of liquid which enters the container. In this apparatus, an accurate indication of the level of liquid in the container is reliant on the sensing mechanism being able to accurately record every droplet entering the container. Particularly at times when large flow rates of liquid enter the container, this accuracy cannot be guaranteed leading to significant cumulative errors. An accurate indication of the level of liquid in the container in this apparatus is also reliant on the sensing mechanism always being on during the pumping process, so that power consumption of the sensing mechanism is correspondingly high.

In view of the above, there is the need for an improved way to determine the level of liquid inside a container connected to a breast pump.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a breast pump comprising:

a pump module for pumping milk from a breast, the pump module being contained within a housing comprising a coupling;

a container attachable to the housing via the coupling to receive milk from the pump;

a sensing assembly within the housing and comprising at least one optical emitter operable to emit optical radiation towards the surface of the body of milk held in the container when the housing is connected to the container, and an optical receiver for receiving the reflected radiation from the surface of the milk; and

a controller electrically connected to the sensing assembly for receiving signals from the optical receiver and calculating the level of the milk inside the container based on the reflected radiation received by the optical receiver.

By determining the level of milk inside the container based on reflected radiation from the surface of the milk in the container, there is no need to monitor the individual droplets of milk entering the container, such that the sensing assembly can avoid errors associated with measuring these droplets. Furthermore, by not needing to measure these droplets, the sensing assembly from the breast pump need not always be on during the pumping process.

Preferably, the at least one optical emitter comprises at least two optical emitters. In this way, the sensing assembly from the breast pump can determine the level of milk inside the container more accurately and irrespective of the orientation of the liquid level inside the container.

Preferably, each optical emitter is equidistant from the optical receiver. In this way, the controller can more easily calculate the level of the milk inside the container based on the reflected radiation originating from each optical emitter.

Each optical emitter may be operable to emit radiation at a different wavelength, or at a different time, than the other optical emitters. In this way, the controller can more easily process the signals from the optical receiver, and more easily distinguish between the radiation emitted by each of the optical emitters.

Preferably, the optical emitter may emit radiation in the visible range of wavelengths. Alternatively it may be UV or IR light. The emitted wavelength is preferably between 10nm and 1mm.

The signals from the optical receiver preferably comprise information relating to the intensity of the radiation received by the optical receiver.

Preferably, the sensing assembly comprises at least one accelerometer electrically connected to the controller. In one embodiment, the controller may be configured to record an accelerometer parameter from the accelerometer, and determine whether the accelerometer parameter exceeds a predetermined threshold. The predetermined threshold may be indicative of an excessive acceleration, which might cause sloshing of milk inside any container connected to the breast pump.

In some cases, the coupling may be a screw thread.

Preferably, the breast pump is sized to be similar to that of a female breast. On this basis, the breast pump is preferably no longer than 20cm in any given linear direction; more preferably no longer than 18cm in any given linear direction; and even more preferably no longer than 15cm in any given linear direction.

The breast pump may contain any suitable power source, such as a battery. The power source is preferably located in the housing.

In some cases, the container may comprise a window through which optical radiation can pass, wherein when the container is connected to the housing, radiation is operable to pass between the optical emitters/receiver and the inside of the container via the window. In other cases, the container may be made entirely of a material through which the optical radiation can pass.

When the container is connected to the housing, each optical emitter and the optical receiver are preferably located adjacent to the container, to ensure reliable transmission of radiation between the device and the container.

In this case, the portion of the container adjacent to each optical emitter and the optical receiver preferably comprises a surface inside the container which comprises at least one channel and/or feature for directing milk away from each optical emitter and/or the optical receiver. In this way the formation of milk on this surface, which would cause erroneous signals from the optical receiver, can be inhibited.

To further inhibit the formation of milk in the vicinity of each optical emitter/receiver, the portion of the container adjacent to each optical emitter and the optical receiver may comprise a surface inside the container which comprises an oleophobic and/or hydrophobic coating.

Preferably, the container has a volumetric capacity of no more than 200ml. These volumetric capacities are particularly relevant when the container is a baby bottle.

It will be appreciated that the sensing assembly from the above breast pump has applications in other fields. Thus according to a second aspect of the present invention, there is provided a sensor module operable to be connected with a container for holding liquid, and suitable for use in detecting the level of liquid inside the container, the sensor module comprising:

a housing having a coupling for attachment to the top of the container;

a sensing assembly within the housing and comprising at least two optical emitters operable to emit optical radiation towards the surface of the body of liquid held in the container when the housing is connected to the container, and an optical receiver for receiving the reflected radiation from the surface of the liquid; and

a controller electrically connected to the sensing assembly for receiving signals from the optical receiver and calculating the level of the liquid inside the container based on the reflected radiation received by the optical receiver.

Existing prior art for such a sensor module is the apparatus disclosed in RU2441367. In this apparatus, the container is an industrially sized milk tank, which only includes a single laser mounted at the top of the tank. Whilst this apparatus is suited for large-sized containers, which do not move in use, the apparatus is less-suited for applications where the container moves in use, or where the liquid level inside the container is non-perpendicular to the laser beam shone into the container. In contrast, the sensor module described above can be used in a variety of different applications, is conveniently located within a housing, and which by virtue of it having at least two optical emitters, can determine the level of liquid even inside containers of irregular shapes, and which can determine the level of liquid inside a container irrespective of the orientation of the liquid level inside the container.

Although not fully recited herein, it will be appreciated that the sensor module according to the second aspect of the invention may include any or all of the optional features described in relation to the breast pump from the first aspect of the present invention.

According to a third aspect of the present invention, there is provided a collar incorporating the sensor module according to the second aspect of the invention, wherein the collar comprises a first end having the coupling, and a second end having a second coupling for attaching the collar to a lid of the container.

In the above case, the second coupling may be a screw thread.

According to fourth aspect of the present invention, there is provided a lid attachable to a container, wherein the lid comprises the sensor module according to the second aspect of the invention.

DESCRIPTION OF THE FIGURES

Figure 1A shows a sectional view of a device being used to determine the level of liquid in a container; and

Figure 1B shows a sectional view of the device and the container from Figure 1A being used at a different orientation.

Figure 2 shows a sectional view of the device and the container from Figure 1A being used whilst undergoing acceleration.

Figure 3 shows a sectional view of the device from Figure 1A being used as part of a breast pump assembly.

Figure 4 shows a sectional view of a device connected between a container and its lid, and which is operable to determine the level of liquid inside the container.

DETAILED DESCRIPTION

With reference to Figures 1A and 1B, there is shown a device 10 for use in detecting the level of liquid inside a container 100.

The device 10 is formed of a housing 12 in which is located a sensing assembly 14 comprising a series of optical emitters 16 which are angled relative to, and each located equidistant from, an optical receiver 18. In operation of the device as will be described, each optical emitter 16 is operable to emit radiation which is received by the optical receiver 18.

The optical emitters 16 and the optical receiver 18 from the sensing assembly 14 are located in a portion 20 of the device 10 which faces the container 100 when the device 10 is connected to the container 100. The portion 20 of the device 10 containing the optical emitters 16 and the optical receiver 18 comprises a window 22 of material which is transparent to optical radiation. In this way, each of the optical emitters 16 and the optical receiver 18 have a line of sight through the window 22 into the container 100 when the device 10 is connected thereto.

A controller 30 comprising a CPU 32 and a memory 34 is provided in the device 10 for controlling the operation of the sensing assembly 14. An accelerometer 36 is also provided in the housing 10, which is operatively connected to the controller 30.

Operation of the device 10 when connected to the container 100 will now be described.

In a principal mode of operation, to determine the level L of liquid inside the container 100, the controller 30 instructs the optical emitters 16 to each emit radiation towards the surface of the liquid inside the container 100 at a given intensity. The optical receiver 18 receives the reflected radiation from each optical emitter 16 via the surface of the liquid and each of these intensities is recorded by the controller.

For each operation of the sensing assembly 14, the controller 30 records the intensities of radiation emitted by each of the optical emitters 16 as intensities IE_1; $IE_2 \ldots IE_n$ (where n is the total number of optical emitters), and records the intensities of radiation received by the optical receiver 18 from each of the optical emitters 16 as received intensities IR_1; $IR_2 \ldots IR_n$.

By comparing the emitted radiation intensities IE_1; $IE_2 \ldots IE_n$ with the received radiation intensities IR_1; $IR_2 \ldots IR_n$, the controller 30 calculates a series of intensity ratios IE_1:IR_1; IE_2:$IR_2 \ldots IE_n$:IR_n, which are then used to determine the level of the liquid inside the container. At the most basic level, if the intensity ratio of IE_1:IR_1 is the same as IE_2:IR_2,

given the optical emitters 16 are equidistant from the optical receiver 18, this indicates that the level of the liquid inside the container is parallel to the top of the bottle, as shown in Figure 1A. In contrast, if these two intensity ratios are different, this indicates that the liquid level is at a different angle, such as that shown in Figure 1B.

To accurately determine the level and the quantity of liquid inside the container 100, the controller 30 processes the recorded intensity ratios using a database located in the memory 34. The database contains an individual record for each container which is operable to connect with the device 10. Each record from the database contains a look-up table of information, which contains expected intensity ratios (IE_1:IR_1 and IE_2:IR_2) for the container 100 when filled at different orientations, and with different quantities of liquid.

By comparing the information from the look-up table with the recorded intensity ratios, the controller 30 calculates the level and quantity of liquid inside the container 100 and stores this information in the memory 34.

In situations where a container 100 to the device 10 contains no stored record in the database, the sensing assembly 14 can be used in a calibration mode to create a new record. In the calibration mode, the sensing assembly 14 is operated as the container is filled, and as it is located at different orientations. At each point during the calibration mode, the controller 30 calculates the recorded intensity ratios (IE_1:IR_1 and IE_2:IR_2) and stores them in the record relating to the container 100. For each set of recorded intensity ratios, the user includes information in the record relating to the orientation and fill level of liquid inside of the container 100.

To improve the accuracy of the results obtained by the device 10 during its use, the controller 30 when recording each intensity ratio also records a parameter from the accelerometer 36 relating to the acceleration experienced by the device 10. For each recorded acceleration parameter, the controller 30 determines whether the parameter exceeds a predetermined threshold acceleration parameter stored in the memory 34. The predetermined threshold is indicative of an excessive acceleration, which causes sloshing of liquid inside the container 100 connected to the device 10. In the event of a recorded acceleration parameter exceeding the predetermined threshold acceleration parameter, the controller 30 flags the recorded intensity ratios associated with the recorded acceleration parameter as being unreliable (due to sloshing).

Even without the use of the accelerometer 36, the controller 30 is nonetheless operable to determine whether a set of recorded intensity ratios occur during a period of excess acceleration. In this regard, for each set of intensity ratios recorded at a given time, the controller 30 checks whether any of these intensity ratios is of a predetermined order of magnitude different than the remaining recorded intensity ratios from the set. In the event that the controller 30 determines that this is the case, this indicates that the liquid inside the container has 'sloshed' as a result of the excess acceleration, as shown in Figure 2. In this event, the controller 30 flags the set of recorded intensity ratios as being unreliable.

It will be appreciated that instead of recording the relative intensities of radiation emitted by the optical emitters 16 with the radiation received by the optical emitter 18, the controller 30 could instead record the time taken for radiation emitted by each of the optical emitters 16 to be received by the optical receiver 18. In this arrangement, the look up table would instead contain time periods as opposed to intensity ratios.

In terms of the applications for the device 10, it will be appreciated that the device can be used in a wide variety of applications.

One possible application is the use of the device 10 to determine the level of liquid located within a container 100, such as a baby bottle, used as part of a breast pump assembly. In this arrangement, the device 10 is associated with a breast pump 200 which assists with the expression of milk from a breast. The breast pump may be located in the housing 12 of the device 10 as shown in Figure 3, or it may be realisably connected to the housing 12. Either way, the device 10 would be connectable to the container 100 such that milk expressed by the breast pump can pass from the pump via a channel 202 into the container 100.

Another application for the device 10 is as a collar for detecting the level/quantity of liquid in a container 100, such as a baby bottle, via its lid 102. An example of the device 10 being used as such a collar is shown in Figure 4. In this arrangement, the device 10 is located between the container 100 and the lid 102, and comprises a first end 42 having a first coupling 44 for attaching the collar to the lid 102. The device comprises a second end 46 having a second coupling 48 for attaching the device 10 to the container 100. In Figure 4,

the first and second couplings are shown as screw threads which engage with respective screw heads on the lid 102 and the container 100.

To allow the device 10 to pass liquid from the lid 102 to the container 100, the device comprises a channel 50 passing from the first end 42 to the second end 46.

In a further application, the device 10 may be integrated into the lid 102 of a container 100. In this application, the device 10 has a similar configuration to that shown in Figure 4, except that the first end 42 is covered and has no coupling 44.

It will be appreciated the device may be connected to a wide variety of different containers 100. In some applications, the container 100 may be a baby bottle, or a drinks bottle.

In certain applications, the container 100 connected to the device 10 may have a volumetric capacity of no more than 500ml, less than 400ml, less than 300ml, and/or less than 200ml. These volumetric capacities are particularly relevant when the container is a baby bottle/drink bottle.

It will also be appreciated that the container 100 connected to the device 10 may comprise an inside surface which comprises an oleophobic and/or hydrophobic coating. In this way, the container 100 is easy to clean between uses. When such a coating is applied to the portion of the container 100 which is adjacent to the optical emitters 16 and the optical receiver 18 from the device 10, this coating also helps prevent liquid from forming in front of these emitters/receiver, which might cause erroneous signals to be recorded by the optical receiver 18 from the sensing assembly 14.

To further reduce such erroneous signals, the portion of the container adjacent to the optical emitters and the optical receiver may comprise a surface inside the container having at least one channel and/or feature for directing liquid away from the optical emitters and/or the optical receiver.

To improve the accuracy of the sensing assembly 14, the container 100 may be made opaque to prevent ambient radiation outside the container 100 from reaching the optical receiver 18. Other possibilities to improve the accuracy to the accuracy of the sensing assembly 14 include the provision of a distinctive pattern/colour/texture on the bottom

inside surface of the container 100. In this way, the distinctive bottom inside surface can be used by the sensing assembly 14 to more easily calibrate itself to the container 100 on which the distinctive bottom inside surface is located. The distinctive bottom may also be used to help identify which container 100 the device is connected to, and thus which record should be used from the database when the device 10 is used.

To further improve the accuracy of the sensing assembly 14, the controller 30 may also be configured to use the recorded information from the accelerometer 36, in situations where the record acceleration is below the predetermined threshold acceleration parameter, to calculate a more accurate liquid level and/or quantity of liquid located inside the container which is compensated for acceleration.

In one particular arrangement, the controller 30 may poll the accelerometer 36 prior to each operation of the sensing assembly 14 to verify that the device 10 is not currently undergoing excessive acceleration. In the event of the controller 30 determining excessive acceleration in the device 10, the controller 30 would continually re-poll the accelerometer, and not operate the sensing assembly 14, until the parameter from the accelerometer is determined as being below the predetermined threshold acceleration parameter stored in the memory 34.

It will also be appreciated that for each container record stored in the database, the container record may comprise a plurality of look up tables, wherein each look up table is associated with a particular liquid used in the container, and wherein each look up table contains its own set of intensity ratios. In this way, the device 10 can more accurately determine the level/quantity of different liquids used in a particular container 100.

As described herein, the sensing assembly 14 has been described as having a plurality of optical emitters 16. It will be appreciated however that the sensing assembly could operate using a single optical emitter 16 and plurality of optical receivers 18. In this arrangement, each record from the database would contain a plurality of ratios relating to the emitted radiation from the optical emitter 16 as received by each of the optical receivers 18. In use of the device 10, the controller 30 would then similarly record the emitted radiation from the optical emitter 16 as received by each of the optical receivers 18. In an alternate arrangement, there may be provided a plurality of optical emitters 16 and a plurality of optical receivers 18, wherein each optical emitter 16 is associated with a respective optical

receiver 18. In its simplest arrangement, the sensing assembly 14 may comprise a single optical emitter 16 and a single optical receiver 18.

In certain configurations, the optical emitters 16 may together emit radiation having the same wavelength. In other configurations, the optical emitters 16 may each emit radiation having a different wavelength. In this latter configuration, the optical receiver 18 would then be able to determine which optical emitter 16 is associated with any given received radiation, based on the wavelength of the received radiation.

The optical emitters 16 may also each emit radiation at different times, such to allow the controller 30 to more easily process the signals from the optical receiver 18, and more easily distinguish between the radiation emitted by each of the optical emitters 16.

In relation to the electrical connection between the controller 30 and the sensing assembly 14, it will be appreciated this electrical connection may be either a wired/wireless connection as required.

Although not shown in the Figures, the device 10 herein described is preferably powered by a battery or some other power source located in the device 10. In other embodiments, the device 10 may be powered using mains electricity.

In one configuration, it is also envisaged that rather than the controller 30 comparing the information from the look-up table with the recorded intensity ratios to calculate the level and quantity of liquid inside the container 100, the controller 30 could instead process the recorded intensity ratios through a liquid-level equation stored in the memory 34. In this configuration, the liquid-level equation could be a generalised equation covering a family of different containers, or could be an equation specific to a container having a given shape and/or type of liquid inside.

It will also be appreciated that in some applications of the device 10, the device could be used to detect the level of a solid, as opposed to a liquid, in a container.

As used herein, the terms 'optical emitter' and 'optical receiver' are intended to cover sensors which can emit radiation in or close to the optical wavelength. Any type of radiation at or close to the optical wavelength is suitable provided that it does not have any harmful

effects. The exact wavelength is not important in the context of the invention. Such sensors thus include those which can emit visible radiation (such as radiation having wavelengths in the region of 400nm-700nm), and/or those which can emit IR radiation (such as radiation having wavelengths in the region of 700nm-1mm and/or those which can emit UV radiation (such as radiation having wavelengths in the region of 10nm to 400nm).

CLAIMS:

1. A breast pump comprising:

a pump module for pumping milk from a breast, the pump module being contained within a housing comprising a coupling;

a container attachable to the housing via the coupling to receive milk from the pump;

a sensing assembly within the housing and comprising at least one optical emitter operable to emit optical radiation towards the surface of the body of milk held in the container when the housing is connected to the container, and an optical receiver for receiving the reflected radiation from the surface of the milk; and

a controller electrically connected to the sensing assembly for receiving signals from the optical receiver and calculating the level of the milk inside the container based on the reflected radiation received by the optical receiver.

2. A breast pump according to claim 1, wherein the at least one optical emitter comprises at least two optical emitters.

3. A breast pump according to claim 2, wherein each optical emitter is equidistant from the optical receiver.

4. A breast pump according to claim 2 or 3, wherein each optical emitter is operable to emit radiation at a different wavelength, or at a different time, than the other optical emitters.

5. A breast pump according to any preceding claim, wherein each optical emitter is an IR optical emitter, and the optical receiver is an IR optical receiver.

6. A breast pump according to any preceding claim, wherein the signals from the optical receiver comprise information relating to the intensity of the radiation received by the optical receiver.

7. A breast pump according to any preceding claim, wherein the sensing assembly comprises at least one accelerometer electrically connected to the controller.

8. A breast pump according to any preceding claim, wherein the coupling is a screw thread.

9. A breast pump according to any preceding claim, wherein the breast pump is no longer than 20cm in any given linear direction.

10. A breast pump according to any preceding claim, wherein the breast pump contains a power source.

11. A breast pump according to any preceding claim, wherein the container comprises a window through which optical radiation can pass, wherein when the container is connected to the housing, radiation is operable to pass between each optical emitter/receiver and the inside of the container via the window.

12. A breast pump according to any preceding claim, wherein when the container is connected to the housing, each optical emitter and the optical receiver are located adjacent to the container.

13. A breast pump according to claim 12, wherein the portion of the container adjacent to each optical emitter and the optical receiver comprises a surface inside the container which comprises at least one channel and/or feature for directing milk away from each optical emitter and/or the optical receiver.

14. A breast pump according to claim 12 or 13, wherein the portion of the container adjacent to each optical emitter and the optical receiver comprises a surface inside the container which comprises an oleophobic and/or hydrophobic coating.

15. A breast pump according to any preceding claim, wherein the container has a volumetric capacity of no more than 200ml.

16. A sensor module operable to be connected with a container for holding liquid, and suitable for use in detecting the level of liquid inside the container, the sensor module comprising:

a housing having a coupling for attachment to the top of the container;

a sensing assembly within the housing and comprising at least two optical emitters operable to emit optical radiation towards the surface of the body of liquid held in the container when the housing is connected to the container, and an optical receiver for receiving the reflected radiation from the surface of the liquid; and

a controller electrically connected to the sensing assembly for receiving signals from the optical receiver and calculating the level of the liquid inside the container based on the reflected radiation received by the optical receiver.

17. A collar incorporating the sensor module according to claim 16, wherein the collar comprises a first end having the coupling, and a second end having a second coupling for attaching the collar to a lid of the container.

18. A collar according to claim 17, wherein the second coupling is a screw thread.

19. A lid attachable to a container, wherein the lid comprises the sensor module according to claim 16.

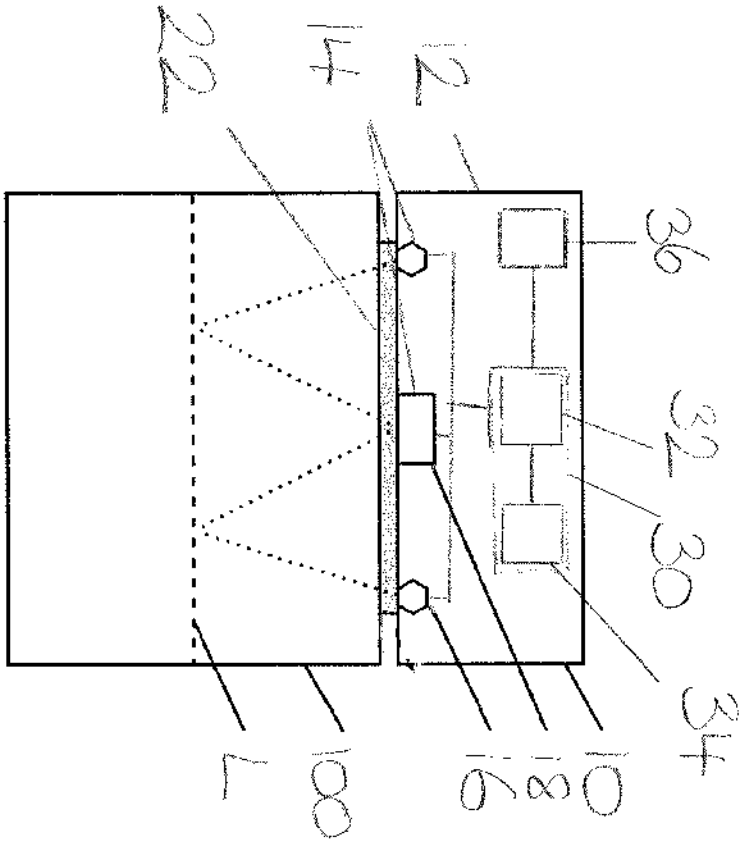

FIG 1A

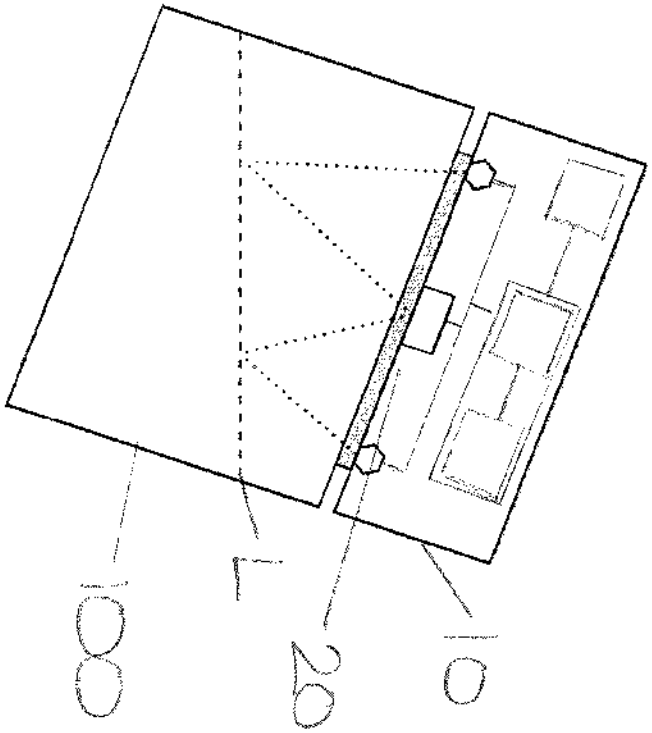

FIG 1B

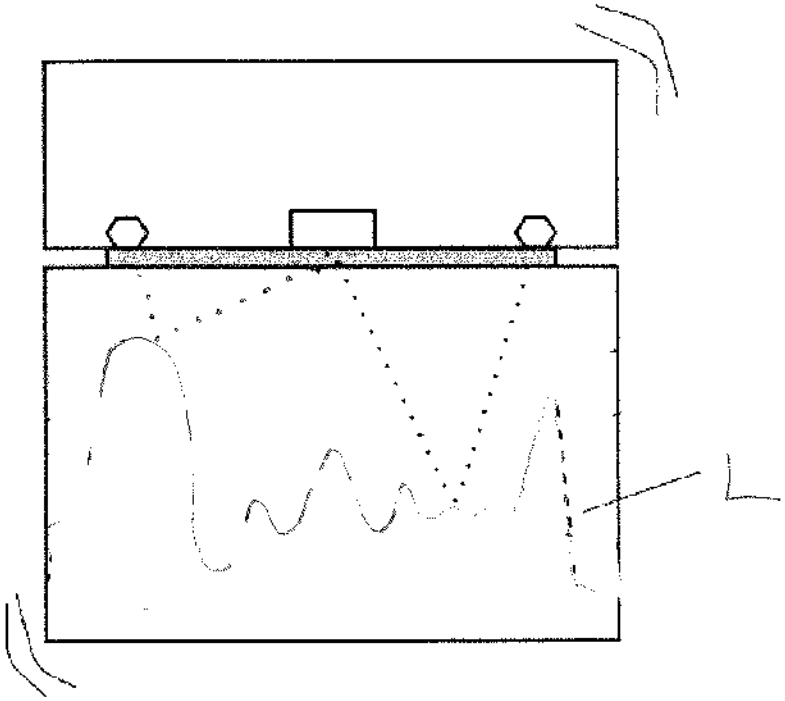

FIG 2

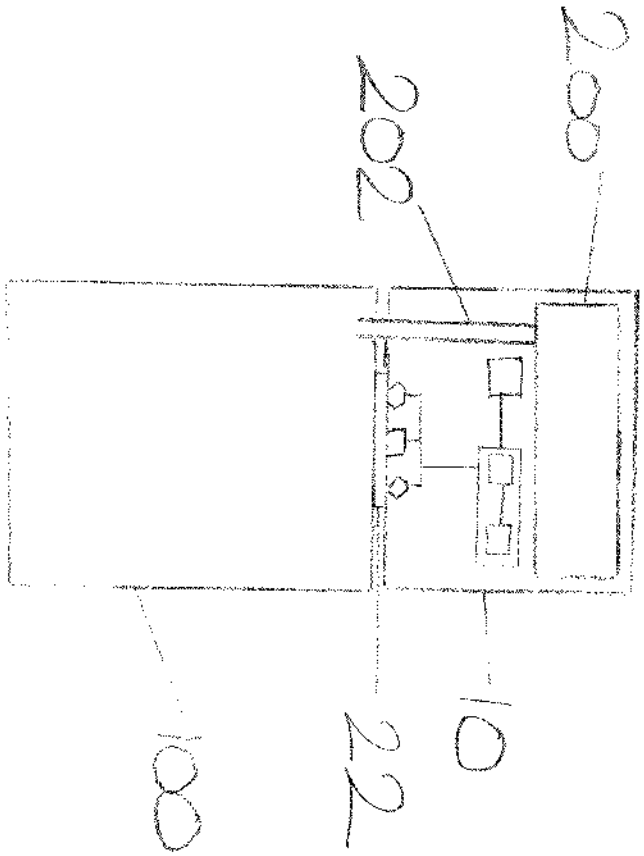

FIG 3

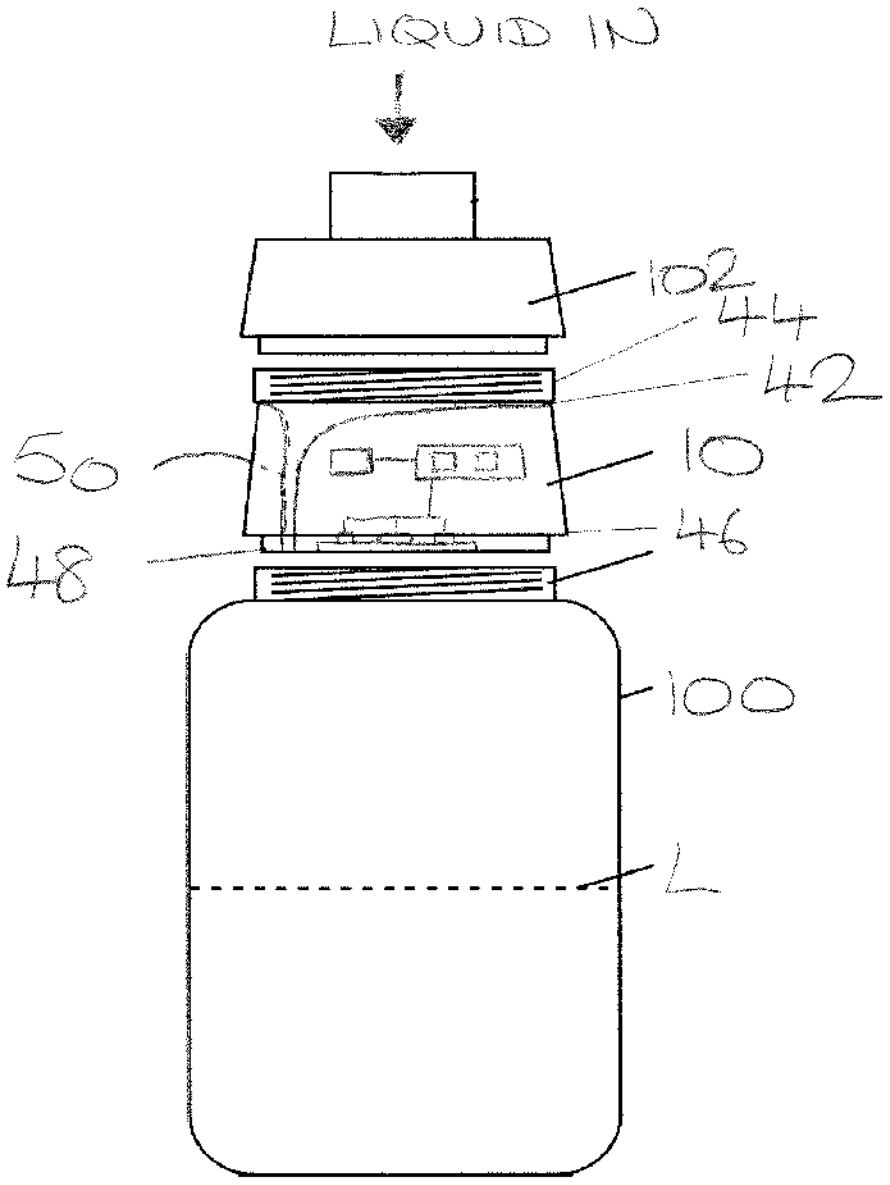

FIG 4.

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Dated 07 June 2018

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Request for grant of a patent

Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

Application number GB1809036.5

1.	Your reference	**Elvie Pump (UK)**
2.	Full name, address and postcode of the applicant or of each applicant Patents ADP number *(if you know it)*	**CHIARO TECHNOLOGY LIMITED** **63 - 66 Hatton Garden** **London EC1N 8LE** **United Kingdom** 11287869002
3.	Title of the invention	**Breast pump system**
4.	Name of your agent *(if you have one)* "Address for service" to which all correspondence should be sent. This may be in the European Economic area or Channel Islands (see warning note below) *(including the postcode)* Patents ADP number *(if you know it)*	**Langley, Mr Peter** **Origin Limited** **Twisden Works** **Twisden Road** **London NW5 1DN** **United Kingdom** 11436136001 ~~**09541046001**~~
5.	Priority declaration: Are you claiming priority from one or more earlier-filed patent applications? If so, please give details of the application(s)	

Country	Application number	Date of filing	PDAS Access Code

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7.	Inventorship: (Inventors must be individuals not companies) Are all the applicants named above also inventors?	**No**	
8.	Are you paying the application fee with this form?	**No**	

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Continuation sheets of this form

Description:	**121**
Claim(s):	**n/a**
Abstract:	**n/a**
Drawing(s):	**44**

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Request for search (Patents Form 9A):	**0**
Request for substantive examination (Patents Form 10):	**0**
Any other documents (please specify):	**PDAS Registration Form**

11. I/We request the grant of a patent on the basis of this application.

Date: **01 Jun 2018**

12. Name, e-mail address, telephone, fax and/or mobile number, if any, of a contact point for the applicant

Langley, Mr Peter
Email: roland@origin.co.uk
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Fax: 02072090643

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BREAST PUMP SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The field of the invention relates to a breast pump system; one implementation of the system is a wearable, electrically powered breast pump system for extracting milk from a mother.

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2. Description of the Prior Art

The specification of the present disclosure is broad and deep. We will now describe the prior art in relation to key aspects of the present disclosure.

Prior art related to breast pump systems

A breast pump system is a mechanical or electro-mechanical device that extracts milk from the breasts of a lactating woman.

A typical breast pump design is as shown in WO 96/25187 A1. A large suction generating device is provided, which is freestanding. This is attached by air lines to one or two breast shields which engage with the user's breasts. A pressure cycle is applied from the suction generating device, via the air lines, to the breast shields. This generates a pressure cycle on the user's breasts to simulate the suction generated by a feeding child.

The suction generating device is a large component that connects to mains power to operate the pumps therein. Milk collection bottles are provided to store the expressed

breast milk. In the system of WO 96/36298 A1 separate bottles are provided attached to each breast shield. A single bottle with tubing connecting to each breast shield may also be used. But for a mother to use this discretely, such as in an office environment, specialised bras must be used. In particular, breast-pumping bras which have a central slit, for the nipple tunnel of the breast shield to extend through, are typically used. The breast shield is held within the bra, with the suction generating device and milk bottle outside the bra.

The fundamental breast pump system has not significantly evolved from this approach, only minor technical improvements have been made.

However, these systems present a number of significant disadvantages. As the suction generating device is a large freestanding unit connected to mains power, the user may feel tethered to the wall. The known devices typically also require a specific user posture and undressing to function normally. This is obviously difficult for a user to do discretely, such as in an office setting. The known devices are also typically noisy, uncomfortable, and hard to clean.

Fully integrated wearable breast pump systems have begun to enter the market, such as described in US 2016 0206794 A1. In such pump systems, the suction source, power supply and milk container are contained in a single, wearable device; there is no need for bulky external components or connections. Such devices can be provided with a substantially breast shaped convex profile so as to fit within a user's bra for discrete pumping, as well as pumping on-the-go without any tethers to electrical sockets or collection stations. The internal breast shield is naturally convex to fit over a breast.

In US 2016 0206794 A1, when viewed from the front, the breast pump device has a 'tear-drop' rounded shape, fuller at its base than at its top. But it uses collapsible bags as milk collection devices. As the collection bag systems are collapsible, it can be difficult for a user to extract all of their milk from the bag, due to the small cut opening that is needed and the capillary action between the bonded plastic sheets that form the bag. This waste can be disheartening for the user, as this is food for their child. The bags are also not re-usable, so the user is required to purchase and maintain a stock of these. As well as presenting a recurring cost, if the user runs out of stock they are unable to use the

product until more bags are purchased.

Furthermore, as a result of the collapsible bags, a complex and somewhat noisy pumping arrangement is necessary. In particular, the breast shield connects to a tube which is provided with compression units which "step" the expressed milk through the tube to the collection bag. This uses the breast milk as a hydraulic fluid to generate suction on the breast. In order to carry this out, a complex sequenced pulsing arrangement must be implemented.

In addition to these systems being particularly complex and wasteful, only a relatively small bag can be used. In US 2016 206794, approximately 110 ml (4 fluid ounces) of milk can be collected before the bag must be changed. While this may be sufficient for some users, others may produce much more milk in a session.

A further integrated wearable breast pump system is shown in US 2013 0023821 A1. In the third embodiment in this document, the breast pump system includes a motor driven vacuum pump and power source. An annular (or punctured disc) membrane is provided, with the flow path of the milk going through the centre of the annulus. The membrane is housed in separate housing and is sealed at its inner and outer edges. The breast shield has a small protrusion to engage with these housing components. However, the design of this breast pump system results in a number of problems. The use of an annular membrane, with the fluid flow path running through the opening of the annulus is undesirable as it results in a large and bulky device. There is therefore a need for improved integrated breast pump systems.

Prior Art related to liquid measurement systems

In the context of breast pump systems, it is useful to measure the quantity of expressed milk. One way to do this is to have a clear container for the breast pump, through which the level of expressed milk inside the container can be seen. However, viewing the milk bottle is not always possible, for example in a breast pump that collects milk while being worn inside a maternity bra.

An existing apparatus for detecting the level of liquid inside a container of a breast pump is that disclosed in US 2016/296681. In this apparatus, a sensing mechanism is provided

at the top of a container, which detects droplets of liquid, specifically breast milk, entering the container. By detecting these droplets entering the container, the apparatus can determine the quantity of liquid which enters the container. In this apparatus, an accurate indication of the level of liquid in the container is reliant on the sensing mechanism being able to accurately record every droplet entering the container.

Particularly at times when liquid enters the container at a high flow rate, this accuracy cannot be guaranteed, leading to significant cumulative errors. An accurate indication of the level of liquid in the container in this apparatus is also reliant on the sensing mechanism always being on during the pumping process, so that power consumption of the sensing mechanism is correspondingly high.

In view of the above, there is the need for an improved way to determine the level of liquid inside a container connected to a breast pump.

Prior Art related to bra clips

Many specialised bras (or brassieres) exist for maternity use and that facilitate nursing and/or breast pumping for milk collection, without the need to remove the bra itself. In a traditional nursing bra, this is achieved with the use of an at least partially detachable cup, which can be unhooked for feeding and/or pumping.

Further specialised bras are known which are provided with cut-out portions or slits which substantially align with the wearer's areola and nipple. Traditional breast pump systems comprise an elongate breast shield which extends away from the breast towards an external bottle and source of suction. The breast shield is arranged to extend through the cut-out portion or slit, with the collection bottle and pumping apparatus placed outside of the bra. These systems require the user to remove or unbutton any over-garments, and are uncomfortable when not pumping.

Integrated, wearable breast pump systems have begun to enter the market, such as previously noted US 2016 0206794 A1. In such pumps, the suction source, power supply and milk container are all in a single, wearable device, as noted above, without the need for bulky external components or connections. Such devices can be provided with a substantially breast shaped profile so as to fit within a user's bra for discrete pumping, as

well as pumping on-the-go without any tethers to electrical sockets or collection stations.

Maternity (or nursing) bras such as disclosed in US 4,390,024 A have partially detachable cups, with several hooks provided along the bra strap for attaching the cups to the strap. The cups can then be attached to different hooks in order to adjust the bra strap length. However, these attachment points are fixed. Additionally, this bra has been designed to accommodate the change in breast size before and after the feeding/pumping process. It is not designed to accommodate a breast pump. Accordingly, there is a need for a better system to accommodate integrated wearable breast pumps.

SUMMARY OF THE INVENTION

The invention is a wearable breast pump system including: a housing shaped at least in part to fit inside a bra and including a pumping mechanism; a breast shield; a rigid or non-collapsible milk container; and in which the breast pump system includes only two parts that are directly removable from the housing in normal use or normal dis-assembly: the breast shield and the rigid, non-collapsible milk container.

BRIEF DESCRIPTION OF THE FIGURES

Aspects of the invention will now be described, by way of example(s), with reference to the following Figures, which each show features of various implementations of the invention including optional features that may be utilised:

Figure 1 is a front view of an assembled breast pump system.

Figure 2 is a rear view of the assembled breast pump system of Figure 1.

Figure 3 is a front view of a partially disassembled breast pump system.

Figure 4 is a rear view of the partially disassembled breast pump system of Figure 3.

Figure 5 is a front view of a further partially disassembled breast pump system.

Figure 6 is a rear view of the further partially disassembled breast pump system of Figure 5.

Figure 7 is a front view of the breast pump system of Figure 1, with the outer shell translucent for ease of explanation.

Figure 8 is a further front view of the breast pump system of Figure 1, with the front of the outer shell removed for ease of explanation.

Figure 9 is a schematic view of a nipple tunnel for a breast shield.

Figure 10 is a schematic of a pneumatic system for a breast pump system.

Figure 11 is a schematic of an alternative pneumatic system for a breast pump system.

Figure 12 is a schematic of a further alternative pneumatic system for a breast pump system.

Figure 13 is a graph depicting measured pressure in the breast pump system of Figure 12 over time.

Figure 14 shows schematics for breast shield sizing and nipple alignment.

Figure 15 shows a screenshot of an application running on a device connected to the breast pump system.

Figure 16 shows a screenshot of an application running on a device connected to the breast pump system.

Figure 17 shows a screenshot of an application running on a device connected to the breast pump system.

Figure 18 shows a screenshot of an application running on a device connected to the breast pump system.

Figure 19 shows a screenshot of an application running on a device connected to the

breast pump system.

Figure 20 shows a screenshot of an application running on a connected device.

Figure 21 shows a screenshot of an application running on a connected device.

Figure 22 shows a screenshot of an application running on a connected device.

Figure 23 shows a screenshot of an application running on a connected device.

Figure 24 shows a screenshot of an application running on a connected device.

Figure 25 shows a screenshot of an application running on a connected device.

Figure 26 shows a diagram of a breast pump sensor network,

Figure 27 shows a sectional view of a device being used to determine the level of liquid in a container;

Figure 28 shows a sectional view of the device and the container from Figure 27 being used at a different orientation.

Figure 29 shows a sectional view of the device and the container from Figure 27 being used whilst undergoing acceleration.

Figure 30 shows a sectional view of the device from Figure 27 being used as part of a breast pump assembly.

Figure 31 shows a sectional view of a device connected between a container and its lid, and which is operable to determine the level of liquid inside the container.

Figure 32 depicts a prior art design for a maternity bra;

Figure 33 depicts a clip and clasp being fitted to a maternity bra.

Figure 34 depicts an alternative clip for adjustment of a maternity bra.

Figure 35 depicts the alternative clip of Figure 34.

Figure 36 depicts an alternative clip for adjustment of a maternity bra.

Figure 37 depicts an alternative clip for adjustment of a maternity bra.

Figure 38 depicts an alternative clip for adjustment of a maternity bra.

Figure 39 depicts adjustment of the maternity bra of Figure 37.

Figure 40 shows a configuration with two piezo pumps mounted in series.

Figure 41 shows a configuration of two piezo pumps mounted in parallel.

Figure 42 shows a plot of the air pressure generated as a function of time by two piezo pumps mounted in series and mounted in parallel respectively.

Figure 43 shows a plot of the air pressure generated as a function of time by two piezo pumps mounted in a dual configuration.

Figure 44 shows a figure of a pump including two piezo pumps in which each piezo pump is connected to a heat sink.

DETAILED DESCRIPTION

We will now describe an implementation of the invention, called the Elvie™ pump, in the following sections:

Section A: The Elvie™ Breast Pump System

Section B: An IR System

Section C: A Bra Clip

Section D: Piezo Pumps and Wearable Devices

Section A: The Elvie™ Breast Pump System

1. Elvie™ Breast Pump System Overview

An implementation of the invention, called the Elvie™ pump, is a breast pump system that is, at least in part, wearable inside a bra. The breast pump system comprises a breast shield for engagement with the user's breast, a housing for receiving at least a portion of the breast shield and a detachable rigid milk collection container attachable, in use, to a lower face of the housing and connected to the breast shield for collecting milk expressed by the user, with a milk-flow pathway defined from an opening in the breast shield to the milk collection container. The housing inside also includes a pump for generating a negative pressure in the breast shield, as well as battery and control electronics Unlike other wearable breast pumps, the only parts of the system that come into contact with milk in normal use are the breast shield and the milk container; milk only flows through the breast shield and then directly into the milk container. Milk does not flow through any parts of the housing at all, for maximum hygiene and ease of cleaning.

With reference to Figure 1 and Figure 2, the assembled breast pump system 100 includes a housing 1 shaped to substantially fit inside a bra. The housing 1 includes one or more pumps and a rechargeable battery. The breast pump system includes two parts that are directly connected to the housing 1: the breast shield 7 and a milk container 3. The breast shield 7 and the milk container 3 are directly removable or attachable from the housing 1 in normal use or during normal dis-assembly (most clearly shown in Figure 5). All other parts that are user-removable in normal use or during normal dis-assembly are attached to either the breast shield 7 or the milk container 3. The breast shield 7 and milk container 3 may be removed or attached for example using a one click or one press action or a push button or any other release mechanism. Audible and/or haptic feedbacks confirm that the pump is properly assembled.

The modularity of the breast pump allows for easy assembly, disassembly and replacement of different parts such as the breast shield and milk collection container. This also allows for different parts of the pump to be easily washed and/or sterilised. The breast shield and bottle assembly, both of which are in contact with milk during

pumping, may therefore be efficiently and easily cleaned; these are the only two items that need to be cleaned; in particular, the housing does not need to be cleaned.

The housing 1, breast shield 7 that is holding a flexible diaphragm, and milk container 3 attach together to provide a closed-loop pneumatic system powered by piezoelectric pumps located in the housing 1. This system then applies negative pressure directly to the nipple, forms an airtight seal around the areola, and provides a short path for expressed milk to collect in an ergonomically shaped milk container 3.

The different parts of the breast shield system are also configured to automatically self-seal under negative pressure for convenience of assembly and disassembly and to reduce the risk of milk spillage. Self-sealing refers to the ability of sealing itself automatically or without the application of adhesive, glue, or moisture (such as for example a self-sealing automobile tire or self-sealing envelopes). Hence once the breast pump system is assembled it self-seals under its assembled condition without the need to force seals into interference fits to create sealed chambers. A degree of interference fitting is usual however, but is not the predominating attachment mechanism. Self-sealing enables simple components to be assembled together with a light push: for example, the diaphragm just needs to be placed lightly against the diaphragm housing; it will self-seal properly and sufficiently when the air-pump applies sufficient negative air-pressure. The diaphragm itself self-seals against the housing when the breast shield is pushed into the housing. Likewise, the breast shield self-seals against the milk container when the milk container is pushed up to engage the housing. This leads to simple and fast assembly and dis-assembly, making it quick and easy to set the device up for use, and to clean the device after a session.

Self-sealing has a broad meaning and may also relate to any, wholly or partly self-energising seals. It may also cover any interference seals, such as a press seal or a friction seal, which are achieved by friction after two parts are pushed together.

Whilst one particular embodiment of the invention's design and a specific form of each of the parts of the breast pump system is detailed below, it can be appreciated that the overall description is not restrictive, but an illustration of topology and function that the design will embody, whilst not necessary employing this exact form or number of

discrete parts.

The breast pump system 100 comprises a housing 1 and a milk collection container (or bottle) 3. The housing 1 (including the one or more pumps and a battery) and the container 3 are provided as a unit with a convex outer surface contoured to fit inside a bra. The milk collection container 3 is attached to a lower face 1A of the housing 1 and forms an integral part of the housing when connected, such that it can be held comfortably inside a bra. While the breast pump 100 may be arranged to be used with just the right or the left breast specifically, the breast pump 100 is preferably used with both breasts, without modification. To this end, the outer surfaces of the breast pump 100 are preferably substantially symmetrical.

Preferably, the width of the complete breast pump device (housing 1 and milk container 3) is less than 110 mm and the height of the complete breast pump device is less than 180 mm.

Overall, the breast pump system 100 gives discrete and comfortable wear and use. The system weighs about 224 grams when the milk container is empty, making it relatively lighter as compared to current solutions; lightness has been a key design goal from the start, and has been achieved through a lightweight piezo pump system and engineering design focussed on minimising the number of components.

The breast pump system 100 is small enough to be at least in part held within any bra without the need to use a specialized bra, such as a maternity bra or a sports bra. The rear surface of the breast pump is also concave so that it may sit comfortably against the breast. The weight of the system has also been distributed to ensure that the breast pump is not top heavy, ensuring comfort and reliable suction against the breast. The centre of gravity of the pump system is, when the container is empty, substantially at or below the horizontal line that passes through the filling point on the breast shield, so that the device does not feel top-heavy to a person while using the pump.

Preferably, when the container is empty, the centre of gravity is substantially at or below the half-way height line of the housing so that the device does not feel top-heavy to a user using the pump.

The centre of gravity of the breast pump, as depicted by Figure 1, is at around 60mm high on the centreline from the base of the breast pump when the milk container is empty. During normal use, and as the milk container gradually receives milk, the centre of gravity lowers, which increases the stability of the pump inside the bra. It reduces to around 40mm high on the centreline from the base of the breast pump when the milk container is full.

The centre of gravity of the breast pump is at about 5.85mm below the centre of the nipple tunnel when the milk container is empty, and reduced to about 23.60mm below the centre of the nipple tunnel when the milk container is full. Generalising, the centre of gravity should be at least 2mm below the centre of the nipple tunnel when the container is empty.

The breast pump 100 is further provided with a user interface 5. This may take the form of a touchscreen and/or physical buttons. In particular, this may include buttons, sliders, any form of display, lights, or any other componentry necessary to control and indicate use of the breast pump 100. Such functions might include turning the breast pump 100 on or off, specifying which breast is being pumped, increasing or decreasing the peak pump pressure. Alternatively, the information provided through the user interface 5 might also be conveyed through haptic feedback, such as device vibration, driven from a miniature vibration motor within the pump housing 1.

In the particular embodiment of the Figures, the user interface 5 comprises power button 5A for turning the pump on and off. The user interface 5 further comprises pump up button 5B and pump down button 5C. These buttons adjust the pressure generated by the pump and hence the vacuum pressure applied to the user's breast. In preferable embodiments, the pump up button 5B could be physically larger than the pump down button 5C. A play/pause button 5D is provided for the user to interrupt the pumping process without turning the device off.

The user interface 5 further comprises a breast toggle button 5E for the user to toggle a display of which breast is being pumped. This may be used for data collection, e.g. via an application running on a connected smartphone; the app sends data to a remote server, where data analysis is undertaken (as discussed in more detail later), or for the user to keep track of which breast has most recently been pumped. In particular, there may be a

pair of LEDs, one to the left of the toggle button 5E and one to the right. When the user is pumping the left breast, the LED to the right of the toggle button 5E will illuminate, so that when the user looks down at the toggle it is the rightmost LED from their point of view that is illuminated. When the user then wishes to switch to the right breast, the toggle button can be pressed and the LED to the left of the toggle button 5E, when the user looks down will illuminate. The connected application can automatically track and allocate how much milk has been expressed, and when, by each breast.

The breast pump system also comprises an illuminated control panel, in which the level of illumination can be controlled at night or when stipulated by the user. A day time mode, and a less bright night time mode that are suitable to the user, are available. The control of the illumination level is either implemented in hardware within the breast pump system itself or in software within a connected device application used in combination with the breast pump system.

As depicted in Figure 1, the housing 1 and milk collection container 3 form a substantially continuous outer surface, with a generally convex shape. This shape roughly conforms with the shape of a 'tear-drop' shaped breast. This allows the breast pump 100 to substantially fit within the cup of a user's bra. The milk collection container 3 is retained in attachment with the housing 1 by means of a latch system, which is released by a one-click release mechanism such as a push button 2 or any other one-handed release mechanism. An audible and/or haptic feedback may also be used to confirm that the milk collection container 3 has been properly assembled.

The European standard EN 13402 for Cup Sizing defines cup sizes based upon the bust girth and the underbust girth of the wearer and ranges from AA to Z, with each letter increment denoting an additional 2 cm difference. Some manufacturers do vary from these conventions in denomination, and some maternity bras are measured in sizes of S, M, L, XL, etc. In preferred embodiments, the breast pump 100 of the present invention corresponds to an increase of between 3 or 4 cup sizes of the user according to EN 13402.

A plane-to-plane depth of the breast pump can also be defined. This is defined as the distance between two parallel planes, the first of which is aligned with the innermost

point of the breast pump 100, and the second of which is aligned with the outermost point of the breast pump 100. This distance is preferably less than 100 mm.

Figure 2 is a rear view of the breast pump 100 of Figure 1. The inner surface of the housing 1 and milk collection container 3 are shown, along with a breast shield 7. The housing 1, milk collection container 3 and breast shield 7 form the three major subcomponents of the breast pump system 100. In use, these sub-components clip together to provide the functioning breast pump system 100. The breast shield 7 is designed to engage with the user's breast, and comprises a concave inner flange 7A which contacts the breast. To allow the breast pump 100 to be used on either of the user's breasts, the breast shield 7 is preferably substantially symmetrical on its inner flange 7A.

The inner flange 7A is substantially oval-shaped. While the inner flange 7A is concave, it is relatively shallow such that it substantially fits the body form of the user's breast. In particular, when measured side-on the inner-most point of the flange 7A and the outer-most point may be separated by less than 25 mm. By having a relatively shallow concave surface, the forces applied can be spread out over more surface area of the breast. The flatter form also allows easier and more accurate location of the user's nipple. In particular, the flange 7A of the breast shield 7 may extend over the majority of the inner surface of the housing 1 and milk collection container 3. Preferably, it may extend over 80% of this surface. By covering the majority of the inner surface, the breast shield is the only component which contact's the wearer's breast. This leaves fewer surfaces which require thorough cleaning as it reduces the risk of milk contacting a part of the device which cannot be easily sterilized. Additionally, this also helps to disperse the pressure applied to the user's breast across a larger area.

The breast shield 7 substantially aligns with the outer edge 1B of the housing 1. The milk collection container 3 may be provided with an arcuate groove for receiving a lower part of the breast shield 7. This is best shown in later Figures. In the assembled arrangement of Figures 1 and 2, the inner surface of the breast pump 100 is substantially continuous.

The breast shield 7 comprises a shield flange for engaging the user's breast, and an elongate nipple tunnel 9) aligned with the opening and extending away from the user's

breast. Breast shield nipple tunnel 9 extends from a curved section 7B in the breast shield 7. In preferable embodiments the nipple tunnel 9 is integral with the breast shield 7. However, it is appreciated that separate removable/interchangeable nipple tunnels may be used. Curved section 7B is positioned over the user's nipple and areola in use. The breast shield 7 forms an at least partial seal with the rest of the user's breast around this portion, under the negative air pressure created by an air-pressure pump.

This breast shield nipple tunnel 9 defines a milk-flow path from the inner surface of the breast shield 7A, through the breast shield nipple tunnel 9 and into the milk collection container 3. The breast shield nipple tunnel 9 is preferably quite short in order to minimise the length of the milk-flow path in order to minimise losses. By reducing the distance covered by the milk, the device is also reduced in size and complexity of small intermediate portions. In particular, the breast shield nipple tunnel 9 may extend less than 70 mm from its start to end, more preferably less than 50 mm. In use, the nipple tunnel 9 is substantially aligned with the user's nipple and areolae. The nipple tunnel comprises a first opening 9A for depositing milk into the collection container and a second opening 19A for transferring negative air pressure generated by the pump to the user's nipple.

The shield flange 7A and nipple tunnel 9 may be detachable from the housing 1 together. The shield flange 7A and nipple tunnel 9 being detachable together helps further simplify the design, and reduce the number of components which must be removed for cleaning and sterilization. However, preferably, the nipple tunnel 9 will be integral with the breast shield 7, in order to simplify the design and reduce the number of components which must be removed for cleaning and sterilisation.

Figures 3 and 4 are of a partially disassembled breast pump 100 of the present invention. In these Figures, the breast shield 7 has been disengaged from the housing 1 and milk collection bottle 3. As shown in Figure 4, the housing 1 comprises a region or slot 11 for receiving the breast shield nipple tunnel 9 of the breast shield 7. The breast shield is held in place thanks to a pair of channels (9B) included in the nipple tunnel 9, each channel including a small indent. When pushing the housing 1 onto the breast shield 7, which has been placed over the breast, ridges in the housing (9C) engage with the channels, guiding the housing into position; a small, spring plunger, such as ball bearing in each

ridge facilitates movement of the housing on to the nipple tunnel 9. The ball bearings locate into the indent to secure the housing on to the nipple tunnel with a light clicking sound. In this way, the user can with one hand place and position the breast shield 7 onto her breast and with her other hand, position and secure the housing **1** on to the breast shield 7. The breast shield 7 can be readily separated from the housing 1 since the ball bearing latch only lightly secures the breast shield 7 to the housing **1**.

Alternatively, the breast shield 7 may also be held in place by means of a clip engaging with a slot located on the housing. The clip may be placed at any suitable point on the shield 7, with the slot in a corresponding location.

The breast shield nipple tunnel 9 of the breast shield 7 is provided with an opening 9A on its lower surface through which expressed milk flows. This opening 9A is configured to engage with the milk collection bottle 3.

The breast pump **100** further comprises a barrier or diaphragm for transferring the pressure from the pump to the milk-collection side of the system. In the depicted example, this includes flexible rubber diaphragm 13 seated into diaphragm housing **19**A. The barrier could be any other suitable component such as a filter or an air transmissive material. Diaphragm housing 19A includes a small air hole into the nipple tunnel 9 to transfer negative air pressure into nipple tunnel 9 and hence to impose a sucking action on the nipple placed in the nipple tunnel 9.

Hence, the air pump acts on one side of the barrier or diaphragm 13 to generate a negative air pressure on the opposite, milk-flow side of the barrier. The barrier has an outer periphery or surface, i.e. the surface of diaphragm housing 19A that faces towards the breast, and the milk-flow pathway extends underneath the outer periphery or surface of the barrier or diaphragm housing 19A. The milk-flow path extending under the outer periphery or surface of the barrier 19A allows for a simpler and more robust design, without the milk-flow pathway extending through the barrier. This provides increased interior space and functionality for the device.

As noted, the milk-flow pathway extends beneath or under the barrier 13 or surface of diaphragm housing 19A. This provides an added benefit of having gravity move the milk down and away from the barrier.

Preferably the milk-flow pathway does not pass through the barrier 32. This results in a simpler and smaller barrier design.

As noted, the diaphragm 13 is mounted on diaphragm housing 19A that is integral to the breast shield. This further helps increase the ease of cleaning and sterilisation as all of the components on the "milk" flow side can be removed.

The barrier 13 may also provide a seal to isolate the air pump from the milk-flow side of the barrier. This helps to avoid the milk becoming contaminated from the airflow or pumping side (i.e. the non-milk-flow side).

Alternatively, the only seal is around an outer edge of the barrier 13. This is a simple design as only a single seal needs to be formed and maintained. Having multiple seals, such as for an annular membrane, introduces additional complexity and potential failure points.

As illustrated in Figures 3 and 4, the barrier may include a flexible diaphragm 13 formed by a continuous circular disc shaped membrane which is devoid of any openings or holes. This provides a larger effective "working" area of the diaphragm (i.e. the area of the surface in contact with the pneumatic gasses) than an annular membrane and hence the membrane may be smaller in diameter to have the same working area.

The diaphragm 13 is arranged so that the milk-flow pathway extends below and past the outer surface or periphery of the diaphragm 13. This means that the milk-flow pathway does not extend through the diaphragm 13. In particular, the milk-flow pathway is beneath the diaphragm 13. However, the diaphragm 13 may be offset in any direction with respect to the milk-flow pathway, provided that the milk-flow pathway does not extend through the diaphragm 13.

Preferably, the diaphragm 13 is a continuous membrane, devoid of any openings. The diaphragm 13 is held in a diaphragm housing 19, which is formed in two parts. The first half 19A of the diaphragm housing 19 is provided on the outer surface of the breast shield 7, above the breast shield nipple tunnel 9 and hence the milk-flow pathway. In

preferred embodiments, the first half 19A of the diaphragm housing 19 is integral with the breast shield. The second half 19B of the diaphragm housing is provided in a recessed portion of the housing 1. The diaphragm 13 self-seals in this diaphragm housing 19 around its outer edge, to form a watertight and airtight seal. Preferably, the self-seal around the outer edge of the diaphragm 13 is the only seal of the diaphragm 13. This is beneficial over systems with annular diaphragms which must seal at an inner edge as well. Having the diaphragm 13 mounted in the breast pump 100 in this manner ensures that it is easily accessible for cleaning and replacement. It also ensures that the breast shield 7 and diaphragm 13 are the only components which need to be removed from the pump 100 for cleaning. Because the diaphragm 13 self-seals under vacuum pressure, it is easily removed for cleaning when the device is turned off.

Figures 5 and 6 show a breast pump 100 according to the present invention in a further disassembled state. In addition to the breast shield 7 and diaphragm 13 being removed, the milk collection container 3 has been unclipped. Preferably, the milk collection container 3 is a substantially rigid component. This ensures that expressed milk does not get wasted, while also enhancing re-usability. In some embodiments, the milk collection container 3 may be formed of three sections: a front bottle potion, a rear bottle potion, and a cap. These three sections may clip together to form the milk collection container 3. This three-part system is easy to empty, easily cleanable since it can be dis-assembled, and easily re-usable. The milk collection container or milk bottle may be formed of at least two rigid sections which are connectable. This allows simple cleaning of the container for re-use. Alternatively, the container may be a single container made using a blow moulding construction, with a large opening to facilitate cleaning. This large opening is then closed with a cap with an integral spout 35 or 'sealing plate' (which is bayonet-mounted and hence more easily cleaned than a threaded mount spout). A flexible rubber valve 37 (or 'sealing plate seal') is mounted onto the cap or spout 35 and includes a rubber duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump; this ensures that negative air-pressure does not need to be applied to the milk container and hence adds to the efficiency of the system. The flexible valve 37 self-seals against opening 9A in nipple tunnel 9. Because it self-seals under vacuum pressure, it automatically releases when the system is off, making it easy to remove the milk container.

Preferably, the milk collection container resides entirely below the milk flow path defined by the breast shield when the breast pump system 100 is positioned for normal use, hence ensuring fast and reliable milk collection.

The milk collection container 3 has a capacity of approximately 5 fluid ounces (148 ml). Preferably, the milk collection container has a volume of greater than 120 ml. More preferably, the milk collection container has a volume of greater than 140 ml. To achieve this, the milk collection container 3 preferably has a depth in a direction extending away from the breast in use, of between 50 to 80 mm, more preferably between 60 mm to 70 mm, and most preferably between 65 mm to 68 mm.

The milk collection container 3 further preferably has a height, extending in the direction from the bottom of the container 3 in use to the cap or spout or sealing plate 35, of between 40 mm to 60 mm, more preferably between 45 mm to 55 mm, and most preferably between 48 mm to 52 mm. The cap 35 may screw into the milk collection bottle 3. In particular, it may be provided with a threaded connection or a bayonet and slot arrangement.

Further preferably, the milk collection container has a length, extending from the leftmost point to the rightmost point of the container 3 in use, of between 100 mm to 120 30 mm, more preferably between 105 mm to 115 mm, and most preferably between 107 mm to 110 mm.

This cap 35 is provided with a one-way valve 37, through which milk can flow only into the bottle. This valve 37 prevents milk from spilling from the bottle once it has been collected. In addition, the valve 37 automatically seals completely unless engaged to the breast shield 7. This ensures that when the pump 100 is dismantled immediately after pumping, no milk is lost from the collection bottle 3. It can be appreciated that this one-way valve 37 might also be placed on the breast shield 7 rather than in this bottle cap 35.

Alternatively, the milk bottle 3 may form a single integral part with a cap 35. Cap 35 may include an integral milk pouring spout.

In certain embodiments, a teat may be provided to attach to the annular protrusion 31A

or attach to the spout that is integral with cap 35, to allow the container 3 to be used directly as a bottle. This allows the milk container to be used directly as a drinking vessel for a child. The milk collection container may also be shaped with broad shoulders such that it can be adapted as a drinking bottle that a baby can easily hold.

Alternatively, or in addition, a spout may be provided to attach to the protrusion 31A for ease of pouring. A cap may also be provided to attach to the protrusion 31A in order to seal the milk collection bottle 3 for easy storage.

The pouring spout, drinking spout, teat or cap may also be integral to the milk collection container.

Further, the removable milk collection container or bottle includes a clear or transparent wall or section to show the amount of milk collected. Additionally, measurement markings (3A) may also be present on the surface of the container. This allows the level of milk within the container to be easily observed, even while pumping. The milk collection container or bottle may for example be made using an optically clear, dishwasher safe polycarbonate material such as Tritan™.

The milk collection container or bottle may include a memory or a removable tag, such as a tag including an NFC chip, that is programmed to store the date and time it was filled with milk, using data from the breast pump system or a connected device such as a smartphone. The container therefore includes wireless connectivity and connects to a companion app. The companion app then tracks the status of multiple milk collection containers or bottles to select an appropriate container or bottle for feeding. The tag of the bottle may also be programmed to store the expiry date of the milk as well as the quantity of the milk stored.

Figures 7 and 8 show front views of a breast pump system **100**. The outer-surface of the housing **1** has been drawn translucent to show the components inside. The control circuitry 71 for the breast pump 100 is shown in these figures. The control circuitry in the present embodiment comprises four separate printed circuit boards, but it is appreciated that any other suitable arrangement may be used.

The control circuitry may include sensing apparatus for determining the level of milk in the container 3. The control circuitry may further comprise a wireless transmission device for communicating over a wireless protocol (such as Bluetooth) with an external device. This may be the user's phone, and information about the pumping may be sent to this device. In embodiments where the user interface comprises a breast toggle button 51C, information on which breast has been selected by the user may also be transmitted with the pumping information. This allows the external device to separately track and record pumping and milk expression data for the left and right breasts.

There should also be a power charging means within the control circuitry 71 for charging the battery 81. While an external socket, cable or contact point may be required for charging, a form of wireless charging may instead be used such as inductive or resonance charging. In the Figures, charging port 6 is shown for charging the battery 81. This port 6 may be located anywhere appropriate on the housing 1.

Figure 8 shows the location of the battery 81 and the pumps 83A, 83B mounted in series inside the housing 1. While the depicted embodiment shows two pumps 83A, 83B it is appreciated that the present invention may have a single pump. Preferably, an air filter 86 is provided at the output to the pumps 83A, 83B. In preferable embodiments, the pumps 83A, 83B are piezoelectric air pumps (or piezo pumps), which operate nearly silently and with minimal vibrations. A suitable piezo pump is manufactured by TTP Ventus, which can deliver in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free flow. The rear side of the second half of the diaphragm housing 19B in the housing 1 is provided with a pneumatic connection spout. The pumps 83A, 83B are pneumatically connected with this connection spout.

Operation of the breast pump 100 will now be described. Once the breast pump 100 is activated and a pumping cycle is begun, the pumps 83A, 83B generates a negative air pressure which is transmitted via an air channel to a first side of the diaphragm 13 mounted on the diaphragm housing 19A. This side of the diaphragm 13 is denoted the pumping side 13B of the diaphragm 13.

The diaphragm 13 transmits this negative air pressure to its opposite side (denoted the milk-flow side 13A). This negative pressure is transferred through a small opening in the

diaphragm housing 19A to the breast shield nipple tunnel 9 and the curved opening 7B of the breast shield 7 that contacts the breast. This acts to apply the pressure cycle to the breast of the user, in order to express milk. The milk is then drawn through the nipple tunnel 9, to the one way valve 37 that remains closed whilst negative pressure is applied. When the negative air pressure is released, the valve 37 opens and milk flows under gravity past the valve 37 and into milk container 3. Negative air pressure is periodically (e.g. cyclically, every few seconds) applied to deliver pre-set pressure profiles such as profiles that imitate the sucking of a child.

While the depicted embodiment of the breast pump 100 is provided with two pumps, the following schematics will be described with a single pump 83. It is understood that the single pump 83 could be replaced by two separate piezo air-pumps 83A, 83B as above.

Figure 9 depicts a schematic of a further embodiment of a breast shield nipple tunnel 9 for a breast pump 100. The breast shield nipple tunnel 9 is provided with an antechamber 91 and a separation chamber 93. A protrusion 95 extends from the walls of the breast shield nipple tunnel 9 to provide a tortuous air-liquid labyrinth path through the breast shield nipple tunnel 9. In the separation chamber 93 there are two opening 97, 99. An air opening 97 is provided in an upper surface 93A of the separation chamber 93. This upper surface 93 is provided transverse to the direction of the breast shield nipple tunnel 9. This opening 97 connects to the first side of the diaphragm housing 19A and is the source of the negative pressure. This airflow opening 97 also provides a route for air to flow as shown with arrow 96. It is appreciated that the tortuous pathway is not necessary and that a breast shield nipple tunnel 9 without such a pathway will work.

The other opening 99 is a milk opening 99. The milk opening 99 is provided on a lower surface 93B of the separation chamber 93 and connects in use to the container 3. After flowing through the tortuous breast shield nipple tunnel 9 pathway, the milk is encouraged to flow through this opening 99 into the container 3. This is further aided by the transverse nature of the upper surface 93A. In this manner, expressed milk is kept away from the diaphragm 13. As such, the breast pump 100 can be separated into a "air" side comprising the pump 83, the connection spout 85 and the pumping side 13B of the diaphragm 13 and a "milk-flow" side comprising the breast shield 7, the milk collection container 3 and the milk-flow side 13A of the diaphragm 13. This ensures that all of the

"milk-flow" components are easily detachable for cleaning, maintenance and replacement. Additionally, the milk is kept clean by ensuring it does not contact the mechanical components. While the present embodiment discusses the generation of negative pressure with the pump 83, it will be appreciated that positive pressure may instead be generated.

While the embodiments described herein use a diaphragm 13, any suitable structure to transmit air pressure while isolating either side of the system may be used.

The breast pump may further comprise a pressure sensor in pneumatic connection with the piezo pump. This allows the output of the pump to be determined.

Figure 10 shows a schematic of a basic pneumatic system 200 for a breast pump 100. In the system 200 milk expressed into the breast shield 7 is directed through the breast shield nipple tunnel 9 through the torturous air-liquid labyrinth interface 95. The milk is directed through the non-return valve 37 to the collection container 3. This side of the system forms the "milk-flow" side 201.

The rest of the pneumatic system 200 forms the air side 202 and is separated from contact with milk. This is achieved by way of a flexible diaphragm 13 which forms a seal between the two sides of the system. The diaphragm 13 has a milk-flow side 13A and an air side or pumping side 13B.

The air side 202 of the system 200 is a closed system. This air side 202 may contain a pressure sensor 101 in pneumatic connection with the diaphragm 13 and the pump 83. Preferably, the pump 83 is a piezoelectric pump (or piezo pump). Due to their low noise, strength and compact size, piezoelectric pumps are ideally suited to the embodiment of a small, wearable breast pump. The pump 83 has an output 83A for generating pressure, and an exhaust to the atmosphere 83B. In a first phase of the expression cycle, the pump 83 gradually applies negative pressure to half of the closed system 202 behind the diaphragm 13. This causes the diaphragm 13 to extend away from the breast, and thus the diaphragm 13 conveys a decrease in pressure into the breast shield 7. The reduced pressure encourages milk expression from the breast, which is directed through the tortuous labyrinth system 95 and the one-way valve 37 to the collection bottle 3.

While in the depicted embodiment the air exhaust 83B is not used, it may be used for functions including, but not limited to, cooling of electrical components, inflation of the bottle to determine milk volume (discussed further later) or inflation of a massage bladder or liner against the breast. This massage bladder may be used to help mechanically encourage milk expression. More than one massage bladder may be inflated regularly or sequentially to massage one or more parts of the breast. Alternatively, the air pump may be used to provide warm air to one or more chambers configured to apply warmth to one or more parts of the breast to encourage let-down.

The air side 202 further comprises a two-way solenoid valve 103 connected to a filtered air inlet 105 and the pump 83. Alternatively, the filter could be fitted on the pump line 83A. If the filter is fitted here, all intake air is filtered but the performance of the pump may drop. After the negative pressure has been applied to the user's breast, air is bled into the system 202 through the valve 103 in a second phase of the expression cycle. In this embodiment, the air filter 105 is affixed to this inlet to protect the delicate components from degradation. In particular, in embodiments with piezoelectric components, these are particularly sensitive.

The second phase of the expression cycle and associated switching of valve 103 is actioned once a predefined pressure threshold has been reached. The pressure is detected by a pressure sensor 101.

In certain embodiments, if the elasticity and extension of the diaphragm 13 may be approximated mathematically at different pressures, the pressure measured by sensor 101 can be used to infer the pressures exposed to the nipple on the opposite side of the diaphragm 13. Figure 11 shows an alternative pneumatic system 300. The core architecture of this system is the same as the system shown in Figure 10.

In this system 300, the closed loop 202 is restricted with an additional three way solenoid valve 111. This valve 111 allows the diaphragm 13 to be selectively isolated from the rest of the closed loop 202. This additional three way valve 111 is located between the diaphragm 13 and the pump 83. The pressure sensor 101 is on the pump 83 side of the three way valve 111. The three way valve 111 is a single pole double throw (SPDT) valve,

wherein: the pole 111A is in pneumatic connection with the pump 83 and pressure sensor; one of the throws **11** is in pneumatic connection with the diaphragm 13; and the other throw 111C is in pneumatic connection with a dead-end 113. This dead-end 113 may either be a simple closed pipe, or any component(s) that does not allow the flow of air into the system 202. This could include, for example, an arrangement of one-way valves.

In this system 300, therefore, the pump 83 has the option of applying negative pressure directly to the pressure sensor 101. This allows repeated testing of the pump in order to calibrate pump systems, or to diagnose issues with the pump in what is called a dead end stop test. This is achieved by throwing the valve to connect the pump 83 to the dead end **113**. The pump 83 then pulls directly against the dead end 113 and the reduction of pressure within the system can be detected by the pressure sensor 101.

The pressure sensor detects when pressure is delivered and is then able to measure the output of the pumping mechanism. The results of the pressure sensor are then sent to an external database for analysis such as a cloud database, or are fed back to an on-board microcontroller that is located inside the housing of the breast pump system.

Based on the pressure sensor measurements, the breast pump system is able to dynamically tune the operation of the pumping mechanism (i.e. the duty or pump cycle, duration of a pumping session, the voltage applied to the pumping mechanism, the peak negative air pressure) in order to ensure a consistent pressure performance across different breast pump systems.

In addition, the breast pump system, using the pressure sensor measurements, is able to determine if the pump is working correctly, within tolerance levels. Material fatigue of the pump is therefore directly assessed by the breast pump system. Hence, if the output of the pumping mechanism degrades over time, the breast pump system can tune the pumping mechanism operation accordingly. As an example, the breast pump system may increase the duration of a pumping session or the voltage applied to the pumping mechanism to ensure the expected pressures are met.

This ensures that the user experience is not altered, despite the changing output of the pump as it degrades over time. This is particularly relevant for piezo pumps where the output of the pump may vary significantly.

The microcontroller can also be programmed to deliver pre-set pressure profiles. The pressure profiles may correspond to, but not necessarily, any suction patterns that would mimic the sucking pattern of an infant. The patterns could mimic for example the sucking pattern of a breastfed infant during a post birth period or at a later period in lactation.

The profiles can also be manually adjusted by the user using a control interface on the housing of the breast pump system or on an application running on a connected device.

Additionally, the user is able to manually indicate the level of comfort that they are experiencing when they are using the system. This can be done using a touch or voice-based interface on the housing of the breast pump system itself or on an application running on a connected device.

The system stores the user-indicated comfort levels together with associated parameters of the pumping system. The pressure profiles may then be fine scaled in order to provide the optimum comfort level for a particular user.

The profiles or any of the pumping parameters may be calculated in order to correlate with maximum milk expression rate or quantity.

The pressure profiles or any of the pumping parameters may also be dynamically adjusted depending on the real time milk expression rate or quantity of milk collected. The pressure profiles or any of the pumping parameters may also be dynamically adjusted when the start of milk let-down has been detected.

Additionally, the system is also able to learn which parameters improve the breast pump system efficiency. The system is able to calculate or identify the parameters of the pumping mechanism that correlate with the quickest start of milk let-down or the highest volume of milk collected for a certain time period. The optimum comfort level for a particular user may also be taken into account.

Figure 12 shows a schematic for a system 400 for a breast pump 100 which can estimate the volume of milk collected in the collection container 3 from data collected on the air-side part 202 of the system 400.

The pump 83 is connected to the circuit via two bleed valves 126, 128. The first bleed valve 126 is arranged to function when the pump 83 applies a negative pressure. As such, this valve 126 is connected to a "bleed in" 127, for supplying atmospheric air to the system 202.

The second bleed valve 128 is arranged to function when the pump 83 applies a positive pressure. As such, this valve 128 is connected to a "bleed out" 129 for bleeding air in the system 202 to the atmosphere.

Although Section C describes the preferred embodiment for measuring or inferring the volume of milk collected in the milk collection container using IR sensors, an alternative method for measuring or inferring the volume of milk collected in the milk collection container using pressure sensors is described also below.

During a milking pump cycle, the pump 83 applies negative pressure on the air side 13B of the diaphragm 13 which causes its extension towards the pump 83. This increases the volume of the space on the milk side 13B of the diaphragm 13. This conveys the decrease in pressure to the breast to encourage expression of milk. A set of three non-return valves 121, 123, 125 ensure that this decrease in pressure is applied only to the breast (via the breast shield 7) and not the milk collection container 3. To measure the volume of milk collected in the container 3, the pump 83 is used instead to apply positive pressure to the diaphragm 13. The diaphragm 13 is forced to extend away from the pump 83 and conveys the pressure increase to the milk side 201 of the system 400. The three non-return valves 121, 123, 125 ensure that this increase in pressure is exclusively conveyed to the milk collection container 13.

The breast pump may further comprise: a first non-return valve between the milk flow side of the diaphragm and the breast shield, configured to allow only a negative pressure to be applied to the breast shield by the pump; a second non-return valve between the milk-flow side of the diaphragm and the milk collection container configured to allow only a positive pressure to be applied to the milk collection container by the pump; and a pressure sensor in pneumatic connection with the pressure-generation side of the diaphragm.

The resulting pressure increase is monitored behind the diaphragm 13 from the air-side 202 by a pressure sensor 101. Preferably, the pressure sensor 101 is a piezoelectric pressure sensor (piezo pressure sensor). The rate at which the pump 83 (at constant strength) is able to increase the pressure in the system 400 is a function of the volume of air that remains in the milk collection container 3. As air is many times more compressible than liquid, the rate at which pressure increases in the system 400 can be expressed as an approximate function of the volume of milk held in the collection container 3.

Thus by increasing the pressure in this fashion, the rate of pressure increase can be determined, from which the volume of milk held in the container 3 is calculable. Figure 13 shows repeated milking and volume measurement cycles as the collection container 3 is filled. To determine the rate of pressure increase the pump 83 was run for a fixed time. As pumping proceeds and the volume of air reduces in the system 400, the pump 83 is able to achieve a higher pressure. Each milking cycle is represented by a positive pressure spike 41. There is a clear upwards trend 43 in magnitude of positive pressures achieved as the collection container 3 is filled.

A method of estimating the pressure applied by a breast pump may comprise the steps of: selecting a pressure cycle from a pre-defined list of pressure cycles; applying pressure with the pump to stimulate milk expression; reading the output of the pressure sensor; and adjusting the applied pressure of the pump to match the pressure profile selected. This allows for repeatable application of force to the breast, even as the pump performance degrades.

Preferably the method further comprises the steps of: approximating the elasticity and extension of the diaphragm at the relevant pressure; and calculating an estimated applied pressure based upon the output of the pressure sensor and the approximated elasticity and extension of the diaphragm.

Alternatively, a method of estimating the milk collected by a breast pump may comprise the steps of: generating a positive pressure with the pump; transmitting the positive pressure via the diaphragm and second non-return valve to only the milk collection

container; measuring the increase in pressure by the pressure sensor in pneumatic connection with the diaphragm; estimating the volume of milk inside the milk collection container based upon the rate of increase of pressure. In this manner, the volume of milk can be estimated remotely.

In this manner, an estimate can be obtained for the volume of milk in the container 3 based upon the measured pressures.

Figure 13 also shows a dead end stop pump test 45 as described above. The negative spike shows the application of negative pressure directly to the pressure sensor 101.

2. Breast shield sizing and nipple alignment

The correct sizing of the breast shield and the alignment of the nipple in the breast shield are key for an efficient and comfortable use of the breast pump. However breast shape, size as well as nipple size and position on the breast vary from one person to another and one breast from another. In addition, women's bodies often change during the pumping life cycle and consequently breast shield sizing may also need to be changed. Therefore, a number of breast shield sizes are available. Guide lines for correct nipple alignment are also provided.

With reference to Figure 14, three breast shield sizes are shown (A1, B1, C1). The substantially clear breast shield gives an unobstructed view of the breast and allows a user to easily confirm that she has the appropriate sized shield for her breast.

In order to determine the correct breast shield size and nipple alignment, the breast shield and the diaphragm are detached from the housing and placed on the breast with the sizing symbol facing upwards (with the diaphragm positioned below the nipple) and the nipple aligned in the centre of the fit lines (as shown in A2, B2, C2). The transparent breast shield allows the user to observe the nipple while adjusting the position of the breast shield in order to align the nipple correctly near the centre of the breast shield nipple tunnel. Prior to using the pump, the nipple is aligned correctly, and the breast shield is pushed into place ensuring the seal is correctly positioned on the breast shield. The fit lines should be directly aligned with the outside of the nipple. The correct

alignment is illustrated B2.

When the nipple is correctly aligned, the user then rotates the breast shield in order for the diaphragm to be positioned on top of the nipple. The user may then quickly assemble the rest of the breast pump (i.e. the housing and the milk container) on the breast shield via a one-click attachment mechanism confirming correct engagement, which may be performed one-handed. Nipple alignment may therefore be easily maintained. Audio and/or haptic feedback may also be provided to further confirm correct engagement.

3. Connected Device Application

Figures 15 to 20 show examples of screenshots of a connected device application that may be used in conjunction with the breast pump system as described above. The interface shown here is an example only and the same data may be presented via any conceivable means including animated graphics, device notifications, audio or text descriptions.

Figure 15 shows a homepage of the application with different functions provided to the user which can be accessed either directly while pumping or at a later time in order for example: to review pump settings or the history of previous pumping sessions.

Figure 16 shows a status page with details of remaining battery life, pumping time elapsed and volume of milk inside the milk container.

Figure 17 shows screenshots of a control page, in which a user is able to control different pump parameters for a single breast pump (A) or two breast pumps (B). The user may press on the play button to either start, pause, or resume a pumping activity. The user may also directly increase or decrease the rate of expression using the (+) or (-) buttons. When only one breast is being pumped (A), the user may also indicate if it is either the right or left breast that is being pumped. The user may also control the pump peak pressure or alternatively may switch between different pre-programmed pressure profiles such as one mimicking the sucking pattern of a baby during expression or stimulation cycle.

Figure 18 shows a page providing a summary of the last recorded pumping session.

Figure 19 shows a page providing a history of previous pumping sessions. The user may scroll down through the page and visualize the data related to specific pumping sessions as a function of time.

The application is also capable of providing notifications relating to pumping. Figure 20 shows a screenshot of the application, in which a user is provided a notification when the milk collection bottle is full. Other generated notifications may include warnings about battery life, Bluetooth connection status or any other wireless communication status, status of miss-assembly, excessive movement or lack of expression.

Figure 21 shows a further example with a screenshot of an application running on a connected device. The page shows the pumping status when a user is using a double pump mode of operation with a pump on each breast. The user is able to manually control each pump individually and may start, stop or change a pumping cycle, increase or decrease each pump peak pressure, or switch between different pre-program pressure profiles such as one mimicking the sucking pattern of a baby during an expression or stimulation cycle. The application also notifies the user when a milk collection container is nearly full as shown in Figure 22.

Figure 23 shows a status page with an alert notifying the user that the milk collection container of the pump on the right breast is full. A message is displayed that the pump session has paused and that the milk collection container should be changed or emptied before resuming pumping.

With reference to Figure 24, when the left and right pump are stopped or paused, the application displays the elapsed time since the start of each session (right and left), the total volume of milk collected in each bottle.

With reference to Figure 25, a page summarising the last session (with a double pump mode) is displayed.

In addition to the data provided to the user, and their interactions with the application, the app will also hold data that the user does not interact with. For example, this may include data associated with pump diagnostics. In addition to all functions and sources of

data discussed above, the application may itself generate metadata associated with its use or inputs, notes or files uploaded by the user. All data handled within the mobile application can be periodically transferred to a cloud database for analysis. An alternative embodiment of the breast pump system may include direct contact between the database and the pump, so that pumping data may be conveyed directly, without the use of a smartphone application.

In addition to providing data to the cloud, the application may also provide a platform to receive data including for example firmware updates.

4. Breast pump data analysis

The discreet, wearable and fully integrated breast pump may offer live expression monitoring and intelligent feedback to the user in order to provide recommendations for improving pump efficiency or performance, user comfort or other pumping/sensing variables, and to enable the user to understand what variables correlate to good milk flow.

Examples of variables automatically collected by the device are: time of day, pump speed, pressure level setting, measured pressure, pressure cycle or duty cycle, voltage supplied to pumps, flow rate, volume of milk, tilt,, temperature, events such as when let-down happens, when a session is finished. The user can also input the following variables: what side they have pump with (left or right or both), and the comfort level.

This is in part possible because the live milk volume measurement system functions reliably (as discussed in Section B). The breast pump system includes a measurement sub system including IR sensors that measures or infers milk flow into the milk container, and that enables a data analysis system to determine patterns of usage in order to optimally control pumping parameters. The generated data may then be distributed to a connected device and/or to a cloud server for analysis in order to provide several useful functions.

Figure 26 illustrates an outline of a smart breast pump system network which includes the breast pump system (100) in communication with a peripheral mobile device and application (270) and several cloud-based databases (268, 273). The breast pump system

(100) includes several sensors (262). Sensor data refers to a broad definition including data generated from any sensor or any other analogue/digital reading directly from the motherboard or any other component. However, within the embodiment detailed, these measurements include one or more of the following, but not limited to: milk volume measurements, temperature sensor readings, skin temperature sensing, pressure sensor readings, accelerometer data and user inputs through any physical device interface.

The device also contains a number of actuators, including, but not restricted to: piezoelectric pump(s), solenoid valve(s), IREDs and an LED display. Sensors and actuators within the device are coordinated by the CPU (263). In addition, any interactions, and data from these components, may be stored in memory (264).

Further to these components, the device also contains a communication chip, such as a Bluetooth chip (265) which can be used to communicate wirelessly with connected devices such as a peripheral mobile device (270). Through this connection any sensor data (267) generated in the breast pump can be sent to the connected device. This user data, along with any other metadata generated from a connected device app, can be provided to an online database which aggregates all user data (273). In addition, the communication chip will also allow the sending of user control data / firmware updates from the connected device to the breast pump system (266).

Raw data (271) collected from the measurement sub-system including sensors (262) may be analysed on a cloud database and the analysed data may be stored on the cloud (272). Through inferences provided by the analysed data, firmware updates (269) may be developed. These can be provided for download to the pump through, for example, an online firmware repository or bundled with the companion app in the connected device app store (268).

In addition, it should be appreciated that despite the sophistication of the proposed breast pump network, the breast pump still retains complete functionality without wireless integration into this network. Relevant data may be stored in the device's memory (264) which may then be later uploaded to the peripheral portion of the system when a connection is established, the connection could be via USB cable or wireless.

The measurement sub-system may analyse one or more of the following:

- the quantity of the liquid in the container above its base;
- the height of the liquid in the container above its base;
- the angle the top surface of the liquid in the container makes with respect to a baseline, such as the horizontal.

Based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase, a haptic and/or visual indicator indicates if the pump is operating correctly to pump milk. For example, the visual indicator is a row of LEDs that changes appearance as the quantity of liquid increases.

The visual indicator may provide:

- an estimation of the flow rate;
- an estimation of the fill rate;
- an indication of how much of the container has been filled.

As a further example, an accelerometer may infer the amount of movement or tilt angle during a pumping session. If the tilt angle excesses a threshold, the system warns or alerts the user of an imminent spillage, or provides the user with an alert to change position. Alternatively, the system may also stop pumping to prevent spillage, and once the tilt angle reduces below the threshold, pumping may resume automatically. By sensing the movement or title angle during a pumping session, the system may also derive the user's activity such as walking, standing or lying.

Many variables can affect milk expression and data analysis of these multiple variables can help mothers to achieve efficient pumping regimes and improve the overall user experience.

Therefore, the measurement sub-system measures or infers milk flow into the milk container and enables a user to understand what variables (e.g. time of day, pump setting) correlates to good milk flow. The amount of milk expressed over one or more sessions is recorded as well as additional metrics such as: time of day, pump setting, length of a single pumping session, vacuum level, cycle times, comfort, liquids consumed by the mother. Live data or feedback is then provided to the user to ensure the breast pump is

being used properly and to support the user in understanding the variables that would correspond to the specific individual optimum use of the breast pump.

Furthermore, live data can be used to automatically and intelligently affect specific pumping parameters in order to produce the most efficient pumping session. For example, if the rate of expression increases, the milking cycle might be adjusted accordingly to achieve a more efficient, or more comfortable pumping cycle.

The measurement sub-system also enables a data analysis system to determine patterns of usage in order to optimally control pumping parameters. Collected metrics are transferred through wireless connections between the pump, a connected device or app and a cloud database. Additionally, the application can also connect to other apps residing on the connected device, such as fitness app or social media app or any other apps. Further metrics may also include the behaviour or specific usage of the user associated with the connected device while using the pump (detection of vision and/or audio cues, internet usage, application usage, calls, text message).

Different aspects of pumping can be automatically changed based on dynamic sensor feedback within the breast pump device. The data analysis system is able to access real-time data of pumping sessions and may be used to perform one or more of the following functions, but not limited to:

- indicate whether the milk is flowing or not flowing,
- measure or infer the quantity and/or height of the liquid in the container above its base,
- give recommendations to the mother for optimal metrics for optimal milk flow,
- give recommendations to the mother for optimal metrics for weaning,
- give recommendations to the mother for optimal metrics for increasing milk supply (e.g. power pumping),
- give recommendations to the mother for optimal metrics if an optimal session start time or a complete session has been missed,
- automatically set metrics for the pumping mechanism, such as length of a single pumping session, vacuum level, cycle times.
- automatically stop pumping when the milk container is full,
- automatically adjust one or more pumping parameters to achieve an optimum

pumping session,

- automatically adjust one or more pumping parameters to achieve a comfortable pumping session,
- automatically change the pumping cycle from a programmed cycle to another different programmed cycle, such as from a stimulation cycle to an expression cycle.

In addition, sensor feedback might be used to improve the physical function of the breast pump system itself. For example, an array of piezoelectric pumps may be dynamically adjusted in response to their operating temperatures so as to optimise the total life of the component whist maintaining peak pressures.

Many additional embodiments may be described for these simple feedback systems, yet the premise remains: real-time sensor feedback is used to automatically and dynamically adjust actuator function. Each feedback program may feasibly include any number and combination of data sources and affect any arrangement of actuators.

The data generated can also be used to generate large datasets of pumping parameters, user metadata and associated expression rates, therefore allowing the analysis of trends and the construction of associations or correlations that can be used to improve pumping efficiency, efficacy or any function related to effective milk expression. The analysis of large user datasets may yield useful general associations between pumping parameters and expression data, which may be used to construct additional feedback systems to include on firmware updates.

Multiple data sources can be interpreted simultaneously and several different changes to pumping might be actuated to increase pumping efficiency, user experience or optimize pump performance.

Collected metrics may be anonymised and exported for sharing to other apps, community or social media platforms on the connected device, or to an external products and services, such as community or social media platform. By contrasting the performance of different users in the context of associated metadata, users may be grouped into discrete 'Pumper profiles' or communities, which may then be used to

recommend, or action the most appropriate selection of intelligent feedback systems to encourage efficient expression. For example, a higher peak pressure may be recommended for women who tend to move more whilst pumping, so as to achieve more efficient expression.

5

SECTION B: IR SYSTEM

This section describes the milk detecting system used in the Elvie™ pump.

With reference to Figures 27 and 28, there is shown a device 270 for use in detecting the level of liquid inside a container 275. The device 270 is formed of a housing 271 in which is located a sensing assembly 272 comprising a series of optical emitters 273 (an array of three optical emitters is used on one implementation) which are relative to, and each located at a distance from, an optical receiver 274. In operation of the device as will be described, each optical emitter 273 is operable to emit radiation which is received by the optical receiver 274. In an embodiment of the invention, the series of optical emitters are each located equidistant from the optical receiver 274.

The optical emitters 273 and the optical receiver 274 from the sensing assembly 272 are located in a portion 276 of the device 270 which faces the container 275 when the device is connected to the container 275. The portion 276 of the device 270 containing the optical emitters 273 and the optical receiver 274 comprises a window 277 of material which is transparent to optical radiation. In this way, each of the optical emitters 273 and the optical receiver 274 have a line of sight through the window 277 into the container 275 when the device 270 is connected thereto.

A controller 278 comprising a CPU 279 and a memory 280 is provided in the device 270 for controlling the operation of the sensing assembly 272. An accelerometer 281 is also provided in the housing 271, which is operatively connected to the controller 278. Operation of the device 270 when connected to the container 275 will now be described.

In a principal mode of operation, to determine the level L of liquid inside the container 275, the controller 278 instructs the optical emitters 273 to each emit radiation towards the surface of the liquid inside the container 275 at a given intensity. The optical receiver 274 receives the reflected radiation from each optical emitter 273 via the surface of the liquid and each of these intensities is recorded by the controller.

For each operation of the sensing assembly 272, the controller 278 records the intensities of radiation emitted by each of the optical emitters 273 as intensities IE1; IE2...IEn

(where n is the total number of optical emitters), and records the intensities of radiation received by the optical receiver 274 from each of the optical emitters 273 as received intensities IR1; IR2…IRn.

By comparing the emitted radiation intensities IE1; IE2…IEn with the received radiation intensities IR1; IR2…IRn, the controller 278 calculates a series of intensity ratios IE1:IR1; IE2:IR2…IEn:IRn, which are then used to determine the level of the liquid inside the container. At the most basic level, if the intensity ratio of IE1:IR1 is the same as IE2:IR2, given the optical emitters 273 are equidistant from the optical receiver 274, this indicates that the level of the liquid inside the container is parallel to the top of the bottle, as shown in Figure 27. In contrast, if these two intensity ratios are different, this indicates that the liquid level is at a different angle, such as that shown in Figure 28.

To accurately determine the level and the quantity of liquid inside the container 275, the controller 278 processes the recorded intensity ratios using a database located in the memory 280. The database contains an individual record for each container which is operable to connect with the device 270. Each record from the database contains a look-up table of information, which contains expected intensity ratios (IE1:IR1 and IE2:IR2) for the container 275 when filled at different orientations, and with different quantities of liquid.

By comparing the information from the look-up table with the recorded intensity ratios, the controller 278 calculates the level and quantity of liquid inside the container 275 and stores this information in the memory 280.

In situations where a container 275 to the device 270 contains no stored record in the database, the sensing assembly 272 can be used in a calibration mode to create a new record. In the calibration mode, the sensing assembly 272 is operated as the container is filled from empty, and as it is positioned at different orientations. At each point during the calibration mode, the controller 278 calculates the recorded intensity ratios (IE1:IR1 and IE2:IR2) and stores them in the record relating to the container 275. For each set of recorded intensity ratios, the user includes information in the record relating to the orientation and fill level of liquid inside of the container 275.

To improve the accuracy of the results obtained by the device 270 during its use, the controller 278 when recording each intensity ratio also records a parameter from the accelerometer 281 relating to the acceleration experienced by the device 270. For each recorded acceleration parameter, the controller 278 determines whether the parameter 278 exceeds a predetermined threshold acceleration parameter stored in the memory 280. The predetermined threshold is indicative of an excessive acceleration, which causes sloshing of liquid inside the container 275 connected to the device 270. In the event of a recorded acceleration parameter exceeding the predetermined threshold acceleration parameter, the controller 278 flags the recorded intensity ratios associated with the recorded acceleration parameter as being unreliable (due to sloshing).

Even without the use of the accelerometer 281, the controller 278 is nonetheless operable to determine whether a set of recorded intensity ratios occur during a period of excess acceleration. In this regard, for each set of intensity ratios recorded at a given time, the controller 278 checks whether any of these intensity ratios is of a predetermined order of magnitude different than the remaining recorded intensity ratios from the set. In the event that the controller 278 determines that this is the case, this indicates that the liquid inside the container has 'sloshed' as a result of the excess acceleration, as shown in Figure 29. In this event, the controller 278 flags the set of recorded intensity ratios as being unreliable.

It will be appreciated that instead of recording the relative intensities of radiation emitted by the optical emitters 273 with the radiation received by the optical emitter 274, the controller 278 could instead record the time taken for radiation emitted by each of the optical emitters 273 to be received by the optical receiver 274. In this arrangement, the look up table would instead contain time periods as opposed to intensity ratios.

In terms of the applications for the device 270, it will be appreciated that the device can be used in a wide variety of applications. One possible application is the use of the device 270 to determine the level of liquid located within a container 275, such as a baby bottle, used as part of a breast pump assembly. In this arrangement, the device 270 is associated with a breast pump 301 which assists with the expression of milk from a breast. The breast pump may be located in the housing 271 of the device 270 as shown in Figure 30, or it may be realisably connected to the housing 271.

Either way, the device 270 would be connectable to the container 275 such that milk expressed by the breast pump can pass from the pump via a channel 302 into the container 275.

The breast pump may be any type of breast pump system including any shapes of milk container or bottle and may comprise a pump module for pumping milk from a breast. The pump module being contained within the housing may comprise: a coupling, a container attachable to the housing via the coupling to receive milk from the pump, a sensing assembly within the housing and comprising at least one optical emitter operable to emit optical radiation towards the surface of the body of milk held in the container when the housing is connected to the container, an optical receiver for receiving the reflected radiation from the surface of the milk, and a controller electrically connected to the sensing assembly for receiving signals from the optical receiver and calculating the level of the milk inside the container based on the reflected radiation received by the optical receiver.

By determining the level of milk inside the container based on reflected radiation from the surface of the milk in the container, there is no need to monitor the individual droplets of milk entering the container, such that the sensing assembly can avoid errors associated with measuring these droplets. For example, because we take multiple reflection-based measurements once the container is filled, we can generate an average measurement that that is more accurate than a single measurement. But with systems that rely in counting individual droplets, that is not possible – further, systemic errors (e.g. not counting droplets below a certain size) will accumulate over time and render the overall results unreliable. Furthermore, by not needing to measure these droplets, the sensing assembly from the breast pump need not always be on during the pumping process, which saves power.

When at least two optical emitters are used, the sensing assembly from the breast pump may determine the level of milk inside the container more accurately and irrespective of the orientation of the liquid level inside the container.

Each optical emitter may be equidistant from the optical receiver in order for the

controller to easily calculate the level of the milk inside the container based on the reflected radiation originating from each optical emitter. The signals from the optical receiver preferably comprise information relating to the intensity of the radiation received by the optical receiver.

Each optical emitter may be operable to emit radiation at a different wavelength, or at a different time, than the other optical emitters. In this way, the controller can more easily process the signals from the optical receiver, and more easily distinguish between the radiation emitted by each of the optical emitters.

The optical emitter may emit radiation in the visible range of wavelengths. Alternatively, it may be UV or IR light. The emitted wavelength may be for example between 10nm and 1mm.

The sensing assembly may also comprise at least one accelerometer electrically connected to the controller. The controller may be configured to record an accelerometer parameter from the accelerometer and determine whether the accelerometer parameter exceeds a predetermined threshold. The predetermined threshold may be indicative of an excessive acceleration, which might cause sloshing of milk inside any container connected to the breast pump.

Another application for the device 270 is as a collar for detecting the level/quantity of liquid in a container 275, such as a baby bottle, via its lid 310. An example of the device 270 being used as such a collar is shown in Figure 31. In this arrangement, the device 270 is located between the container 275 and the lid 310, and comprises a first end 311 having a first coupling 312 for attaching the collar to the lid 310. The device comprises a second end 313 having a second coupling 314 for attaching the device 270 to the container 275. The second coupling may be a screw thread, shown in Figure 31, on the inside surface of the container 275. In this way, the distinctive bottom inside surface can be used by the sensing assembly 272 to more easily calibrate itself to the container 275 on which the distinctive bottom inside surface is located. The distinctive bottom may also be used to help identify which container 275 the device is connected to, and thus which record should be used from the database when the device 270 is used.

To further improve the accuracy of the sensing assembly 272, the controller 278 may also be configured to use the recorded information from the accelerometer 281, in situations where the record acceleration is below the predetermined threshold acceleration parameter, to calculate a more accurate liquid level and/or quantity of liquid located inside the container which is compensated for acceleration.

In one particular arrangement, the controller 278 may poll the accelerometer 281 prior to each operation of the sensing assembly 272 to verify that the device 270 is not currently undergoing excessive acceleration. In the event of the controller 278 determining excessive acceleration in the device 270, the controller 278 would continually re-poll the accelerometer, and not operate the sensing assembly 272, until the parameter from the accelerometer is determined as being below the predetermined threshold acceleration parameter stored in the memory 280.

It will also be appreciated that for each container record stored in the database, the container record may comprise a plurality of look up tables, wherein each look up table is associated with a particular liquid used in the container, and wherein each look up table contains its own set of intensity ratios. In this way, the device 270 can more accurately determine the level/quantity of different liquids used in a particular container 275.

As described herein, the sensing assembly 272 has been described as having a plurality of optical emitters 273. It will be appreciated however that the sensing assembly could operate using a single optical emitter 273 and plurality of optical receivers 274. In this arrangement, each record from the database would contain a plurality of ratios relating to the emitted radiation from the optical emitter 273 as received by each of the optical receivers 274. In use of the device 270, the controller 278 would then similarly record the emitted radiation from the optical emitter 273 as received by each of the optical receivers 274. In an alternate arrangement, there may be provided a plurality of optical emitters 273 and a plurality of optical receivers 274, wherein each optical emitter 273 is associated with a respective optical receiver 274. In its simplest arrangement, the sensing assembly 272 may comprise a single optical emitter 273 and a single optical receiver 274.

In certain configurations, the optical emitters 273 may together emit radiation having the same wavelength. In other configurations, the optical emitters 273 may each emit

radiation having a different wavelength. In this latter configuration, the optical receiver 274 would then be able to determine which optical emitter 273 is associated with any given received radiation, based on the wavelength of the received radiation.

The optical emitters 273 may also each emit radiation at different times, such to allow the controller 278 to more easily process the signals from the optical receiver 274, and more easily distinguish between the radiation emitted by each of the optical emitters 273.

In relation to the electrical connection between the controller 278 and the sensing assembly 272, it will be appreciated this electrical connection may be either a wired/wireless connection as required.

Although not shown in the Figures, the device 270 herein described is preferably powered by a battery or some other power source located in the device 270. In other embodiments, the device 270 may be powered using mains electricity.

In one configuration, it is also envisaged that rather than the controller 278 comparing the information from the look-up table with the recorded intensity ratios to calculate the level and quantity of liquid inside the container 275, the controller 278 could instead process the recorded intensity ratios through a liquid-level equation stored in the memory 280. In this configuration, the liquid-level equation could be a generalised equation covering a family of different containers, or could be an equation specific to a container having a given shape and/or type of liquid inside.

It will also be appreciated that in some applications of the device 270, the device could be used to detect the level of a solid, as opposed to a liquid, in a container. As used herein, the terms 'optical emitter' and 'optical receiver' are intended to cover sensors which can emit radiation in or close to the optical wavelength. Any type of radiation at or close to the optical wavelength is suitable provided that it does not have any harmful effects. The exact wavelength is not important in the context of the invention. Such sensors thus include those which can emit visible radiation (such as radiation having wavelengths in the region of 400nm-700nm), and/or those which can emit IR radiation (such as radiation having wavelengths in the region of 700nm-1mm and/or those which can emit UV radiation (such as radiation having wavelengths in the region of 10nm to

400nm).

Existing prior art for such a sensor module is the apparatus disclosed in RU2441367. In this apparatus, the container is an industrially sized milk tank, which only includes a single laser mounted at the top of the tank. Whilst this apparatus is suited for large-sized containers, which do not move in use, the apparatus is less-suited for applications where the container moves in use, or where the liquid level inside the container is non perpendicular to the laser beam shone into the container. In contrast, the sensor module described above can be used in a variety of different applications, is conveniently located within a housing, and which by virtue of it having at least two optical emitters, can determine the level of liquid even inside containers of irregular shapes, and which can determine the level of liquid inside a container irrespective of the orientation of the liquid level inside the container.

Further to the embodiments of the fluid measurement system in different contexts, it can be appreciated that different functions entirely may be possible using the same component structure. For example, it is known that certain molecules within breast milk absorb specific wavelengths of light at characteristic propensities. Whilst the proposed system uses multiplexed IREDs at the same wavelengths to perform proximity measurements, the same array of IREDs may instead be used to emit several different wavelengths of light and determine their absorption upon reflection. If appropriately calibrated, the system may be able to report on the presence or concentration of specific compounds in the expressed milk, such as fat, lactose or protein content.

In addition to this embodiment, it is feasible that the system might be applied to monitor the change in volume of any other container of liquid, given there is sufficient reflection of IR off its surface. These embodiments might include for example: liquid vessel measurement such as for protein shakes, cement or paint, or volume measurements within a sealed beer keg.

SECTION C: BRA CLIP

This section describes a bra clip that forms an accessory to the Elvie™ pump.

It relates to a system allowing a user to quickly and simply adjust the cup size of a maternity bra to allow discrete and comfortable insertion and use of an integrated wearable breast pump. As such, the user does not need a specialised adjustable bra; instead the present system works with all conventional maternity bras. The user also does not have to purchase any larger bras to wear while pumping.

As shown in Figure 32, a typical maternity bra 320 comprises a support structure made up of shoulder straps 321 which support the bra 320 on the wearer's shoulders, and a bra band 322 for extending around a user's ribcage, comprising two wings 323 and a central panel or bridge 324. The straps 321 are typically provided with adjustment mechanisms 325 for varying the length of the straps 321 to fit the bra 320 to the wearer. At the outermost end of each wing, an attachment region 326 is provided. Typically, hooks 327 and loops 328 are provided for securing the bra 320 at the user's back. However, any other suitable attachment mechanism may be used. Alternatively, the attachment region 326 may be provided at the front of the bra 320 in the bridge region 324, with a continuous wing 323 extending continuously around the wearer's back. Typically, a number of sets of loops 328 are provided to allow for variation in the tightness of the bra 320 on the wearer. While shown as having a separation in Figure 32, the wings 323 and bridge 324 may form a single continuous piece in certain designs. Likewise, while shown with a distinct separation in Figure 32, the shoulder straps 321 and the wings 323 may likewise form a single continuous piece.

The maternity bra 320 is further provided with two breast-supporting cups 329 attached to the support structure. The cups 329 define a cup size, which defines the difference in protrusion of the cups 329 from the band 322. The European standard EN 13402 for Cup Sizing defines cup sizes based upon the bust girth and the underbust girth of the wearer and ranges from AA to Z, with each letter increment denoting a 2 cm difference between the protrusion of the cups 329 from the band 322. Some manufacturers do vary from these conventions in denomination, and some maternity bras are measured in sizes

of S, M, L, XL, etc.

The cups 329 may be stitched to the bra band 321. At least one of the cups 329, is in detachable attachment with the corresponding strap 321. In particular, this is achieved at attachment point 330 where a hook 331 attached to the bra strap 321 engages with a clasp 331 attached to the cup 329. The hook 331 and the bra strap adjuster 325 are set such that in the closed position, the cup size of the bra 320 fits the wearer's breasts.

In Figure 32, the left cup 329 is shown attached to its attachment point 330, which the right cup 329 is unattached. In this manner, the wearer is able to detach the cup 329 to expose their breast for feeding or for breast pumping. Once this is completed, the cup 329 is reattached and the maternity bra 320 continues to function as a normal bra.

While in the depicted embodiments, a hook 331 is shown on the bra strap 321 and a clasp 332 is shown on the cup 329, it is appreciated that the provision of these may be reversed, or that alternative attachment mechanisms may be used.

A maternity bra therefore may comprise a support structure comprising shoulder straps and a bra band and a first and a second cup each attached to the support structure to provide a first cup size, at least one cup being at least partially detachable from the support structure at an attachment point.

In other embodiments, the detachable attachment point 330 may be provided at a different location, such as at the attachment between the bra band 322 and the cup 329. The mechanism for such an attachment point is the same as described above.

A clip has been designed such that it is configured to be attached to the support structure at a position away from the attachment point. This results in the original attachment point being usable, with the clip providing an alternative attachment point to give, in effect, an adjusted cup size.

Alternatively, the clip may also be attachable to the support structure at a plurality of non-discrete positions. This ensures essentially infinite adjustment of the clip position such that the perfect position for the user can be found.

The clip can also extend between an unextended and an extended state, and can attach to the support structure at the attachment point; the first cup size is providable when the at least partially detachable cup is attached to the clip when the clip is an unextended state; the second cup size is providable when the at least partially detachable cup is attached to the clip when the clip is in an extended state. An extendable clip like this allows quick switching between the two states in use.

Figure 33 depict a clip 335 according to the present invention, along with a clasp 332 shown in isolation from the bra cup 329 it is normally attached to. The clip comprises a first engagement mechanism and at least one second engagement mechanism(s). The clip is attachable in a releasable manner to the support structure at a first position via the first engagement mechanism and attachable in a releasable manner to one of the partially detachable cups via the second engagement mechanism to provide a second cup size different to the first cup size. The clip 335 is provided with a material pathway 336 which receives a portion of the bra strap 321. In the particular embodiment of these Figures, the clip 335 is substantially U-shaped, with a narrowing profile towards its open end. However, it is appreciated that any other suitable shape with a material pathway may be used, such as an S-shape or E-shape. The clip 335 is designed to be attached to the bra strap 321 in a releasable manner, with the slot 336 acting as a support engaging mechanism. The releasable manner means that the clip 335 may be simply removed from the bra 320 without causing any damage to the functioning of the bra 320. To enhance the ease of attachment, the clip 335 may be provided with outwardly extending wings 204 which help direct the bra strap 321 into the clip 335. The clip 335 is further provided with a hook 220 acting as a cup engaging mechanism which can engage with the clasp 332.

Figure 33 (c) shows the clip 335 being attached to a bra strap 321 in order to provide a second attachment point 337 for the clasp 332 to attach to, and hence to provide a second cup size for the bra 320. In this particular embodiment, the clip 335 is attached in a portion of strap 321A below the original attachment point 330 and hence the second attachment point 337 is likewise below the original attachment point. This results in a second cup size larger than the first cup size. In preferred embodiments, as shown in these Figures, the clip 335 engages with the support structure in a direction transverse to

the direction in which it engages with the cup.

Figure 33 (d) and (e) show how a wearer is able to move between the first and second cup sizes. In 33(d), the cup 329 is attached at the first attachment point 330 to provide a first cup size. The wearer then disengages the clasp 332 from the hook 331 at the hook 338 at the second engagement point 239. In this manner, the wearer is easily able to transition between the two cup sizes.

Figures 34 and 35 show an alternative design for a clip 340. This clip 340 is substantially "E-shaped", with a back portion 341 and first, second and 5 third prongs 342A, 342B, 342C extending transverse from this back portion 341. The three prongs 342A, 342B, 342C are spaced apart along the length of the back portion 341. The first and third prongs 342A, 342C are provided with attachment clips 343A, 343B.

These attachment clips 343A, 343B can engage with the clasp 332 of a bra to provide the second cup size. Depending upon the orientation of the clip 300, one or the other of the attachment clips 343A, 343B will be used to attach the clasp 332 of the bra. By providing these clips 343A, 343B on both of the first and the third prongs 342A, 342C the clip is easily reversible so it can be used on either side of the bra. Preferably the clip 340 is also symmetrical, to aid the reversibility of the clip 340.

Figure 35 shows the clip 340 attached to a bra. As can be seen, the first and third prongs 342A, 342C extend on the front side of the bra strap, with the second prong 342B extending on the rear side of the bra strap. In this manner, the clip 340 is attached to the strap. In preferable embodiments, a grip-enhancing member 344 such as a number of projections and/or roughened patches can be provided on the second prong 342B in order to strengthen this grip.

In alternative embodiments, the attachment clip could be provided on the second, centremost prong 342B. In such an arrangement, the centremost prong 342B would be on the outside of the bra, with the first and third prongs 342A, 342C on the inside.

The provision of the attachable clip allows maternity bras already owned by the wearer to be quickly transformed into bras with quick switchable double cup size options.

This allows the use of integrated wearable breast pumps which increase the user's required cup size. This allows more design freedom for the breast pump in terms of size and shape, while still allowing the user to discretely pump with the pump held within their bra. By allowing conversion of the user's existing maternity bras, they are not forced to purchase specially designed bras to wear with the pump. The bra is hence normally at the first engagement point 330 when the breast pump device is not being used. As shown in Figure 33, the clasp 332 is then engaged by the user to discretely switch between the two configurations, and the user then inserts the pump without any complex adjustment or removal of clothing.

Preferably, the clip will be relatively unobtrusive in size and shape and hence can be left in place when the bra is first put on and used when necessary. To this end, the clip is preferably machine washable without significant damage or degradation.

In some embodiments, the clip may be switchable between positions for engaging with each cup so that a single clip may be used on either side of the bra. To achieve this, the clip is preferably reversible. This may provide the user with a visual indication of which breast has produced milk most recently so switching can take place.

In a preferred embodiment, the first engagement mechanism engages with the support structure in a first direction and the second engagement mechanism engages with the cup in a second direction transverse to the first direction. This increases ease of attachment as with this structure the sideways engagement of the clip to the support structure ensures that the second attachment mechanism is correctly orientated for the cup.

The second engagement mechanism may be one or more of a hook or a snap or a clip. This ensures easy interfacing with the traditional hook and clasp systems already provided on maternity bras.

Preferably the clip further comprises two distinct second engagement mechanisms which can be used interchangeably dependent upon the orientation of the clip. This makes the clip easier to use as it can be quickly switched between each bra strap, and the user does not have to worry which way up to put the clip on.

Preferably, the clip comprises a material pathway with an opening for receiving a portion of the support structure as the first engagement mechanism for securing the clip to the bra. This ensures a quick and simple method for attaching the clip to the bra. In particular, the clip may substantially U-shaped, and the material pathway is between the arms of the U.

Preferably, the clip comprises three prongs extending from a central support, the three prongs arranged as a central prong and two outer prongs so as to receive the support structure on one side of the central prong and on the opposite side of each respective outer prong, at least one prong being provided with the second engagement mechanism. This ensures a strong attachment to the bra and a simple design.

Preferably, both outer prongs are each provided with a respective second engagement mechanism. This ensures that the clip is reversible for easier attachment to the bra.

A method of adjusting the cup size of a maternity bra is provided according to the present invention, comprising: providing a maternity bra comprising: a support structure comprising shoulder straps and a bra band; and a first and second cup each attached to the support structure to provide a first cup size, the at least one cup being detachable from the support structure at an attachment point, providing a clip comprising first and section engagement mechanisms, attaching the first engagement mechanism of the clip in a releasable manner to a first position of the support structure of the maternity bra, attaching one of the detachable cup to the second engagement mechanism of the clip in a releasable manner to provide a second cup size different to the first cup size.

This clip and method allow a user to quickly and simply adjust the cup size of a maternity bra to allow discrete and comfortable insertion and use of an integrated wearable breast pump.

Preferably, the method further comprises the step of inserting a breast pump into the detachable cup. The adjustment of the size of the bra allows the bra to support the breast pump against the user's breast for comfort and ease.

Preferably, the method further comprises the steps of: detaching the first engagement mechanism of the clip from the first position support structure of the maternity bra; attaching the first engagement mechanism of the clip in a releasable manner to a second position of the support structure of the maternity bra; and attaching the other of the detachable cups to the second engagement mechanism of the clip in a releasable manner to provide a second cup size different to the first cup size. This allows the user to use a single clip on either of the cups.

An alternative embodiment may be provided, with an extendable clip 360 as shown in Figure 36. In such an embodiment the clip is attached to the hook 331 on the strap 321 in a releasable manner, with the clasp 332 attached to an expandable portion of the clip. The clip is then able to expand between an unexpanded state where the clasp 332 is held in substantially the same position as the first attachment point 330 to provide the first cup size, and an expanded state, where the clasp 332 is held in a second position away from the first attachment point 330 to provide the second cup size.

For example, an elongate clip with first and second opposite ends may be provided. A first attachment point for attaching to the hook 331 is provided at the first end, and a second attachment point for attaching to the clasp 332 is provided at the second end. The elongate clip is hinged between the two ends, such that the clip can be folded between an elongate configuration to a closed configuration where the second end touches the first end. A clasp can be provided on the clip to hold the second end in this closed configuration. Thus, in the closed position the clasp 332 is held in substantially the same location as the first attachment point 330 to provide the first cup size, and in the open position the clasp is held away from the first attachment point 330 to provide the second cup size.

Other extendable clip embodiments are also possible, for example sliding clips or elastic clips.

Additional embodiments of a maternity bra adjuster are provided in Figures 37 and 38. The alternative proposed solution is a small adapter device, which comprises a first portion 370 including a clasp 373 and a second portion 372 including a hook 374, in which the first and second portions are separated by a small distance 371 in order to

provide two different adjustable sizes. The first portion includes a clasp 373 that is designed to attach to the hook on the bra strap 321. It may also include a top hook 375 positioned underneath the clasp, and a clip 376 on the rear side. The second portion includes a bottom hook 372.

The clasp 332 that is present on the cup 329 of the maternity bra, may then either engage with the top hook (321) to provide a first cup size, and engage with the bottom hook (332) to provide a second cup size that is different from the first cup size, as illustrated in Figure 39. The user may then discretely switch between a non pumping position, provided by the first cup size, and a second pumping position without any complex adjustment or removal of clothing needed, while using a wearable breast pump system (100).

The first portion and second portion may be made of plastic and may be separated by a stretchy material such as elastic or elastomeric material. The first portion may also include a clip on the rear side, the purpose of which is to allow the user to leave the clip attached to the bra for an extended time period.

Section D: Use of Piezo Pump in Wearables

As described in Section A, the breast pump system includes a piezo air pump, resulting in a fully wearable system that delivers a quiet, comfortable and discreet operation in normal use. This section gives further information on the piezo air pump.

In comparison with other pumps of comparable strength, piezo pumps are smaller, lighter and quieter. In operation, the Elvie breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise; tests indicate that it makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.

Piezo pumps also have lower current draw, allowing for increased battery life. A piezo pump is therefore ideally suited for wearable devices with its low noise, high strength and compact size. Further, as shown in the breast pump system of Figures 7 and 8, more than one piezo pump may be used.

Whilst a breast pump system is largely described in previous sections, the use of piezo mounted either in series or in parallel can also be implemented in any medical wearable devices or any wearable device. The piezo pump may pump air as well as any liquid.

With reference to Figure 40, a diagram illustrating a configuration of two piezo pumps mounted in series is shown.

With reference to Figure 41, a diagram illustrating a configuration of two piezo pumps mounted in parallel is shown.

With reference to Figure 42, the air pressure generated as a function of time by two piezo pumps mounted in series and two piezo pumps mounted in parallel are compared. In this example, the parallel configuration produces higher flow rate and achieves -100mmHg negative air pressure faster than the series configuration. In comparison, the series configuration produces lower flow rate and takes slightly longer to reach 100mmHg. However, the parallel configuration cannot achieve as high as a vacuum as the series configuration and plateaus at -140mmHg. In comparison, the series

configuration is able to generate about -240mmHg.

A dual configuration is also implemented in which more than one piezo pump is configured such that they can easily switch between a parallel mode and a series mode. This dual configuration would suit wearable devices that would need to achieve either lower or higher pressure faster.

Figure 43 shows a plot of the air pressure generated as a function of time by two piezo pumps mounted in a dual configuration. In this dual configuration, the piezo pumps first start with a parallel mode in order to benefit from faster flow rate, and then switch to a series mode (as indicated by the switch-over point) when stronger vacuums are required, enabling to save up to 500ms on cycle time with elastic loads.

Additionally, a piezo pump may be used in combination with a heat sink in order to efficiently manage the heat produced by the wearable pump. This configuration may be used to ensure that the wearable device can be worn comfortably. The heat sink or heat sinks are configured to ensure that the maximum temperature of any parts of the breast pump system that might come into contact with the skin (especially prolonged contact for greater than 1 minute) are no more than 48°C and preferably no more than 43°C.

The heat sink may store the heat produced by a piezo pump in order to help diverting the heat produced to another location. This not only ensures that the wearable system can be worn comfortably, but also increases the lifetime of a piezo pump.

Figure 44 shows a picture of a wearable breast pump housing including multiple piezo pumps (440). The breast pump system is wearable and the housing is shaped at least in part to fit inside a bra. By applying a voltage to the piezo pumps, the pressure provided by the pumps increase. The generation of higher pressure by the piezo pumps also means higher heat produced that needs to be managed. Each piezo pump is therefore connected to a heat sink (441), such as a thin sheet of copper. The heat sink has a long thermal path length that diverts the heat away from the piezo pump.

The use of a heat sink in combination with a piezo pump is particularly relevant when the wearable device is worn directly or near the body, and where the management of heat induced by the piezo pump is crucial.

A wearable device including a piezo pump may therefore include a thermal cut out, and may allow for excess heat to be diverted to a specific location. The heat sink may be connected to an air exhaust so that air warmed by the piezo pumps vents to the atmosphere. For example, the wearable system is a breast pump system and the heat sink stores heat, which can then be diverted to warm the breast shield of the breast pump system.

Use cases application include but are not limited to:

- Wound therapy;
- High degree burns;
- Sleep apnoea;
- Deep vein thrombosis;
- Sports injury.

APPENDIX: SUMMARY OF KEY FEATURES

In this section, we summarise the various features implemented in the Elvie™ pump system. We organize these features into six broad categories:

A. Elvie Breast Pump: General Usability Feature Cluster

B. Elvie Piezo Air Pump Feature Cluster

C. Elvie Milk Container Feature Cluster

D. Elvie IR System Feature Cluster

E. Elvie Bra Clip Feature Cluster

F. Other Features, outside the breast pump context

Drilling down, we now list the features for each category:

A. Elvie Breast Pump: General Usability Feature Cluster

Feature 1 Elvie is wearable and includes only two parts that are removable from the pump main housing in normal use.

Feature 2 Elvie is wearable and includes a clear breast shield giving an unobstructed view of the breast for easy nipple alignment.

Feature 3 Elvie is wearable and includes a clear breast shield with nipple guides for easy breast shield sizing.

Feature 4 Elvie is wearable and includes a breast shield that audibly attaches to the housing.

Feature 5 Elvie is wearable and includes a breast shield that attaches to the housing with a single push.

Feature 6 Elvie is wearable and not top heavy, to ensure comfort and reliable suction against the breast.

Feature 7 Elvie is wearable and has a Night Mode for convenience.

Feature 8 Elvie is wearable and includes a haptic or visual indicator showing when milk is flowing or not flowing well.

Feature 9 Elvie is wearable and collects data to enable the mother to understand what variables (e.g. time of day, pump speed etc.) correlate to good milk-flow.

Feature 10 Elvie is wearable and collects data that can be exported to social media.

Feature 11 Elvie is wearable and has a smart bottle that stores the time and/or date of pumping to ensure the milk is used when fresh.

Feature 12 A smart bottle that stores the time and/or date of pumping to ensure the milk is used when fresh.

Feature 13 Elvie is wearable and includes a sensor to infer the amount of movement or tilt angle during normal use.

Feature 14 Elvie includes a control to toggle between expressing milk from the left breast and the right breast.

Feature 15 Elvie includes a pressure sensor.

Feature 16 Elvie includes a microcontroller to enable fine tuning between pre-set pressure profiles.

Feature 17 Elvie enables a user to set the comfort level they are experiencing.

Feature 18 Elvie includes a microcontroller to dynamically and automatically alter pump operational parameters.

Feature 19 Elvie automatically learns the optimal conditions for let-down.

B. Elvie Piezo Air Pump Feature Cluster

Feature 20 Elvie is wearable and has a piezo air-pump for quiet operation.

Feature 21 Elvie has a piezo air-pump and self-sealing diaphragm

Feature 22 Elvie uses more than one piezo air pump in series.

Feature 23 Elvie is wearable and has a piezo air-pump, a breast shield and a diaphragm that fits directly onto the breast shield.

Feature 24 Elvie is wearable and has a piezo air-pump for quiet operation and a re-useable, rigid milk container for convenience.

Feature 25 Elvie has a piezo-pump for quiet operation and is a connected device.

Feature 26 Elvie uses a piezo in combination with a heat sink that manages the heat produced by the pump.

Feature 27 Elvie is wearable and gently massages a mother's breast using small bladders inflated by air from its negative pressure air-pump.

Feature 28 Elvie is wearable and gently warms a mother's breast using small chambers inflated by warm air from its negative pressure air-pump.

C. Elvie Milk Container Feature Cluster

Feature 29 Elvie is wearable and includes a re-useable, rigid milk container that forms the lower part of the pump, to fit inside a bra comfortably.

Feature 30 Elvie is wearable and includes a milk container that latches to the housing with a simple push to latch action.

Feature 31 Elvie is wearable and includes a removable milk container with an integral milk pouring spout for convenience.

Feature 32 Elvie is wearable and includes a removable milk container below the milk flow path defined by a breast shield for fast and reliable milk collection.

Feature 33 Elvie is wearable and includes a breast shield and removable milk container of optically clear, dishwasher safe plastic for ease of use and cleaning.

Feature 34 Elvie is wearable and includes various components that self-seal under negative air pressure, for convenience of assembly and disassembly.

Feature 35 Elvie is wearable and includes a spout at the front edge of the milk container for easy pouring.

Feature 36 Elvie is wearable and includes a milk container that is shaped with broad shoulders and that can be adapted as a drinking bottle that baby can easily hold.

D. Elvie IR System Feature Cluster

Feature 37 Elvie is wearable and includes a light-based system that measures the quantity of milk in the container for fast and reliable feedback.

Feature 38 The separate IR puck for liquid quantity measurement.

Feature 39 The separate IR puck combined with liquid tilt angle measurement.

E. Bra Clip Feature

Feature 40 Bra Adjuster.

F. Other Features that can sit outside the breast pump context

Feature 41 Wearable device using more than one piezo pump connected in series or in parallel.

Feature 42 Wearable medical device using a piezo pump and a heat sink attached together.

We define these features in terms of the device; methods or process steps which correspond to these features or implement the functional requirements of a feature are also covered.

We'll now explore each feature 1 – 41 in depth. Note that each feature can be combined with any other feature; any sub-features described as 'optional' can be combined with any other feature or sub-feature.

A. Elvie Breast Pump: General Usability Feature Cluster

Feature 1 Elvie is wearable and includes only two parts that are removable from the pump main housing in normal use

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) a breast shield;

(c) a rigid or non-collapsible milk container;

and in which the breast pump system includes only two parts that are directly removable from the housing in normal use or normal dis-assembly: the breast shield and the rigid, non-collapsible milk container.

Optional:

- The only parts of the system that come into contact with milk in normal use are the breast shield and the milk container.
- Milk only flows through the breast shield and then directly into the milk container.
- The breast shield and milk container are each pressed or pushed into engagement with the housing.
- The breast shield and milk container are each pressed or pushed into a latched engagement with the housing.
- The two removable parts are each insertable into and removable from the housing using an action confirmed with an audible sound, such as a click.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and nipple tunnel shaped to receive a nipple.

- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield slides into the housing using guide members.
- housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings, in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.
- Breast shield includes or operates with a flexible diaphragm that (a) flexes when negative air pressure is applied to it by an air pump system in the housing, and (b) transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- No other parts are removable from the breast shield, apart from the flexible diaphragm.
- The milk container attaches to a lower surface of the housing and forms the base of the breast pump system in use.
- The milk container mechanically or magnetically latches to the housing.
- The milk container is released by the user pressing a button on the housing.
- The milk container includes a removable cap and a removable valve that is seated on the lid.
- In normal use, the milk container is positioned entirely within a bra.

- No other parts are removable from the milk container, apart from the cap and the valve.
- All parts that are user-removable in normal use are attached to either the breast shield or the milk container.
- Audible or haptic feedback confirms the pump system is properly assembled for normal use with the milk container locked to the housing and the breast shield locked to the housing.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 2 Elvie is wearable and includes a clear breast shield giving an unobstructed view of the breast for easy nipple alignment

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a breast shield including a substantially transparent nipple tunnel, shaped to receive a nipple, providing to the mother placing the breast shield onto her breast a clear and unobstructed view of the nipple when positioned inside the nipple tunnel, to facilitate correct nipple alignment.

Optional:

- The breast shield is configured to provide to the mother a clear and unobstructed view of the nipple when the breast shield is completely out, of or separated from, the housing.
- The breast shield is configured to provide to the mother a clear and unobstructed view of the nipple when the breast shield is partially out of, or partially separated from, the housing.
- Entire breast shield is substantially transparent.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast.

- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.
- Breast shield includes or operates with a flexible diaphragm that (a) flexes when negative air pressure is applied to it by an air pump system in the housing, and (b) transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel includes on its lower surface an opening through which expressed milk flows.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- A milk container attaches to a lower surface of the housing and forms the base of the breast pump system in use.
- The milk container mechanically or magnetically latches to the housing.
- The milk container is released by the user pressing a button on the housing.

- The milk container includes a removable cap and a removable valve that is seated on the lid.
- In normal use, the milk container is positioned entirely within a bra.

Feature 3 Elvie is wearable and includes a clear breast shield with nipple guides for easy breast shield sizing

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a breast shield including a substantially transparent nipple tunnel shaped to receive a nipple, the nipple tunnel including guide lines that define the correct spacing of the nipple from the side walls of the nipple tunnel.

Optional:

- The guide lines run generally parallel to the sides of the nipple placed within the nipple tunnel.
- Breast shield is selected by the user from a set of different sizes of breast shield to give the correct spacing.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around the nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers in the housing locate into small indents in the breast shield.

- Breast shield latches into position against the housing using magnets.
- Breast shield includes or operates with a flexible diaphragm that (a) flexes when negative air pressure is applied to it by an air pump system in the housing, and (b) transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel includes on its lower surface an opening through which expressed milk flows.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 4 Elvie is wearable and includes a breast shield that audibly attaches to the housing.

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a breast shield that is attachable to the housing with a mechanism that latches with an audible click when the breast shield is slid on to or against the housing with sufficient force.

Optional:

- The breast shield is configured to slide onto or against the housing in a direction parallel to the long dimension of a nipple tunnel in the breast shield.

- Breast shield is removable from the housing with an audible click when the breast shield is pulled away from the housing with sufficient force.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around the nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.
- Breast shield includes or operates with a flexible diaphragm that (a) flexes when negative air pressure is applied to it by an air pump system in the housing, and (b) transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.
- The edge of the flexible diaphragm seals, self-seals, self-energising seals, or interference fit seals against the housing when the breast shield attaches to the housing.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel includes on its lower surface an opening through which expressed milk flows.

- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 5 Elvie is wearable and includes a breast shield that attaches to the housing with a single push

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a breast shield configured to attach to the housing with a single, sliding push action.

Optional:

- The breast shield is configured to slide onto or against the housing in a direction parallel to the long dimension of a nipple tunnel in the breast shield.
- The single push action overcomes a latching resistance.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into a nipple tunnel in the breast shield to position a diaphragm housing portion of the breast shield at the top of the breast.
- Housing is configured to slide onto the breast shield when the breast shield has been placed onto a breast using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.
- Breast shield includes or operates with a flexible diaphragm that (a) flexes when negative air pressure is applied to it by an air pump system in the housing, and (b)

transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.

- The edge of the flexible diaphragm seals, self-seals, self-energising seals, or interference fit seals against the housing when the breast shield attaches to the housing.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel includes on its lower surface an opening through which expressed milk flows.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- A milk container attaches to a lower surface of the housing and forms the base of the breast pump system in use.
- The milk container mechanically or magnetically latches to the housing.
- The milk container is released by the user pressing a button on the housing.
- The milk container includes a removable cap and a removable valve that is seated on the lid.
- In normal use, the milk container is positioned entirely within a bra.

Feature 6 Elvie is wearable and not top heavy, to ensure comfort and reliable suction against the breast

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism

(b) and a breast shield;

(c) a milk container;

and in which the centre of gravity of the pump system is, when the milk container is empty, substantially at or below (i) the half-way height line of the housing or (ii) the horizontal line that passes through a nipple tunnel or filling point on a breast shield, so that the device is not top-heavy for a woman using the pump.

Optional:

- The milk container is a re-useable milk container that when connected to the housing is positioned to form the base of the housing.
- In which the centre of gravity only moves lower during use as the milk container gradually receives milk, which increases the stability of the pump inside the bra.
- In which milk only passes downwards when moving to the milk container, passing through the nipple tunnel and then through an opening in the lower surface of the nipple tunnel directly into the milk container, or components that are attached to the milk container.
- System is configured so that its centre of gravity is no more than 60mm up from the base of the milk container also below the top of the user's bra cup.
- In which the pumping mechanism and the power supply for that mechanism are positioned within the housing to provide a sufficiently low centre of gravity.
- In which the pumping mechanism is one or more piezo air pumps, and the low weight of the piezo air pumps enables the centre of gravity to be substantially at or below (i) the half-way height line of the housing or (ii) the horizontal line that passes through the nipple tunnel or filling point on the breast shield.
- In which the pumping mechanism is one or more piezo air pumps, and the small size of the piezo air pumps enables the components in the housing to be arranged so that the centre of gravity is substantially at or below (i) the half-way height line of the housing or (ii) the horizontal line that passes through the nipple tunnel or filling point on the breast shield.
- In which the pumping mechanism is one or more piezo air pumps, and the low weight of the battery or batteries needed to power that piezo air pumps enables the centre of gravity to be substantially at or below (i) the half-way height line of

the housing or (ii) the horizontal line that passes through the nipple tunnel or filling point on the breast shield.

- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 7 Elvie is wearable and has a Night Mode for convenience

A breast pump system including:

(a) a housing including a pumping mechanism;

(b) an illuminated control panel;

(c) a control system that reduces or adjusts the level or colour of illumination of the control panel at night or when stipulated by the user.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Control system is implemented in hardware in the pump itself using a 'night mode' button.
- Control system is implemented in software within a connected device app running on the user's smartphone.
- Control system is linked to the illumination level on a connected device app., so that when the connected app is in 'night mode', the illuminated control panel is also in 'night mode', with a lower level of illumination, and when the illuminated control panel on the housing is in 'night mode', then the connected app is also in 'night mode'.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast. The pumping mechanism is one or more piezo air pumps, selected for quiet operation.

Feature 8 Elvie is wearable and includes a haptic or visual indicator showing when milk is flowing or not flowing well

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) a milk container that is configured to be concealed within a bra and is hence not visible to the mother in normal use;

(c) a visual and/or haptic indicator that indicates whether milk is flowing or not flowing into the milk container.

Optional:

- A haptic and/or visual indicator indicates if the pump is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase
- The visual indicator is a row of LEDs that changes appearance as the quantity of liquid increases.
- The haptic and/or visual indicator provides an indication of an estimation of the flow rate.
- The visual indicator provides a colour-coded indication of an estimation of the flow rate.
- The visual indicator provides an indication of how much of the container has been filled.
- The visual indicator is part of a user interface in a connected, companion application, running on a smartphone or other personal device, such as a smart watch or smart ring.
- The haptic indicator is part of a user interface in a connected, companion application, running on a smartphone or other personal device, such as a smart watch or smart ring.
- A sub-system measures or infers the quantity and/or the height of the liquid in the container.
- The sub-system measures or infers the quantity and/or the height of the liquid in the container by using one or more light emitters and light detectors to detect

light from the emitters that has been reflected by the liquid, and measuring the intensity of that reflected light.

- Sub-system includes or communicates with an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the sub-system to accurately measure or infer the quantity and/or the height of the liquid in the container.
- A sub-system measures or infers the angle the top surface of the liquid in the container makes with respect to a baseline, such as the horizontal.
- A haptic and/or visual indicator indicates if the amount of milk in the milk container has reached a preset quantity or level.
- A haptic and/or visual indicator indicates if there is too much movement of the breast pump system for viable operation.
- Milk container is attached to the lower part of the housing and forms the base of the breast pump system.
- Milk container is made of transparent material.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 9 **Elvie is wearable and collects data to enable the mother to understand what variables (e.g. time of day, pump speed etc.) correlate to good milk-flow**

A breast pump system including:

(a) a housing including a pumping mechanism;

(b) a milk container;

(c) a measurement sub-system that measures or infers milk flow into the milk container;

and in which the measurement sub-system provides data to a data analysis system that determines metrics that correlate with user-defined requirements for milk-flow rate or milk expression.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- User-defined requirement is to enhance or increase milk-flow.
- User-defined requirement is to reduce milk-flow.
- The data analysis system analyses data such as any of the following: amount of milk expressed over one or more sessions, rate at which milk is expressed over one or more sessions, profile of the rate at which milk is expressed over one or more sessions.
- The data analysis system determines metrics such as any of the following: pump speed, length of a single pumping session, negative air pressure or vacuum level, peak negative air pressure or vacuum level, pump cycle time or frequency, changing profile of pump speed over a single pumping session time of day.
- The data analysis system determines metrics such as any of the following: amount and type of liquids consumed by the mother, state of relaxation of the mother before or during a session, state of quiet experienced by the mother before or during a session, what overall milk expression profile the mother most closely matches.
- Data analysis system is local to the breast pump system, or runs on a connected device, such as a smartphone, or is on a remote server or is on the cloud, or is any combination of these.
- measurement sub-system measures or infers the quantity and/or the height of the liquid in the container above its base.
- Measurement sub-system measures or infers angle the top surface of the liquid in the container makes with respect to a baseline, such as the horizontal.
- Data analysis system gives recommended metrics for improving milk flow
- Data analysis system gives recommended metrics for weaning.
- Data analysis system gives recommended metrics for increasing milk supply (e.g. power pumping).
- Data analysis system gives recommended metrics if an optimal session start time or a complete session has been missed.

- Data analysis system leads to automatic setting of metrics for the pumping mechanism, such as pump speed, length of a single pumping session, vacuum level, cycle times, changing profile of pump speed over a single pumping session.
- Data analysis system enables sharing across large numbers of connected devices or apps information that in turn optimizes the milk pumping or milk weaning efficacy of the breast pump.
- Metrics include the specific usage of the connected device by a woman while using the pump (for example by the detection of vision and/or audio cues).
- The measurement sub-system measures or infers the quantity and/or the height of the liquid in the container.
- The measurement sub-system measures or infers the quantity and/or the height of the liquid in the container by using one or more light emitters and light detectors to detect light from the emitters that has been reflected by the liquid, and measuring the intensity of that reflected light.
- The measurement sub-system includes or communicates with an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the measurement sub-system to accurately measure or infer the quantity and/or the height of the liquid in the container.
- Milk container is a re-useable milk container that when connected to the housing is positioned to form the base of the housing.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 10 Elvie is wearable and collects data that can be exported to social media.

A breast pump system including:

(a) a housing including a pumping mechanism;

(b) a milk container;

(c) a data sub-system that collects and provides data to a connected device or remote application or remote server;

(d) and in which the collected data, in whole or in part, is used by a data analysis system that provides inputs to a social media or community function or platform.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- The data analysis system analyses metrics such as any of the following: amount of milk expressed over one or more sessions, rate at which milk is expressed over one or more sessions, profile of the rate at which milk is expressed over one or more sessions.
- The data analysis system analyses metrics such as any of the following: pump speed, length of a single pumping session, negative air pressure or vacuum level, peak negative air pressure or vacuum level, pump cycle time or frequency, changing profile of pump speed over a single pumping session time of day.
- The data analysis system analyses metrics such as any of the following: amount and type of liquids consumed by the mother, state of relaxation of the mother before or during a session, state of quiet experienced by the mother before or during a session, what overall milk expression profile the mother most closely matches.
- Data analysis system is local to the breast pump system, or runs on a connected device, such as a smartphone, or is on a remote server or is on the cloud, or is any combination of these.
- The social media or community function or platform organizes the collected data into different profiles.
- The social media or community function or platform enables a user to select a matching profile from a set of potential profiles.
- each profile is associated with a specific kind of milk expression profile, and provides information or advice that is specifically relevant to each milk expression profile.
- Information or advice includes advice on how to increase milk expression by varying parameters, such as time of milk expression, frequency of a milk

expression session, pump speed, length of a single pumping session, vacuum level, cycle times, changing profile of pump speed over a single pumping session and any other parameter that can be varied by a mother to help her achieve her milk expression goals.

- The application is connected to other applications residing on the connected device, such as a fitness app.
- The collected data includes data received from other connected apps.
- The collected data is anonymised before it is shared.
- The sub-system includes a wi-fi connectivity component for direct connectivity to a remote server.
- The milk container is a re-useable milk container that when connected to the housing is positioned to form the base of the housing.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 11 Elvie is wearable and has a smart bottle that stores the time and/or date of pumping to ensure the milk is used when fresh

A breast pump system including a pumping mechanism and a milk container and including:

(a) a housing including the pumping mechanism;

(b) a milk container;

(c) and in which the milk container or any associated part, such as a lid, includes a memory or tag that is automatically programmed to store the time and/or date it was filled with milk.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Memory or tag is programmed to store the quantity of milk in the milk container.
- Memory or tag stores the milk expiry date.

- Memory or tag stores a record of the temperature of the milk or the ambient temperature around the milk, and calculates an expiry date using that temperature record.
- System includes a clock and writes the time and/or date the milk container was filled with milk to the memory or tag on the milk container.
- Clock is in the housing.
- Clock is in the milk container.
- Milk container includes a display that shows the time and/or date it was filled with milk.
- Milk container includes a display that shows the quantity of milk that it was last filled with milk.
- Milk container includes a display that shows whether the left or right breast was used to fill the milk container.
- Memory or tag is connected to a data communications sub-system.
- Memory or tag is a remotely readable memory or tag, such as a NFC tag, enabling a user to scan the milk container with a reader device, such as a smartphone, and have the time and/or date that container was filled with milk, displayed on the reader device.
- Reader device shows the time and/or date a specific milk container was filled with milk.
- Reader device shows the quantity of milk that a specific milk container was last filled with.
- Reader device shows the time and/or date and/or quantity that each of several different milk containers were filled with.
- Reader device shows whether the left or right breast was used to fill the milk contained in a specific milk container.
- A sub-system measures or infers milk flow into the milk container.
- The sub-system measures or infers the quantity and/or the height of the liquid in the container.
- The sub-system measures or infers the quantity and/or the height of the liquid in the container by using one or more light emitters and light detectors to detect light from the emitters that has been reflected by the liquid, and measuring the intensity of that reflected light.

- Sub-system includes an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the sub-system to accurately measure or infer the quantity and/Tr the height of the liquid in the container.
- The sub-system is in the housing.
- Milk container is a re-useable milk container that when connected to the housing is positioned to form the base of the housing.
- Pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 12 A smart bottle that stores the time and/or date of pumping to ensure the milk is used when fresh.

A smart bottle or container that includes or is associated with a memory or a tag that is programmed to store the date and time it is filled using data from a pump or a connected device, such as a smartphone.

Optional:

- The container includes wireless connectivity and connects to a companion app.
- The memory or tag includes an NFC chip and is read using a NFC reader.
- The memory or tag stores also an expiry date.
- Memory or tag stores a record of the temperature of the milk or the ambient temperature around the milk, and calculates an expiry date using that temperature record.
- The memory or tag stores also the quantity of milk stored.
- System includes a clock and writes the time and/or date the milk container was filled with milk to the memory or tag on the milk container.
- Clock is in the housing.
- Clock is in the container.
- Milk container includes a display that shows the time and/or date it was filled with milk.
- Milk container includes a display that shows the quantity of milk that it was last filled with milk.

- Milk container includes a display that shows whether the left or right breast was used to fill the milk contained.
- Milk container includes a display that shows the expiry date.
- memory or tag is connected to a data communications sub-system.
- Memory or tag is a remotely readable memory or tag, such as a NFC tag, enabling a user to scan the milk container with a reader device, such as a smartphone.
- Reader device shows the time and/or date a specific milk container was filled with milk.
- Reader device shows the quantity of milk that a specific milk container was last filled with.
- Reader device shows the time and/or date and/or quantity that each of several different containers were filled with.
- Reader device shows whether the left or right breast was used to fill the milk contained in a specific milk container.
- Reader device shows the expiry date.
- Container includes wireless connectivity and connects to a companion application.
- An application tracks status of one or more smart containers and enables a user to select an appropriate smart container for a feeding session.
- The pump is wearable.
- The pump is in a housing shaped to fit inside a bra and the container is a milk container that is connected to the housing and is positioned to form the base of the housing.
- Container is used for liquids other than milk.

Feature 13 Elvie is wearable and includes a sensor to infer the amount of movement or tilt angle during normal use.

A breast pump system including:

(a) a housing;

(b) a milk container;

(c) the housing including a sensor, such as an accelerometer, that measures or determines the movement and/or tilt angle of the housing, during a pumping session and automatically affects or adjusts the operation of the system depending on the output of the sensor.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- If the tilt angle of the housing exceeds a threshold, then the system automatically affects the operation of the system by warning or alerting the mother of a potential imminent spillage (e.g. from milk flowing back out of a breast shield) using an audio, or visual or haptic alert, or a combination of audio, haptic and visual alerts.
- If the tilt angle of the housing exceeds a threshold, then the system automatically adjusts the operation of the system by stopping the pump to prevent spillage.
- When the tilt angle of the housing reduces below the threshold, the system automatically adjusts the operation of the system by causing pumping to resume automatically.
- If the tilt angle of the housing exceeds a threshold, then the system automatically affects the operation of the system by providing the mother with an alert to change position.
- The container includes an optically clear region.
- There are one or more light emitters and detectors positioned in the base of the housing, the light emitters and receivers operating as part of a sub-system that measures or infers the tilt angle of the milk in the container.
- The sub-system measures the quantity of liquid in the milk container and also takes the measured tilt angle of the housing into account.
- If the tilt angle is above a certain threshold, the system ignores the quantity of liquid measured.
- The sub-system derives or infers the mother's activity, such as walking, standing or lying activities, from the sensor.
- The milk container is a re-useable milk container that when connected to the housing is positioned to form the base of the housing.

- Sub-system stores a time-stamped record of movement and/or tilt angles of the housing in association with milk flow data.
- System includes a breast shield that attaches to the housing.
- System includes a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 14 Elvie includes a control to toggle between recording whether milk is being expressed from the left breast and the right breast.

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra;

(b) a control interface that the user can select to indicate or record if milk is being expressed from the left or the right breast.

Optional:

- Control interface is a physical interface on the housing.
- Control interface is a single button on the housing.
- Control interface is from an application running on a device, such as a smartphone or smart ring.
- Visual indicators on the housing indicate whether the breast pump system is being set up the left or the right breast.
- The visual indicator for the left breast is on the right-hand side of the housing, when viewed from the front; and the visual indicator for the right breast is on the left-hand side of the housing, when viewed from the front.
- The housing includes a button labeled to indicate the left breast and a button labeled to indicate the right breast, that are respectively illuminated to indicate from which breast the milk is being expressed.
- Breast pump system is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 15 Elvie includes a pressure sensor.

A breast pump system including (i) a pumping mechanism that applies negative air-pressure and (ii) an air pressure sensor configured to measure the negative pressure delivered by the negative air-pressure mechanism and (iii) a measurement sub-system that measures or infers milk flow or milk volume.

Optional:

- The system also includes a control sub-system that combines or relates the air-pressure measurements with the milk flow or milk volume measurements
- The control sub-system automatically adjusts the negative air-pressure to give the optimal milk flow or milk volume.
- The control sub-system automatically adjusts the negative air-pressure during a pumping session to give the optimal milk flow or milk volume within comfort constraints defined by the user.
- The air pressure sensor detects pressure created by the pumping mechanism.
- Sensor is a piezo air pressure sensor
- Air pressure sensor measures the negative air pressure during a normal milk expression session.
- Air pressure sensor measures the negative air pressure during a calibration session, and the system uses the results to vary the operation of the pumping mechanism so that it deliver consistent performance over time.
- Air pressure sensor measures the negative air pressure during a calibration session, and the system uses the results to vary the operation of the pumping mechanism so that different pumping mechanisms in different breast pump systems all deliver consistent performance
- Air pressure sensor measures the negative air pressure during a calibration session, and the system uses the results to determine if the pumping mechanism is working correctly, within tolerance levels.
- The operation of the pumping mechanism is varied by altering the duty or pump cycle.
- The operation of the pumping mechanism is varied by altering the voltage applied to the pumping mechanism.
- Pumping mechanism is a piezo air pump.

- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a flexible diaphragm that seals, self-seals, self-energising seals or interference fit seals against a diaphragm housing that forms part of a breast shield.
- Breast pump system is wearable and includes a housing that is shaped at least in part to fit inside a bra.
- Breast pump system includes a milk container and a measurement sub-system that automatically measures the quantity of milk in the milk container.
- The measurement sub-system includes one or more light emitters and one or more light detectors, operating as part of a sub-system that measures or infers the quantity of the milk in the container and/or the height of the milk in the container above its base, and in which the light detectors detect and measure the intensity of the light from the emitters that has been reflected from the surface of the milk.

Feature 16 Elvie includes a microcontroller to enable fine tuning between pre-set pressure profiles

A breast pump system including (i) a pumping mechanism that applies negative air-pressure and (ii) a microcontroller programmed to cause the pumping mechanism to deliver various pre-set pressure profiles and to permit the user to manually vary the pressure to a value or values that are in-between the values available from a pre-set pressure profile.

Optional:

- The user manually varies the pressure using a control interface on a housing of the breast pump system
- The user manually varies the pressure using a control interface on an application running on a wireless device such as a smartphone that is wirelessly connected to the breast pump system.
- The user manually varies the pressure by altering a control parameter of the pumping mechanism.
- The user manually varies the pressure by altering the duty cycle or timing of the

pumping mechanism.

- The user manually varies the pressure by altering the voltage applied to the pumping mechanism.
- The system includes an air pressure sensor configured to measure the negative air pressure delivered by the pumping mechanism.
- The air pressure sensor is a piezo air pressure sensor.
- Pumping mechanism is a piezo air pump.
- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a flexible diaphragm that seals, self-seals, self-energising seals or interference fit seals against a diaphragm housing that forms part of a breast shield.
- Pressure profile defines one or more maximum negative air pressure levels.
- Pressure profile defines one or more maximum negative air pressure levels, each for a pre-set time.
- Pressure profile defines one or more cycle time.
- Pressure profile defines peak flow rate.
- Breast pump system is wearable and includes a housing that is shaped at least in part to fit inside a bra.
- Breast pump system includes a milk container and a measurement sub-system that automatically measures the quantity of milk in the milk container.
- The measurement sub-system includes one or more light emitters and one or more light detectors, operating as part of a sub-system that measures or infers the quantity of the milk in the container and/or the height of the milk in the container above its base, and in which the light detectors detect and measure the intensity of the light from the emitters that has been reflected from the surface of the milk.

Feature 17 Elvie enables a user to set the comfort level they are experiencing

A breast pump system including (i) a pumping mechanism that applies negative air-pressure and (ii) a microcontroller programmed to control the pumping mechanism and to permit the user to manually indicate the level of comfort that they are experiencing when the system is in use.

Optional:

- The user manually indicates the level of comfort that they are experiencing using a touch or voice-based interface on a housing of the breast pump system
- The user manually indicate the level of comfort that they are experiencing using a touch or voice-based interface on an application running on a wireless device, such as a smartphone, that is wirelessly connected to the breast pump system.
- The system stores user-indicated comfort levels together with associated parameters of the pumping system.
- The system is a connected device and a remote server stores user-indicated comfort levels together with associated parameters of the pumping system.
- The parameters of the pumping system include one or more of: pumping strength, peak negative air pressure; flow rate; voltage applied to the pumping mechanism; duty or timing cycle of the pumping mechanism.
- System automatically varies parameters of the pumping system and then enables the user to indicate which parameters are acceptable.
- System includes an air pressure sensor that measures the negative air pressure delivered by the pumping mechanism.
- The air pressure sensor is a piezo air pressure sensor.
- Pumping mechanism is a piezo air pump.
- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a flexible diaphragm that seals, self-seals, self-energising seals or interference fit seals against a diaphragm housing that forms part of a breast shield.
- Breast pump system is wearable and includes a housing that is shaped at least in part to fit inside a bra.
- Breast pump system includes a milk container and a measurement sub-system that automatically measures the quantity of milk in the milk container.
- The measurement sub-system includes one or more light emitters and one or more light detectors, operating as part of a sub-system that measures or infers the quantity of the milk in the container and/or the height of the milk in the container above its base, and in which the light detectors detect and measure the

intensity of the light from the emitters that has been reflected from the surface of the milk.

Feature 18 Elvie includes a microcontroller to dynamically and automatically alter pump operational parameters

A breast pump system including (i) a pumping mechanism that applies negative air-pressure and (ii) a microcontroller programmed to automatically change one or more parameters of the pumping mechanism, and to automatically measure or relate milk expression data as a function of different values of one or more of these parameters.

Optional:

- The milk expression data includes one or more of the following: milk expression rate or quantity; comfort; optimal pumping mode; optimal pumping mode given remaining battery power.
- The system automatically calculates or identifies the parameters of the pumping mechanism that correlate with maximum milk expression rate or quantity and uses that set of parameters.
- The system automatically calculates or identifies the parameters of the pumping mechanism that correlate with maximum milk expression rate or quantity and uses that set of parameters if the comfort experienced by the user when those parameters are used is above a threshold.
- The system displays the parameters of the pumping mechanism that correlate with maximum milk expression rate or quantity to the user.
- The system displays the parameters of the pumping mechanism that correlate with maximum milk expression rate or quantity to the user and enables the user to manually select those parameters if they are acceptable.
- Parameters of the pumping mechanism includes pumping strength, peak negative air pressure; flow rate; voltage applied to the pumping mechanism; duty or timing cycle of the pumping mechanism.
- System includes an air pressure sensor that measures the negative air pressure delivered by the pumping mechanism.
- The air pressure sensor is a piezo air pressure sensor.

- Pumping mechanism is a piezo air pump.
- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a flexible diaphragm that seals, self-seals, self-energising seals or interference fit seals against a diaphragm housing that forms part of a breast shield.
- Breast pump system is wearable and includes a housing that is shaped at least in part to fit inside a bra.
- Breast pump system includes a milk container and a measurement sub-system that automatically measures the quantity of milk in the milk container.
- The measurement sub-system includes one or more light emitters and one or more light detectors, operating as part of a sub-system that measures or infers the quantity of the milk in the container and/or the height of the milk in the container above its base, and in which the light detectors detect and measure the intensity of the light from the emitters that has been reflected from the surface of the milk.

Feature 19 Elvie automatically learns the optimal conditions for let-down

A breast pump system including (i) a pumping mechanism that applies negative air-pressure and (ii) a microcontroller programmed to dynamically change one or more parameters of the pumping mechanism, and to automatically detect the start of milk let-down.

Optional:

- The microcontroller is programmed to dynamically change one or more parameters of the pumping mechanism, to enable it to learn or optimize the parameters relating to milk let-down.
- The system automatically calculates or identifies or learns the parameters of the pumping mechanism that correlate with the quickest start of milk let-down.
- The system automatically calculates or identifies or learns the parameters of the pumping mechanism that correlate with the quickest start of milk let-down and uses that set of parameters if the comfort experienced by the user when those

parameters are used is above a threshold or are otherwise acceptable to the user.

- The system displays the parameters of the pumping mechanism that correlate with the quickest start of milk let-down to the user.
- The system displays the parameters of the pumping mechanism that correlate with the quickest start of milk let-down and enables the user to manually select those parameters if they are acceptable.
- parameters of the pumping mechanism includes pumping strength, peak negative air pressure; flow rate; voltage applied to the pumping mechanism; duty or timing cycle of the pumping mechanism.
- System includes an air pressure sensor that measures the negative air pressure delivered by the pumping mechanism.
- The air pressure sensor is a piezo air pressure sensor.
- Pumping mechanism is a piezo air pump.
- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a flexible diaphragm that seals, self-seals, self-energising seals or interference fit seals against a diaphragm housing that forms part of a breast shield.
- Breast pump system is wearable and includes a housing that is shaped at least in part to fit inside a bra.
- Breast pump system includes a milk container and a measurement sub-system that automatically measures the quantity of milk in the milk container.
- The measurement sub-system includes one or more light emitters and one or more light detectors, operating as part of a sub-system that measures or infers the quantity of the milk in the container and/or the height of the milk in the container above its base, and in which the light detectors detect and measure the intensity of the light from the emitters that has been reflected from the surface of the milk.

B. Elvie Piezo Air Pump Feature Cluster

Feature 20 Elvie is wearable and has a piezo air-pump for quiet operation

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra;

(b) a piezo air-pump in the housing that is part of a closed loop system that drives, a separate, deformable diaphragm to generate negative air pressure.

Optional:

- The deformable diaphragm inside the housing is driven by negative air pressure generated by the piezo pump.
- Piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement.
- The closed system is separated from a 'milk' side by a flexible diaphragm.
- Deformable diaphragm is removably mounted against a part of a breast shield.
- Deformable diaphragm is a unitary or one-piece object that is removably mounted against a part of a breast shield.
- Deformable diaphragm is not physically connected to the piezo air-pump.
- Piezo air-pump is a closed loop air-pump that drives a physically separate and remote deformable diaphragm that removably fits directly onto the breast shield
- Deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 25gm.
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.

- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise. The piezo pump is fed by air that passes through an air filter.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 21 Elvie has a piezo air-pump and self-sealing diaphragm

A breast pump system including:

(a) a housing;

(b) a piezo air-pump in the housing that is part of a closed loop system that drives, a physically separate, deformable, self-sealing diaphragm, to generate negative air pressure.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement .
- The closed system is separated from a 'milk' side by the flexible diaphragm.
- Deformable diaphragm is removably mounted against a part of a breast shield.
- Deformable diaphragm is a unitary or one-piece object that is removably mounted against a part of a breast shield.
- Deformable diaphragm is not physically connected to the piezo air-pump.
- Piezo air-pump is a closed loop air-pump that drives a physically separate and remote deformable diaphragm that removably fits directly onto the breast shield.
- Deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the

diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.

- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 10 gm, and may weigh less than 6gm.
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.
- The piezo pump is fed by air that passes through an air filter.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 22 Elvie uses more than one piezo air pump in series

A breast pump system including:

(a) a housing;

(b) multiple piezo air-pumps in the housing that drives a deformable diaphragm inside the housing to generate negative air pressure; in which the multiple piezo air-pumps can be operated at different times in series-connected and in parallel-connected modes.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Parallel connected mode is used during a first part of a pumping cycle to reach a defined negative air pressure more quickly than series connected mode would, and then the system switches to a series connected mode to reach a greater negative air pressure than series connected mode can reach.
- An actuator switches the system from parallel-connected piezo pump mode to series-connected piezo pump mode.

- Each piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- Each piezo air pump weighs less than 10 gm, and may weigh less than 6gm..
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.
- Each piezo pump is fed by air that passes through an air filter.
- Each piezo air pump forms part of a closed or closed loop system.
- Each piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.
- The piezo-air pumps are a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- The piezo air-pump is a closed loop negative air-pressure system that drives a physically separate and remote deformable, self-sealing diaphragm that removably fits directly onto the breast shield.

Feature 23 Elvie is wearable and has a piezo air-pump, a breast shield and a diaphragm that fits directly onto the breast shield

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra;

(b) a breast shield that attaches to the housing;

(b) a piezo air-pump in the housing that drives a deformable diaphragm that fits directly onto the breast shield.

Optional:

- Deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- Deformable diaphragm is removable from the diaphragm housing for cleaning.

- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Piezo air pump forms part of a closed or closed loop system.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- The piezo air-pump is a closed loop negative air-pressure system that drives a physically separate and remote deformable, self-sealing diaphragm that removably fits directly onto the breast shield.
- Piezo air pump is position at or close to the base of the housing.
- There are two or more piezo air pumps.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement.
- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 10 gm, and may weigh less than 6gm.
- In operation, the breast pump system makes less then 30dB noise at maximum. power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.The piezo pump is fed by air that passes through an air filter.
- The breast shield and milk container are each pressed or pushed into engagement with the housing.
- The breast shield and milk container are each pressed or pushed into a latched engagement with the housing.
- The breast shield and milk container are each insertable into and removable from the housing using an action confirmed with an audible sound, such as a click.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and a nipple tunnel shaped to receive a nipple.

- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield slides into the housing using guide members.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.

Feature 24 Elvie is wearable and has a piezo air-pump for quiet operation and a re-useable, rigid milk container for convenience

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra;

(b) a piezo air-pump in the housing;

(c) and a re-useable, rigid or non-collapsible milk container that when connected to the housing forms an integral part of the housing and that is also removable from the housing.

Optional:

- Piezo air pump forms part of a closed or closed loop system.
- Piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- The closed system is separated from a 'milk' side by a flexible diaphragm.

- A deformable diaphragm inside the housing is driven by negative air pressure generated by the piezo pump.
- The piezo air-pump is a closed loop negative air-pressure system that drives a physically separate and remote deformable, self-sealing diaphragm that removably fits directly onto the breast shield.
- The deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- The deformable diaphragm is removable from the diaphragm housing for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel in the breast shield includes an opening on its lower surface that is positioned through which expressed milk flows directly into the milk container.
- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 10 gm, and may weigh less than 6gm.
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.
- The milk container forms the base of the system.
- The milk container has a flat base so that it can rest stably on a surface.
- The milk container is removable from the housing.
- The milk container includes a clear or transparent wall or section to show the amount of milk collected.
- The milk container is scalable for storage.
- The milk container obviates the need for consumable or replaceable milk pouches.

Feature 25 Elvie has a piezo-pump for quiet operation and is a connected device

A breast pump system including

(a) a housing;

(b) a piezo air-pump in the housing;

(c) a milk container;

(d) a data connectivity module that enables data collection relating to the operation of the piezo air-pump and transmission of that data to a data analysis system.

Optional:

- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Transmission is to an application running on a connected device such as a smartphone, or a server, or the cloud.
- The data collection and transmission relates to any other operational data of the system.
- Piezo air pump forms part of a closed or closed loop system.
- Piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- The piezo air-pump is a closed loop negative air-pressure system that drives a physically separate and remote deformable, self-sealing diaphragm that removably fits directly onto the breast shield.
- The closed system is separated from a 'milk' side by a flexible diaphragm.
- A deformable diaphragm inside the housing is driven by negative air pressure generated by the piezo pump.

- The deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- Deformable diaphragm is removable from the diaphragm housing for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel in the breast shield includes an opening on its lower surface that is positioned through which expressed milk flows directly into the milk container.
- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 10 gm, and may weigh less than 6gm.
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.
- A sub-system measures or infers the quantity and/or the height of the liquid in the container and shares that data with the data connectivity module.
- The sub-system measures or infers the quantity and/or the height of the liquid in the container by using one or more light emitters and light detectors to detect light from the emitters that has been reflected by the liquid, and measuring the intensity of that reflected light.
- Sub-system includes an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the sub-system to accurately measure or infer the quantity and/or the height of the liquid in the container.
- The data analysis system analyses metrics such as any of the following: amount of milk expressed over one or more sessions, rate at which milk is expressed over one or more sessions, profile of the rate at which milk is expressed over one or more sessions.
- The data analysis system analyses metrics such as any of the following: pump speed, length of a single pumping session, negative air pressure or vacuum level,

peak negative air pressure or vacuum level, pump cycle time or frequency, changing profile of pump speed over a single pumping session time of day.

- The data analysis system analyses metrics such as any of the following: amount and type of liquids consumed by the mother, state of relaxation of the mother before or during a session, state of quiet experienced by the mother before or during a session, what overall milk expression profile the mother most closely matches.

Feature 26 Elvie uses a piezo in combination with a heat sink that manages the heat produced by the pump.

A breast pump system including:

(a) a housing;

(b) a piezo air-pump in the housing that drives a deformable diaphragm inside the housing to generate negative air pressure;

(c) a heat sink to manage the heat produced by the piezo-air pump to ensure it can be worn comfortably.

Optional:

- The heat sink is configured to ensure that the maximum temperature of any parts of the breast pump system that might come into contact with the skin, especially prolonged contact for greater than 1 minute, are no more than 48°C and preferably no more than 43°C.
- The breast pump is wearable and the housing is shaped at least in part to fit inside a bra.
- Heat sink is connected to an air exhaust so that air warmed by the piezo pumps vents to the atmosphere.
- Heat sink warms a breast shield.
- Piezo air pump forms part of a closed or closed loop system.
- Piezo air pump is positioned at or close to the base of the housing.
- There are two or more piezo air pumps.

- There are two or more piezo air pumps, each connected to its own or a shared heat sink.
- There are two or more piezo air pumps mounted in a series arrangement.
- There are two or more piezo air pumps mounted in a parallel arrangement.
- The piezo-air pump is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.
- The piezo air-pump is a closed loop negative air-pressure system that drives a physically separate and remote deformable, self-sealing diaphragm that removably fits directly onto the breast shield.
- The closed system is separated from a 'milk' side by a flexible diaphragm.
- A deformable diaphragm inside the housing is driven by negative air pressure generated by the piezo pump.
- The deformable diaphragm is a flexible generally circular diaphragm that sits over a diaphragm housing that is an integral part of a breast shield.
- The deformable diaphragm is removable from the diaphragm housing for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- Nipple tunnel in the breast shield includes an opening on its lower surface that is positioned through which expressed milk flows directly into the milk container.
- The piezo pump delivers in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow.
- The piezo air pump weighs less than 25g.
- In operation, the breast pump system makes less then 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.
- In operation, the breast pump system makes approximately 24dB noise at maximum power and 22dB at normal power, against a 20dB ambient noise.

Feature 27 Elvie is wearable and gently massages a mother's breast using small bladders inflated by air from its negative pressure air-pump

A breast pump system including:

(a) a housing;

(b) an air-pump in the housing that drives a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast;

(c) in which the air pump also provides air to regularly or sequentially inflate one or more air bladders or liners that are configured to massage one or more parts of the breast.

Optional:

- Air-pump is a piezo pump.
- Breast pump system is wearable and the housing is shaped at least in part to fit inside a bra.
- Bladders or liners are formed in a breast shield that attaches to the housing.

Feature 28 Elvie is wearable and gently warms a mother's breast using small chambers inflated by warm air from its negative pressure air-pump

A breast pump system including:

(a) a housing;

(b) an air-pump, such as a piezo pump, in the housing that drive a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast;

(c) in which the air pump also provides warm air to regularly or sequentially inflate one or more air chambers that are configured to apply warmth to one or more parts of the breast.

Optional:

- Breast pump system is wearable and the housing is shaped at least in part to fit inside a bra.
- The air chamber is a deformable diaphragm positioned on a breast shield that attaches to the housing.

C. Elvie Milk Container Feature Cluster

Feature 29 Elvie is wearable and includes a re-useable, rigid milk container that forms the lower part of the pump, to fit inside a bra comfortably

A wearable breast pump system configured including:

(a) a housing shaped at least in part with a curved surface to fit inside a bra and including a pumping mechanism;

(b) and a re-useable rigid or non-collapsible milk container that when connected to the housing forms an integral, lower part of the housing, with a surface shaped to continue the curved shape of the housing, so that the pump system can be held comfortably inside the bra.

Optional:

- The milk container forms the base of the system.
- The milk container has a flat base so that it can rest stably on a surface.
- The milk container is attached to the housing with a push action.
- The milk container includes a clear or transparent wall or section to show the amount of milk collected.
- The milk container is sealable for storage.
- The milk container obviates the need for consumable or replaceable milk pouches.
- The milk container includes an aperture, spout or lid that sits directly underneath an opening in a nipple tunnel of a breast shield, and expressed milk flows under gravity through the opening in the nipple tunnel and into the milk container.
- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a

breast shield, and milk flows under gravity through the opening into the milk container.

- The milk container is made using a blow moulding construction.
- The milk container has a large diameter opening to facilitate cleaning that is at least 3cm in diameter.
- The large opening is closed with a bayonet-mounted cap with an integral spout.
- A flexible rubber or elastomeric valve is mounted onto the cap or spout and includes a rubber or elastomeric duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump mechanism to ensure that negative air-pressure is not applied to the milk container.
- The pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 30 Elvie is wearable and includes a milk container that latches to the housing with a simple push to latch action

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a milk container that is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action.

Optional:

- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a breast shield, and milk flows under gravity through the opening into the milk container.
- Milk container, when connected to the housing, forms an integral, lower part of the housing and that is removable from the housing with a release mechanism that can be operated with one hand.

- Mechanism that releasably attaches or latches is a mechanical or magnetic mechanism.
- Mechanical mechanism includes flanges on the top of the milk container, or the sealing plate that seals the opening to the milk contained, that engage with and move past a surface to occupy a latched position over that surface when the milk container is pressed against the housing to lock into the housing.
- The housing includes a button that when pressed releases the milk container from the housing by flexing the surface away from the flanges so that the flanges no longer engage with and latch against the surface.
- Mechanism that attaches or latches the milk container into position does so with an audible click.
- The milk container forms the base of the system.
- The milk container has a flat base so that it can rest stably on a surface.
- The milk container is removable from the housing by releasing the latch and moving the housing off the milk container.
- The milk container includes a clear or transparent wall or section to show the amount of milk collected.
- The milk container is sealable for storage.
- The milk container obviates the need for consumable or replaceable milk pouches.
- The milk container includes an aperture that sits directly underneath an opening in a nipple tunnel of a breast shield, and expressed milk flows under gravity through the opening in the nipple tunnel and into the milk container.
- The milk container is made using a blow moulding construction.
- The milk container has a large diameter opening to facilitate cleaning that is at least 3cm in diameter.
- The large opening is closed with a bayonet-mounted cap with an integral spout.
- A flexible rubber or elastomeric valve is mounted onto the cap or spout and includes a rubber or elastomeric duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump to ensure that negative air-pressure is not applied to the milk container.

- The pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 31 Elvie is wearable and includes a removable milk container with an integral milk pouring spout for convenience

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a re-useable milk container that is connected to the housing with a surface shaped to continue the curved or breast-like shape of the pump, so that the pump can be held comfortably inside a bra and where the milk container includes a pouring spout for pouring milk.

Optional:

- Spout is integral to the milk container.
- Spout is integral to a removable lid to the milk container.
- Spout is positioned at or close to the front edge of the milk container.
- Spout is removable from the container, such as by clipping off the container.
- A teat is attachable to the spout.
- A flexible rubber or elastomeric valve is mounted onto the cap or spout and includes a rubber or elastomeric duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump to ensure that negative air-pressure is not applied to the milk container.
- The milk container forms the base of the system.
- The milk container has a flat base so that it can rest stably on a surface.
- The milk container is removable from the housing.
- The milk container includes a clear or transparent wall or section to show the amount of milk collected.
- The milk container is sealable for storage.

- The milk container obviates the need for consumable or replaceable milk pouches.
- The milk container includes an aperture that sits directly underneath an opening in a nipple tunnel of a breast shield, and expressed milk flows under gravity through the opening in the nipple tunnel and into the milk container through the pouring spout in the milk container.
- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a breast shield, and milk flows under gravity through the opening into the milk container.
- The milk container is made using a blow moulding construction.
- The milk container has a large diameter opening to facilitate cleaning that is at least 3cm in diameter.
- The large opening is closed with a bayonet-mounted cap with an integral spout.
- The pumping mechanism is a closed loop negative air-pressure system that applies negative pressure to a region surrounding a woman's breast to pump milk form that breast.

Feature 32 Elvie is wearable and includes a removable milk container below the milk flow path defined by a breast shield for fast and reliable milk collection

A wearable breast pump system including:

(a) a housing including a pumping mechanism, the housing being shaped at least in part to fit inside a bra;

(b) and a breast shield including a nipple tunnel shaped to receive a nipple, and including an opening that defines the start of a milk flow path;

(c) a re-useable milk container that when connected to the housing is positioned entirely below the opening or the milk flow path, when the breast pump is positioned or oriented for normal use.

Optional:

- The milk container includes an aperture that sits directly underneath the opening in the nipple tunnel in the breast shield, and expressed milk flows under gravity through the opening in the nipple tunnel and into the milk container through the pouring spout in the milk container.
- Milk flows from the opening directly into the milk container.
- Milk flows from the opening directly into the milk container.
- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against the opening in the breast shield, and milk flows under gravity through the opening into the milk container.
- Milk flows from the opening directly onto a valve that is attached to the milk container, the valve closing whilst there is sufficient negative air pressure in the volume of air between the valve and the breast shield opening, and then opening to release the milk into the container when the air pressure rises sufficiently.
- Milk flows from the opening directly onto a valve that is attached to a spout, that is in turn attached to the milk container.
- The milk container has a large diameter opening to facilitate cleaning that is at least 3cm in diameter.
- The large opening is closed with a bayonet-mounted cap with an integral spout.
- A flexible rubber or elastomeric valve is mounted onto the milk container cap or spout and includes a rubber or elastomeric duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump to ensure that negative air-pressure is not applied to the milk container, and milk flows towards and is retained by the duck bill valve whilst the valve is closed, and flows past the valve into the milk container when the negative air pressure is released and the valve opens.
- The breast shield and milk container are each pressed or pushed into engagement with the housing.
- The breast shield and milk container are each pressed or pushed into a latched engagement with the housing.
- The two removable parts are each insertable into and removable from the housing using an action confirmed with an audible sound, such as a click.

- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and a nipple tunnel shaped to receive a nipple.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield slides into the housing using guide members.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.

Feature 33 Elvie is wearable and includes a breast shield and removable milk container of optically clear, dishwasher safe plastic for ease of use and cleaning

A breast pump system including:

(a) a housing including a pumping mechanism;

(b) and a breast shield defining a region shaped to receive a nipple, the region defining the start of a milk flow path;

(c) a re-useable, rigid or non-collapsible milk container that when connected to the housing is positioned to form the base of the housing;

and in which the breast shield and the milk container are made substantially of an optically clear, dishwasher safe material.

Optional:

- The material is a polycarbonate material, such as Tritan™.

- breast pump system is wearable and the housing is shaped at least in part to fit inside a bra.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and a nipple tunnel shaped to receive a nipple.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield operates with a flexible diaphragm that flexes when negative air pressure is applied to it by an air pump system in the housing, and transfers that negative air-pressure to pull the breast and/or nipple against the breast shield to cause milk to be expressed.
- Flexible diaphragm is removable from a diaphragm housing portion of the breast shield for cleaning.
- Diaphragm housing includes an air hole that transfers negative air pressure to a nipple tunnel in the breast shield, the negative air pressure arising when the diaphragm moves away from the diaphragm housing and towards the housing, and the negative air pressure in the nipple tunnel pulling the breast and/or nipple against the breast shield to cause milk to be expressed.
- The breast shield and milk container are each pressed or pushed into engagement with the housing.
- The breast shield and milk container are each pressed or pushed into a latched engagement with the housing.
- The breast shield and milk container are each insertable into and removable from the housing using an action confirmed with an audible sound, such as a click.
- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a breast shield, and milk flows under gravity through the opening into the milk container.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and a nipple tunnel shaped to receive a nipple.

- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield slides into the housing using guide members.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.
- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.

Feature 34 Elvie is wearable and includes various components that self-seal under negative air pressure, for convenience of assembly and disassembly

A wearable breast pump system including:

(a) a housing shaped at least in part to fit inside a bra and including an air pumping mechanism;

(b) a breast shield;

(c) a diaphragm that flexes in response to changes in air pressure caused by the air pumping mechanism and that seals to the breast shield;

(d) a re-useable milk container that seals to the breast shield;

and in which either or both of the diaphragm and the re-useable milk container substantially self-seal under the negative air pressure provided by the pumping mechanism.

Optional:

- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a

breast shield, and milk flows under gravity through the opening into the milk container.

- The re-useable milk container includes a 1 way valve that self-seals against a conduit from the breast shield and allows milk to pass into the container but not spill out, and in which the valve (a) closes and (b) partly or wholly self-seals against the conduit under the negative air pressure provided by the pumping mechanism.
- The 1 way valve is attached to the milk container, or a lid or spout of the milk container with an interference fit and is readily removed in normal use for separate cleaning.
- The diaphragm partly or wholly self-seals to the breast shield under the negative air pressure provided by the pumping mechanism.
- The diaphragm partly or wholly self-seals to the housing under the negative air pressure provided by the pumping mechanism.
- The diaphragm is attached to the diaphragm housing using elastomeric or rubber latches and is readily removed in normal use for separate cleaning.
- The breast shield and milk container are each pressed or pushed into engagement with the housing.
- The breast shield and milk container are each pressed or pushed into a latched engagement with the housing.
- The breast shield and milk container are each insertable into and removable from the housing using an action confirmed with an audible sound, such as a click.
- Breast shield is a one-piece item including a generally convex surface shaped to fit over a breast and a nipple tunnel shaped to receive a nipple.
- Breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use.
- Breast shield is configured to be rotated smoothly around a nipple inserted into the nipple tunnel to position a diaphragm housing portion of the breast shield at the top of the breast.
- Breast shield slides into the housing using guide members.
- Housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.
- Breast shield latches into position against the housing.

- Breast shield latches into position against the housing when spring plungers, such as ball bearings in the housing locate into small indents in the breast shield.
- Breast shield latches into position against the housing using magnets.

Feature 35 Elvie is wearable and includes a spout at the front edge of the milk container for easy pouring

A wearable breast pump system configured as a single unit and including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a milk container that forms an integral part of the housing;

(c) a re-useable pouring spout that is positioned at or close to the front edge of the milk container.

Optional:

- Milk container is a multifunctional bottle, operating as both a storage container to contain milk that is being expressed, as well as a refrigeratable and freezable storage bottle for that milk, as well as a bottle from which that milk can be drunk by a baby.
- Spout is integral to a removable lid to the milk container.
- Spout is removable from the container, such as by clipping off the container.
- A teat is attachable to the spout.
- By placing the spout at or close to the front edge of the milk container, the milk container fully empties more readily than where the spout is placed in the middle of the lid of a milk container.
- The spout sits generally under an opening in the breast shield spout or nipple tunnel through which expressed milk flows.
- The re-useable milk container includes a 1 way valve that self-seals against a conduit from the breast shield and allows milk to pass into the container but not spill out, and in which the valve (a) closes and (b) partly or wholly self-seals against the conduit under the negative air pressure provided by the pumping mechanism.

- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a breast shield, and milk flows under gravity through the opening into the milk container.

Feature 36 Elvie is wearable and includes a milk container that is shaped with broad shoulders and that can be adapted as a drinking bottle that baby can easily hold

A wearable breast pump system configured as a single unit and including:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) a breast shield;

(c) a milk container that is removable from the housing and is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall.

Optional:

- Teat is attachable directly to the milk container.
- Pouring or drinking spout is integral to the milk container.
- The shoulders are at least 2cm in width, and the neck is no more than 1 cm in height, to enable a baby to readily grip and hold the container when feeding from the milk in the container.
- Spout/teat/straw resides near the edge of the container's rim.
- Milk container is a multifunctional bottle, operating as both a storage container to contain milk that is being expressed, as well as a refrigertable and freezable storage bottle for that milk, as well as a bottle from which that milk can be drunk by a baby.
- The re-useable milk container includes a 1 way valve that self-seals against a conduit from the breast shield and allows milk to pass into the container but not spill out, and in which the valve (a) closes and (b) partly or wholly self-seals

against the conduit under the negative air pressure provided by the pumping mechanism.

- The milk container includes an aperture, spout or lid that self-seals under the negative air-pressure from the pumping mechanism against an opening in a breast shield, and milk flows under gravity through the opening into the milk container.
- Spout is integral to the milk container.
- Spout is integral to a removable lid to the milk container.
- Spout is positioned at or close to the front edge of the milk container.
- Spout is removable from the container, such as by clipping off the container.
- A teat is attachable to the spout.
- A flexible rubber or elastomeric valve is mounted onto the cap or spout and includes a rubber or elastomeric duck-bill valve that stays sealed when there is negative air-pressure being applied by the air pump to ensure that negative air-pressure is not applied to the milk container.
- The milk container forms the base of the system.
- The milk container has a flat base so that it can rest stably on a surface.
- The milk container is removable from the housing.
- The milk container includes a clear or transparent wall or section to show the amount of milk collected.
- The milk container is scalable for storage.
- The milk container obviates the need for consumable or replaceable milk pouches.
- The milk container includes an aperture that sits directly underneath an opening in a nipple tunnel of a breast shield, and expressed milk flows under gravity through the opening in the nipple tunnel and into the milk container through the pouring spout in the milk container.
- The milk container is made using a blow moulding construction.
- The milk container has a large diameter opening to facilitate cleaning that is at least 3cm in diameter.
- The large opening is closed with a bayonet-mounted cap with an integral spout.

D. Elvie IR System Feature Cluster

Feature 37 Elvie is wearable and includes a light-based system that measures the quantity of milk in the container for fast and reliable feedback

A system for milk volume determination, for use as part of a breast pump, or breast milk collecting device, including:

(a) a re-useable rigid or non-collapsible milk container;
(b) at least one light emitter, configured to direct radiation towards the surface of the milk;
(c) at least one light detector, configured to detect reflected radiation from the surface of the milk;

wherein the light emitters and detectors operate as part of a sub-system that measures the height of, or infers the quantity of, the milk in the container.

Optional:

The wearable breast pump system includes:

(a) a housing shaped at least in part to fit inside a bra and including a pumping mechanism;

(b) and a breast shield;

(c) a re-useable rigid or non-collapsible milk container that when connected to the housing is positioned to form the base of the housing;

and in which the top of the container includes an optically clear region that is aligned below one or more light emitters positioned in the base of the housing.

- The sub-system measures or infers the quantity and/or the height of the liquid in the container by using one or more light emitters and light detectors to detect light from the emitters that has been reflected by the liquid, and measuring the intensity of that reflected light.
- Sub-system includes an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the sub-system to accurately measure or infer the quantity and/or the height of the liquid in the container.

- The sub-system measures or infers the quantity and/or the height of the liquid in the container and shares that data with a data connectivity module.
- Where the quantity or level exceeds a threshold, then the pumping mechanism automatically changes mode, e.g. from a stimulation mode to an expression mode.
- Where the quantity or level exceeds a threshold, then the pumping mechanism automatically stops.
- Milk-flow data is captured and stored.
- If milk-flow falls below a threshold, then a notification is provided to the mother.

Feature 38 The separate IR puck for liquid quantity measurement

A liquid-level measuring system for measuring the quantity of liquid in a container for a breast pump; the system including:

(a) one or more light emitters directing light at the surface of the liquid in the container;

(b) one or more light receivers configured to detect light from the light emitters that has been reflected from the liquid;

(c) a sub-system that infers, measures or calculates the quantity in the liquid using measured properties of the detected light;

(d) a collar or other fixing system that positions the system over the container.

Optional:

- The quantity of milk is measured as milk enters the container or as milk is removed from the container.
- Measured property includes the reflected light intensity

Feature 39 The separate IR puck combined with liquid tilt angle measurement

A liquid-level measuring system for measuring the tilt angle of liquid in a container; the system including:

(a) one or more light emitters directing light at the surface of the liquid in the container;

(b) one or more light receivers configured to measure properties of the light reflected from the liquid;

(c) a sub-system including an accelerometer that infers, measures or calculates the tilt angle of the liquid using measured properties of the detected light;

(d) a collar or other fixing system that positions the system over the container.

Optional:

- Measured property includes the reflected light intensity
- The quantity of liquid is measured as liquid enters the container or as liquid is removed from the container.
- Sub-system includes an accelerometer and uses a signal from the accelerometer to determine if the liquid is sufficiently still to permit the sub-system to accurately measure or infer the quantity and/or the height of the liquid in the container.
- The sub-system measures or infers the quantity and/or the height of the liquid in the container and shares that data with a data connectivity module.

Generally applicable optional features

- Weight of the entire unit, unfilled, is under 250g and preferably 214g.
- Silver based bactericide is used on all parts that are not steam or heat sterilized in normal cleaning.
- Housing includes a rechargeable battery.
- System is self-contained.
- System is a closed loop system.
- Breast pump system is a self-contained, wearable device that includes an integral rechargeable battery, control electronics, and one or more air pumps operating as a closed system, driving a flexible diaphragm that in turn delivers negative air-pressure to the breast, to cause milk to be expressed.
- Housing has a generally rounded or convex front surface and has a generally tear-drop shape when seen from the front.

E. Bra Clip Feature Cluster

Feature 40 Bra Adjuster

A bra adjuster for a nursing or maternity bra, the nursing or maternity bra including a bra cup with a flap that can be undone to expose the nipple, and the flap attaching to the shoulder strap using a clasp, hook or other fastener attached to the flap, and a corresponding fastener attached to the shoulder strap;

and in which the bra adjuster is attachable at one end to the fastener attached to the flap, and at its other end to the fastener attached to the shoulder strap, and hence increases the effective bra cup size sufficiently to accommodate a wearable breast pump, and is also detachable from the flap and shoulder strap.

Optional:

- Bra adjuster is retained in position on the bra during normal wearing of the bra, even when the flap is attached directly to the shoulder strap, and is used to increases the effective bra cup size only when the wearable breast pump is used.
- Bra adjuster is extensible or elastic.
- Bra adjuster is of a fixed length.
- Bra adjuster includes a clip that the user can slide onto the bra strap to secure the bra adjuster in position.
- Bra adjuster is machine-washing washable.

F. Other Features that can sit outside the breast pump context

Feature 41 Wearable device using more than one piezo pump connected in series or in parallel

A wearable device including multiple piezo pumps mounted together either in series or in parallel.

Optional:

- The wearable device is a medical wearable device.
- The piezo pumps air or any liquid etc.
- The system can switch between a parallel mode and a series mode to arrive to lower or higher pressure quicker.

Feature 42 Wearable medical device using a piezo pump and a heat sink attached together.

A wearable medical device including a piezo pump and a heat sink attached together.

Optional

- The wearable device uses more than one piezo pump connected in series.
- The wearable device uses more than one piezo pump connected in parallel.
- Each piezo pump is connected to its own heat sink, or to a common heat sink.
- The or each heat sink is configured to ensure that the maximum temperature of any parts of the breast pump system that might come into contact with the skin, especially prolonged contact for greater than 1 minute, are no more than 48°C and preferably no more than 43°C
- The wearable device includes a thermal cut out.
- Excess heat is diverted to a specific location on the device that is selected to not be in prolonged contact with the skin of the user, in normal use.
- Use cases application:
    - Wound therapy
    - High degree burns
    - Sleep apnea
    - Deep vein thrombosis
    - Sports injury.
- Wearable medical device is powered/charged via USB.

Note

It is to be understood that the above-referenced arrangements are only illustrative of the application for the principles of the present invention. Numerous modifications and alternative arrangements can be devised without departing from the spirit and scope of

the present invention. While the present invention has been shown in the drawings and fully described above with particularity and detail in connection with what is presently deemed to be the most practical and preferred example(s) of the invention, it will be apparent to those of ordinary skill in the art that numerous modifications can be made without departing from the principles and concepts of the invention as set forth herein.

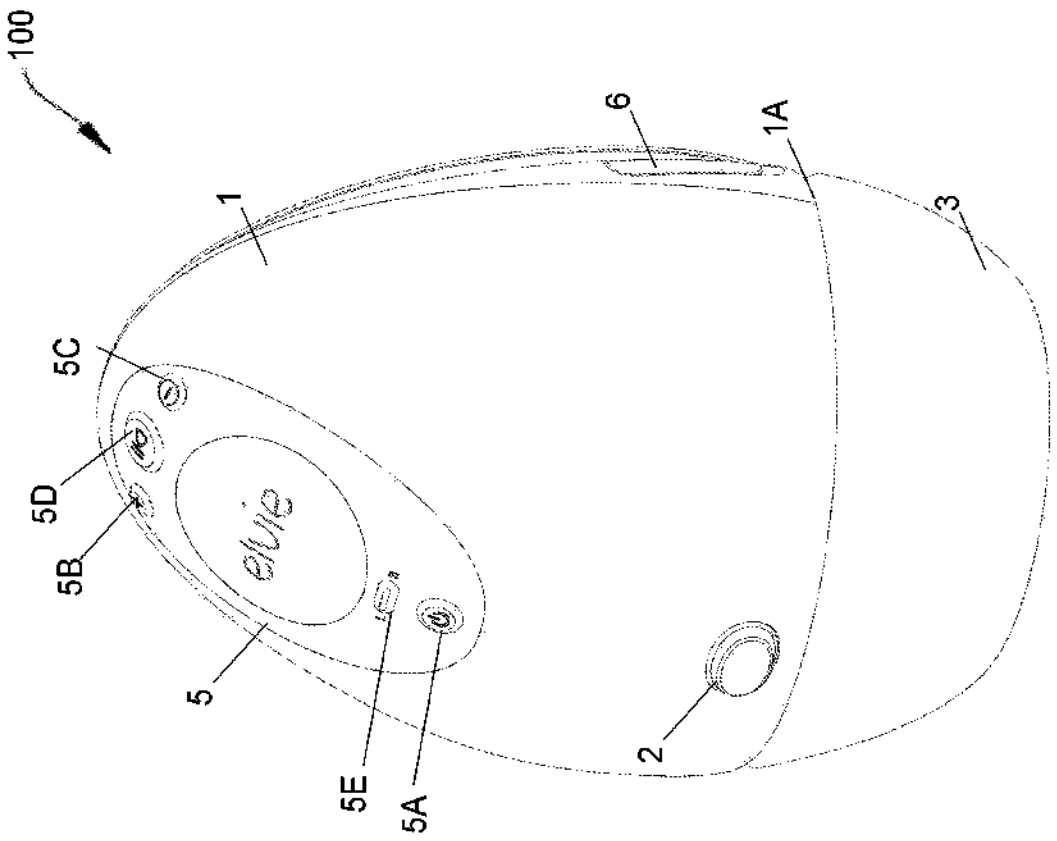

FIGURE 1

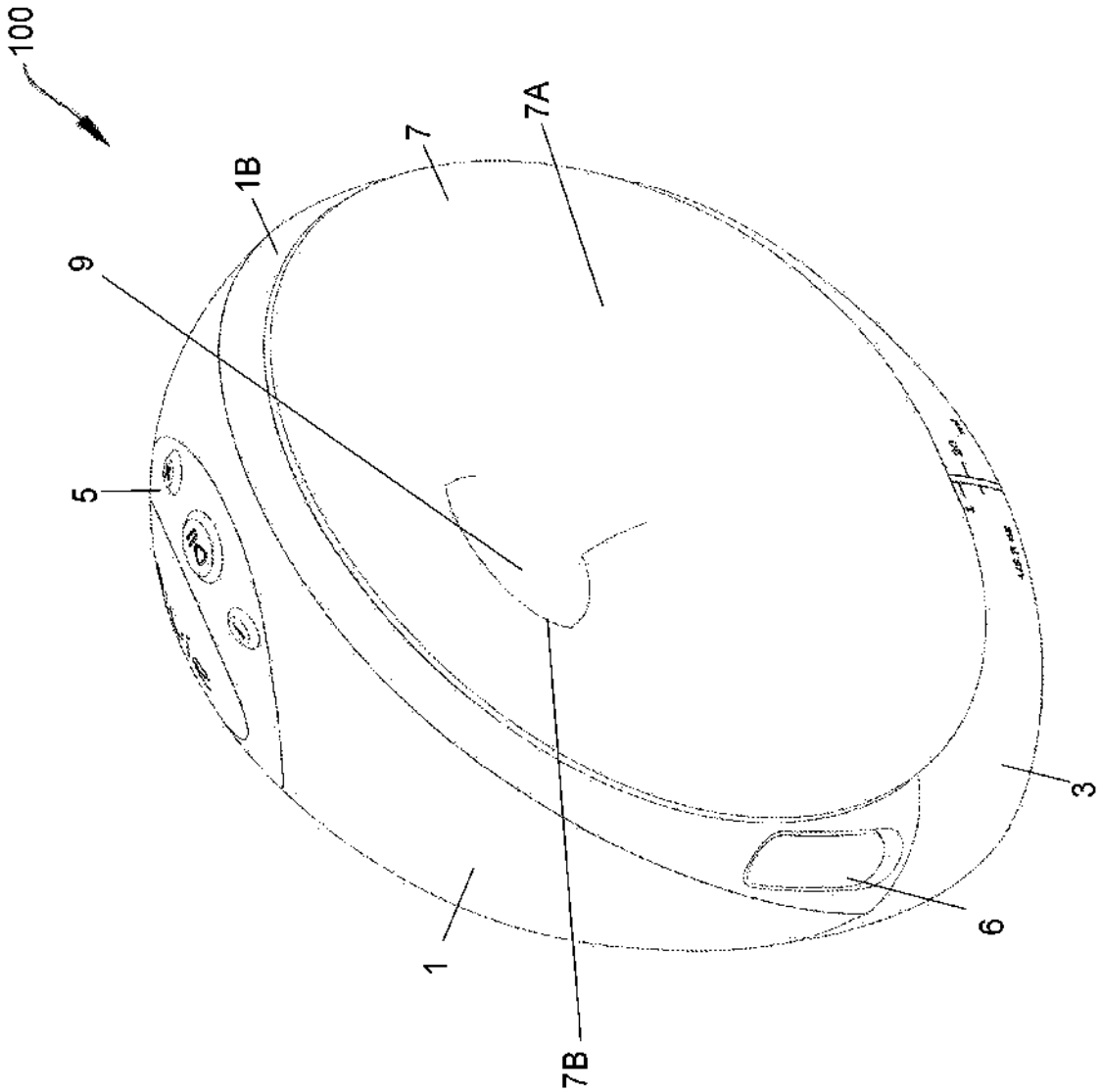

FIGURE 2

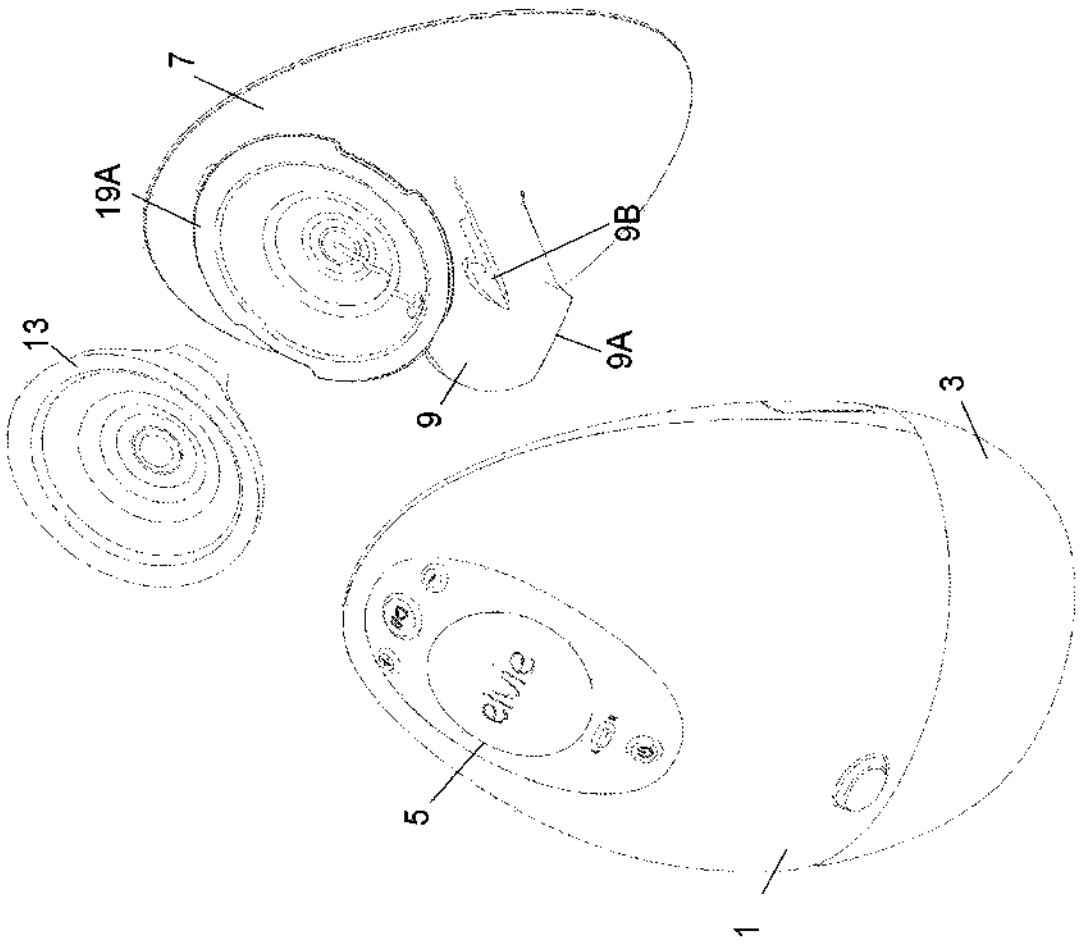

FIGURE 3

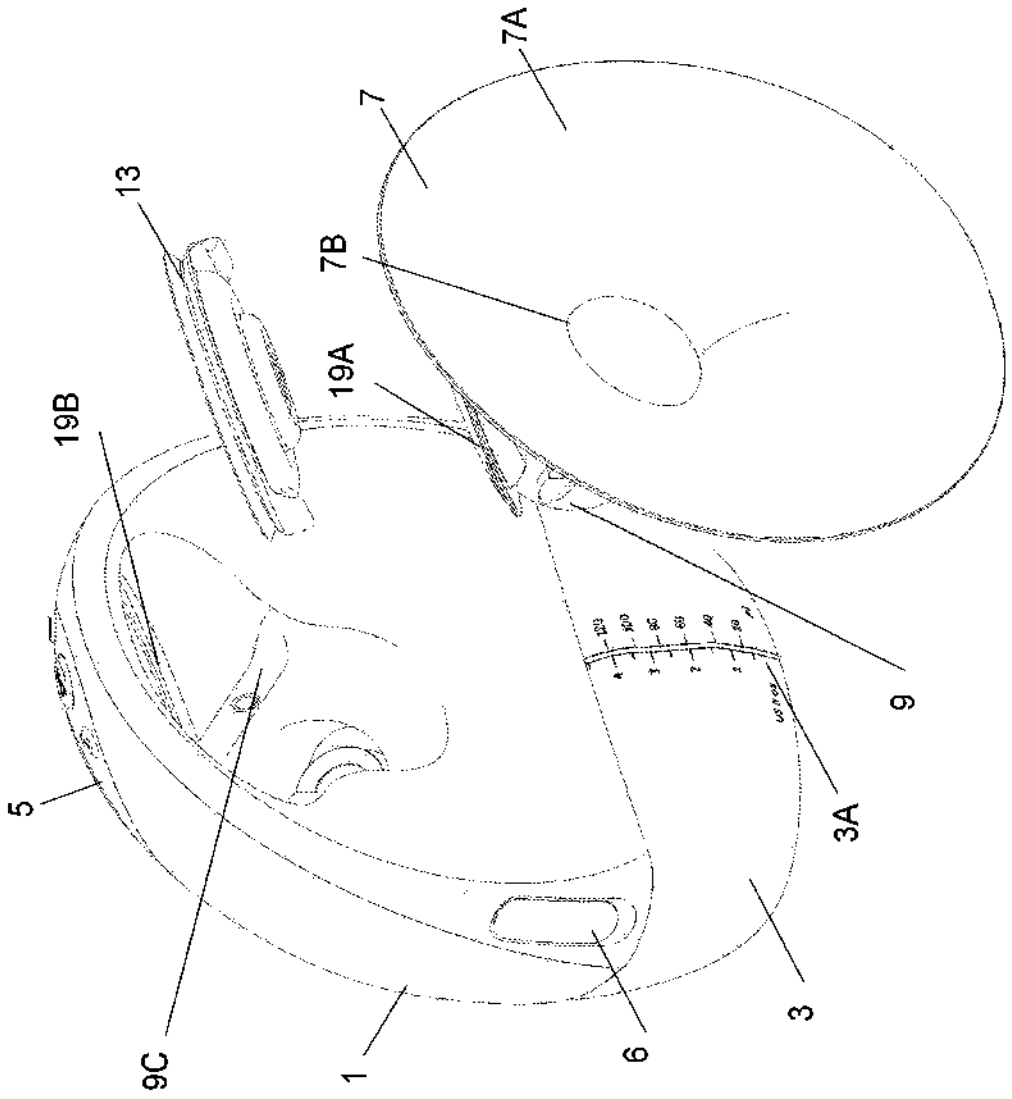

FIGURE 4

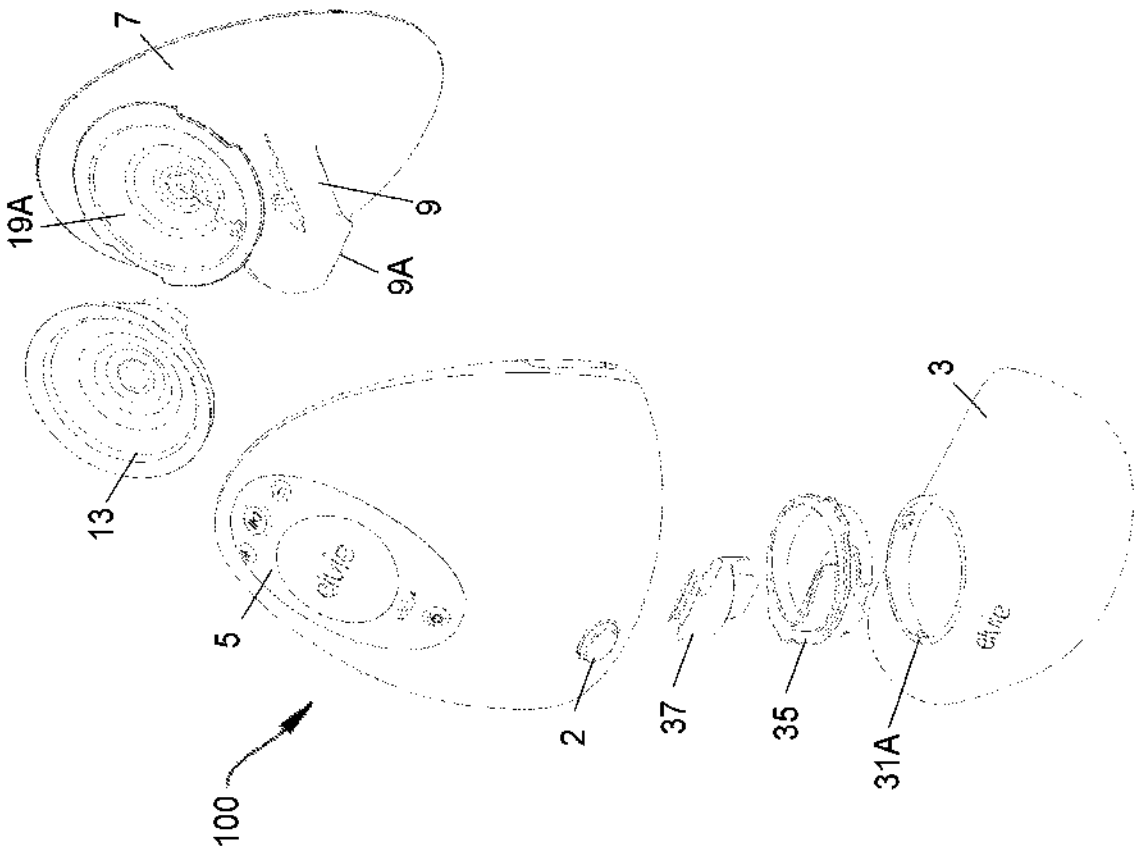

FIGURE 5

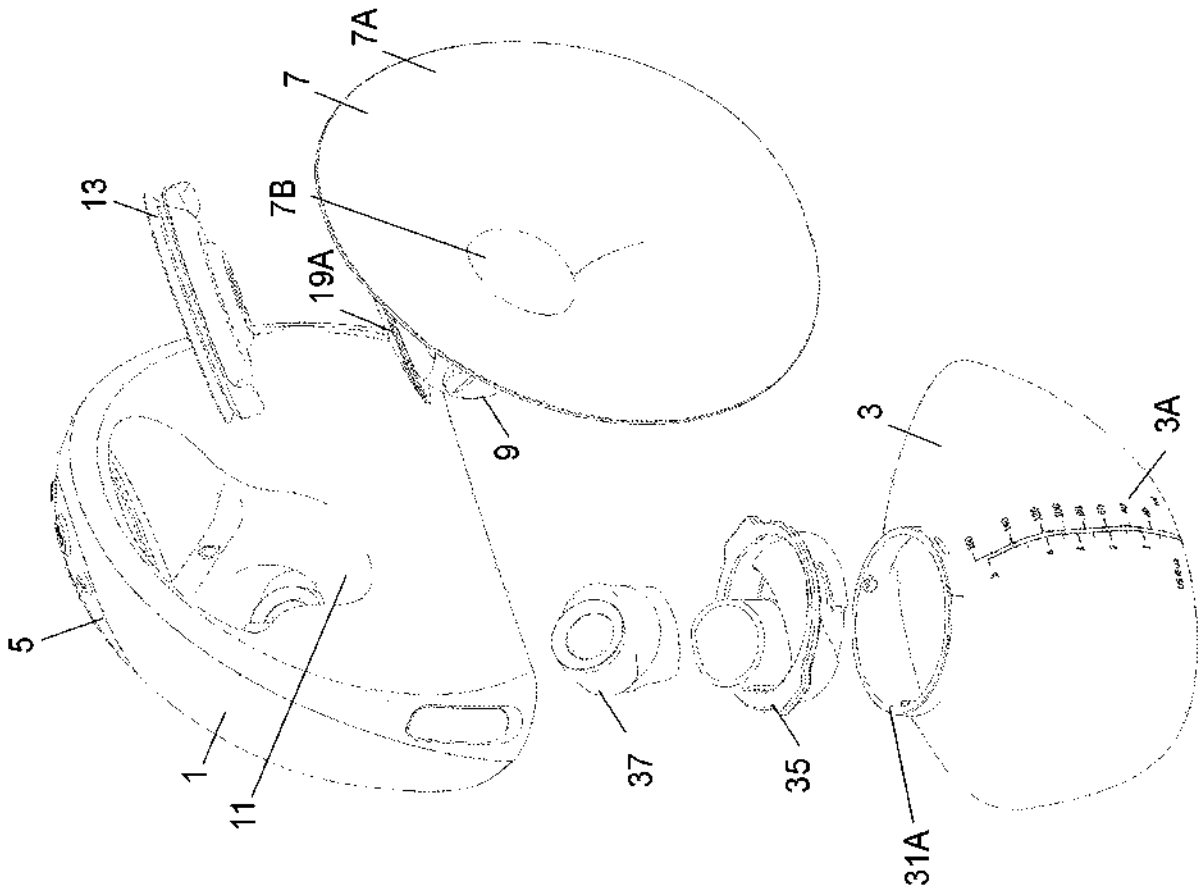

FIGURE 6

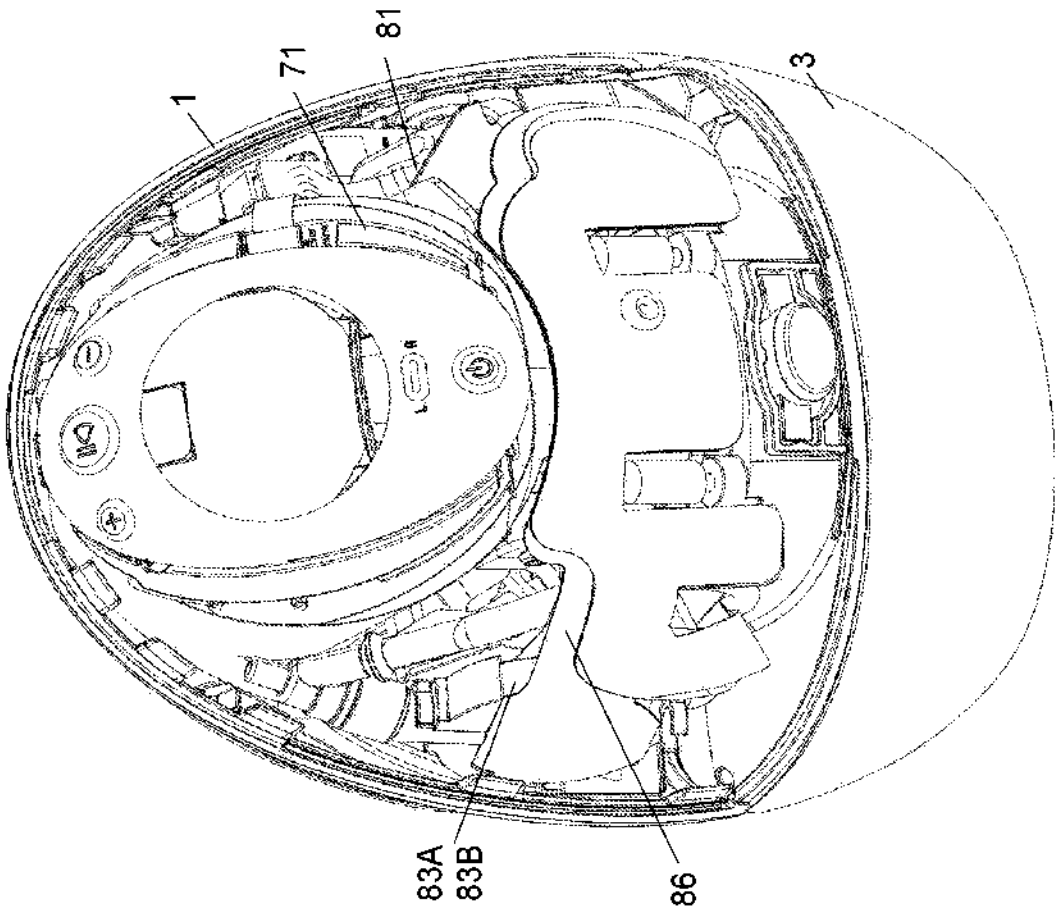

FIGURE 7

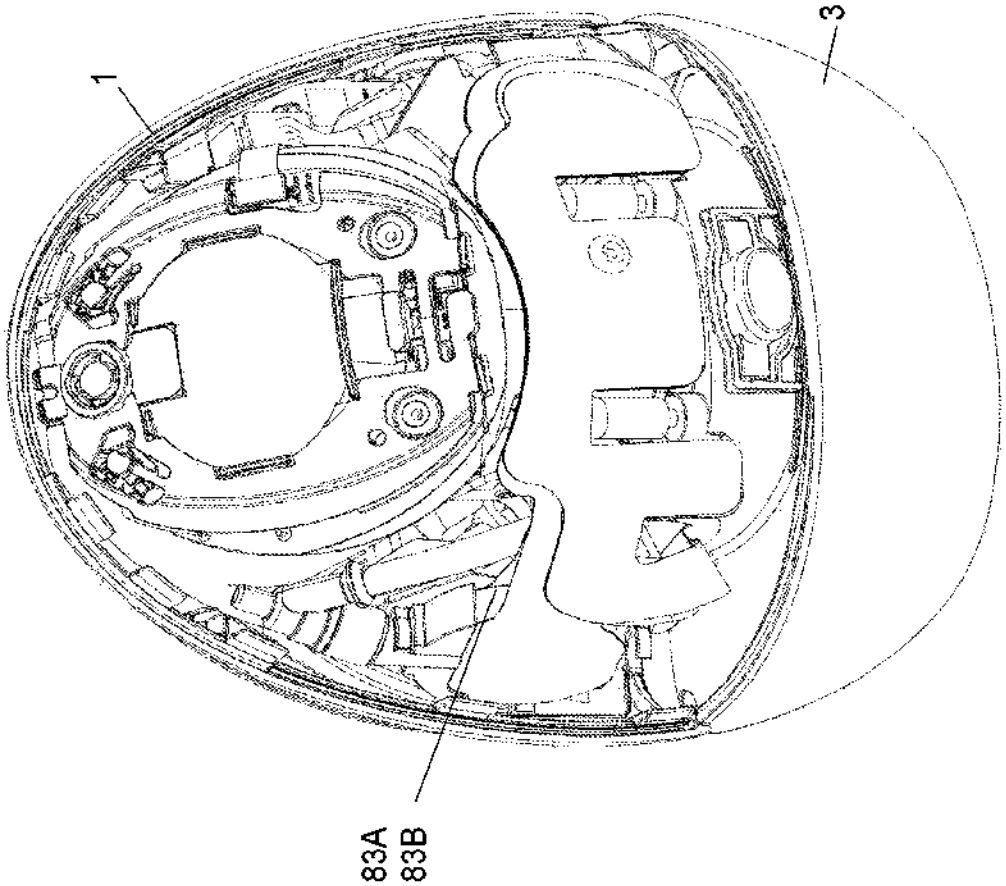

FIGURE 8

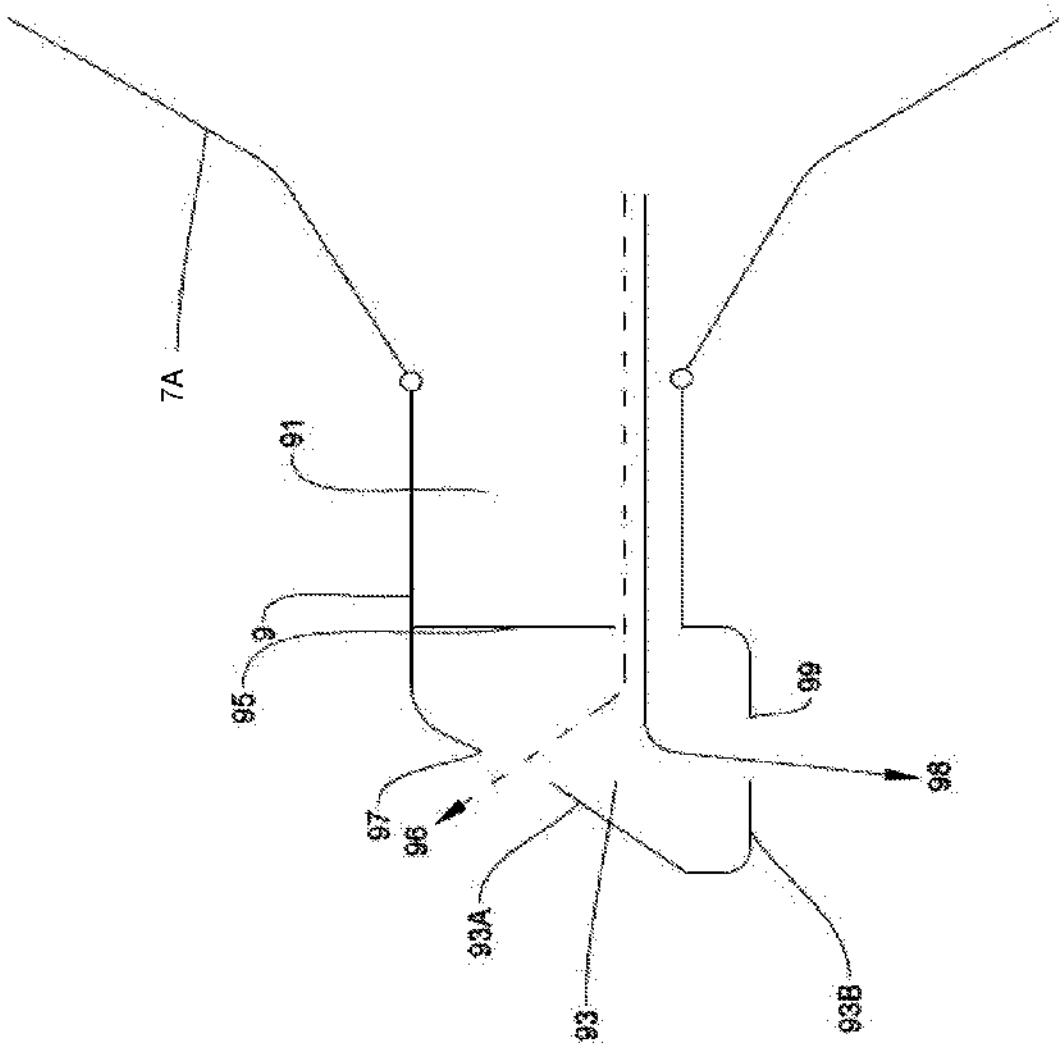

FIGURE 9

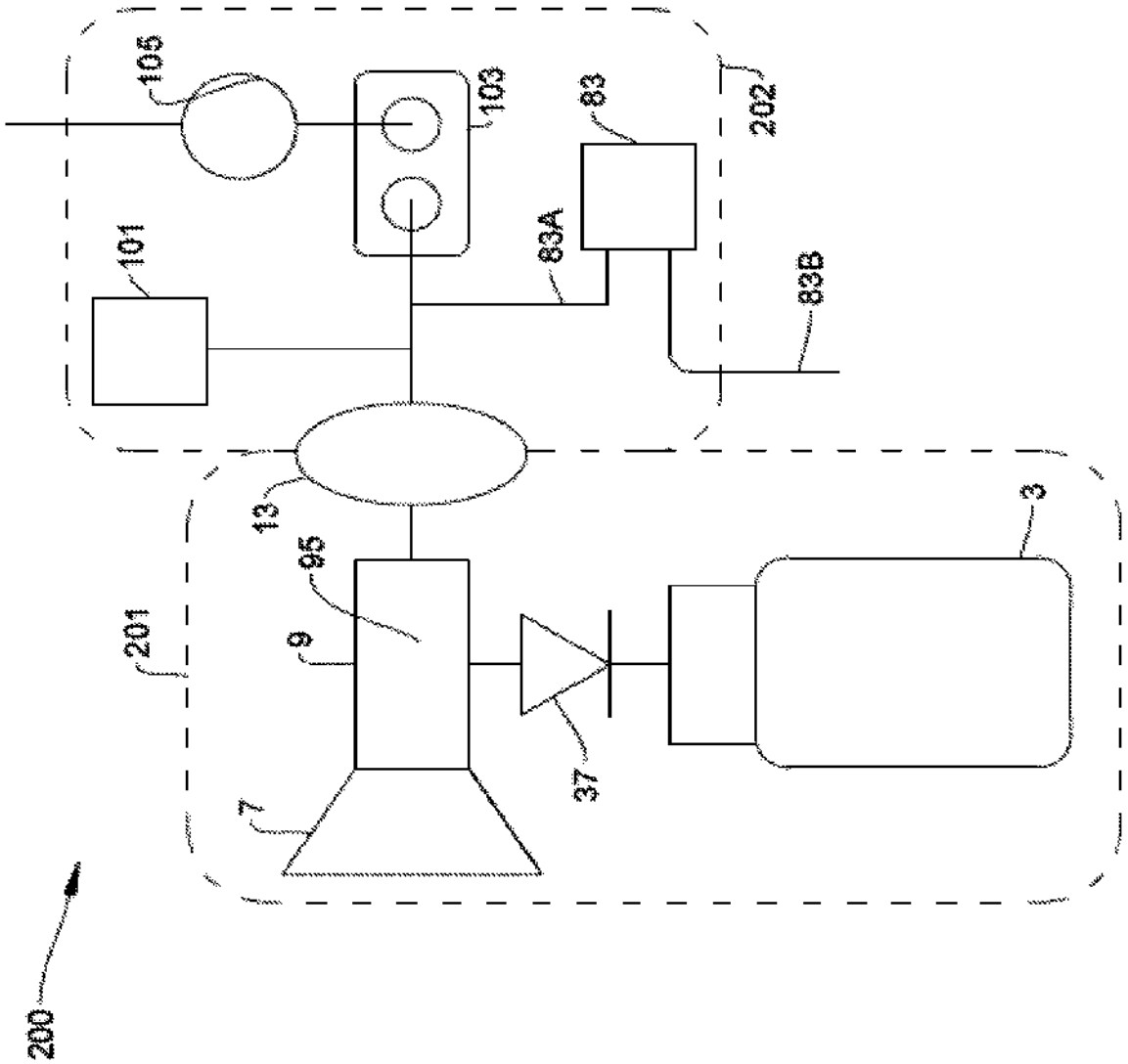

FIGURE 10

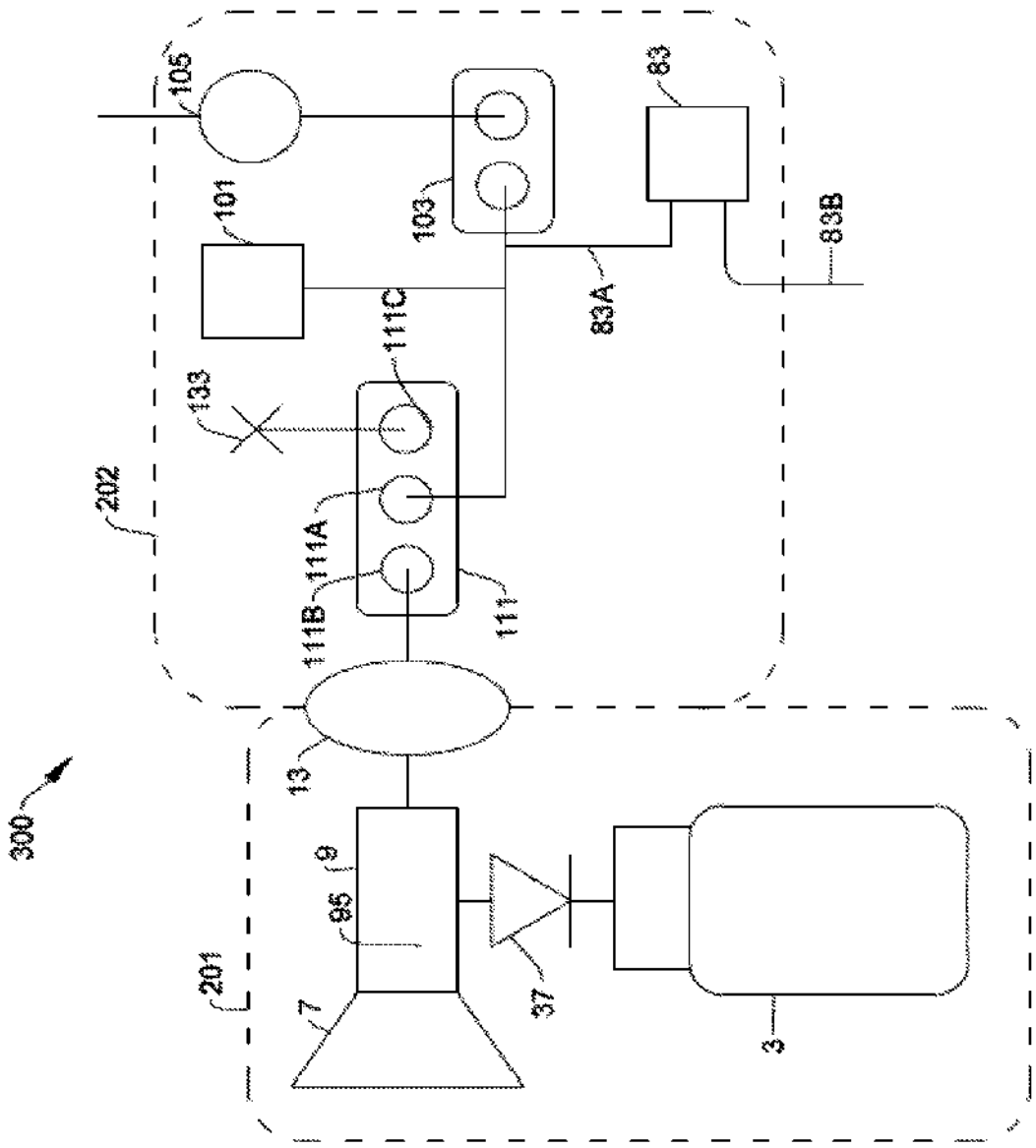
300
202
201
105
101
103
83
83B
83A
111C
133
111A
111B
111
13
9
95
7
37
3

FIGURE 11

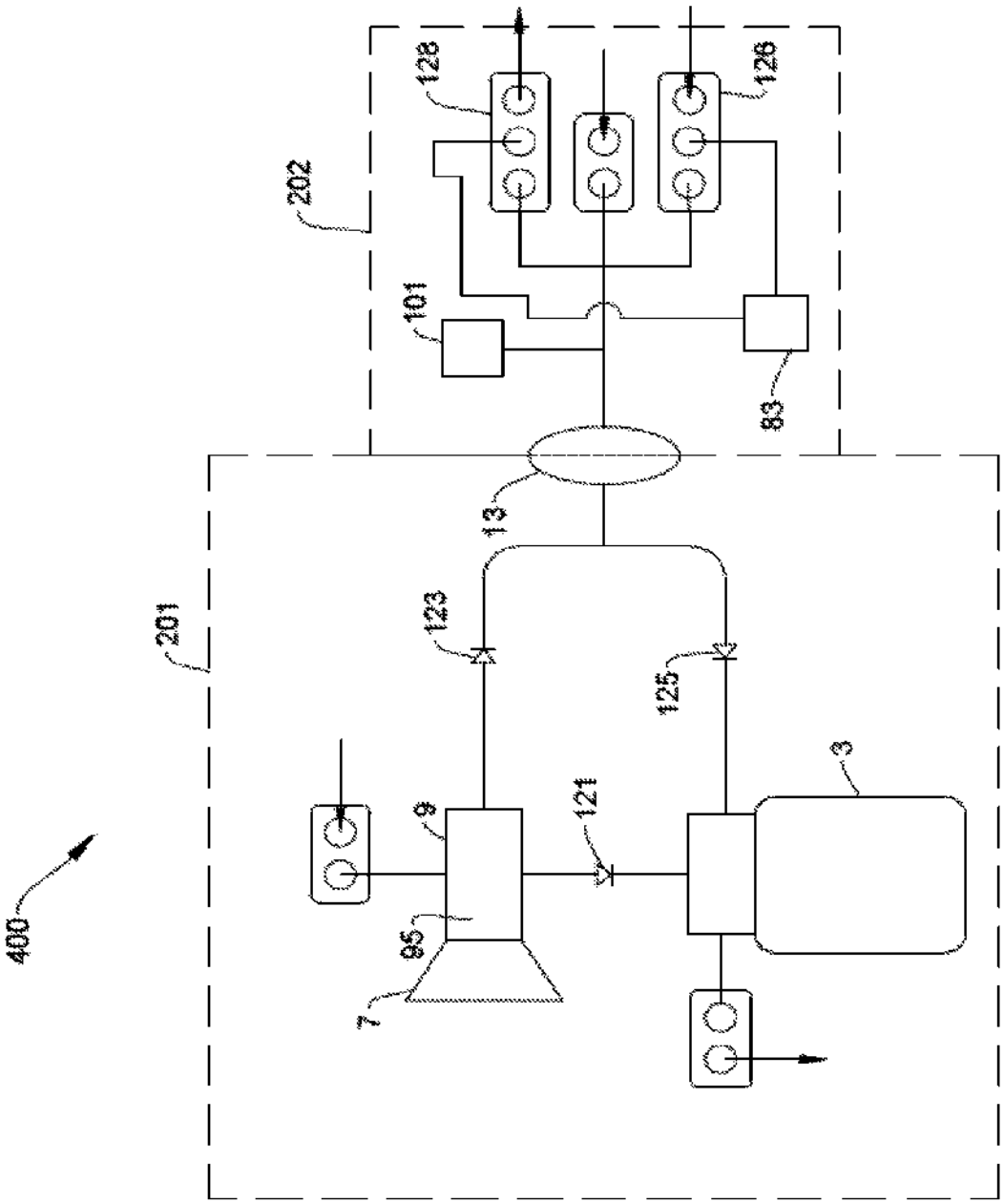

FIGURE 12

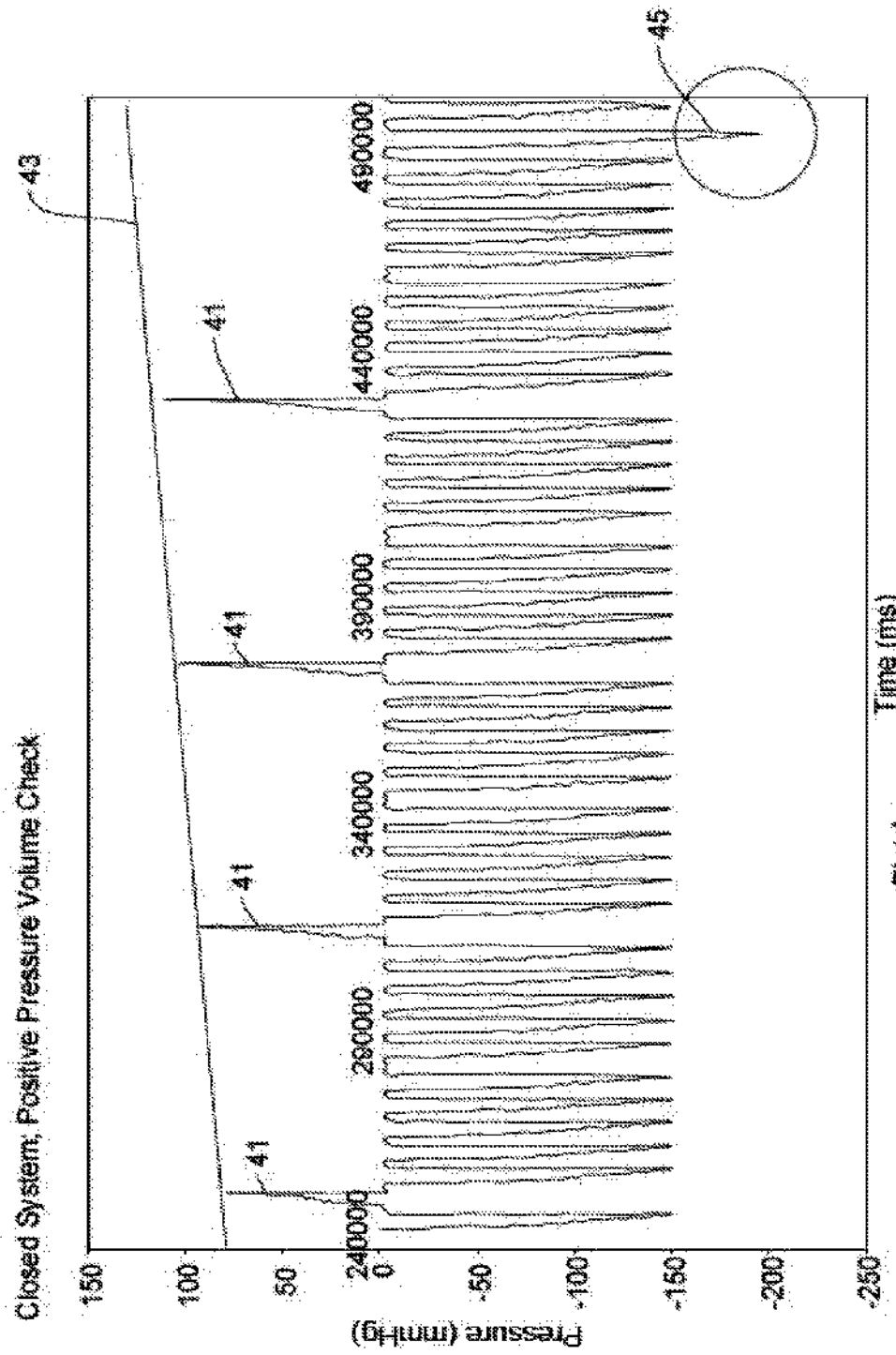
Closed System, Positive Pressure Volume Check
43
41
41
41
41
45
240000
280000
340000
390000
440000
490000
150
100
50
0
-50
-100
-150
-200
-250
Pressure (mmHg)
Time (ms)
Plot Area

FIGURE 13

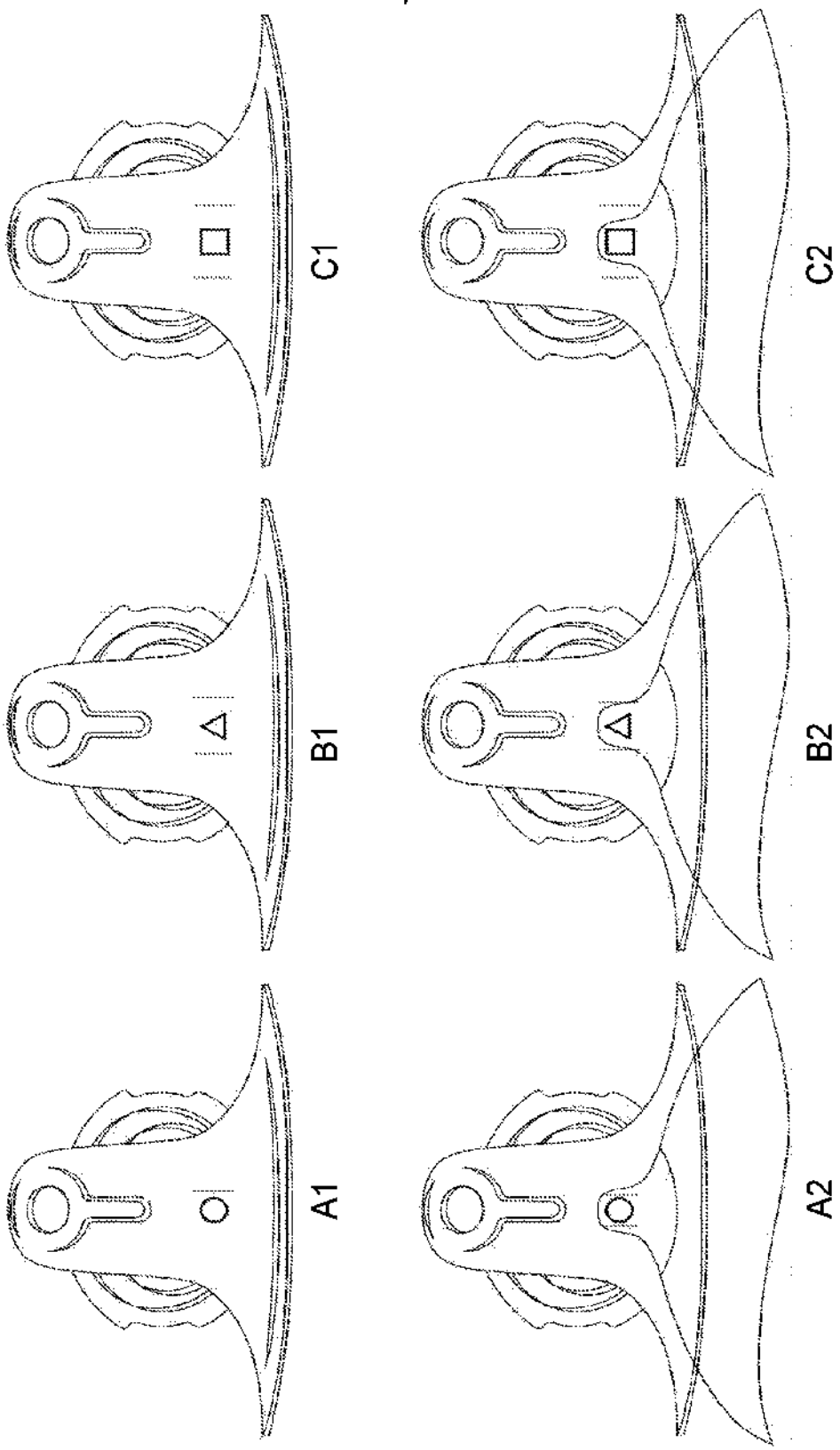

FIGURE 14

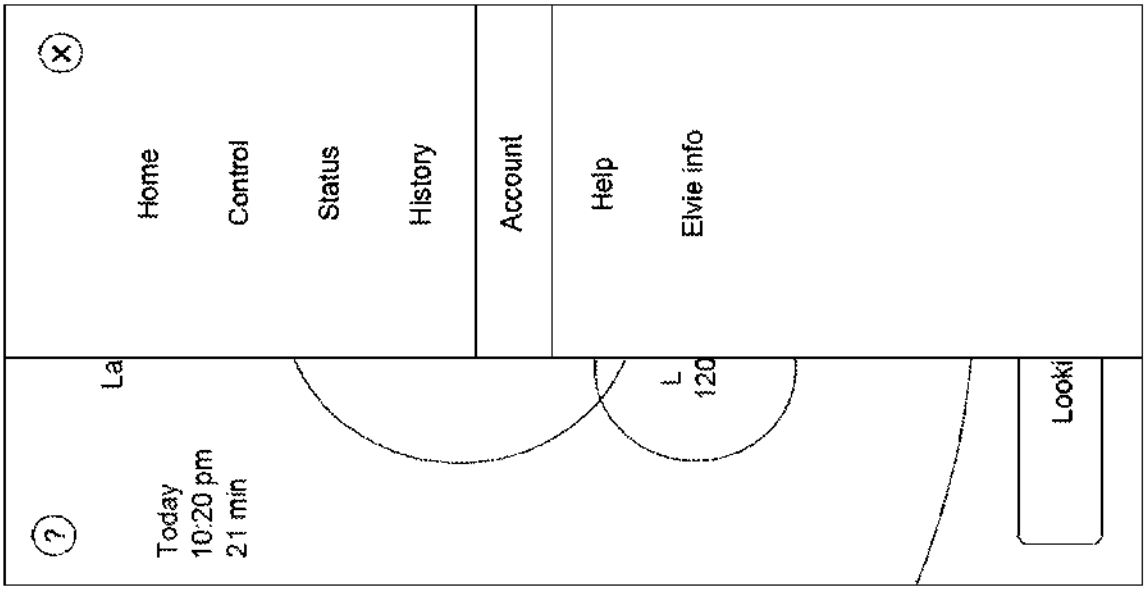
Home
Control
Status
History
Account
Help
Elvie info
Today
10:20 pm
21 min
Looki

FIGURE 15

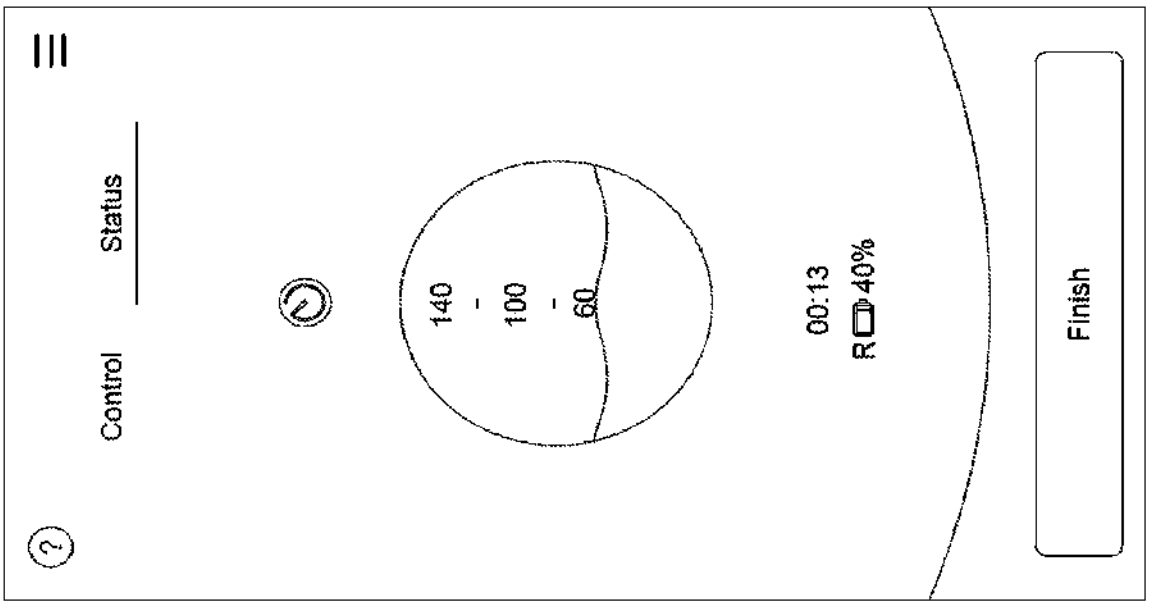

FIGURE 16

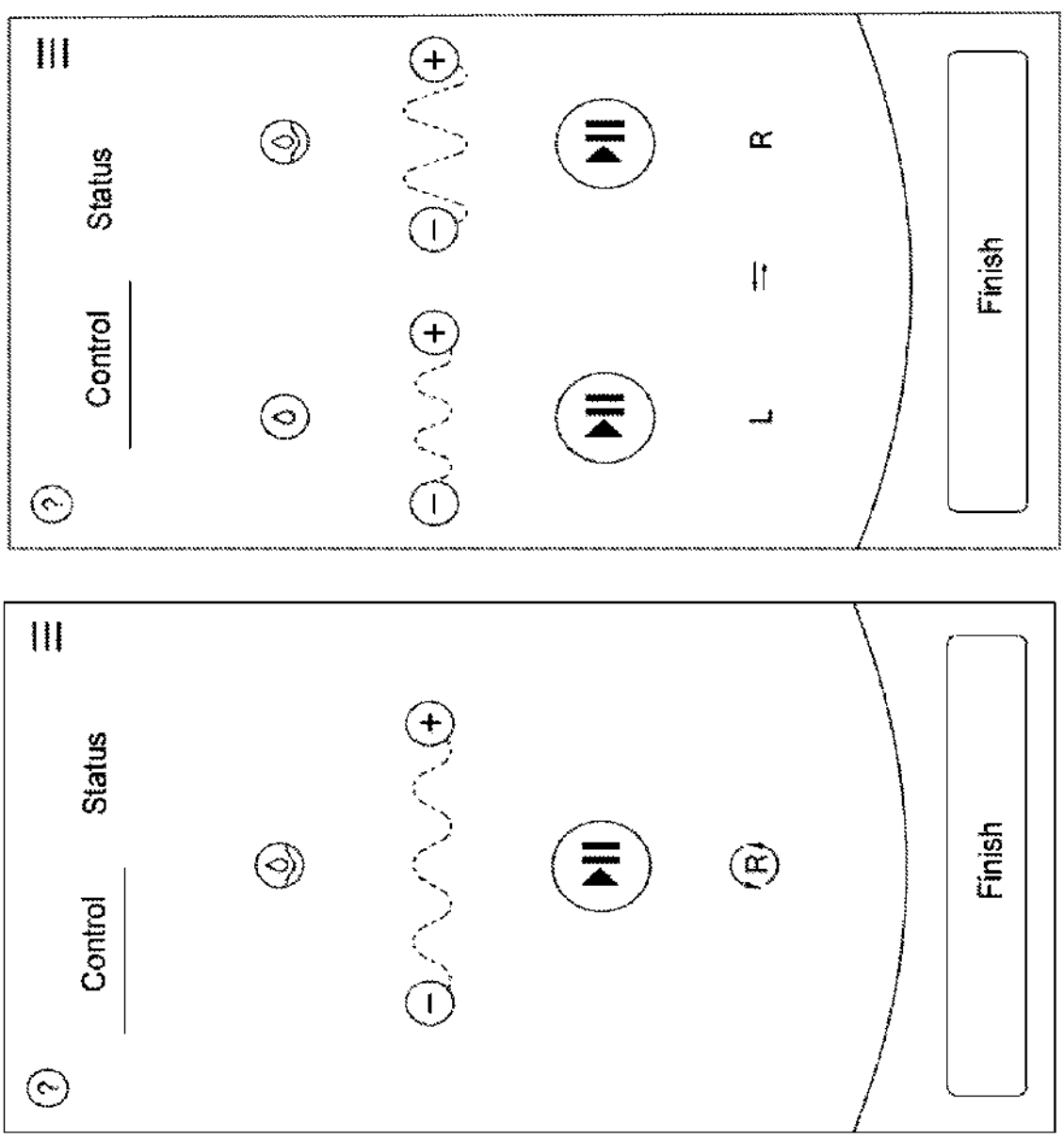

FIGURE 17

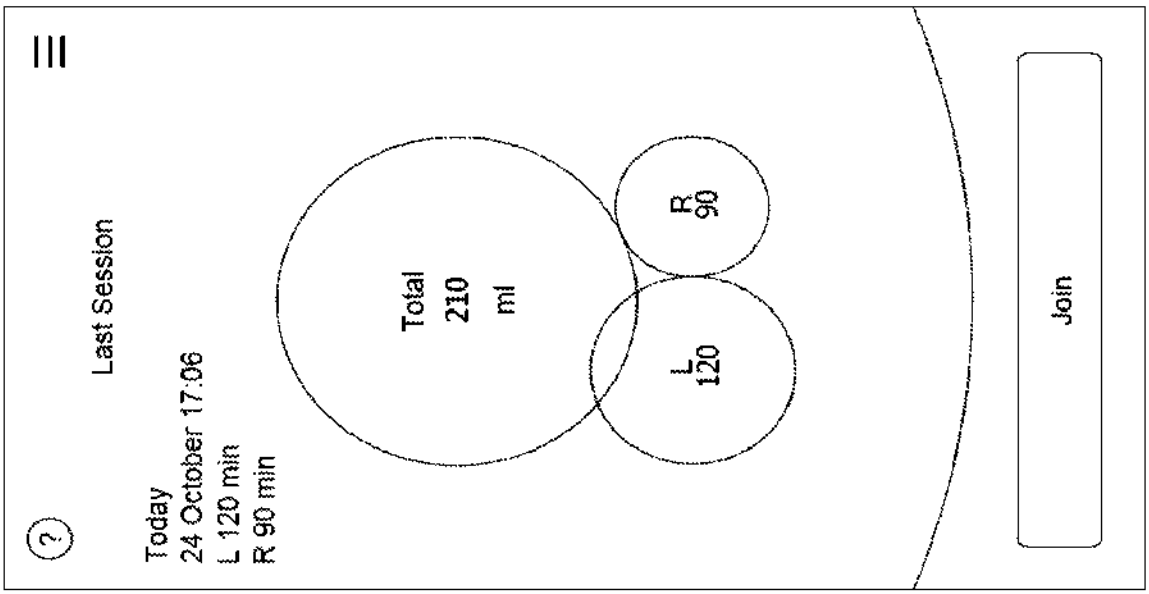
III
Last Session
Today
24 October 17:06
L 120 min
R 90 min
Total
210
ml
L
120
R
90
Join

FIGURE 18

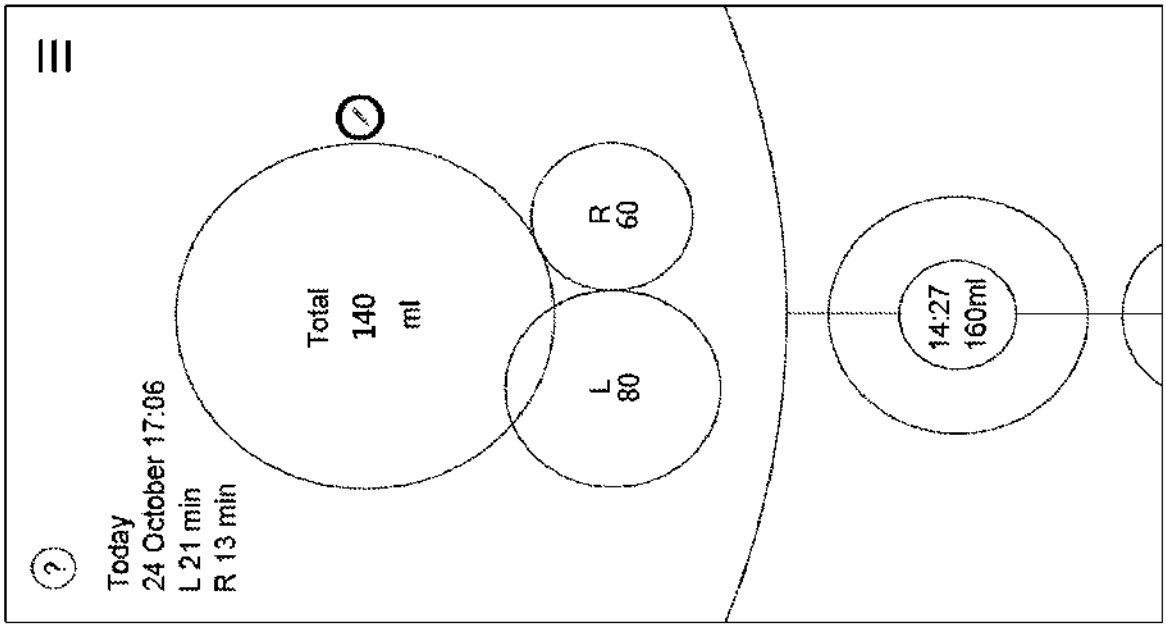
Today
24 October 17:06
L 21 min
R 13 min
Total
140
ml
L
80
R
60
14:27
160ml

FIGURE 19

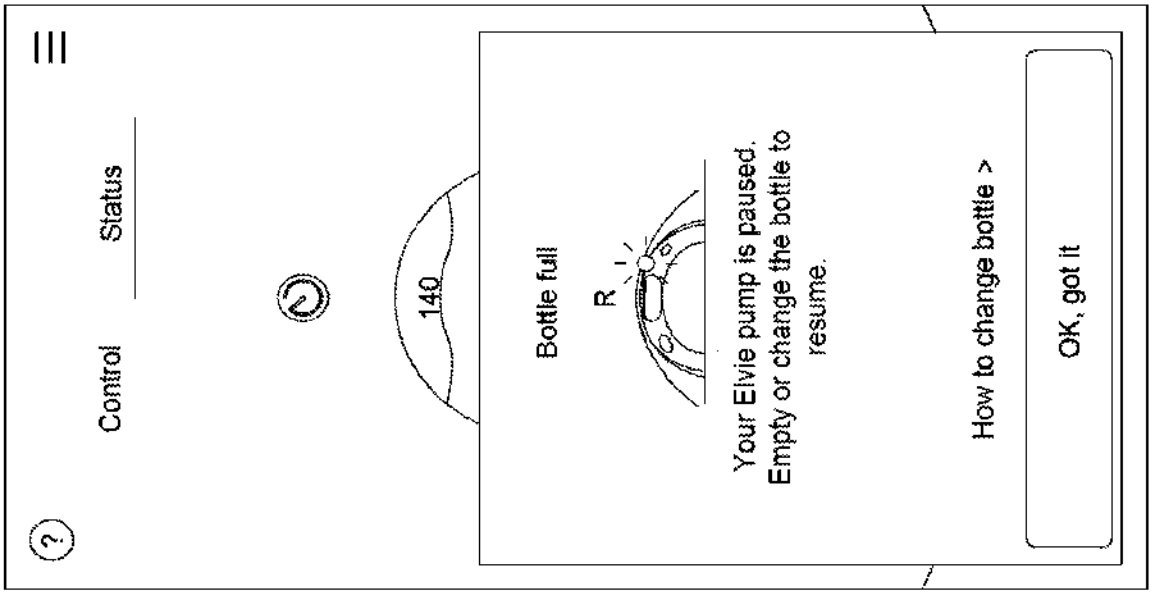
Control
Status
140
Bottle full
R
Your Elvie pump is paused.
Empty or change the bottle to resume.
How to change bottle >
OK, got it

FIGURE 20

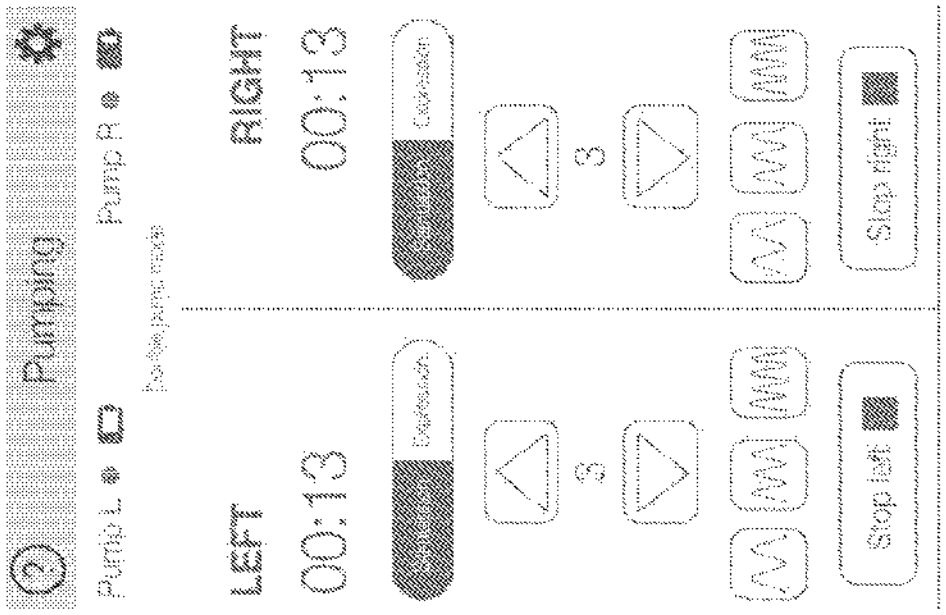
Pumpro
Pump L
Pump R
LEFT
00:13
Duration
RIGHT
00:13
Duration
Stop left
Stop right
Stop
Set a timer

FIGURE 21

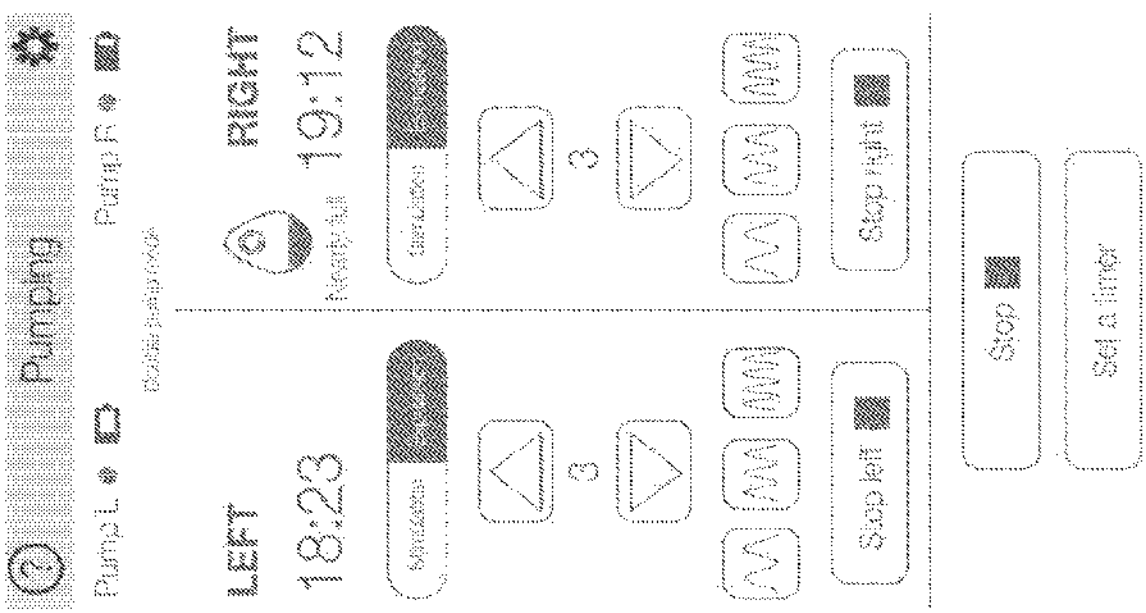
Pumping
Pump L
Pump R
LEFT
18:23
RIGHT
19:12
Nearly full
3
3
Stop left
Stop right
Stop
Set a timer

FIGURE 22

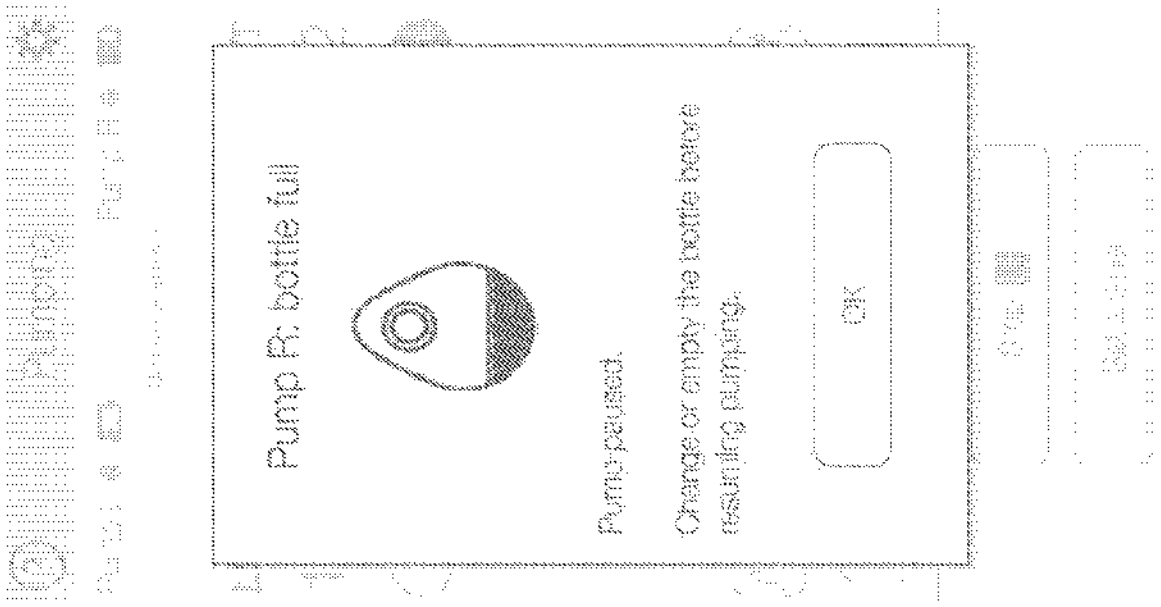
Pump Pr. bottle full
Pump paused.
Change or empty the bottle before resuming pump.
OK

FIGURE 23

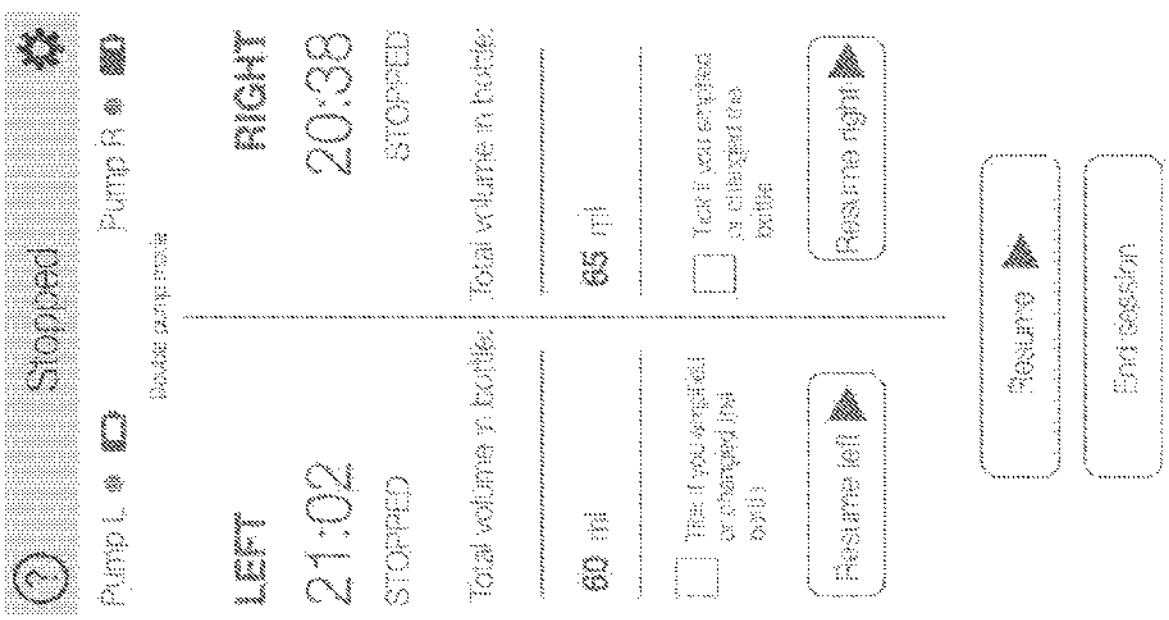
Stopped
Pump L
Pump R
Double pump mode
LEFT
21:02
STOPPED
Total volume in bottle:
60 ml
Tick if you emptied or changed the bottle
Resume left
RIGHT
20:38
STOPPED
Total volume in bottle:
65 ml
Tick if you emptied or changed the bottle
Resume right
Resume
End session

FIGURE 24

PUMP
Pump L
Pump R
LAST SESSION
Start time: 3:04pm today
Total volume: 125ml
LEFT
21mins 13s
60ml
RIGHT
16mins 11s
65ml
Full history >
NEW SESSION
Start

FIGURE 25

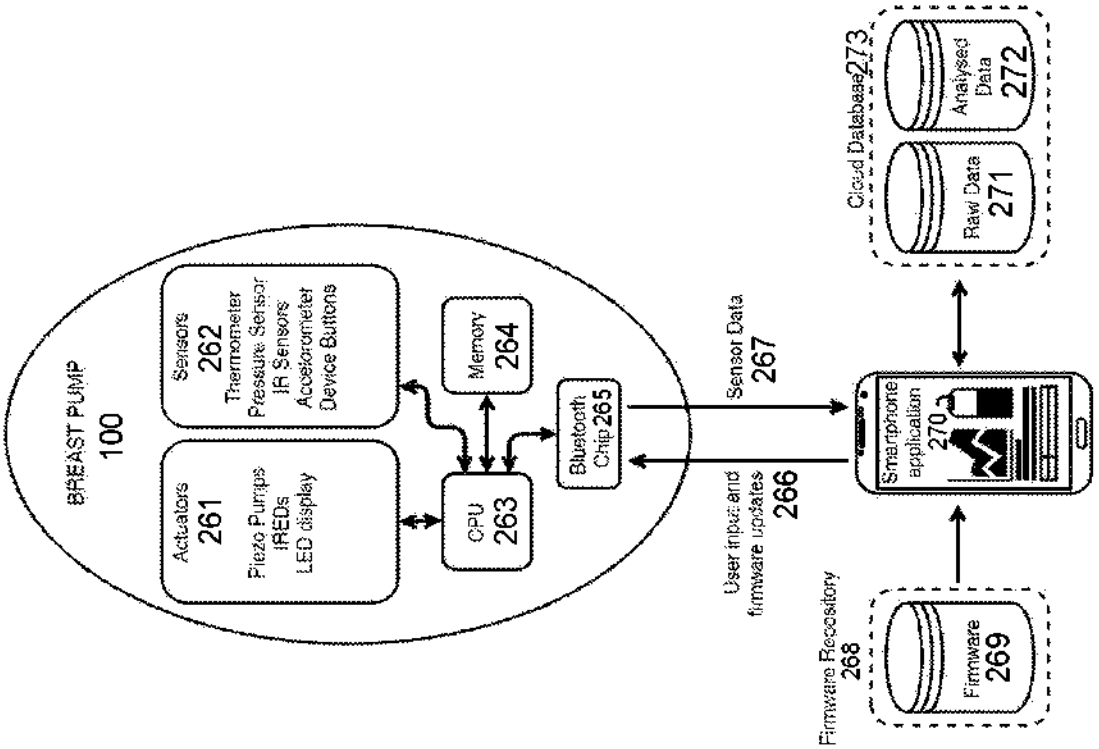
BREAST PUMP
100
Actuators
261
Piezo Pumps
IREDs
LED display
Sensors
262
Thermometer
Pressure Sensor
IR Sensors
Accelerometer
Device Buttons
CPU
263
Memory
264
Bluetooth
Chip 265
Sensor Data
267
User input and
firmware updates
266
Smartphone
application
270
Cloud Database 273
Raw Data
271
Analysed
Data
272
Firmware Repository
268
Firmware
269

FIGURE 26

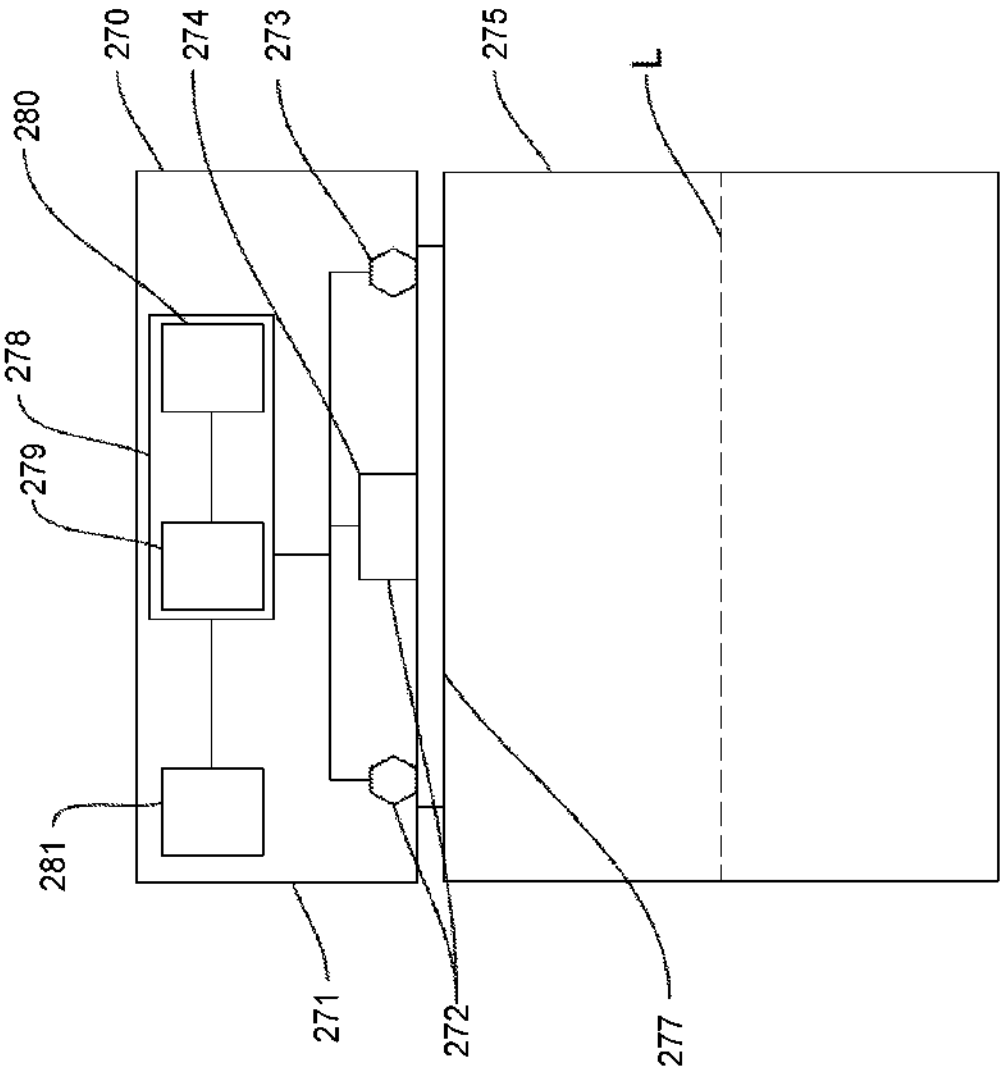

FIGURE 27

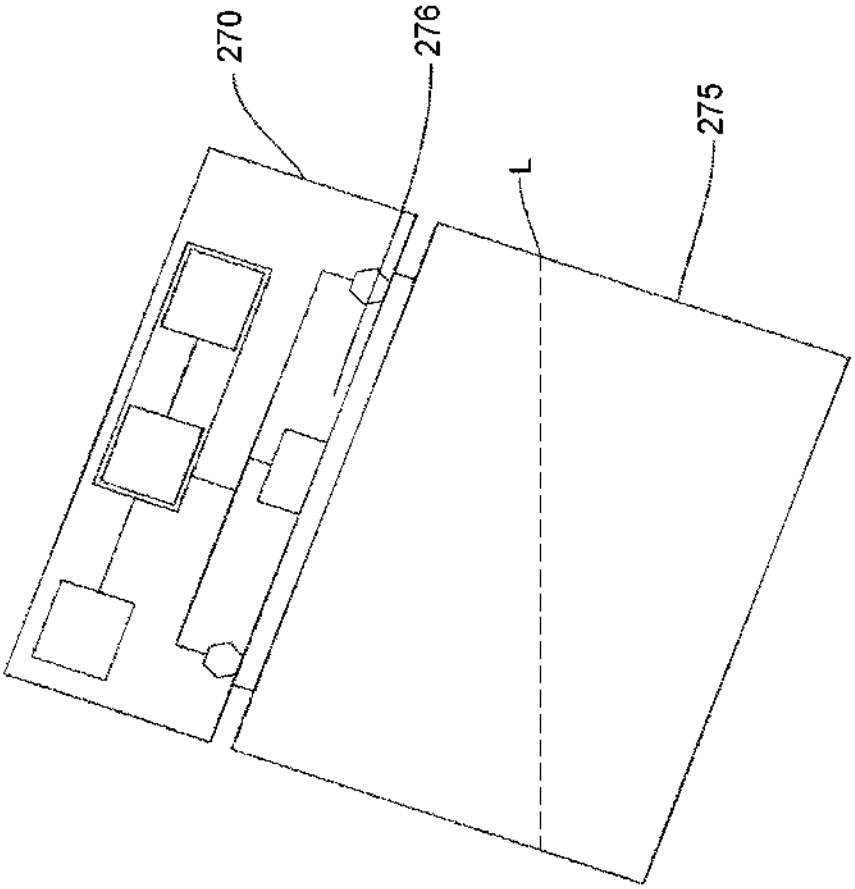

FIGURE 28

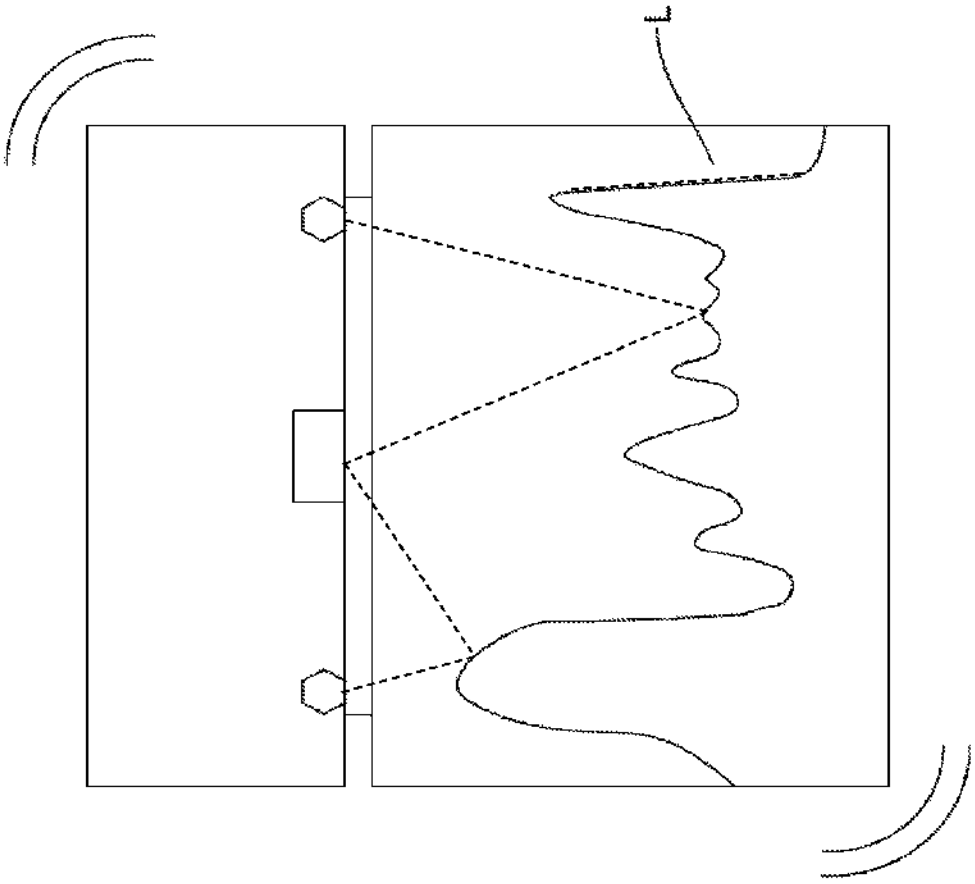

FIGURE 29

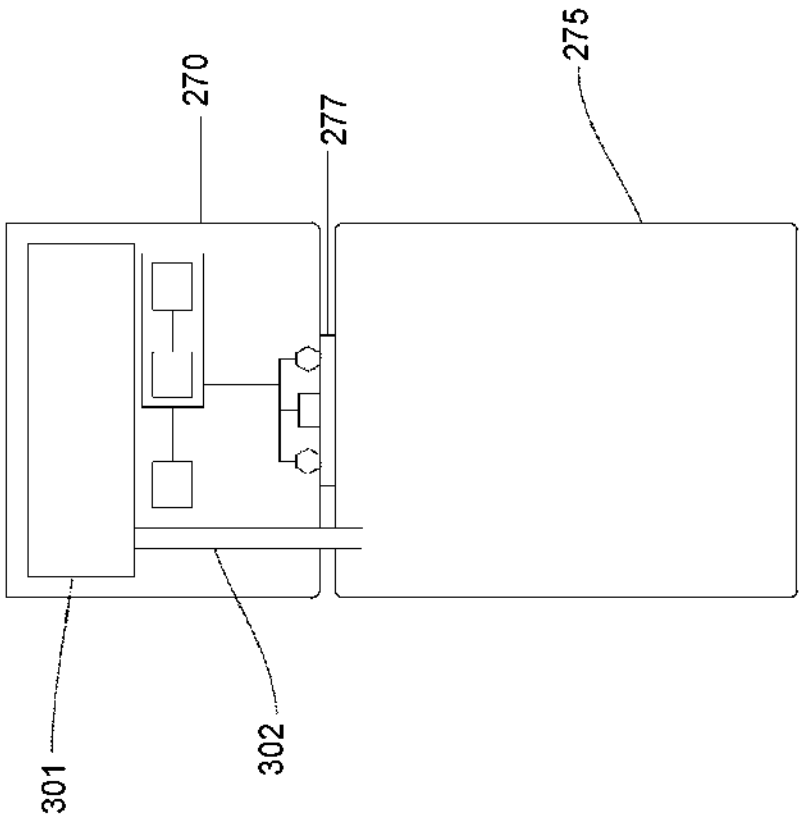

FIGURE 30

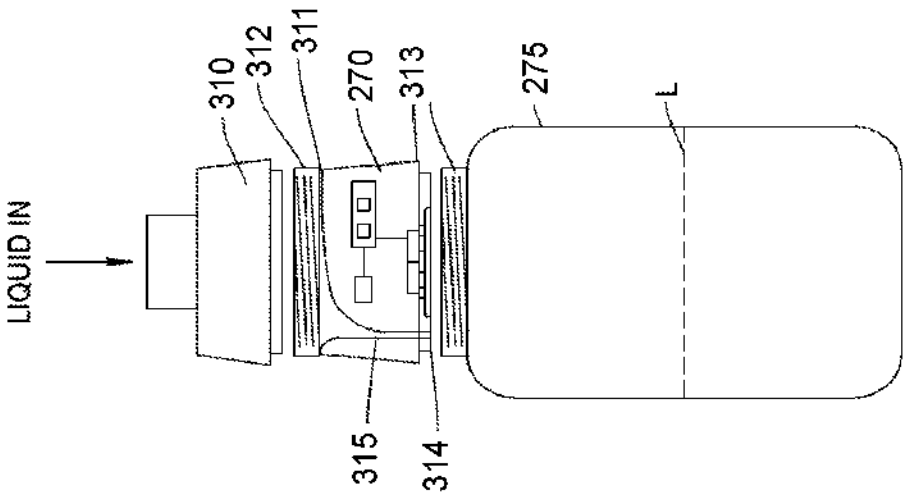

FIGURE 31

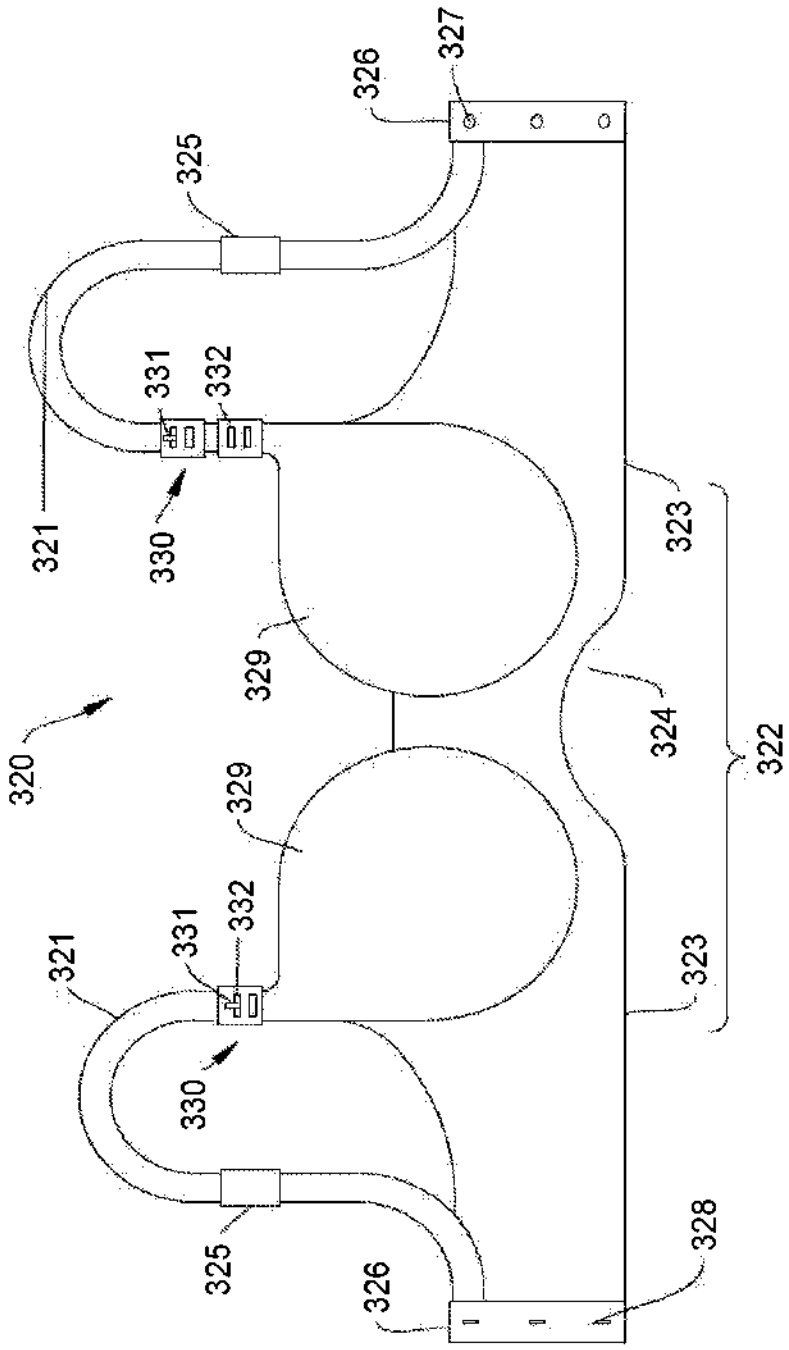

FIGURE 32

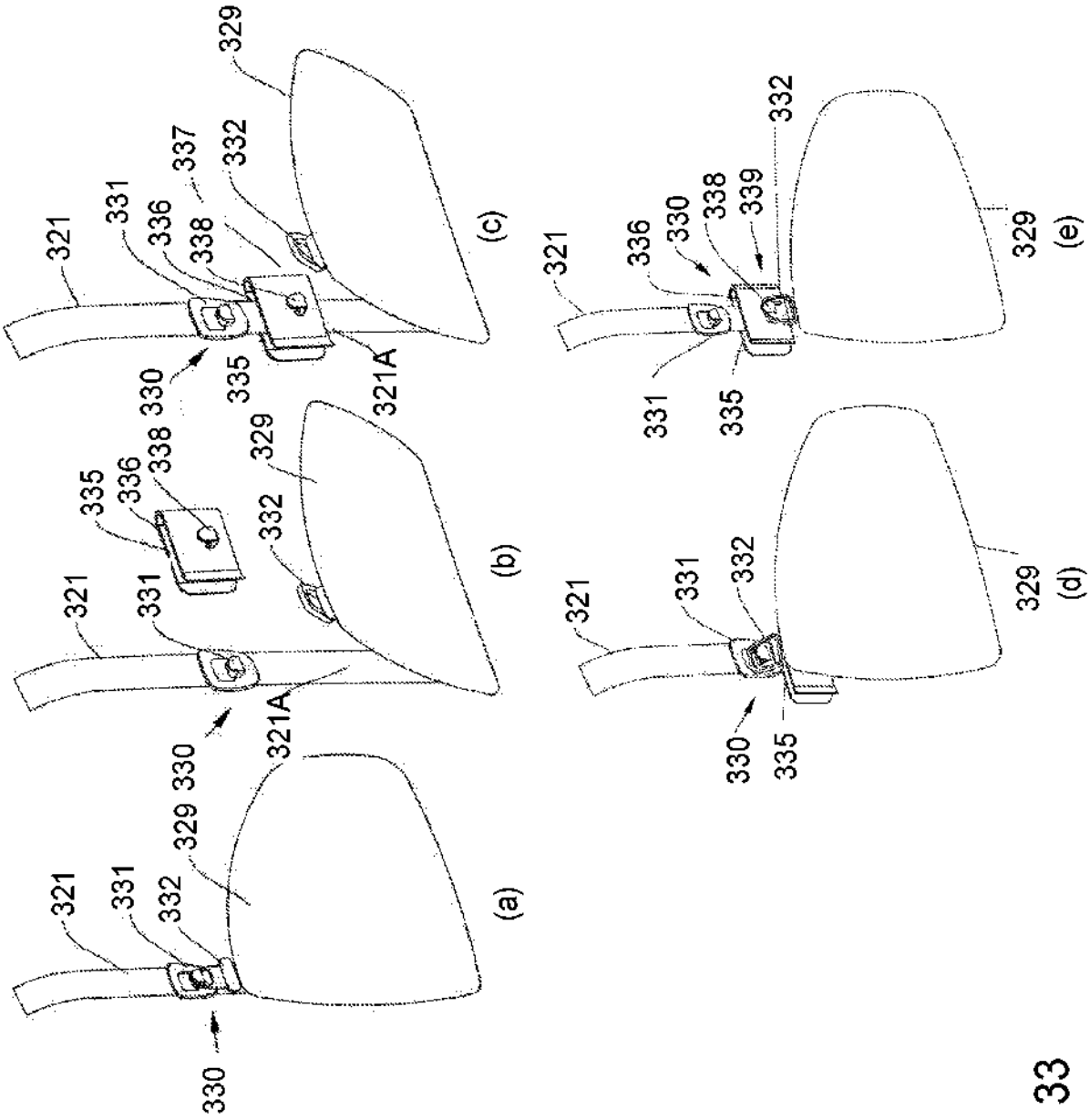
321
331
332
329
330
(a)
321
331
335
336
338
329
332
330
321A
(b)
321
331
336
338
337
332
329
330
335
321A
(c)
321
336
330
338
339
332
329
331
335
(e)
321
331
332
329
330
335
(d)

FIGURE 33

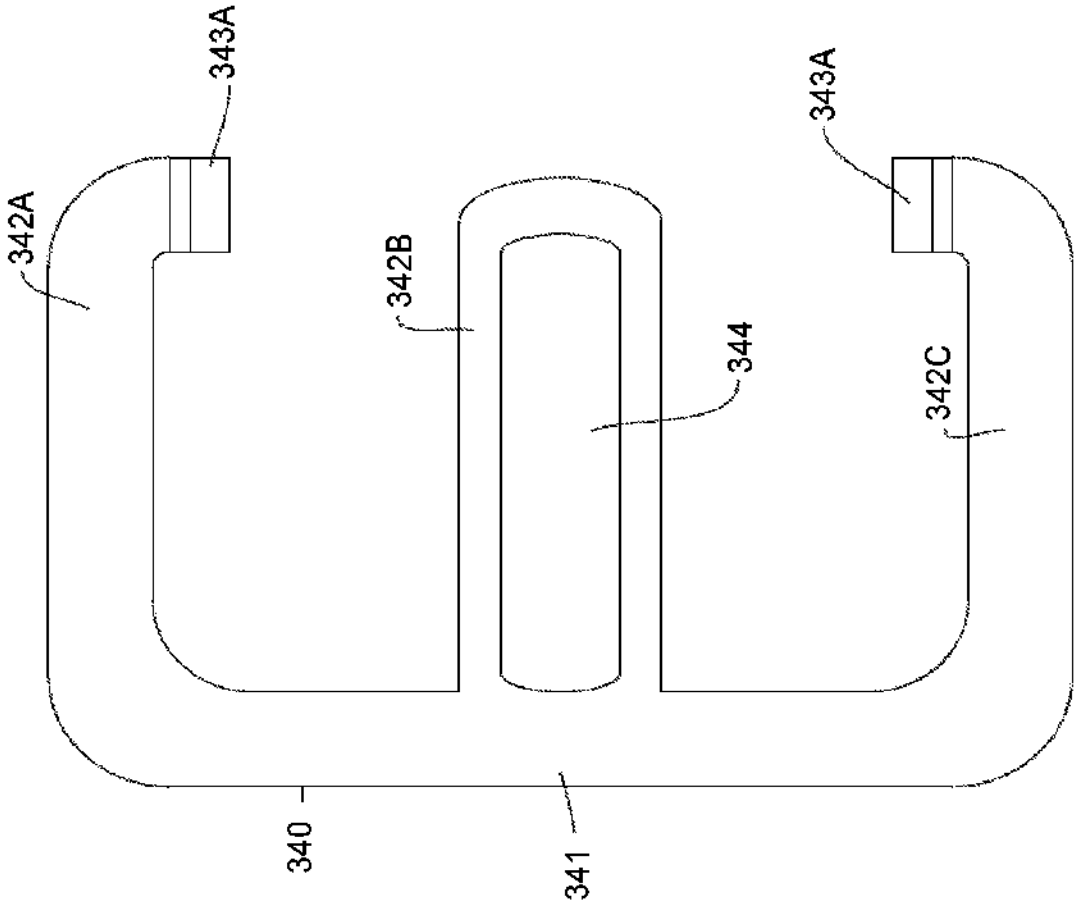

FIGURE 34

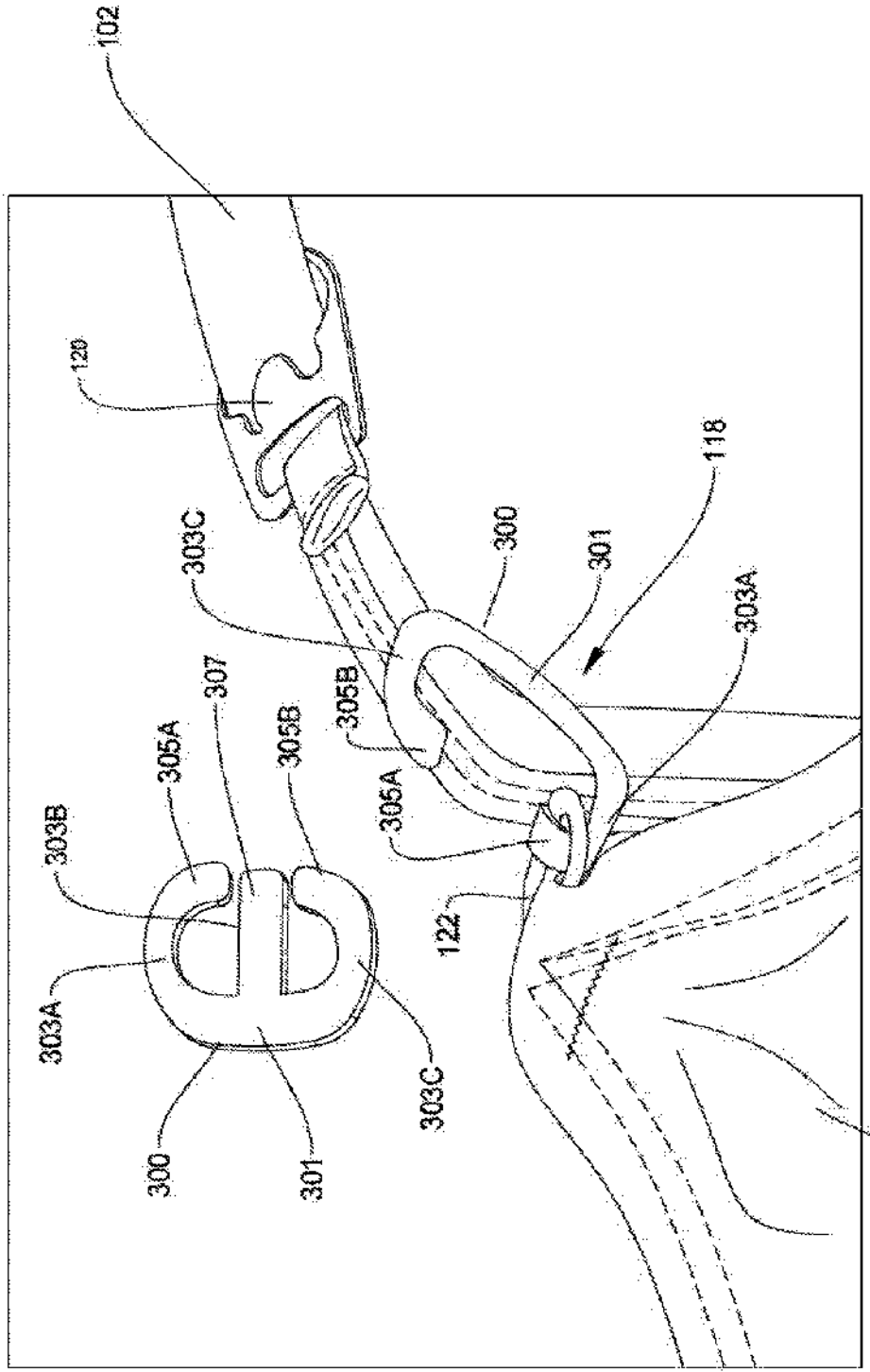
102
128
303C
300
301
118
303A
307
305B
305A
305B
305A
303B
122
303A
303C
300
301
116

FIGURE 35

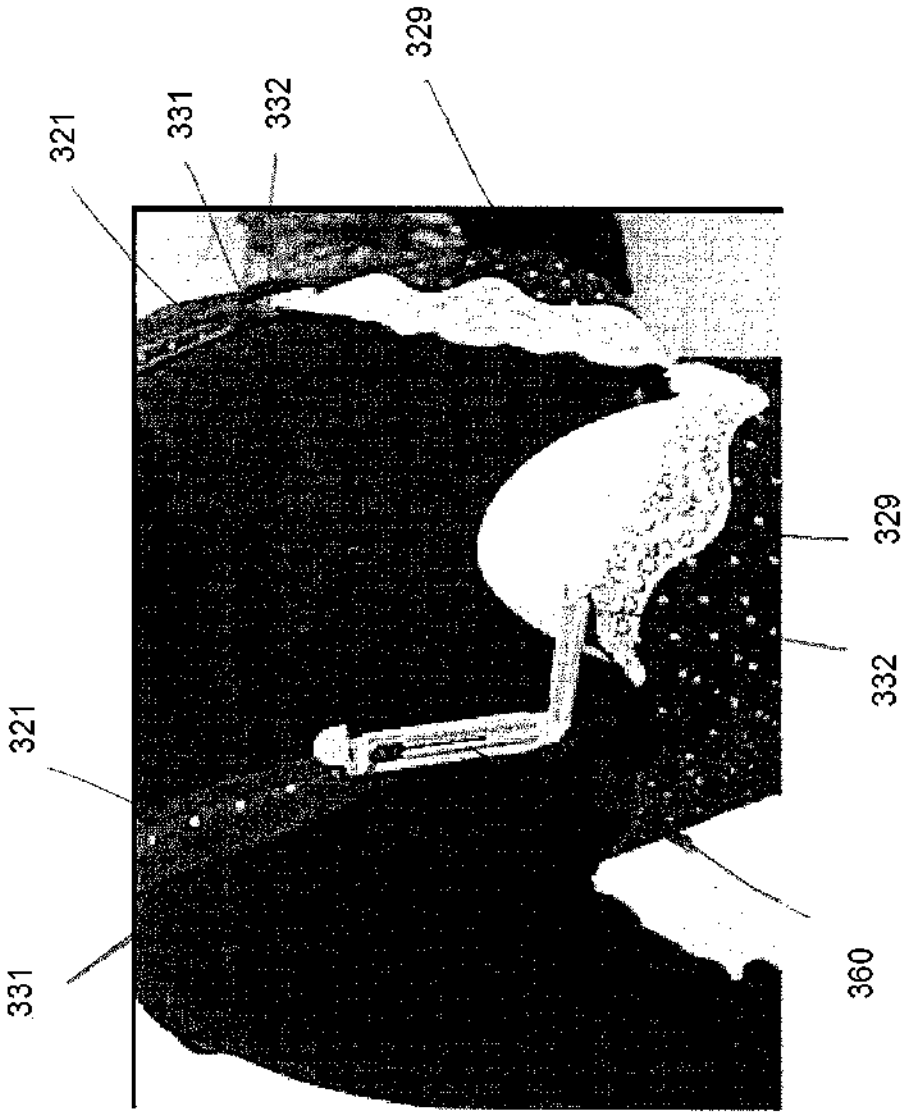

FIGURE 36

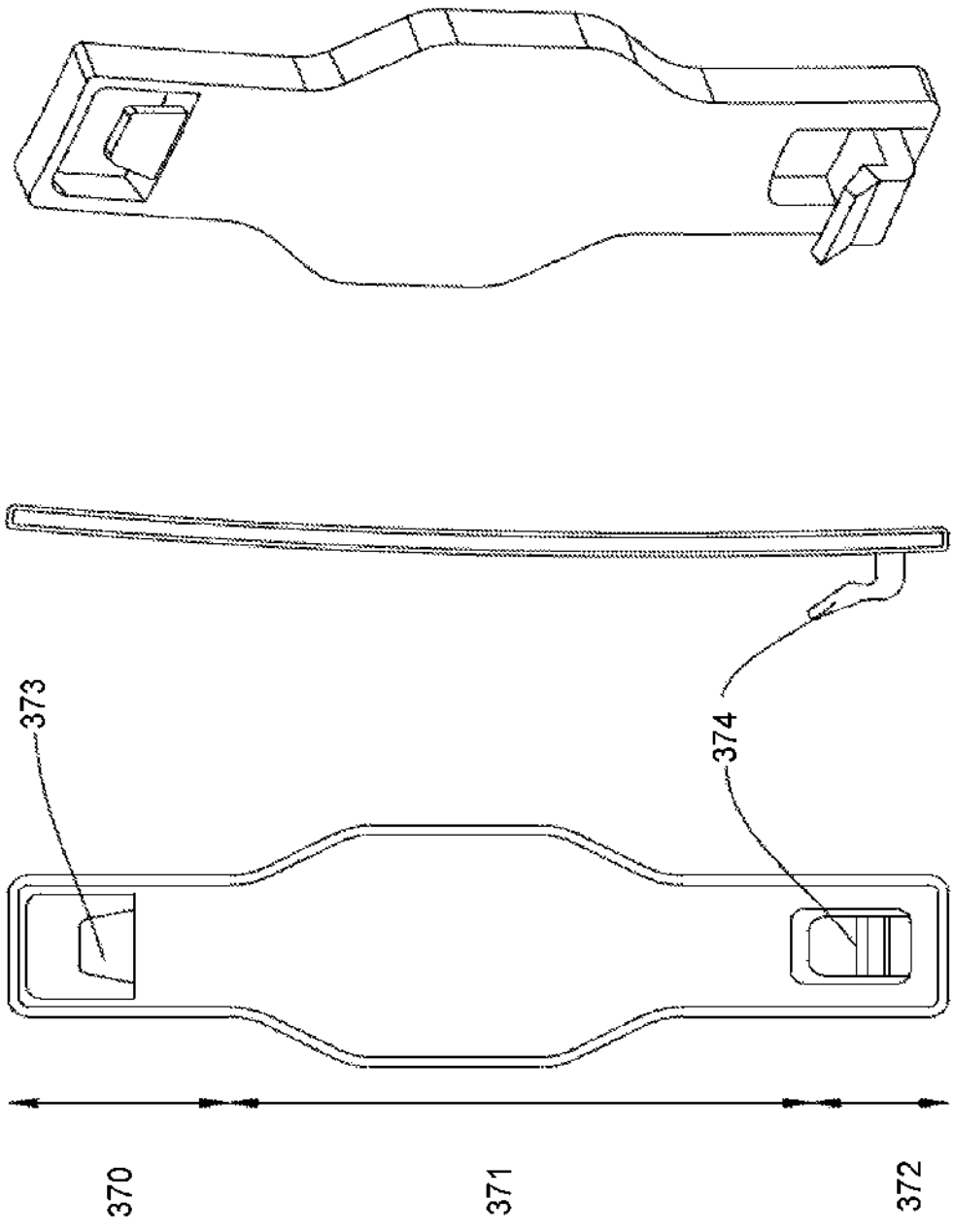

FIGURE 37

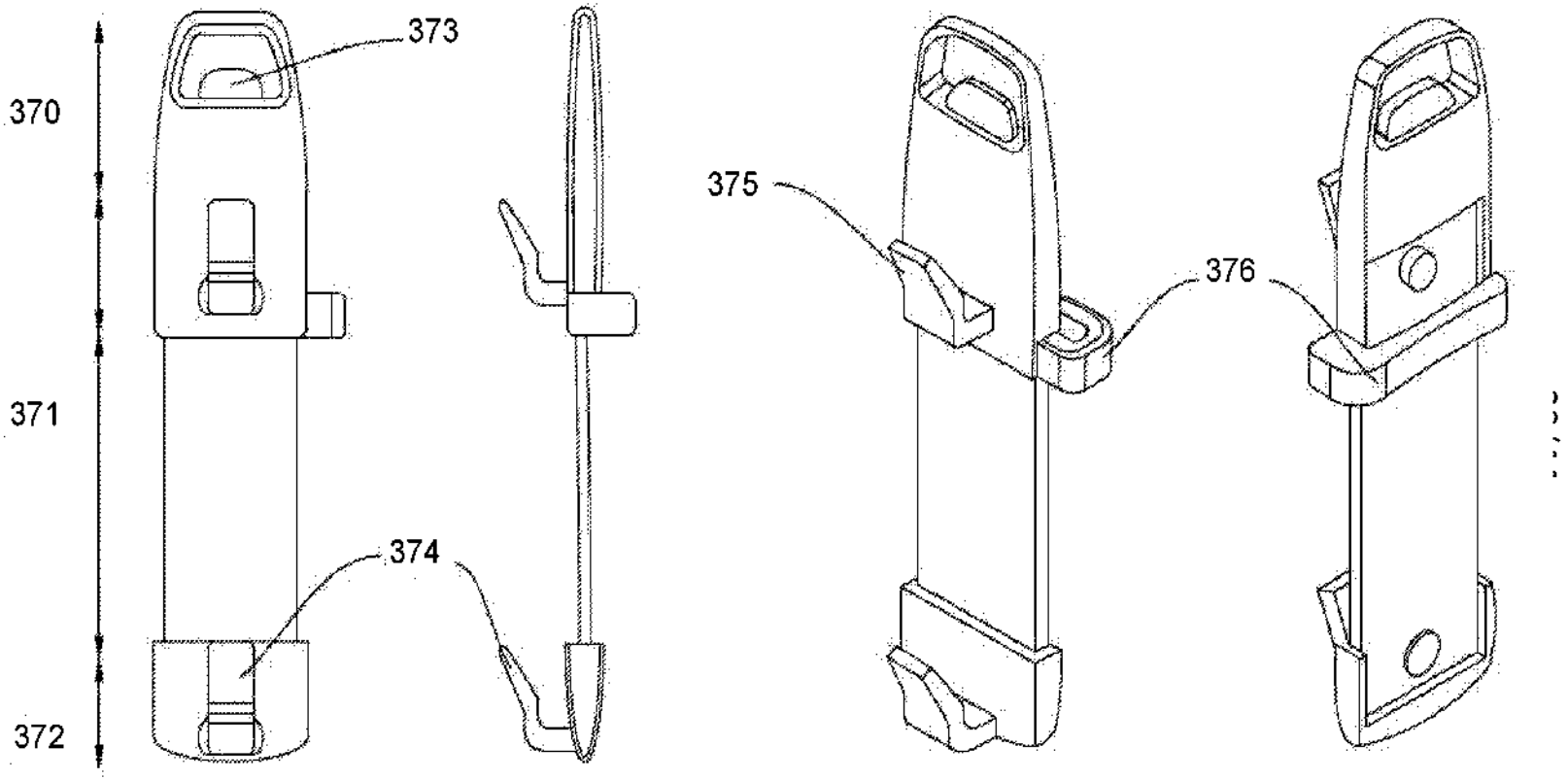

FIGURE 38

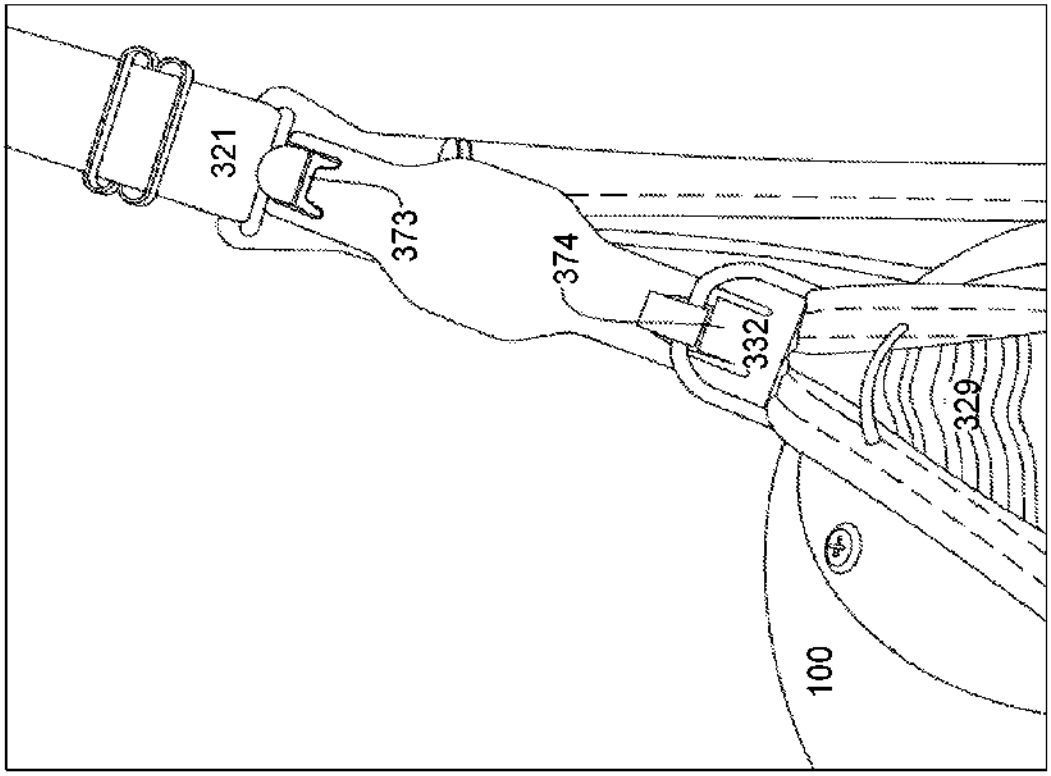

FIGURE 39

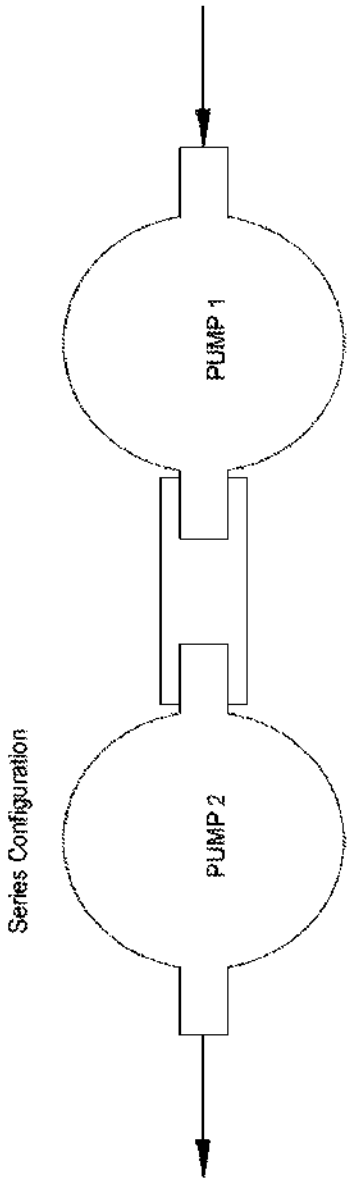

FIGURE 40

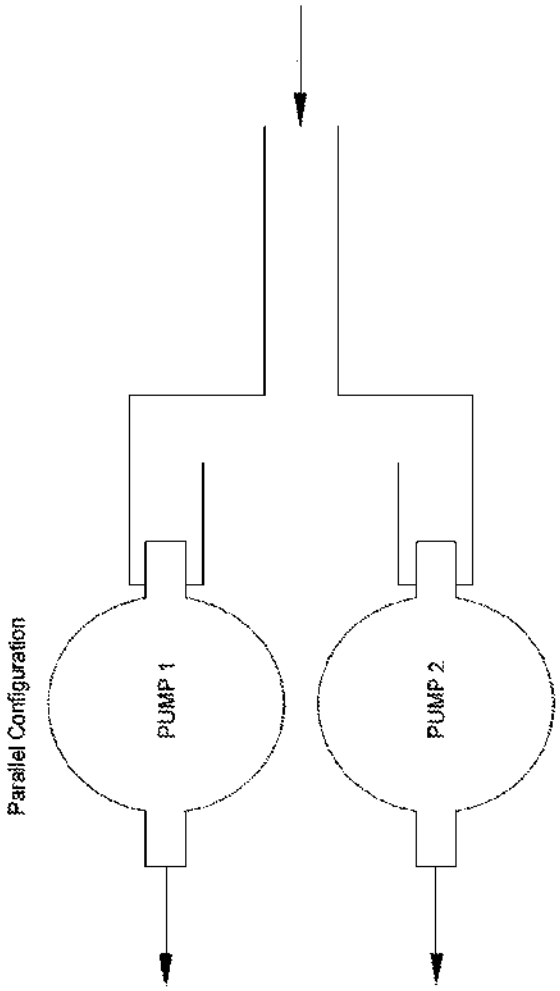

FIGURE 41

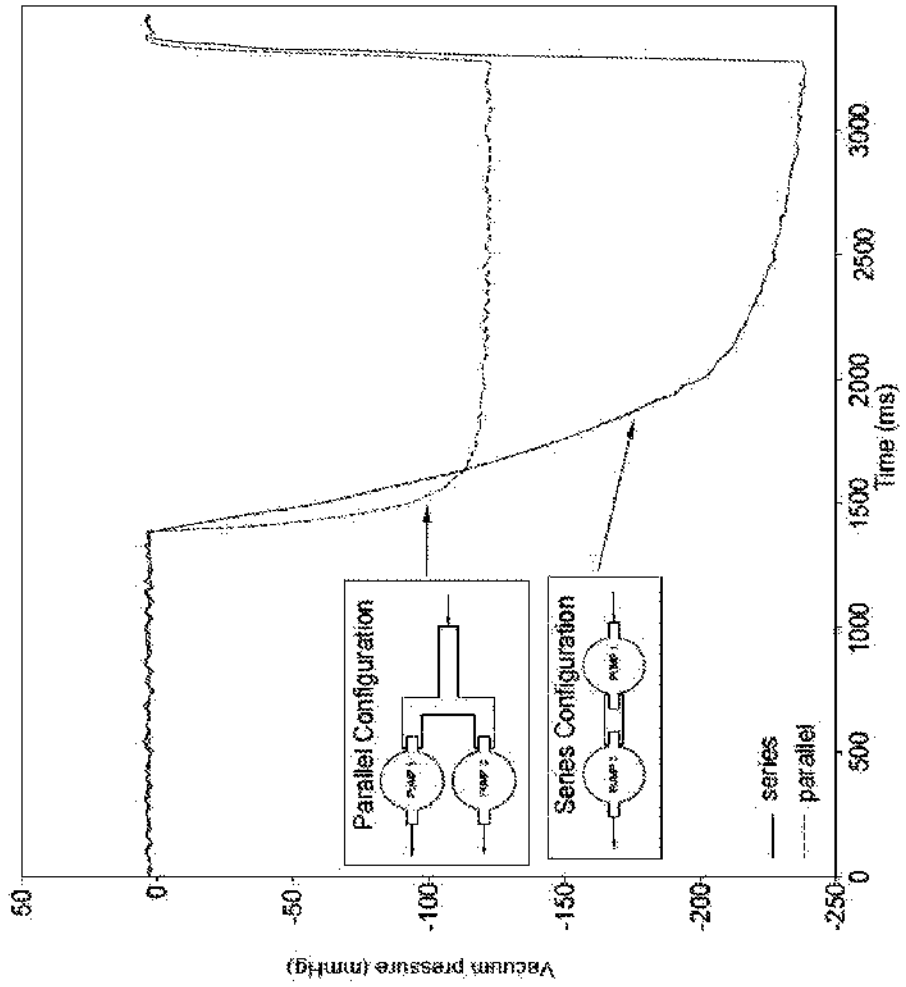
Vacuum pressure (mmHg)
50
0
-50
-100
-150
-200
-250
0
500
1000
1500
2000
2500
3000
Time (ms)
series
parallel
Parallel Configuration
Series Configuration

FIGURE 42

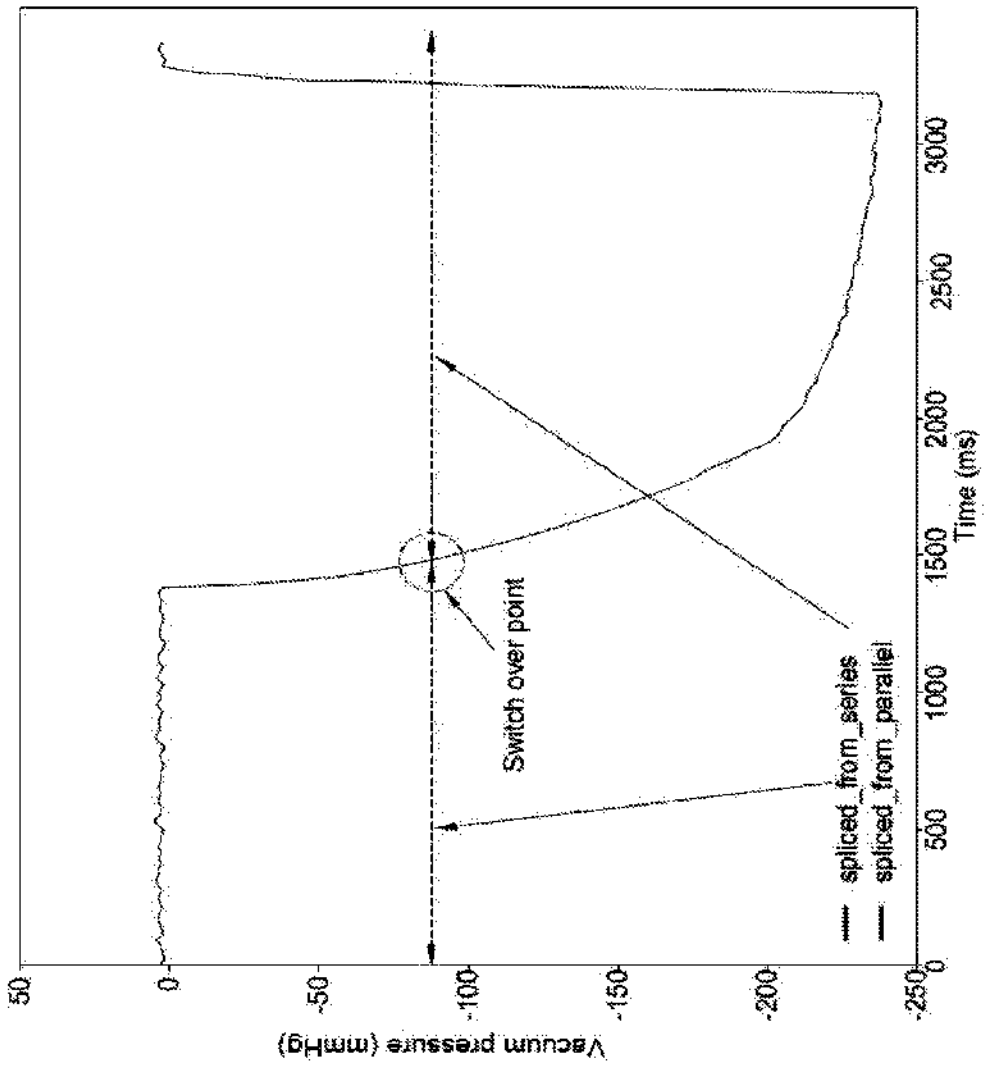
Vacuum pressure (mmHg)
50
0
-50
-100
-150
-200
-250
0
500
1000
1500
2000
2500
3000
Time (ms)
Switch over point
spliced_from_series
spliced_from_parallel

FIGURE 43

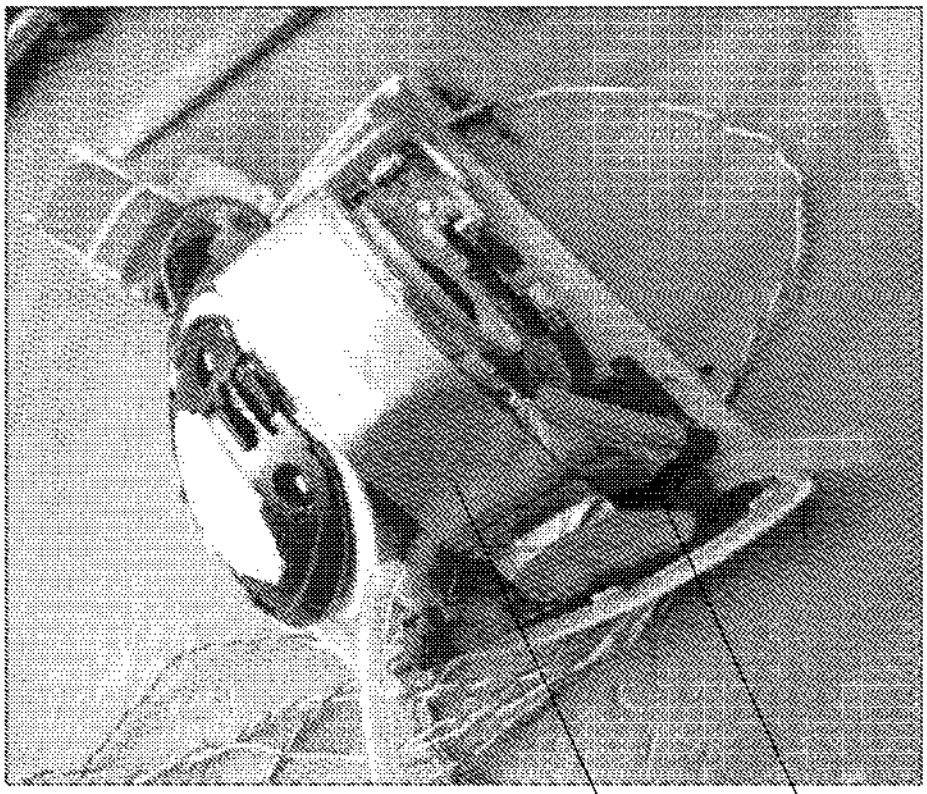

FIGURE 44

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Request for grant of a patent

Concept House
Cardiff Road
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Application number GB 1709566.2

1.	Your reference	**MJD/P153992GB00**
2.	Full name, address and postcode of the applicant or of each applicant	**CHIARO TECHNOLOGY LIMITED** **Second Floor 63-66 Hatton Garden** **London EC1N 8LE** **Greater London** **United Kingdom**
	Patents ADP number *(if you know it)*	**11287869002**
3.	Title of the invention	**BREAST PUMP**
4.	Name of your agent *(if you have one)*	**Boult Wade Tennant**
	"Address for service" to which all correspondence should be sent. This may be in the European Economic area or Channel Islands (see warning note below) *(including the postcode)*	**Boult Wade Tennant** **Verulam Gardens** **70, Gray's Inn Road** **London WC1X 8BT** **United Kingdom**
	Patents ADP number *(if you know it)*	**42001**
5.	Priority declaration: Are you claiming priority from one or more earlier-filed patent applications? If so, please give details of the application(s)	

Country	Application number	Date of filing	PDAS Access Code

6.	Divisionals etc: Is this application a divisional application, or being made following resolution of an entitlement dispute about an earlier application. If so, please give the application number and filing date of the earlier application	Number of earlier UK application	Date of filing *(day / month / year)*
7.	Inventorship: (Inventors must be individuals not companies) Are all the applicants named above also inventors?	**No**	
8.	Are you paying the application fee with this form?	**Yes**	

9. Accompanying documents: please enter the number of pages of each item accompanying this form.

Continuation sheets of this form

Description:	**20**
Claim(s):	**6**
Abstract:	**n/a**
Drawing(s):	**13**

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Priority documents:	**0**
Statement of inventorship and right to grant of a patent (Patents Form 7):	**1**
Request for search (Patents Form 9A):	**1**
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11. I/We request the grant of a patent on the basis of this application.

Signature: **/DRAPER, Martyn John/** Date: **15 Jun 2017**

12. Name, e-mail address, telephone, fax and/or mobile number, if any, of a contact point for the applicant

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BREAST PUMP

BACKGROUND

A breast pump is a mechanical device that extracts milk from the breasts of a lactating woman.

The typical breast pump design is as shown in WO 96/25187 A1. A large suction generating device is provided, which is freestanding. This is attached by air lines to one or two breast shields which engage with the user's breasts. A pressure cycle is applied from the suction generating device, via the air lines, to the breast shields. This generates a pressure cycle on the user's breasts to simulate the suction generated by a feeding child. The suction generating device is a large component that connects to mains power to operate the pumps therein.

Milk collection bottles are provided to store the expressed breast milk. In the system of WO 96/36298 A1 separate bottles are provided attached to each breast shield. However, in alternative embodiments there may be a single bottle with tubing connecting the breast shields thereto. For a mother to use this somewhat discretely, such as in an office environment, specialised bras must be used. In particular, breast-pumping bras which have a central slit, for the spout of the breast shield to extend through are typically used. The breast shield is held within the bra, with the suction generating device and milk bottle outside the bra.

The fundamental breast pump system has not been significantly altered from this, with minor technical improvements being the main developments.

However, these systems present a number of significant disadvantages. As the suction generating device is a large freestanding unit connected to the mains power, the user may feel tethered to the wall. The devices also require a specific user posture and undressing to function normally. This is obviously difficult for a user to do discretely, such as in an office setting.

Fully integrated wearable breast pumps have begun to enter the market, such as US 2016 206794 A1. In such pumps, the suction source, power supply and milk container are locally provided, without the need for bulky external components or connections. Such devices can be provided with a substantially breast shaped profile so as to fit within a

user's bra for discrete pumping, as well as pumping on-the-go without any tethers to electrical sockets or collection stations.

In US 2016 206794 A1, the breast pump has an offset shape favouring the lower half of the pump, and requires complex collapsible bag systems as milk collection devices. This is to force the pump to fit within the user's existing bras.

As the collection bag systems are collapsible, it will be very difficult for a user to extract all of their milk from the bag due to the small cut opening and capillary action between the bonded plastic sheets. This waste can be disheartening for the user as this is food for their child. The bags are also not re-usable, so the user is required to purchase and maintain a stock of these. As well as presenting a recurring cost, if the user runs out of stock they are unable to use the product until more bags are purchased.

Furthermore, as a result of the collapsible bags, a complex pumping arrangement is necessary. In particular, the breast shield connects to a tube which is provided with a plurality of compression units which "step" the expressed milk through the tube to the collection bag. This uses the breast milk as a hydraulic fluid to generate suction on the breast. In order to carry this out, a complex sequenced pulsing arrangement must be implemented.

In addition to these systems being particularly complex and wasteful, a relatively small bag must be used. In US 2016 206794, approximately 110 ml (4 fluid ounces) of milk can be collected before the bag must be changed. While this may be sufficient for some users, others may produce much more milk in a session.

A further integrated wearable breast pump is shown in US 2013 0023821 A1. In the third embodiment in this document, an integral breast pump is provided including a motor driven vacuum pump and power source. An annular (or punctured disc) membrane is provided, with the flow path of the milk going through the centre of the annulus. The membrane is housed in separate housing components and is sealed at its inner and outer edges. The breast shield has a small protrusion to engage with these housing components. However, the design of this breast pump results in a number of problems. The use of an annular membrane, with the fluid flow path running through the opening of the annulus is undesirable as it results in a large and bulky device.

There is therefore a need for improved integrated breast pump systems.

SUMMARY OF THE INVENTION

A breast pump according to a first embodiment of the present invention is provided according to claim 1. This breast pump is for wearing inside a bra, and comprises: a breast shield for engagement with the user's breast; a housing for receiving at least a portion of the breast shield; a pump inside the housing for generating a negative pressure in the breast shield; a battery inside the housing for powering the pump; a detachable rigid milk collection container attachable, in use, to a lower face of the housing and being in connected to the breast shield for collecting milk expressed by the user, with a milk-flow pathway defined from an opening in the breast shield to the milk collection container; and a barrier, the pump acting on one side of the barrier to generate a pressure on the opposite, milk-flow side of the barrier, the barrier having an outer periphery, wherein: the shield, housing, pump, battery and container are provided as a unit with a convex outer surface contoured to fit in a bra; and the milk-flow pathway extends past the outer periphery of the barrier.

This breast pump allows discrete wearing and use, which can fit within a user's bra. The milk-flow path extending past the outer periphery of the barrier allows for a simpler and more robust design, without the milk-flow pathway extending through the barrier. This provides increased interior space and functionality of the device.

A breast pump according to a second embodiment of the present invention is provided according to claim 2. The breast pump is for wearing inside a bra, the breast pump comprising: a breast shield for engagement with the user's breast; a housing for receiving at least a portion of the breast shield; a pump inside the housing for generating a negative pressure in the breast shield; a battery inside the housing for powering the pump; a detachable rigid milk collection container attachable, in use, to a lower face of the housing and connected to the breast shield for collecting milk expressed by the user with a milk-flow pathway defined from an opening in the breast shield to the milk collection container, wherein: the shield, housing, pump, battery and container are provided as a unit with a convex outer surface contoured to fit in a bra; and the breast shield comprises a shield flange for engaging the user's breast, and an elongate spout aligned with the opening and extending away from the user's breast, the spout being substantially aligned, in use, with the user's nipple and areolae; the spout comprising a first opening for depositing milk into

the collection container and a second opening for transferring pressure generated by the pump to the user's nipple, the shield flange and spout being detachable from the housing together.

This breast pump allows discrete wearing and use, which can fit within a user's bra. The shield flange and spout being detachable together helps further simplify the design, and reduce the number of components which must be removed for cleaning and sterilisation.

A breast pump according to a third embodiment of the present invention is provided according to claim 3. This breast pump is for wearing inside a bra, and comprises: a breast shield for engagement with the user's breast; a housing for receiving at least a portion of the breast shield; a piezo pump inside the housing for generating a negative pressure in the breast shield; a battery inside the housing for powering the pump; a detachable milk collection container attachable, in use, to a lower face of the housing and connected to the breast shield for collecting milk expressed by the user with a milk-flow pathway defined from an opening in the breast shield to the milk collection container, wherein the shield, housing, pump, battery and container are provided as a unit with a convex outer surface contoured to fit in a bra.

This breast pump allows discrete wearing and use, which can fit within a user's bra. The piezo pump is ideally suited for this environment as it is low noise and high strength with a compact size.

The breast shield of embodiments 1 or 3 may further comprise a shield flange for engaging the user's breast, and an elongate spout aligned with the opening and extending away from the user's breast, the spout being substantially aligned, in use, with the user's nipple and areolae; the spout comprising a first opening for depositing milk into the collection container and a second opening for transferring pressure generated by the pump to the user's nipple.

The shield flange and spout may be detachable from the housing together. Preferably, the spout will be integral with the breast shield. This helps to simplify the design and reduce the number of components which must be removed for cleaning and sterilisation.

The breast shield cup may extend over a majority of the inner surface of the unit, preferably the breast shield extends over 80% of the inner surface of the unit. This reduces the risk of milk contacting a part of the device which cannot be easily sterilised. This also helps to disperse the pressure applied to the user's breast across a larger area. Additionally, by covering the majority of the inner surface, the breast shield is the only component which contact's the wearer's breast. This leaves fewer surfaces which require thorough cleaning.

The spout may connect directly to the container. By reducing the distance covered by the milk, the device is reduced in size and complexity of small intermediate portions.

The spout may comprise an opening directly above the milk collection container. By reducing the distance covered by the milk, the device is reduced in size and complexity of small intermediate portions.

The breast pump of the second or third embodiments may further comprise a barrier mounted in the breast pump, the pump acting on one side of the barrier to generate a pressure on the opposite, milk-flow, side of the barrier.

Preferably, the barrier has an outer periphery and the milk-flow pathway extends past the outer periphery of the barrier. This allows for a simpler and more robust design, without the milk-flow pathway extending through the barrier.

Preferably the milk-flow pathway extends beneath the barrier. This provides an added benefit of having gravity tend the milk away from the barrier.

Preferably the milk-flow pathway does not pass through the barrier. This results in a simpler and smaller barrier design.

Preferably, the barrier is mounted on a housing on the breast shield. More preferably, the housing is integral with the breast shield. This further helps increase the ease of cleaning and sterilisation as all of the components on the "dirty" side can be removed.

Preferably, the barrier is not an annulus.

The barrier may provide a seal to isolate the pump from the milk-flow side of the barrier. This helps to avoid the milk becoming contaminated from the "dirty" airflow side.

Preferably, the only seal is around an outer edge of the barrier. This is a simple design as only a single seal needs to be formed and maintained. Having multiple seals, such as for an annular membrane, introduces additional complexity and potential failure points.

Preferably, the barrier is a diaphragm.

Preferably, the diaphragm is a continuous membrane which is devoid of any openings or holes. This provides a larger effective "working" area of the diaphragm (i.e. the area of the surface in contact with the pneumatic gasses) than an annular membrane and hence the membrane may be smaller to have the same working area.

The breast pump may further comprise a pressure sensor in pneumatic connection with the piezo pump. This allows the output of the pump to be determined.

Preferably, the width of the breast pump is less than 110 mm.

Preferably, the height of the breast pump is less than 180 mm.

Preferably, the plane to plane depth of the breast pump less than 100 mm.

Preferably, in use, the breast pump extends from the user's breasts by between 3 to 4 cup sizes as per the European standard EN 13402.

Preferably, the milk container has a volume of greater than 120 ml. More preferably, the milk container has a volume of greater than 140 ml.

Preferably, the milk container has a volume of less than 150 ml.

The milk container and housing may form a substantially continuous outer surface of the breast pump. This helps ensure that the breast pump in use fits within a conventional bra system discretely.

The milk container may be at least partially transparent on the outer surface of the breast pump. This allows the level of milk within the container to be easily observed even while pumping.

The milk container may be provided with a spout. This makes it easier for the end user to pour the collected milk into other containers for use or storage.

The milk container may be provided with attachment means for attaching a teat to the container. This allows the milk container to be used directly as a drinking vessel for a child.

The breast shield may be removable. This allows the shield to be easily washed and sterilised.

The milk collection container may be formed of at least two rigid sections which are connectable. This allows simple cleaning of the container for re-use.

The breast pump may further comprise a one-way valve between an inner surface of the breast shield, for engaging with the breast in use, and the milk container.

The one-way valve may be located in an opening to the container.

The pump of the first or second embodiments may be a piezo pump.

The breast shield may be detachable from the breast pump.

The breast pump of the may further comprise a single pole, double throw pneumatic valve, wherein: the pole is in pneumatic connection with the pump and pressure sensor; one of the throws is in pneumatic connection with the diaphragm; and the other throw is in pneumatic connection with a dead-end.

The breast pump may further comprise: a first non-return valve between the milk-flow side of the diaphragm and the breast shield, configured to allow only a negative pressure to be applied to the breast shield by the pump; a second non-return valve between the milk-flow side of the diaphragm and the milk collection container configured to allow only a positive pressure to be applied to the milk collection container by the pump; and a pressure sensor in pneumatic connection with the pressure-generation side of the diaphragm.

A method of estimating the pressure applied by a breast pump according to an aspect of the present invention is provided according to claim 42, comprising the steps of: providing a breast pump according to the third embodiment; selecting a pressure cycle from a pre-defined list of pressure cycles; applying pressure with the pump to stimulate milk expression; reading the output of the pressure sensor; and adjusting the applied pressure of the pump to match the pressure profile selected. This allows for repeatable application of force to the breast, even as the pump performance degrades.

Preferably the method further comprises the steps of: approximating the elasticity and extension of the diaphragm at the relevant pressure; and calculating an estimated applied pressure based upon the output of the pressure sensor and the approximated elasticity and extension of the diaphragm.

A method of estimating the milk collected by a breast pump according to an aspect of the present invention is provided according to claim 44, comprising the steps of: providing a breast pump according to claim 33; generating a positive pressure with the pump; transmitting the positive pressure via the diaphragm and second non-return valve to only the milk collection container; measuring the increase in pressure by the pressure sensor in pneumatic connection with the diaphragm; estimating the volume of milk inside the milk collection container based upon the rate of increase of pressure. In this manner, the volume of milk can be estimated remotely.

DESCRIPTION OF THE FIGURES

The invention will now be described with respect to the Figures in which:

Figure 1 is a front view of an assembled breast pump;

Figure 2 is a rear view of the assembled breast pump of Figure 1;

Figure 3 is a front view of a partially disassembled breast pump;

Figure 4 is a rear view of the partially disassembled breast pump of Figure 3;

Figure 5 is a front view of a further partially disassembled breast pump;

Figure 6 is a rear view of the further partially disassembled breast pump of Figure 5;

Figure 7 is a front view of the breast pump of Figure 1, with the outer shell translucent for ease of explanation;

Figure 8 is a further front view of the breast pump of Figure 1, with the front of the outer shell removed for ease of explanation;

Figure 9 is a schematic view of a spout for a breast shield;

Figure 10 is a schematic of a pneumatic system for a breast pump;

Figure 11 is a schematic of an alternative pneumatic system for a breast pump;

Figure 12 is a schematic of a further alternative pneumatic system for a breast pump; and

Figure 13 is a graph depicting measured pressure in the breast pump system of Figure 12 over time.

DETAILED DESCRIPTION

Figure 1 is a front view of a breast pump 100 according to the present invention. The breast pump 100 comprises a housing 1 and a milk collection container (or bottle) 3. The milk collection container 3 is attached to a lower face 1A of the housing 1. While the breast pump 100 may be arranged to be used with one of the right or the left breast specifically, it is preferred the breast pump 100 can be used with either breast without modification. To this end, the outer surfaces of the breast pump 100 are preferably substantially symmetrical

The breast pump 100 is further provided with a user interface 5. This may take the form of a touchscreen and/or physical buttons. In particular, this may include buttons, sliders, any form of display, lights, or any other componentry necessary to control and indicate use of the breast pump 100. Such functions might include turning the breast pump 100 on, specifying which breast is being pumped, or increasing the peak pump pressure. Alternatively, the information provided through the user interface 5 might also be conveyed through haptic feedback, such as device vibration, driven from a miniature vibration motor within the pump housing 1.

In the particular embodiment of the Figures, the user interface 5 comprises power button 5A for turning the pump on and off. The user interface 5 further comprises pump up

button 5B and pump down button 5C. These buttons adjust the pressure generated by the pump and hence applied to the user's breast. In preferable embodiments, the pump up button 5B is physically larger than the pump down button 5C. A play/pause button 5D is provided for the user to interrupt the pumping process without turning the device on and off.

The user interface 5 further comprises a breast toggle button 5E for the user to toggle a display of which breast is being pumped. This may be used for data collection, which is discussed in more detail later, or for the user to keep track of which breast has most recently been pumped. In particular, there may be a pair of LEDs, one to the left of the toggle button 5E and one to the right. When the user is pumping the left breast, the LED to the right of the toggle button 5E will illuminate, so that when the user looks down at the toggle it is the leftmost LED from their point of view that is illuminated. When the user then wishes to switch to the right breast, the toggle button can be pressed and the LED to the left of the toggle button 5E will illuminate.

As depicted in Figure 1, the housing 1 and milk collection container 3 form a substantially continuous outer surface, with a generally convex shape. This shape roughly conforms with the shape of a breast. This allows the breast pump 100 to fit within the cup of a user's bra. The milk collection container 3 is retained in attachment with the housing 3 by means of a latch system, which is released by button 2.

The European standard EN 13402 for Cup Sizing defines cup sizes based upon the bust girth and the underbust girth of the wearer and ranges from AA to Z, with each letter increment denoting an additional 2 cm difference. Some manufacturers do vary from these conventions in denomination, and some maternity bras are measured in sizes of S, M, L, XL, etc. In preferred embodiments, the breast pump 100 of the present invention corresponds to an increase of between 3 or 4 cup sizes of the user according to EN 13402.

A plane-to-plane depth of the breast pump can also be defined. This is defined as the distance between two parallel planes, the first of which is aligned with the innermost point of the breast pump 100, and the second of which is aligned with the outermost point of the breast pump 100. This distance is preferably less than 100 mm.

Figure 2 is a rear view of the breast pump 100 of Figure 1. The inner surface of the housing 1 and milk collection container 3 are shown, along with a breast shield 7. The

housing 1, milk collection container 3 and breast shield 7 form the three major sub-components of the breast pump 100. In use, these sub-components clip together to provide the functioning breast pump 100. The breast shield 7 is designed to engage with the user's breast, and comprises a concave inner flange 7A which contacts the breast. To allow the breast pump 100 to be used on either of the user's breasts, the breast shield 7 is preferably substantially symmetrical on its inner flange 7A.

The inner flange 7A is substantially oval-shaped. While the inner flange 7A is concave, it is relatively shallow such that it substantially fits the body form of the user's breast. In particular, when measured side-on the inner-most point of the flange 7A and the outer-most point may be separated by less than 25 mm. By having a relatively shallow concave surface, the forces applied can be spread out over more surface area of the breast. The flatter form also allows easier and more accurate location of the user's nipple. In particular, the flange 7A of the breast shield 7 may extend over the majority of the inner surface of the housing 1 and milk collection container 3. Preferably, it may extend over 80% of this surface.

The breast shield 7 substantially aligns with the outer edge 1B of the housing 1. The milk collection container 3 may be provided with an arcuate groove for receiving a lower part of the breast shield 7. This is best shown in later Figures. In the assembled arrangement of Figures 1 and 2, the inner surface of the breast pump 100 is substantially continuous.

The breast shield 7 further comprises a spout 9 extending from an opening 7B in the breast shield 7. In preferable embodiments the spout 9 is integral with the breast shield 7. However, it is appreciated that separate removable/interchangeable spouts may be used. The opening 7B is aligned with the user's nipple and areola in use. The breast shield 7 forms an at least partial seal with the rest of the user's breast around this portion. This spout 9 defines a milk-flow path from the inner surface of the breast shield 7A, through the spout 9 and into the milk collection container 3. The spout 9 is preferably quite short in order to minimise the length of the milk-flow path in order to minimise losses. In particular, the spout 9 may extend less than 70 mm from its start to end, more preferably less than 50 mm,

Figures 3 and 4 are of a partially disassembled breast pump 100 of the present invention. In these Figures, the breast shield 7 has been disengaged from the housing 1 and milk collection bottle 3. As shown in Figure 4, the housing 1 comprises a slot 11 for receiving the spout 9 of the breast shield 7. The breast shield 7 is held in place by means of a clip 15 engaging with a slot 17 in the housing 1. While this clip 15 is shown at the top of the breast shield 7, it may be placed at any suitable point on the shield 7, with the slot 17 in a corresponding location. The spout 9 of the breast shield 7, is provided with a protrusion 9A on its lower surface. This protrusion 9A is configured to engage with the milk collection bottle 3.

The breast pump 100 further comprises a barrier for transferring the pressure from the pump to the milk-collection side of the system. In the depicted example, this is flexible diaphragm 13. However, it is appreciated that the barrier could be any other suitable component such as a filter or an air transmissive material.

The diaphragm 13 is arranged so that the milk-flow pathway extends past the outer periphery of the diaphragm 13. This means that the milk-flow pathway does not extend through the diaphragm 13. In particular, the milk-flow pathway is beneath the diaphragm 13. However, is appreciated that the diaphragm 13 may be offset in any direction with respect to the milk-flow pathway provided that the milk-flow pathway does not extend through the diaphragm 13.

Preferably, the diaphragm 13 is a continuous membrane, devoid of any openings.

The diaphragm 13 is held in a diaphragm housing 19, which is formed in two parts. The first half 19A of the diaphragm housing 19 is provided on the outer surface of the breast shield 7, above the spout 9 and hence the milk-flow pathway. In preferred embodiments, the first half 19A of the diaphragm housing 19 is integral with the breast shield. The second half 19B of the diaphragm housing is provided in a recessed portion of the housing 1. The diaphragm 13 seals in this diaphragm housing 19 around its outer edge, to form a watertight and airtight seal. Preferably, the seal around the outer edge of the diaphragm 13 is the only seal of the diaphragm 13. This is beneficial over systems with annular diaphragms which must seal at an inner edge as well. Having the diaphragm 13 mounted in the breast pump 100 in this manner ensures that it is easily accessible for

cleaning and replacement. It also ensures that the breast shield 7 and diaphragm 13 are the only components which need to be removed from the pump 100 for cleaning.

Figures 5 and 6 show a breast pump 100 according to the present invention in a further disassembled state. In addition to the breast shield 7 and diaphragm 13 being removed, the milk collection container 3 has been unclipped.

Preferably, the milk collection container 3 is a substantially rigid component. This ensures that expressed milk does not get wasted therein, while also enhancing re-usability. In some embodiments, the milk collection container 3 may be formed of three sections: a front bottle potion, a rear bottle potion, and a cap. These three sections may clip together to form the milk collection container 3. This three part system is easy to empty, easily cleanable, and easily re-usable.

However, in the preferred embodiments the milk bottle 3 is a single integral part with a cap 35. The milk collection container 3 has a capacity of approximately 5 fluid ounces (148 ml).

To achieve this, the milk collection container 3 preferably has a depth in a direction extending away from the breast in use, of between 50 to 80 mm, more preferably between 60 mm to 70 mm, and most preferably between 65 mm to 68 mm.

The milk collection container 3 further preferably has a height, extending in the direction from the bottom of the container 3 in use to the cap 35, of between 40 mm to 60 mm, more preferably between 45 mm to 55 mm, and most preferably between 48 mm to 52 mm.

Further preferably, the milk collection container has a length, extending from the leftmost point to the rightmost point of the container 3 in use, of between 100 mm to 120 mm, more preferably between 105 mm to 115 mm, and most preferably between 107 mm to 110 mm.

This cap 35 is provided with a one-way valve 37, through which milk can flow. This valve 37 prevents milk from spilling from the bottle once it has been collected. In addition, the valve 37 automatically seals completely unless engaged to the breast shield 7. This

ensures that when the pump 100 is dismantled immediately after pumping, no milk is lost from the collection bottle 3. It can be appreciated that this one-way valve 37 might also be placed on the breast shield 7 rather than in this bottle cap 35. The cap 35 may screw into the milk collection bottle 3. In particular, it may be provided with a threaded connection or a bayonet and slot arrangement.

In certain embodiments, a teat may be provided to attach to the annular protrusion 31A to allow the container 3 to be used directly as a bottle. Alternatively, or in addition, a spout may be provided to attach to the protrusion 31A for ease of pouring.

Figures 7 and 8 show front views of a breast pump 100 according to the present invention. The outer-surface of the housing 1 has been drawn translucent to show the components inside. The control circuitry 71 for the breast pump 100 is shown in these figures. The control circuitry in the present embodiment comprises four separate printed circuit boards, but it is appreciated that any other suitable arrangement may be used.

The control circuitry may include sensing apparatus for determining the level of milk in the container 3. The control circuitry may further comprise a wireless transmission device for communicating over a wireless protocol (such as Bluetooth) with an external device. This may be the user's phone, and information about the pumping may be sent to this device. In embodiments where the user interface 5 comprises a breast toggle button 5E, information on which breast has been selected by the user may also be transmitted with the pumping information. This allows the external device to separate pumping data for the left and right breasts.

There should also be charging means within the control circuitry 71 for charging the battery 81. While an external socket, cable or contact point may be required for charging, a form of wireless charging may instead be used such as inductive or resonance charging. In the Figures, charging port 6 is shown for charging the battery 81. This port 6 may be located anywhere appropriate on the housing 1.

Figure 8 shows the location of the battery 81 and the pumps 83A, 83B mounted in series inside the housing 1. While the depicted embodiment shows two pumps 83A, 83B it is appreciated that the present invention may have a single pump.

Preferably, an air filter 86 is provided at the output to the pumps 83A, 83B.In preferable embodiments, the pumps 83A, 83B are piezoelectric pumps (or piezo pump). A suitable piezo pump is manufactured by TTP Ventus, which can deliver in excess of 400mBar (40 kPa) stall pressure and 1.5 litres per minute free flow.

The rear side of the second half of the diaphragm housing 19B in the housing 1 is provided with a pneumatic connection spout. The pumps 83A, 83B are pneumatically connected with this connection spout.

Operation of the breast pump 100 will not be described. Once the breast pump 100 is activated and a pumping cycle is begun, the pumps 83A, 83B generates a negative pressure which is transmitted via the connection spout 85 to a first side of the diaphragm 13 in the diaphragm housing 19. This side of the diaphragm 13 is denoted the pumping side 13B of the diaphragm 13.

The diaphragm 13 transmits this negative pressure to its opposite side (denoted the milk-flow side 13A). This negative pressure is transferred from the first side of the diaphragm housing 19A to the opening 7B of the breast shield 7 via the spout 9. This acts to apply the pressure cycle to the breast of the user, in order to express milk. The milk is then drawn through the spout 9, through the one way valve 37 and into the milk collection container 3. The negative pressure is then released, and periodically reapplied in a manner to imitate the sucking of a child.

While the depicted embodiment of the breast pump 100 is provided with two pumps, the following schematics will be described with a single pump 83. It is understood that the single pump 83 could be replaced by two separate pumps 83A, 83B as above.

Figure 9 depicts a schematic of a further embodiment of a spout 9 for a breast pump 100. The spout 9 is provided with an antechamber 91 and a separation chamber 93. A protrusion 95 extends from the walls of the spout 9 to provide a tortuous air-liquid labyrinth path through the spout 9. In the separation chamber 93 there are two opening 97, 99. An air opening 97 is provided in an upper surface 93A of the separation chamber 93. This upper surface 93 is provided transverse to the direction of the spout 9. This opening 97 connects to the first side of the diaphragm housing 19A and is the source of the negative pressure. This airflow opening 97 also provides a route for air to flow as shown

with arrow 96. It is appreciated that the tortuous pathway is not necessary and that a spout 9 without such a pathway will work.

The other opening 99 is a milk opening 99. The milk opening 99 is provided on a lower surface 93B of the separation chamber 93 and connects in use to the container 3. After flowing through the tortuous spout 9 pathway, the milk is encouraged to flow through this opening 99 into the container 3. This is further aided by the transverse nature of the upper surface 93A.

In this manner, expressed milk is kept away from the diaphragm 13. As such, the breast pump 100 can be separated into a "clean" air-flow side comprising the pump 83, the connection spout 85 and the pumping side 13B of the diaphragm 13 and a "dirty" milk-flow side comprising the breast shield 7, the milk collection container 3 and the milk-flow side 13A of the diaphragm 13. This ensures that all of the "dirty" components are easily detachable for cleaning, maintenance and replacement. Additionally, the milk is kept "clean" by ensuring it does not contact the mechanical components.

While the present embodiment discusses the generation of negative pressure with the pump 83, it will be appreciated that positive pressure may instead be generated.

While the embodiments described herein use a diaphragm 13, any suitable structure to transmit pressure while isolating either side of the system may be used.

Figure 10 shows a schematic of a basic pneumatic system 200 for a breast pump 100. In the system 200 milk expressed into the breast shield 7 is directed through the breast shield spout 9 through the torturous air-liquid labyrinth interface 95. The milk is directed through the non-return valve 37 to the collection container 3. This side of the system forms the "dirty" side 201.

The rest of the pneumatic system 200 forms the "clean" side 202 and is separated from contact with milk. This is achieved by way of a flexible diaphragm 13 which forms a seal between the two sides of the system. The diaphragm 13 has a milk-flow side 13A and an air-flow side 13B.

The "clean" side 202 of the system 200 is a closed system. This side 202 may contain a pressure sensor 101 in pneumatic connection with the diaphragm 13 and the pump 83. Preferably, the pump 83 is a piezoelectric pump (or piezo pump). Due to their low noise, strength and compact size, piezoelectric pumps are ideally suited to the embodiment of a small, wearable breast pump. The pump 83 has an output 83A for generating pressure, and an exhaust to the atmosphere 83B. In a first phase of the expression cycle, the pump 83 gradually applies negative pressure to clean half of the closed system 202 behind the diaphragm 13. This causes the diaphragm 13 to extend away from the breast, and thus the diaphragm 13 conveys a decrease in pressure into the breast shield 7. The reduced pressure encourages milk expression from the breast, which is directed through the tortuous labyrinth system 95 and the one-way valve 37 to the collection bottle 3.

While in the depicted embodiment the exhaust 83B is not used, it may be used for functions including, but not limited to, cooling of electrical components, inflation of the bottle to determine milk volume (discussed further later) or inflation of a massage bladder against the breast. This massage bladder may be used to help mechanically encourage milk expression.

The "clean" side 202 further comprises a two-way solenoid valve 103 connected to a filtered air inlet 105 and the pump 83. Alternatively, the filter could be fitted on the pump line 83A. If the filter is fitted here, all intake air is filtered but the performance of the pump may drop. After the negative pressure has been applied to the user's breast, air is bled into the system 202 through the valve 103 in a second phase of the expression cycle. In this embodiment, the air filter 105 is affixed to this inlet to protect the delicate components from degradation. In particular, in embodiments with piezoelectric components these are particularly sensitive.

The second phase of the expression cycle and associated switching of valve 103 is actioned once a predefined pressure threshold has been reached. The pressure is detected by a pressure sensor 101.

In certain embodiments, if the elasticity and extension of the diaphragm 13 may be approximated mathematically at different pressures, the pressure measured by sensor 101 can be used to infer the pressures exposed to the nipple on the opposite side of the diaphragm 13.

Figure 11 shows an alternative pneumatic system 300. The core architecture of this system is the same as the system shown in Figure 10.

In this system 300, the closed loop 202 is restricted with an additional three way solenoidal valve 111. This valve 111 allows the diaphragm 13 to be selectively isolated from the rest of the closed loop 202. This additional three way valve 111 is located between the diaphragm 13 and the pump 83. The pressure sensor 101 is on the pump 83 side of the three way valve 111. The three way valve 111 is a single pole double throw (SPDT) valve, with the diaphragm 13 connected to one of the throws 111B. The pump 83 is connected to the pole 111A. The final throw 111C is connected to a dead-end 113. This dead-end 113 may either be a simple closed pipe, or any component(s) that does not allow the flow of air into the system 202. This could include, for example, an arrangement of one-way valves.

In this system 300, therefore, the pump 83 has the option of applying negative pressure directly to the pressure sensor 101. This allows repeated testing of the pump in order to calibrate pump systems, or to diagnose issues with the pump in what is called a dead end stop test. This is achieved by throwing the valve to connect the pump 83 to the dead end 113. The pump 83 then pulls directly against the dead end 113 and the reduction of pressure within the system can be detected by the pressure sensor 101.

Using this function, material fatigue of the pump 83 can be assessed directly. Principally, this knowledge can be used to ensure user experience is not altered, despite the changing output of the pump 83 as it degrades over time. For example, the pump cycle may be changed to drive longer or operate under increased voltage to ensure the same pressures are met. This is particularly relevant for piezo pumps where the output may vary significantly.

Figure 12 shows a schematic for a system 400 for a breast pump 100 which can estimate the volume of milk collected in the collection container 3 from data collected on the "clean" airflow part 202 of the system 400.

The pump 83 is connected to the circuit via two bleed valves 126, 128. The first bleed valve 126 is arranged to function when the pump 83 applies a negative pressure. As

such, this valve 126 is connected to a "bleed in" 127, for supplying atmospheric air to the system 202.

The second bleed valve 128 is arranged to function when the pump 83 applies a positive pressure. As such, this valve 128 is connected to a "bleed out" 129 for bleeding air in the system 202 to the atmosphere.

During a milking pump cycle, the pump 83 applies negative pressure on the "clean" side 13B of the diaphragm 13 which causes its extension towards the pump 83. This increases the volume of the space on the "dirty" side 13B of the diaphragm 13. This conveys the decrease in pressure to the breast to encourage expression of milk. A set of three non-return valves 121, 123, 125 ensure that this decrease in pressure is applied only to the breast (via the breast shield 7) and not the milk collection container 3.

To measure the volume of milk collected in the container 3, the pump 83 is used instead to apply positive pressure to the diaphragm 13. The diaphragm 13 is forced to extend away from the pump 83 and conveys the pressure increase to the "dirty side" 201 of the system 400. The three non-return valves 121, 123, 125 ensure that this increase in pressure is exclusively conveyed to the milk collection container 13.

The resulting pressure increase is monitored behind the diaphragm 13 from the "clean" side 202 by a pressure sensor 101. Preferably, the pressure sensor 101 is a piezoelectric pressure sensor (piezo pressure sensor). The rate at which the pump 83 (at constant strength) is able to increase the pressure in the system 400 is a function of the volume of air that remains in the milk collection container 3. As air is many times more compressible than liquid, the rate at which pressure increases in the system 400 can be expressed as an approximate function of the volume of milk held in the collection container 3.

Thus by increasing the pressure in this fashion, the rate of pressure increase can be determined, from which the volume of milk held in the container 3 is calculable.

The inventor has proved this method for estimating milk volume. Figure 13 shows repeated milking and volume measurement cycles as the collection container 3 is filled. To determine the rate of pressure increase the pump 83 was run for a fixed time. As pumping

proceeds and the volume of air reduces in the system 400, the pump 83 is able to achieve a higher pressure. Each milking cycle is represented by a positive pressure spike 41. There is a clear upwards trend 43 in magnitude of positive pressures achieved as the collection container 3 is filled.

In this manner, an estimate can be obtained for the volume of milk in the container 3 based upon the measured pressures.

Figure 13 also shows a dead end stop pump test 45 as described above. The negative spike 45 shows the application of negative pressure directly to the pressure sensor 101.

CLAIMS:

1. A breast pump for wearing inside a bra, the breast pump comprising:

a breast shield for engagement with the user's breast;

a housing for receiving at least a portion of the breast shield;

a pump inside the housing for generating a negative pressure in the breast shield;

a battery inside the housing for powering the pump;

a detachable rigid milk collection container attachable, in use, to a lower face of the housing and connected to the breast shield for collecting milk expressed by the user with a milk-flow pathway defined from an opening in the breast shield to the milk collection container; and

a barrier, the pump acting on one side of the barrier to generate a pressure on the opposite, milk-flow, side of the barrier, the barrier having an outer periphery,

wherein:

the shield, housing, pump, battery and container are provided as a unit with a convex outer surface contoured to fit in a bra; and

the milk-flow pathway extends past the outer periphery of the barrier.

2. A breast pump for wearing inside a bra, the breast pump comprising:

a breast shield for engagement with the user's breast;

a housing for receiving at least a portion of the breast shield;

a pump inside the housing for generating a negative pressure in the breast shield;

a battery inside the housing for powering the pump;

a detachable rigid milk collection container attachable, in use, to a lower face of the housing and connected to the breast shield for collecting milk expressed by the user with a milk-flow pathway defined from an opening in the breast shield to the milk collection container,

wherein:

the shield, housing, pump, battery and container are provided as a unit with a convex outer surface contoured to fit in a bra; and

the breast shield comprises a shield flange for engaging the user's breast, and an elongate spout aligned with the opening and extending away from the user's breast, the spout being substantially aligned, in use, with the user's nipple and areolae; the spout comprising a first opening for depositing milk into the collection container and a second opening for transferring pressure generated by the pump to the user's nipple, the shield flange and spout being detachable from the housing together.

3. A breast pump for wearing inside a bra, the breast pump comprising:

a breast shield for engagement with the user's breast;

a housing for receiving at least a portion of the breast shield;

a piezo pump inside the housing for generating a negative pressure in the breast shield;

a battery inside the housing for powering the pump;

a detachable milk collection container attachable, in use, to a lower face of the housing and connected to the breast shield for collecting milk expressed by the user with a milk-flow pathway defined from an opening in the breast shield to the milk collection container,

wherein the shield, housing, pump, battery and container are provided as a unit with a convex outer surface contoured to fit in a bra.

4. The breast pump according to claim 1 or 3 wherein the breast shield comprises a shield flange for engaging the user's breast, and an elongate spout aligned with the opneing extending away from the user's breast, the spout being substantially aligned, in use, with the user's nipple and areolae; the spout comprising a first opening for depositing milk into the collection container and a second opening for transferring pressure generated by the pump to the user's nipple.

5. The breast pump of claim 4, wherein the shield flange and spout are detachable from the housing together

6. The breast pump of claim 2, 4 or 5, wherein the spout is integral with the breast shield.

7. The breast pump according to claim 2 or 4 to 6, wherein the breast shield cup extends over a majority of the inner surface of the unit.

8. The breast pump of claim 7, wherein the breast shield extends over 80% of the inner surface of the unit.

9. The breast pump of any of claims 2 or 4 to 8, wherein the spout connects directly to the container.

10. The breast pump of any of claims 2 or 4 to 9, wherein the spout comprises an outflow opening for depositing milk directly above the milk collection container.

11. The breast pump of any of claims 2 or 3, and claims 4 to 10 when dependent upon claims 2 or 3, further comprising a barrier, the pump acting on one side of the barrier to generate a pressure on the opposite, milk-flow, side of the barrier.

12. The breast pump of claim 10, wherein the barrier has an outer periphery and the milk-flow pathway extends past the outer periphery of the barrier.

13. The breast pump of any of claims 2, 11 or 12, wherein the milk-flow pathway is beneath the barrier.

14. The breast pump of any of claims 2 or 11 to 13, wherein the milk-flow pathway does not pass through the barrier.

15. The breast pump of any of claims 2 or 11 to 14, wherein the barrier is mounted in a housing on the breast shield.

16. The breast pump of claim 15, wherein the housing is integral with the breast shield.

17. The breast pump of any of claims 2 or 11 to 16, wherein the barrier is not an annulus.

18. The breast pump of any of claims 2 or 11 to 17, wherein the barrier provides a seal to isolate the pump from the milk-flow side of the barrier.

19. The breast pump of claim 18, wherein the only seal is around an outer edge of the barrier.

20. The breast pump of any of claims 2 or 11 to 19, wherein the barrier is a diaphragm.

21. The breast pump of claim 20, wherein the diaphragm is a continuous membrane which is devoid of any openings or holes.

22. The breast pump according to any preceding claim, further comprising a pressure sensor in pneumatic connection with the pump.

23. The breast pump of any preceding claim, wherein the width of the breast pump is less than 110 mm.

24. The breast pump of any preceding claim, wherein the height of the breast pump is less than 180 mm.

25. The breast pump of any preceding claim, wherein the plane to plane depth of the breast pump is less than 100 mm.

26. The breast pump of any preceding claim, wherein, in use, the breast pump extends from the user's breasts by 3 to 4 cup sizes as per the European standard EN 13402.

27. The breast pump of any preceding claim, wherein the milk container has a volume of greater than 120 ml.

28. The breast pump of claim 27, wherein the milk container has a volume of greater than 140 ml.

29. The breast pump of claim 27 or 28, wherein the milk container has a volume of less than 150 ml.

30. The breast pump of any preceding claim, wherein the milk container and housing form a substantially continuous outer surface of the breast pump.

31. The breast pump of any preceding claim, wherein the milk container is at least partially transparent on the outer surface of the breast pump.

32. The breast pump of any preceding claim, wherein the milk container is provided with a spout.

33. The breast pump of any preceding claim, wherein the milk container is provided with attachment means for attaching a teat to the container.

34. The breast pump of any preceding claim, wherein the breast shield is removable.

35. The breast pump of any preceding claim, wherein the milk collection container is formed of at least two rigid sections which are connectable.

36. The breast pump of any preceding claim, further comprising a one-way valve between an inner surface of the breast shield, for engaging with the breast in use, and the milk container.

37. The breast pump of claim 36, wherein the one-way valve is located in an opening to the container.

38. The breast pump of claim 1 or 2, wherein the pump is a piezo pump.

39. The breast pump of any of any preceding claim, wherein the breast shield is detachable from the breast pump.

40. The breast pump of any of claims 22 or 23 to 39 when dependent upon claim 22, further comprising a single pole, double throw pneumatic valve, wherein:

the pole is in pneumatic connection with the pump and pressure sensor;

one of the throws is in pneumatic connection with the diaphragm; and

the other throw is in pneumatic connection with a dead-end.

41. The breast pump of any of claim22 or 23 to 40 when dependent upon claim 22, further comprising:

a first non-return valve between the milk-flow side of the diaphragm and the breast shield, configured to allow only a negative pressure to be applied to the breast shield by the pump;

a second non-return valve between the milk-flow side of the diaphragm and the milk collection container configured to allow only a positive pressure to be applied to the milk collection container by the pump; and

a pressure sensor in pneumatic connection with the pressure-generation side of the diaphragm.

42. A method of estimating the pressure applied by a breast pump according to claim 40, comprising the steps of:

providing a breast pump according to claim 40;

selecting a pressure cycle from a pre-defined list of pressure cycles;

applying pressure with the pump to stimulate milk expression;

reading the output of the pressure sensor;

adjusting the applied pressure of the pump to match the pressure profile selected by the user.

43. The method of claim 42, further comprising:

approximating the elasticity and extension of the diaphragm at the relevant pressure; and

calculating an estimated applied pressure based upon the output of the pressure sensor and the approximated elasticity and extension of the diaphragm.

44. A method of estimating the milk collected by a breast pump according to claim 41, comprising the steps of:

providing a breast pump according to claim 41;

generating a positive pressure with the pump;

transmitting the positive pressure via the diaphragm and second non-return valve to only the milk collection container;

measuring the increase in pressure by the pressure sensor in pneumatic connection with the diaphragm;

estimating the volume of milk inside the milk collection container based upon the rate of increase of pressure.

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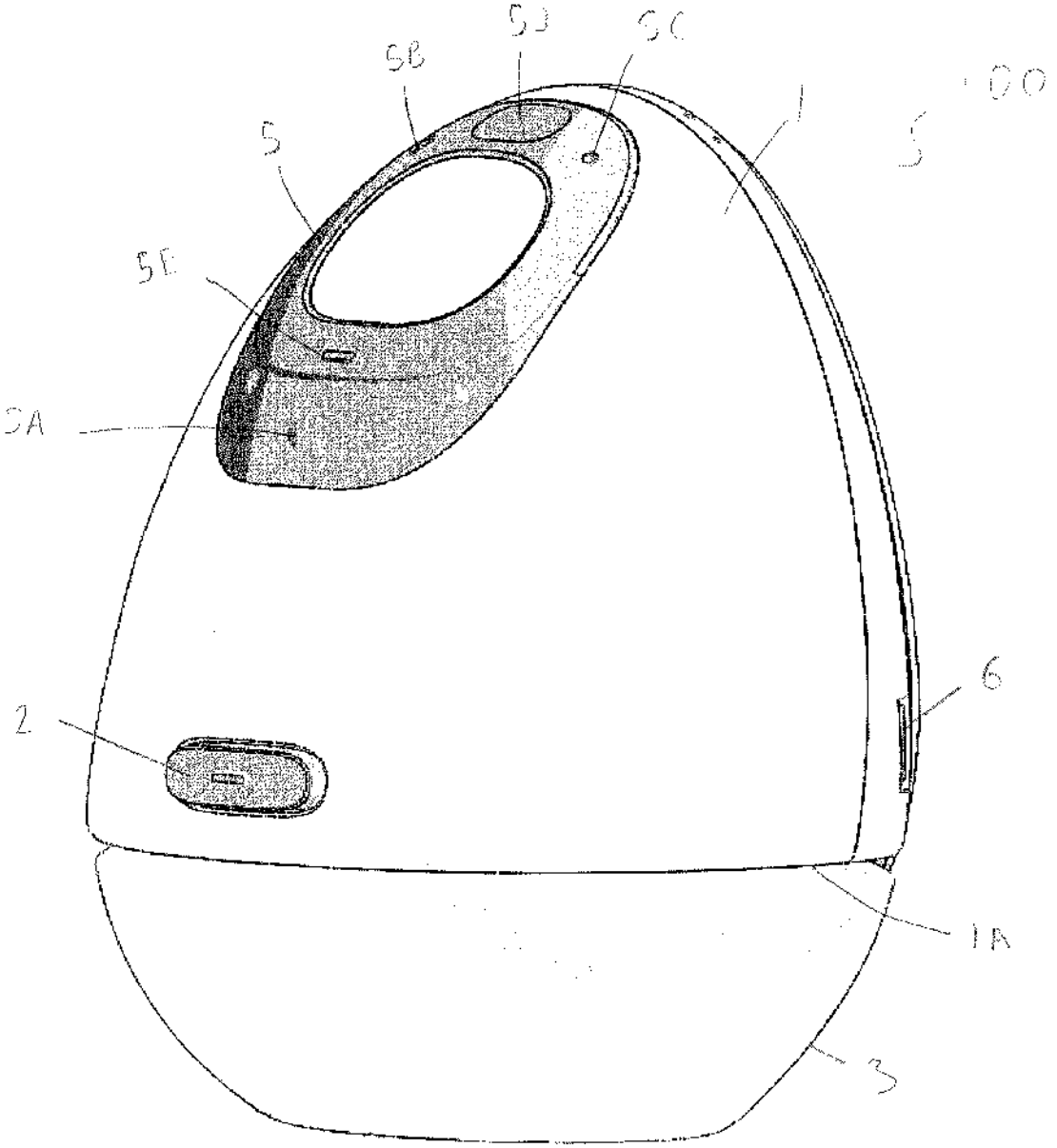

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Fig 2

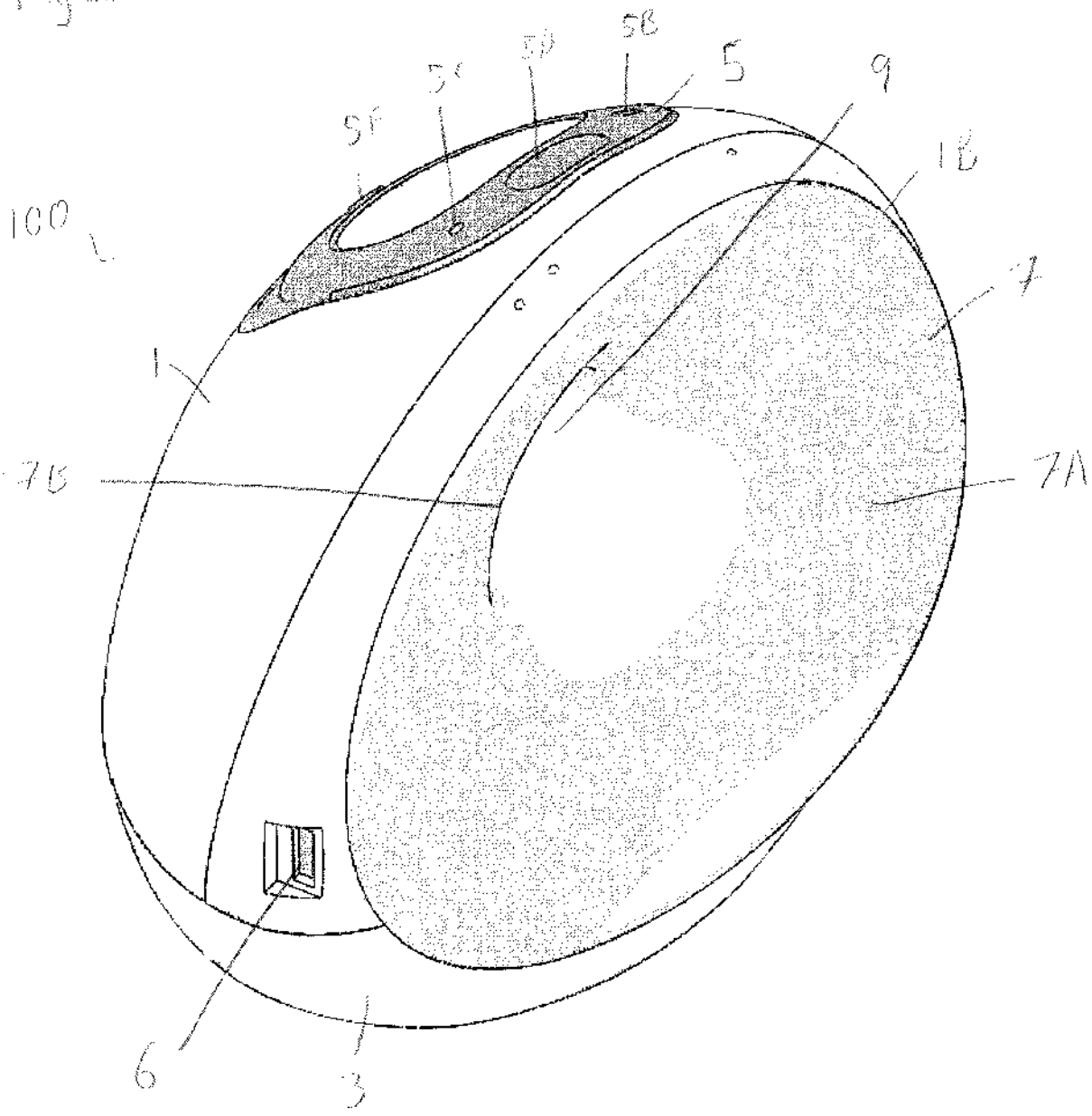

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Fig. 3

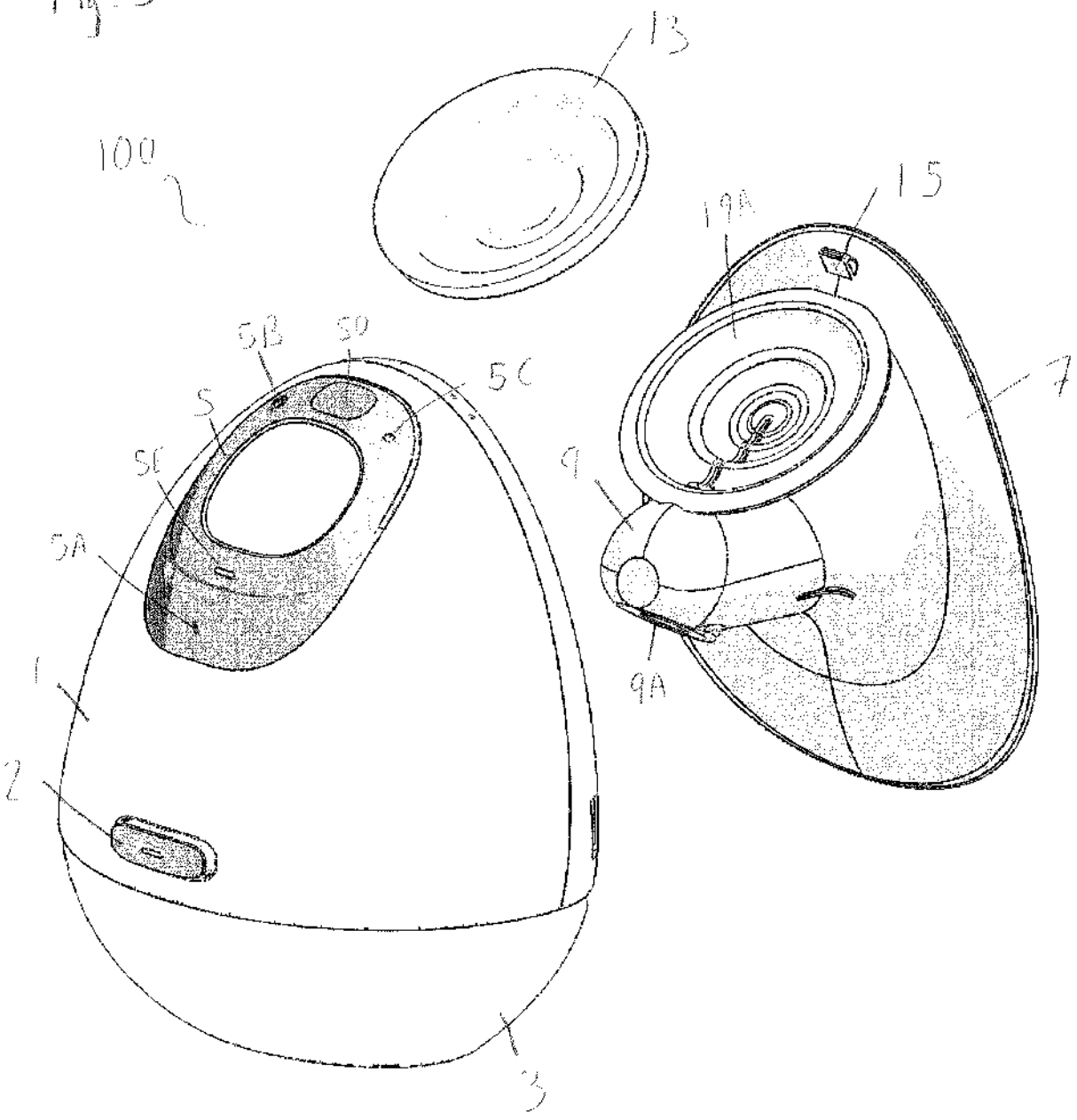

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Fig 1

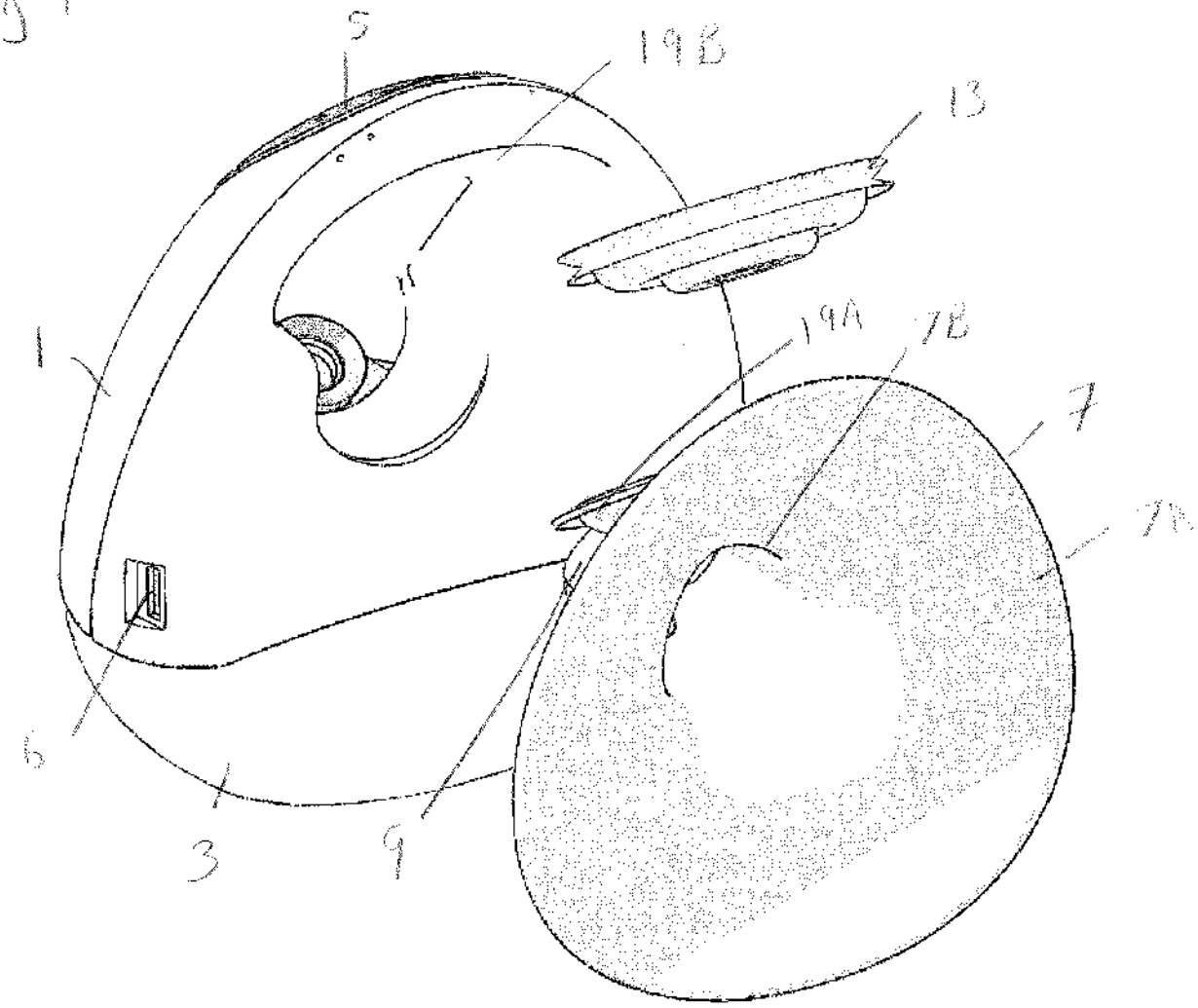

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Fig. 5

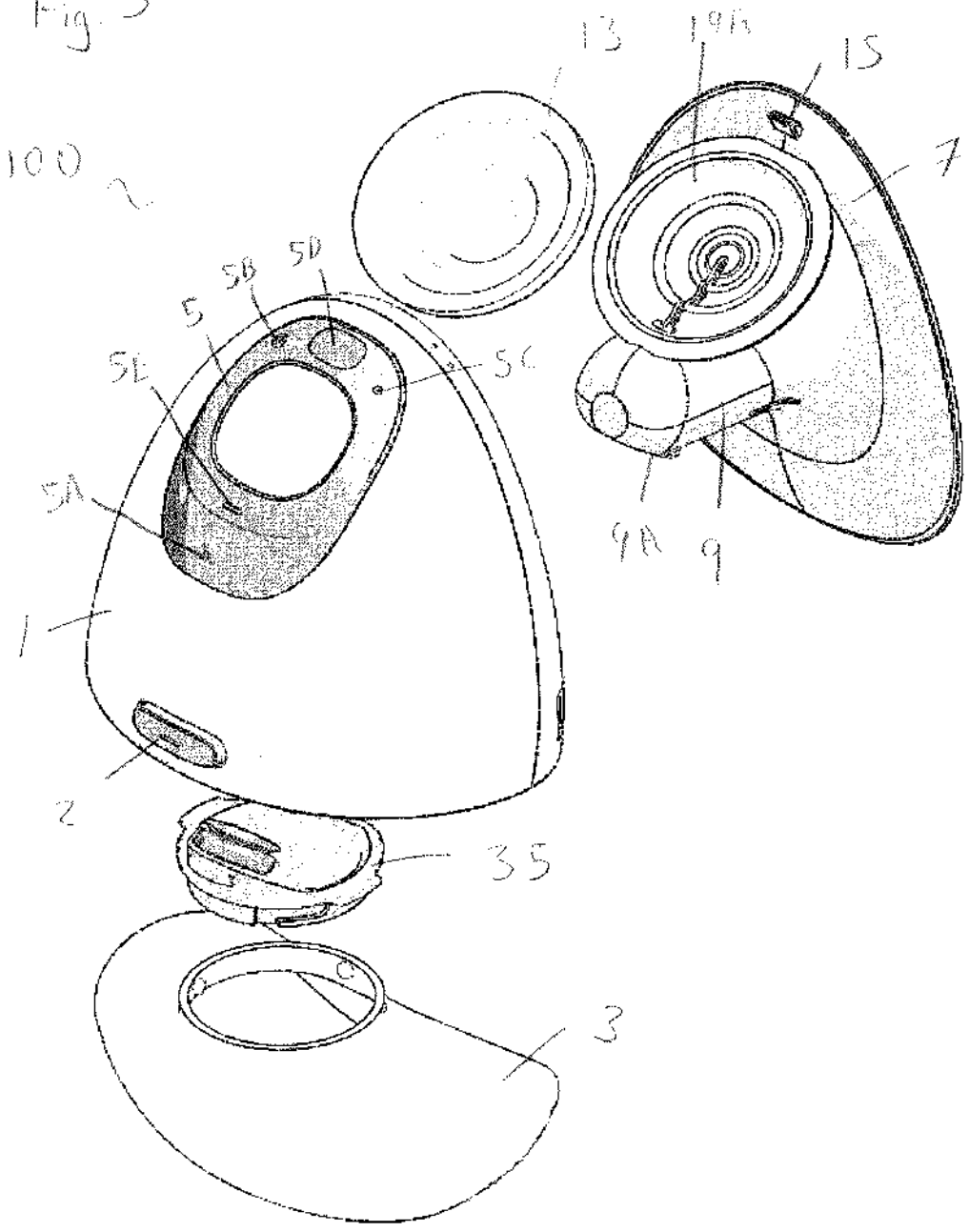

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Fig 6

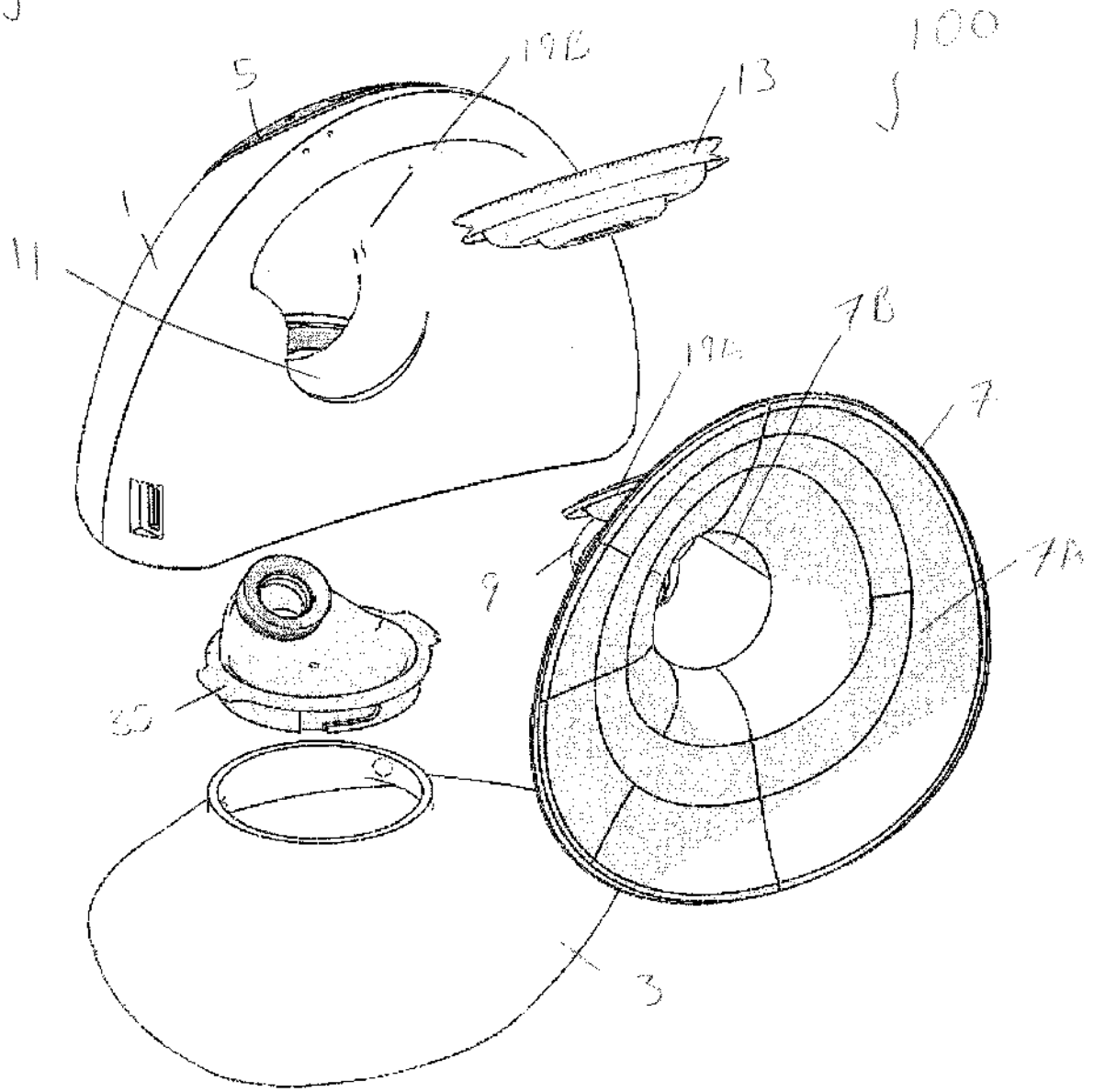

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Fig 7

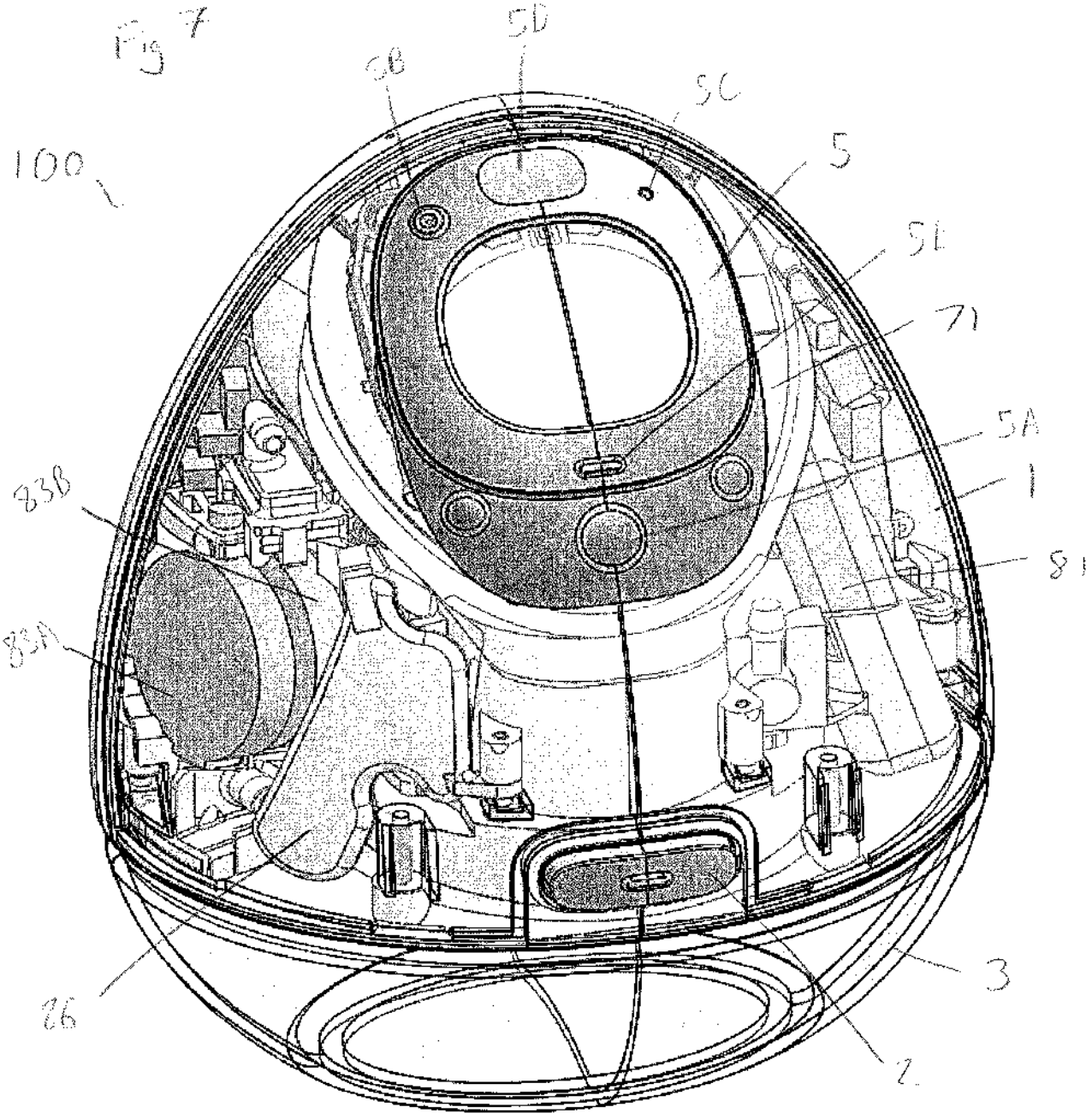

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Fig 8

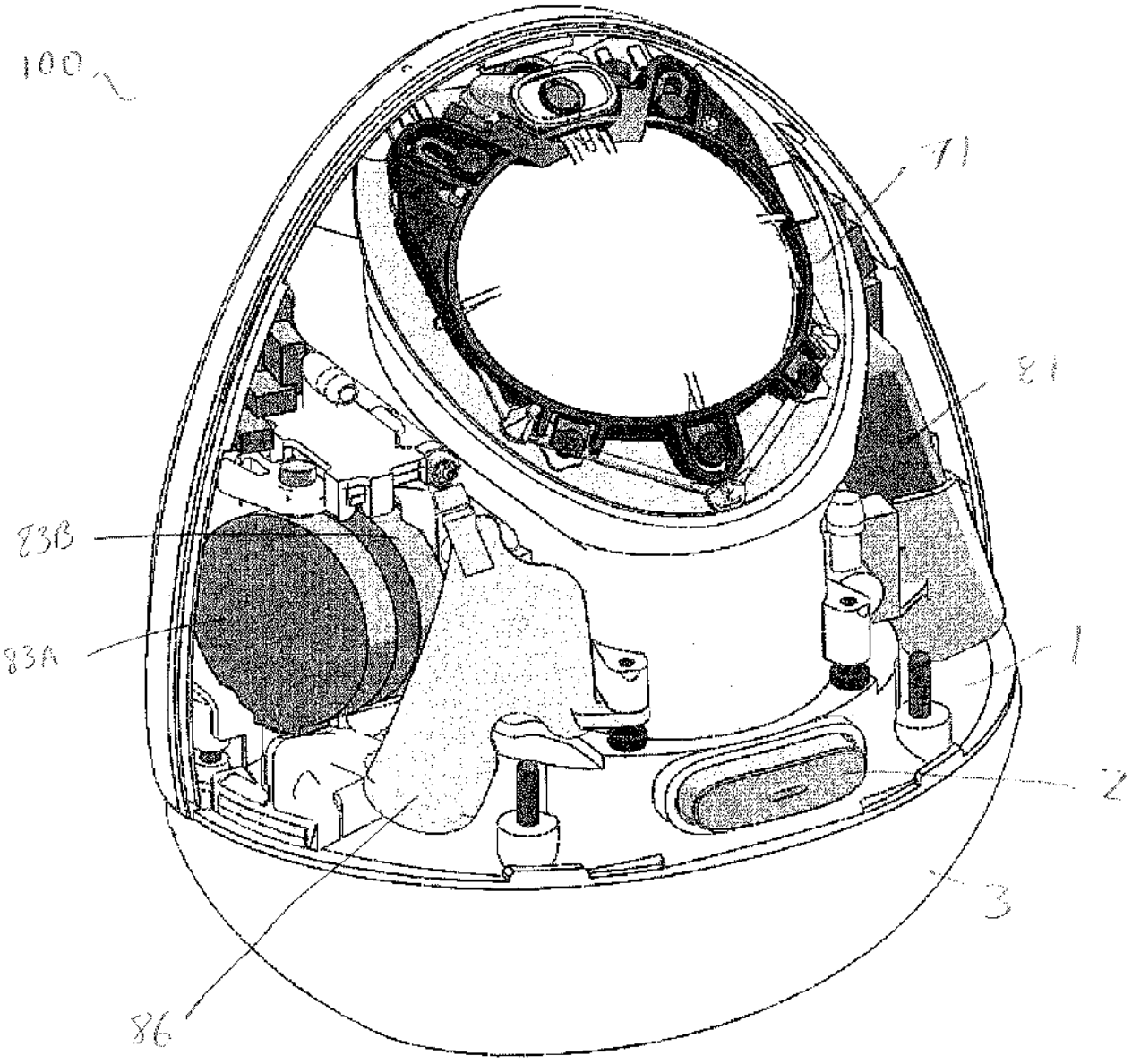

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Fig 9

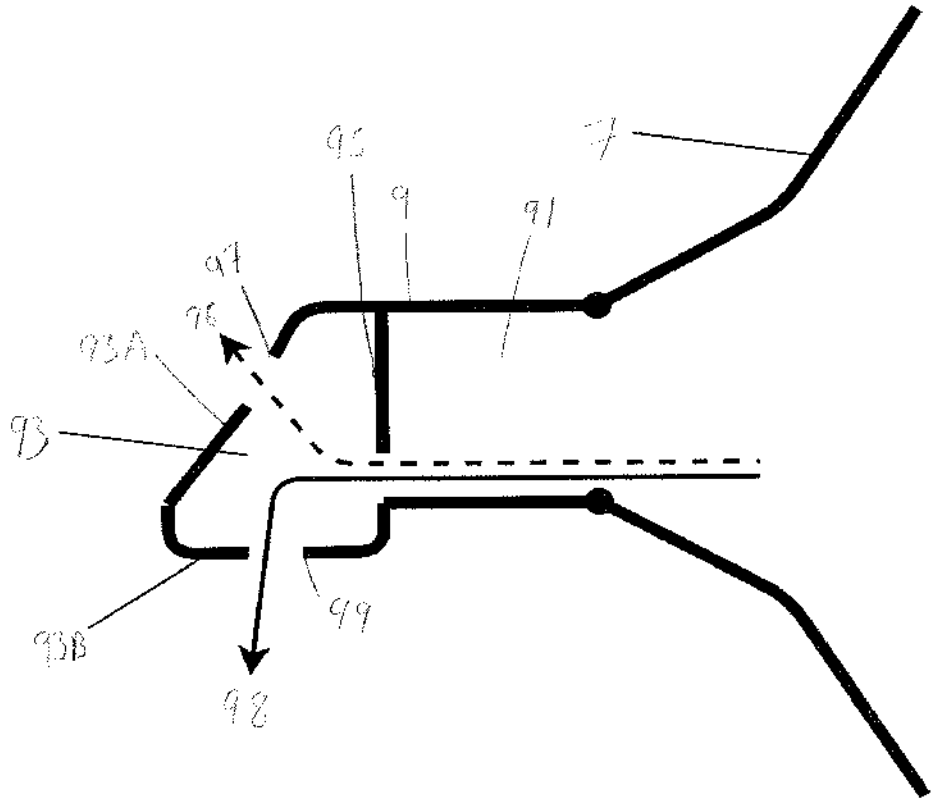

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Fig 10

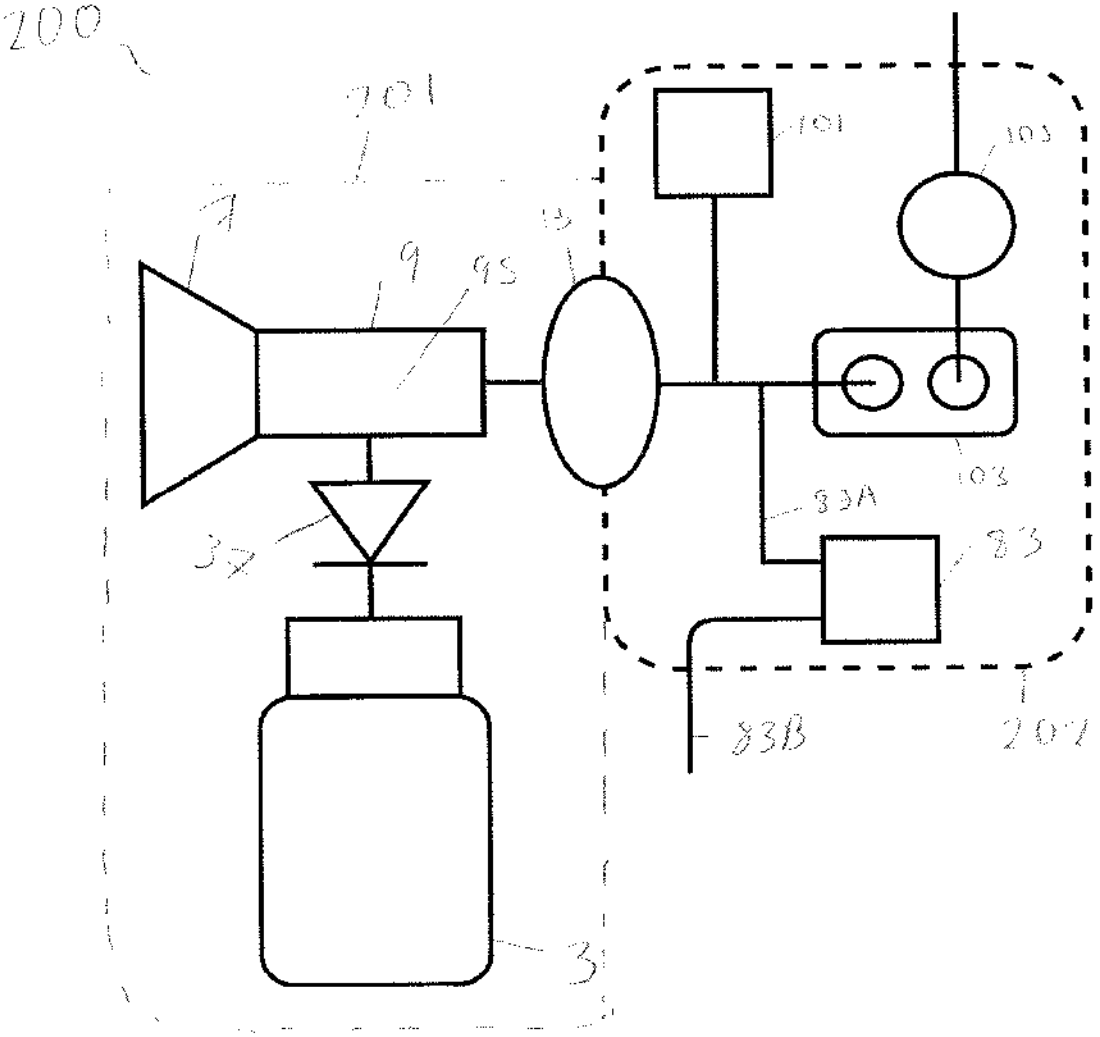

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Fig 11

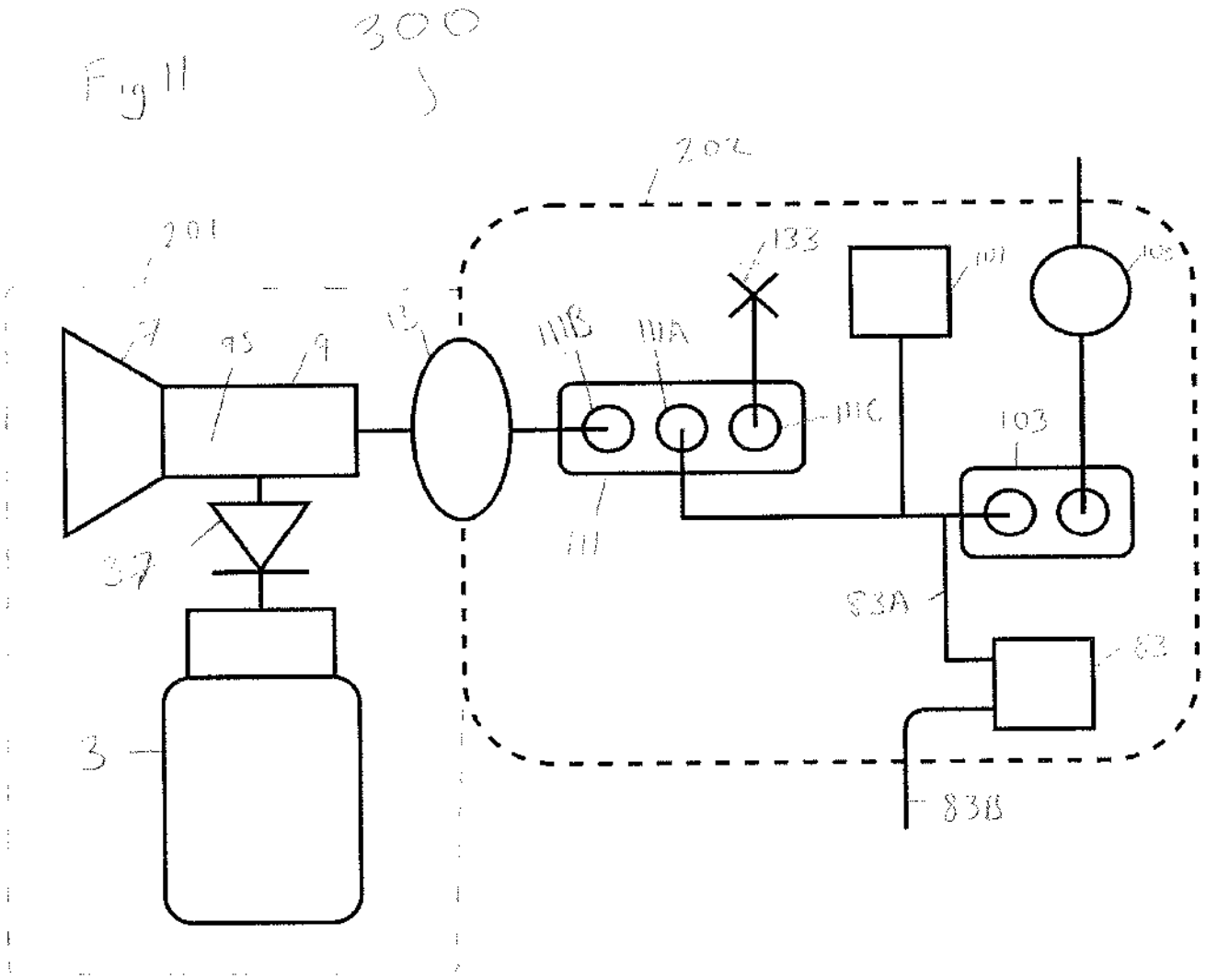

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Fig. 12

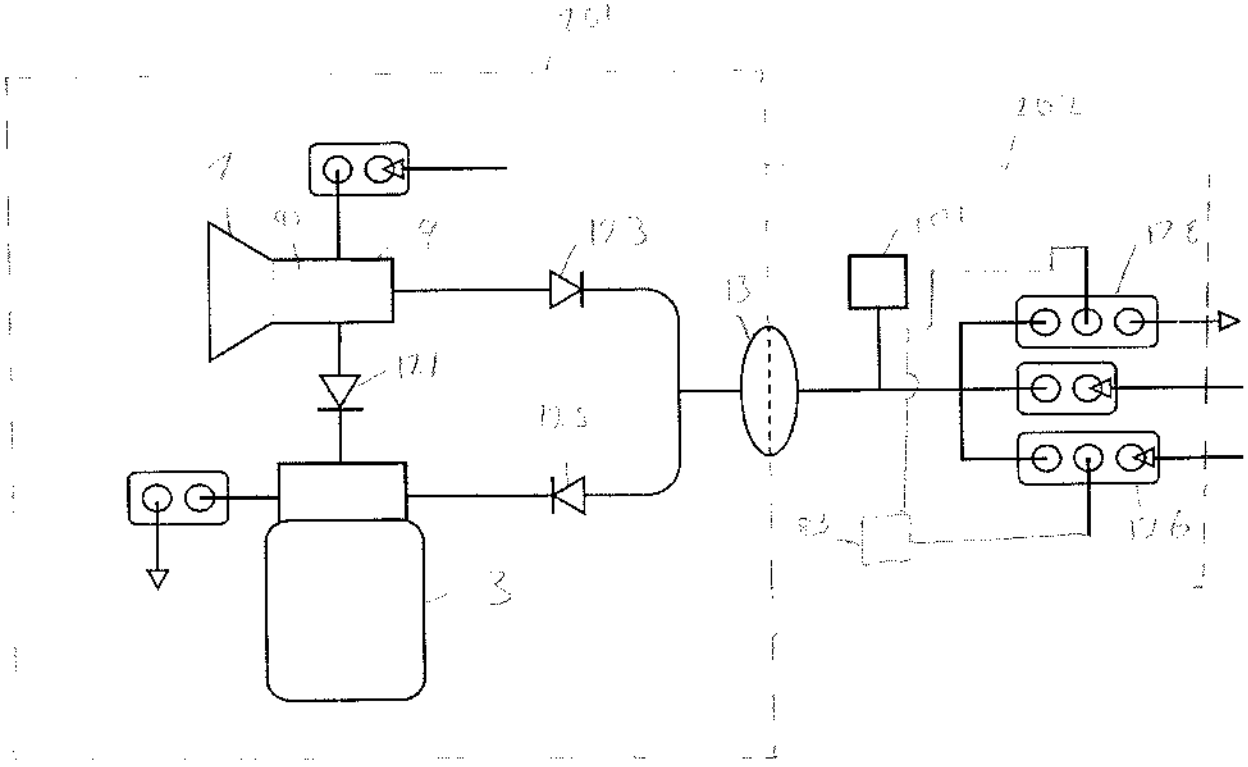

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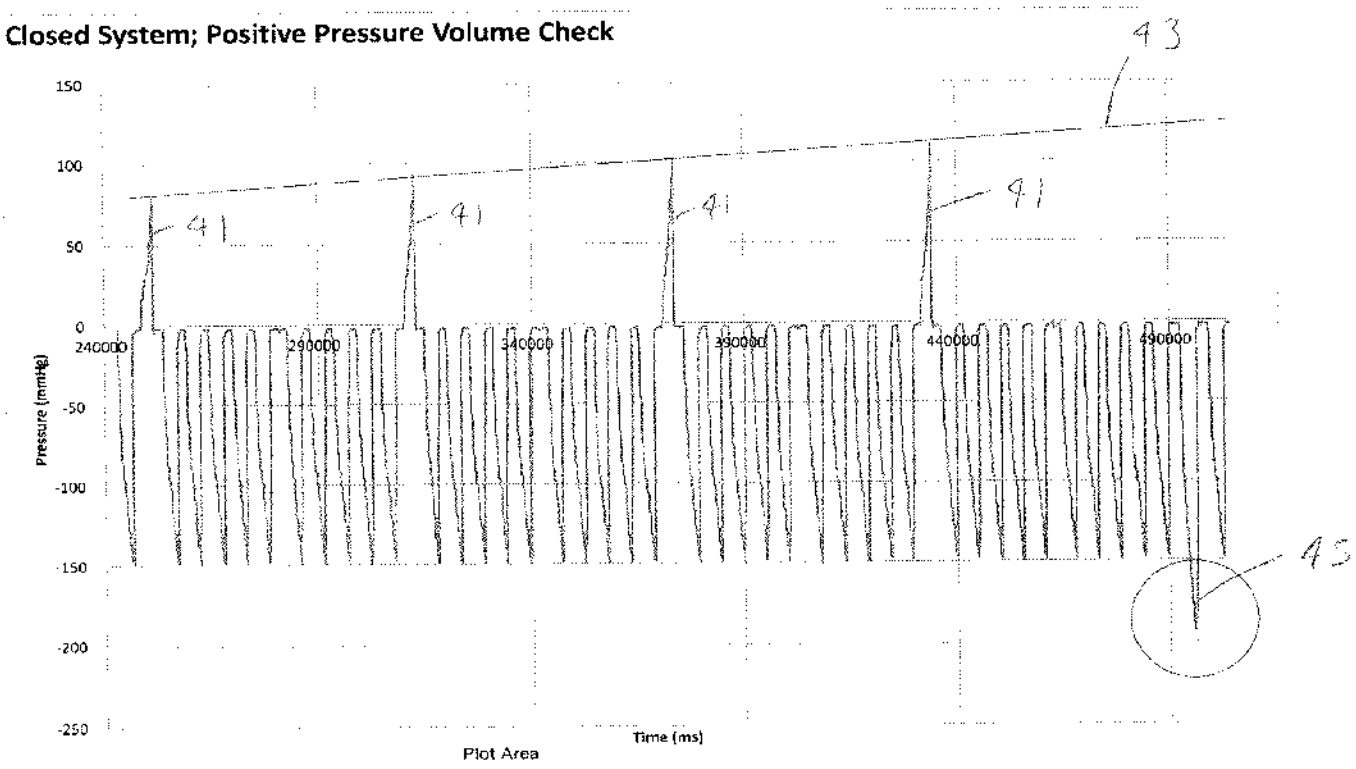
Fig 13



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Signed A HAYES

Dated 19 June 2017

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Application number GB 1709561.3

1.	Your reference	**MJD/P153994GB00**
2.	Full name, address and postcode of the applicant or of each applicant	**CHIARO TECHNOLOGY LIMITED** **Second Floor 63-66 Hatton Garden** **London EC1N 8LE** **Greater London** **United Kingdom**
	Patents ADP number *(if you know it)*	**11287869002**
3.	Title of the invention	**BRA CLIP**
4.	Name of your agent *(if you have one)*	**Boult Wade Tennant**
	"Address for service" to which all correspondence should be sent. This may be in the European Economic area or Channel Islands (see warning note below) *(including the postcode)*	**Boult Wade Tennant** **Verulam Gardens** **70, Gray's Inn Road** **London WC1X 8BT** **United Kingdom**
	Patents ADP number *(if you know it)*	**42001**
5.	Priority declaration: Are you claiming priority from one or more earlier-filed patent applications? If so, please give details of the application(s)	

Country	Application number	Date of filing	PDAS Access Code

6.	Divisionals etc: Is this application a divisional application, or being made following resolution of an entitlement dispute about an earlier application. If so, please give the application number and filing date of the earlier application	Number of earlier UK application	Date of filing *(day / month / year)*
7.	Inventorship: (Inventors must be individuals not companies) Are all the applicants named above also inventors?	**No**	
8.	Are you paying the application fee with this form?	**Yes**	

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Continuation sheets of this form

Description:	**9**
Claim(s):	**3**
Abstract:	**n/a**
Drawing(s):	**7**

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Priority documents:	**0**
Statement of inventorship and right to grant of a patent (Patents Form 7):	**1**
Request for search (Patents Form 9A):	**1**
Request for a substantive examination (Patents Form 10):	**0**
Any other documents (please specify):	**PDAS Registration Form**

11. I/We request the grant of a patent on the basis of this application.

Signature: **/DRAPER, Martyn John/** Date: **15 Jun 2017**

12. Name, e-mail address, telephone, fax and/or mobile number, if any, of a contact point for the applicant

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BRA CLIP

BACKGROUND

Many specialised bras (or brassieres) exist for maternity that facilitate nursing and/or breast pumping for milk collection without the need to remove the bra itself. In a traditional nursing bra, this is achieved with the use of an at least partially detachable cup, which can be unhooked for feeding and/or pumping.

Further specialised bras are known which are provided with cut-out portions or slits which substantially align with the wearer's areola and nipple. Traditional breast pumps comprise an elongate breast shield which extends away from the breast towards an external bottle and source of suction. The breast shield is arranged to extend through the cut-out portion or slit, with the collection bottle and pumping apparatus connected thereto outside of the bra. These require the user to remove or unbutton any over-garments, and are uncomfortable for use when not pumping.

Integrated wearable breast pumps have begun to enter the market, such as US 2016 206794 A1. In such pumps, the suction source, power supply and milk container are locally provided, without the need for bulky external components or connections. Such devices can be provided with a substantially breast shaped profile so as to fit within a user's bra for discrete pumping, as well as pumping on-the-go without any tethers to electrical sockets or collection stations.

In US 2016 206794 A1, the applicant has appreciated that the added size of the breast pump means that the combination of the user's breast and the breast pump may no longer fit within the user's regular bra. This is particularly relevant as over-compression of the user's breast will result in the closing of the user's milk ducts and hence reduced expression. To address this, the breast pump of US 2016 206794 A1 has an offset shape favouring the lower half of the pump, and requires complex collapsible bag systems as milk collection devices. This is to force the pump to fit within the user's existing bras. This works by breast milk leaving the breast and enters the bag, and the breast shrinking in a corresponding volume to the expansion of the bag. The inventors consider that this is unlikely to be a perfect 1 to 1 transfer of volume, and hence the compression on the breast may increase as the collapsible bags fill.

In addition to these systems being particularly complex and wasteful, a relatively smaller bag must be used. In US 2016 206794, approximately 110 ml (4 fluid ounces) of milk can be collected before the bag must be changed. While this may be sufficient for some users, others may produce much more milk in a session. Additionally, even this small increase in cup size may make bras less comfortable for the user.

It is our understanding that in the product which has been brought to market based on the disclosure of US 2016 206794 does increase the effective cup size of the wearer by around 2 cup sizes based upon European standard EN 13402 which is discussed later.

Maternity (or nursing) bras such as disclosed in US 4,390,024 A have partially detachable cups, with a plurality of attaching means provided along the bra strap for attaching the cups to the strap. The cup can then be attached to different points in order to adjust the support provided. However, these attachment points are fixed. Additionally, this bra has been designed to accommodate the change in breast size before and after the feeding/pumping process. It is not designed to accommodate a breast pump.

Accordingly, there is a need for a better system to accommodate integrated wearable breast pumps.

SUMMARY OF THE INVENTION

A maternity bra system is provided according to the present invention comprising: a maternity bra comprising: a support structure comprising shoulder straps and a bra band; and a first and a second cup each attached to the support structure to provide a first cup size, at least one cup being at least partially detachable from the support structure at an attachment point, the system further comprising: a clip comprising a first engagement mechanism and at least one second engagement mechanism(s), the clip being attachable in a releasable manner to the support structure at a first position via the first engagement mechanism and attachable in a releasable manner to one of the partially detachable cups via the second engagement mechanism to provide a second cup size different to the first cup size.

This system allows a user to quickly and simply adjust the cup size of a maternity bra to allow discrete and comfortable insertion and use of an integrated wearable breast pump. As such, the user does not need a specialised adjustable bra; instead the present

system works with all conventional maternity bras. The user also does not have to purchase any larger bras to wear while pumping.

The clip may be configured to be attached to the support structure at a position away from the attachment point. This results in the original attachment point being usable, with the clip providing an alternative attachment point for the adjusted cup size.

The clip may be attachable to the support structure at a plurality of non-discrete positions. This ensures essentially infinite adjustment of the clip position such that the perfect position for the user can be found.

The clip may be extendable between an unextended and an extended state, and attaches to the support structure at the attachment point; the first cup size is providable when the at least partially detachable cup is attached to the clip when the clip is an unextended state; the second cup size is providable when the at least partially detachable cup is attached to the clip when the clip is in an extended state.

An extendable clip like this allows quick switching between the two states in use.

Preferably, the attachment point is on at least one of the shoulder straps. Again this matches the standard system used in most maternity bras.

A clip is provided for use in the system described above according to the present invention. The clip comprising first and section engagement mechanisms and being releasably attachable to a support structure of a maternity bra with the first engagement mechanism and an at least partially detachable cup of a maternity bra with the second engagement mechanism to provide a second cup size which is different to a first cup size providable when the cup is attached to the support structure of the bra at an attachment point.

In a preferred embodiment, the first engagement mechanism engages with the support structure in a first direction and the second engagement mechanism engages with the cup in a second direction transverse to the first direction. This increases ease of attachment as with this structure the sideways engagement of the clip to the support

structure ensures that the second attachment mechanism is correctly orientated for the cup.

The second engagement mechanism may be one or more of a hook or a snap or a clip. This ensures easy interfacing with the traditional hook and clasp systems already provided on maternity bras.

Preferably the clip further comprises two distinct second engagement mechanisms which can be used interchangeably dependent upon the orientation of the clip. This makes the clip easier to use as it can be quickly switched between each bra strap, and the user does not have to worry which way up to put the clip on.

Preferably, the clip comprises a material pathway with an opening for receiving a portion of the support structure as the first engagement mechanism for securing the clip to the bra. This ensures a quick and simple method for attaching the clip to the bra. In particular, the clip may substantially U-shaped, and the material pathway is between the arms of the U.

Preferably, the clip comprises three prongs extending from a central support, the three prongs arranged as a central prong and two outer prongs so as to receive the support structure on one side of the central prong and on the opposite side of each respective outer prong, at least one prong being provided with the second engagement mechanism. This ensures a strong attachment to the bra and a simple design.

Preferably, both outer prongs are each provided with a respective second engagement mechanism. This ensures that the clip is reversible for easier attachment to the bra.

A method of adjusting the cup size of a maternity bra is provided according to the present invention, comprising: providing a maternity bra comprising: a support structure comprising shoulder straps and a bra band; and a first and second cup each attached to the support structure to provide a first cup size, the at least one cup being detachable from the support structure at an attachment point, providing a clip comprising first and section engagement mechanisms, attaching the first engagement mechanism of the clip in a releasable manner to a first position of the support structure of the maternity bra, attaching one of the detachable cup to the second engagement mechanism of the clip in a releasable manner to provide a second cup size different to the first cup size.

This clip and method allow a user to quickly and simply adjust the cup size of a maternity bra to allow discrete and comfortable insertion and use of an integrated wearable breast pump.

Preferably, the method further comprises the step of inserting a breast pump into the detachable cup. The adjustment of the size of the bra allows the bra to support the breast pump against the user's breast for comfort and ease.

Preferably, the method further comprises the steps of: detaching the first engagement mechanism of the clip from the first position support structure of the maternity bra; attaching the first engagement mechanism of the clip in a releasable manner to a second position of the support structure of the maternity bra; and attaching the other of the detachable cups to the second engagement mechanism of the clip in a releasable manner to provide a second cup size different to the first cup size. This allows the user to use a single clip on either of the cups.

DESCRIPTION OF THE FIGURES

The following invention will be described with reference to the following Figures in which:

Figure 1 depicts a prior art design for a maternity bra;

Figures 2A and 2B depict a clip and clasp according to the present invention;

Figures 3A, 3B and 3C depict the clip of Figures 2A and 2B being fitted to a maternity bra according to the present invention;

Figures 4A and 4B depict adjustment of the maternity bra of Figures 3A, 3B and 3C according to the present invention;

Figure 5 depicts an alternative clip for adjustment of a maternity bra according to the present invention;

Figure 6 depicts the alternative clip of Figure 5; and

Figure 7 depicts an alternative clip for adjustment of a maternity bra according to the present invention.

DETAILED DESCRIPTION

As shown in Figure 1, a typical maternity bra 100 comprises a support structure made up of shoulder straps 102 which support the bra 100 on the wearer's shoulders, and a bra band 104 for extending around a user's ribcage, comprising two wings 106 and a

central panel or bridge 108. The straps 102 are typically provided with adjustment mechanisms 103 for varying the length of the straps 102 to fit the bra 100 to the wearer.

At the outermost end of each wing, an attachment region 110 is provided. Typically, hooks 112 and loops 114 are provided for securing the bra 100 at the user's back. However, any other suitable attachment mechanism may be used. Alternatively, the attachment region 110 may be provided at the front of the bra 100 in the bridge region 108, with a continuous wing 106 extending continuously around the wearer's back. Typically, a number of sets of loops 114 are provided to allow for variation in the tightness of the bra 100 on the wearer.

While shown as having a separation in Figure 1, the wings 106 and bridge 108 may form a single continuous piece in certain designs. Likewise, while shown with a distinct separation in Figure 1, the shoulder straps 102 and the wings 106 may likewise form a single continuous piece.

The maternity bra 100 is further provided with two breast-supporting cups 116 attached to the support structure. The cups 116 define a cup size, which defines the difference in protrusion of the cups 116 from the band 104. The European standard EN 13402 for Cup Sizing defines cup sizes based upon the bust girth and the underbust girth of the wearer and ranges from AA to Z, with each letter increment denoting a 2 cm difference between the protrusion of the cups 116 from the band 104. Some manufacturers do vary from these conventions in denomination, and some maternity bras are measured in sizes of S, M, L, XL, etc.

The cups 116 may be stitched to the bra band 102. At least one of the cups 116, is in detachable attachment with the corresponding strap 102. In particular, this is achieved at attachment point 118 where a hook 120 attached to the bra strap 102 engages with a clasp 122 attached to the cup 116. The hook 120 and the bra strap adjuster 103 are set such that in the closed position, the cup size of the bra 100 fits the wearer's breasts. In Figure 1, the left cup 116 is shown attached to its attachment point 118, which the right cup 116 is unattached. In this manner, the wearer is able to detach the cup 116 to expose their breast for feeding or for breast pumping. Once this is completed, the cup 116 is reattached and the maternity bra 100 continues to function as a normal bra.

While in the depicted embodiments, a hook 120 is shown on the bra strap 102 and a clasp 122 is shown on the cup 116, it is appreciated that the provision of these may be reversed, or that alternative attachment mechanisms may be used.

In other embodiments, the detachable attachment point 118 may be provided at a different location, such as at the attachment between the bra band 104 and the cup 116. The mechanism for such an attachment point is the same as described above.

Figure 2A and 2B depict a clip 200 according to the present invention, along with a clasp 122 shown in isolation from the bra cup 116 it is normally attached to. The clip 200 is provided with a material pathway 203 which receives a portion of the bra strap 102. In the particular embodiment of these Figures, the clip 200 is substantially U-shaped, with a narrowing profile towards its open end 202. However, it is appreciated that any other suitable shape with a material pathway may be used, such as an S-shape or E-shape. The clip 200 is designed to be attached to the bra strap 102 in a releasable manner, with the slot 203 acting as a support engaging mechanism. The releasable manner means that the clip 200 may be simply removed from the bra 100 without causing any damage to the functioning of the bra 100. To enhance the ease of attachment, the clip 200 may be provided with outwardly extending wings 204 which help direct the bra strap 102 into the clip 200. The clip 200 is further provided with a hook 220 acting as a cup engaging mechanism which can engage with the clasp 122.

Figures 3A, 3B and 3C show the clip 200 being attached to a bra strap 102 in order to provide a second attachment point 228 for the clasp 122 to attach to, and hence to provide a second cup size for the bra 100. In this particular embodiment, the clip 200 is attached in a portion of strap 102A below the original attachment point 118 and hence the second attachment point 228 is likewise below the original attachment point. This results in a second cup size larger than the first cup size. In preferred embodiments, as shown in these Figures, the clip 200 engages with the support structure in a direction transverse to the direction in which it engages with the cup.

Figures 4A and 4B show how a wearer is able to move between the first and second cup sizes. In Figure 4A, the cup 116 is attached at the first attachment point 118 to provide a first cup size. The wearer then disengages the clasp 122 from the hook 120 at the first engagement point 118. As shown in Figure 4B, the clasp 122 is then engaged with

the hook 220 at the second engagement point 218. In this manner, the wearer is easily able to transition between the two cup sizes.

Figures 5 and 6 show an alternative design for a clip 300. This clip 300 is substantially "E-shaped", with a back portion 301 and first, second and third prongs 303A, 303B, 303C extending transverse from this back portion 301. The three prongs 303A, 303B, 303C are spaced apart along the length of the back portion 301. The first and third prongs 303A, 303C are provided with attachment clips 305A, 305B.

These attachment clips 305A, 305B are engageable with the clasp 122 of a bra to provide the second cup size. Depending upon the orientation of the clip 300, one or the other of the attachment clips 305A, 305B will be used to attach the clasp 122 of the bra. By providing these clips 305A, 305B on both of the first and the third prongs 303A, 303C the clip is easily reversible so it can be used on either side of the bra. Preferably the clip 300 is also symmetrical, to aid the reversibility of the clip 300.

Figure 6 shows the clip 300 attached to a bra. As can be seen, the first and third prongs 303A, 303C extend on the front side of the bra strap, with the second prong 303B extending on the rear side of the bra strap. In this manner, the clip 300 is attached to the strap. In preferably embodiments, a grip-enhancing member 307 such as a number of projections and/or roughened patches can be provided on the second prong 303B in order to strengthen this grip.

In alternative embodiments, the attachment clip could be provided on the second, centremost prong 303B. In such an arrangement, the centremost prong 303B would be on the outside of the bra, with the first and third prongs 303A, 303C on the inside.

The provision of the attachable clip allows maternity bras already owned by the wearer to be quickly transformed into bras with quick switchable double cup size options. This allows the use of integrated wearable breast pumps which increase the user's cup size. This allows more design freedom for the breast pump in terms of size and shape, while still allowing the user to discretely pump with the pump held within their bra. By allowing conversion of the user's existing maternity bras, they are not forced to purchase specially designed bras to wear with the pump. As such, the present invention allows a

user to discretely switch between the two configurations, and insert the pump without any complex adjustment or removal of clothing.

Preferably, the clip will be relatively unobtrusive in size and shape and hence can be left in place when the bra is first put on and used when necessary. To this end, the clip is preferably machine washable without significant damage or degradation.

In some embodiments, the clip may be switchable between positions for engaging with each cup so that a single clip may be used on either side of the bra. To achieve this, the clip is preferably reversible. This may provide the user with a visual indication of which breast has produced milk most recently so switching can take place.

An alternative embodiment may be provided, with an extendable clip as shown in Figure 7. In such an embodiment the clip is attached to the hook 120 on the strap 102 in a releasable manner, with the clasp 122 attached to an expandable portion of the clip. The clip is then able to expand between an unexpanded state where the clasp 122 is held in substantially the same position as the first attachment point 118 to provide the first cup size, and an expanded state, where the clasp 122 is held in a second position away from the first attachment point 118 to provide the second cup size.

For example, an elongate clip with first and second opposite ends may be provided. A first attachment point for attaching to the hook 120 is provided at the first end, and a second attachment point for attaching to the clasp 122 is provided at the second end. The elongate clip is hinged between the two ends, such that the clip can be folded between an elongate configuration to a closed configuration where the second end touches the first end. A clasp can be provided on the clip to hold the second end in this closed configuration. Thus, in the closed position the clasp 122 is held in substantially the same location as the first attachment point 118 to provide the first cup size, and in the open position the clasp is held away from the first attachment point 118 to provide the second cup size.

Other extendable clip embodiments are also possible, for example sliding clips or elastic clips.

CLAIMS:

1. A maternity bra system comprising:

a maternity bra comprising:

a support structure comprising shoulder straps and a bra band; and

a first and a second cup each attached to the support structure to provide a first cup size, at least one cup being detachable from the support structure at an attachment point,

the system further comprising:

a clip comprising a first engagement mechanism and at least one second engagement mechanism(s), the clip being attachable in a releasable manner to the support structure at a first position via the first engagement mechanism and attachable in a releasable manner to one of the detachable cups via the second engagement mechanism to provide a second cup size different to the first cup size.

2. The maternity bra system of claim 1, wherein the clip is configured to be attached to the support structure at a position away from the attachment point.

3. The maternity bra system of claim 2, wherein the clip is attachable to the support structure at a plurality of non-discrete positions.

4. The maternity bra system of claim 1, wherein:

the clip is extendable between an unextended and an extended state, and attaches to the support structure at the attachment point;

the first cup size is providable when the at least partially detachable cup is attached to the clip when the clip is an unextended state;

the second cup size is providable when the at least partially detachable cup is attached to the clip when the clip is in an extended state.

5. The maternity bra system of any preceding claim, wherein the attachment point is on at least one of the shoulder straps.

6. The maternity bra system of any preceding claim, wherein the second cup size is larger than the first cup size.

7. A clip for use in a system according to any preceding claim, the clip comprising first and section engagement mechanisms and being attachable in a releasable manner to a support structure of a maternity bra with the first engagement mechanism and an at least partially detachable cup of a maternity bra with the second engagement mechanism to provide a second cup size which is different to a first cup size providable when the cup is attached to the support structure of the bra at an attachment point.

8. The maternity bra system or clip of any preceding claim, wherein the first engagement mechanism engages with the support structure in a first direction and the second engagement mechanism engages with the cup in a second direction transverse to the first direction.

9. The maternity bra system of clip of any preceding claim, wherein the second engagement mechanism is one or more of a hook or a snap or a clip.

10. The maternity bra system or clip of any preceding claim, wherein the clip further comprises two distinct second engagement mechanisms which can be used interchangeably dependent upon the orientation of the clip.

11. The maternity bra system or clip of any preceding claim, wherein the clip comprises a material pathway with an opening for receiving a portion of the support structure as the first engagement mechanism for securing the clip to the bra.

12. The maternity bra system or clip of claim 11, wherein the clip is substantially U-shaped, and the material pathway is between the arms of the U.

13. The maternity bra system or clip of any of claims 1 to 11, wherein the clip comprises three prongs extending from a central support, the three prongs arranged as a central prong and two outer prongs so as to receive the support structure on one side of the central prong and on the opposite side of each respective outer prong, at least one prong being provided with the second engagement mechanism.

14. The maternity bra system or clip of claim 13, wherein both outer prongs are each provided with a respective second engagement mechanism.

15. A method of adjusting the cup size of a maternity bra, comprising:

providing a maternity bra comprising:

a support structure comprising shoulder straps and a bra band; and

a first and second cup each attached to the support structure to provide a first cup size, at least one cup being detachable from the support structure at an attachment point,

providing a clip comprising first and section engagement mechanisms;

attaching the first engagement mechanism of the clip in a releasable manner to a first position of the support structure of the maternity bra;

attaching one of the detachable cups to the second engagement mechanism of the clip in a releasable manner to provide a second cup size different to the first cup size.

16. The method of claim 15, further comprising the step of inserting a breast pump into the one of the detachable cup.

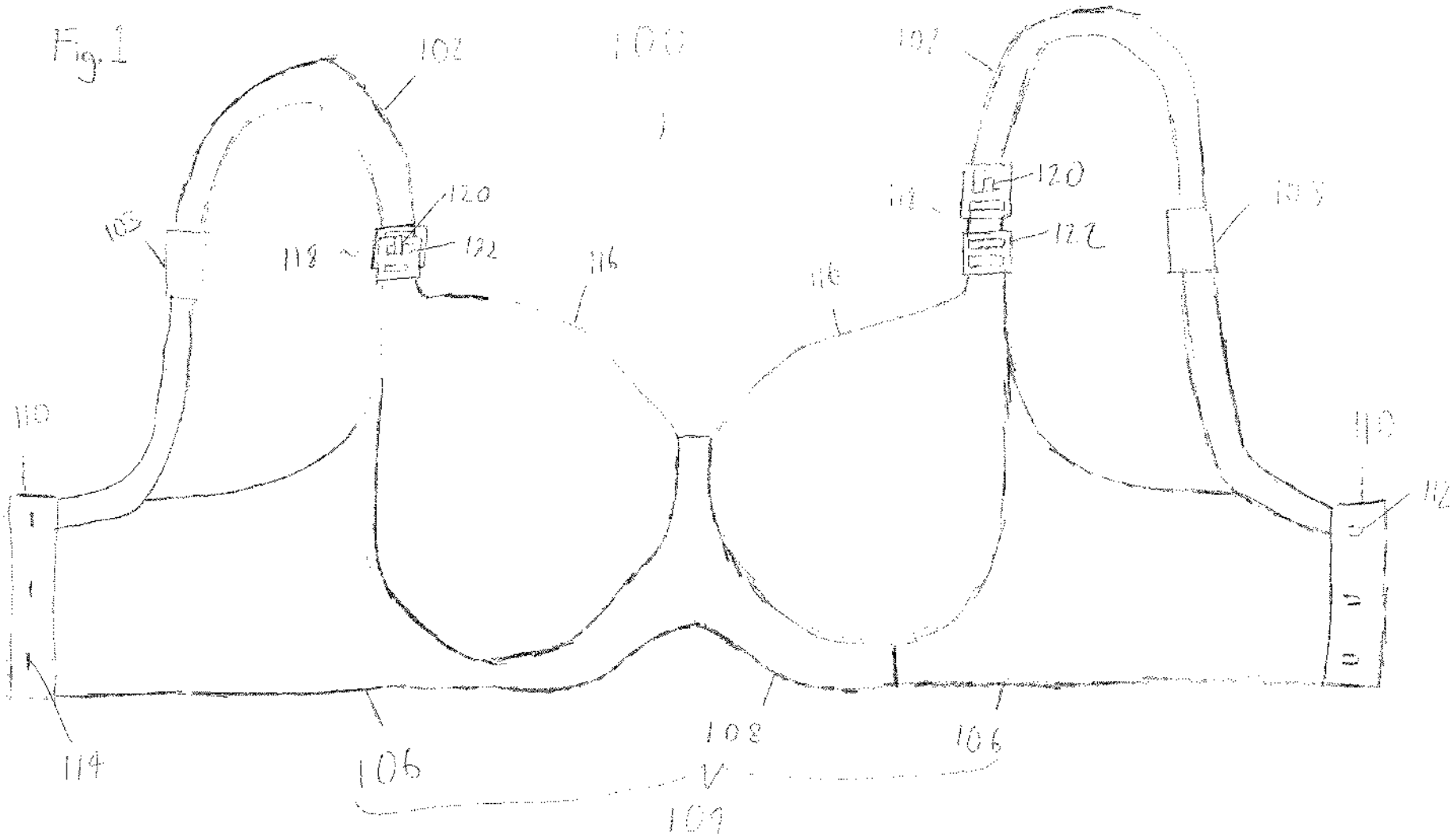
17. The method of claim 15 or 16, further comprising the steps of:

detaching the first engagement mechanism of the clip from the first position support structure of the maternity bra;

attaching the first engagement mechanism of the clip in a releasable manner to a second position of the support structure of the maternity bra; and

attaching the other of the detachable cups to the second engagement mechanism of the clip in a releasable manner to provide a second cup size different to the first cup size.

Fig. 1



Prior Art

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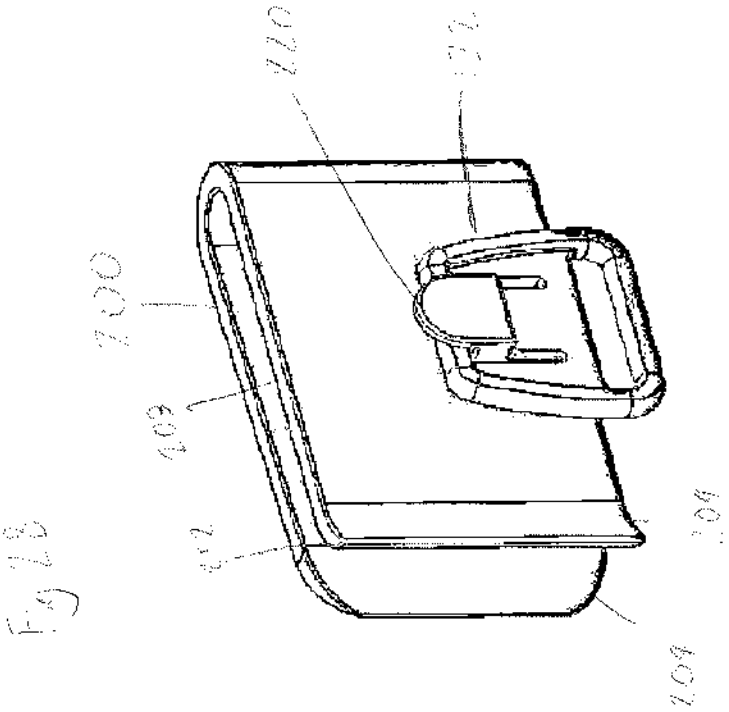

Fig 2B

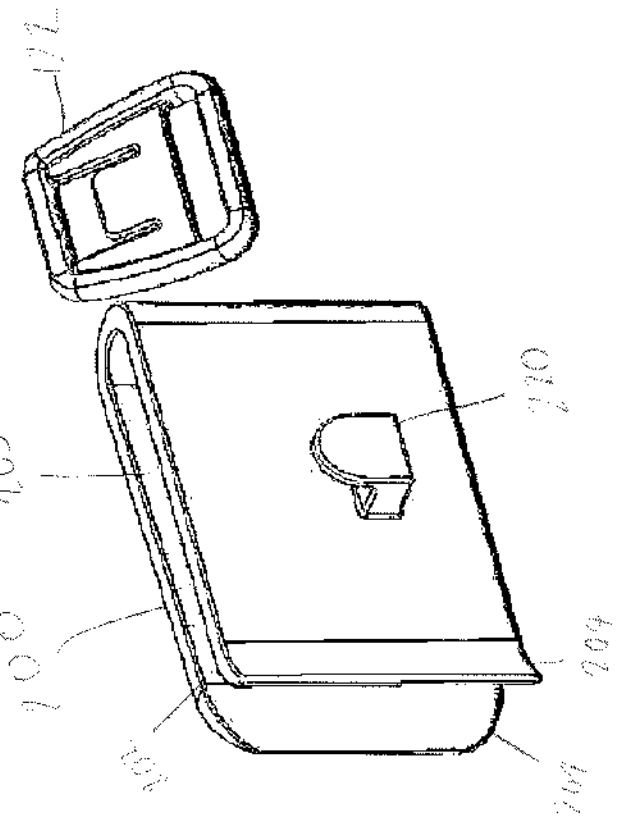

Fig 2A

3/7

Fig 2A

Fig 2B

Fig 2C

Fig. 4A

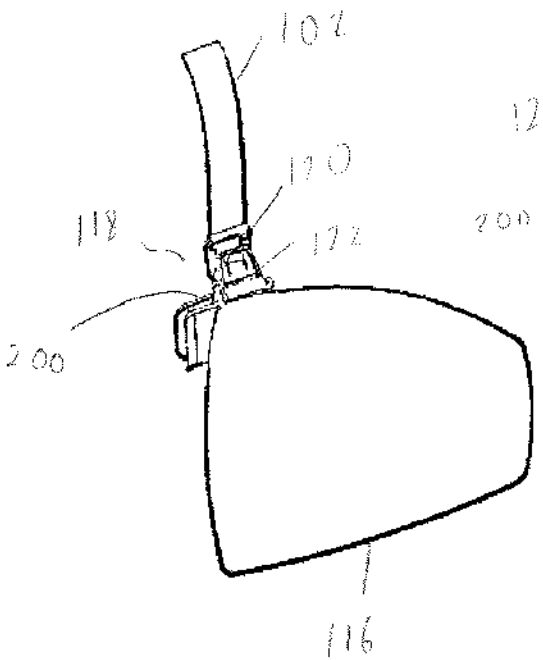

Fig. 4B

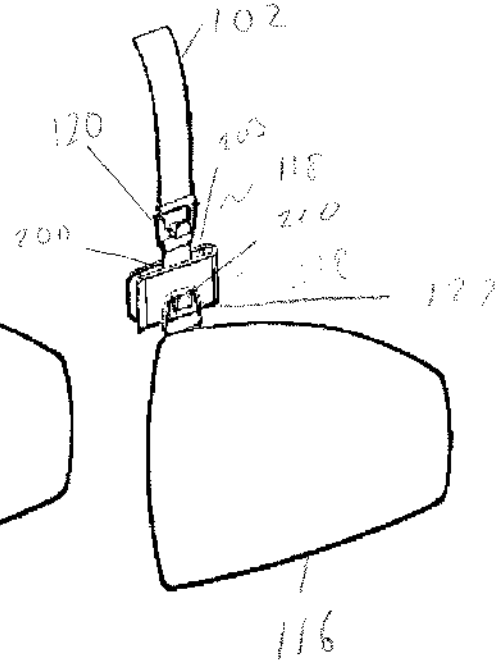

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Fig.5

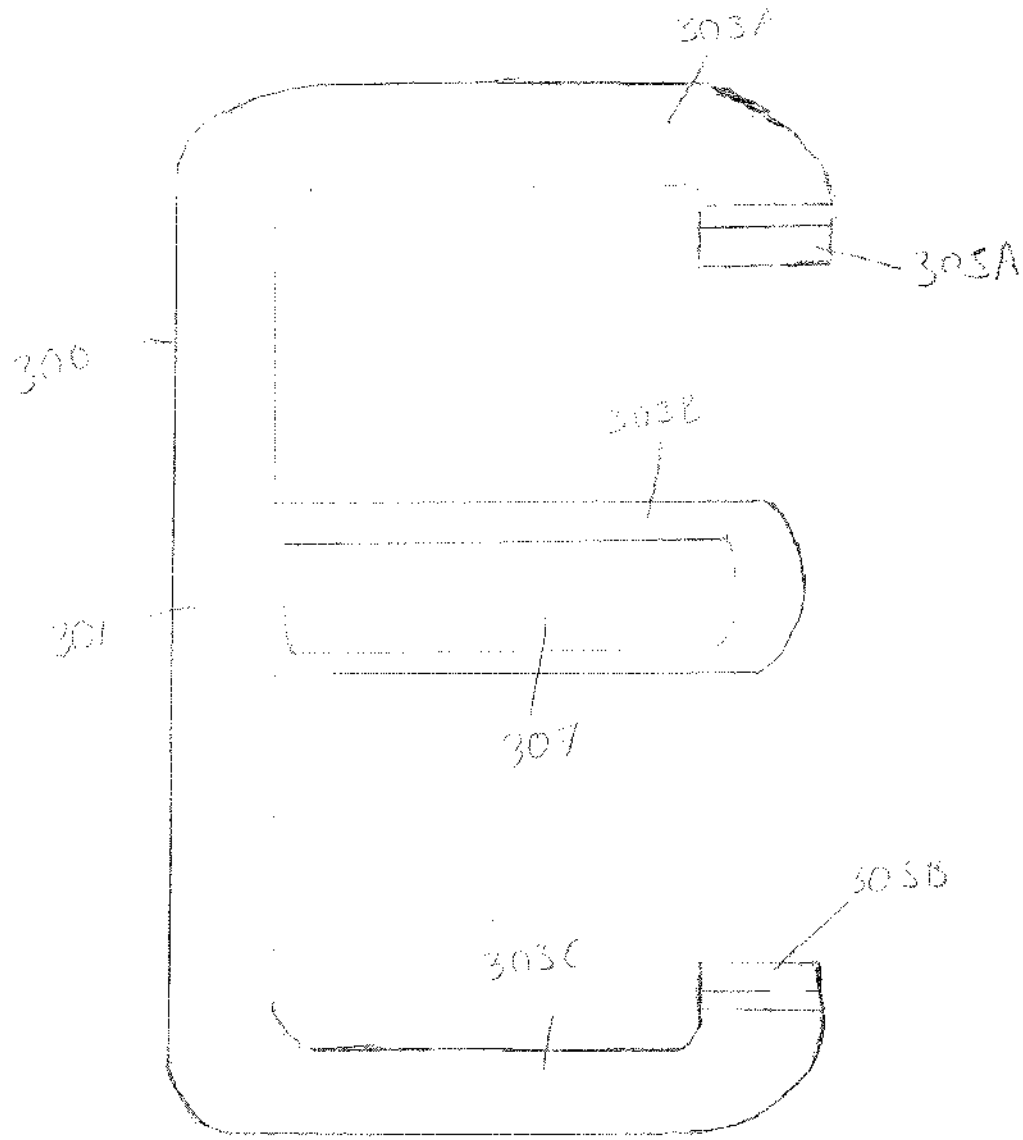
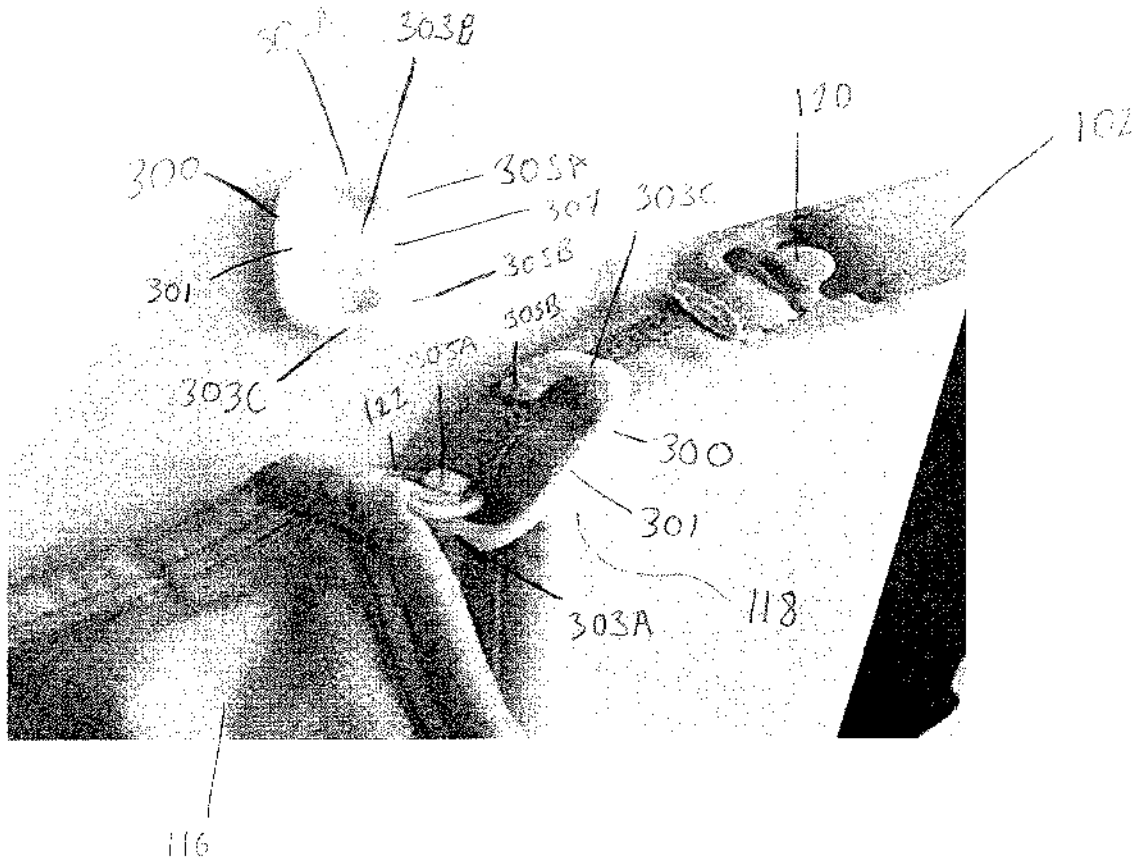
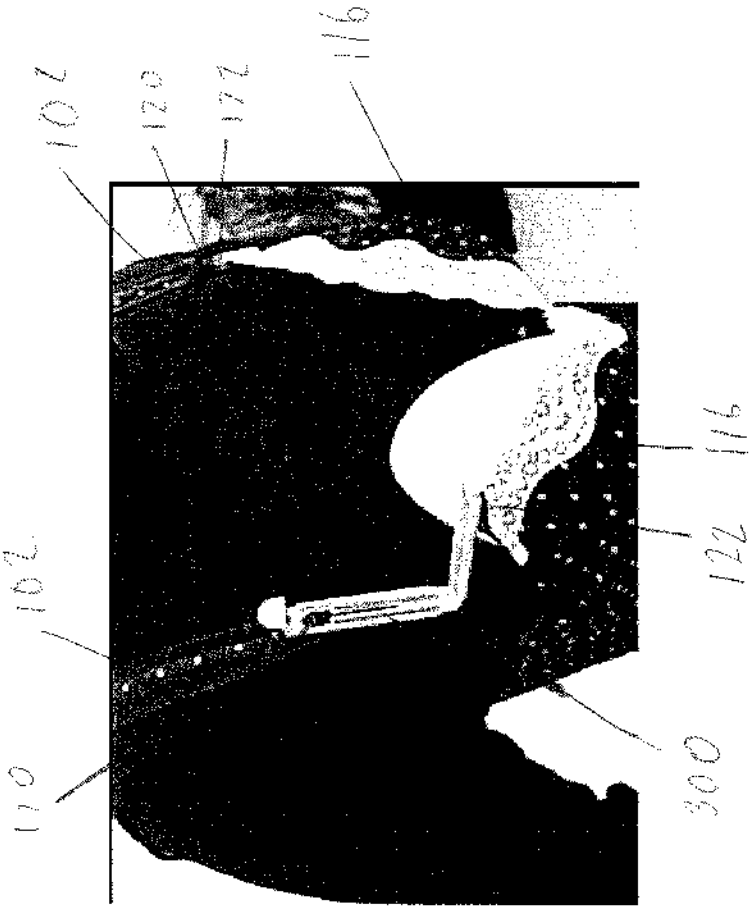


Fig 6


303B
300
305A
307
303C
120
102
301
305B
303C
305B
305A
122
300
301
118
303A
116

7/17

Fig 7



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17/203,292	03/16/2021	3783	1540	373499.00057	30	1

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Date Mailed: 03/29/2021

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Power of Attorney: The patent practitioners associated with Customer Number 78905

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which is a CON of 16/009,547 06/15/2018 PAT 10926011

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
UNITED KINGDOM 1709561.3 06/15/2017 Access Code Provided
UNITED KINGDOM 1709564.7 06/15/2017 Access Code Provided
UNITED KINGDOM 1709566.2 06/15/2017 Access Code Provided
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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/203,292**

Projected Publication Date: 07/08/2021

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

BREAST PUMP SYSTEM

Preliminary Class

604

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/203,292

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	80		N/A	
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A	350		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	400		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	30 minus 20 =	* 10	x 50 =	500	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*	x 240 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			210			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2			TOTAL	1540		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/203,292	03/16/2021	Jonathan O'TOOLE	373499.00057	9955

78905 7590 05/06/2021

Saul Ewing Arnstein & Lehr LLP (Philadelphia)
Attn: Patent Docket Clerk
Centre Square West
1500 Market Street, 38th Floor
Philadelphia, PA 19102-2186

EXAMINER	
ART UNIT	PAPER NUMBER
3783	

NOTIFICATION DATE	DELIVERY MODE
05/06/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patents@saul.com

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 17/203,292	**Applicant(s)** O'TOOLE et al.	
	Examiner APRIL M WISE	**Art Unit** OPET	**AIA (FITF) Status** Yes

1. THE REQUEST FILED 16 March 2021 IS **GRANTED** .

The above-identified application has met the requirements for prioritized examination

A. ☑ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination.** The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;

B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims** , or a multiple dependent claim;

C. filing a **request for continued examination** ;

D. filing a notice of appeal;

E. filing a request for suspension of action;

F. mailing of a notice of allowance;

G. mailing of a final Office action;

H. completion of examination as defined in 37 CFR 41.102; or

I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to undersigned at (571)272-1642.

In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/APRIL M WISE/ Paralegal Specialist, Office of Petitions	

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PTO-2298 (Rev. 02-2012)

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/203,292	03/16/2021	Jonathan O'TOOLE	373499.00057	9955

78905 7590 06/24/2021

Saul Ewing Arnstein & Lehr LLP (Philadelphia)
Attn: Patent Docket Clerk
Centre Square West
1500 Market Street, 38th Floor
Philadelphia, PA 19102-2186

EXAMINER	
FREDRICKSON, COURTNEY B	
ART UNIT	**PAPER NUMBER**
3783	
NOTIFICATION DATE	**DELIVERY MODE**
06/24/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patents@saul.com

Office Action Summary	Application No. 17/203,292	Applicant(s) O'TOOLE et al.	
	Examiner COURTNEY FREDRICKSON	Art Unit 3783	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 16March2021.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-30 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-30 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 16March2021 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☑ All b)☐ Some** c)☐ None of the:

1.☑ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Information Disclosure Statement

The information disclosure statement (IDS) submitted is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Objections

Claims 4, 11, and 14 are objected to because of the following informalities:

Claim 4 should be amended to recite "piece item that, in use, presents..." to correct for grammar.

Claim 11 should be amended to recite "...the device includes [[a]] the diaphragm" since the diaphragm is already recited in claim 1.

Claim 14 should be amended to recite "...the nipple tunnel [[portion]]" in line 2 to keep claim language consistent.

Appropriate correction is required.

Claim Interpretation

The following is a quotation of 35 U.S.C. 112(f):

> (f) Element in Claim for a Combination. – An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The following is a quotation of pre-AIA 35 U.S.C. 112, sixth paragraph:

> An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The claims in this application are given their broadest reasonable interpretation using the plain meaning of the claim language in light of the specification as it would be understood by one of ordinary skill in the art. The broadest reasonable interpretation of a claim element (also commonly referred to as a claim limitation) is limited by the description in the specification when 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is invoked.

As explained in MPEP § 2181, subsection I, claim limitations that meet the following three-prong test will be interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph:

(A) the claim limitation uses the term "means" or "step" or a term used as a substitute for "means" that is a generic placeholder (also called a nonce term or a non-structural term having no specific structural meaning) for performing the claimed function;

(B) the term "means" or "step" or the generic placeholder is modified by functional language, typically, but not always linked by the transition word "for" (e.g., "means for") or another linking word or phrase, such as "configured to" or "so that"; and

(C) the term "means" or "step" or the generic placeholder is not modified by sufficient structure, material, or acts for performing the claimed function.

Use of the word "means" (or "step") in a claim with functional language creates a rebuttable presumption that the claim limitation is to be treated in accordance with 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph. The presumption that the claim limitation is interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is rebutted when the claim limitation recites sufficient structure, material, or acts to entirely perform the recited function.

Absence of the word "means" (or "step") in a claim creates a rebuttable presumption that the claim limitation is not to be treated in accordance with 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph. The presumption that the claim limitation is not interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is rebutted when the claim limitation recites function without reciting sufficient structure, material or acts to entirely perform the recited function.

Claim limitations in this application that use the word "means" (or "step") are being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, except as otherwise indicated in an Office action. Conversely, claim limitations in this application that do not use the word "means" (or "step") are not being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, except as otherwise indicated in an Office action.

This application includes one or more claim limitations that do not use the word "means," but are nonetheless being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, because the claim limitation(s) uses a generic placeholder that is coupled with functional language without reciting sufficient structure to perform the recited function and the generic placeholder is not preceded by a structural modifier.

Such claim limitation(s) is/are: "**mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action**" in **claim 19**. The examiner note that this limitation will be interpreted to mean "a mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2, and functional equivalents thereof.

Because this/these claim limitation(s) is/are being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, it/they is/are being interpreted to cover the corresponding structure described in the specification as performing the claimed function, and equivalents thereof.

If applicant does not intend to have this/these limitation(s) interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, applicant may: (1) amend the claim limitation(s) to avoid it/them being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph (e.g., by reciting sufficient structure to perform the claimed function); or (2) present a sufficient showing that the claim limitation(s) recite(s) sufficient structure to perform the claimed function so as to avoid it/them being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-30 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly

claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

Regarding claim 1, the claim recites "a diaphragm holder" in part (ii) of the claim. It is unclear if this is the same diaphragm holder as recited in part (i)(e) of the claim or a second diaphragm holder. For examination purposes, the second diaphragm holder is considered to be the same as the first holder.

Claim 3 recites the limitation "the breast" in line 3. There is insufficient antecedent basis for this limitation in the claim.

Claim 4 recites the limitation "the nipple" in line 2. There is insufficient antecedent basis for this limitation in the claim.

Claim 7 recites the limitation "the top" and "the bottom" in line 2. There is insufficient antecedent basis for these limitations in the claim.

Regarding claim 12, it is unclear if the "substantially circular diaphragm holder" in line 3 is the same diaphragm holder recited in claim 1 or if the claim intends to introduce a different holder which is substantially circular. For examination purposes, the claim is interpreted as further limiting the diaphragm holder of claim 1 to be substantially circular.

Regarding claim 13, the claim recites "a diaphragm holder" in line 2 of the claim. It is unclear if this is the same diaphragm holder as recited in claim 1 or a different diaphragm holder. For examination purposes, the diaphragm holder of claim 13 is considered to be the same as claim 1.

Claim 13 recites the limitation "the recess" and "the rear surface" in lines 2 and 3 of the claim. There is insufficient antecedent basis for these limitations in the claim.

Regarding claim 14, the claim recites "a diaphragm holder" in line 2 of the claim. It is unclear if this is the same diaphragm holder as recited in claim 1 or a different diaphragm holder. For examination purposes, the diaphragm holder of claim 14 is considered to be the same as claim 1.

Claim 21 recites the limitation "the top" and "the base" in lines 1 and 3, respectively, of the claim. There is insufficient antecedent basis for these limitations in the claim.

Claim 27 recites the limitation "the quantity", "the height", and "the liquid" in line 3 of the claim. There is insufficient antecedent basis for these limitations in the claim.

Claims 2, 5-6, 8-11, 15-20, 22-26, and 28-30 are also rejected by virtue of being dependent on claim 1.

The following is a quotation of 35 U.S.C. 112(d):

> (d) REFERENCE IN DEPENDENT FORMS.—Subject to subsection (e), a claim in dependent form shall contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed. A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.

The following is a quotation of pre-AIA 35 U.S.C. 112, fourth paragraph:

> Subject to the following paragraph [i.e., the fifth paragraph of pre-AIA 35 U.S.C. 112], a claim in dependent form shall contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed. A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.

Claim 11 is rejected under 35 U.S.C. 112(d) or pre-AIA 35 U.S.C. 112, 4th paragraph, as being of improper dependent form for failing to further limit the subject matter of the claim upon which it depends, or for failing to include all the limitations of the claim upon which it depends. The claim is directed towards a diaphragm that prevents milk from reaching the pump; this limitation is already present in claim 1, part

(i)(e). As such, claim 11 fails to further limit claim 1. Applicant may cancel the claim(s), amend the claim(s) to place the claim(s) in proper dependent form, rewrite the claim(s) in independent form, or present a sufficient showing that the dependent claim(s) complies with the statutory requirements. In the present application, it is recommended to cancel claim 11 and change the dependency of claims 12-14 to be dependent on claim 1.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory

double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP § 2146 *et seq.* for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claims 1-12 and 14-30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim 11 of copending Application No. 17/181057 in view of the teachings below.

Although the claims at issue are not identical, they are not patentably distinct from each other because all of the elements of the application claims can be found in the application claim. With regard to **claim 1** of the application, claim 11 of the '057 application discloses a breast pump device that is configured as a self-contained, in-bra wearable device (preamble of claim 1), and that includes: (i) a housing (claim 1) that

includes (a) a rechargeable battery (claim 1); (c) control electronics (claim 1); (d) an air pump generating negative air pressure (claim 1); (e) a diaphragm configured to prevent milk from reaching the pump (claim 11), (ii) a breast shield made up of a breast flange and a nipple tunnel (claim 1) and that is configured to slide out from the housing together with the diaphragm (claim 11); and (iii) a milk container that is configured to attach to the housing (claim 1). Further, claim 11 of '057 includes additional features not recited in the instant application claims, thus the '057 claim is more specific. It has been held that the specific invention anticipates the generic invention. See *In re Goodman*, USPQ2d 2010 (Fed. Cir. 1993).

Thus, claim 11 of '057 claims all of the claimed limitations set forth in claim 1 of the instant application except in that '057 does not claim a power charging circuit for controlling the charging of the rechargeable battery and the control electronics and the air pump being powered by rechargeable battery; a diaphragm seated in a diaphragm holder and the diaphragm is configured to be removable from a diaphragm holder for cleaning.

Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) which has a housing (main body 34 in fig. 1a) that includes a battery (battery 48 in fig. 14a) capable of being recharged (paragraph 151 teaches that the battery can be recharged) and operable to power the control electronics (controller 52 in fig. 14a; paragraph 12 teaches the battery is electrically connected to the controller) and the pump (drivers 46 and 44 in fig. 14a; paragraph 12 teaches the battery is electrically connected to the pump). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified

claim 11 of the '057 application to have the rechargeable battery which powers the control electronics and pump. The modification of the rechargeable battery coupled to the pump and control electronics would provide the added benefit of enabling the system to be used without being plugged into an AC source and would allow the battery to be reused.

Yodfat (US 20110009824) teaches a wearable pump for transferring fluid to a body (10 in fig. 9). Yodfat further teaches that the pump comprises a housing (housing of 10 in fig. 9) which includes a rechargeable battery (240 in fig. 10; paragraph 116 discloses the energy storage can be a rechargeable battery); a power charging circuit for controlling the charging of the rechargeable battery ("recharging module" 170 in fig. 10; paragraph 125 discloses the module directs charging current to the rechargeable battery). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the device of claim 11 of the '057 application to have the power charging circuit for controlling the charging of the rechargeable battery, as taught by Yodfat, for the purpose of enabling charging of the rechargeable battery while the battery is housed in the housing (paragraph 125).

Khalil (US 20130023821) teaches a similar breast pump system (fig. 10) which comprises a diaphragm (membrane 3 in fig. 11) seated in a diaphragm holder (membrane housing parts 2 and 4 in fig. 11). Khalil further teaches that the diaphragm is intended to be cleaned (paragraph 21), indicating that it must be removable from the diaphragm holder. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified claim 11 of the '057 application to have the diaphragm seated in a diaphragm holder and be configured to

be removed from the holder for cleaning. This modification would ensure that the pump chamber and underpressure chamber of the device remain unchanged in terms of volume which ensures a uniform pump output (paragraph 31) and would enable the diaphragm to be cleaned for between uses.

'292 Claims	'057 Claims	Teaching
1	8	See discussion above
2		Vogelin (US 20070179439) is directed towards a breast pump system (fig. 1) having a breast shield (3 in fig. 1) which is made from a polypropylene, which is a known rigid material (paragraph 62). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast shield of the claim of the reference application to be made from polypropylene for the purpose of enabling the shield to be sterilized (paragraph 62).
3		Rigert (US 20180028733) teaches a breast shield system (1 in fig. 1) for a breast pump which comprises a shield (10 in fig. 2). Rigert further teaches that the shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast (paragraph 15 discloses that the shield can be rotated to determine the optimal level of comfort for a user depending on breast size and shape; the examiner notes that the shield of Rigert is capable of rotating smoothly since fig. 2 shows the interior of the shield is smooth and the size of the nipple relative to the nipple tunnel is not defined). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application have the claimed feature or the purpose of finding the optimal position for the user's breast shape and size.
4		Khalil teaches the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.

6		Khalil teaches the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed; fig. 11 shows that the shield comprises the breast flange and the nipple tunnel and no other stubs are joined). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
7		Khalil teaches the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical). It would have been obvious to have modified the claim of the reference application for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	11	
9		Guthrie (US 20160220745) teaches a breast pump system (fig. 2A) having a housing (204 in fig. 2A) which is configured to slide onto a breast shield (201 in fig. 2A) when the breast shield has been placed onto a breast using guide members (paragraph 39 discloses a threaded attachment; the examiner notes that the term "sliding" is interpreted to mean "to move smoothly along a surface" using the threads as guide members). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable attachment mechanism for coupling the shield to the housing.
10		Miller (US 20160325031) teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to have modified the claim of the reference application with the claimed limitation for the purpose of enabling easy cleaning of the shield and container.
11	11	
12		Khalil teaches the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (fig. 5 shows the membrane sealing to holder 2). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this shape is sufficient to transfer suction to the nipple.

14		Khalil teaches the diaphragm is removable from a diaphragm holder (4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this position enables the nipple tunnel to be fluidically connected to the milk container (fig. 10 shows the housing attaching to a milk container).
15		Phillips (US 20160296682) teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of the reference application to be made Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).
16		Thompson (US 7662018) teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application to have the claimed feature since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).
17		Khalil teaches the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the entire device can be held comfortably inside the bra (fig. 9 shows that the entire device is capable of being held in a bra). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature since it provides a hands-free breast pump unit which can be worn inside the bra (paragraph 70)
18		Khalil teaches the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature for the purpose of preventing milk from being sucked back into the pump.

19		Khalil teaches the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action (the examiner notes that this limitation is being interpreted to mean a "mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2 of applicant's specification; locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the milk container includes a cap that is removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and a removable valve that enables milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection). It would have been obvious to have modified the claim of the reference application for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Khalil teaches a top of a container which is optically clear (paragraph 69 discloses the container is clear in its entirety). Guthrie (US 20160220743) teaches a system subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie '743 further teaches that this sensor subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling accurate measurement of the milk while milk is being expressed and enabling a user to view the expressed milk.
22		Khalil teaches the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall (fig. 11 shows the container is capable of being used as a drinking bottle since it is shown to be wider than tall). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this configuration helps provide a hands-free pump which can be worn in a bra (paragraph 70).

23		Khalil teaches the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container (the examiner notes that the term "lower" is a relative direction and is not defined by the claim; fig. 5 of Khalil shows an opening formed in the surface of the nipple tunnel, this surface being it's "lower surface"). It would have been obvious to have modified the claim of the reference application for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) comprises a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). It would have been obvious to have modified the claim of the reference application for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).
25		Khalil teaches the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9). It would have been obvious to have modified the claim of the reference application to have the claimed features since Khalil teaches that this configuration assists in providing for a hands-free unit which can be worn in a bra (paragraph 70).
26		Makower (US 20160206794) teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). It would have been obvious to have modified the claim of the reference application to have the claimed features for enabling a user to keep track of milk expression data to monitor pumping efficiency over time.

27		Makower (US 20160206794) teaches having a visual indicator that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling a user to keep track of milk expression data to monitor pumping efficiency over time.
28		Takeuchi (US 20170043065) teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). It would have been obvious to have modified the claim of the reference application to have the claimed features for reducing motor sound and vibration (paragraph 7).
29		It appears that the device of the claim of the reference application would operate equally well with the claimed stall pressure since the vacuum pump of the claim would inherently possess some stall pressure (which is interpreted as the maximum pressure or vacuum at zero flow). Further, Applicant has not disclosed that the claimed value of the stall pressure solves any stated problem or is for any particular purpose. Instead, Applicant's specification merely states that a suitable pump usable with the breast pump system, which is currently commercially available, has the capability to exhibit the claimed stall pressure (pg. 22 of the specification). However, Applicant does not assert that this stall pressure is beneficial, or even needed, in the claimed breast pump device. It merely is an inherent property of a suitable pump usable with the breast pump system. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified to have the pump deliver in excess of 400mBar stall pressure because it appears to be an arbitrary design consideration which fails to patentably distinguish over the claim of the reference application. Chen (US 20140031744) also teaches a breast pump system (fig. 1; 30) which produces at least 9 L/min of free air flow (paragraph 39 discloses that the vacuum source as a flow rate; the examiner notes that Applicant's specification does not provide a definition for "free air flow", as such, the flow rate of Chen is considered to be equivalent to the claimed "free air flow" since the vacuum source of Chen is delivering air, as disclosed in paragraph 39). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast pump system of the claim of the reference application to have an air flow rate of not less than 9 L/min for

		the purpose of establishing an effective suckling frequency, as taught by Chen (paragraph 39). Finally, Mendoza (US 6227936) teaches a bra which is designed to support a breast pump to allow the mother's hands to remain free (1:8-12). Mendoza further discloses that the bra must be able to support up to 8 ounces when the pump is full (1:58-62). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the system of the claim of the reference application to be a lightweight air pump that enables the total weight of the system, unfilled with milk, to be less than 250gm, as taught by Mendoza since Mendoza teaches that a lightweight system is crucial for enabling the system to be supported by a bra.
30		Baker (US 20090281485) directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing (paragraph 144). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of making the device for discrete and comfortable for the user and others around the user.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 1-12 and 14-30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim 12 of copending Application No. 17/203050 in view of the teachings below (see table below).

Although the claims at issue are not identical, they are not patentably distinct from each other because all of the elements of the application claims can be found in the application claim. With regard to **claim 1** of the application, claim 12 of the '050 application discloses a breast pump device that is configured as a self-contained, in-bra wearable device (preamble of claim 1), and that includes: (i) a housing (claim 1) that includes (a) a rechargeable battery (claim 1); (b) a power charging circuit for controlling the charging of the rechargeable battery (claim 1) ; (c) control electronics powered by the rechargeable battery (claim 1); (d) an air pump powered by the rechargeable battery

and generating negative air pressure (claim 1); (e) a diaphragm configured to prevent milk from reaching the pump (claim 12), (ii) a breast shield made up of a breast flange and a nipple tunnel (claim 1) and that is configured to slide out from the housing together with the diaphragm (claim 12); and (iii) a milk container that is configured to attach to the housing (claim 1). Further, claim 12 of '050 includes additional features not recited in the instant application claims, thus the '050 claim is more specific. It has been held that the specific invention anticipates the generic invention. See *In re Goodman*, USPQ2d 2010 (Fed. Cir. 1993).

Thus, claim 12 of '050 claims all of the claimed limitations set forth in claim 1 of the instant application except in that '050 does not claim a diaphragm seated in a diaphragm holder and the diaphragm is configured to be removable from a diaphragm holder for cleaning.

Khalil (US 20130023821) teaches a similar breast pump system (fig. 10) which comprises a diaphragm (membrane 3 in fig. 11) seated in a diaphragm holder (membrane housing parts 2 and 4 in fig. 11). Khalil further teaches that the diaphragm is intended to be cleaned (paragraph 21), indicating that it must be removable from the diaphragm holder. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified claim 12 of the '050 application to have the diaphragm seated in a diaphragm holder and be configured to be removed from the holder for cleaning. This modification would ensure that the pump chamber and underpressure chamber of the device remain unchanged in terms of volume which ensures a uniform pump output (paragraph 31) and would enable the diaphragm to be cleaned for between uses.

'292 Claims	'050 Claims	Teaching
1	12	See discussion above
2		Vogelin (US 20070179439) is directed towards a breast pump system (fig. 1) having a breast shield (3 in fig. 1) which is made from a polypropylene, which is a known rigid material (paragraph 62). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast shield of the claim of the reference application to be made from polypropylene for the purpose of enabling the shield to be sterilized (paragraph 62).
3		Rigert (US 20180028733) teaches a breast shield system (1 in fig. 1) for a breast pump which comprises a shield (10 in fig. 2). Rigert further teaches that the shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast (paragraph 15 discloses that the shield can be rotated to determine the optimal level of comfort for a user depending on breast size and shape; the examiner notes that the shield of Rigert is capable of rotating smoothly since fig. 2 shows the interior of the shield is smooth and the size of the nipple relative to the nipple tunnel is not defined). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application have the claimed feature or the purpose of finding the optimal position for the user's breast shape and size.
4		Khalil teaches the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed; fig. 11 shows that the shield comprises the breast flange and the nipple tunnel and no other stubs are joined). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.

7		Khalil teaches the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical). It would have been obvious to have modified the claim of the reference application for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	12	
9		Guthrie (US 20160220745) teaches a breast pump system (fig. 2A) having a housing (204 in fig. 2A) which is configured to slide onto a breast shield (201 in fig. 2A) when the breast shield has been placed onto a breast using guide members (paragraph 39 discloses a threaded attachment; the examiner notes that the term "sliding" is interpreted to mean "to move smoothly along a surface" using the threads as guide members). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable attachment mechanism for coupling the shield to the housing.
10		Miller (US 20160325031) teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to have modified the claim of the reference application with the claimed limitation for the purpose of enabling easy cleaning of the shield and container.
11	12	
12		Khalil teaches the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (fig. 5 shows the membrane sealing to holder 2). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
14		Khalil teaches the diaphragm is removable from a diaphragm holder (4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this position enables the nipple tunnel to be fluidically connected to the milk container (fig. 10 shows the housing attaching to a milk container).

15		Phillips (US 20160296682) teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of the reference application to be made Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).
16		Thompson (US 7662018) teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application to have the claimed feature since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).
17		Khalil teaches the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the entire device can be held comfortably inside the bra (fig. 9 shows that the entire device is capable of being held in a bra). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature since it provides a hands-free breast pump unit which can be worn inside the bra (paragraph 70)
18		Khalil teaches the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature for the purpose of preventing milk from being sucked back into the pump.

19		Khalil teaches the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action (the examiner notes that this limitation is being interpreted to mean a "mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2 of applicant's specification; locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the milk container includes a cap that is removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and a removable valve that enables milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection). It would have been obvious to have modified the claim of the reference application for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Khalil teaches a top of a container which is optically clear (paragraph 69 discloses the container is clear in its entirety). Guthrie (US 20160220743) teaches a system subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie '743 further teaches that this sensor subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling accurate measurement of the milk while milk is being expressed and enabling a user to view the expressed milk.
22		Khalil teaches the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall (fig. 11 shows the container is capable of being used as a drinking bottle since it is shown to be wider than tall). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this configuration helps provide a hands-free pump which can be worn in a bra (paragraph 70).

23		Khalil teaches the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container (the examiner notes that the term "lower" is a relative direction and is not defined by the claim; fig. 5 of Khalil shows an opening formed in the surface of the nipple tunnel, this surface being it's "lower surface"). It would have been obvious to have modified the claim of the reference application for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) comprises a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). It would have been obvious to have modified the claim of the reference application for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).
25		Khalil teaches the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9). It would have been obvious to have modified the claim of the reference application to have the claimed features since Khalil teaches that this configuration assists in providing for a hands-free unit which can be worn in a bra (paragraph 70).
26		Makower (US 20160206794) teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). It would have been obvious to have modified the claim of the reference application to have the claimed features for enabling a user to keep track of milk expression data to monitor pumping efficiency over time.

27		Makower (US 20160206794) teaches having a visual indicator that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling a user to keep track of milk expression data to monitor pumping efficiency over time.
28		Takeuchi (US 20170043065) teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). It would have been obvious to have modified the claim of the reference application to have the claimed features for reducing motor sound and vibration (paragraph 7).
29		It appears that the device of the claim of the reference application would operate equally well with the claimed stall pressure since the vacuum pump of the claim would inherently possess some stall pressure (which is interpreted as the maximum pressure or vacuum at zero flow). Further, Applicant has not disclosed that the claimed value of the stall pressure solves any stated problem or is for any particular purpose. Instead, Applicant's specification merely states that a suitable pump usable with the breast pump system, which is currently commercially available, has the capability to exhibit the claimed stall pressure (pg. 22 of the specification). However, Applicant does not assert that this stall pressure is beneficial, or even needed, in the claimed breast pump device. It merely is an inherent property of a suitable pump usable with the breast pump system. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified to have the pump deliver in excess of 400mBar stall pressure because it appears to be an arbitrary design consideration which fails to patentably distinguish over the claim of the reference application. Chen (US 20140031744) also teaches a breast pump system (fig. 1; 30) which produces at least 9 L/min of free air flow (paragraph 39 discloses that the vacuum source as a flow rate; the examiner notes that Applicant's specification does not provide a definition for "free air flow", as such, the flow rate of Chen is considered to be equivalent to the claimed "free air flow" since the vacuum source of Chen is delivering air, as disclosed in paragraph 39). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast pump system of the claim of the reference application to have an air flow rate of not less than 9 L/min for

		the purpose of establishing an effective suckling frequency, as taught by Chen (paragraph 39). Finally, Mendoza (US 6227936) teaches a bra which is designed to support a breast pump to allow the mother's hands to remain free (1:8-12). Mendoza further discloses that the bra must be able to support up to 8 ounces when the pump is full (1:58-62). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the system of the claim of the reference application to be a lightweight air pump that enables the total weight of the system, unfilled with milk, to be less than 250gm, as taught by Mendoza since Mendoza teaches that a lightweight system is crucial for enabling the system to be supported by a bra.
30		Baker (US 20090281485) directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing (paragraph 144). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of making the device for discrete and comfortable for the user and others around the user.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 1-12 and 14-30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim 20 of copending Application No. 17/203313 in view of the teachings below (see table below).

Although the claims at issue are not identical, they are not patentably distinct from each other because all of the elements of the application claims can be found in the patent claim. With regard to **claim 1** of the application, claim 20 of the '313 application discloses a breast pump device that is configured as a self-contained, in-bra wearable device (preamble of claim 1), and that includes: (i) a housing (claim 1) that includes (a) a rechargeable battery (claim 1); (b) a power charging circuit for controlling the charging of the rechargeable battery (claim 1) ; (c) control electronics powered by

the rechargeable battery (claim 1); (d) an air pump powered by the rechargeable battery and generating negative air pressure (claim 1); (e) a diaphragm configured to prevent milk from reaching the pump (claim 20), (ii) a breast shield made up of a breast flange and a nipple tunnel (claim 1) and that is configured to slide out from the housing together with the diaphragm (claim 20); and (iii) a milk container that is configured to attach to the housing (claim 1). Further, claim 20 of '313 includes additional features not recited in the instant application claims, thus the '313 claim is more specific. It has been held that the specific invention anticipates the generic invention. See *In re Goodman,* USPQ2d 2010 (Fed. Cir. 1993).

Thus, claim 20 of '313 claims all of the claimed limitations set forth in claim 1 of the instant application except in that '313 does not claim a diaphragm seated in a diaphragm holder and the diaphragm is configured to be removable from a diaphragm holder for cleaning.

Khalil (US 20130023821) teaches a similar breast pump system (fig. 10) which comprises a diaphragm (membrane 3 in fig. 11) seated in a diaphragm holder (membrane housing parts 2 and 4 in fig. 11). Khalil further teaches that the diaphragm is intended to be cleaned (paragraph 21), indicating that it must be removable from the diaphragm holder. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified claim 20 of the '313 application to have the diaphragm seated in a diaphragm holder and be configured to be removed from the holder for cleaning. This modification would ensure that the pump chamber and underpressure chamber of the device remain unchanged in terms of

volume which ensures a uniform pump output (paragraph 31) and would enable the diaphragm to be cleaned for between uses.

'292 Claims	'313 Claims	Teaching
1	20	See discussion above
2		Vogelin (US 20070179439) is directed towards a breast pump system (fig. 1) having a breast shield (3 in fig. 1) which is made from a polypropylene, which is a known rigid material (paragraph 62). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast shield of the claim of the reference application to be made from polypropylene for the purpose of enabling the shield to be sterilized (paragraph 62).
3		Rigert (US 20180028733) teaches a breast shield system (1 in fig. 1) for a breast pump which comprises a shield (10 in fig. 2). Rigert further teaches that the shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast (paragraph 15 discloses that the shield can be rotated to determine the optimal level of comfort for a user depending on breast size and shape; the examiner notes that the shield of Rigert is capable of rotating smoothly since fig. 2 shows the interior of the shield is smooth and the size of the nipple relative to the nipple tunnel is not defined). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application have the claimed feature or the purpose of finding the optimal position for the user's breast shape and size.
4		Khalil teaches the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed; fig. 11 shows that the shield comprises the breast flange and the nipple tunnel and no other stubs are joined). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.

7		Khalil teaches the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical). It would have been obvious to have modified the claim of the reference application for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	20	
9		Guthrie (US 20160220745) teaches a breast pump system (fig. 2A) having a housing (204 in fig. 2A) which is configured to slide onto a breast shield (201 in fig. 2A) when the breast shield has been placed onto a breast using guide members (paragraph 39 discloses a threaded attachment; the examiner notes that the term "sliding" is interpreted to mean "to move smoothly along a surface" using the threads as guide members). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable attachment mechanism for coupling the shield to the housing.
10		Miller (US 20160325031) teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to have modified the claim of the reference application with the claimed limitation for the purpose of enabling easy cleaning of the shield and container.
11	20	
12		Khalil teaches the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (fig. 5 shows the membrane sealing to holder 2). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
14		Khalil teaches the diaphragm is removable from a diaphragm holder (4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this position enables the nipple tunnel to be fluidically connected to the milk container (fig. 10 shows the housing attaching to a milk container).

15		Phillips (US 20160296682) teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of the reference application to be made Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).
16		Thompson (US 7662018) teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application to have the claimed feature since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).
17		Khalil teaches the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the entire device can be held comfortably inside the bra (fig. 9 shows that the entire device is capable of being held in a bra). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature since it provides a hands-free breast pump unit which can be worn inside the bra (paragraph 70)
18		Khalil teaches the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature for the purpose of preventing milk from being sucked back into the pump.

19		Khalil teaches the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action (the examiner notes that this limitation is being interpreted to mean a "mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2 of applicant's specification; locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the milk container includes a cap that is removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and a removable valve that enables milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection). It would have been obvious to have modified the claim of the reference application for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Khalil teaches a top of a container which is optically clear (paragraph 69 discloses the container is clear in its entirety). Guthrie (US 20160220743) teaches a system subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie '743 further teaches that this sensor subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling accurate measurement of the milk while milk is being expressed and enabling a user to view the expressed milk.
22		Khalil teaches the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall (fig. 11 shows the container is capable of being used as a drinking bottle since it is shown to be wider than tall). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this configuration helps provide a hands-free pump which can be worn in a bra (paragraph 70).

23		Khalil teaches the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container (the examiner notes that the term "lower" is a relative direction and is not defined by the claim; fig. 5 of Khalil shows an opening formed in the surface of the nipple tunnel, this surface being it's "lower surface"). It would have been obvious to have modified the claim of the reference application for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) comprises a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). It would have been obvious to have modified the claim of the reference application for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).
25		Khalil teaches the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9). It would have been obvious to have modified the claim of the reference application to have the claimed features since Khalil teaches that this configuration assists in providing for a hands-free unit which can be worn in a bra (paragraph 70).
26		Makower (US 20160206794) teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). It would have been obvious to have modified the claim of the reference application to have the claimed features for enabling a user to keep track of milk expression data to monitor pumping efficiency over time.

27		Makower (US 20160206794) teaches having a visual indicator that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling a user to keep track of milk expression data to monitor pumping efficiency over time.
28		Takeuchi (US 20170043065) teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). It would have been obvious to have modified the claim of the reference application to have the claimed features for reducing motor sound and vibration (paragraph 7).
29		It appears that the device of the claim of the reference application would operate equally well with the claimed stall pressure since the vacuum pump of the claim would inherently possess some stall pressure (which is interpreted as the maximum pressure or vacuum at zero flow). Further, Applicant has not disclosed that the claimed value of the stall pressure solves any stated problem or is for any particular purpose. Instead, Applicant's specification merely states that a suitable pump usable with the breast pump system, which is currently commercially available, has the capability to exhibit the claimed stall pressure (pg. 22 of the specification). However, Applicant does not assert that this stall pressure is beneficial, or even needed, in the claimed breast pump device. It merely is an inherent property of a suitable pump usable with the breast pump system. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified to have the pump deliver in excess of 400mBar stall pressure because it appears to be an arbitrary design consideration which fails to patentably distinguish over the claim of the reference application. Chen (US 20140031744) also teaches a breast pump system (fig. 1; 30) which produces at least 9 L/min of free air flow (paragraph 39 discloses that the vacuum source as a flow rate; the examiner notes that Applicant's specification does not provide a definition for "free air flow", as such, the flow rate of Chen is considered to be equivalent to the claimed "free air flow" since the vacuum source of Chen is delivering air, as disclosed in paragraph 39). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast pump system of the claim of the reference application to have an air flow rate of not less than 9 L/min for

		the purpose of establishing an effective suckling frequency, as taught by Chen (paragraph 39). Finally, Mendoza (US 6227936) teaches a bra which is designed to support a breast pump to allow the mother's hands to remain free (1:8-12). Mendoza further discloses that the bra must be able to support up to 8 ounces when the pump is full (1:58-62). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the system of the claim of the reference application to be a lightweight air pump that enables the total weight of the system, unfilled with milk, to be less than 250gm, as taught by Mendoza since Mendoza teaches that a lightweight system is crucial for enabling the system to be supported by a bra.
30		Baker (US 20090281485) directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing (paragraph 144). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of making the device for discrete and comfortable for the user and others around the user.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 1-12 and 14-30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim 8 of copending Application No. 17/203327 in view of the teachings below (see table below).

Although the claims at issue are not identical, they are not patentably distinct from each other because all of the elements of the application claims can be found in the patent claim. With regard to **claim 1** of the application, claim 8 of the '327 application discloses a breast pump device that is configured as a self-contained, in-bra wearable device (preamble of claim 1), and that includes: (i) a housing (claim 1) that includes (a) a rechargeable battery (claim 1); (b) a power charging circuit for controlling the charging of the rechargeable battery (claim 1) ; (c) control electronics powered by

the rechargeable battery (claim 1); (d) an air pump powered by the rechargeable battery and generating negative air pressure (claim 1); (e) a diaphragm configured to prevent milk from reaching the pump (claim 8), (ii) a breast shield made up of a breast flange and a nipple tunnel (claim 1) and that is configured to slide out from the housing together with the diaphragm (claim 8); and (iii) a milk container that is configured to attach to the housing (claim 1). Further, claim 8 of '327 includes additional features not recited in the instant application claims, thus the '327 claim is more specific. It has been held that the specific invention anticipates the generic invention. See *In re Goodman*, USPQ2d 2010 (Fed. Cir. 1993).

Thus, claim 8 of '327 claims all of the claimed limitations set forth in claim 1 of the instant application except in that '327 does not claim a diaphragm seated in a diaphragm holder and the diaphragm is configured to be removable from a diaphragm holder for cleaning.

Khalil (US 20130023821) teaches a similar breast pump system (fig. 10) which comprises a diaphragm (membrane 3 in fig. 11) seated in a diaphragm holder (membrane housing parts 2 and 4 in fig. 11). Khalil further teaches that the diaphragm is intended to be cleaned (paragraph 21), indicating that it must be removable from the diaphragm holder. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified claim 8 of the '327 application to have the diaphragm seated in a diaphragm holder and be configured to be removed from the holder for cleaning. This modification would ensure that the pump chamber and underpressure chamber of the device remain unchanged in terms of

volume which ensures a uniform pump output (paragraph 31) and would enable the diaphragm to be cleaned for between uses.

'292 Claims	'327 Claims	Teaching
1	8	See discussion above
2		Vogelin (US 20070179439) is directed towards a breast pump system (fig. 1) having a breast shield (3 in fig. 1) which is made from a polypropylene, which is a known rigid material (paragraph 62). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast shield of the claim of the reference application to be made from polypropylene for the purpose of enabling the shield to be sterilized (paragraph 62).
3		Rigert (US 20180028733) teaches a breast shield system (1 in fig. 1) for a breast pump which comprises a shield (10 in fig. 2). Rigert further teaches that the shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast (paragraph 15 discloses that the shield can be rotated to determine the optimal level of comfort for a user depending on breast size and shape; the examiner notes that the shield of Rigert is capable of rotating smoothly since fig. 2 shows the interior of the shield is smooth and the size of the nipple relative to the nipple tunnel is not defined). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application have the claimed feature or the purpose of finding the optimal position for the user's breast shape and size.
4		Khalil teaches the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed; fig. 11 shows that the shield comprises the breast flange and the nipple tunnel and no other stubs are joined). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.

7		Khalil teaches the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical). It would have been obvious to have modified the claim of the reference application for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	8	
9		Guthrie (US 20160220745) teaches a breast pump system (fig. 2A) having a housing (204 in fig. 2A) which is configured to slide onto a breast shield (201 in fig. 2A) when the breast shield has been placed onto a breast using guide members (paragraph 39 discloses a threaded attachment; the examiner notes that the term "sliding" is interpreted to mean "to move smoothly along a surface" using the threads as guide members). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable attachment mechanism for coupling the shield to the housing.
10		Miller (US 20160325031) teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to have modified the claim of the reference application with the claimed limitation for the purpose of enabling easy cleaning of the shield and container.
11	8	
12		Khalil teaches the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (fig. 5 shows the membrane sealing to holder 2). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
14		Khalil teaches the diaphragm is removable from a diaphragm holder (4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this position enables the nipple tunnel to be fluidically connected to the milk container (fig. 10 shows the housing attaching to a milk container).

15		Phillips (US 20160296682) teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of the reference application to be made Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).
16		Thompson (US 7662018) teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application to have the claimed feature since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).
17		Khalil teaches the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the entire device can be held comfortably inside the bra (fig. 9 shows that the entire device is capable of being held in a bra). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature since it provides a hands-free breast pump unit which can be worn inside the bra (paragraph 70)
18		Khalil teaches the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature for the purpose of preventing milk from being sucked back into the pump.

19		Khalil teaches the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action (the examiner notes that this limitation is being interpreted to mean a "mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2 of applicant's specification; locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the milk container includes a cap that is removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and a removable valve that enables milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection). It would have been obvious to have modified the claim of the reference application for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Khalil teaches a top of a container which is optically clear (paragraph 69 discloses the container is clear in its entirety). Guthrie (US 20160220743) teaches a system subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie '743 further teaches that this sensor subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling accurate measurement of the milk while milk is being expressed and enabling a user to view the expressed milk.
22		Khalil teaches the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall (fig. 11 shows the container is capable of being used as a drinking bottle since it is shown to be wider than tall). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this configuration helps provide a hands-free pump which can be worn in a bra (paragraph 70).

23		Khalil teaches the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container (the examiner notes that the term "lower" is a relative direction and is not defined by the claim; fig. 5 of Khalil shows an opening formed in the surface of the nipple tunnel, this surface being it's "lower surface"). It would have been obvious to have modified the claim of the reference application for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) comprises a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). It would have been obvious to have modified the claim of the reference application for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).
25		Khalil teaches the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9). It would have been obvious to have modified the claim of the reference application to have the claimed features since Khalil teaches that this configuration assists in providing for a hands-free unit which can be worn in a bra (paragraph 70).
26		Makower (US 20160206794) teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). It would have been obvious to have modified the claim of the reference application to have the claimed features for enabling a user to keep track of milk expression data to monitor pumping efficiency over time.

27		Makower (US 20160206794) teaches having a visual indicator that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling a user to keep track of milk expression data to monitor pumping efficiency over time.
28		Takeuchi (US 20170043065) teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). It would have been obvious to have modified the claim of the reference application to have the claimed features for reducing motor sound and vibration (paragraph 7).
29		It appears that the device of the claim of the reference application would operate equally well with the claimed stall pressure since the vacuum pump of the claim would inherently possess some stall pressure (which is interpreted as the maximum pressure or vacuum at zero flow). Further, Applicant has not disclosed that the claimed value of the stall pressure solves any stated problem or is for any particular purpose. Instead, Applicant's specification merely states that a suitable pump usable with the breast pump system, which is currently commercially available, has the capability to exhibit the claimed stall pressure (pg. 22 of the specification). However, Applicant does not assert that this stall pressure is beneficial, or even needed, in the claimed breast pump device. It merely is an inherent property of a suitable pump usable with the breast pump system. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified to have the pump deliver in excess of 400mBar stall pressure because it appears to be an arbitrary design consideration which fails to patentably distinguish over the claim of the reference application. Chen also teaches a breast pump system (fig. 1; 30) which produces at least 9 L/min of free air flow (paragraph 39 discloses that the vacuum source as a flow rate; the examiner notes that Applicant's specification does not provide a definition for "free air flow", as such, the flow rate of Chen is considered to be equivalent to the claimed "free air flow" since the vacuum source of Chen is delivering air, as disclosed in paragraph 39). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast pump system of the claim of the reference application to have an air flow rate of not less than 9 L/min for the

		purpose of establishing an effective suckling frequency, as taught by Chen (paragraph 39). Finally, Mendoza teaches a bra which is designed to support a breast pump to allow the mother's hands to remain free (1:8-12). Mendoza further discloses that the bra must be able to support up to 8 ounces when the pump is full (1:58-62). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the system of the claim of the reference application to be a lightweight air pump that enables the total weight of the system, unfilled with milk, to be less than 250gm, as taught by Mendoza since Mendoza teaches that a lightweight system is crucial for enabling the system to be supported by a bra.
30		Baker (US 20090281485) directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing (paragraph 144). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of making the device for discrete and comfortable for the user and others around the user.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 1-12 and 14-30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim 8 of copending Application No. 17/203355 in view of the teachings below (see table below).

Although the claims at issue are not identical, they are not patentably distinct from each other because all of the elements of the application claims can be found in the patent claim. With regard to **claim 1** of the application, claim 8 of the '355 application discloses a breast pump device that is configured as a self-contained, in-bra wearable device (preamble of claim 1), and that includes: (i) a housing (claim 1) that includes (a) a rechargeable battery (claim 1); (b) a power charging circuit for controlling the charging of the rechargeable battery (claim 1) ; (c) control electronics powered by the rechargeable battery (claim 1); (d) an air pump powered by the rechargeable battery

and generating negative air pressure (claim 1); (e) a diaphragm configured to prevent milk from reaching the pump (claim 8), (ii) a breast shield made up of a breast flange and a nipple tunnel (claim 1) and that is configured to slide out from the housing together with the diaphragm (claim 8); and (iii) a milk container that is configured to attach to the housing (claim 1). Further, claim 8 of '355 includes additional features not recited in the instant application claims, thus the '355 claim is more specific. It has been held that the specific invention anticipates the generic invention. See *In re Goodman*, USPQ2d 2010 (Fed. Cir. 1993).

Thus, claim 8 of '355 claims all of the claimed limitations set forth in claim 1 of the instant application except in that '355 does not claim a diaphragm seated in a diaphragm holder and the diaphragm is configured to be removable from a diaphragm holder for cleaning.

Khalil (US 20130023821) teaches a similar breast pump system (fig. 10) which comprises a diaphragm (membrane 3 in fig. 11) seated in a diaphragm holder (membrane housing parts 2 and 4 in fig. 11). Khalil further teaches that the diaphragm is intended to be cleaned (paragraph 21), indicating that it must be removable from the diaphragm holder. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified claim 8 of the '355 application to have the diaphragm seated in a diaphragm holder and be configured to be removed from the holder for cleaning. This modification would ensure that the pump chamber and underpressure chamber of the device remain unchanged in terms of volume which ensures a uniform pump output (paragraph 31) and would enable the diaphragm to be cleaned for between uses.

'292 Claims	'355 Claims	Teaching
1	8	See discussion above
2		Vogelin (US 20070179439) is directed towards a breast pump system (fig. 1) having a breast shield (3 in fig. 1) which is made from a polypropylene, which is a known rigid material (paragraph 62). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast shield of the claim of the reference application to be made from polypropylene for the purpose of enabling the shield to be sterilized (paragraph 62).
3		Rigert (US 20180028733) teaches a breast shield system (1 in fig. 1) for a breast pump which comprises a shield (10 in fig. 2). Rigert further teaches that the shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast (paragraph 15 discloses that the shield can be rotated to determine the optimal level of comfort for a user depending on breast size and shape; the examiner notes that the shield of Rigert is capable of rotating smoothly since fig. 2 shows the interior of the shield is smooth and the size of the nipple relative to the nipple tunnel is not defined). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application have the claimed feature or the purpose of finding the optimal position for the user's breast shape and size.
4		Khalil teaches the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed; fig. 11 shows that the shield comprises the breast flange and the nipple tunnel and no other stubs are joined). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.

7		Khalil teaches the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical). It would have been obvious to have modified the claim of the reference application for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	8	
9		Guthrie (US 20160220745) teaches a breast pump system (fig. 2A) having a housing (204 in fig. 2A) which is configured to slide onto a breast shield (201 in fig. 2A) when the breast shield has been placed onto a breast using guide members (paragraph 39 discloses a threaded attachment; the examiner notes that the term "sliding" is interpreted to mean "to move smoothly along a surface" using the threads as guide members). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable attachment mechanism for coupling the shield to the housing.
10		Miller (US 20160325031) teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to have modified the claim of the reference application with the claimed limitation for the purpose of enabling easy cleaning of the shield and container.
11	8	
12		Khalil teaches the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (fig. 5 shows the membrane sealing to holder 2). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
14		Khalil teaches the diaphragm is removable from a diaphragm holder (4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this position enables the nipple tunnel to be fluidically connected to the milk container (fig. 10 shows the housing attaching to a milk container).

15		Phillips (US 20160296682) teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of the reference application to be made Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).
16		Thompson (US 7662018) teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application to have the claimed feature since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).
17		Khalil teaches the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the entire device can be held comfortably inside the bra (fig. 9 shows that the entire device is capable of being held in a bra). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature since it provides a hands-free breast pump unit which can be worn inside the bra (paragraph 70)
18		Khalil teaches the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature for the purpose of preventing milk from being sucked back into the pump.

19		Khalil teaches the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action (the examiner notes that this limitation is being interpreted to mean a "mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2 of applicant's specification; locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the milk container includes a cap that is removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and a removable valve that enables milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection). It would have been obvious to have modified the claim of the reference application for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Khalil teaches a top of a container which is optically clear (paragraph 69 discloses the container is clear in its entirety). Guthrie (US 20160220743) teaches a system subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie '743 further teaches that this sensor subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling accurate measurement of the milk while milk is being expressed and enabling a user to view the expressed milk.
22		Khalil teaches the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall (fig. 11 shows the container is capable of being used as a drinking bottle since it is shown to be wider than tall). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this configuration helps provide a hands-free pump which can be worn in a bra (paragraph 70).

23		Khalil teaches the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container (the examiner notes that the term "lower" is a relative direction and is not defined by the claim; fig. 5 of Khalil shows an opening formed in the surface of the nipple tunnel, this surface being it's "lower surface"). It would have been obvious to have modified the claim of the reference application for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) comprises a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). It would have been obvious to have modified the claim of the reference application for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).
25		Khalil teaches the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9). It would have been obvious to have modified the claim of the reference application to have the claimed features since Khalil teaches that this configuration assists in providing for a hands-free unit which can be worn in a bra (paragraph 70).
26		Makower (US 20160206794) teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). It would have been obvious to have modified the claim of the reference application to have the claimed features for enabling a user to keep track of milk expression data to monitor pumping efficiency over time.

27		Makower (US 20160206794) teaches having a visual indicator that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling a user to keep track of milk expression data to monitor pumping efficiency over time.
28		Takeuchi (US 20170043065) teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). It would have been obvious to have modified the claim of the reference application to have the claimed features for reducing motor sound and vibration (paragraph 7).
29		It appears that the device of the claim of the reference application would operate equally well with the claimed stall pressure since the vacuum pump of the claim would inherently possess some stall pressure (which is interpreted as the maximum pressure or vacuum at zero flow). Further, Applicant has not disclosed that the claimed value of the stall pressure solves any stated problem or is for any particular purpose. Instead, Applicant's specification merely states that a suitable pump usable with the breast pump system, which is currently commercially available, has the capability to exhibit the claimed stall pressure (pg. 22 of the specification). However, Applicant does not assert that this stall pressure is beneficial, or even needed, in the claimed breast pump device. It merely is an inherent property of a suitable pump usable with the breast pump system. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified to have the pump deliver in excess of 400mBar stall pressure because it appears to be an arbitrary design consideration which fails to patentably distinguish over the claim of the reference application. Chen also teaches a breast pump system (fig. 1; 30) which produces at least 9 L/min of free air flow (paragraph 39 discloses that the vacuum source as a flow rate; the examiner notes that Applicant's specification does not provide a definition for "free air flow", as such, the flow rate of Chen is considered to be equivalent to the claimed "free air flow" since the vacuum source of Chen is delivering air, as disclosed in paragraph 39). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast pump system of the claim of the reference application to have an air flow rate of not less than 9 L/min for the

		purpose of establishing an effective suckling frequency, as taught by Chen (paragraph 39). Finally, Mendoza teaches a bra which is designed to support a breast pump to allow the mother's hands to remain free (1:8-12). Mendoza further discloses that the bra must be able to support up to 8 ounces when the pump is full (1:58-62). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the system of the claim of the reference application to be a lightweight air pump that enables the total weight of the system, unfilled with milk, to be less than 250gm, as taught by Mendoza since Mendoza teaches that a lightweight system is crucial for enabling the system to be supported by a bra.
30		Baker (US 20090281485) directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing (paragraph 144). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of making the device for discrete and comfortable for the user and others around the user.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 1-12 and 14-30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim 8 of copending Application No. 17/203150 in view of the teachings below (see table below).

Although the claims at issue are not identical, they are not patentably distinct from each other because all of the elements of the application claims can be found in the patent claim. With regard to **claim 1** of the application, claim 8 of the '150 application discloses a breast pump device that is configured as a self-contained, in-bra wearable device (preamble of claim 1), and that includes: (i) a housing (claim 1) that includes (a) a rechargeable battery (claim 1); (b) a power charging circuit for controlling the charging of the rechargeable battery (claim 1) ; (c) control electronics powered by

the rechargeable battery (claim 1); (d) an air pump powered by the rechargeable battery and generating negative air pressure (claim 1); (e) a diaphragm configured to prevent milk from reaching the pump (claim 8), (ii) a breast shield made up of a breast flange and a nipple tunnel (claim 1) and that is configured to slide out from the housing together with the diaphragm (claim 8); and (iii) a milk container that is configured to attach to the housing (claim 1). Further, claim 8 of '150 includes additional features not recited in the instant application claims, thus the '150 claim is more specific. It has been held that the specific invention anticipates the generic invention. See *In re Goodman,* USPQ2d 2010 (Fed. Cir. 1993).

Thus, claim 8 of '150 claims all of the claimed limitations set forth in claim 1 of the instant application except in that '150 does not claim a diaphragm seated in a diaphragm holder and the diaphragm is configured to be removable from a diaphragm holder for cleaning.

Khalil (US 20130023821) teaches a similar breast pump system (fig. 10) which comprises a diaphragm (membrane 3 in fig. 11) seated in a diaphragm holder (membrane housing parts 2 and 4 in fig. 11). Khalil further teaches that the diaphragm is intended to be cleaned (paragraph 21), indicating that it must be removable from the diaphragm holder. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified claim 8 of the '150 application to have the diaphragm seated in a diaphragm holder and be configured to be removed from the holder for cleaning. This modification would ensure that the pump chamber and underpressure chamber of the device remain unchanged in terms of

volume which ensures a uniform pump output (paragraph 31) and would enable the diaphragm to be cleaned for between uses.

'292 Claims	'150 Claims	Teaching
1	8	See discussion above
2		Vogelin (US 20070179439) is directed towards a breast pump system (fig. 1) having a breast shield (3 in fig. 1) which is made from a polypropylene, which is a known rigid material (paragraph 62). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast shield of the claim of the reference application to be made from polypropylene for the purpose of enabling the shield to be sterilized (paragraph 62).
3		Rigert (US 20180028733) teaches a breast shield system (1 in fig. 1) for a breast pump which comprises a shield (10 in fig. 2). Rigert further teaches that the shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast (paragraph 15 discloses that the shield can be rotated to determine the optimal level of comfort for a user depending on breast size and shape; the examiner notes that the shield of Rigert is capable of rotating smoothly since fig. 2 shows the interior of the shield is smooth and the size of the nipple relative to the nipple tunnel is not defined). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application have the claimed feature or the purpose of finding the optimal position for the user's breast shape and size.
4		Khalil teaches the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed; fig. 11 shows that the shield comprises the breast flange and the nipple tunnel and no other stubs are joined). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.

7		Khalil teaches the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical). It would have been obvious to have modified the claim of the reference application for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	8	
9		Guthrie (US 20160220745) teaches a breast pump system (fig. 2A) having a housing (204 in fig. 2A) which is configured to slide onto a breast shield (201 in fig. 2A) when the breast shield has been placed onto a breast using guide members (paragraph 39 discloses a threaded attachment; the examiner notes that the term "sliding" is interpreted to mean "to move smoothly along a surface" using the threads as guide members). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable attachment mechanism for coupling the shield to the housing.
10		Miller (US 20160325031) teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to have modified the claim of the reference application with the claimed limitation for the purpose of enabling easy cleaning of the shield and container.
11	8	
12		Khalil teaches the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (fig. 5 shows the membrane sealing to holder 2). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
14		Khalil teaches the diaphragm is removable from a diaphragm holder (4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this position enables the nipple tunnel to be fluidically connected to the milk container (fig. 10 shows the housing attaching to a milk container).

15		Phillips (US 20160296682) teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of the reference application to be made Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).
16		Thompson (US 7662018) teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application to have the claimed feature since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).
17		Khalil teaches the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the entire device can be held comfortably inside the bra (fig. 9 shows that the entire device is capable of being held in a bra). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature since it provides a hands-free breast pump unit which can be worn inside the bra (paragraph 70)
18		Khalil teaches the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature for the purpose of preventing milk from being sucked back into the pump.

19		Khalil teaches the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action (the examiner notes that this limitation is being interpreted to mean a "mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2 of applicant's specification; locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the milk container includes a cap that is removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and a removable valve that enables milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection). It would have been obvious to have modified the claim of the reference application for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Khalil teaches a top of a container which is optically clear (paragraph 69 discloses the container is clear in its entirety). Guthrie (US 20160220743) teaches a system subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie '743 further teaches that this sensor subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling accurate measurement of the milk while milk is being expressed and enabling a user to view the expressed milk.
22		Khalil teaches the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall (fig. 11 shows the container is capable of being used as a drinking bottle since it is shown to be wider than tall). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this configuration helps provide a hands-free pump which can be worn in a bra (paragraph 70).

23		Khalil teaches the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container (the examiner notes that the term "lower" is a relative direction and is not defined by the claim; fig. 5 of Khalil shows an opening formed in the surface of the nipple tunnel, this surface being it's "lower surface"). It would have been obvious to have modified the claim of the reference application for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) comprises a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). It would have been obvious to have modified the claim of the reference application for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).
25		Khalil teaches the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9). It would have been obvious to have modified the claim of the reference application to have the claimed features since Khalil teaches that this configuration assists in providing for a hands-free unit which can be worn in a bra (paragraph 70).
26		Makower (US 20160206794) teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). It would have been obvious to have modified the claim of the reference application to have the claimed features for enabling a user to keep track of milk expression data to monitor pumping efficiency over time.

27		Makower (US 20160206794) teaches having a visual indicator that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling a user to keep track of milk expression data to monitor pumping efficiency over time.
28		Takeuchi (US 20170043065) teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). It would have been obvious to have modified the claim of the reference application to have the claimed features for reducing motor sound and vibration (paragraph 7).
29		It appears that the device of the claim of the reference application would operate equally well with the claimed stall pressure since the vacuum pump of the claim would inherently possess some stall pressure (which is interpreted as the maximum pressure or vacuum at zero flow). Further, Applicant has not disclosed that the claimed value of the stall pressure solves any stated problem or is for any particular purpose. Instead, Applicant's specification merely states that a suitable pump usable with the breast pump system, which is currently commercially available, has the capability to exhibit the claimed stall pressure (pg. 22 of the specification). However, Applicant does not assert that this stall pressure is beneficial, or even needed, in the claimed breast pump device. It merely is an inherent property of a suitable pump usable with the breast pump system. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified to have the pump deliver in excess of 400mBar stall pressure because it appears to be an arbitrary design consideration which fails to patentably distinguish over the claim of the reference application. Chen also teaches a breast pump system (fig. 1; 30) which produces at least 9 L/min of free air flow (paragraph 39 discloses that the vacuum source as a flow rate; the examiner notes that Applicant's specification does not provide a definition for "free air flow", as such, the flow rate of Chen is considered to be equivalent to the claimed "free air flow" since the vacuum source of Chen is delivering air, as disclosed in paragraph 39). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast pump system of the claim of the reference application to have an air flow rate of not less than 9 L/min for the

		purpose of establishing an effective suckling frequency, as taught by Chen (paragraph 39). Finally, Mendoza teaches a bra which is designed to support a breast pump to allow the mother's hands to remain free (1:8-12). Mendoza further discloses that the bra must be able to support up to 8 ounces when the pump is full (1:58-62). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the system of the claim of the reference application to be a lightweight air pump that enables the total weight of the system, unfilled with milk, to be less than 250gm, as taught by Mendoza since Mendoza teaches that a lightweight system is crucial for enabling the system to be supported by a bra.
30		Baker (US 20090281485) directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing (paragraph 144). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of making the device for discrete and comfortable for the user and others around the user.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 1-12 and 14-30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim 23 of copending Application No. 17/203109 in view of the teachings below (see table below).

Although the claims at issue are not identical, they are not patentably distinct from each other because all of the elements of the application claims can be found in the patent claim. With regard to **claim 1** of the application, claim 23 of the '109 application discloses a breast pump device that is configured as a self-contained, in-bra wearable device (preamble of claim 1), and that includes: (i) a housing (claim 1) that includes (a) a rechargeable battery (claim 1); (b) a power charging circuit for controlling the charging of the rechargeable battery (claim 1) ; (c) control electronics powered by

the rechargeable battery (claim 1); (d) an air pump powered by the rechargeable battery and generating negative air pressure (claim 1); (e) a diaphragm configured to prevent milk from reaching the pump (claim 8), (ii) a breast shield made up of a breast flange and a nipple tunnel (claim 1) and that is configured to slide out from the housing together with the diaphragm (claim 8); and (iii) a milk container that is configured to attach to the housing (claim 1). Further, claim 23 of '109 includes additional features not recited in the instant application claims, thus the '109 claim is more specific. It has been held that the specific invention anticipates the generic invention. See *In re Goodman*, USPQ2d 2010 (Fed. Cir. 1993).

Thus, claim 23 of '109 claims all of the claimed limitations set forth in claim 1 of the instant application except in that '109 does not claim a diaphragm seated in a diaphragm holder and the diaphragm is configured to be removable from a diaphragm holder for cleaning.

Khalil (US 20130023821) teaches a similar breast pump system (fig. 10) which comprises a diaphragm (membrane 3 in fig. 11) seated in a diaphragm holder (membrane housing parts 2 and 4 in fig. 11). Khalil further teaches that the diaphragm is intended to be cleaned (paragraph 21), indicating that it must be removable from the diaphragm holder. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified claim 23 of the '109 application to have the diaphragm seated in a diaphragm holder and be configured to be removed from the holder for cleaning. This modification would ensure that the pump chamber and underpressure chamber of the device remain unchanged in terms of

volume which ensures a uniform pump output (paragraph 31) and would enable the diaphragm to be cleaned for between uses.

'292 Claims	'109 Claims	Teaching
1	23	See discussion above
2		Vogelin (US 20070179439) is directed towards a breast pump system (fig. 1) having a breast shield (3 in fig. 1) which is made from a polypropylene, which is a known rigid material (paragraph 62). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast shield of the claim of the reference application to be made from polypropylene for the purpose of enabling the shield to be sterilized (paragraph 62).
3		Rigert (US 20180028733) teaches a breast shield system (1 in fig. 1) for a breast pump which comprises a shield (10 in fig. 2). Rigert further teaches that the shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast (paragraph 15 discloses that the shield can be rotated to determine the optimal level of comfort for a user depending on breast size and shape; the examiner notes that the shield of Rigert is capable of rotating smoothly since fig. 2 shows the interior of the shield is smooth and the size of the nipple relative to the nipple tunnel is not defined). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application have the claimed feature or the purpose of finding the optimal position for the user's breast shape and size.
4		Khalil teaches the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed; fig. 11 shows that the shield comprises the breast flange and the nipple tunnel and no other stubs are joined). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.

7		Khalil teaches the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical). It would have been obvious to have modified the claim of the reference application for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	23	
9		Guthrie (US 20160220745) teaches a breast pump system (fig. 2A) having a housing (204 in fig. 2A) which is configured to slide onto a breast shield (201 in fig. 2A) when the breast shield has been placed onto a breast using guide members (paragraph 39 discloses a threaded attachment; the examiner notes that the term "sliding" is interpreted to mean "to move smoothly along a surface" using the threads as guide members). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable attachment mechanism for coupling the shield to the housing.
10		Miller (US 20160325031) teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to have modified the claim of the reference application with the claimed limitation for the purpose of enabling easy cleaning of the shield and container.
11	23	
12		Khalil teaches the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (fig. 5 shows the membrane sealing to holder 2). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
14		Khalil teaches the diaphragm is removable from a diaphragm holder (4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this position enables the nipple tunnel to be fluidically connected to the milk container (fig. 10 shows the housing attaching to a milk container).

15		Phillips (US 20160296682) teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of the reference application to be made Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).
16		Thompson (US 7662018) teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application to have the claimed feature since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).
17		Khalil teaches the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the entire device can be held comfortably inside the bra (fig. 9 shows that the entire device is capable of being held in a bra). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature since it provides a hands-free breast pump unit which can be worn inside the bra (paragraph 70)
18		Khalil teaches the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature for the purpose of preventing milk from being sucked back into the pump.

19		Khalil teaches the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action (the examiner notes that this limitation is being interpreted to mean a "mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2 of applicant's specification; locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the milk container includes a cap that is removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and a removable valve that enables milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection). It would have been obvious to have modified the claim of the reference application for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Khalil teaches a top of a container which is optically clear (paragraph 69 discloses the container is clear in its entirety). Guthrie (US 20160220743) teaches a system subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie '743 further teaches that this sensor subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling accurate measurement of the milk while milk is being expressed and enabling a user to view the expressed milk.
22		Khalil teaches the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall (fig. 11 shows the container is capable of being used as a drinking bottle since it is shown to be wider than tall). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this configuration helps provide a hands-free pump which can be worn in a bra (paragraph 70).

23		Khalil teaches the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container (the examiner notes that the term "lower" is a relative direction and is not defined by the claim; fig. 5 of Khalil shows an opening formed in the surface of the nipple tunnel, this surface being it's "lower surface"). It would have been obvious to have modified the claim of the reference application for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) comprises a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). It would have been obvious to have modified the claim of the reference application for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).
25		Khalil teaches the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9). It would have been obvious to have modified the claim of the reference application to have the claimed features since Khalil teaches that this configuration assists in providing for a hands-free unit which can be worn in a bra (paragraph 70).
26		Makower (US 20160206794) teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). It would have been obvious to have modified the claim of the reference application to have the claimed features for enabling a user to keep track of milk expression data to monitor pumping efficiency over time.

27		Makower (US 20160206794) teaches having a visual indicator that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling a user to keep track of milk expression data to monitor pumping efficiency over time.
28		Takeuchi (US 20170043065) teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). It would have been obvious to have modified the claim of the reference application to have the claimed features for reducing motor sound and vibration (paragraph 7).
29		It appears that the device of the claim of the reference application would operate equally well with the claimed stall pressure since the vacuum pump of the claim would inherently possess some stall pressure (which is interpreted as the maximum pressure or vacuum at zero flow). Further, Applicant has not disclosed that the claimed value of the stall pressure solves any stated problem or is for any particular purpose. Instead, Applicant's specification merely states that a suitable pump usable with the breast pump system, which is currently commercially available, has the capability to exhibit the claimed stall pressure (pg. 22 of the specification). However, Applicant does not assert that this stall pressure is beneficial, or even needed, in the claimed breast pump device. It merely is an inherent property of a suitable pump usable with the breast pump system. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified to have the pump deliver in excess of 400mBar stall pressure because it appears to be an arbitrary design consideration which fails to patentably distinguish over the claim of the reference application. Chen also teaches a breast pump system (fig. 1; 30) which produces at least 9 L/min of free air flow (paragraph 39 discloses that the vacuum source as a flow rate; the examiner notes that Applicant's specification does not provide a definition for "free air flow", as such, the flow rate of Chen is considered to be equivalent to the claimed "free air flow" since the vacuum source of Chen is delivering air, as disclosed in paragraph 39). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast pump system of the claim of the reference application to have an air flow rate of not less than 9 L/min for the

		purpose of establishing an effective suckling frequency, as taught by Chen (paragraph 39). Finally, Mendoza teaches a bra which is designed to support a breast pump to allow the mother's hands to remain free (1:8-12). Mendoza further discloses that the bra must be able to support up to 8 ounces when the pump is full (1:58-62). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the system of the claim of the reference application to be a lightweight air pump that enables the total weight of the system, unfilled with milk, to be less than 250gm, as taught by Mendoza since Mendoza teaches that a lightweight system is crucial for enabling the system to be supported by a bra.
30		Baker (US 20090281485) directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing (paragraph 144). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of making the device for discrete and comfortable for the user and others around the user.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 1-12 and 14-30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim 16 of copending Application No. 17/203179 in view of the teachings below (see table below).

Although the claims at issue are not identical, they are not patentably distinct from each other because all of the elements of the application claims can be found in the patent claim. With regard to **claim 1** of the application, claim 16 of the '179 application discloses a breast pump device that is configured as a self-contained, in-bra wearable device (preamble of claim 1), and that includes: (i) a housing (claim 1) that includes (a) a rechargeable battery (claim 1); (b) a power charging circuit for controlling the charging of the rechargeable battery (claim 1) ; (c) control electronics powered by

the rechargeable battery (claim 1); (d) an air pump powered by the rechargeable battery and generating negative air pressure (claim 1); (e) a diaphragm configured to prevent milk from reaching the pump (claim 8), (ii) a breast shield made up of a breast flange and a nipple tunnel (claim 1) and that is configured to slide out from the housing together with the diaphragm (claim 8); and (iii) a milk container that is configured to attach to the housing (claim 1). Further, claim 16 of '179 includes additional features not recited in the instant application claims, thus the '179 claim is more specific. It has been held that the specific invention anticipates the generic invention. See *In re Goodman,* USPQ2d 2010 (Fed. Cir. 1993).

Thus, claim 16 of '179 claims all of the claimed limitations set forth in claim 1 of the instant application except in that '179 does not claim a diaphragm seated in a diaphragm holder and the diaphragm is configured to be removable from a diaphragm holder for cleaning.

Khalil (US 20130023821) teaches a similar breast pump system (fig. 10) which comprises a diaphragm (membrane 3 in fig. 11) seated in a diaphragm holder (membrane housing parts 2 and 4 in fig. 11). Khalil further teaches that the diaphragm is intended to be cleaned (paragraph 21), indicating that it must be removable from the diaphragm holder. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified claim 16 of the '179 application to have the diaphragm seated in a diaphragm holder and be configured to be removed from the holder for cleaning. This modification would ensure that the pump chamber and underpressure chamber of the device remain unchanged in terms of

volume which ensures a uniform pump output (paragraph 31) and would enable the diaphragm to be cleaned for between uses.

'292 Claims	'179 Claims	Teaching
1	16	See discussion above
2		Vogelin (US 20070179439) is directed towards a breast pump system (fig. 1) having a breast shield (3 in fig. 1) which is made from a polypropylene, which is a known rigid material (paragraph 62). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast shield of the claim of the reference application to be made from polypropylene for the purpose of enabling the shield to be sterilized (paragraph 62).
3		Rigert (US 20180028733) teaches a breast shield system (1 in fig. 1) for a breast pump which comprises a shield (10 in fig. 2). Rigert further teaches that the shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast (paragraph 15 discloses that the shield can be rotated to determine the optimal level of comfort for a user depending on breast size and shape; the examiner notes that the shield of Rigert is capable of rotating smoothly since fig. 2 shows the interior of the shield is smooth and the size of the nipple relative to the nipple tunnel is not defined). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application have the claimed feature or the purpose of finding the optimal position for the user's breast shape and size.
4		Khalil teaches the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed; fig. 11 shows that the shield comprises the breast flange and the nipple tunnel and no other stubs are joined). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.

7		Khalil teaches the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical). It would have been obvious to have modified the claim of the reference application for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	16	
9		Guthrie (US 20160220745) teaches a breast pump system (fig. 2A) having a housing (204 in fig. 2A) which is configured to slide onto a breast shield (201 in fig. 2A) when the breast shield has been placed onto a breast using guide members (paragraph 39 discloses a threaded attachment; the examiner notes that the term "sliding" is interpreted to mean "to move smoothly along a surface" using the threads as guide members). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable attachment mechanism for coupling the shield to the housing.
10		Miller (US 20160325031) teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to have modified the claim of the reference application with the claimed limitation for the purpose of enabling easy cleaning of the shield and container.
11	16	
12		Khalil teaches the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (fig. 5 shows the membrane sealing to holder 2). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
14		Khalil teaches the diaphragm is removable from a diaphragm holder (4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this position enables the nipple tunnel to be fluidically connected to the milk container (fig. 10 shows the housing attaching to a milk container).

15		Phillips (US 20160296682) teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of the reference application to be made Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).
16		Thompson (US 7662018) teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application to have the claimed feature since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).
17		Khalil teaches the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the entire device can be held comfortably inside the bra (fig. 9 shows that the entire device is capable of being held in a bra). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature since it provides a hands-free breast pump unit which can be worn inside the bra (paragraph 70)
18		Khalil teaches the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature for the purpose of preventing milk from being sucked back into the pump.

19		Khalil teaches the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action (the examiner notes that this limitation is being interpreted to mean a "mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2 of applicant's specification; locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the milk container includes a cap that is removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and a removable valve that enables milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection). It would have been obvious to have modified the claim of the reference application for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Khalil teaches a top of a container which is optically clear (paragraph 69 discloses the container is clear in its entirety). Guthrie (US 20160220743) teaches a system subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie '743 further teaches that this sensor subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling accurate measurement of the milk while milk is being expressed and enabling a user to view the expressed milk.
22		Khalil teaches the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall (fig. 11 shows the container is capable of being used as a drinking bottle since it is shown to be wider than tall). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this configuration helps provide a hands-free pump which can be worn in a bra (paragraph 70).

23		Khalil teaches the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container (the examiner notes that the term "lower" is a relative direction and is not defined by the claim; fig. 5 of Khalil shows an opening formed in the surface of the nipple tunnel, this surface being it's "lower surface"). It would have been obvious to have modified the claim of the reference application for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) comprises a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). It would have been obvious to have modified the claim of the reference application for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).
25		Khalil teaches the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9). It would have been obvious to have modified the claim of the reference application to have the claimed features since Khalil teaches that this configuration assists in providing for a hands-free unit which can be worn in a bra (paragraph 70).
26		Makower (US 20160206794) teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). It would have been obvious to have modified the claim of the reference application to have the claimed features for enabling a user to keep track of milk expression data to monitor pumping efficiency over time.

27		Makower (US 20160206794) teaches having a visual indicator that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling a user to keep track of milk expression data to monitor pumping efficiency over time.
28		Takeuchi (US 20170043065) teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). It would have been obvious to have modified the claim of the reference application to have the claimed features for reducing motor sound and vibration (paragraph 7).
29		It appears that the device of the claim of the reference application would operate equally well with the claimed stall pressure since the vacuum pump of the claim would inherently possess some stall pressure (which is interpreted as the maximum pressure or vacuum at zero flow). Further, Applicant has not disclosed that the claimed value of the stall pressure solves any stated problem or is for any particular purpose. Instead, Applicant's specification merely states that a suitable pump usable with the breast pump system, which is currently commercially available, has the capability to exhibit the claimed stall pressure (pg. 22 of the specification). However, Applicant does not assert that this stall pressure is beneficial, or even needed, in the claimed breast pump device. It merely is an inherent property of a suitable pump usable with the breast pump system. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified to have the pump deliver in excess of 400mBar stall pressure because it appears to be an arbitrary design consideration which fails to patentably distinguish over the claim of the reference application. Chen also teaches a breast pump system (fig. 1; 30) which produces at least 9 L/min of free air flow (paragraph 39 discloses that the vacuum source as a flow rate; the examiner notes that Applicant's specification does not provide a definition for "free air flow", as such, the flow rate of Chen is considered to be equivalent to the claimed "free air flow" since the vacuum source of Chen is delivering air, as disclosed in paragraph 39). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast pump system of the claim of the reference application to have an air flow rate of not less than 9 L/min for the

		purpose of establishing an effective suckling frequency, as taught by Chen (paragraph 39). Finally, Mendoza teaches a bra which is designed to support a breast pump to allow the mother's hands to remain free (1:8-12). Mendoza further discloses that the bra must be able to support up to 8 ounces when the pump is full (1:58-62). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the system of the claim of the reference application to be a lightweight air pump that enables the total weight of the system, unfilled with milk, to be less than 250gm, as taught by Mendoza since Mendoza teaches that a lightweight system is crucial for enabling the system to be supported by a bra.
30		Baker (US 20090281485) directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing (paragraph 144). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of making the device for discrete and comfortable for the user and others around the user.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 1-12 and 14-30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim 8 of copending Application No. 17/203397 in view of the teachings below (see table below).

Although the claims at issue are not identical, they are not patentably distinct from each other because all of the elements of the application claims can be found in the patent claim. With regard to **claim 1** of the application, claim 8 of the '397 application discloses a breast pump device that is configured as a self-contained, in-bra wearable device (preamble of claim 1), and that includes: (i) a housing (claim 1) that includes (a) a rechargeable battery (claim 1); (b) a power charging circuit for controlling the charging of the rechargeable battery (claim 1) ; (c) control electronics powered by

the rechargeable battery (claim 1); (d) an air pump powered by the rechargeable battery and generating negative air pressure (claim 1); (e) a diaphragm configured to prevent milk from reaching the pump (claim 8), (ii) a breast shield made up of a breast flange and a nipple tunnel (claim 1) and that is configured to slide out from the housing together with the diaphragm (claim 8); and (iii) a milk container that is configured to attach to the housing (claim 1). Further, claim 8 of '397 includes additional features not recited in the instant application claims, thus the '397 claim is more specific. It has been held that the specific invention anticipates the generic invention. See *In re Goodman*, USPQ2d 2010 (Fed. Cir. 1993).

Thus, claim 8 of '397 claims all of the claimed limitations set forth in claim 1 of the instant application except in that '397 does not claim a diaphragm seated in a diaphragm holder and the diaphragm is configured to be removable from a diaphragm holder for cleaning.

Khalil (US 20130023821) teaches a similar breast pump system (fig. 10) which comprises a diaphragm (membrane 3 in fig. 11) seated in a diaphragm holder (membrane housing parts 2 and 4 in fig. 11). Khalil further teaches that the diaphragm is intended to be cleaned (paragraph 21), indicating that it must be removable from the diaphragm holder. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified claim 8 of the '397 application to have the diaphragm seated in a diaphragm holder and be configured to be removed from the holder for cleaning. This modification would ensure that the pump chamber and underpressure chamber of the device remain unchanged in terms of

volume which ensures a uniform pump output (paragraph 31) and would enable the diaphragm to be cleaned for between uses.

'292 Claims	'397 Claims	Teaching
1	8	See discussion above
2		Vogelin (US 20070179439) is directed towards a breast pump system (fig. 1) having a breast shield (3 in fig. 1) which is made from a polypropylene, which is a known rigid material (paragraph 62). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast shield of the claim of the reference application to be made from polypropylene for the purpose of enabling the shield to be sterilized (paragraph 62).
3		Rigert (US 20180028733) teaches a breast shield system (1 in fig. 1) for a breast pump which comprises a shield (10 in fig. 2). Rigert further teaches that the shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast (paragraph 15 discloses that the shield can be rotated to determine the optimal level of comfort for a user depending on breast size and shape; the examiner notes that the shield of Rigert is capable of rotating smoothly since fig. 2 shows the interior of the shield is smooth and the size of the nipple relative to the nipple tunnel is not defined). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application have the claimed feature or the purpose of finding the optimal position for the user's breast shape and size.
4		Khalil teaches the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed; fig. 11 shows that the shield comprises the breast flange and the nipple tunnel and no other stubs are joined). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.

7		Khalil teaches the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical). It would have been obvious to have modified the claim of the reference application for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	8	
9		Guthrie (US 20160220745) teaches a breast pump system (fig. 2A) having a housing (204 in fig. 2A) which is configured to slide onto a breast shield (201 in fig. 2A) when the breast shield has been placed onto a breast using guide members (paragraph 39 discloses a threaded attachment; the examiner notes that the term "sliding" is interpreted to mean "to move smoothly along a surface" using the threads as guide members). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable attachment mechanism for coupling the shield to the housing.
10		Miller (US 20160325031) teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to have modified the claim of the reference application with the claimed limitation for the purpose of enabling easy cleaning of the shield and container.
11	8	
12		Khalil teaches the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (fig. 5 shows the membrane sealing to holder 2). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
14		Khalil teaches the diaphragm is removable from a diaphragm holder (4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this position enables the nipple tunnel to be fluidically connected to the milk container (fig. 10 shows the housing attaching to a milk container).

15		Phillips (US 20160296682) teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of the reference application to be made Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).
16		Thompson (US 7662018) teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application to have the claimed feature since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).
17		Khalil teaches the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the entire device can be held comfortably inside the bra (fig. 9 shows that the entire device is capable of being held in a bra). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature since it provides a hands-free breast pump unit which can be worn inside the bra (paragraph 70)
18		Khalil teaches the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature for the purpose of preventing milk from being sucked back into the pump.

19		Khalil teaches the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action (the examiner notes that this limitation is being interpreted to mean a "mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2 of applicant's specification; locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the milk container includes a cap that is removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and a removable valve that enables milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection). It would have been obvious to have modified the claim of the reference application for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Khalil teaches a top of a container which is optically clear (paragraph 69 discloses the container is clear in its entirety). Guthrie (US 20160220743) teaches a system subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie '743 further teaches that this sensor subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling accurate measurement of the milk while milk is being expressed and enabling a user to view the expressed milk.
22		Khalil teaches the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall (fig. 11 shows the container is capable of being used as a drinking bottle since it is shown to be wider than tall). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this configuration helps provide a hands-free pump which can be worn in a bra (paragraph 70).

23		Khalil teaches the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container (the examiner notes that the term "lower" is a relative direction and is not defined by the claim; fig. 5 of Khalil shows an opening formed in the surface of the nipple tunnel, this surface being it's "lower surface"). It would have been obvious to have modified the claim of the reference application for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) comprises a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). It would have been obvious to have modified the claim of the reference application for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).
25		Khalil teaches the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9). It would have been obvious to have modified the claim of the reference application to have the claimed features since Khalil teaches that this configuration assists in providing for a hands-free unit which can be worn in a bra (paragraph 70).
26		Makower (US 20160206794) teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). It would have been obvious to have modified the claim of the reference application to have the claimed features for enabling a user to keep track of milk expression data to monitor pumping efficiency over time.

27		Makower (US 20160206794) teaches having a visual indicator that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling a user to keep track of milk expression data to monitor pumping efficiency over time.
28		Takeuchi (US 20170043065) teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). It would have been obvious to have modified the claim of the reference application to have the claimed features for reducing motor sound and vibration (paragraph 7).
29		It appears that the device of the claim of the reference application would operate equally well with the claimed stall pressure since the vacuum pump of the claim would inherently possess some stall pressure (which is interpreted as the maximum pressure or vacuum at zero flow). Further, Applicant has not disclosed that the claimed value of the stall pressure solves any stated problem or is for any particular purpose. Instead, Applicant's specification merely states that a suitable pump usable with the breast pump system, which is currently commercially available, has the capability to exhibit the claimed stall pressure (pg. 22 of the specification). However, Applicant does not assert that this stall pressure is beneficial, or even needed, in the claimed breast pump device. It merely is an inherent property of a suitable pump usable with the breast pump system. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified to have the pump deliver in excess of 400mBar stall pressure because it appears to be an arbitrary design consideration which fails to patentably distinguish over the claim of the reference application. Chen also teaches a breast pump system (fig. 1; 30) which produces at least 9 L/min of free air flow (paragraph 39 discloses that the vacuum source as a flow rate; the examiner notes that Applicant's specification does not provide a definition for "free air flow", as such, the flow rate of Chen is considered to be equivalent to the claimed "free air flow" since the vacuum source of Chen is delivering air, as disclosed in paragraph 39). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast pump system of the claim of the reference application to have an air flow rate of not less than 9 L/min for the

		purpose of establishing an effective suckling frequency, as taught by Chen (paragraph 39). Finally, Mendoza teaches a bra which is designed to support a breast pump to allow the mother's hands to remain free (1:8-12). Mendoza further discloses that the bra must be able to support up to 8 ounces when the pump is full (1:58-62). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the system of the claim of the reference application to be a lightweight air pump that enables the total weight of the system, unfilled with milk, to be less than 250gm, as taught by Mendoza since Mendoza teaches that a lightweight system is crucial for enabling the system to be supported by a bra.
30		Baker (US 20090281485) directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing (paragraph 144). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of making the device for discrete and comfortable for the user and others around the user.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claims 1-12 and 14-30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim 8 of copending Application No. 17/203418 in view of the teachings below (see table below).

Although the claims at issue are not identical, they are not patentably distinct from each other because all of the elements of the application claims can be found in the patent claim. With regard to **claim 1** of the application, claim 8 of the '418 application discloses a breast pump device that is configured as a self-contained, in-bra wearable device (preamble of claim 1), and that includes: (i) a housing (claim 1) that includes (a) a rechargeable battery (claim 1); (b) a power charging circuit for controlling the charging of the rechargeable battery (claim 1) ; (c) control electronics powered by

the rechargeable battery (claim 1); (d) an air pump powered by the rechargeable battery and generating negative air pressure (claim 1); (e) a diaphragm configured to prevent milk from reaching the pump (claim 8), (ii) a breast shield made up of a breast flange and a nipple tunnel (claim 1) and that is configured to slide out from the housing together with the diaphragm (claim 8); and (iii) a milk container that is configured to attach to the housing (claim 1). Further, claim 8 of '418 includes additional features not recited in the instant application claims, thus the '418 claim is more specific. It has been held that the specific invention anticipates the generic invention. See *In re Goodman,* USPQ2d 2010 (Fed. Cir. 1993).

Thus, claim 8 of '418 claims all of the claimed limitations set forth in claim 1 of the instant application except in that '418 does not claim a diaphragm seated in a diaphragm holder and the diaphragm is configured to be removable from a diaphragm holder for cleaning.

Khalil (US 20130023821) teaches a similar breast pump system (fig. 10) which comprises a diaphragm (membrane 3 in fig. 11) seated in a diaphragm holder (membrane housing parts 2 and 4 in fig. 11). Khalil further teaches that the diaphragm is intended to be cleaned (paragraph 21), indicating that it must be removable from the diaphragm holder. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified claim 8 of the '418 application to have the diaphragm seated in a diaphragm holder and be configured to be removed from the holder for cleaning. This modification would ensure that the pump chamber and underpressure chamber of the device remain unchanged in terms of

volume which ensures a uniform pump output (paragraph 31) and would enable the diaphragm to be cleaned for between uses.

'292 Claims	'418 Claims	Teaching
1	8	See discussion above
2		Vogelin (US 20070179439) is directed towards a breast pump system (fig. 1) having a breast shield (3 in fig. 1) which is made from a polypropylene, which is a known rigid material (paragraph 62). It would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast shield of the claim of the reference application to be made from polypropylene for the purpose of enabling the shield to be sterilized (paragraph 62).
3		Rigert (US 20180028733) teaches a breast shield system (1 in fig. 1) for a breast pump which comprises a shield (10 in fig. 2). Rigert further teaches that the shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast (paragraph 15 discloses that the shield can be rotated to determine the optimal level of comfort for a user depending on breast size and shape; the examiner notes that the shield of Rigert is capable of rotating smoothly since fig. 2 shows the interior of the shield is smooth and the size of the nipple relative to the nipple tunnel is not defined). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application have the claimed feature or the purpose of finding the optimal position for the user's breast shape and size.
4		Khalil teaches the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed; fig. 11 shows that the shield comprises the breast flange and the nipple tunnel and no other stubs are joined). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.

7		Khalil teaches the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical). It would have been obvious to have modified the claim of the reference application for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	8	
9		Guthrie (US 20160220745) teaches a breast pump system (fig. 2A) having a housing (204 in fig. 2A) which is configured to slide onto a breast shield (201 in fig. 2A) when the breast shield has been placed onto a breast using guide members (paragraph 39 discloses a threaded attachment; the examiner notes that the term "sliding" is interpreted to mean "to move smoothly along a surface" using the threads as guide members). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable attachment mechanism for coupling the shield to the housing.
10		Miller (US 20160325031) teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to have modified the claim of the reference application with the claimed limitation for the purpose of enabling easy cleaning of the shield and container.
11	8	
12		Khalil teaches the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (fig. 5 shows the membrane sealing to holder 2). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
14		Khalil teaches the diaphragm is removable from a diaphragm holder (4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this position enables the nipple tunnel to be fluidically connected to the milk container (fig. 10 shows the housing attaching to a milk container).

15		Phillips (US 20160296682) teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of the reference application to be made Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).
16		Thompson (US 7662018) teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application to have the claimed feature since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).
17		Khalil teaches the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the entire device can be held comfortably inside the bra (fig. 9 shows that the entire device is capable of being held in a bra). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature since it provides a hands-free breast pump unit which can be worn inside the bra (paragraph 70)
18		Khalil teaches the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature for the purpose of preventing milk from being sucked back into the pump.

19		Khalil teaches the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action (the examiner notes that this limitation is being interpreted to mean a "mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2 of applicant's specification; locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the milk container includes a cap that is removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and a removable valve that enables milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection). It would have been obvious to have modified the claim of the reference application for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Khalil teaches a top of a container which is optically clear (paragraph 69 discloses the container is clear in its entirety). Guthrie (US 20160220743) teaches a system subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie '743 further teaches that this sensor subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling accurate measurement of the milk while milk is being expressed and enabling a user to view the expressed milk.
22		Khalil teaches the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall (fig. 11 shows the container is capable of being used as a drinking bottle since it is shown to be wider than tall). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this configuration helps provide a hands-free pump which can be worn in a bra (paragraph 70).

23		Khalil teaches the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container (the examiner notes that the term "lower" is a relative direction and is not defined by the claim; fig. 5 of Khalil shows an opening formed in the surface of the nipple tunnel, this surface being it's "lower surface"). It would have been obvious to have modified the claim of the reference application for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) comprises a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). It would have been obvious to have modified the claim of the reference application for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).
25		Khalil teaches the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9). It would have been obvious to have modified the claim of the reference application to have the claimed features since Khalil teaches that this configuration assists in providing for a hands-free unit which can be worn in a bra (paragraph 70).
26		Makower (US 20160206794) teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). It would have been obvious to have modified the claim of the reference application to have the claimed features for enabling a user to keep track of milk expression data to monitor pumping efficiency over time.

27		Makower (US 20160206794) teaches having a visual indicator that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling a user to keep track of milk expression data to monitor pumping efficiency over time.
28		Takeuchi (US 20170043065) teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). It would have been obvious to have modified the claim of the reference application to have the claimed features for reducing motor sound and vibration (paragraph 7).
29		It appears that the device of the claim of the reference application would operate equally well with the claimed stall pressure since the vacuum pump of the claim would inherently possess some stall pressure (which is interpreted as the maximum pressure or vacuum at zero flow). Further, Applicant has not disclosed that the claimed value of the stall pressure solves any stated problem or is for any particular purpose. Instead, Applicant's specification merely states that a suitable pump usable with the breast pump system, which is currently commercially available, has the capability to exhibit the claimed stall pressure (pg. 22 of the specification). However, Applicant does not assert that this stall pressure is beneficial, or even needed, in the claimed breast pump device. It merely is an inherent property of a suitable pump usable with the breast pump system. Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified to have the pump deliver in excess of 400mBar stall pressure because it appears to be an arbitrary design consideration which fails to patentably distinguish over the claim of the reference application. Chen also teaches a breast pump system (fig. 1; 30) which produces at least 9 L/min of free air flow (paragraph 39 discloses that the vacuum source as a flow rate; the examiner notes that Applicant's specification does not provide a definition for "free air flow", as such, the flow rate of Chen is considered to be equivalent to the claimed "free air flow" since the vacuum source of Chen is delivering air, as disclosed in paragraph 39). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast pump system of the claim of the reference application to have an air flow rate of not less than 9 L/min for the

		purpose of establishing an effective suckling frequency, as taught by Chen (paragraph 39). Finally, Mendoza teaches a bra which is designed to support a breast pump to allow the mother's hands to remain free (1:8-12). Mendoza further discloses that the bra must be able to support up to 8 ounces when the pump is full (1:58-62). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the system of the claim of the reference application to be a lightweight air pump that enables the total weight of the system, unfilled with milk, to be less than 250gm, as taught by Mendoza since Mendoza teaches that a lightweight system is crucial for enabling the system to be supported by a bra.
30		Baker (US 20090281485) directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing (paragraph 144). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of making the device for discrete and comfortable for the user and others around the user.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Allowable Subject Matter

Claim 1 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), 2nd paragraph, set forth in this Office action and the double patenting rejections above.

The following is a statement of reasons for the indication of allowable subject matter: The closest piece of prior art is Khalil. Khalil does not teach or disclose a breast shield configured to slide out from the housing together with the diaphragm. The examiner notes that the term "together" is interpreted to mean that the breast shield and the diaphragm move at the same time and further notes that this interpretation appears consistent with Applicant's specification (paragraph 82 discloses that the breast shield

holds the diaphragm and would, therefore, move with the diaphragm). Instead, Khalil discloses a substantially similar, self-contained, in-bra breast pump system (fig. 10) which comprises a breast shield (1 in fig. 11), a diaphragm (3 in fig. 11), and a housing (6' and 6" snap together to form a housing). Fig. 4 shows that the shield is engaged to the housing through a lip 11 and is capable of being removed from the housing. However, the diaphragm (3) is shown in fig. 10 to be positioned between the housing parts (6' and 6") so that the diaphragm holder pieces (2 and 4 in fig. 11) engage the vacuum pump (81 in fig. 11) through a hose (80 in fig. 10) and the milk container (7' in fig. 11). In order to remove the diaphragm from the housing, a user would need for first remove the breast shield from the housing in order to access the diaphragm through the opening in housing part 6' in order to disconnect the diaphragm from the vacuum pump for removal. For this reason, the diaphragm of Khalil is incapable of sliding together with the shield from the housing nor would a PHOSITA be motivated to modify the device of Khalil to perform this function.

Claim 13 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: The closest piece of prior art is Khali. However, Khalil does not teach or disclose a diaphragm holder that is formed as a recess in a rear surface of the housing. Instead, Khalil teaches a diaphragm holder (2 and 4 in fig. 11) which are seated in a space formed between housing parts 6' and 6" in fig. 11. As such, Khalil cannot be

considered to teach or disclose a holder which is formed as a recess in a rear surface nor would a PHOSITA be motivated to modify the device of Khalil to meet this limitation.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to COURTNEY FREDRICKSON whose telephone number is (571)270-7481. The examiner can normally be reached on Monday-Friday (9 AM - 5 PM EST).

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NATHAN PRICE can be reached on 571-270-5421. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access

to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/COURTNEY B FREDRICKSON/
Examiner, Art Unit 3783

Notice of References Cited	Application/Control No. 17/203,292	Applicant(s)/Patent Under Reexamination O'TOOLE et al.	
	Examiner COURTNEY FREDRICKSON	Art Unit 3783	Page 1 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20090281485-A1	11-2009	BAKER; PETER CHRISTENSEN	A61M1/0058	604/35
*	B	US-20140031744-A1	01-2014	CHEN; CHEAN-SHUI	A61M1/066	604/74
*	C	US-20160220743-A1	08-2016	Guthrie; Gabrielle V.	G16H40/63	1/1
*	D	US-20160220745-A1	08-2016	Guthrie; Gabrielle V.	A61M1/06	1/1
*	E	US-20130023821-A1	01-2013	KHALIL; Gamal	A61M1/82	604/74
*	F	US-20170072118-A1	03-2017	Makower; Joshua	A61M1/062	1/1
*	G	US-20160206794-A1	07-2016	MAKOWER; JOSHUA	A61M1/064	1/1
*	H	US-6227936-B1	05-2001	Mendoza; Amelia	A41C3/04	2/104
*	I	US-20160325031-A1	11-2016	Miller; Jared	A61M39/24	1/1
*	J	US-20160296682-A1	10-2016	Phillips; Andrew Luke	A61J13/00	1/1
*	K	US-20170043065-A1	02-2017	TAKEUCHI; Susumu	A61M1/80	1/1
*	L	US-7662018-B1	02-2010	Thompson; Pamela J.	A61J13/00	450/37
*	M	US-20180028733-A1	02-2018	Rigert; Mario	A61M1/064	1/1

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Notice of References Cited	Application/Control No. 17/203,292	Applicant(s)/Patent Under Reexamination O'TOOLE et al.	
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U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20070179439-A1	08-2007	Vogelin; Stefan	F16K15/144	604/74
*	B	US-20110009824-A1	01-2011	Yodfat; Ofer	A61M5/1723	604/151
	C					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/203,292	O'TOOLE et al.
	Examiner	Art Unit
	COURTNEY FREDRICKSON	3783

CPC - Searched*		
Symbol	Date	Examiner
a61m1/06, 1/062, 1/066; a61j13/00; a41c4/04	06/19/2021	cbf

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
see SEARCH history	06/19/2021	cbf
Searched inventors in PALM and SEARCH	06/19/2021	cbf
Consulted parent history	06/19/2021	cbf
Consulted SPE Nathan Price for allowable subject matter	06/19/2021	cbf

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/COURTNEY B FREDRICKSON/ Examiner, Art Unit 3783	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/203,292	O'TOOLE et al.
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✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	06/18/2021								
	1	✓								
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	30	✓								

Bibliographic Data

Application No: 17/203,292

Foreign Priority claimed: ◉ Yes ○ No

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Verified and Acknowledged: /COURTNEY B FREDRICKSON/ (Examiner's Signature) | Initials

Title: BREAST PUMP SYSTEM

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/16/2021	604	3783	373499.00057
RULE			

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CONTINUING DATA

This application is a CON of 17181057 02/22/2021

17181057 is a CON of 16009547 06/15/2018 PAT 10926011

FOREIGN APPLICATIONS

UNITED KINGDOM GB1709561.3 06/15/2017

UNITED KINGDOM GB1709564.7 06/15/2017

UNITED KINGDOM GB1709566.2 06/15/2017

UNITED KINGDOM GB1809036.5 06/01/2018

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$3,710

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	268	a61m1/$.cpc. AND ((breast milk) WITH pump$4) AND ((power$4 battery) WITH (charg$4 recharg$4))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/12 04:05 PM
L2	65	("20020193731"|"20040056641"|"20040074281"|"20040267215"|"20050219302"|"20060122575"|"20070051172"|"20070051727"|"20080262420"|"20120277636"|"20140052056"|"20150217036"|"20150217037"|"20150283311"|"20160000980"|"20160058929"|"20160082165"|"20160082166"|"20160151551"|"20160158424"|"20160206794"|"20160220743"|"20160220745"|"20160287767"|"20160296681"|"20160310650"|"20170021068"|"20170035951"|"20170143879"|"20170220753"|"20180021490"|"2849881"|"4390024"|"5474683"|"5941847"|"5973770"|"6045529"|"6090065"|"6383163"|"6440100"|"6461324"|"6547756"|"6579258"|"6663587"|"6749582"|"7048519"|"7201735"|"7312554"|"7314400"|"7776008"|"8057425"|"8118772"|"8187227"|"8262606"|"8282596"|"8376986"|"8702646"|"8801495"|"8876760"|"8926556"|"9033913"|"9173587"|"9345274"|"9539377"|"D548831").PN.	(US-PGPUB; USPAT)	OR	OFF	OFF	2018/08/07 01:17 PM
L3	214	(jonathan near3 o'toole).inv. (adam near3 rollo).inv. (andrew near3 carr).inv.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 01:42 PM
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		piezo$9	JPO)				
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L6	7	("5730139" | "6423010" | "6602199" | "7479154" | "8206414" | "8425426" | "8992445").PN. OR ("9192325").URPN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/07 01:59 PM
L7	582	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 02:16 PM
L8	3369	(a61m1/062 a61m1/066 a61m1/06).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 02:58 PM
L9	2787	(a61m1/062 a61m1/066 a61m1/06).cpc. not L7	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 02:58 PM
L10	45	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/07 02:59 PM

		20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$).did. or (WO-2015174330-$ or WO-2016024558-$).did.					
L11	14	L10 and (pump$4 same diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 02:59 PM
L12	2	"60479361".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/07 03:04 PM
L13	143	a61j13/00.cpc.	(US-PGPUB; USPAT)	OR	OFF	OFF	2018/08/10 10:30 AM
L14	409	a61j13/00.cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 10:30 AM
L15	3369	(a61m1/062 a61m1/066 a61m1/06).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 10:43 AM
L16	582	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 10:44 AM
L17	0	(a61m1/062 a61m1/066 a61m1/06).cpc. not (L16 L15)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 10:44 AM
L18	2665	(a61m1/062 a61m1/066 a61m1/06).cpc. not (L16 L14)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 10:44 AM
L19	71	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/10 11:47 AM

		US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$).did.					

L20	37	L19 and (air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 11:48 AM
L21	4	L19 and ((air with pump$4) same diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 11:50 AM
L22	16	L19 and (pump$4 same diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 12:15 PM
L23	1	L19 and piezo	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 12:40 PM
L24	0	a61m1/1058.cpc. and breast and diaphragm	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/10 12:42 PM
L25	5	breast same pump$4 same piezo$8 same air	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/10 12:43 PM
L26	1	("9884172").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/10 01:58 PM
L27	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:40 AM
L28	2	"59563385".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 10:20 AM
L29	1	"59563425".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 10:20 AM
L30	87	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 10:26 AM

		20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$).did.					
L31	44	L30 and (air with	(US-PGPUB; USPAT;	OR	OFF	OFF	2018/08/24

		pump$4)	USOCR; FPRS; EPO; JPO)				10:26 AM
L32	17	L30 and (pump$4 with diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 10:27 AM
L33	51	L27 and "air pump"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 11:07 AM
L34	4	"47900902".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 11:13 AM
L35	10	("20030212374" | "20050251089" | "20050283900" | "20070135778" | "20110054389" | "3084691" | "4229029" | "5295957" | "6070659").PN. OR ("9511176").URPN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/24 11:16 AM
L36	2	"51149640".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 11:17 AM
L37	271	L27 and (control$4 same select$4 left same right same breast)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 12:50 PM
L38	3	L30 and (recharg$4 with battery)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 01:04 PM
L39	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:41 PM
L40	9	L39 and ((center centre) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:41 PM
L41	11	L39 and (light with milk with (volume quantity amount height))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:48 PM
L42	0	L39 and (radiation with milk with (volume quantity amount height))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:51 PM
L43	2	L39 and (radiation same milk same (volume quantity amount height))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:51 PM
L44	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:13 PM
L45	10	L44 and ((piezo piezoelectric piezo-electric) same air same pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:13 PM
L46	1	a61m1/1058 and	(US-PGPUB; USPAT;	OR	OFF	OFF	2018/08/24

		(suction$4 vacuum$4 aspirat$4)	USOCR; FPRS; EPO; JPO)				07:23 PM
L47	27	a61m1/1058.cpc. and (suction$4 vacuum$4 aspirat$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:23 PM
L48	23	L44 and (indicator same milk same (express$4 flow$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:26 PM
L49	51	L44 and (air same pressure same sens$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:30 PM
L50	19	L44 and ((indicat$4 record$4) same (right and left))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:38 PM
L51	56	L44 and (pump$4 with series)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:42 PM
L52	77	L44 and (pump$4 with weigh$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:47 PM
L53	87	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 07:59 PM

		20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$).did.					
L54	44	L53 and (air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:59 PM
L55	5	L54 and (air with filter$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:59 PM

L56	3	L44 and (pump$4 with (db decibal?))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:07 PM
L57	6	L44 and ((db decibal?))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:07 PM
L58	26	L44 and (sens$4 with (orientation angle tilt placement))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:16 PM
L59	9	L44 and ((indicat$4 input$4 document$4 record$4) with comfort)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:31 PM
L60	484	a61m$/$.cpc. and ((indicat$4 input$4 document$4 record$4) with comfort)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:32 PM
L61	1	L44 and "social media"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:52 PM
L62	408	a61m$/$.cpc. and ((piezo piezoelectric piezo-electric) same air same pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/25 06:13 PM
L63	3606	a61m$/$.cpc. and (pump$4 with weigh$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/25 06:18 PM
L64	359	a61m$/$.cpc. and ((pump$4 with weigh$4) same (portable lightweight carry$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/25 06:30 PM
L65	1	("20160166745").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/25 07:16 PM
L66	1	("20160058928").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/25 07:23 PM
L67	1	("20110004154").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/26 10:55 AM
L68	96	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/26 11:09 AM

		US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-					

		8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$).did.					
L69	2	L69 and (radiation same (height quantity amount volume))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/26 11:09 AM
L70	96	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/26 12:24 PM

		20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-					

		2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$).did.					
L71	3	L71 and ((diaphragm membrane) with shield)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/26 12:24 PM
L72	3606	a61m$/$.cpc. and (pump$4 with weigh$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:09 PM
L73	137	L73 and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:09 PM
L74	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:10 PM
L75	9	L75 and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:10 PM
L76	19	L75 and (shield with snap$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:16 PM
L77	1	("20110152855").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 01:20 PM
L78	32	L75 and (flow with rate with air)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:33 PM
L79	3	L75 and (stall with pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:56 PM
L80	98	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/27 01:56 PM

		US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$).did. or (WO-2015174330-$ or					

		WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$).did.					
L81	17	L81 and (pressure same (mmhg kpa mbar pa bar))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:57 PM
L82	18	(("7550034") or ("8123502") or ("8297947") or ("8371829") or ("8409160") or ("8646479") or ("8734131") or ("8763633") or ("8821134") or ("9051931") or ("9127665") or ("9239059") or ("9279421") or ("9334858") or ("9506463") or ("9752565") or ("9709042") or ("9777851")).PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 02:08 PM
L83	0	L83 and breast	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:08 PM
L84	10	L83 and (lactat$3 milk)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:08 PM
L85	14	L81 and (piezo piezoelectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:10 PM
L86	5	L75 and ((piezo piezoelectric) with air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:47 PM
L87	230	(((piezo piezoelectric) with air with pump$4) same (miniature small compact lightweight))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:48 PM
L88	6	L88 and (breast milk lactat$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:53 PM

L89	161	a61m$/$.cpc. and ((piezo piezoelectric piezo-electric) with air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:11 PM
L90	0	(2017/0072118).CCLS.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:19 PM
L91	1	("20170072118").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:19 PM
L92	40	(((piezo piezoelectric) with air with pump$4) same (miniature small compact lightweight)) same (vacuum$4 suction$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:22 PM
L93	3	"45513973".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/27 03:23 PM
L94	364	(((piezo piezoelectric) with pump$4) same (miniature small compact lightweight)) same (vacuum$4 suction$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:32 PM
L95	3	"20170035951"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:33 PM
L96	1	L96 and (suction$4 with piezoelectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:34 PM
L97	1	("20130064683").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:38 PM
L98	1	("20170072118").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:39 PM
L99	1	(US-20170172485-$).did.	(US-PGPUB)	OR	OFF	OFF	2018/08/28 04:48 PM
L100	0	L100 and "function of"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 04:48 PM
L101	100	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/28 05:19 PM

		US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-					

		7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L102	0	L102 and ((meaur$4 with milk) same rate)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:20 PM
L103	0	L102 and ((meaur$4 with milk) same (frequency speed))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:20 PM
L104	16	L102 and ((measur$4 with milk) same (frequency speed rate))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:21 PM
L105	0	L102 and ((measur$4 with milk) with "function of")	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:23 PM
L106	6	L102 and (decrease with (rate speed frequency strong))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:10 PM
L107	2	L102 and (latch$4 with adjust$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:22 PM
L108	50	(a61m$/$).cpc. and (wear$4 with pump$4) and ((center centre) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:24 PM
L109	0	(a61m$/$).cpc. and (wear$4 with pump$4) and (((center centre) with gravity) same comfort$5)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:25 PM
L110	83	(a61m$/$).cpc. and (((center centre) with gravity) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:26 PM

		comfort$5)					
L111	101	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 09:43 AM

		US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L112	3	L112 and (shield with (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:43 AM
L113	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:47 AM
L114	86	L114 and ((diapragm housing) with (housing case mount$4) with shield)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:53 AM
L115	9	L114 and ((diapragm membrane) with (housing case mount$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:54 AM

		with shield)					
L116	34	L112 and (diaphragm membrane)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:07 AM
L117	28	L114 and (diaphragm membrane) and (shield with dispos$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:10 AM
L118	28	L114 and ((diaphragm membrane) with (coupl$4 attach$4 mount$4) with shield)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:23 AM
L119	0	a61j16/00.cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:41 AM
L120	409	a61j13/00.cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:42 AM
L121	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:23 PM
L122	23	L122 and (sens$4 same (orient$4 plac$4 situat$4) same (nipple shield))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:23 PM
L123	11	L122 and ((sens$4 accelerometer) with breast with (move moved moving movement))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:32 PM
L124	10	L122 and accelerometer	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:33 PM
L125	1	("20170072118").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/29 02:27 PM
L126	259	L122 and ((lower$4 decrea$4) with (suction$4 intens$4 pain comfort discomfort))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 02:51 PM
L127	45	L122 and ((lower$4 decrea$4) with (intens$4 pain comfort discomfort))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 02:59 PM
L128	11	(a61m$/$.cpc.) and ((miniature compact small) same (piezoelectric piezo-electric piezo) same pump$4 same (suction$4 vacuum$4) same (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 03:40 PM
L129	127	L122 and ((pressure	(US-PGPUB; USPAT;	OR	OFF	OFF	2018/08/29

		suction$4) with (mmhg kpa mbar pa bar))	USOCR; FPRS; EPO; JPO)				05:16 PM
L130	2	"60479361".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 05:29 PM
L131	106	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 05:31 PM

		20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L132	104	L132 and @ad<="20170615"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 05:32 PM
L133	14	(US-20160166745-$ or	(US-PGPUB; USPAT)	OR	OFF	OFF	2018/08/29

		US-20150283311-$ or US-20180110906-$ or US-20140378895-$ or US-20140031744-$ or US-20160220743-$ or US-20160256617-$ or US-20080177224-$ or US-20130023821-$ or US-20160058928-$ or US-20170043065-$ or US-20110004154-$).did. or (US-10039871-$ or US-6358226-$).did.					06:08 PM
L134	1	"52574056".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 06:46 PM
L135	0	("2009024080").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/29 06:53 PM
L136	1	("20090024080").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/29 06:53 PM
L137	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 07:30 PM
L138	203	L138 and ((shield nipple) with (remov$4 replac$4 clean$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 07:30 PM
L139	1	("4535627").PN.	(US-PGPUB; USPAT)	OR	OFF	OFF	2019/01/08 12:52 PM
L140	74	(("20180361040") or ("20180236147") or ("20120277728") or ("7785305") or ("20080208116") or ("7223255") or ("7789865") or ("8118772") or ("20080275385") or ("9956331") or ("8057425") or ("20070219486") or ("20020193731") or ("10046097") or ("20140378946") or ("20180326130") or ("20120316493") or ("8568350") or ("20030191427") or ("8070716") or ("9539377") or ("20160303298") or ("20160206794") or ("9539376") or ("20160310649") or ("20160287769") or ("20160310650") or ("20180001002") or	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/01/08 12:54 PM

		("20090099511") or ("7776008") or ("20090062731") or ("20160296682") or ("20050154349") or ("20030191433") or ("5749850") or ("20100292636") or ("7559915") or ("20080262420") or ("20160325031") or ("20170173232") or ("7749188") or ("6887217") or ("6139521") or ("20180021490") or ("20150065994") or ("20180028732") or ("20150196460") or ("9636282") or ("7758540") or ("8945046") or ("20080243059") or ("20110251552") or ("20170119942") or ("20130023821") or ("6997897") or ("9033913") or ("20150157776") or ("20090254028") or ("5514166") or ("20010038799") or ("20070161947") or ("20130046234") or ("8926556") or ("7255681") or ("7008400") or ("6257847") or ("20100145264") or ("20170151380") or ("20070078383") or ("5542921") or ("20180333523") or ("8075516") or ("20180369464") or ("20110071466")).PN.					
L141	111	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2019/01/08 01:02 PM

		US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or					

		US-20180333523-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L142	35	L142 and (heavy weight "center of gravity" "centre of gravity" mass)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 01:03 PM
L143	3497	(a61m1/062 a61m1/066 a61m1/06).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 01:22 PM
L144	284	L144 and (heavy weight "center of gravity" "centre of gravity")	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 01:22 PM
L145	3497	(a61m1/062 a61m1/066 a61m1/06).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 04:06 PM
L146	18	L146 and (weight with distribut$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2019/01/08 04:06 PM

			JPO)				
L147	1	("4535627").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/03/14 02:19 PM
L148	112	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2019/04/16 03:00 PM

		(US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or US-20180333523-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$ or US-5542921-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					

L149	21	L149 and (pump$4 with (lightweight mass weight heavy))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 03:00 PM
L150	94	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (pump$4 with (weight lightweight))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 03:14 PM
L151	47	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (pump$4 with (mass heavy))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 05:04 PM
L152	26	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (pump$4 with (mass heavy)) not L151	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 05:04 PM
L153	1	("20110274566").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/04/19 01:51 PM
L154	1	("20110274566").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/08/09 12:52 PM
L155	57	(breast with pump) and (noise same pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:04 AM
L156	1	(16/009547).APP.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/08/15 09:08 AM
L157	1	L157 and (pressure same noise)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:08 AM
L158	635	((piezo piezoelectric) with pump) and (noise same pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:10 AM
L159	1	L157 and piezo	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:16 AM
L160	26	(breast with pump) and (mmhg and noise)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:24 AM
L161	1	L157 and (liter litre)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:30 AM
L162	1	((piezo piezoelectric) with pump) and "YIP Ventus"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:33 AM
L163	19	(("7550034") or ("8123502") or ("8297947") or ("8371829") or ("8409160") or ("8646479") or ("8734131") or ("8763633") or	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/08/15 09:36 AM

		("8821134") or ("9051931") or ("9127665") or ("9234518") or ("9239059") or ("9279421") or ("9334858") or ("9506463") or ("9752565") or ("9709042") or ("9777851")).PN.					
L164	5	L164 and (mmhg mbar kpa)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:36 AM
L165	0	L164 and (litre liter)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:37 AM
L166	2	L164 and piezo	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:37 AM
L167	17	L164 and (piezo piezoelectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:37 AM
L168	1	L164 and (piezo piezoelectric) and (noise same pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:38 AM
L169	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:50 AM
L170	1	L170 and gravity	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:50 AM
L171	1	L170 and (gravity same nipple)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:51 AM
L172	61	(breast with pump$4) and ((centre center) with container)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:55 AM
L173	1	L170 and (gravity same container)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:55 AM
L174	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 11:54 AM
L175	1	L176 and (high height)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 11:54 AM
L176	25	(breast with pump$4) and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 12:55 PM
L177	113	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2020/01/09 03:02 PM

		US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or					

		US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or US-20180333523-$ or US-20180361040-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$ or US-5542921-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L178	30	L179 and noise	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 03:02 PM
L179	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2020/01/13 01:45 PM

			JPO)				
L180	1	L181 and gravity	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/13 01:45 PM
L181	1	L181 and length	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/13 01:46 PM
L182	1	L181 and height	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/13 01:48 PM
L183	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:29 PM
L184	1	L185 and "half-way"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:29 PM
L185	113	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2020/01/14 02:36 PM

		20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or US-20180333523-$ or US-20180361040-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$ or US-5542921-$).did. or (WO-2015174330-$ or WO-2016024558-$ or					

		WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L186	3	L187 and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:37 PM
L187	2	L187 and (top with heavy)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:37 PM
L188	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:06 AM
L189	1	L190 and (weight mass)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:06 AM
L190	1	L190 and (housing same battery)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:07 AM
L191	1	L190 and (shield same (mold$4 mould$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:08 AM
L192	1	L190 and (diaphragm same seal$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:09 AM
L193	0	L190 and (diaphragm same tunnel same flange)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:15 AM
L194	0	L190 and (diaphragm same spaced)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:15 AM
L195	0	L190 and (diaphragm same surround)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:15 AM
L196	1	verhoef.inv. and dog and figure	(US-PGPUB)	OR	OFF	OFF	2020/01/15 01:27 PM
L197	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:28 PM
L198	1	L199 and (shield with single)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:28 PM

L199	67	(a61m$/$).cpc. and (wear$4 with pump$4) and ((center centre) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:32 PM
L200	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:32 PM
L201	1	L202 and (shield with single)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:32 PM
L202	1	L202 and (shield with piece)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:33 PM
L203	0	L202 and ((housing diagraphm) with spac$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 03:18 PM
L204	1	L202 and (shield with housing with diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 03:19 PM
L205	1	L202 and ((housing diaphragm) with spac$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 03:19 PM
L206	143	(breast with pump) and (piezo piezoelectric) and (membrane diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 11:42 AM
L207	78	("20030191433" | "20040024351" | "20040101414" | "20050059928" | "20050131332" | "20050234370" | "20060106334" | "20080045888" | "20080177224" | "20080243059" | "20090024080" | "20100010682" | "20100106082" | "20100217148" | "20110071466" | "20110196291" | "20110245763" | "20110270162" | "20120101575" | "20120277728" | "20130023821" | "20130123688" | "20130131588" | "20130177455" | "20140066734" | "20140378895" | "20140378946" | "20150065994" | "20150100016" |	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2020/09/28 12:42 PM

		"20150148709" | "20150196247" | "20150292500" | "20160015876" | "20160256618" | "20160287769" | "20170072118" | "20170080134" | "20170173232" | "4263912" | "4311141" | "4768547" | "4821580" | "5542921" | "5634468" | "5658133" | "5810772" | "5827191" | "6273868" | "6287252" | "6328082" | "6440100" | "6547756" | "6579258" | "6712785" | "6840918" | "7201735" | "7223255" | "7621797" | "7824363" | "7972297" | "7988661" | "8057425" | "8070715" | "8070716" | "8262606" | "8282596" | "8353865" | "8357116" | "8376986" | "8671701" | "8684961" | "8801495" | "9050404" | "9162016" | "9173587" | "9199017" | "9278167" | "D459233").PN. OR ("10625005").URPN.					
L208	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 02:57 PM
L209	1	L210 and 19a	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 02:57 PM
L210	132289	"201" and recess	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:02 PM
L211	0	L210 and recess	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:02 PM
L212	645454	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. diaphragm	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:06 PM
L213	574	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and diaphragm	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:06 PM
L214	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/29 09:51 AM
L215	1	L216 and flat	(US-PGPUB; USPAT;	OR	OFF	OFF	2020/09/29

			USOCR; FPRS; EPO; JPO)				09:51 AM
L216	57377	breast.clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:16 PM
L217	398558	pump$4.clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:16 PM
L218	92405	(piezo piezoelectric).clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:16 PM
L219	72010	diaphragm.clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L220	26553	(db decibal).clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L221	27368	(db decibal).clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L222	2	L218 and L219 and L220 and L221	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L223	2	L218 and L219 and L220 and L224	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L226	32	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((usb "universal serial bus") WITH (charg$4 recharg$4 power$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/18 12:16 PM
L227	0	214 AND (usb SAME socket)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 12:25 PM
L228	2	214 AND socket	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 12:25 PM
L229	2	"61007742".fmid.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; JPO)	OR	ON	ON	2021/05/18 12:34 PM

L230	7	"2015069095".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 12:38 PM
L231	122	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/18 01:00 PM

		20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1					

		OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)				
L232	18	231 AND recharg$5	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 01:00 PM
L233	2	214 AND (rigid SAME	(US-PGPUB; USPAT;	OR	ON	ON	2021/05/18

		shield)	USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				01:05 PM
L234	27173	a61m5/14244,14248.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 01:42 PM
L235	555	234 AND ((power$4 batter$4) WITH (charg$5 recharg$5) WITH (usb "universal serial bus"))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 01:42 PM
L236	82	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND bra AND wireless$4 AND (control$4 processor electronic$4) AND (power$4 battery)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/18 01:53 PM
L237	82	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND bra AND wireless$4 AND (control$4 processor electronic$4) AND (power$4 batter$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/18 01:53 PM
L238	14	231 AND ((charg$5 recharg$5) WITH (power$4 batter$4)) AND wireless$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 03:59 PM
L239	2	"20140275857".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 04:48 PM
L240	12	231 AND (rigid WITH (bottle container))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2021/05/18 04:52 PM

			AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L241	2	214 AND (shield WITH (flexible silicon$4 material soft rubber))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 05:35 PM
L242	2	231 AND (rigid WITH shield)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 05:38 PM
L243	128	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/20 03:05 PM

		US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-					

		A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-					

		2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L244	8	243 AND ((membrane diaphragm) SAME shield)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/20 03:06 PM
L245	88	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH rigid)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:09 PM
L246	0	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH (plastic rigid) WITH steriliz$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:13 PM
L247	7	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH steriliz$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:13 PM
L248	68	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (rigid WITH polypropylene)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:14 PM
L249	25	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((bottle container) WITH steriliz$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:17 PM
L250	19	243 AND ((bottle container) WITH (rigid polypropylene plastic))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:23 PM
L251	21	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((bottle container) WITH magnet$6)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 05:49 PM
L252	2	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 05:57 PM

		((shield nipple flange) WITH guide WITH line)					
L253	207	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield nipple flange) WITH line)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 05:57 PM
L254	5	"6328709".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/20 05:59 PM
L255	91	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (nipple WITH line)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 06:00 PM
L256	130	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/21 12:39 PM

		20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1					

		OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-					

		2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L257	1	256 AND ((bottle container milk) WITH (clear transparent) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 12:39 PM
L258	6	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((bottle container milk) WITH (clear transparent) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:40 PM
L259	6	(breast WITH pump$4) AND ((bottle container milk) WITH (clear transparent) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:41 PM
L260	73	(breast WITH pump$4) AND ((bottle container milk) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:41 PM
L261	11	(breast WITH pump$4) AND ((bottle container milk bag) WITH (polycarbonate tritan)) AND ((bottle container milk storage bag) WITH (clear transparent "see through" see-through))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:45 PM
L262	55	(breast WITH pump$4) AND ((bottle container milk bag) WITH (magnet$6))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 01:09 PM
L263	182	(breast WITH pump$4) AND ((shield flange) WITH (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 01:26 PM
L264	132	((US-6440100-B1 OR US-6547756-B1 OR	(USPAT; US-PGPUB; FPRS; USOCR;	OR	ON	ON	2021/05/21 01:26 PM

		US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1	IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))				

		OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-					

		20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L265	9	264 AND (clear transparent) WITH (container bottle bag)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2021/05/21 01:27 PM

			IBM_TDB)				
L266	4	264 AND (polycarbonate) WITH (container bottle bag)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 01:27 PM
L267	6	(breast WITH pump$4) AND ((bottle container milk) WITH (polycarbonate tritan)) AND ((bottle container milk) WITH dishwash$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 02:28 PM
L268	34	264 AND ((alert$4 indicat$4 light) WITH (milk))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 03:46 PM
L269	19	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH start$4 WITH stop$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:36 PM
L270	21	264 AND (milk WITH (indicat$4 alert$4 display$4) WITH (flow$4 volume))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:39 PM
L271	20	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH (quantity volume) WITH threshold)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:55 PM
L272	95	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH (quantity volume) WITH (predetermin$4 limit level))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:58 PM
L273	38	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH (quantity volume) WITH (predetermin$4 limit level) WITH (increas$4 decreas$4 chang$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:58 PM
L274	4	(a61m1/062 a61m1/066	(US-PGPUB; USPAT;	OR	OFF	OFF	2021/05/21

		a61m1/06 a41c4/04 a61j13/00).cpc. AND (pump$4 WITH alert$4 WITH (correct$4))	USOCR; FPRS; EPO; JPO)				05:00 PM
L275	0	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (operat$4 WITH alert$4 WITH (correct$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 05:00 PM
L276	9	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (alert$4 WITH (correct$4 proper$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 05:00 PM
L277	23	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH rotat$4 WITH position$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 05:44 PM
L278	62	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH slid$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:03 PM
L279	26	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH slid$4 WITH (attach$4 coupl$4 connect$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:04 PM
L280	71	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH thread$4 WITH (attach$4 coupl$4 connect$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:06 PM
L281	26	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((clean$4 disinfect$4 sanitiz$4) WITH (shield flange) WITH (container bottle bag))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:20 PM
L282	111	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (diaphragm WITH (housing holder))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:44 PM
L283	2	"20120277728".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2021/05/21 06:46 PM

			SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L284	7	264 AND (light WITH emit$4)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 06:55 PM
L285	11	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (db decibel)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 07:12 PM
L286	77	(breast WITH pump$4) AND (db decibel)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 07:17 PM
L287	75	willow AND (breast WITH pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 07:26 PM
L288	20047	(a61m a61b).cpcl. AND (pump$ wth piezo piezoelectric) AND (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L289	9898	(a61m a61b).cpcl. AND (pump$ WITH piezo piezoelectric) AND (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L290	892	(a61m a61b).cpcl. AND (pump$ WITH piezo piezoelectric) SAME (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L291	892	(a61m a61b).cpcl. AND (pump$4 WITH piezo piezoelectric) SAME (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L292	24	(a61m a61b).cpcl. AND (pump$4 WITH (piezo	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2021/05/21 07:33 PM

		piezoelectric)) SAME (decibel db)	AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L293	654	(a61m a61b).cpcl. AND (pump$4 WITH (piezo piezoelectric)) AND (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:34 PM
L294	337	(a61m a61b).cpcl. AND (pump$4 WITH (piezo piezoelectric)) AND (decibel db)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2021/05/21 07:34 PM
L295	138	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/22 09:07 AM

		US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-					

		A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1 OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-					

		2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L296	13	295 AND (bar mbar kpa) AND "flow rate"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 09:07 AM
L297	2	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (pressure WITH kpa mmhg mbar bar) AND ((air vacuum$4 suction$4) WITH l/min)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/22 09:21 AM
L298	157	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (pressure WITH (kpa mmhg mbar bar))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/22 09:23 AM
L299	2	16/009547.app. AND (mechanism SAME container SAME housing)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 10:47 AM
L300	2	16/009547.app. AND (mechanism WITH container WITH housing)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO;	OR	ON	ON	2021/05/22 10:47 AM

			JPO; DERWENT; IBM_TDB)				
L301	40	295 AND magnet$6	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 10:50 AM
L302	6	295 AND (magnet$6 WITH (container bag bottle))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 10:51 AM
L303	599	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND diaphragm	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/24 12:04 PM
L304	7	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/24 02:33 PM
L305	140	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2 OR US-8579874-B1).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/06/02 03:38 PM

		OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-					

		20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1					

		OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1 OR US-20090281485-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L306	2	140 AND piezo	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 03:38 PM
L307	14	140 AND piezo$8	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 03:38 PM
L308	32	305 AND piezo$8	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO;	OR	ON	ON	2021/06/02 03:39 PM

			JPO; DERWENT; IBM_TDB)				
L309	6	305 AND piezo$8 AND parallel	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 03:41 PM
L310	14	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((container milk bottle) WITH (angle tilt$4) WITH (sens$4 detect$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:47 PM
L311	14	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH right WITH breast WITH data)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:54 PM
L312	78	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (which WITH breast WITH data)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:57 PM
L313	14	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH breast WITH data)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:57 PM
L314	10	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH breast WITH sens$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:57 PM
L315	11	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH breast WITH select$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:59 PM
L316	33	305 AND (maximum WITH (suction$4 vacuum$4))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 04:02 PM
L317	16	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((icon button) WITH start$4 WITH (stop$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 04:06 PM

		paus$4))					
L318	0	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield flange) WITH tritan)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 04:08 PM
L319	3	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield flange) WITH (transparent clear)) AND ((shield flange) WITH polycarbonate)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 04:08 PM
L321	195	((milk lactat$4 breast) WITH pump$4) AND ((shield flange) WITH magnet$6)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/14 01:25 PM
L322	4	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield flange) WITH (transparent clear)) AND ((shield flange) WITH (tritan polycarbonate))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/15 12:15 PM
L323	250	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) SAME (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/15 01:51 PM
L324	19	("7550034," "8123502," "8297947," "8371829," "8409160," "8646479," "8734131," "8763633," "8821134," "9051931," "9127665," "9234518," "9239059," "9279421," "9334858," "9506463," "9752565," "9709042," "9777851").pn.	(USPAT)	OR	ON	ON	2021/06/16 12:28 PM
L325	9	324 AND stall	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 12:28 PM
L326	19	"stall pressure" WITH (aspirat$4 vacuum$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2021/06/16 12:35 PM

		suction$4)	AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L327	4184	(stall WITH pressure WITH pump$4)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 12:39 PM
L328	3	324 AND mbar	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 01:42 PM
L329	50	(ttp WITH ventus)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 01:54 PM
L330	3	(ttp WITH ventus)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2021/06/16 01:54 PM
L331	252	(ventus)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2021/06/16 01:55 PM
L332	36	((stall WITH pressure WITH pump$4) SAME piezo$10)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 02:28 PM
L333	18	324 AND maximum	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 02:35 PM
L334	52	pump$4 WITH stall WITH piezo$10	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2021/06/16 02:38 PM

			SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L335	220	(breast SAME pump$4 SAME piezo$10)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 03:17 PM
L336	79	(breast WITH pump$4) AND (pressure WITH (stall$4 crack$4 occlusion break$4 block$4) WITH (mmhg kpa mbar bar pa))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 03:35 PM
L337	68	ventus AND piezo$10	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 04:11 PM
L338	11	337 AND stall	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 04:12 PM
L339	11	337 AND (mmhg mbar kpa)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 04:13 PM
L340	0	324 AND l/min	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 03:43 PM
L341	11	324 AND (air WITH flow$4)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2021/06/19 03:43 PM

			SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L342	157	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2 OR US-8579874-B1 OR US-3702623-A).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/06/19 03:48 PM

		A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR					

		US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1 OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1 OR US-20090281485-A1 OR US-20120277636-A1 OR US-20150141761-A1 OR US-20160331879-A1 OR US-20150328380-A1 OR US-20100324477-A1 OR US-20170226994-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR					

		WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1 OR CN-106794291-A OR WO-2020046777-A1 OR WO-2018202556-A1 OR CN-105873631-A OR WO-9622116-A1 OR CN-211835562-U OR KR-20170044650-A OR WO-2020217934-A1 OR JP-2016010524-A).did. AND FTDB.dbnm.) OR ((CN-211835562-U).did. AND DWPI.dbnm.)					
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L344	6	324 AND (free WITH flow)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 03:49 PM
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			AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
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Filing Date	
First Named Inventor	Jonathan O'Toole
Art Unit	
Examiner Name	
Attorney Docket Number	373499.00057

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	2849881	A	1958-09-02	ANDERSON	
	2	4390024	A	1983-06-28	WILLIAMS	
	3	4535627	A	1985-08-20	PROST, et al.	
	4	5474683	A	1995-12-12	BRYANT, et al.	
	5	5941847	A	1999-08-24	HUBER, et al.	
	6	5973770	A	1999-10-26	CARTER, et al.	
	7	6045529	A	2000-04-04	NUEESCH	
	8	6090065	A	2000-07-18	GILES	

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	9	6227936	B1	2001-05-08	MENDOZA	
	10	6328709	B1	2001-12-11	HUNG, et al.	
	11	6358226	B1	2002-03-19	RYAN	
	12	6383163	B1	2002-05-07	KELLY, et al.	
	13	6440100	B1	2002-08-27	PRENTISS	
	14	6461324	B1	2002-10-08	SCHLENSOG	
	15	6547756	B1	2003-04-15	GRETER, et al.	
	16	6579258	B1	2003-06-17	ATKIN, et al.	
	17	6663587	B2	2003-12-16	SILVER, et al.	
	18	6749582	B2	2004-06-15	BRITTO, et al.	
	19	7048519	B2	2006-05-23	FONG, et al.	

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	Examiner Name	
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	20	7201735	B2	2007-04-10	ATKIN, et al.	
	21	D548831	S	2007-08-14	CHARLEZ	
	22	7312554	B2	2007-12-25	VOGELEY	
	23	7314400	B2	2008-01-01	FILDAN, et al.	
	24	7662018	B1	2010-02-16	THOMPSON	
	25	7776008	B2	2010-08-17	RENZ, et al.	
	26	8057425	B1	2011-11-15	MYERS, et al.	
	27	8118772	B2	2012-02-21	DAO, et al.	
	28	8187227	B2	2012-05-29	LUZBETAK, et al.	
	29	8262606	B2	2012-09-11	GRETER, et al.	
	30	8282596	B2	2012-10-09	GRETER, et al.	

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	31	8376986	B2	2013-02-19	VAN, et al.	
	32	8702646	B2	2014-04-22	GARBEZ, et al.	
	33	8801495	B1	2014-08-12	GUINDON	
	34	8876760	B2	2014-11-04	BOSMAN, et al.	
	35	8926556	B2	2015-01-06	VAN EIJKELENBORG, et al.	
	36	9033913	B2	2015-05-19	KHALIL, et al.	
	37	9173587	B2	2015-11-03	VAN SCHIJNDEL, et al.	
	38	9345274	B1	2016-05-24	PRILL	
	39	9539377	B2	2017-01-10	MAKOWER, et al.	
	40	10039871	B2	2018-08-07	POLLEN, et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020193731	A1	2002-12-19	MYERS, et al.	
	2	20040056641	A1	2004-03-25	MYERS, et al.	
	3	20040074281	A1	2004-04-22	LOBDELL, et al.	
	4	20040267215	A1	2004-12-30	CHARLEZ, et al.	
	5	20050219302	A1	2005-10-06	VOGELEY, et al.	
	6	20060122575	A1	2006-06-08	WAKABAYASHI	
	7	20070051172	A1	2007-03-08	PERINET, et al.	
	8	20070051727	A1	2007-03-08	HOLLEY	
	9	20080177224	A1	2008-07-24	KELLY, et al.	
	10	20080262420	A1	2008-10-23	DAO, et al.	

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	11	20080275386	A1	2008-11-06	MYERS	
	12	20110004154	A1	2011-01-06	VAN, et al.	
	13	20110196291	A1	2011-08-11	VISCHER, et al.	
	14	20110274566	A1	2011-11-10	AMIROUCHE, et al.	
	15	20120277636	A1	2012-11-01	BLONDHEIM, et al.	
	16	20130023821	A1	2013-01-24	KHALIL, et al.	
	17	20140031744	A1	2014-01-30	CHEN	
	18	20140052056	A1	2014-02-20	GARBEZ, et al.	
	19	20140275857	A1	2014-09-18	TOTH, et al.	
	20	20140323962	A1	2014-10-30	KOOIJKER, et al.	
	21	20140378895	A1	2014-12-25	BARACK	

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	Attorney Docket Number	373499.00057

	22	20150217036	A1	2015-08-06	POLLEN, et al.	
	23	20150217037	A1	2015-08-06	POLLEN, et al.	
	24	20150283311	A1	2015-10-08	ALVAREZ, et al.	
	25	20160000980	A1	2016-01-07	ALVAREZ, et al.	
	26	20160058928	A1	2016-03-03	NOWROOZI, et al.	
	27	20160058929	A1	2016-03-03	MEDVEDEV, et al.	
	28	20160082165	A1	2016-03-24	ALVAREZ, et al.	
	29	20160082166	A1	2016-03-24	GUTHRIE, et al.	
	30	20160151551	A1	2016-06-02	FELBER	
	31	20160158424	A1	2016-06-09	CHEN, et al.	
	32	20160166745	A1	2016-06-16	AALDERS	

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	33	20160206794	A1	2016-07-21	MAKOWER, et al.	
	34	20160220743	A1	2016-08-04	GUTHRIE, et al.	
	35	20160220745	A1	2016-08-04	GUTHRIE, et al.	
	36	20160256617	A1	2016-09-08	HANSEN	
	37	20160271305	A1	2016-09-22	KURIHARA, et al.	
	38	20160287767	A1	2016-10-06	SIMMONS, et al.	
	39	20160296681	A1	2016-10-13	GASKIN, et al.	
	40	20160310650	A1	2016-10-27	MAKOWER, et al.	
	41	20170021068	A1	2017-01-26	GASKIN, et al.	
	42	20170035951	A1	2017-02-09	TANAKA	
	43	20170043065	A1	2017-02-16	TAKEUCHI	

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	Application Number	
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	44	20170072117	A1	2017-03-16	KURIHARA, et al.	
	45	20170072118	A1	2017-03-16	MAKOWER, et al.	
	46	20170095599	A1	2017-04-06	KONDO, et al.	
	47	20170143879	A1	2017-05-25	OKAGUCHI	
	48	20170220753	A1	2017-08-03	GUTHRIE, et al.	
	49	20180021490	A1	2018-01-25	CHANG, et al.	
	50	20180110906	A1	2018-04-26	BARACK	

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	1	3311982	DE	C2	1983-10-13	BATTELLE MEMORIAL INSTITUTE		
	2	0503280	EP	A2	1992-02-08	PIERBURG GMBH		

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	3	9420158	WO	A1	1994-09-15	DEKA PRODUCTS LIMITED PARTNERSHIP		
	4	19750620	DE	A1	1999-06-02	SIEMENS AG, 80333 MUENCHEN, DE		
	5	1586340	EP	A2	2005-10-19	SEA PROFIT (HONG KONG) LIMITED		
	6	2005114116	WO	A1	2005-12-01	LANE, JOHN, DENNIS; ESPARZA, JOSEPH, LUIS; NICHOLS		
	7	2005114113	WO	A3	2006-03-02	ACCU-GAUGE LIMITED		
	8	1430918	EP	B1	2008-05-14	MEDELA HOLDING AG		
	9	2344380	RU	C1	2009-01-20	GOSUDARSTVENNOE OBRAZOVATEL'NOE UCHREZHDENIE VYSSH		
	10	2009134271	WO	A1	2009-11-05	UTC POWER CORPORATION		
	11	2473022	GB	B	2011-12-14			
	12	2441367	RU	C2	2012-02-10	OBSHCHESTVO S OGRANICHENNOJ OTVETSTVENNOST'JU 'NAU		
	13	2436277	EP	A1	2012-04-04	DREW, LORNA		

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	14	2210628	EP	B1	2013-02-13	MEDELA HOLDING AG		
	15	2499248	GB	B	2014-04-02	ELIZABETH MORANA		
	16	1404393	EP	B1	2014-12-24	MEDELA HOLDING AG		
	17	2015081459	WO	A1	2015-06-11	CHEN, JUNBO		
	18	2015116749	WO	A1	2015-08-06	CORNING INCORPORATED		
	19	2015120321	WO	A1	2015-08-13	NAIA HEALTH, INC.		
	20	2015150225	WO	A1	2015-10-08	KONINKLIJKE PHILIPS N.V.		
	21	2015174330	WO	A1	2015-11-19	MURATA MANUFACTURING CO., LTD.		
	22	2016002606	WO	A1	2016-01-07	MURATA MANUFACTURING CO., LTD.		
	23	2016006494	WO	A1	2016-01-14	MURATA MANUFACTURING CO., LTD.		
	24	2016006496	WO	A1	2016-01-14	MURATA MANUFACTURING CO., LTD.		

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	25	2016007560	WO	A1	2016-01-14	NAYA HEALTH, INC.		
	26	2016010524	JP	A	2016-01-21	MURATA MFG CO LTD		
	27	2016014469	WO	A1	2016-01-28	EXPLORAMED NC7, LLC		
	28	2016014488	WO	A1	2016-01-28	EXPLORAMED NC7, LLC		
	29	105288759	CN	A	2016-02-03	SHANGHAI NORMAL UNIVERSITY		
	30	2016024558	WO	A1	2016-02-18	MURATA MANUFACTURING CO., LTD.		
	31	2016039083	WO	A1	2016-03-17	MURATA MANUFACTURING CO., LTD.		
	32	2016104673	WO	A1	2016-06-30	MURATA MANUFACTURING CO., LTD.		
	33	2077868	EP	B1	2016-07-27	MEDELA HOLDING AG		
	34	2016164853	WO	A1	2016-10-13	NAYA HEALTH, INC.		
	35	1263487	EP	B2	2016-11-23	MEDELA HOLDING AG		

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	36	2017061349	WO	A1	2017-04-13	MURATA MANUFACTURING CO., LTD.		
	37	2017108555	WO	A1	2017-06-29	KONINKLIJKE PHILIPS N.V.		
	38	2017139480	WO	A1	2017-08-17	EXPLORAMED NC7, INC.		

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	1	Whisper Wear Hands-Free Breast Pump, Model: WWPMP01, User Guide, pps. 1-20, Distributed with product at least as early as 2007 (see https://web.archive.org/web/20070621162539/http://www.whisperwear.com/pump_single.html)	

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	Attorney Docket Number	373499.00057

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That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

✓ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Mark D. Simpson/	Date (YYYY-MM-DD)	2021-03-16
Name/Print	Mark D Simpson	Registration Number	32942

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.B.F./

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.B.F./

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/203,292	03/16/2021	Jonathan O'TOOLE	373499.00057

CONFIRMATION NO. 9955

78905
Saul Ewing Arnstein & Lehr LLP (Philadelphia)
Attn: Patent Docket Clerk
Centre Square West
1500 Market Street, 38th Floor
Philadelphia, PA 19102-2186

PUBLICATION NOTICE

OC000000126826485

Title:BREAST PUMP SYSTEM

Publication No.US-2021-0205514-A1
Publication Date:07/08/2021

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently **http**://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17203292
Filing Date	2021-03-16
First Named Inventor	Jonathan O'Toole
Art Unit	3783
Examiner Name	C. Fredrickson
Attorney Docket Number	373499.00057

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5542921	A	1996-08-06	MEYERS, et al.	
	2	7833190	B1	2010-11-16	HALL	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070135761	A1	2007-06-14	CHENG, et al.	
	2	20170112983	A1	2017-04-27	THORNE, et al.	
	3	20180333523	A1	2018-11-22	CHANG, et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17203292
	Filing Date	2021-03-16
	First Named Inventor	Jonathan O'Toole
	Art Unit	3783
	Examiner Name	C. Fredrickson
	Attorney Docket Number	373499.00057

	1							

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17203292
	Filing Date	2021-03-16
	First Named Inventor	Jonathan O'Toole
	Art Unit	3783
	Examiner Name	C. Fredrickson
	Attorney Docket Number	373499.00057

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

✓ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

✓ See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Mark D. Simpson/	Date (YYYY-MM-DD)	2021-09-05
Name/Print	Mark D. Simpson	Registration Number	32942

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	43688928
Application Number:	17203292
International Application Number:	
Confirmation Number:	9955
Title of Invention:	BREAST PUMP SYSTEM
First Named Inventor/Applicant Name:	Jonathan O'TOOLE
Customer Number:	78905
Filer:	Mark D. Simpson/Lynn White
Filer Authorized By:	Mark D. Simpson
Attorney Docket Number:	373499.00057
Receipt Date:	05-SEP-2021
Filing Date:	16-MAR-2021
Time Stamp:	19:55:55
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	38945190_1.PDF	1036985 9f754b2533b025d27cf3dbd9da95aa5a20219cb	no	4

Warnings:

Information:	
Total Files Size (in bytes):	1036985

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	17/203,292
Filing Date	March 16, 2021
First Named Inventor	Jonathan O'TOOLE
Title	BREAST PUMP SYSTEM
Art Unit	3783
Examiner Name	Courtney B. Fredrickson
Attorney Docket Number	ELVI-002/14US

SIGNATURE of Applicant or Patent Practitioner

Signature	/Kassity L. Mai/	Date (Optional)	September 17, 2021
Name	Kassity L. Mai	Registration Number	68,774
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ *Total of 1 forms are submitted.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

[X] I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 58249

OR

[ ] I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

[X] The address associated with the above-mentioned Customer Number

OR

[ ] The address associated with Customer Number:

OR

[ ] Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Chiaro Technology Limited

[ ] Inventor or Joint Inventor (title not required below)

[ ] Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

[X] Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

[ ] Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	Hannah Brunskill	Date (Optional)	September 13, 2021
Name	Hannah Brunskill		
Title	Head of Legal		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

[X] Total of 1 forms are submitted.

Electronic Acknowledgement Receipt

EFS ID:	43791477
Application Number:	17203292
International Application Number:	
Confirmation Number:	9955
Title of Invention:	BREAST PUMP SYSTEM
First Named Inventor/Applicant Name:	Jonathan O'TOOLE
Customer Number:	78905
Filer:	Kassity L. Mai/Julie Chandler
Filer Authorized By:	Kassity L. Mai
Attorney Docket Number:	373499.00057
Receipt Date:	17-SEP-2021
Filing Date:	16-MAR-2021
Time Stamp:	11:28:42
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	ELVI_002_14US_Power_of_Attorney.pdf	118916 2d97ce2f0425 4b9a25da0f192264dd145d387a9f	no	2

Warnings:

Information:	
Total Files Size (in bytes):	118916

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/203,292	03/16/2021	Jonathan O'TOOLE	ELVI-002/14US

CONFIRMATION NO. 9955

58249
COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

POA ACCEPTANCE LETTER

OC000000128544629

Date Mailed: 09/22/2021

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/17/2021.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/ytdemisse/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/203,292	03/16/2021	Jonathan O'TOOLE	373499.00057

CONFIRMATION NO. 9955

78905
Saul Ewing Arnstein & Lehr LLP (Philadelphia)
Attn: Patent Docket Clerk
Centre Square West
1500 Market Street, 38th Floor
Philadelphia, PA 19102-2186

POWER OF ATTORNEY NOTICE

OC000000128544606

Date Mailed: 09/22/2021

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/17/2021.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/ytdcmissc/

Docket No.: ELVI-002/14US
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Inventor:	Jonathan O'TOOLE	Confirmation No.:	9955
Application No.:	17/203,292	Group Art Unit:	3783
Filed:	March 16, 2021	Examiner:	Courtney B. Fredrickson

For: BREAST PUMP SYSTEM

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT/RESPONSE TO OFFICE ACTION

In response to the non-final Office Action dated June 24, 2021, to which the deadline for responding is September 24, 2021, Applicant submits the following Amendments and/or Remarks, and respectfully requests reconsideration of the application in view thereof.

Any extensions of time necessary to prevent abandonment of this application are hereby petitioned for under 37 C.F.R. §1.136(a), and any additional fees required (including fees for net addition of claims) are hereby authorized to be charged to our Deposit Account No. 50-1283.

Amendments to the Claims are reflected in the listing of the claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 7 of this paper.

IN THE CLAIMS:

Set forth below in ascending order, with status identifiers, is a complete listing of all claims currently under examination. Changes to any amended claims are indicated by [[double brackets]], ~~strikethrough~~ and/or underlining. This listing also reflects any cancellation and/or addition of claims.

1. (Currently Amended) A breast pump device that is configured as a self-contained, in-bra wearable device, the breast pump device comprising ~~and that includes~~:

(i) a housing that includes (a) a ~~rechargeable~~ battery, and; ~~(b) a power charging circuit for controlling the charging of the rechargeable battery; (c) control electronics powered by the rechargeable battery; (d)~~ (b) an air pump powered by the ~~rechargeable~~ battery and generating negative air pressure;

[[(e)]](ii) a diaphragm configured to prevent milk from reaching the pump ~~and seated in a diaphragm holder~~;

[[(ii)]](iii) a breast shield made up of a breast flange and a nipple tunnel and that is configured to slide out from the housing together with the diaphragm~~, and the diaphragm is configured to be removable from a diaphragm holder for cleaning~~; and

[[(iii)]](iv) a milk container that is configured to attach to the housing.

2. (Canceled)

3. (Currently Amended) The breast pump device of Claim 1, in which the breast shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto [[the]]a breast.

4. (Currently Amended) The breast pump device of Claim 1, in which the breast shield is a one piece item that, in use, presents a single continuous surface to [[the]]a nipple and a breast.

5. (Original) The breast pump device of Claim 1, in which the breast shield integrates the breast flange and nipple tunnel as a one-piece item.

6. (Original) The breast pump device of Claim 1, in which the breast flange and the nipple tunnel are a single, integral item with no joining stubs.

7. (Currently Amended) The breast pump device of Claim 1, in which the breast shield is generally symmetrical about a centre-line running from [[the]]a top to [[the]]a bottom of the breast shield when positioned upright for normal use.

8. (Currently Amended) The breast pump device of Claim 1, in which the breast shield is configured to slide in and out from the housing, together with the diaphragm ~~that prevents milk from reaching the pump~~, on guide members in the breast shield.

9. (Original) The breast pump device of Claim 1, in which the housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.

10. (Currently Amended) The breast pump device of Claim 1, in which the breast pump device includes only the breast shield and the milk container ~~two parts~~ that are directly removable from the housing in normal use or normal dis-assembly~~: the breast shield and the milk container~~.

11. (Canceled)

12. (Currently Amended) The breast pump device of Claim [[11]]1, in which the diaphragm is substantially circular and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing.

13. (Currently Amended) The breast pump device of Claim [[11]]1, in which the diaphragm is a membrane that is seated against a diaphragm holder ~~that is formed as the recess in the rear surface of the housing~~, the diaphragm deforming in response to changes in air pressure caused by the air pump to create negative air pressure in the nipple tunnel.

14. (Currently Amended) The breast pump device of Claim 1, in which the diaphragm is removable from a diaphragm holder that sits above the breast flange and the nipple tunnel ~~portion~~.

15. (Original) The breast pump device of Claim 1, in which the milk container is substantially rigid.

16. (Currently Amended) The breast pump device of Claim 1, in which the milk container is configured to attach to a lower part of the housing and to form a flat bottomed base for the breast pump device.

17. (Currently Amended) The breast pump device of Claim 1, in which the milk container has a surface shaped to continue a curved shape of the housing, so that the breast pump ~~entire~~ device can be held comfortably inside the bra.

18. (Original) The breast pump device of Claim 1, in which the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container.

19. (Currently Amended) The breast pump device of Claim 1, in which the milk container is attachable to the housing with a mechanical or magnetic mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action.

20. (Original) The breast pump device of Claim 1, in which the milk container includes a cap that is removable from the milk container and a removable valve that enables milk to pass into the milk container in one direction.

21. (Currently Amended) The breast pump device of Claim 1, in which [[the]]a top of the milk container includes an optically clear region that is aligned below one or more light emitters positioned in [[the]]a base of the housing.

22. (Currently Amended) The breast pump device of Claim 1, in which the milk container ~~is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it~~ is wider than [[it]]the milk container is tall.

23. (Currently Amended) The breast pump device of Claim 1, in which the nipple tunnel includes on [[its]]a lower surface an opening through which expressed milk flows under gravity into the milk container.

24. (Original) The breast pump device of Claim 1, in which the housing includes a wireless data communications system powered by the rechargeable battery.

25. (Original) The breast pump device of Claim 1, in which the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra, and a rear surface that is shaped to contact, at least in part, the breast shield.

26. (Currently Amended) The breast pump device of Claim 1, in which the housing includes at least one of a visual or ~~and/or~~ haptic indicator that indicates whether milk is flowing or not flowing into the milk container.

27. (Currently Amended) The breast pump device of Claim 1, in which the housing includes at least one of a visual or ~~and/or~~ haptic indicator that indicates if the pump is operating correctly to pump milk, based on whether [[the]]a quantity or a ~~and/or the~~ height of ~~the~~ liquid in the milk container above [[its]]a base of the milk container is increasing above a threshold rate of increase.

28. (Currently Amended) The breast pump device of Claim 1, in which the air pump comprises a piezo air pump system.

29. (Currently Amended) The breast pump device of Claim 1, in which the air pump delivers in excess of 400 mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow and

is a lightweight air pump that enables [[the]]a total mass of the breast pump device ~~system~~, unfilled with milk, to be less than 250 gm.

30. (Currently Amended) The breast pump device of Claim 1, in which the breast pump device makes less than 30 dB noise at maximum power and less than 25 dB at normal power, against a 20 dB ambient noise.

31. (New) A breast pump device that is configured as a self-contained, in-bra wearable device, the breast pump device comprising:

(i) a housing that includes (a) a battery, and (b) an air pump powered by the battery and generating negative air pressure;

(ii) a breast shield made up of a breast flange and a nipple tunnel and that is configured to slide out from the housing on linear guide members; and

(iii) a milk container that is configured to attach to the housing.

32. (New) The breast pump device of claim 31, wherein the air pump is configured to generate negative air pressure with a maximum suction of approximately 240 mmHg.

REMARKS

Upon entry to these amendments, claims 1, 3-10, and 12-32 are pending in the present application. In this response, claims 1, 3, 4, 7, 8, 10, 12-14, 16, 17, 19, 21-23, and 26-30 have been amended, and claims 2 and 10 have been cancelled, without prejudice or disclaimer. New claims 31 and 32 have been added. Support for the claim amendments can be found throughout the application as originally filed. No new matter is added. Based on the above Amendments and the following Remarks, Applicant respectfully requests that the Examiner reconsider and withdraw all outstanding rejections.

Interview Summary

The undersigned would like to thank Examiner Courtney Fredrickson for her time and attention extended during the telephone interview conducted on September 23, 2021. During the interview, proposed amendments to the claims were discussed as reflected herein. The Examiner indicated that the proposed amendments should overcome the current rejections, but that further consideration and searching would be required.

Allowable Subject Matter

Applicant appreciates the Examiner's indication that previously presented claims 1 and 13 contain allowable subject matter if rewritten to overcome the rejections under 35 USC § 112(b). While Applicant has amended independent claim 1, Applicant respectfully submits that amended independent claim 1 (and its dependents) are patentable, at least in view of its recitations and for those reasons discussed with the Examiner during the interview.

Claim Objection

Claims 4, 11, and 14 were objected to due to certain informalities. In response, Applicant has amended claims 4, 11, and 14 accordingly. At least in view of the amendments, Applicant respectfully requests that the objections of these claims be withdrawn.

Claim Interpretation – 35 USC § 112(f)

The Office Action states that the previous wording of claim 19 invoked 35 U.S.C. 112(f). While Applicant disagrees, Applicant has amended claim 19 to recite "a mechanical or magnetic mechanism" and respectfully submits that the amended claim does not invoke 35 U.S.C. 112(f).

Claim Rejections – 35 USC § 112(b) and (d)

Claims 1-30 stand rejected under 35 U.S.C. 112(b), as being indefinite. Claim 11 stands rejected under 35 U.S.C. 112(d), as being improper. In response, Applicant has amended the claims to address the concerns raised in the Office Action.

For at least the foregoing reasons, Applicant submits that the claims are not indefinite or improper and respectfully requests withdrawal of the rejections under 35 U.S.C. 112.

Double Patenting Rejections

Claims 1-12, and 14-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claim 11 of copending Application No. 17/181,057. Claims 1-12, and 14-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claim 12 of copending Application No. 17/203,050. Claims 1-12, and 14-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claim 20 of copending Application No. 17/203,313. Claims 1-12, and 14-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claim 8 of copending Application No. 17/203,327. Claims 1-12, and 14-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claim 8 of copending Application No. 17/203,355. Claims 1-12, and 14-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claim 8 of copending Application No. 17/203,150. Claims 1-12, and 14-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claim 23 of copending Application No. 17/203,109. Claims 1-12, and 14-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claim 16 of copending Application No.

17/203,179. Claims 1-12, and 14-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claim 8 of copending Application No. 17/203,397. Claims 1-12, and 14-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claim 8 of copending Application No. 17/203,418.

Applicant will address the provisional nonstatutory double patenting rejections and will consider filing a terminal disclaimer once all the claims are indicated to be allowable.

New Claims 31 and 32

New independent claim 31 and its dependent claim 32 have been added. While the Examiner has yet to have the opportunity to examine these claims, Applicant respectfully submits that these independent claims are patentable, at least in view of their recitations and for those reasons discussed with the Examiner during the interview.

CONCLUSION

In view of the foregoing, Applicant respectfully submits that no further impediments exist to the allowance of this application and, therefore, requests an indication of allowability. However, the Examiner is requested to call the undersigned if any questions or comments arise.

The Director is hereby authorized to charge any appropriate fees under 37 C.F.R. §§1.16, 1.17, and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 50-1283 referencing Docket No. ELVI-002/14US.

Dated: September 24, 2021

Respectfully submitted,
COOLEY LLP

By: /Kassity L. Mai/
Kassity L. Mai
Reg. No. 68,774
C. Scott Talbot
Reg. No. 34,262

USPTO CUSTOMER NO. 58249

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Electronic Acknowledgement Receipt	
EFS ID:	43864135
Application Number:	17203292
International Application Number:	
Confirmation Number:	9955
Title of Invention:	BREAST PUMP SYSTEM
First Named Inventor/Applicant Name:	Jonathan O'TOOLE
Customer Number:	58249
Filer:	Kassity L. Mai/Donna Doyle
Filer Authorized By:	Kassity L. Mai
Attorney Docket Number:	ELVI-002/14US
Receipt Date:	24-SEP-2021
Filing Date:	16-MAR-2021
Time Stamp:	17:56:29
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		ELVI-002_14US-Response.pdf	170735 1284c18b966c984f03dcf9482768fa51ca00f6f7	yes	10

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	6
	Applicant Arguments/Remarks Made in an Amendment	7	10
Warnings:			
Information:			
	Total Files Size (in bytes):	170735	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/203,292	Filing Date 03/16/2021	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $240 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

AMENDMENT	09/24/2021	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 30	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $240 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	SLIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/DIANIECE M JACOBS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/203,292	03/16/2021	Jonathan O'TOOLE	ELVI-002/14US	9955

58249 7590 09/28/2021

COOLEY LLP
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1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

EXAMINER	
FREDRICKSON, COURTNEY B	

ART UNIT	PAPER NUMBER
3783	

NOTIFICATION DATE	DELIVERY MODE
09/28/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zIPPatentDocketingMailboxUS@cooley.com

Applicant-Initiated Interview Summary	Application No. 17/203,292	Applicant(s) O'TOOLE et al.		
	Examiner COURTNEY FREDRICKSON	Art Unit 3783	AIA (First Inventor to File) Status Yes	Page 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	Title	Type
COURTNEY FREDRICKSON	Examiner	Telephonic
Kassity Mai	Attorney	
Scott Talbot	Attorney	

Date of Interview: 23 September 2021

Issues Discussed:

Proposed Amendment(s)

Applicant discussed potentially removing the limitation regarding the diaphragm holder from claim 1. The examiner indicated that would likely not impact allowability due to the allowability hinging on the breast shield being configured to slide out from the housing together with the diaphragm. Applicant further discussed removing some components from the housing in claim 1. The examiner indicated that further consideration would be needed but would likely not impact allowability.

/COURTNEY B FREDRICKSON/ Examiner, Art Unit 3783	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

Agenda for Telephone Interview
September 23, 2021; 10:00 AM ET
By e-mail – courtney.fredrickson@uspto.gov

I. PTO Representative – Examiner Courtney Fredrickson

II. Applicants' Representatives: Kassity Mai (Reg. No. 68,774), Scott Talbot (Reg. No. 34,262)

III. Discussion of following patent applications:

a. U.S. Patent Application No. 17/203,050 (Attorney Docket No. ELVI-002/07US)

b. U.S. Patent Application No. 17/203,327 (Attorney Docket No. ELVI-002/16US)

c. U.S. Patent Application No. 17,203/109 (Attorney Docket No. ELVI-002/09US)

d. U.S. Patent Application No. 17/203,292 (Attorney Docket No. ELVI-002/14US)

e. U.S. Patent Application No. 17/203,313 (Attorney Docket No. ELVI-002/15US)

Used in Lieu of PTO/SB/08A/B
(Based on PTO 11-07 version)

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 3

Complete if Known	
Application Number	17/203,292
Filing Date	March 16, 2021
First Named Inventor	Jonathan O'TOOLE
Art Unit	3783
Examiner Name	Courtney B. FREDRICKSON
Attorney Docket Number	ELVI-002/14US

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	001	US-7666162	02-23-2010	RENZ; Charles J. et al.	
	002	US-8608685	12-17-2013	TASHIRO; Mitsuo et al.	
	003	US-10881766	01-05-2021	O'TOOLE; Jonathan et al.	
	004	US-10926011	02-23-2021	O'TOOLE; Jonathan et al.	
	005	US-20040087898	05-06-2004	WENIGER; Gotthilf	
	006	US-20090281482	11-12-2009	BAKER; Peter Christensen et al.	
	007	US-20100292636	11-18-2010	RENZ; Charles J. et al.	
	008	US-20120165729	06-28-2012	CUDWORTH; Nicholas	
	009	US-20140263611	09-18-2014	BAUER; Ryan	
	010	US-20160228625	08-11-2016	HOLTZ; Raymond et al.	
	011	US-20180110900	04-26-2018	KORENFELD; Michael S.	
	012	US-20210170080	06-10-2021	O'TOOLE; Jonathan et al.	
	013	US-20210196873	07-01-2021	O'TOOLE; Jonathan et al.	
	014	US-20210196874	07-01-2021	O'TOOLE; Jonathan et al.	
	015	US-20210196875	07-01-2021	O'TOOLE; Jonathan et al.	
	016	US-20210196876	07-01-2021	O'TOOLE; Jonathan et al.	
	017	US-20210205511	07-08-2021	O'TOOLE; Jonathan et al.	
	018	US-20210205512	07-08-2021	O'TOOLE; Jonathan et al.	
	019	US-20210205513	07-08-2021	O'TOOLE; Jonathan et al.	
	020	US-20210205515	07-08-2021	O'TOOLE; Jonathan et al.	
	021	US-20210205516	07-08-2021	O'TOOLE; Jonathan et al.	
	022	US-20210205517	07-08-2021	O'TOOLE; Jonathan et al.	
	023	US-20210205518	07-08-2021	O'TOOLE; Jonathan et al.	
	024	US-20210228789	07-29-2021	O'TOOLE; Jonathan et al.	
	025	US-20210268158	09-02-2021	O'TOOLE; Jonathan et al.	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Used in Lieu of PTO/SB/08A/B
(Based on PTO 11-07 version)

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 2 of 3

Complete if Known	
Application Number	17/203,292
Filing Date	March 16, 2021
First Named Inventor	Jonathan O'TOOLE
Art Unit	3783
Examiner Name	Courtney B. FREDRICKSON
Attorney Docket Number	ELVI-002/14US

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	026	CN-101549180-A	10-07-2009	PIGEON CORP [JP]	Corresponds to US8608685	☒
	027	EP-0503280-A2	09-16-1992	PIERBURG GMBH [DE]		☒
	028	GB-2435617-B	03-05-2008	PLAYTEX PRODUCTS INC [US]		☐

Examiner Signature		Date Considered	

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Sheet 3 of 3

Complete if Known	
Application Number	17/203,292
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First Named Inventor	Jonathan O'TOOLE
Art Unit	3783
Examiner Name	Courtney B. FREDRICKSON
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NON-PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author(in CAPITAL LETTERS),title of the article(when appropriate), title of the item (book,magazine,journal,serial,symposium,catalog,etc.),date,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
	029	GB Search Report, dated 15 November 2017, issued in priority GB Application No. GB1709561.3.	☐
	030	GB Search Report, dated 28 November 2017, issued in priority GB Application No. GB1709566.2.	☐
	031	GB Search Report, dated 29 November 2017, issued in priority GB Application No. GB1709564.7.	☐
	032	International Search Report issued in PCT/GB2018/051659 dated December 4, 2018, 9 pages.	☐

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Bibliographic data

Title:	Breast pump
Pub/Pat no:	CN101549180A
Pub/Issue Date:	2009-10-07
Inventor(s):	MITSUO TASHIRO[JP]| SHINICHI KATAOKA[JP]|TASHIRO MITSUO |KATAOKA SHINICHI
Applicant(s):	PIGEON CORP[JP]
Classification:	A61M1/06A1
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Abstract of CN101549180A

A breast pump can be configured to be capable of easily attaching/detaching a primary side serving as a sealed space which is in communication with a milking space and allows the passage of breast milk, with a secondary side in which a case is connected with a pressure changing apparatus 51. The breast pump can include a breast pump main body 21 connected to the pressure changing apparatus by a conduit, wherein a milking part is disposed so as to liquid-tightly separate a sealed space (or a space that is in fluid communication with the sealed space), and the pressure changing apparatus from each other. A pressure transmission part 30 for transmitting pressure changed by the pressure changing apparatus can be provided. The pressure transmission part can include a deformable part 32 where a volume in the sealed space can be deformed by a pressure fluctuation generated by the pressure changing apparatus. A case 31 can accommodate the deformable part and be connected with the pressure changing apparatus at one end, and the other end of the case can include attachment structure 33 for communicably attaching/detaching the case with the portion of the milking part that forms the sealed space.

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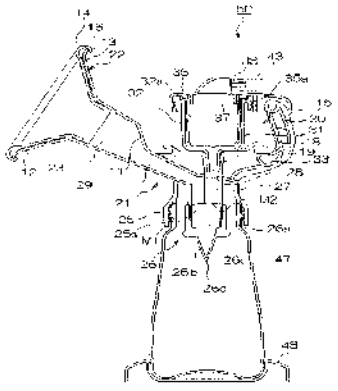
权利要求书 2 页 说明书 16 页 附图 9 页

[54] 发明名称

吸奶器

[57] 摘要

本发明提供一种吸奶器，能够容易地对与吸奶空间连通的母乳所通过的密闭空间即一次侧和与压力改变机构连接的壳体所存在的一侧即二次侧进行装拆。吸奶器具有吸奶器主体(21)和压力改变机构(51)，吸奶部具有用于传递通过所述压力改变机构被改变的压力的压力传递部(30)，该压力传递部将密闭空间或与其连通的空间和所述压力改变机构液密地分离。所述压力传递部具有：变形部(32)，该变形部使所述密闭空间或与该密闭空间连通的空间内所占的体积或容积因所述压力改变机构所产生的压力变化而变形；壳体(31)，用于收容该变形部，并且一端与所述压力改变机构侧连接，在该壳体的另一端，具有用于以能够连通的方式对该壳体内和所述密闭空间进行装拆的装拆机构(33)。



1. 一种吸奶器，具有：与使用者的乳房抵接的大致圆锥状的吸奶部；包含所述吸奶部、以连通的方式与瓶进行装拆的吸奶器主体；与所述吸奶部连接，交替地产生负压状态以及比该负压状态压力高的至少大气压状态的压力改变机构，其特征在于，

具有用于传递通过所述压力改变机构被改变的压力的压力传递部，该压力传递部被配置成，当所述吸奶部进行吸奶时，将因抵接使用者的乳房而形成的密闭空间或与该密闭空间连通的空间和所述压力改变机构液密地分离，

所述压力传递部具有：变形部，该变形部使所述密闭空间或与该密闭空间连通的空间内所占的体积或容积因所述压力改变机构所产生的压力变化而变形；壳体，用于收容该变形部，并且一端与所述压力改变机构侧连接，

在该壳体的另一端，具有用于以能够连通的方式对该壳体内和所述密闭空间进行装拆的装拆机构。

2. 如权利要求 1 所述的吸奶器，其特征在于，所述壳体是在内部收容了所述变形部的筒状体，在该筒状体上具有作为所述装拆机构的、从与所述另一端对应的端部突出的管状突出部，而在所述密闭空间中，具有在该空间内延伸的筒状连接部，使所述筒状连接部的内径比所述壳体侧的所述管状突出部的外径稍大，由此，将所述管状突出部插入所述筒状连接部，成为所述壳体和所述密闭空间被气密接合的结构。

3. 如权利要求 2 所述的吸奶器，其特征在于，所述壳体的所述管状突出部的周边为平坦的底部，在所述吸奶器主体的所述筒状连接部的开口周边形成有平坦的接触面部，将所述管状突出部插入所述筒状连接部，将所述壳体的所述平坦的底部推入至与所述平坦的接触面部抵接的位置，由此，成为所述壳体和所述密闭空间气密接合的结构。

4. 如权利要求 3 所述的吸奶器，其特征在于，所述筒状连接部以在将所述吸奶器主体载置在所述瓶上的状态下、向瓶下方大致垂直延伸的方式形成，并且，所述管状突出部向前端逐渐变细。

5. 如权利要求 1～4 的任一项所述的吸奶器，其特征在于，具有盖部件，该盖部件将收纳所述变形部的所述壳体的一端侧覆盖，并且，与作为所述压力改变机构的负压形成机构连接的管相对于该盖部件装拆，所述盖部件具有卡定机构，在所述壳体和所述密闭空间被接合的状态下，所述卡定机构用于在将所述盖部件安装在所述壳体的一端侧的位置上，将该盖部件相对于所述吸奶器主体的所述密闭空间侧进行卡定。

6. 如权利要求 5 所述的吸奶器，其特征在于，所述卡定机构设置在所述盖部件的周缘部，该卡定机构相对于从所述吸奶器主体侧向上方突出的支承机构被卡定。

7. 如权利要求 5 所述的吸奶器，其特征在于，使从所述盖部件的周缘部延伸的卡定机构相对于在所述吸奶器主体的所述筒状连接部的开口周边所设置的接触面部的周缘部进行卡定。

吸奶器

技术领域

本发明涉及用于吸取母乳的吸奶器的改进。

背景技术

供母亲等吸取母乳使用的吸奶器，例如具有用于与乳房抵接的喇叭部、和用于在因乳房抵接该喇叭部而形成的空间中产生负压的泵等的负压形成机构。被吸引到负压空间的母乳流入瓶等中而被贮存，负压形成空间和所述泵通过连接机构连接（参照专利文献1）。

在这样的吸奶器中，被收容在设置于所述连接机构的外壳中的阀体根据母乳液面的上升而可动，从而阻塞向负压形成机构即所述泵侧的开口。由此，能够防止母乳回流到负压形成机构即泵侧，并能够防止机械结构生锈及被污染。另外，即使在负压形成机构不是由泵等的机械构造构成、而是由杆等的手动机构构成的情况下，也能够避免因母乳回流到该杆等而沾污使用者的手等不良情况。

但是，在这样的吸奶器中，设置在所述连接机构上的、将所述负压空间和所述泵侧连通的开口，是会因阀体的动作而被阻塞的构造。

因此，负压空间和泵侧无法成为始终完全地液密分离的构造，即使阀体将所述开口阻塞，也存在着母乳本身以及随负压成为雾状的母乳等从微小的间隙回流到泵侧的危险。

因此，可能会造成泵的机械部分污损、杂菌繁殖，在手动的负压形成机构中也同样存在着污损和不卫生的问题。

因此，本申请中提出了专利文献2所示的吸奶器。

该吸奶器中具有压力传递部，该压力传递部被配置成，当吸奶部进行吸奶时，能够将因与使用者的乳房抵接而形成的密闭空间、

或与该密闭空间连通的空间和所述压力改变机构液密地分离，该压力传递部用于传递被所述压力改变机构改变了的压力，所述压力传递部具有变形部，该变形部在所述密闭空间或与该密闭空间连通的空间内所占的体积或容积因所述压力改变机构的动作而变化。

因此，由于压力传递部将形成于所述吸奶部的所述密闭空间和泵等的压力改变机构完全液密分离，因而能够有效地防止吸取出的母乳从所述密闭空间侧回流到所述压力改变机构。其结果是，能够有效地防止压力改变机构侧接触母乳而产生腐蚀和破损，或是被污染成为不卫生的状态。

专利文献 1：日本特开平 11-226117

专利文献 2：日本特开 2006-102220

但是，在专利文献 2 的吸奶器中，虽然能够实现将与吸奶空间连通的母乳所通过的密闭空间即一次侧和与压力改变机构连接的壳体所存在的一侧即二次侧液密分离的结构，但它们在构造上是相互结合的构造。

因此，在搬运时、收纳时等，一次侧的构造和二次侧的构造是结合的，因而产生了操作、清洁时等不方便的另外的问题。

发明内容

因此，本发明的目的在于提供一种吸奶器，能够容易地对与吸奶空间连通的母乳所通过的密闭空间即一次侧和与压力改变机构连接的壳体所存在的一侧即二次侧进行装拆，并能够使清洁等的操作变得极其容易。

上述目的在第一发明中是通过如下所述的吸奶器实现的，吸奶器具有：与使用者的乳房抵接的大致圆锥状的吸奶部；包含所述吸奶部、以连通的方式与瓶进行装拆的吸奶器主体；与所述吸奶部连接，交替地产生负压状态以及比该负压状态压力高的至少大气压状态的压力改变机构，其中，具有用于传递通过所述压力改变机构被改变的压力的压力传递部，该压力传递部被配置成，当所述吸奶部

进行吸奶时，将因抵接使用者的乳房而形成的密闭空间或与该密闭空间连通的空间和所述压力改变机构液密地分离，所述压力传递部具有：变形部，该变形部使所述密闭空间或与该密闭空间连通的空间内所占的体积或容积因所述压力改变机构所产生的压力变化而变形；壳体，用于收容该变形部，并且一端与所述压力改变机构侧连接，在该壳体的另一端，具有用于以能够连通的方式对该壳体内和所述密闭空间进行装拆的装拆机构。

根据第一发明的结构，所述压力传递机构通过壳体内收容的所述变形部的体积变化使所述密闭空间的内压变化，由此，改变对抵接于所述吸奶部的乳房的吸引压。

而且，因此，由于所述压力传递部将形成于所述吸奶部的所述密闭空间和泵等的压力改变机构完全地分离，因而能够有效地防止吸取出的母乳从所述密闭空间侧回流到所述压力改变机构。因此，能够有效地防止压力改变机构侧与母乳接触发生腐蚀、破损而被污染成为不卫生的状态。

而且，所述压力传递部具有一端与所述压力改变机构侧连接的壳体，在该壳体的另一端具有用于将该壳体内和所述密闭空间以能够连通的方式进行装拆的装拆机构。因此，例如，能够容易地将收容有变形部的壳体装拆，与密闭空间侧分离，不仅便于携带、移动，尤其在清洗时等，能够容易地仅对需要频繁清洗的一次侧即密闭空间侧进行分离、清洗。

第二发明在第一发明的结构的基础上，所述壳体是在内部收容了所述变形部的筒状体，在该筒状体上具有作为所述装拆机构的、从与所述另一端对应的端部突出的管状突出部，而在所述密闭空间中，具有在该空间内延伸的筒状连接部，使所述筒状连接部的内径比所述壳体侧的所述管状突出部的外径稍大，由此，将所述管状突出部插入所述筒状连接部，成为所述壳体和所述密闭空间被气密接合的结构。

根据第二发明的结构，在所述密闭空间中设置有筒状连接部，

由于该筒状连接部具有比壳体侧的管状突出部的外径稍大的内径，所以通过仅将该管状突出部插入筒状连接部这一简单的操作，就能够将压力改变机构侧和密闭空间侧连接。

第三发明在第二发明的结构的基础上，所述壳体的所述管状突出部的周边为平坦的底部，在所述吸奶器主体的所述筒状连接部的开口周边形成有平坦的接触面部，将所述管状突出部插入所述筒状连接部，将所述壳体的所述平坦的底部推入至与所述平坦的接触面部抵接的位置，由此，成为所述壳体和所述密闭空间气密接合的结构。

根据第三发明的结构，所述壳体的所述管状突出部的周边为平坦的底部，在所述吸奶器主体的所述筒状连接部的开口周边形成有平坦的接触面部，只要将所述管状突出部插入所述筒状连接部、将所述壳体的所述平坦的底部压入到与所述平坦的接触面部抵接的位置，便能够极其容易地将所述壳体和所述密闭空间接合。

第四发明在第三发明的结构的基础上，所述筒状连接部以在将所述吸奶器主体载置在所述瓶上的状态下、向瓶下方大致垂直延伸的方式形成，并且，所述管状突出部向前端逐渐变细。

根据第四发明的结构，只要将管状突出部向下插入筒状连接部，由于前端细而插入容易，并且当插入得较深时，随着该管状突出部的外径扩大，该管状突出部能够与筒状连接部的内表面紧密地接触、实现嵌合，能够极其容易地接合。

第五发明在第一－第四任意一个发明的结构的基础上，具有盖部件，该盖部件将收纳所述变形部的所述壳体的一端侧覆盖，并且，与作为所述压力改变机构的负压形成机构连接的管相对于该盖部件装拆，所述盖部件具有卡定机构，在所述壳体和所述密闭空间被接合的状态下，所述卡定机构用于在将所述盖部件安装在所述壳体的一端侧的位置上，将该盖部件相对于所述吸奶器主体的所述密闭空间侧进行卡定。

根据第五发明的结构，所述盖部件具有所述卡定机构，由此，

能够使壳体相对于密闭空间侧的接合状态不会轻易脱落。

第六发明在第五发明的结构的基础上，所述卡定机构设置在所述盖部件的周缘部，该卡定机构相对于从所述吸奶器主体侧向上方突出的支承机构被卡定。

根据第六发明的结构，卡定机构设置在所述盖部件的周缘部，由于该卡定机构是相对于从所述吸奶器主体侧向上方突出的支承机构被卡定的结构，因此，在与所述管状突出部和筒状连接部的接合位置不同的位置进行所述卡定机构的卡定，能够更稳定地维持接合状态。

第七发明在第五发明的结构的基础上，使从所述盖部件的周缘部延伸的卡定机构相对于在所述吸奶器主体的所述筒状连接部的开口周边所设置的接触面部的周缘部进行卡定。

根据第七发明的结构，由于能够利用在吸奶器主体的所述筒状连接部的开口周边所设置的接触面部来卡定盖部件，因而不需要在吸奶器主体侧形成用于卡定的特别的机构，另外，还能够相应地谋求小型化。

（发明的效果）

如上所述，根据本发明，能够提供一种吸奶器，能够容易地对与吸奶空间连通的母乳所通过的密闭空间即一次侧和与压力改变机构连接的壳体所存在的一侧即二次侧进行装拆，并能够使清洁等的操作变得极其容易。

附图说明

图 1 是本发明的第一实施方式的吸奶器的概略立体图。

图 2 是图 1 的吸奶器的吸奶单元的概略剖视图。

图 3 是图 1 的吸奶器的盖部件的概略立体图。

图 4 是图 1 的吸奶器的电机部的分解立体图。

图 5 是图 1 的吸奶器的活塞部的分解立体图。

图 6 是图 1 的吸奶器的压力调整部的分解立体图。

图 7 是图 1 的吸奶器的变形例一的说明图。

图 8 是图 1 的吸奶器的变形例二的说明图。

图 9 是本发明的第二实施方式的吸奶器的主要部位的图。

（附图标记的说明）

15...支承机构，20...吸奶器，21...（吸奶器）主体，22...吸奶部，23...通气路，28...筒状连接部，29...密闭空间，30...压力传递部，31...壳体，32...变形部（件），33...（装拆机构）管状突出部，35...盖部件，50...吸奶单元，51...泵单元

具体实施方式

以下，参照附图详细说明本发明的优选实施方式。

另外，由于以下所述的实施方式是本发明的优选具体例，因而在技术方面附加了优选的各种限定，但只要在以下的说明中没有特别限定本发明的主旨的记载，本发明的范围就不限于这些实施方式。

图 1 是表示本发明的实施方式的吸奶器的结构的概略立体图。

图 1 表示吸奶器 20 的整体，在图中，吸奶器 20 具有吸奶单元 50 和通过管 43 与该吸奶单元 50 连接的作为压力改变机构的泵单元 51。

首先，对吸奶单元 50 进行说明。

图 2 是吸奶单元 50 的概略剖视图，在图 1 以及图 2 中，吸奶单元 50 具有吸奶器主体 21（以下称为“主体”），该吸奶器主体 21 能够相对于用于贮存吸取出的母乳的容器即瓶 47 装拆。

主体 21 例如其整体由较轻的、牢固的合成树脂材料成形，例如，由聚碳酸酯、聚环烯烃、聚醚砜、聚酰胺、聚丙烯等形成。

如图 2 所示，主体 21 具有与用于贮存吸取出的母乳的瓶 47 进行装拆的装拆部 25。装拆部 25 是例如扁平的筒状部分，在内侧具有内螺纹部 25a，该内螺纹部 25a 与形成在瓶 47 的瓶口周围的外螺纹部螺合。此外，瓶 47 可以是吸奶器 20 的专用品，也可以使用能与装拆部 25 配合的哺乳瓶等瓶体。此外，瓶 47 被载置在支承台 48 上。

在图 2 中，在主体 21 的装拆部 25 的上部，设置有以斜向倾斜的状态向外敞开的圆锥状或喇叭状的吸奶部 22。

该吸奶部 22 具有：构成通气路 23 的稍微扩开的开放通路 11；一体设置在开放通路 11 的前端侧的、大幅扩开成喇叭状的开放前端部 12。它们由与主体 21 相同的材料成形，具有较高的刚性，不易变形。

另外，在开放前端部 12 的内侧，设置有形状与开放前端部 12 大致相同的筒状的吸奶口变形部件 13。吸奶口变形部件 13 能够相对于开放前端部 12 装拆。该吸奶口变形部件 13 由硅橡胶、人造橡胶、天然橡胶等弹性体形成。

另外，在吸奶口变形部件 13 的开放前端部 12，以覆盖其全周的方式设有凸状刺激部 14。

在密闭空间的负压升高时，凸状刺激部 14 与乳房抵接、提高乳房与密闭空间的密闭性，并且，推压乳房、随着吸奶的进行给予良性刺激，发挥按摩的效果。

吸奶部 22 的通气路 23 作为通气以及吸取出的母乳的通路，是向斜上方逐渐扩大的筒状，其下端侧向下方弯折并朝向瓶 47 侧。

另外，吸奶部 22 的通气路 23 的开口 M1 位于主体 21 与瓶 47 之间的装拆部 25 的内侧，并安装有小室阀 26。与通气路 23 邻接地设置有另一个通气路 27。

通气路 27 的下端开口 M2 如图所示地在小室阀 26 中与通气路 23 连通，通气路 27 的上端向上方延伸并与压力传递部 30 的壳体 31 下端连通。

因此，由吸奶部 22 的内侧和通气路 23、通气路 27 形成在吸奶时形成吸引母乳的负压的密闭空间 29。

如图 2 所示，上述小室阀 26 是整体由硅橡胶、人造橡胶、天然橡胶等弹性体形成的帽状的形态，图 2 的两侧壁 26b、26c 是向下端幅宽逐渐相互接近地形成的弹性体的倾斜壁。在两侧壁 26b、26c 的接近的下端，设置有狭缝 26d，吸取的母乳在小室 26a 中贮存到规定

量时，伴随其重量和如下所述的负压解除时的压力的变化，两侧壁26b、26c的前端侧打开，狭缝26d开放，母乳流入瓶47内。另外，通过在倾斜壁的下端形成狭缝26d，能够发挥防止负压时瓶47内的空气进入小室26a的空气阀的功能。

主体21的通气路27的上部与后述的筒状连接部28一体形成，在其上部，沿着该筒状连接部28的开口的周边部形成有接触面部18。该接触面部18是当装拆后述的壳体31时进行抵接、配置的部分，是呈适于容纳该壳体31的底面的形态的平坦或略呈凹状的皿状的部分，在其外缘形成有凸缘部19。

而且，在与主体21的吸奶部22外伸的部位相反的一侧，形成有向上方突出的支承机构15。在本实施方式中，支承机构15是例如从上述接触面部18的侧方的位置向上方延伸的部分，是以支柱状或臂状起立的突出体。支承机构15的上端到达图2的壳体31的上端附近。相对于该支承机构15，通过如下述那样支承壳体31的盖部件35，从而经由该盖部件35稳定地支承壳体31。

图3是表示壳体31的从下方观察的概略立体图，图3（a）是将盖部件35安装在壳体31上的状态，图3（b）是分解立体图。

压力传递部30的壳体31在该情况下例如是纵向长的圆筒体，其内部空间也是纵向长的空间，并收容有变形部。变形部在本实施方式中是与壳体31分体的独立部件，作为能够相对于壳体31装拆的变形部件32而构成。

变形部件32由不透气的薄材料形成，具有柔软的性质，能够容易地变形。

尤其，在本实施方式中，如图2以及图3所示，变形部件32是以与由硬质的合成树脂的成形品等形成的圆筒壳体即壳体31的内侧空间内接的形状形成的、一端开口而另一端被封闭的有底圆筒形的变形部件，例如是由硅橡胶、人造橡胶、天然橡胶等的弹性体、以极其柔软、不会因反复伸缩的变形而产生断裂等情况的材料形成的。

如图2以及图3所示，变形部件32在其上端的开口周缘部一体

地具有凸缘部 32a，该凸缘部 32a 载置、抵接在壳体 31 的上端开口的周缘部上。

在壳体 31 的上端开口的外缘部，形成有外螺纹部等的装拆机构 34，通过螺纹旋入盖部件 35 的下侧内周 35a 等方法，盖部件 35 能够相对于壳体 31 装拆（参照图 2）。

在盖部件 35 的内侧，在其下端设置有较低地向下方突出的肋 37。

由此，在盖部件 35 通过螺纹旋入而相对于壳体 31 完成安装的图 2 的状态下，由于该变形部件 32 的凸缘部 32a 以紧密接触的方式被夹在壳体 31 的开口周缘部的上表面与盖部件 35 的下表面之间，因而变形部件 32 的内侧成为气密的状态。

而且，在盖部件 35 的上端，在本实施方式的情况下，具有向横向略微突出的安装部 38，通过将其插入图 1 所示的可挠性的管 43 的端部，能够与该管 43 实现装拆，在图 2 的状态下，管 43 经由盖部件 35 与变形部件 32 的内侧空间连通。因此，该空间经由管 43 成为与后述的压力改变机构连通的二次侧的空间。

该二次侧的空间通过变形部件 32 与一次侧的空间即密闭空间 29 液密地分离，该一次侧的空间包括经由从图 2 的吸奶部 22 的通气路 23 连续的小室 26a 而连通的通气路 27、以及经由后述的装拆机构 33 连接的壳体 31 的内部。也就是说，以气体或液体都完全不会漏出的方式气密且液密地实现密封。

而且，如图 2 以及图 3 所示，在壳体 31 的下端，平坦的底部 39 的中央部较细地向下方垂直突出，形成有内部为空洞的筒状的作为上述装拆机构的管状突出部 33。该管状突出部 33 优选随着趋向前端其外径逐渐变细。

与此相应地，在图 2 所说明的主体 21 的接触面部 18 的中心附近，形成有筒状连接部 28。如图所示，该筒状连接部 28 向瓶 47 垂直地延伸并与小室 26a 连通。而且，通过使筒状连接部 28 的内径比壳体 31 的管状突出部 33 的外径略大，当该管状突出部 33 被插入时，

筒状连接部 28 的内径与其以紧密接触的方式外接，在该状态下能够保持气密状态。

图 2 表示了如上述这样、将管状突出部 33 嵌入筒状连接部 28 中的状态，另外，在盖部件 35 被安装到壳体 31 上的状态下，盖部件 35 的卡定机构 36 卡定于支承机构 15，从而稳定地维持壳体 31 的安装状态。

即，盖部件 35 的外周缘部横向延长，形成由收容支承机构 15 的上端的凹部等构成的卡定机构 36。

由此，在通过螺纹旋入等方法将盖部件 35 安装在收容了变形部件 32 的壳体 31 的上端的状态下，与将该壳体 31 的管状突出部 33 嵌入筒状连接部 28 同时地，通过使支承机构 15 的前端收容到盖部件 35 的卡定机构 36 中，由此，不但能够简单地进行安装，还能够通过安装部和卡定部这两点进行支承，从而稳定地保持安装状态。

以下说明作为压力改变机构的泵单元 51。

图 1 中表示了泵单元 51 的概略立体图。

如图 1 所说明的那样，泵单元 51 通过可挠性的管 43 与吸奶单元 50 连接。泵单元 51 作为真空泵，当后述的开关被打开时，能够将吸奶单元 50 的二次侧的空间即压力传递部 30 的壳体 31 内以及与其连通的空间吸成负压。在此情况下，根据后述的构造，能够以脉动状态实现负压形成。即，能够进行如下的脉动压力变动：使压力变动而连续地进行从负压状态至少到大气压状态的变动。

在图 1 中，在泵单元 51 的箱体 52 上露出有：将泵单元 51 的驱动打开、关闭的开关（按钮）54；用于调整负压形成过程中的脉动的周期的循环按钮 55；用于调整负压压力的旋钮 53。另外，在泵单元 52 上还安装有可挠性的管 43。

参照图 4 至图 6。

在泵单元 51 的箱体 52 的内侧，收容有电机部 70、气缸部 60、压力调整部 90 等。

电机部 70 具有电机 72 和该电机 72 的电机轴结合于其上的齿轮

单元 73。电机 72 在本实施方式中使用直流电机。

齿轮单元 73 中，延伸有使电机轴的旋转适当减速而进行传递的驱动轴 74，该驱动轴 74 与偏心凸轮 63 连接。偏心凸轮 63 的凸轮轴与气缸部 60 的活塞杆连接，驱动轴 74 的旋转运动被转换成活塞杆的往复运动。

即，气缸部 60 具有气缸 62，在该气缸 62 内，以能够进退的方式插入活塞杆 67。在活塞杆 67 的活塞头上安装有其间夹有垫片 66 的两个活塞环 64a、64b，利用固定板 65 将其用螺丝固定。

在气缸 62 内部，连通有吸引管 85、排气管 86、压力调整管 87。由此，通过活塞杆 67 进行往复运动，借助规定的阀驱动，在气缸 62 内形成负压，该负压经由吸引管 85 进行传递。

在此，通过适当地选择活塞环 64a、64b 的材质，能够降低活塞杆 67 在气缸 62 内的滑动阻力，减少电力损耗，能够谋求节能化，并能够提高密封性。

因此，这些活塞环 64a、64b 优选由特氟隆（注册商标）、尼龙、聚甲醛等耐热性较好且滑动阻力低的材料形成，具有比气缸内径稍大的外径，并形成有活塞鳍片，随着活塞杆 67 的往复运动，该活塞鳍片与气缸 62 的内壁接触的凸缘状的外缘部能够变形。

为了谋求活塞杆 67 在气缸 62 内的滑动阻力的降低、并使密封性良好，作为活塞环 64a、64b 的材质，可以选择特氟隆（注册商标）。

但是，由于特氟隆（注册商标）无法在模具内成形，因而存在着制造成本升高的缺点。

因此，在本实施方式中，以聚甲醛的成形品来形成这些活塞环 64a、64b。由此，能够降低活塞杆 67 在气缸 62 内的滑动阻力，减少电力损耗，能够谋求节能化，并且能够提高密封性，还能够实现制造成本的降低。

排气管 86 与排气阀连接。吸引管 85 经由管安装口如图 1 所示从箱体 52 露出，与可挠性的管 43 连接，从而与吸奶单元 50 的盖部件 35 连接。压力调整管 87 与压力调整部 90 连接。

在箱体 52 内收纳有控制电路基板，该控制电路基板例如被固定支承在收纳单元中，该控制电路基板控制泵单元 51 的驱动，并连接有泵单元 51 的打开关闭开关（按钮）54 和用于调整负压形成中的脉动周期的循环按钮 55 等。

压力调整部 90 与气缸部 60 的气缸 62 连通，具有零件的收纳壳体 91。在该收纳壳体 91 内具有板 92，为了调整气缸 62 内的负压，该板 92 具有直径大的负压调整用孔和直径小的负压调整用孔。通过使该板 92 旋转来进行板 92 的这些孔的切换。板 92 通过衬垫 93 和垫块 94 被固定在按钮 53 上。

本实施方式的吸奶器 20 如上所述地构成，在图 1 中，操作泵单元 51 打开关闭开关按钮 54，起动该泵单元 51 时，电机 72 旋转，驱动轴 74 经由齿轮单元 73 旋转，该旋转运动经由偏心凸轮 63 被转换成气缸 62 内的活塞杆 67 的往复运动。通过活塞杆的往复运动，气缸 62 内形成的负压脉动变化，经由吸引管 85 以及可挠性的管 43 被传递到图示的吸奶单元 50 的压力传递部 30。

由此，在图 2 中，壳体 31 内的变形部件 32 内部的气压降低。因此，在壳体 31 内，由于与变形部件 32 的外侧的空间之间的气压差，变形部件 32 的内部空间以被压溃的方式变形，其底部上升、接近盖部件 35 侧。即，由于变形部 32 在壳体 31 内大幅度地减小体积，所以与变形部件 32 的外侧的壳体 31 的空间连通的密闭空间 29 内，气压大幅度地减小。

即，由于在密闭空间 29 内负压增大，因而母乳被从乳房吸引，被吸取出的母乳通过通气路 23 内，流入小室 26a。而且，此时，伴随着压力差，吸奶口变形部件 13 的凸状刺激部 14 向乳房侧变形，推压乳房进行刺激，因而能够进一步促进母乳的分泌。

接着，当基于泵单元 51 的气缸杆 67 的往复动作，负压状态被解除时，再次如图 2 所示地，变形部件 32 以恢复其形态的方式变位。由此，在壳体 31 内，当由于变形部件 32 使体积增大而使密闭空间内的气压升高时，母乳的吸引压降低。

通过重复进行以上动作，作为压力改变机构的泵单元 51 的动作通过压力传递部 30 的变形部件 32 的动作被传递至密闭空间 29，从而密闭空间 29 的负压被增减，由此，实现与婴儿的哺乳动作接近的状态，能够使吸取出的母乳贮存在瓶 47 中。

另外，在此，在上述动作中，当经由管 43 作用负压时，变形部件 32 以向盖部件 35 侧贴靠的方式收缩变形。此时，虽然收缩变形了的变形部件 32 欲贴靠盖部件 35 侧，但由于肋 37 的存在，能够阻止其完全地贴靠。

而且，压力传递部 30 具有上端经由盖部件 35 与泵单元 51 连接的壳体 31，在该壳体 31 的下端具有装拆机构 33，该装拆机构 33 用于将该壳体 31 内和密闭空间 29 以能够连通的方式装拆。由此，例如，能够容易地对收容有变形部件 32 的壳体 31 进行装拆，并能够使其与密闭空间 29 侧分离，不仅便于携带、移动，尤其在清洗时等，能够容易地仅对需要频繁清洗的一次侧即密闭空间 29 侧进行分离、清洗。

这样，能够容易地对与吸奶空间连通的母乳所通过的密闭空间 29 即一次侧和与压力改变机构即泵单元 51 侧连接的壳体 31 的侧即二次侧进行装拆，能够使清扫等的操作变得极其容易。

另外，由于压力传递部 30 将形成于吸奶部 22 的密闭空间和泵等的压力改变机构完全液密且气密地分离，所以能够有效地防止滞留在密闭空间侧即小室 26a 等的母乳或成为雾状的母乳回流到泵单元 51。因此，能够有效地防止泵单元 51 等的压力改变机构侧接触到母乳而发生腐蚀、破损以及被污染成为不卫生的状态。

另外，在本实施方式中，壳体 31 是内部收容有变形部件 32 的筒状体，在该筒状体上具有作为装拆机构的管状突出部 33。

而且，在密闭空间 29 中，具有在该密闭空间 29 内延伸的筒状连接部 28，通过使筒状连接部 28 的内径比管状突出部 33 的外径稍大，从而成为将管状突出部 33 插入筒状连接部 28、壳体 31 和密闭空间 29 气密地接合的结构。

由此，通过仅将管状突出部 33 插入筒状连接部 28 这一简单的操作，就能够将泵单元 51 侧和密闭空间 29 侧连接。

而且，如上所述，壳体 31 的管状突出部 33 的周边为平坦的底部，在主体 21 的筒状连接部 28 的开口周边形成有平坦的接触面部 18。因此，只要将管状突出部 33 插入筒状连接部 28、将壳体 31 的平坦的底部压入到与平坦的接触面部 18 抵接的位置，便能够极其容易地以气密状态将壳体 31 和密闭空间 29 接合。

而且，上述筒状连接部 28 是如图 2 所示、在载置瓶 47 的状态下向瓶 47 下方大致垂直延伸而形成的，管状突出部 33 以向前端逐渐变细的方式形成。

因此，只通过将管状突出部 33 向下插入筒状连接部 28，由于前端细而插入容易，并且当插入得较深时，随着该管状突出部 33 的外径扩大，该管状突出部 33 能够与筒状连接部 28 的内表面紧密地接触、实现嵌合，能够极其容易地接合。

而且，在本实施方式中，具有盖部件 35，该盖部件 35 覆盖收纳变形部 32 的壳体 31 的上端侧，并且，与作为压力改变机构的负压形成机构即管单元 51 连接的管 43 能够相对于该盖部件 35 装拆。

而且，在壳体 31 和密闭空间 29 被接合的状态下，在将盖部件 35 安装到壳体 31 的上端侧的位置上，具有用于将盖部件 35 相对于主体 21 的密闭空间 29 侧进行卡定的卡定机构 36，因此，壳体 31 的相对于密闭空间 29 侧的接合状态被稳定地支承，不会轻易脱落。

而且，在本实施方式中，图 3 的卡定机构 36 设置在盖部件 35 的周缘部上。该卡定机构 36 是如图 2 所说明的那样、相对于从主体 21 侧向上方突出的支承机构 15 被卡定的结构。

由此，在与管状突出部 33 和筒状连接部 28 的接合位置不同的位置进行该卡定，能够更稳定地维持接合状态。

图 7 及图 8 表示设置在盖部件上的卡定机构的变形例。

图 7 表示第一变形例，盖部件的结构与图 3 的情况稍有不同。

在该例中，盖部件 35-1 的外缘具有向下方延长的一对脚片 36-1、

36-1，该脚片 36-1、36-1 能够根据规定的弹性向相互接近、远离的方向变形。在各脚片 36-1、36-1 的下端附近形成有钩状的卡定部 45、45。

因此，如图 7 的下部所示，当使盖部件 35-1 相对于壳体 31 从上方下降进行覆盖时，各脚片 36-1、36-1 与接触面部 18 的凸缘部 19 接触，通过略微打开各脚片 36-1、36-1 便能够越过凸缘部 19 的外缘，该凸缘部 19 进入各脚片 36-1、36-1 的卡定部 45、45 而被卡定。

图 8 表示第二变形例，盖部件的结构与图 3 的情况稍有不同。

在该例中，在盖部件 35-2 上不仅形成有与图 3 的盖部件 35 相同的卡定机构 36，而且其相反侧的端部外缘向下方延长，形成有脚片 36-2。在该脚片 36-2 的下端部形成有钩状的卡定部 46。

由此，盖部件 35-2 通过卡定部 46 在卡定在凸缘部 19 上的同时，相对于支承机构 15 也被卡定。

这样，根据各变形例，在与管状突出部和筒状连接部的接合位置不同的位置，通过卡定机构实现卡定，能够更稳定地维持接合状态。不仅如此，由于能够利用主体 21 的筒状连接部的开口周边所设置的接触面部 18 卡定盖部件，因而不需要在主体 21 侧形成用于卡定的特别的机构，另外，还能够相应地谋求小型化。

图 9 表示第二实施方式的主要部位，图示的结构以外的结构与第一实施方式相同，因此以下以不同点为中心进行说明。

在图 9（a）中，壳体 31 能够相对于吸奶单元 50-1 的主体 21 装拆。该壳体 31 的下端部如图 9（b）所示，成为在径向上鼓出的凸缘状的卡定机构 41。

即，该卡定机构 41 具有鼓出成凸缘状的周缘向下方弯折且其前端趋向内侧的阶梯部 41b，接触面部 18 的凸缘部 19 的前端能够卡定在该阶梯部上。

如图 9（a）所示，在卡定机构 41 上，沿其圆周方向形成有多个狭缝 41a，由此，该卡定机构 41 能够弹性变形，通过如图 9（b）所示那样嵌入接触面部 18 的凸缘部 19，能够容易地变形、装拆。

本实施方式如上所述地构成，不仅能够发挥与第一实施方式相同的作用效果，即使不使用图 2 那样的支承机构 15，也能够形成用于维持壳体 31 的接合状态的卡定机构。

因此，即使省略图 2 那样的支承机构 15，也能够得到与第一实施方式同等的接合稳定性。

此外，本发明不限于上述实施方式。

例如，壳体 31 中收容的变形部件可以与壳体一体地构成，成为作为其一部分的“变形部”。

变形部不仅可以是有底圆筒体，也可以使用折皱构造等各种形态。

装拆机构即管状突出部 33 可以适当地改变成与实施方式不同的形状、构造。

此外，上述各实施方式、变形例的个别结构可以根据需要省略，或与未说明的其他结构进行组合。

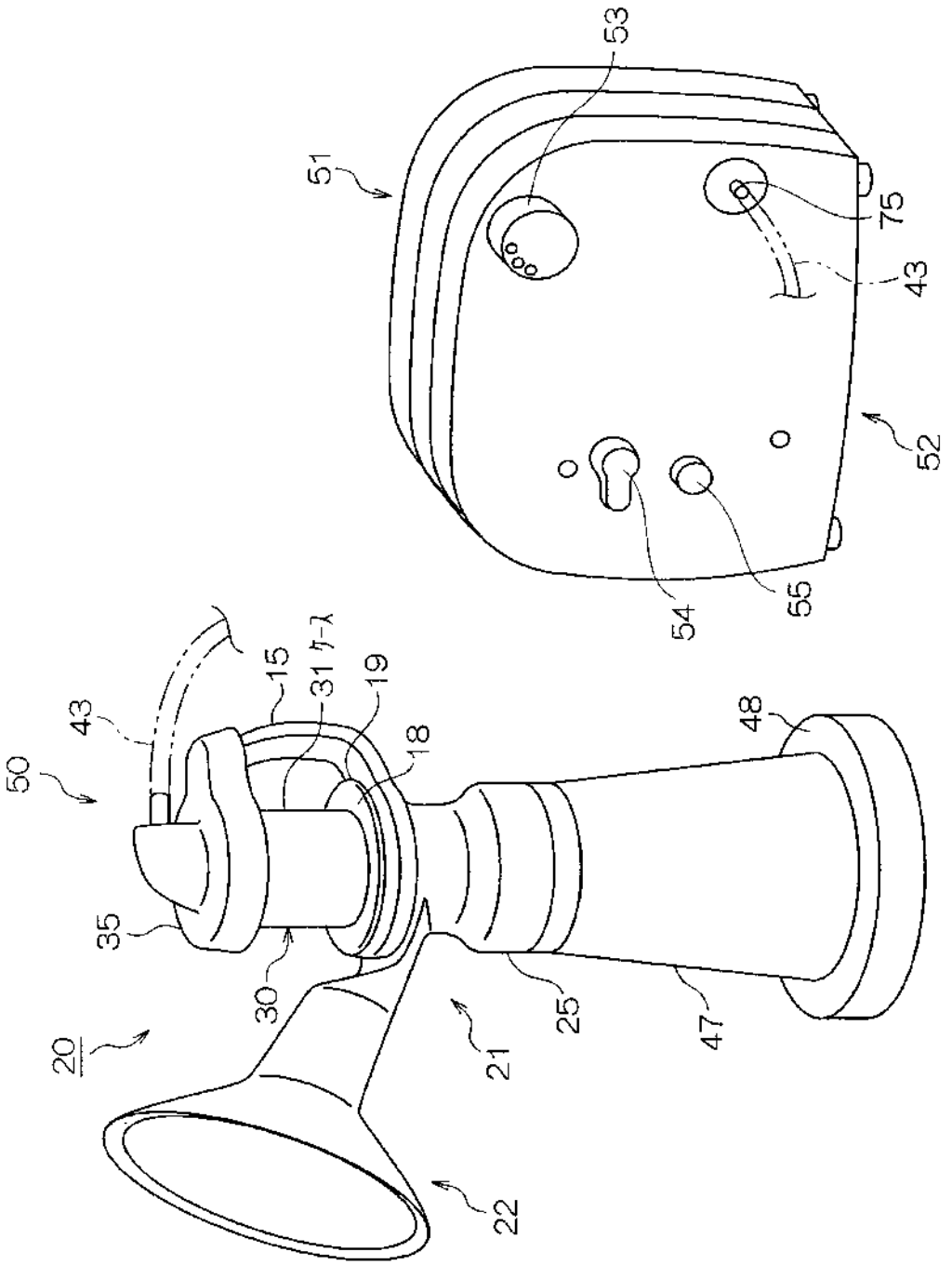
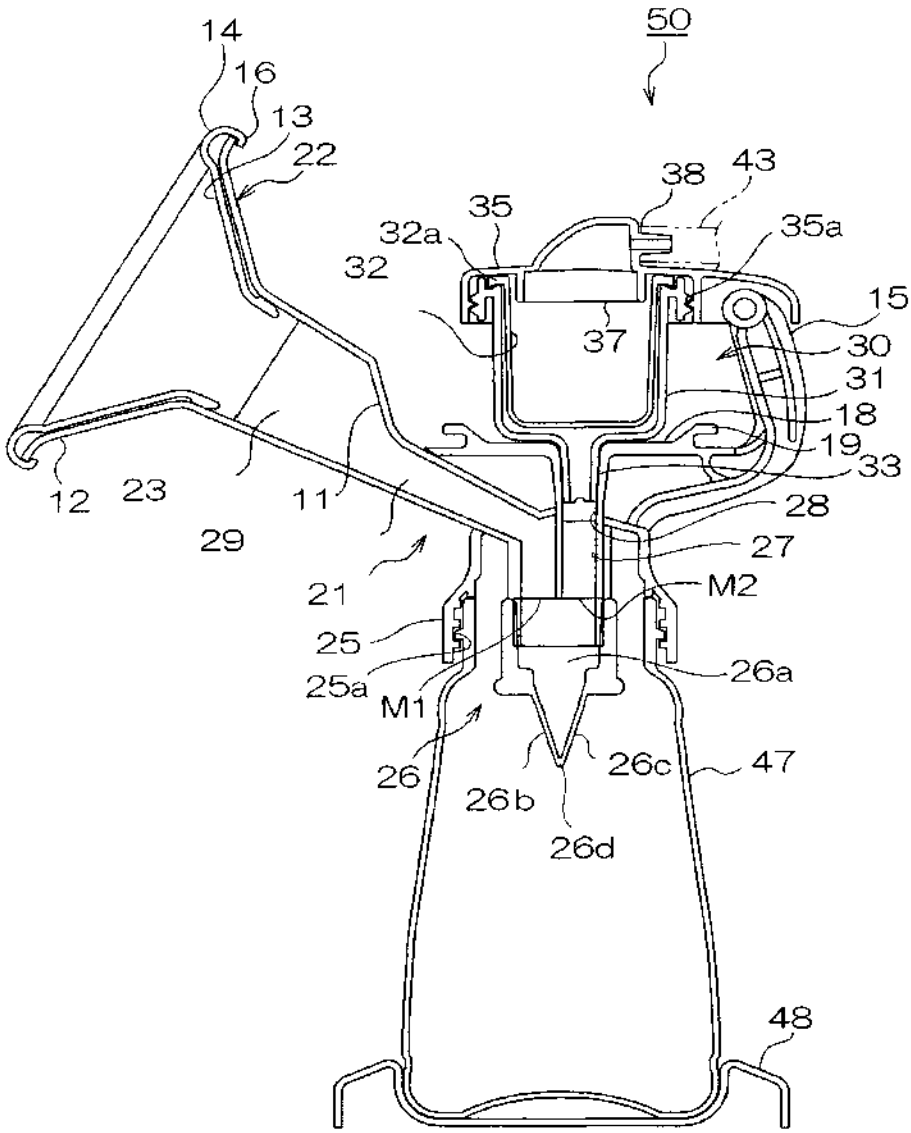


图 1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M2
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25a
M1
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26c
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26b
26d
48

图 2

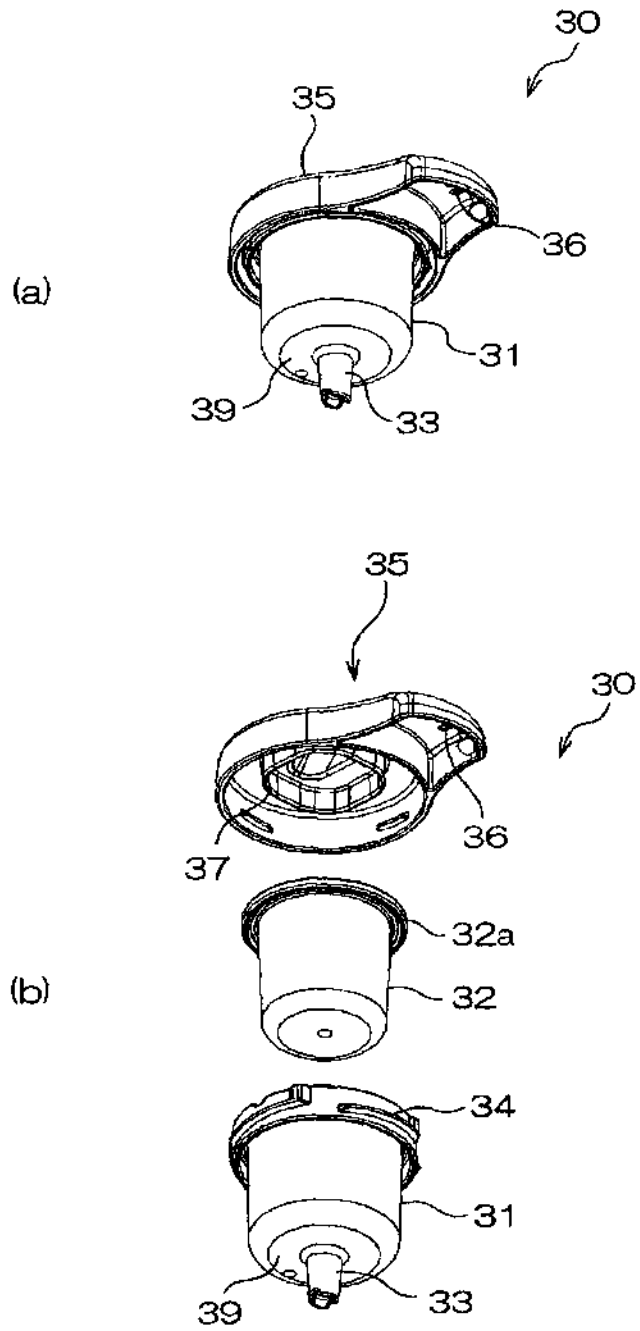


图 3

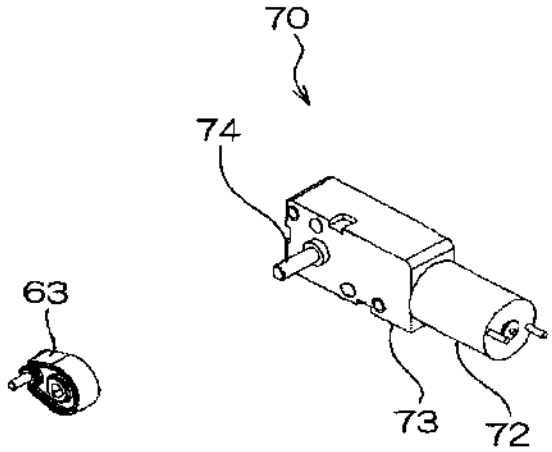


图 4

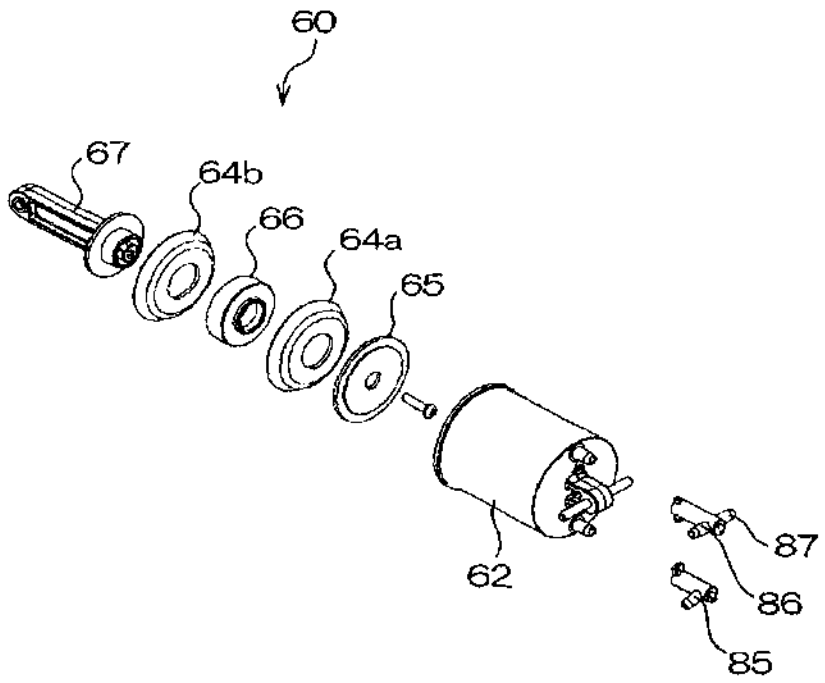


图 5

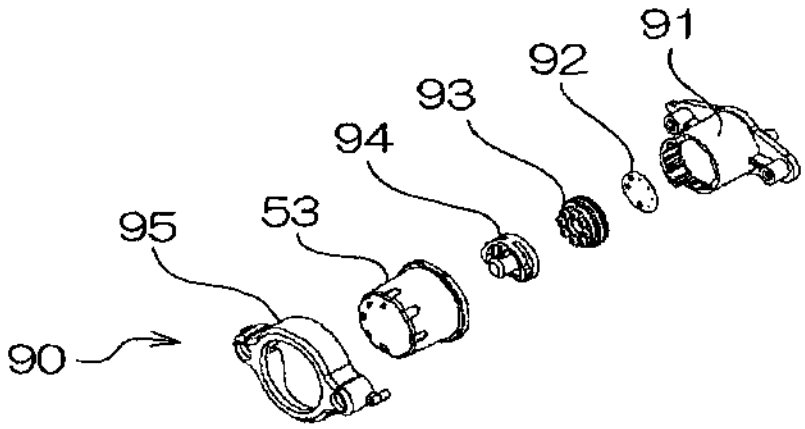


图 6

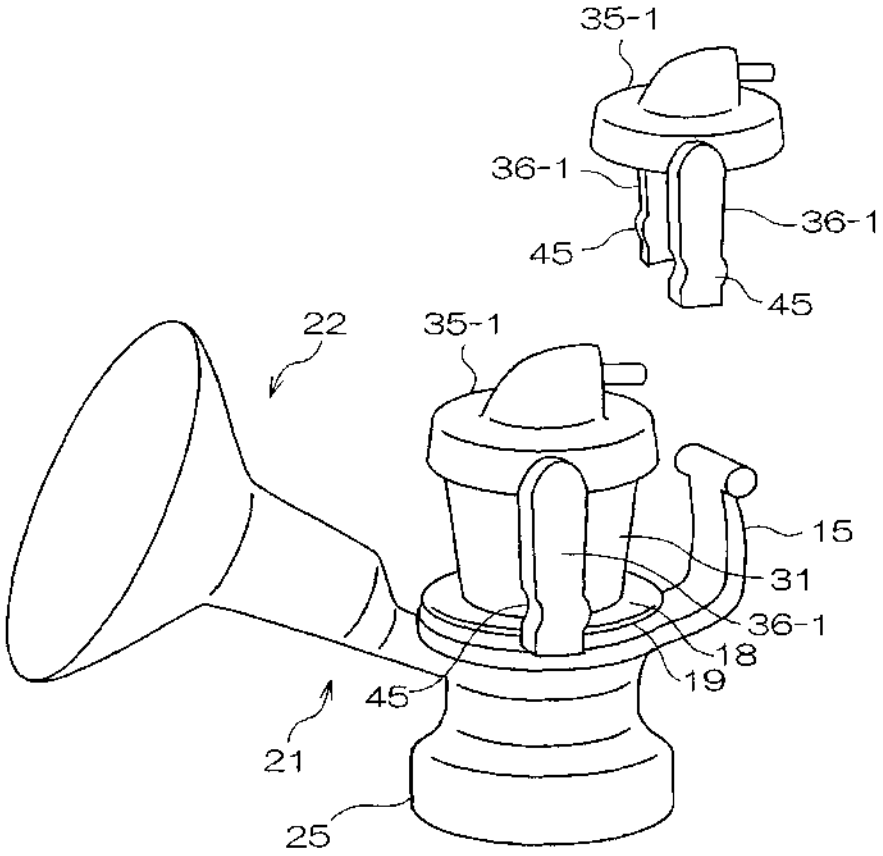


图 7

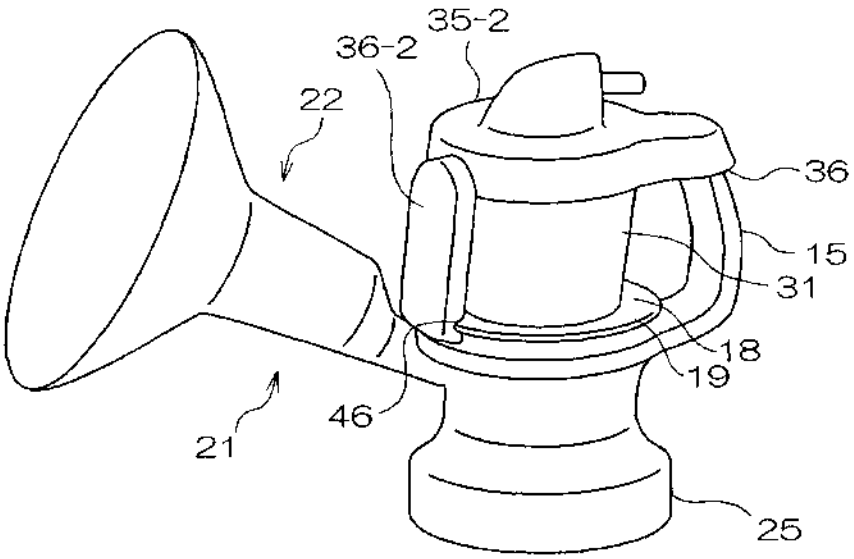
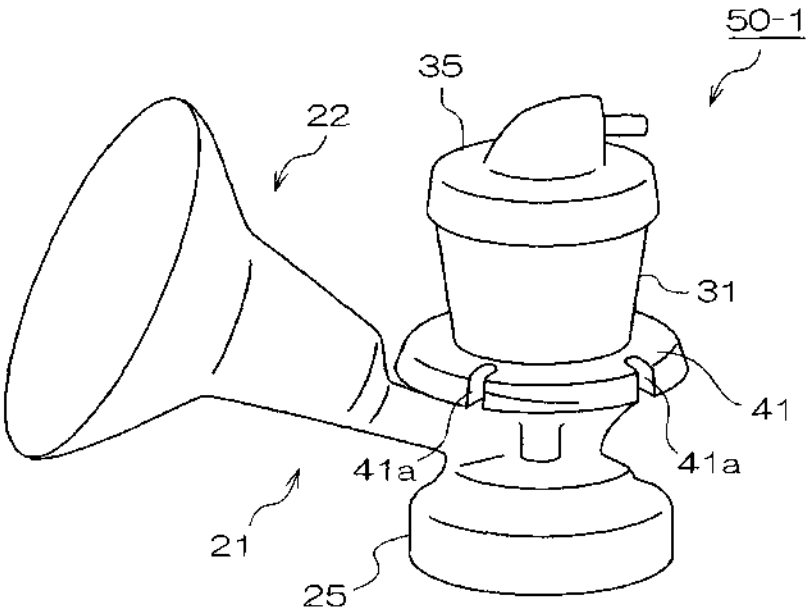


图 8

(a)



(b)

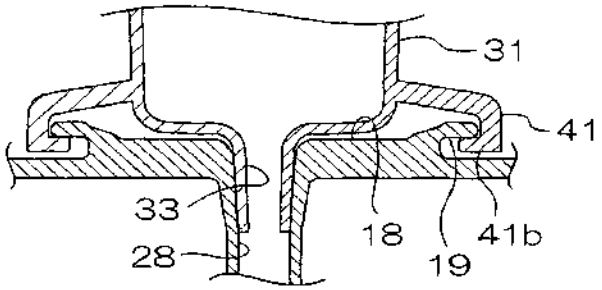


图 9

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INT CL **A61M**
Other
ONLINE: WPI, EPODOC
updated as appropriate

Additional Fields
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INT CL **A61M**
Other
ONLINE: WPI, EPODOC

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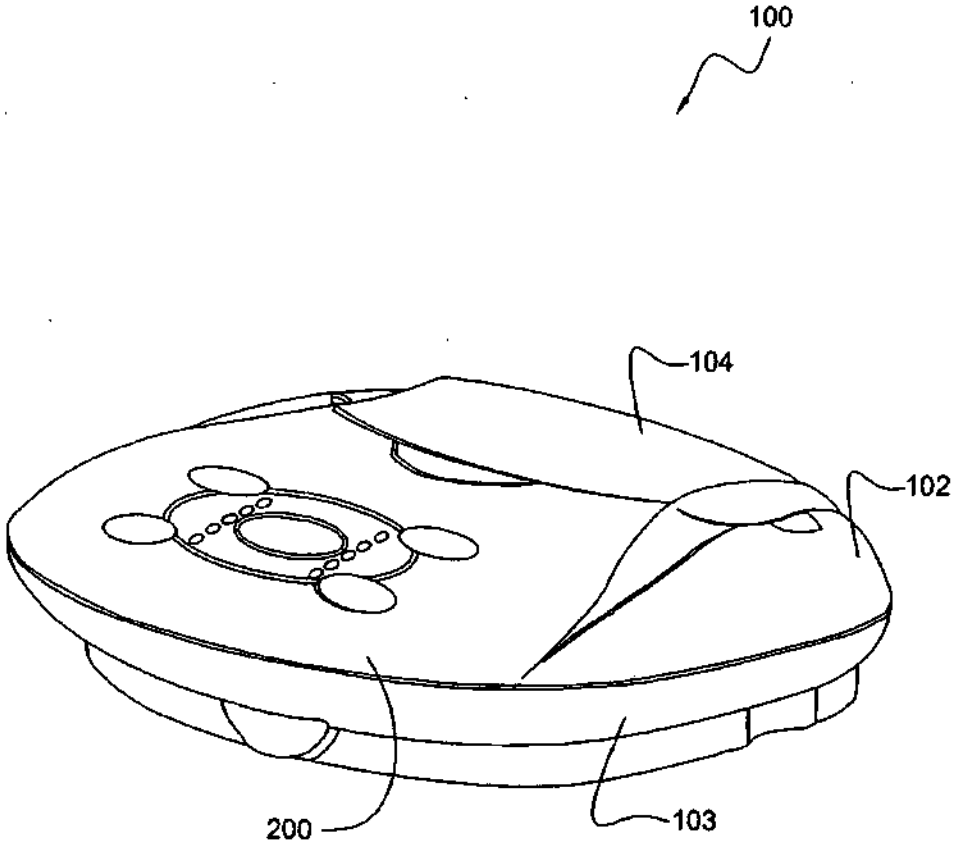

Fig. 1

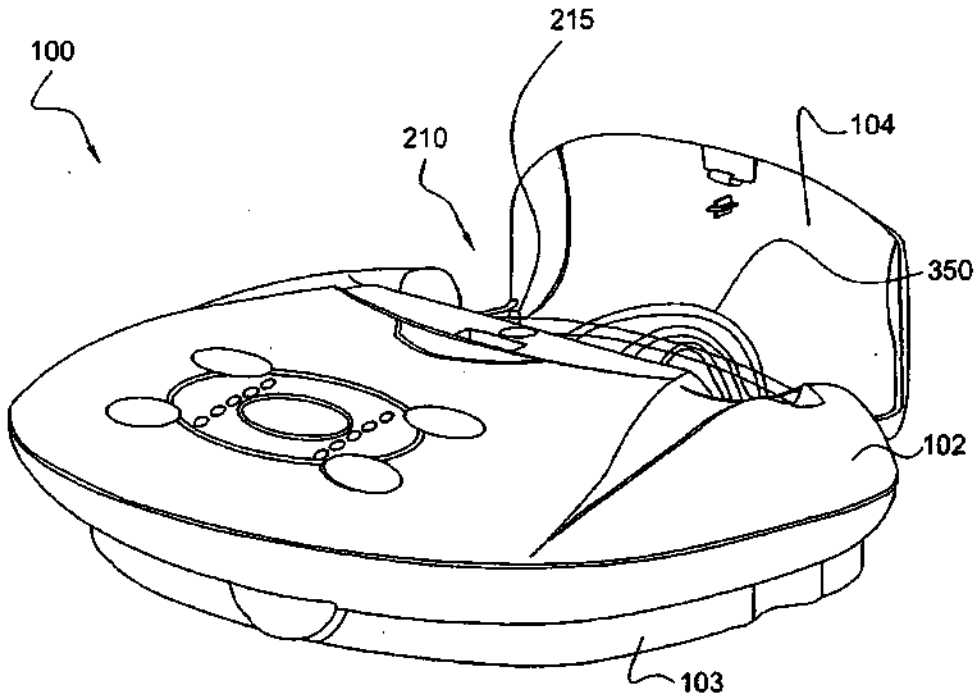

Fig. 2

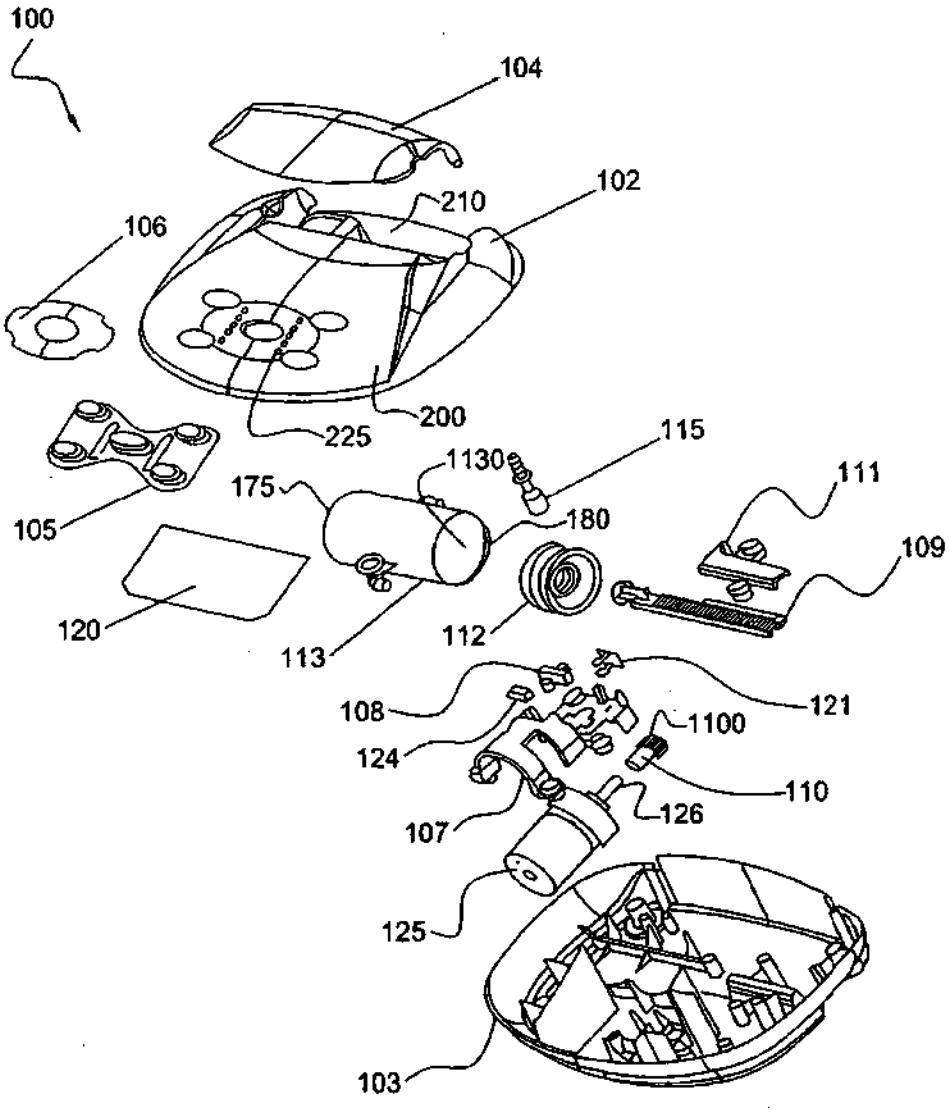
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Fig. 3

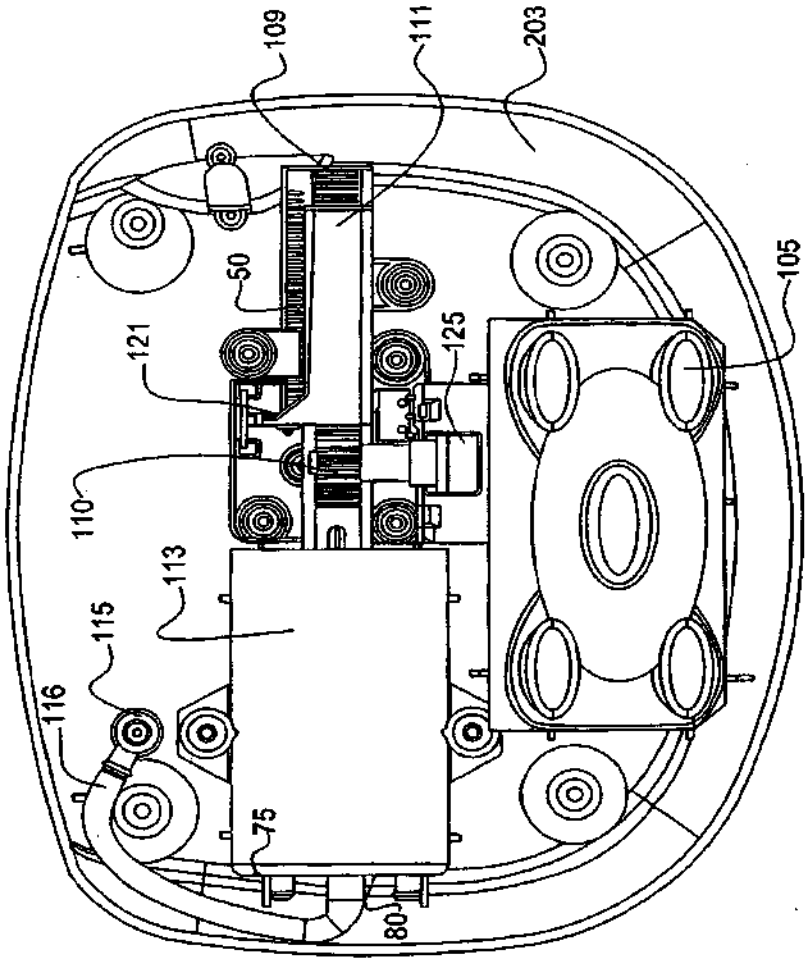

Fig. 4

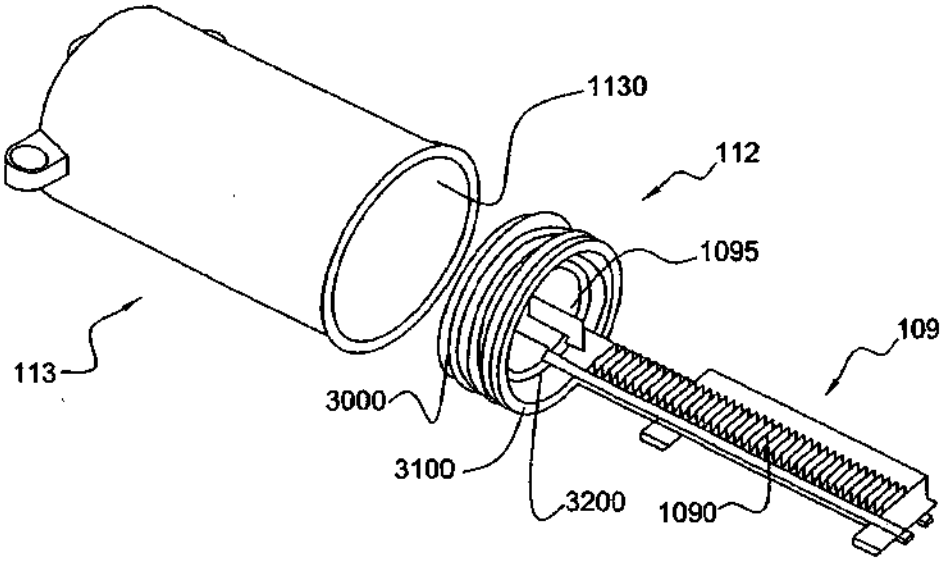
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Fig. 5

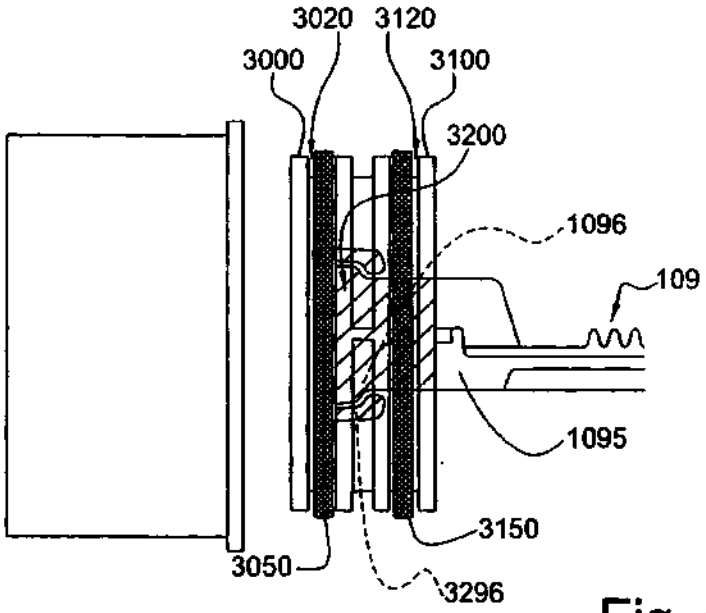
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Fig. 6

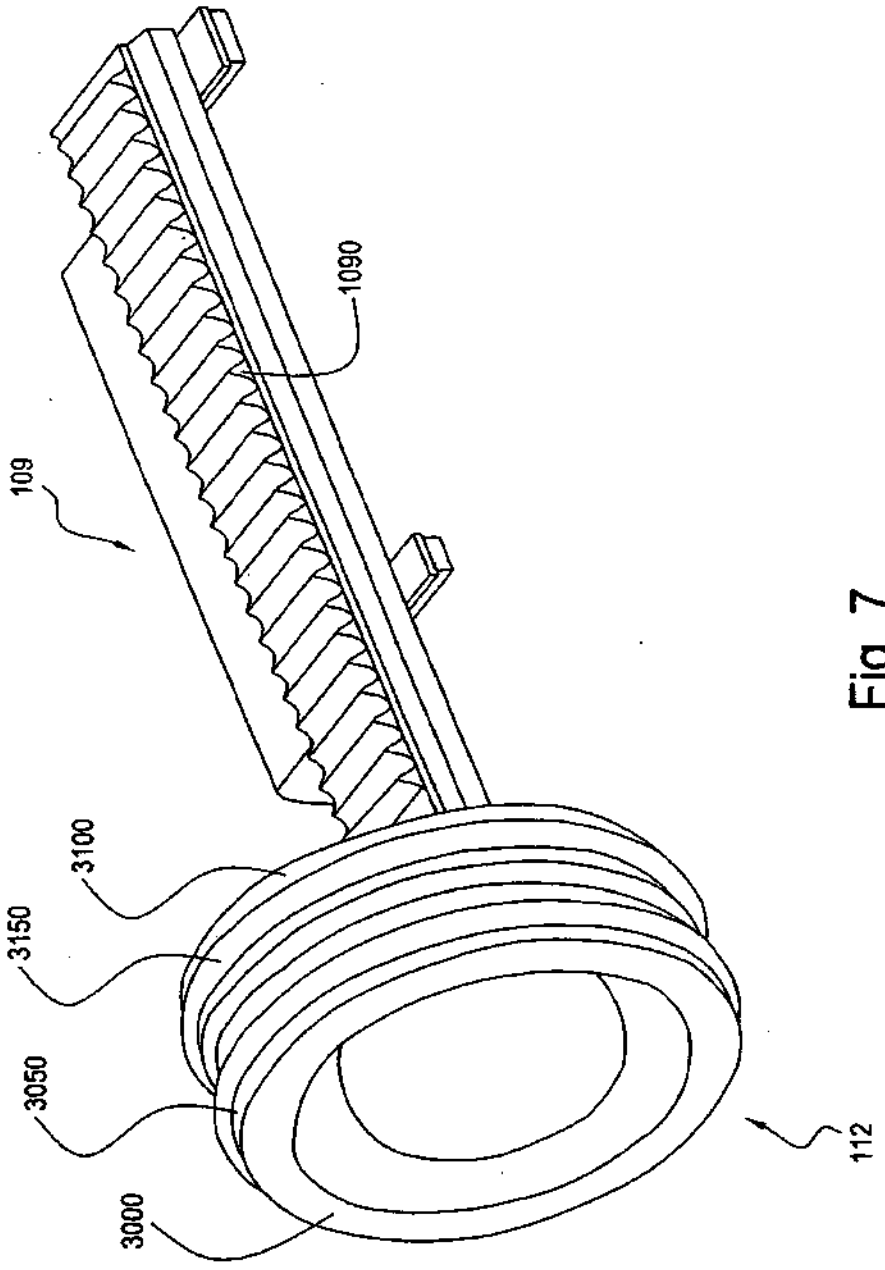

Fig. 7

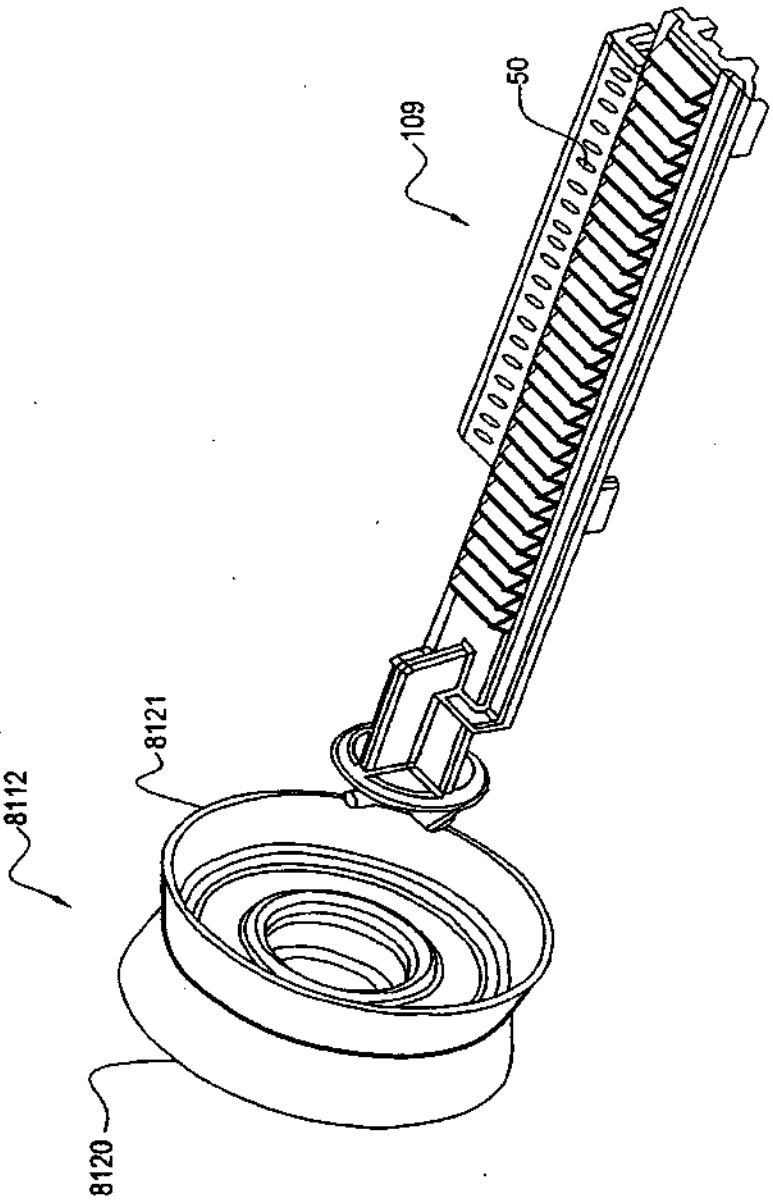

Fig. 8

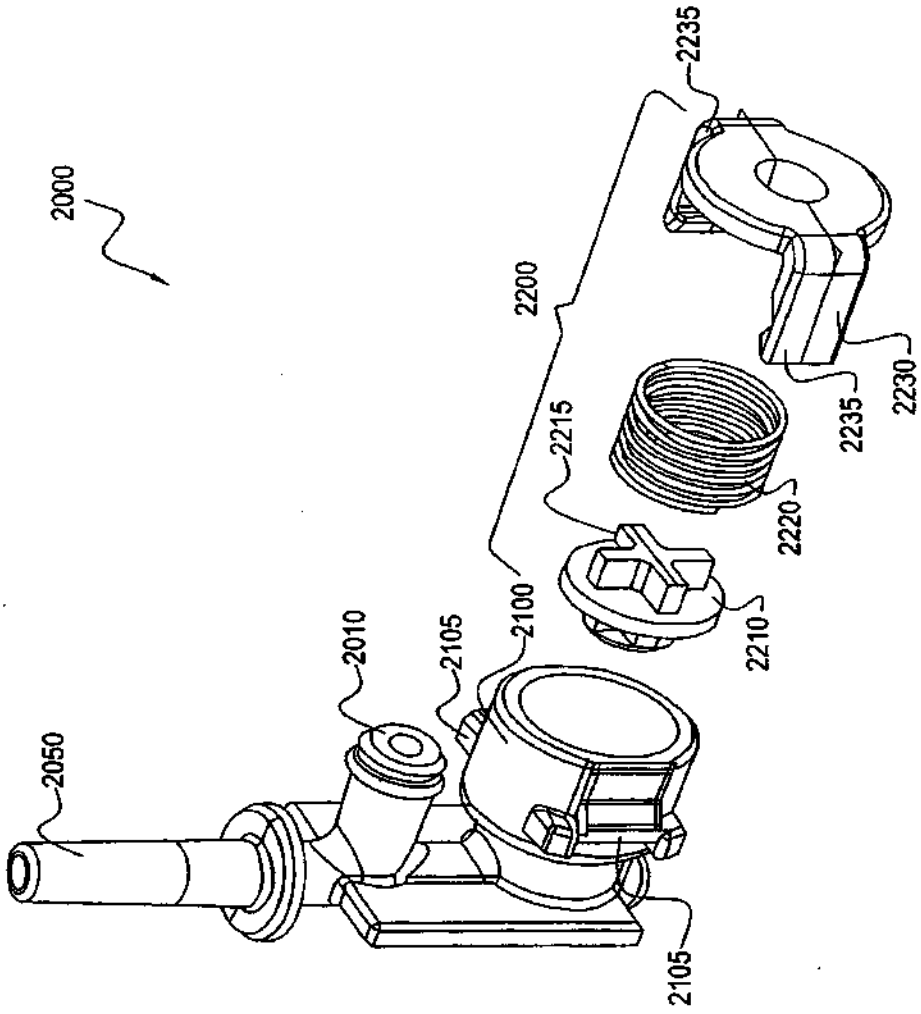
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Fig. 9

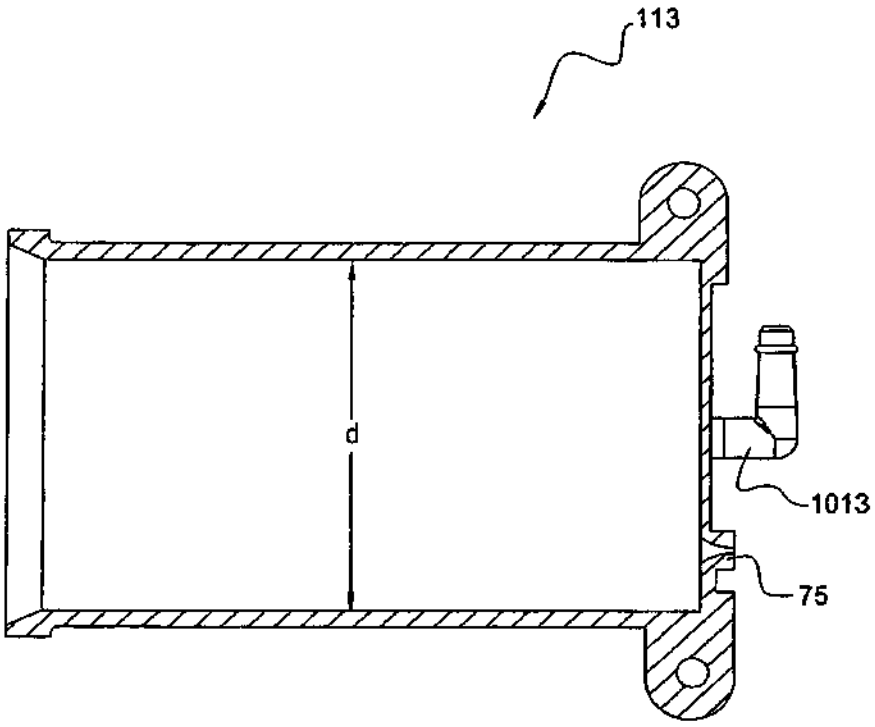


Fig. 10

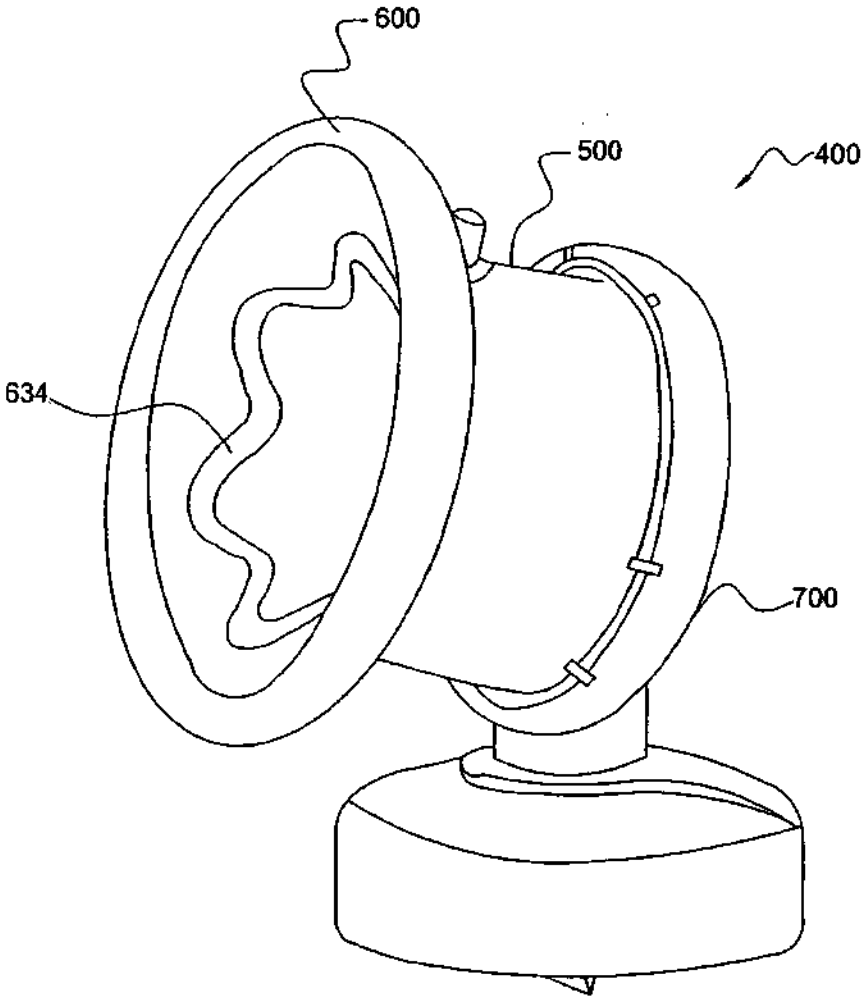


Fig. 11

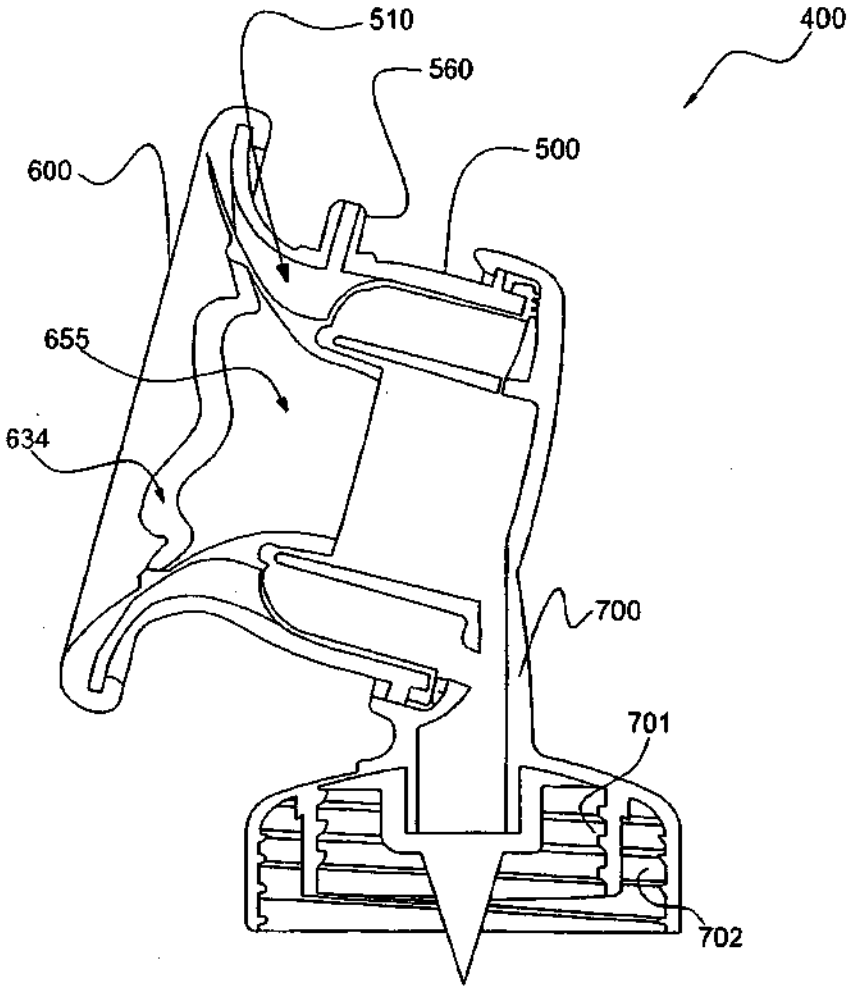


Fig. 12

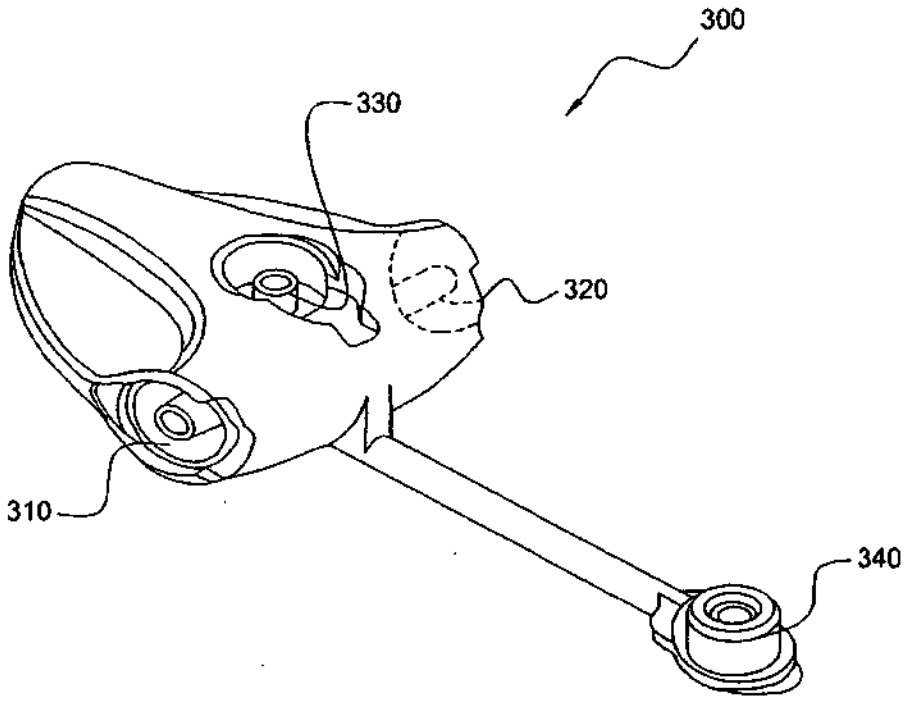
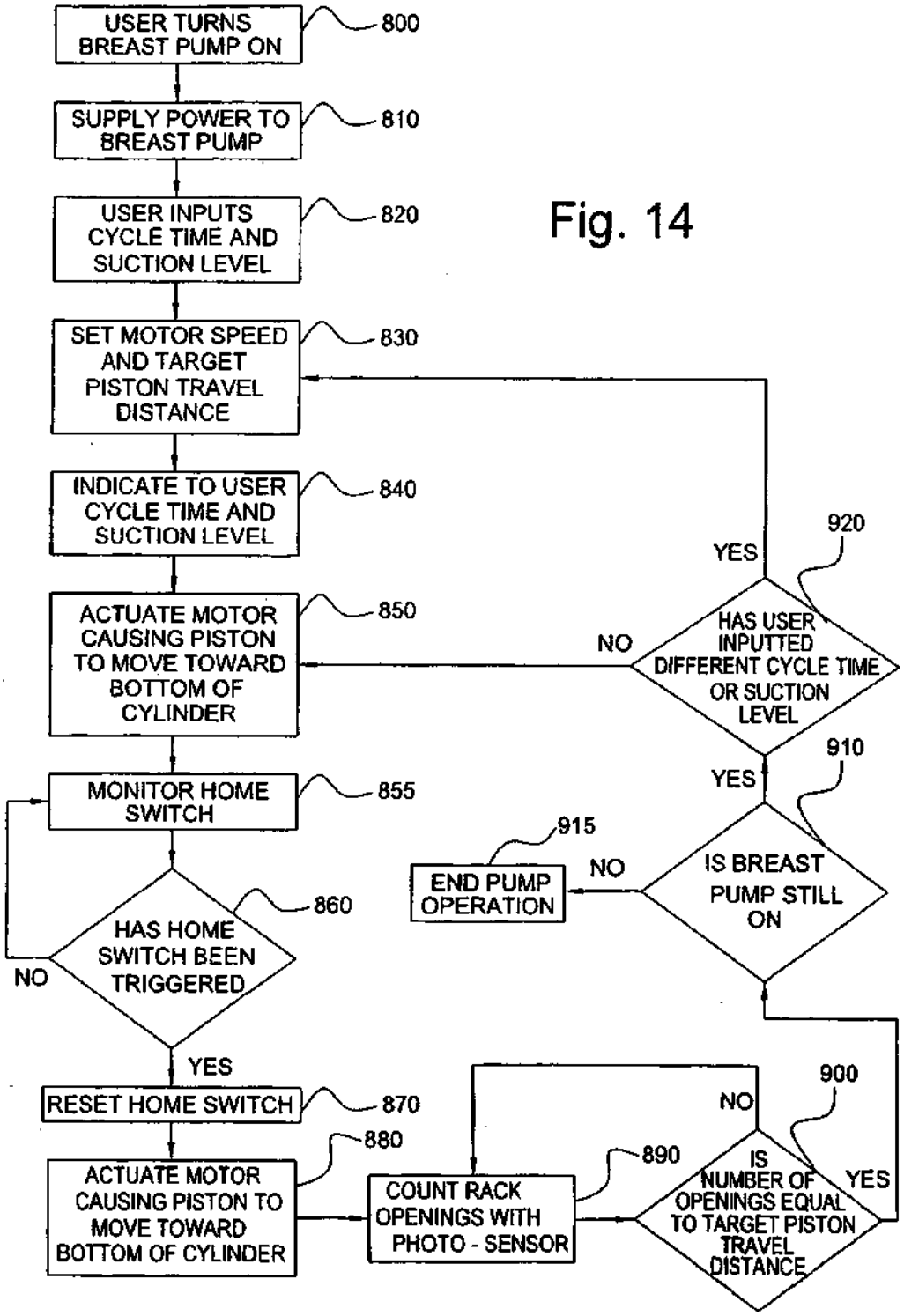


Fig. 13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SET MOTOR SPEED AND TARGET PISTON TRAVEL DISTANCE
830
INDICATE TO USER CYCLE TIME AND SUCTION LEVEL
840
ACTUATE MOTOR CAUSING PISTON TO MOVE TOWARD BOTTOM OF CYLINDER
850
MONITOR HOME SWITCH
855
HAS HOME SWITCH BEEN TRIGGERED
860
NO
YES
RESET HOME SWITCH
870
ACTUATE MOTOR CAUSING PISTON TO MOVE TOWARD BOTTOM OF CYLINDER
880
COUNT RACK OPENINGS WITH PHOTO - SENSOR
890
IS NUMBER OF OPENINGS EQUAL TO TARGET PISTON TRAVEL DISTANCE
900
NO
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END PUMP OPERATION
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Fig. 14

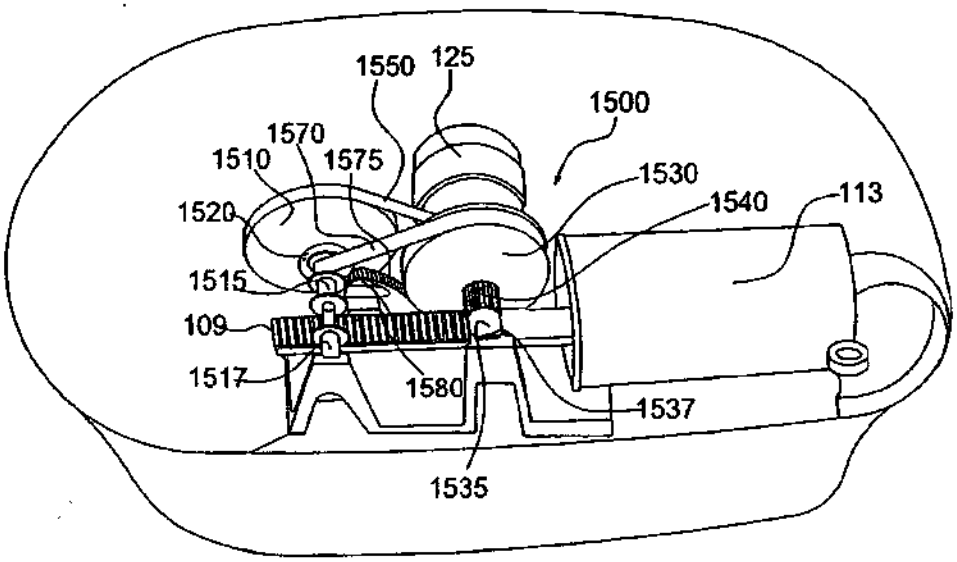
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Fig. 15

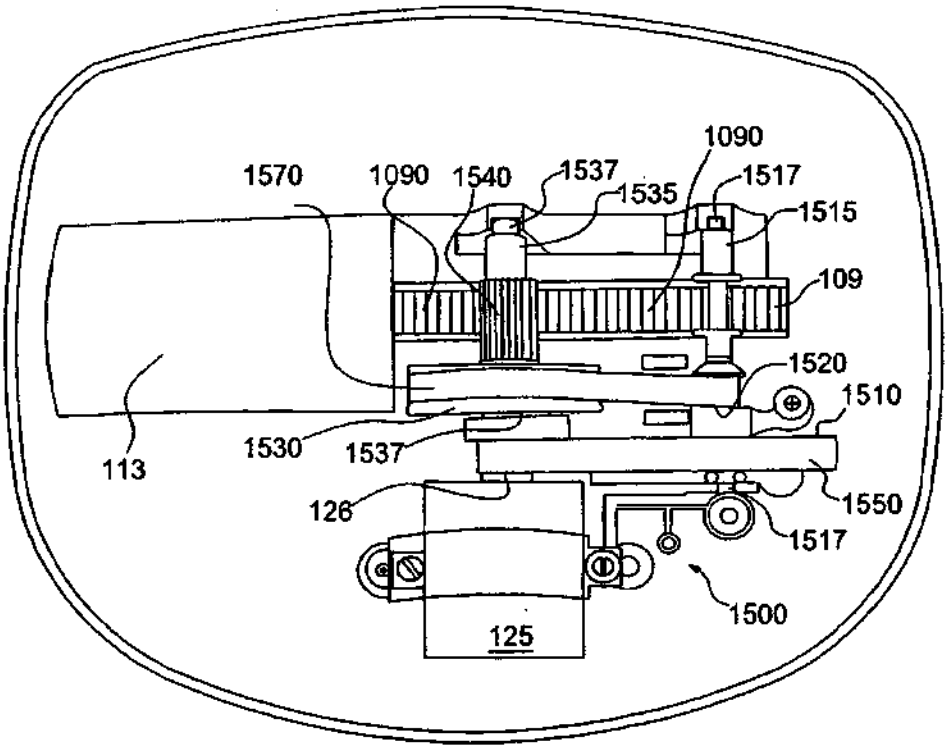
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Fig. 16

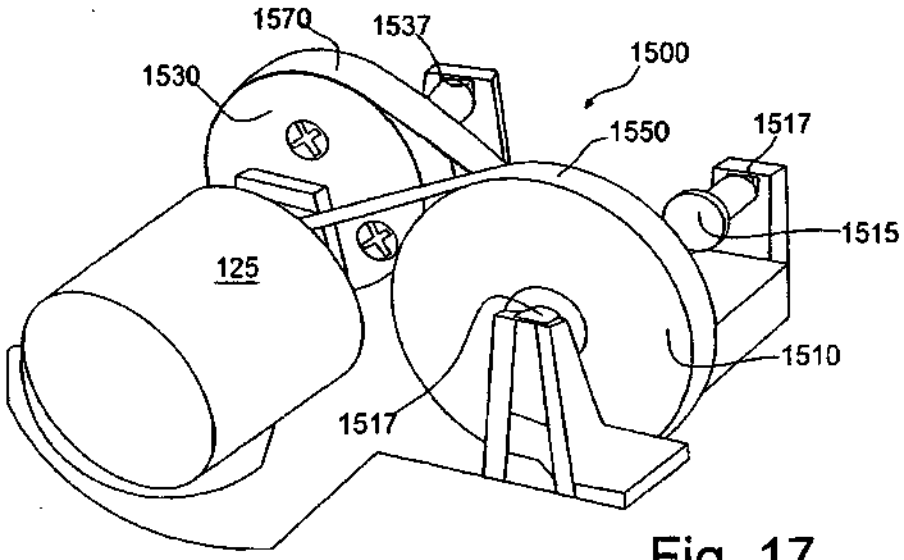
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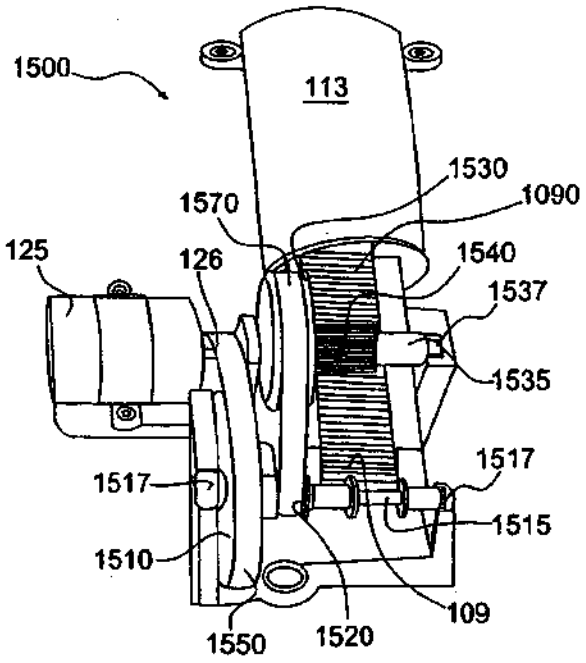
Fig. 17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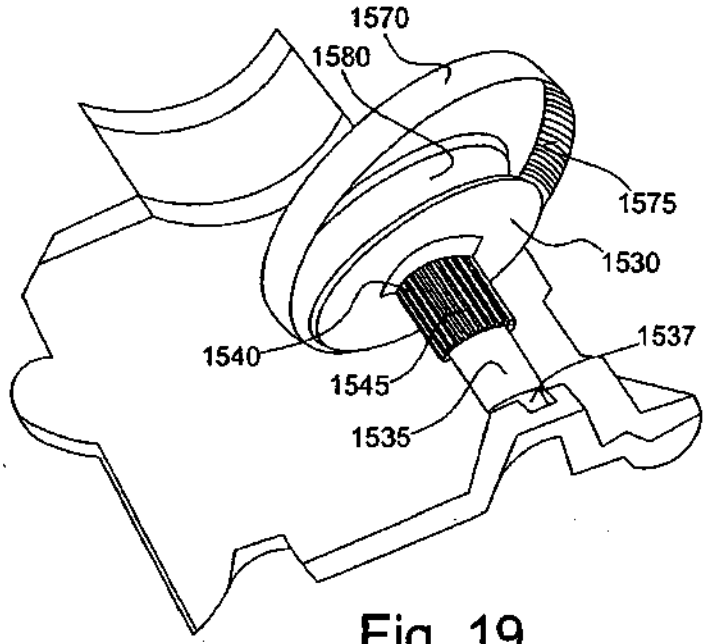
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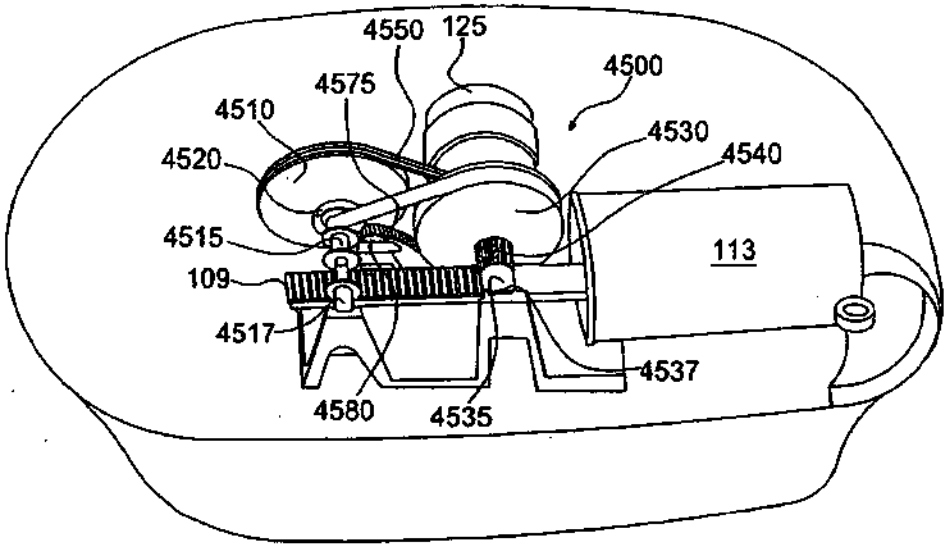
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Fig. 20

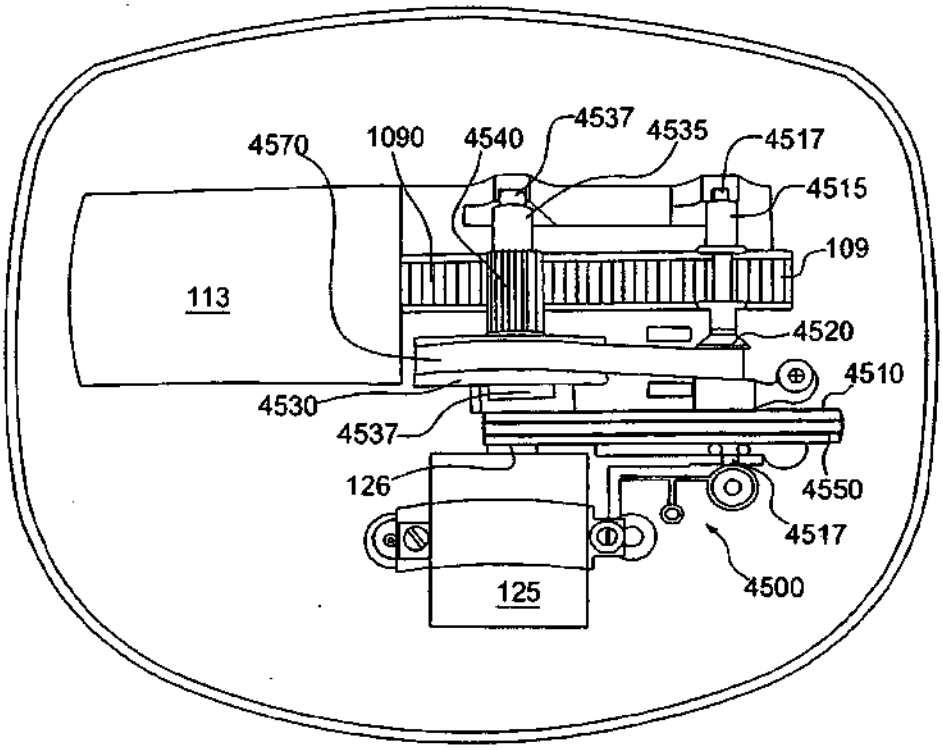
4570
1090
4540
4537
4535
4517
4515
109
113
4520
4510
4530
4537
126
4550
4517
4500
125

Fig. 21

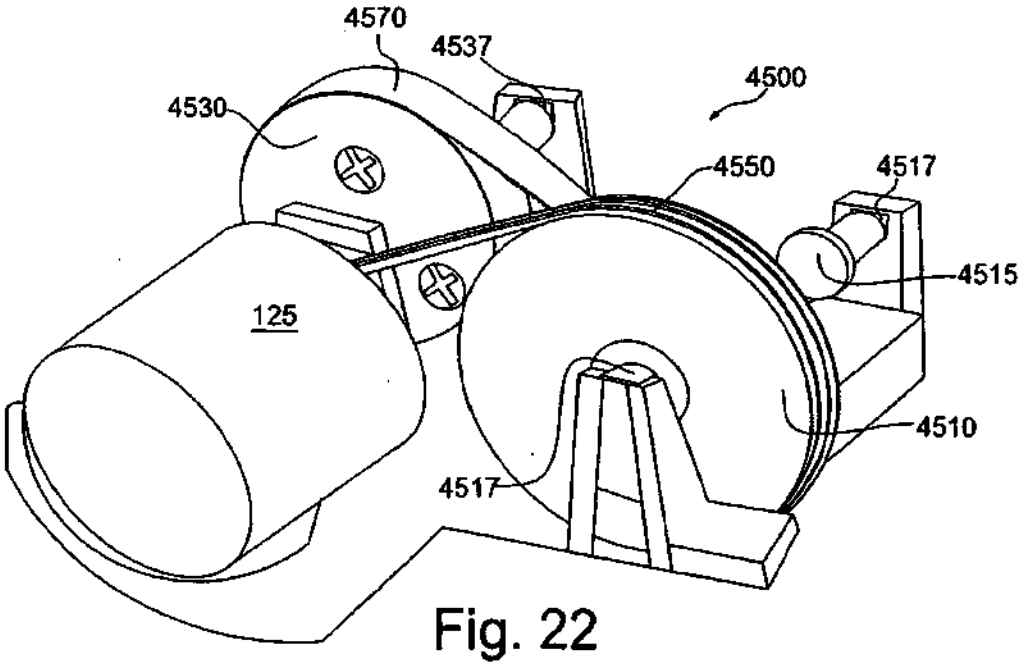
4570
4537
4500
4530
4550
4517
4515
125
4510
4517

Fig. 22

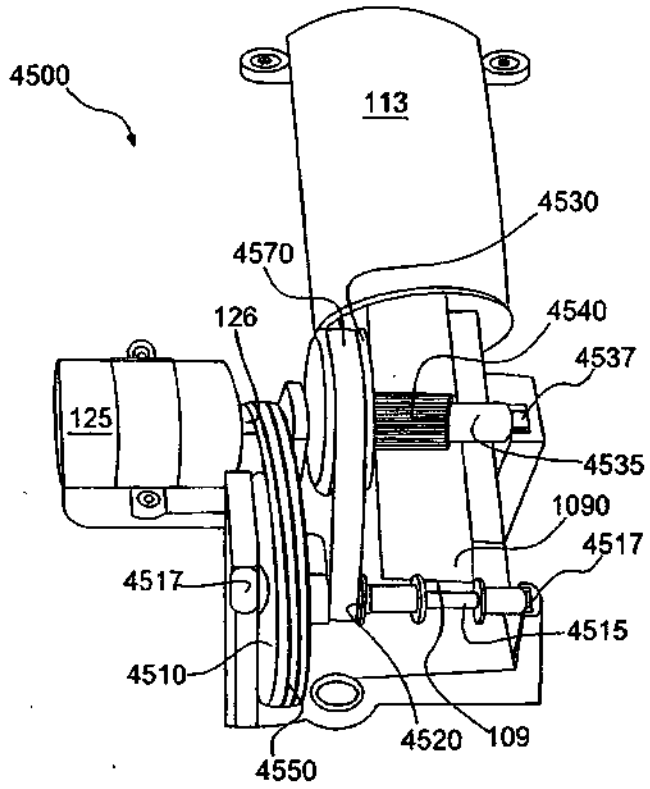
4500
113
4530
4570
126
4540
4537
125
4535
1090
4517
4517
4515
4510
4520
109
4550

Fig. 23

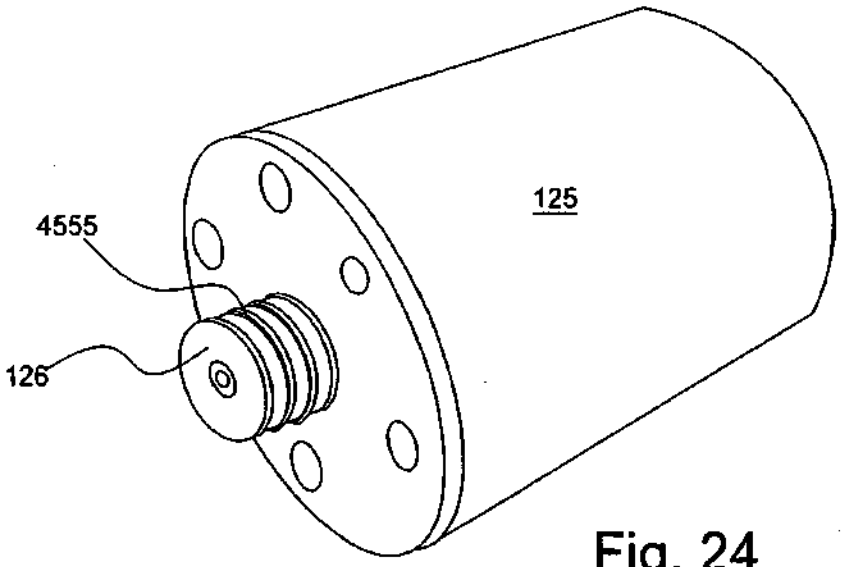
125
4555
126

Fig. 24

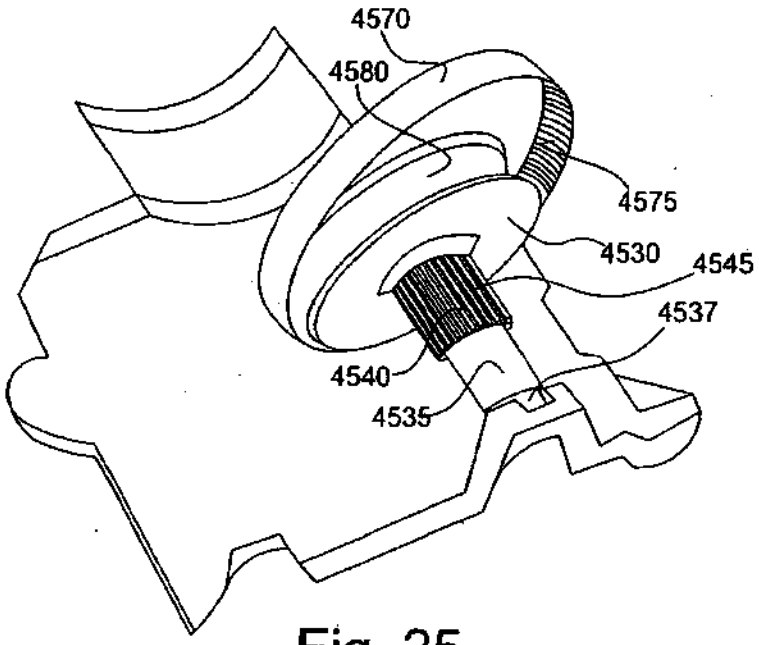
4570
4580
4575
4530
4545
4537
4540
4535

Fig. 25

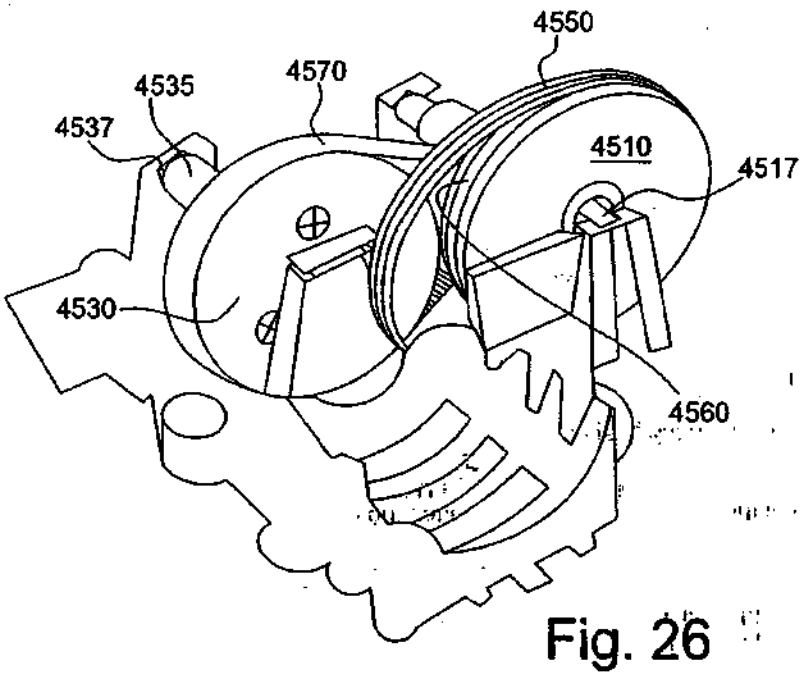
4550
4535
4570
4537
4510
4517
4530
4560

Fig. 26

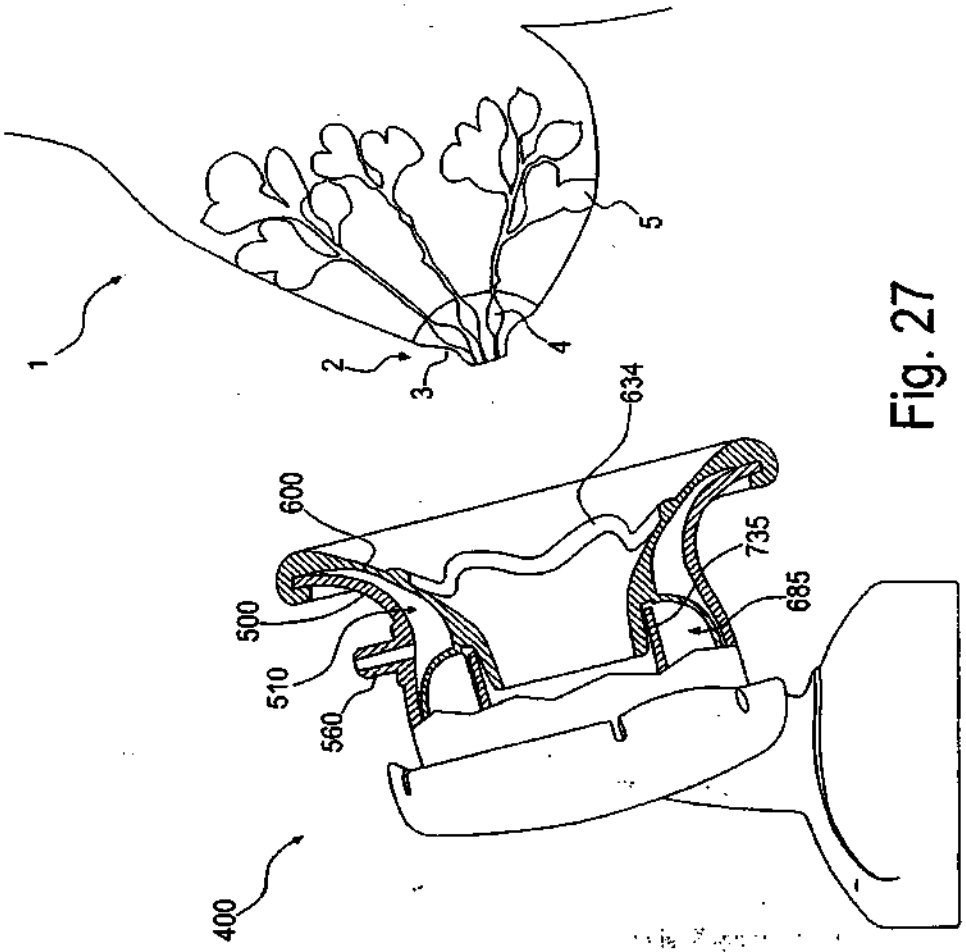

Fig. 27

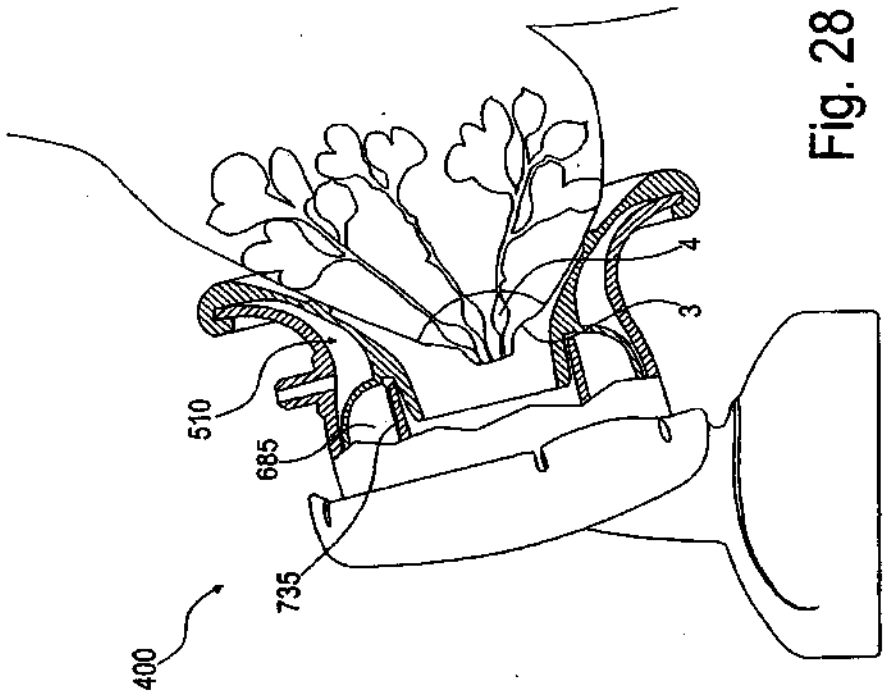

Fig. 28

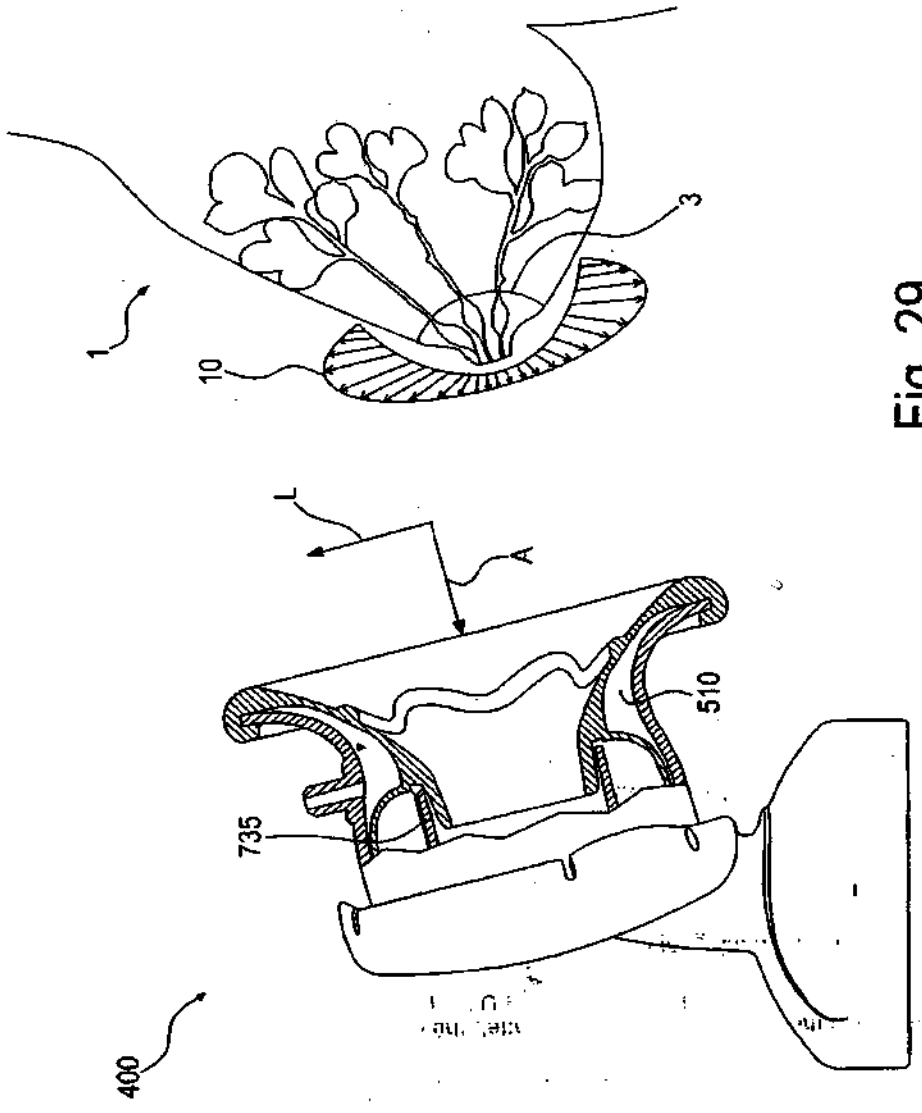

Fig. 29

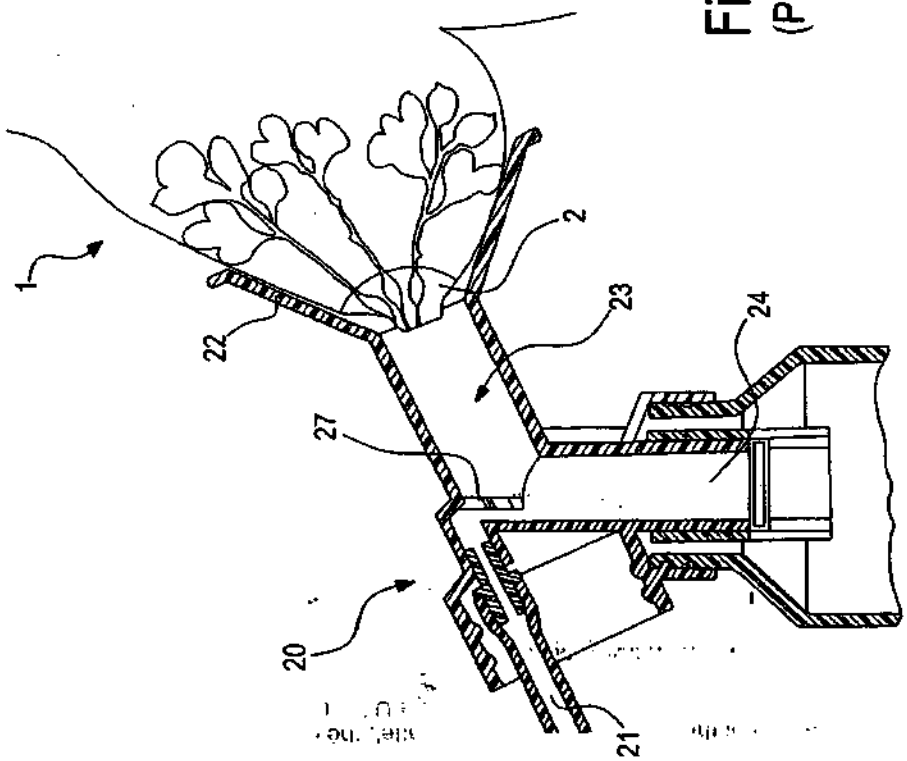

Fig. 30
(Prior Art)

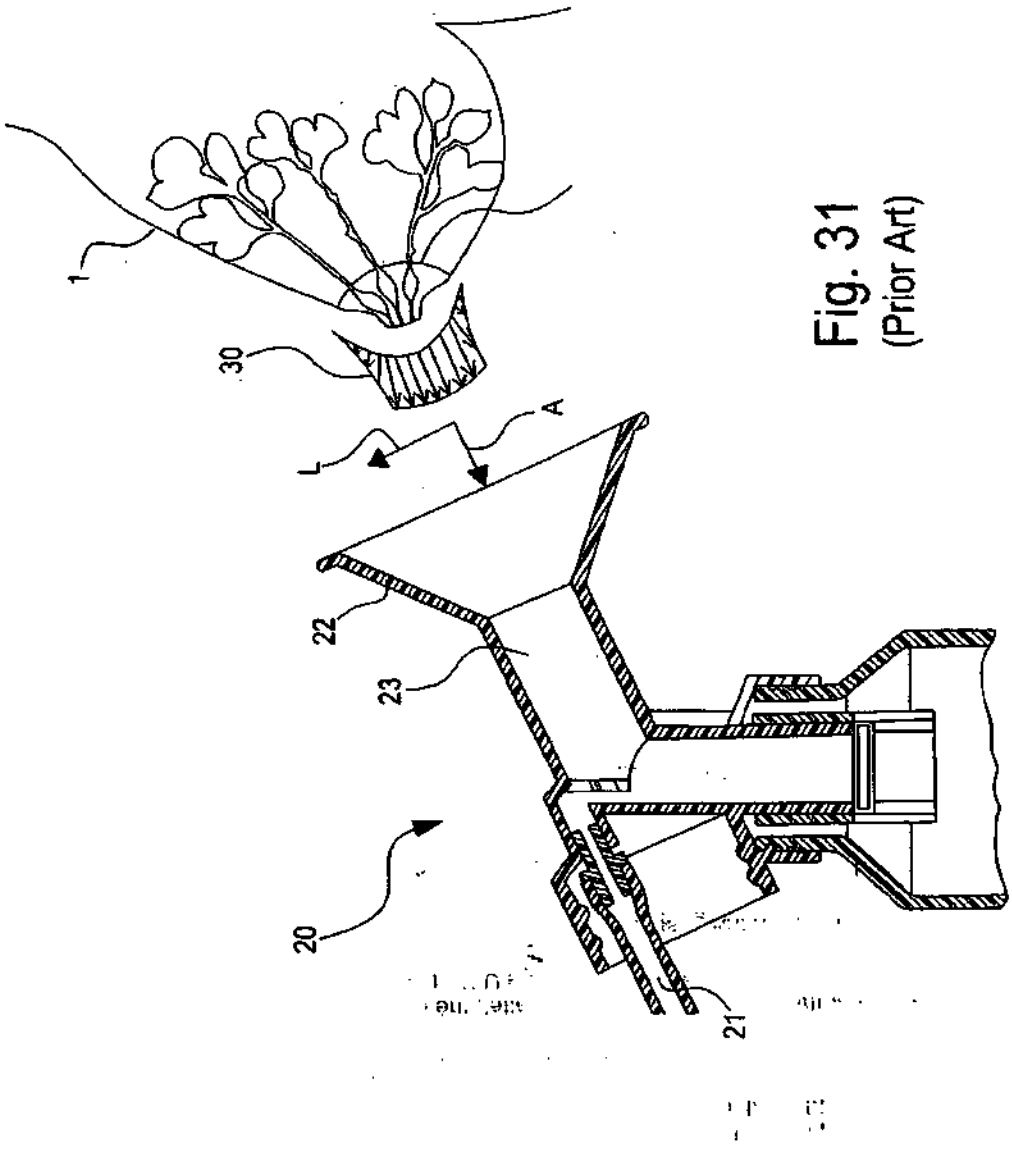

Fig. 31
(Prior Art)

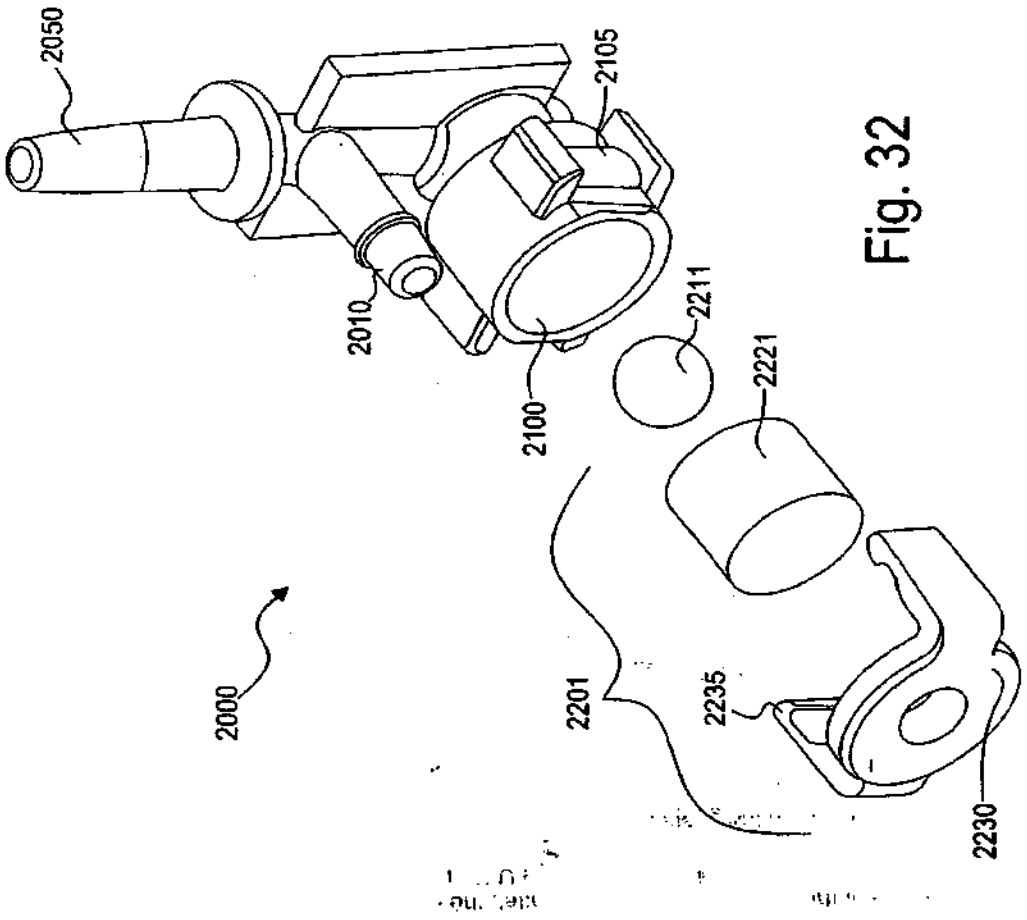

Fig. 32

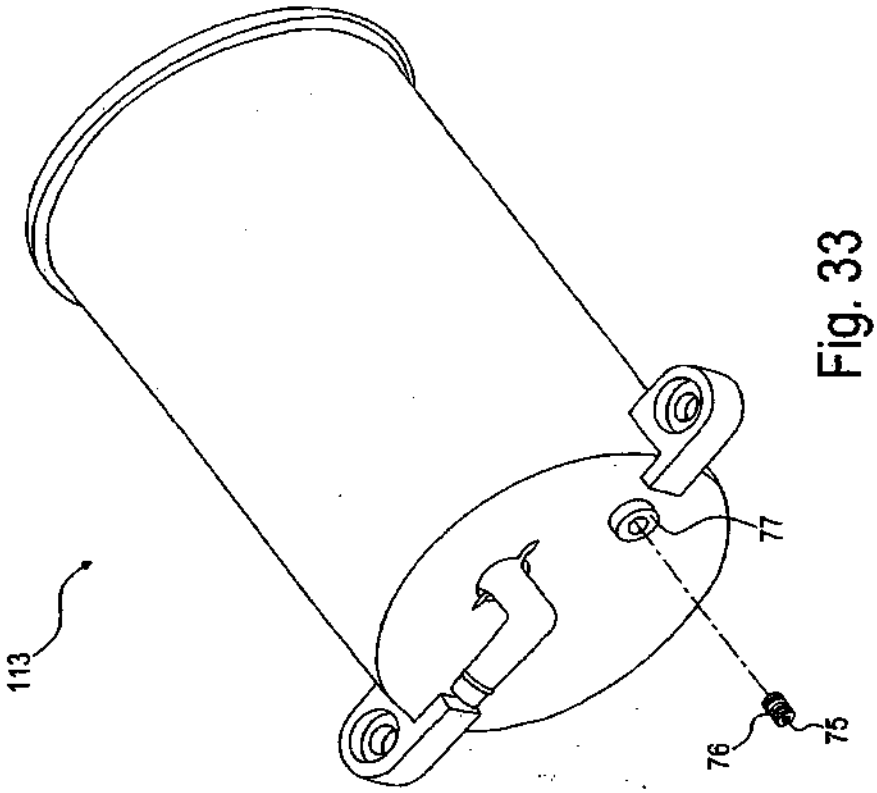

Fig. 33

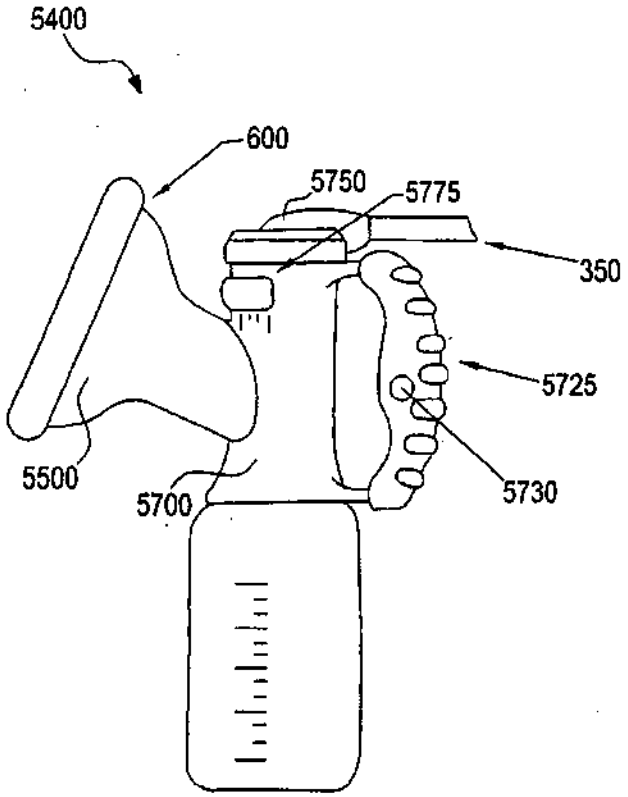
5400
600
5750
5775
350
5725
5500
5700
5730

Fig. 34

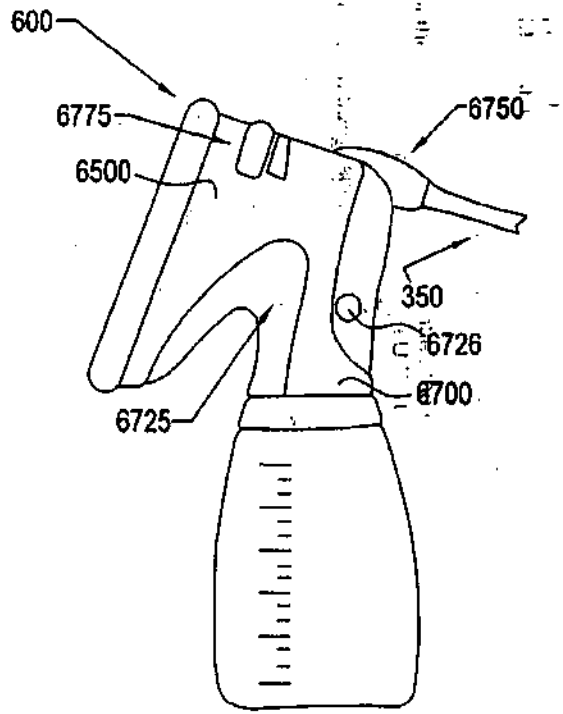
600
6775
6750
6500
350
6726
6700
6725

Fig. 35

Fig. 36

Fig. 37

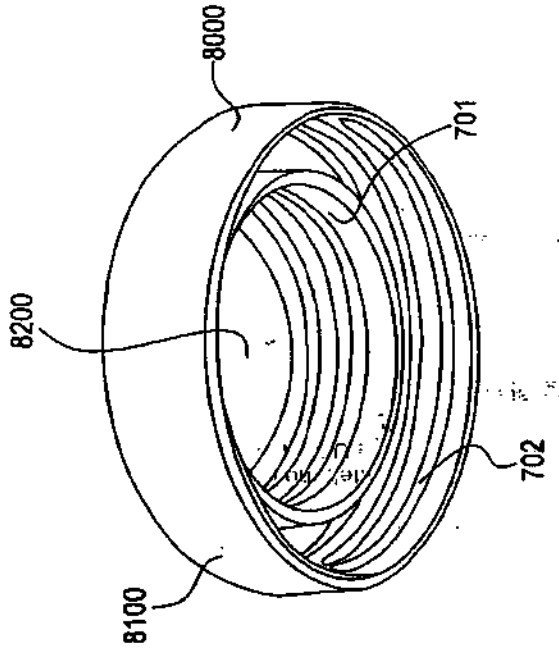

Fig. 38

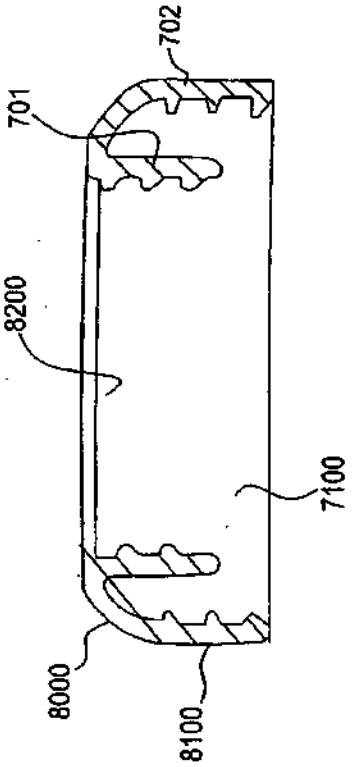

Fig. 39

BREAST PUMP

BACKGROUND OF THE INVENTION

The present invention relates to apparatus and methods for obtaining breast milk. More particularly, the present invention relates to a breast pump that can apply a variable pressure to a breast to express breast milk and to a method effecting the same.

Breast pump systems for obtaining breast milk, both manually and automatically, are known in the art. Conventional systems use a vacuum source to generate a negative pressure or vacuum that is transmitted through tubing to a breast hood or cup that is placed on the breast. This conventional device and method uses a negative pressure on the breast to express the breast milk.

Such systems suffer from the drawback of applying only a vacuum source as negative pressure to the breast to induce the expression of breast milk. Moreover, such conventional systems suffer from the drawback of applying the negative pressure or force axially to the nipple, resulting in elongation and distention of the nipple in an axial direction that is both uncomfortable and inefficient for the expression of breast milk.

SUMMARY OF THE INVENTION

It is an object of the present invention to substantially monitor and control the pressure source of a breast pump in real-time.

It is an object of the present invention to provide a breast pump system for expressing milk that can apply a positive pressure or a negative pressure to a breast to express the milk.

It is another object of the present invention to provide such a system that supplies the positive and negative pressure from a single source.

It is still another object of the present invention to provide such a system that facilitates control of the positive and negative pressure applied to the breast.

It is yet another object of the present invention to provide such a system that widens the nipple to express milk.

It is a further object of the present invention to provide such a system that reduces axial elongation or distention of the nipple.

It is another further object of the present invention to apply a negative force or negative pressure gradient to the nipple that has a greater lateral component than axial component.

It is yet a further object of the present invention to accommodate breasts of differing size and/or shape by providing a kit with interchangeable breast hoods of differing size and/or shape.

These and other objects and advantages are provided by a breast cup having a hood for receiving the breast and in fluid communication with a pressure source. The hood creates a negative force on the nipple during a negative pressure stroke. The negative force has a lateral component and an axial component. The lateral component is greater than the axial component.

The present invention includes a breast pump for expressing breast milk from a breast, the pump comprising a pressure source with a movable structure for generating

pressure during a pressure stroke. The movable structure has a variable pressure volume or variable cycle time. The pump also has a controller operably connected to the pressure source. The controller regulates the pressure volume based upon a distance traveled by the movable structure and regulates the variable cycle time based upon a speed of the movable structure. The controller provides substantially real-time monitoring of the distance traveled and the speed.

Preferably, the controller regulates the pressure cycle based on a non-sinusoidal wave signal of the pressure versus variable cycle time.

A method of expressing breast milk from a breast is described having the steps of applying a pressure to the breast; and performing substantially real-time monitoring and controlling of the pressure with a controller. Said pressure may be controlled in part based on a variable pressure volume of a movable structure or a variable cycle time of said movable structure. As before, the controller regulates the pressure volume based upon a distance traveled by the movable structure or regulates the variable cycle time based upon a speed of the movable structure and the controller provides substantially real-time monitoring of the distance traveled or the speed.

Preferably, the controller regulates the pressure cycle based on a non-sinusoidal wave signal of the pressure versus a cycle time.

There is disclosed a breast cup having a breast receiving member in fluid communication with a vacuum source. The breast receiving member applies a negative pressure to the nipple during a negative pressure stroke causing the nipple to widen along a lateral direction.

Described is a breast pump system having a pressure source and a breast cup for receiving the breast. The breast cup is in fluid communication with the pressure source.

The breast cup creates a negative force on the nipple during a negative pressure stroke. The negative force has a lateral component and an axial component. The lateral component is greater than the axial component.

A breast pump system is also disclosed having a vacuum source and a breast receiving member that is in fluid communication with the vacuum source. The breast receiving member applies a negative pressure to the nipple during a negative pressure stroke causing the nipple to widen along a lateral direction.

Additionally disclosed is a breast pump kit having a holder and a plurality of hoods for receiving the breast. Each of the plurality of hoods are selectively engageable to the holder and a pressure source for expressing the breast milk from the breast. At least one of the plurality of hoods has a different size or a different shape than another of the plurality of hoods.

There is described a breast pump system having a pump generating pressure and a plurality of hoods for receiving the breast. Each of the plurality of hoods are selectively fluidly connectable to the pump for expressing the breast milk from the breast. At least one of the plurality of hoods has a different size or a different shape than another of the plurality of hoods.

A breast pump system is disclosed having a pressure source with an evacuation volume for generating a pressure and an air hole. The system also has a breast cup for receiving the breast and in fluid communication with the pressure source for applying the pressure to the breast. The air hole has a diameter and is in fluid communication with the atmosphere and the evacuation volume. The diameter of the air hole is between about 0.15 mm to 0.75 mm.

A method describes expressing breast milk from a breast having the steps of applying a negative pressure to the breast from a pressure source during a vacuum stroke; applying a positive pressure to the breast from the pressure source during a massage stroke; and providing air from the atmosphere to the pressure source during the vacuum stroke.

There is also a method disclosing the expression of breast milk from a breast having the step of applying a negative pressure on at least a portion of the nipple causing the nipple to widen along a lateral direction.

A pump for providing pressure is described which has a housing, an actuator and an insert. The housing defines a volume and has a pressure exhaust. The actuator is operably connected to the housing for producing the pressure in the volume. The insert is connected to the housing. The insert has a hole disposed therethrough. The hole provides fluid communication between the volume and atmosphere.

A breast cup is disclosed for placing a breast in fluid communication with a first container and a second container that have openings with different diameters. The breast cup has a funnel for receiving the breast and a housing connected to the funnel. The funnel has a base. The base has a circumferential wall, a flange extending inwardly from the circumferential wall to define an opening, first threads, and second threads. The first threads have a first diameter and a first pitch. The first diameter and the first pitch allow for selective engagement with the first container. The second threads have a second diameter and a second pitch. The second diameter and the second pitch allow for selective engagement with the second container. The first threads and the second threads are concentrically disposed along the base.

There is also described a nipple ring for engaging a nipple with a first container and a second container that have openings with different diameters. The nipple ring has a

body having a circumferential wall, a flange extending inwardly from the circumferential wall to define an opening, first threads, and second threads. The first threads have a first diameter and a first pitch. The first diameter and the first pitch allow for selective engagement with the first container. The second threads have a second diameter and a second pitch. The second diameter and the second pitch allow for selective engagement with the second container. The first threads and the second threads are concentrically disposed along the body.

Also disclosed is a cap for engaging with a first container and a second container that have openings with different diameters. The cap has a body with a circumferential wall, a top wall connected to the circumferential wall, first threads, and second threads. The first threads have a first diameter and a first pitch. The first diameter and the first pitch allow for selective engagement with the first container. The second threads have a second diameter and a second pitch. The second diameter and the second pitch allow for selective engagement with the second container. The first threads and the second threads are concentrically disposed along the body.

The first pitch can be equal to the second pitch. The first threads can extend from the flange. The second threads can be disposed on the circumferential wall. The funnel can be selectively removable from the housing.

The housing can be a first material and the insert can be a second material. The housing can be plastic and the insert can be metal. The housing can be a cylinder and the actuator can be a piston. The cylinder can be an orifice and the insert can be disposed in the orifice. The insert can be press fit into the orifice. The insert can be a plurality of inserts, and each of the plurality of inserts can be selectively engageable with the cylinder.

The breast cup can also have a barrier member operably connected to the hood, wherein the barrier member reduces the axial component of the negative force during the

negative pressure stroke. The hood can have a housing, a flexible insert sealingly secured to the housing, and a displacement volume formed between the housing and the flexible insert, wherein the displacement volume is in fluid communication with the pressure source. The displacement volume can substantially surround the nipple when the breast is received in the hood. The flexible insert can have a bladder in fluid communication with the pressure source with the displacement volume being defined at least partially by the bladder. The bladder and the displacement volume can contract to form the negative force on the nipple during the negative pressure stroke.

The breast cup can also have a barrier member disposed substantially adjacent to the bladder, thereby preventing the breast from contacting the bladder. The flexible insert can define an inner volume for receiving the breast, and the barrier member can have a cylindrical shape and be disposed in the inner volume. The flexible insert can have a funnel shape with a massaging projection formed thereon. The massaging projection can have a star-like shape.

The negative pressure created at the breast cup can cause the nipple to widen along a lateral direction more than the nipple elongates along an axial direction. The negative pressure can have an average lateral component and an average axial component, wherein during the negative pressure stroke the average lateral component is greater than the average axial component. The barrier member can be operably connected to the breast receiving member, and can reduce elongation of the nipple along the axial direction during the negative pressure stroke. The breast receiving member can have a housing, a flexible insert sealingly secured to the housing, and a displacement volume formed between the housing and the flexible insert, wherein the displacement volume is in fluid communication with the vacuum source.

The vacuum or pressure source can be a piston movably disposed in a cylinder. The system can have a reversible motor operably connected to the piston. The system can

also have a rack having first teeth and a gear having second teeth. The rack can be connected to the piston and the gear can be operably connected to the reversible motor. The first teeth can engage with the second teeth to reciprocally move the piston in the cylinder. The cylinder can have a first diameter and an air hole. The air hole can have a second diameter and be in fluid communication with the atmosphere. The first diameter of the cylinder can be significantly larger than the second diameter of the air hole.

The system can have a controller operably connected to the reversible motor. The controller can determine a distance that the piston has traveled relative to the cylinder. The controller can reverse the motor based at least in part upon that distance. The system can also have a motor with variable speed. The controller can adjust the speed based upon a desired cycle time for applying the negative pressure to the breast. The controller can regulate the pressure cycle based on a non-sinusoidal wave signal of pressure versus variable cycle time.

Each of the plurality of hoods of the kit can have a housing, a flexible insert sealingly secured to the housing, and a displacement volume formed between the housing and the flexible insert and in fluid communication with the pressure source. The housing and/or the flexible insert of the at least one of the plurality of hoods can have a different size or a different shape than the housing and/or the flexible insert of the another of the plurality of hoods. The kit can also have a container, wherein the holder is selectively engageable with the container. The holder can have a plurality of engagement structures for selectively engaging a plurality of different sized containers. The flexible insert of the at least one of the plurality of hoods can have a first massaging projection, and the flexible insert of the another of the plurality of hoods can have a second massaging projection. The first and second massaging projections can have a different size or a different shape.

BRIEF DESCRIPTION OF THE DRAWINGS

Other and further objects, advantages and features of the present invention will be understood by reference to the following:

Fig. 1 is a front perspective view of a breast pump of the breast pump system of the present invention;

Fig. 2 is a front perspective view of the breast pump of Fig. 1 in an opened position;

Fig. 3 is an exploded perspective view of the breast pump of Fig. 1;

Fig. 4 is a top view of the breast pump of Fig. 1 without the cover;

Fig. 5 is an exploded perspective view of a piston and cylinder of the present invention;

Fig. 6 is an exploded side view of a portion of the piston and cylinder of Fig. 5;

Fig. 7 is a front perspective view of the piston of Fig. 5;

Fig. 8 is an exploded perspective view of an alternative embodiment of the piston;

Fig. 9 is an exploded perspective view of a pressure relief valve of the system of Fig. 1;

Fig. 10 is a cross-sectional plan view of the cylinder of Fig. 5;

Fig. 11 is a front perspective view of a breast cup;

Fig. 12 is a side cross-sectional view of the breast cup of Fig. 11;

Fig. 13 is a rear perspective view of a T-connector;

Fig. 14 is a flow chart depicting a method for pumping a breast according to the system of Figs. 1 and 11;

Fig. 15 is a top perspective view of a preferred embodiment of breast pump for the breast pump system of the present invention;

Fig. 16 is a top view of the breast pump of Fig. 15;

Fig. 17 is a top perspective view of the drive system of the breast pump of Fig. 15;

Fig. 18 is a side perspective view of the drive system of Fig. 17;

Fig. 19 is a top perspective view of a portion of the gear reduction system of the drive system of Fig. 15, partially assembled;

Fig. 20 is a top perspective view of an alternative embodiment of breast pump for the breast pump system of the present invention;

Fig. 21 is a top view of the breast pump of Fig. 20;

Fig. 22 is a top perspective view of the drive system of the breast pump of Fig. 20;

Fig. 23 is a side perspective view of the drive system of Fig. 20;

Fig. 24 is a top perspective view of the motor of the drive system of Fig. 20;

Fig. 25 is a top perspective view of a portion of the gear reduction system of the drive system of Fig. 20, partially assembled;

Fig. 26 is a top perspective view of the gear reduction system of the drive system of Fig. 20, partially assembled;

Fig. 27 is a partial cross-sectional side view of the breast cup of Fig. 11 with a breast;

Fig. 28 is a partial cross-sectional side view of the breast cup of Fig. 27 applied to the breast prior to the negative pressure stroke;

Fig. 29 is an exploded cross-sectional view of the breast cup and breast of Fig. 27 during the negative pressure stroke showing a representation of the negative pressure gradient or force on the breast;

Fig. 30 is a cross-sectional side view of a prior art breast cup applied to a breast prior to the negative pressure stroke;

Fig. 31 is an exploded cross-sectional view of the prior art breast cup and breast of Fig. 30 during the negative pressure stroke showing a representation of the negative pressure gradient or force on the breast;

Fig. 32 is an exploded perspective view of the pressure relief valve of Fig. 9 with another embodiment of a relief assembly;

Fig. 33 is a perspective view of the cylinder of Fig. 5 with another embodiment of the pressure differential hole;

Fig. 34 is an alternative embodiment of a breast cup;

Fig. 35 is another alternative embodiment of a breast cup;

Fig. 36 is a bottom perspective view of a nipple ring with a nipple;

Fig. 37 is a side cross-sectional view of the nipple ring and nipple of Fig. 36;

Fig. 38 is a bottom perspective view of a cap; and

Fig. 39 is a side cross-sectional view of the cap of Fig. 38.

DESCRIPTION OF THE INVENTION

Referring to the drawings and, in particular, Figs. 1 and 2, there is shown a breast pump of the present invention generally represented by reference numeral 100. Breast pump 100, along with breast cup 400 shown in Fig. 11, form the major components of the breast pump system of the present invention. Breast pump 100 has a top housing 102 and a bottom housing 103 that are adapted to form an assembled unit.

Referring to Figs. 1 through 3, top housing 102 has a substantially ellipsoidal shape with a flat front face 200 and a storage compartment 210 having a compartment door 104. Preferably, door 104 is hingedly connected to top housing 102 to form a selectively sealable storage compartment 210 for storing air tubing or conduit 350 that connects breast pump 100 to the other components of the system, which will be discussed later in greater detail.

Face 200 can receive a button pad 105 having an LED cover 106. Pad 105 is used by the consumer to control breast pump 100. Bottom housing 103 can securely house the various components of the breast pump, which include a rack gear 109, a pinion gear 110 that can engage the rack gear, a piston 112, a cylinder 113 that can receive the piston, and a motor 125 having a shaft 126 upon which the pinion gear is mounted. Due in part to this design, breast pump 100 provides pumping with low noise. Breast pump 100 can be made of any rigid material, such as, for example, plastic.

Referring to Figs. 3 through 7, breast pump 100 utilizes piston 112 and cylinder 113 to create both a positive pressure and a negative pressure for obtaining breast milk. Piston 112 is driven by rack gear 109, which is affixed thereto. Piston 112 has a substantially cylindrical-shape with a first head 3000 and a second head 3100. First and second heads 3000, 3100 preferably have annular channels 3020, 3120 formed therein, respectively. Channels 3020, 3120 are disposed along the outer circumference of first and second heads 3000, 3100, respectively. Preferably, channels 3020, 3120 are centrally located along the outer circumference of first head 3000 and second head 3100. Seated in channels 3020, 3120 are sealing members 3050, 3150, respectively. Preferably, sealing members 3050, 3150 are o-ring gaskets. Sealing members 3050, 3150 have a diameter or width that is larger than the depth or height of channel 3020 and channel 3120. Sealing members 3050, 3150 extend beyond the outer circumference of first head 3000 and second head 3100 forming a sealing engagement with an inner surface 1130 of cylinder 113 as piston 112 is driven back and forth in the cylinder.

The use of multiple sealing members, i.e., o-ring gasket 3050 and o-ring gasket 3150 on piston 112, provide a double sealing to increase the efficiency of creating the positive pressure and negative pressure. While this embodiment uses two sealing members to create two separate sealing surfaces, any number of sealing members can be used to create any number of sealing surfaces for sealing piston 112 with cylinder 113.

Additionally, while this embodiment uses piston 112 having o-ring sealing gaskets 3050, 3150, alternative sealing structures can be used between the piston and cylinder 113.

Rack gear 109 has teeth 1090 that engage with pinion gear 110 having teeth 1100. Pinion gear 110 is operatively connected to motor 125, preferably via shaft 126. When motor 125 is activated, shaft 126 and pinion gear 110 rotate. Teeth 1090 on rack 109 and teeth 1100 on pinion 110 mesh and translate the reciprocal rotational motion of motor 125 and shaft 126 into a reciprocal longitudinal motion along a single axis in both directions.

Preferably, rack gear 109 has a first end 1095 that engages with a recess 3200 formed in piston 112. Recess 3200 is preferably centrally located in piston 112. First end 1095 of rack gear 109 preferably has a snap fit or friction fit engagement with recess 3200 of piston 112. Preferably, there are detent structures 1096, 3296 formed on first end 1095 and recess 3200, respectively. This facilitates production of these components and also provides for any slight pivotal movement that may be required of piston 112 with respect to rack gear 109.

An alternative embodiment of a piston is shown in Fig. 8 and generally represented by reference numeral 8112. Piston 8112 has a substantially V-shape with a leading edge 8120 and a trailing edge 8121. Leading edge 8120 and trailing edge 8121 sealingly engage an inner surface 1130 of cylinder 113 as piston 8112 is driven back and forth in the cylinder. The use of multiple edges, i.e., leading edge 8120 and following edge 8121, on piston 8112 that sealingly engage inner surface 1130 of cylinder 113, provide a double sealing to increase the efficiency of creating the positive pressure and negative pressure.

Referring to Figs. 3 through 7, motor 125 is preferably variable speed. This allows a user to control and vary the cycle time of the pumping of the breast. Breast

pump 100 further has a motor cover 107 and a bearing 108 to reduce vibration and to secure motor 125 to bottom housing 103.

The positive and negative pressures can be varied by changing the displacement of air volume in cylinder 113. In this embodiment, this is done by use of a photoelectric or photo-sensor system. The photo-sensor system has two or more photo-sensors 121 and a position switch 124. The photo-sensors 121 count the number of openings 50 on rack gear 109, as the rack gear moves back and forth. Thus, a user can control the distance that rack gear 109 travels and correspondingly control the air volume displacement in cylinder 113. Alternative displacement or distance monitors can also be used, such as, for example a coded wheel for counting the slots on the wheel; counting of the belt teeth; rotary encoder which counts its own revolutions; or a hall effect sensor.

To ensure that piston 112 is properly moving to the front of cylinder 113, the photo-sensor system further includes position switch 124, preferably located at the front of the cylinder, which acts as a starter for the counter. Alternatively, the position switch can be an opening 50 having a different size or shape that is detectable by photo-sensor 121.

Rack gear 109 can also have a safety mechanism attached thereto. Photo-sensor 121 will be reading openings 50 as rack gear 109 moves backwards. If for some reason rack gear 109 misses its target and moves too far, the safety will trigger the position switch. When the position switch is triggered while rack gear 109 is moving backwards, the software can trigger the system to move forward again and return to the position position.

Breast pump 100 has a guide cover 111 positioned over rack gear 109. Guide cover 111 provides added stability to the breast pump by guiding and vibration dampening the reciprocal movement of rack gear 109. Guide cover 111 also provides

accuracy to the photo-sensor system by reducing the risk of misalignment of photo-sensors 121 and openings 50.

The photo-sensor system and motor 125 are preferably connected to a PC or circuit board 120. Thus, the distance piston 112 travels, which translates to the amount of positive and negative pressure, and the piston speed, which translates to the cycle time, are electronically controlled.

Referring to Figs. 15 through 19, a preferred embodiment of a drive system is shown and generally represented by reference numeral 1500. Drive system 1500 is usable with breast pump 100 of Figs. 1 through 7 to provide the linear reciprocal movement of piston 112 with cylinder 113.

Drive system 1500 is a belt drive system for a rack and pinion drive having gear reduction incorporated therein. Drive system 1500 has a first drive wheel or pulley 1510; a second gear, drive wheel or pulley 1520 secured to the first drive wheel 1510; a third gear, drive wheel or pulley 4530; and a pinion gear 1540 secured to the third gear.

First drive wheel 1510 is operably connected to motor drive shaft 126 by a first belt 1550. In the preferred embodiment, first belt 1550 is a non-toothed belt. More preferably, first belt 1550 has resiliency or flexibility. The use of flexible or resilient belt 1550 provides a secure connection between drive shaft 126 and first drive wheel 1510 and also reduces noise and vibration. Drive shaft 126 and first drive wheel 1510 have smooth outer surfaces upon which the first belt 1550 is secured.

First drive wheel 1510 is operably connected to second gear 1520 by a first co-axial shaft 1515. In the preferred embodiment, first shaft 1515 is rotatably mounted between opposing first bearings 1517. However, alternative rotatable mounting arrangements or securing structures could also be used. To reduce noise and vibration,

motor shaft 126 and first drive wheel 1510 are made of metal. First drive wheel 1510 and second gear 1520 have different diameters that partially provide for gear reduction between motor shaft 126 and pinion gear 1540.

Second gear 1520 is operably connected to third gear 1530 by a second belt 1570. Preferably, second belt 1570 has teeth 1575 that mesh with teeth 1580 formed along the circumference of second gear 1520 and third gear 1530. Second and third gears 1520, 1530 have different diameters that partially provide for gear reduction between motor shaft 126 and pinion gear 1540. Drive system 1500 can also have a tension pulley 1580 that provides tension to second belt 1570.

Third gear 1530 is operably connected to pinion gear 1540 by a second co-axial shaft 1535. In the preferred embodiment, second shaft 1535 is rotatably mounted between opposing second bearings 1537. However, alternative rotatable mounting arrangements or securing structures could also be used. Preferably, third gear 1530 is integrally molded with pinion gear 1540 along second shaft 1535.

Pinion gear 1540 has teeth 1545 that engage with teeth 1090 of rack gear 109. When motor 125 is activated, the rotational motion of shaft 126 is translated into a reciprocal longitudinal motion along a single axis of rack gear 109 in both directions. Drive system 1500, through use of first and second belts 1550, 1570 and first, second and third drive wheels or gears 1510, 1520, 1530, is able to provide a desired ratio of movement between motor shaft 126 and pinion gear 1540, i.e., gear reduction.

The use of a combination of the non-toothed belt 1550 and the toothed belt 1570 reduces noise and vibration, while maintaining a secure, sturdy drive system 1500 that is able to provide the necessary back and forth linear motion at the desired speeds and pressure for breast pump 100.

Referring to Figs. 20 through 26, an alternative embodiment of a drive system is shown and generally represented by reference numeral 4500. Drive system 4500 is also usable with breast pump 100 of Figs. 1 through 7 to provide the linear reciprocal movement of piston 112 with cylinder 113.

Drive system 4500 is a belt drive system having gear reduction incorporated therein. Drive system 4500 has a first gear, drive wheel or pulley 4510; a second gear, drive wheel or pulley 4520 secured to the first gear; a third gear, drive wheel or pulley 4530; and a pinion gear 4540 secured to the third gear.

First gear 4510 is operably connected to motor drive shaft 126 by a first belt 4550. In the preferred embodiment, first belt 4550 is a plurality of belts, and more preferably, three belts. First belts 4550 are preferably non-toothed belts. More preferably, first belts 4550 are o-rings having resiliency or flexibility. The use of flexible or resilient belts 4550, such as, for example, o-rings, provides a secure connection between drive shaft 126 and first gear 4510, and also reduces noise and vibration. Drive shaft 126 and first gear 4510 have annular channels 4555, 4560, formed therein, respectively. Annular channels 4555, 4560 are guides that assist in holding first belts 4550 in place and facilitate assembly of drive system 4500.

First gear 4510 is operably connected to second gear 4520 by a first co-axial shaft 4515. In this alternative embodiment, first shaft 4515 is rotatably mounted between opposing first bearings 4517. However, alternative rotatable mounting arrangements or securing structures could also be used. To reduce noise and vibration, motor shaft 126 and first gear 4510 are made of metal. First and second gears 4510, 4520 have different diameters that partially provide for gear reduction between motor shaft 126 and pinion gear 4540.

Second gear 4520 is operably connected to third gear 4530 by a second belt 4570. Preferably, second belt 4570 has teeth 4575 that mesh with teeth 4580 formed along the circumference of second gear 4520 and third gear 4530. Second and third gears 4520, 4530 have different diameters that partially provide for gear reduction between motor shaft 126 and pinion gear 4540. Drive system 4500 can also have a tension pulley 4580 that provides tension to second belt 4570.

Third gear 4530 is operably connected to pinion gear 4540 by a second co-axial shaft 4535. In this alternative embodiment, second shaft 4535 is rotatably mounted between opposing second bearings 4537. However, alternative rotatable mounting arrangements or securing structures could also be used. Preferably, third gear 4530 is integrally molded with pinion gear 4540 along second shaft 4535.

Pinion gear 4540 has teeth 4545 that engage with teeth 1090 of rack gear 109. When motor 125 is activated, the rotational motion of shaft 126 is translated into a reciprocal longitudinal motion along a single axis of rack gear 109 in both directions. Drive system 4500, through use of first and second belts 4550, 4570 and first, second and third gears 4510, 4520, 4530, is able to provide a desired ratio of movement between motor shaft 126 and pinion gear 4540, i.e., gear reduction.

The use of a combination of the non-toothed o-ring belts 4550 and the toothed belt 4570 reduces noise and vibration, while maintaining a secure, sturdy drive system 4500 that is able to provide the necessary back and forth linear motion at the desired speeds and pressure for breast pump 100.

The embodiments of the drive systems 1500 and 4500 described above utilize belts for gear reduction. However, alternative embodiments can use a gear-box that reduces the gearing to the desired ratio that is transferred to the rack and pinion gearing that drives breast pump 100.

Referring back to Figs. 3 through 9, cylinder 113 has a supply tube 116 that is secured to a supply connector 115 for supplying the positive and negative pressure to breast cup 400. Preferably, supply connector has an outlet 215 disposed in storage compartment 210. Air tubing 350 can be secured to outlet 215 and also secured to breast cup 400. Storage compartment 210 can be opened or closed during the pumping operation. Cylinder 113 is in fluid communication with a pressure relief valve 2000 (shown in Fig. 9) that is preferably set at about 1.5 in. Hg.

Pressure relief valve 2000 has an intake 2010 and an exhaust 2050. Intake 2010 is in fluid communication with cylinder 113 and exhaust 2050 is in fluid communication with breast cup 400, by tubing 350. Pressure relief valve 2000 has a relief exhaust 2100 that is in fluid communication with intake 2010 and exhaust 2050. Relief exhaust 2100 is substantially tubular and is secured to a relief assembly 2200.

Relief assembly 2200 has a flexible insert 2210, a biasing member 2220 and a retaining member 2230. Flexible insert 2210 sealing engages with the inner surface of relief exhaust 2100 to prevent air from exiting through the relief exhaust. Insert 2210 has a securing member 2215 that mates with biasing member 2200. In this embodiment, securing member 2215 is a cross-shaped structure that is received in the inner volume of biasing member 2200. Preferably, biasing member 2220 is a spring. More preferably, biasing member 2220 is a coil spring. Retaining member 2230 is a cap-like structure having opposing retaining arms 2235 that engage with a corresponding pair of engaging protrusions 2105 positioned on the outer surface of relief exhaust 2100. Insert 2210 and spring 2220 are held in the inner volume of relief exhaust 2100 by cap 2230.

Spring 2220 has a biasing strength or resistance that is equal to the relief pressure of relief pressure valve 2000. When a positive pressure exceeds the relief pressure, which in this embodiment is preferably set at about 1.5 in. Hg, the force created on the inner

surface of insert 2210 overcomes the biasing force of spring 2220 and the insert moves toward cap 2230 and outside of the inner volume of relief exhaust 2100. Air exits pressure relief valve 2000 through relief exhaust 2100 until the positive pressure in the pressure relief valve decreases below the biasing strength of spring 2220, at which time insert 2210 moves back in the inner volume of the relief exhaust, sealingly engaging the inner surfaces of the relief exhaust.

Referring also to Fig. 32, pressure relief valve 2000 is shown with a preferred relief assembly 2201 that includes an insert 2211 and a biasing member 2221. Relief assembly 2201 functions similarly to the insert 2210 and the spring 2220 of relief assembly 2200, as described above. Insert 2211 is a ball and biasing member 2221 is foam having a cylindrical shape. Relief assembly 2201 is advantageous because the ball 2211 is more easily assembled in relief exhaust 2100. Additionally, the foam cylinder 2221 is more consistent because it easily mates with the ball 2211 and provides a consistent spring actuation force. Additionally, alternative pressure relief valves can be used which are adjustable so that the "massage strength", i.e., the amount of positive pressure on the user's breast, can be controlled.

Circuit board 120, shown in Fig. 3, allows a user to program several levels of speed and several levels of suction. In this embodiment, the speed (cycle time) ranges from about 45 cycles/minute (cpm) to about 75 cpm. The embodiment provides for pre-set programming of a number of speed levels within the speed range. Preferably, the number of levels can be from about two to about eight levels. More preferably, the user can program five levels of speeds within the speed range. The embodiment also envisions programming of the speed levels by the user.

The suction range for use with a single breast cup 400 and the preferred drive system 1500 shown in Figs. 15 through 21, is from about 3 in. Hg to about 10 in. Hg, and from about 3 in. Hg to about 8 in. Hg for two breast cups. The suction range for use with

a single breast cup 400 and the gear box system shown in Figs. 3 and 4 is from about 3 in. Hg to about 9 in. Hg, and from about 3 in. Hg to about 8 in. Hg for two breast cups. The embodiment provides for pre-set programming of a number of suction levels within the suction range. Preferably, the number of levels can be from about two to about eight levels. More preferably, the user can program five levels of suction within the suction range. The present invention also envisions programming of the suction levels by the user.

Computer software can also be used to control the amount of positive and negative pressure. This allows the amounts of positive and negative pressure to be personalized for the user and also varied over the duration of the pumping process to maximize efficiency.

Breast pump 100 is preferably controlled by a software-driven circuit board 120, along with a gear motor 125, a rack and pinion set 109, 110, and a piston system 112, 113. The software and system are designed to provide maximum flexibility and to facilitate changing of the pressure curve or "wave." This is feasible because the software controls the speed of motor 120 and the distance that piston 112 will travel in cylinder 113. The distance piston 112 travels relates to the pressure levels. By controlling speed and pressure levels with software, the pressure curve or "wave" can be controlled.

Once a determination is made that there is a specific "wave" or pressure curve that is similar to the sucking of an infant or most comfortable to the mother, then the desired wave can be obtained by changing the timing (motor speed and piston distance). Through use of software, a user has the ability to apply memory to a particular pressure curve and the variation of that pressure curve over time so as to maximize the comfort for the user.

In this embodiment, a sine wave is used for the control of breast pump 100. This is based on the assumption that the most comfortable pressure curve would be one that

increases and decreases in pressure gradually, similar to a sine wave, without sharp pressure peaks and valleys providing a pinching feeling on the user. The back and forth motion of piston 112 approximates the desired sine wave. However, to avoid sharp pressure peaks, the timing of piston 112 is slowed down at these peaks, and the pressure is held constant for a duration of time at the maximum and minimum suction points on the wave. This results in a pressure curve having a steady sine wave that is more comfortable to the user.

Alternative waves can also be used for the pressure curve, if such a wave is determined to be desirable by the mother. For example, if a mother prefers a "saw tooth" pressure curve with sharp peaks, the timing of piston 112 can be changed to simply cycle back and forth, minimizing the pause when piston 112 changes direction. Also, for example, if a mother prefers a "square curve", the timing of piston 112 can be changed to hold the piston position when the piston is ready to change direction, and then quickly ramp down and hold its position again before it ramps back up. This will create a "square curve" wave.

Use of software control provides for numerous choices of waves or pressure curves. This further allows the flexibility to change or offer greater choice with one breast pump 100. In contrast, contemporary pumps have the drawback of not allowing the flexibility of changing pressure curve waves. Breast Pump 100 allows for inter-cycle control of the pressure and speed. In the preferred embodiment, this is done through use of a reversible, variable speed motor 125 operably connected to a linear system incorporating piston 112 and cylinder 113. Thus, contemporary devices could seemingly use a particular sinusoidal pressure curve repeatedly, while the breast pump 100 has the ability to use any type of wave and to change the wave during the cycle.

The control system and software provide for a closed-loop control system or inter-cycle real-time adjustment. Thus, real-time monitoring of the control variables occurs,

such as piston distance traveled and speed. As the motor and other components age and wear, the closed-loop control system accounts for such detrimental changes to provide accurate cycle time and pressure sought by the user. The real-time monitoring and control provides effectively equal speed levels for both single and double cup pumping even with the changes in torque.

Cylinder 113 has a pressure differential hole 75. Preferably, pressure differential hole 75 is located along bottom face 80 of cylinder 113. Pressure differential hole 75 is substantially smaller than exhaust hole 1013 and supply tube 116 through which the air flows for generating the positive and negative pressure. Pressure differential hole 75 provides a variance in the amount of positive pressure as compared to the amount of negative pressure. Pressure differential hole 75 is effective for the higher ranges of vacuum to provide the "lost" air at the end of the vacuum stroke. On the positive pressure stroke, a small amount of air will be released through pressure differential hole 75 but the air will be reintroduced during the negative pressure stroke when the level of pressure is higher.

Referring to Fig. 33, cylinder 113 is shown with a preferred embodiment of a pressure differential insert 76. Pressure differential hole 75 is disposed through pressure differential insert 76. Insert 76 is then connected to cylinder 113 through a cylinder hole 77 disposed through the wall of the cylinder. Insert 76 is preferably press fit into cylinder hole 77. However, alternative connection methods can also be used, such as, for example, threads or adhesive. Pressure differential insert 76 is a machined metal piece that allows for the machining of pressure differential hole 75 with a precise diameter within very small tolerances.

The use of insert 76 is advantageous over disposing pressure differential hole 75 directly through the wall of cylinder 113 because of the significant lack of precision in either molding the hole or drilling the hole through a plastic part. Additionally, pressure

differential insert 76 can be selectively inserted through cylinder hole 77 so that a plurality of inserts having a plurality of differently sized pressure differential holes 75 can be used. By providing for different diameters for pressure differential hole 75, the suction levels produced by the pump can be altered.

Pressure differential hole 75 allows for reclaiming of the air during the negative pressure stroke that is lost over time during use of breast pump 100 so that the positive pressure can be accurately maintained over time. During testing of breast pump 100, unexpected and significant results occurred from the use of differently sized diameters of pressure differential hole 75. It was discovered that a pressure differential hole 75 having a diameter of between about 0.15 mm to about 0.75 mm maintained an accurate positive pressure over time while providing the desired negative pressure. The volume of cylinder 113 was 126 cm^3. Preferably, pressure differential hole 75 has a diameter of between about 0.25 mm to about 0.5 mm, and most preferably the diameter is about 0.3 mm.

Referring to Fig. 10, cylinder 113 is formed as a zero- draft cylinder. The outer diameter of piston 112 creates a seal with the inner diameter d of cylinder 113 to move the volume of air inside the cylinder, creating vacuum and pressure on the breast. Breast pump 100 requires a cylinder 113 that has a consistent inner diameter d through the entire length of the cylinder to create an appropriate seal while minimizing interference or resistance to piston 112. Typical injection molded parts require a draft angle that would create a non-uniform inner diameter d of cylinder 113.

Cylinder 113 is preferably molded as a zero-draft cylinder that provides a uniform inner diameter d and more preferably, molded in a single piece. As shown in Fig. 10, cylinder 113 is a one piece, plastic injection molded part. A two-part cylinder or a machined-cylinder have drawbacks which the single piece, zero draft cylinder 113 overcomes. The two-part cylinder requires an extruded tube attached to an end cap, with the two parts joined using a weld or using an adhesive. The machined part is typically a

metal tube. One of the advantages to the zero-draft, one-piece cylinder 113 is that it is injection moldable.

Referring to Figs. 3 through 10, button pad 105 is the user interface or control mechanism for breast pump 100. Button pad 105 has a pair of positive and negative keys for increasing or decreasing the level of suction and speed. Pad 105 further includes an on/off switch.

Due to the reciprocal back and forth motion of piston 112 in cylinder 113, breast pump 100 supplies both a positive pressure and a negative pressure to a woman's breast through a single hose or tubing 350. While this embodiment uses a piston/cylinder mechanism to create positive and negative pressure, alternative expandable volumes or pressure sources can also be used. Such alternative embodiments include a bellows mechanism or a diaphragm that would require fewer parts.

Referring to Figs. 11 and 12, breast Cup, hood, or breast receiving member 400 is shown. Breast cup 400 has a housing 500 having an air orifice 560, a flexible insert 600, and a holder 700. Housing 500 is a rigid structure and flexible insert 600 is a flexible structure. Housing 500 is adapted for sealing engagement with insert 600 to form a displacement volume 510 between the housing and the insert. The funnel-like shape of insert 600 provides for an inner volume 655 for receiving of the breast. Air orifice 560 is in fluid communication with displacement volume 510.

Breast pump 100 is placed in fluid communication with breast cup 400 via air tubing 350 that is connected to air orifice 560 and in fluid communication with cylinder 113. Breast pump supplies both a positive and negative pressure to breast cup 400. The positive and negative pressure created by breast pump 100 causes air to flow through air orifice 560 into and out of displacement volume 510. The positive and negative pressure supplied to breast cup 400 causes flexible insert 600 and, in particular, displacement

volume 510 to expand and contract to apply reciprocating positive and negative forces on the user's breast.

Due to the negative pressure being created by evacuation of displacement volume 510 and the substantial collapsing of insert 600 upon housing 500, breast cup 400 has a maximum suction level inherently incorporated therein. Unlike contemporary devices that provide vacuum directly to the nipple from the vacuum source and are thus vulnerable to over-sucking, breast cup 400 can only provide a maximum negative pressure based upon the displacement volume 510. Once all of the air is evacuated from displacement volume 510, breast cup 400 preferably no longer increases the negative pressure or force applied to the breast. Breast pump 100 and breast cup 400 are able to apply both a positive and a negative pressure to a user's breast through a single air tubing 350, which is connected to air orifice 560.

The volume disposed in displacement volume 510 is preferably between 22 to 52 cubic centimeters, and more preferably between 32 to 42 cubic centimeters. The expandable and contractible displacement volume 510 provides an upper limit to the amount of negative pressure that can be applied to a user's breast, which can further serve as a safety feature in use of breast pump 100. Additionally, the sealing engagement of insert 600 and housing 500 provides a barrier between the user's breast and breast pump 100 to prevent any breast milk from entering air tubing 350 or the breast pump. Insert 600 can also include a massaging member 634. Massaging member 634 has a star-like shape, which provides additional massaging action to the breast. Alternative shapes can also be used for massaging member 634.

Referring to Figs. 27 through 29, breast cup 400 is shown in partial cross-section with a breast 1. The breast 1 has a nipple 2 with an areola 3, and milk lakes or ducts 4, which are supplied by milk glands 5. Breast cup 400 has bladders 685 on insert 600 and tubular member 735 on holder 700. Bladders 685 partially define displacement volume

510. When air is evacuated from the bladders 685 and the displacement volume 510 such that insert 600 is pulled toward and against housing 500, then the negative pressure, vacuum or negative force is applied to breast 1.

Tubular member 735 is disposed substantially adjacent to bladders 685 and extends partially through insert 600. Tubular member 735 is a rigid barrier between the breast 1 and bladders 685 to prevent the breast from making contact with and impinging the bladders, which would reduce the amount of their inflation and deflation, and thus reduce the reciprocating pressure applied to the breast.

Positioning of the breast cup 400 on the breast 1, results in the nipple 2, areola 3 and milk ducts 4 being substantially surrounded by displacement volume 510. Nipple 2 being substantially surrounded by the displacement volume and the use of tubular member 735 to create a rigid barrier in front of areola 3 and adjacent to bladders 685, results in a negative pressure gradient, vacuum or negative force 10 being applied to nipple 2 upon evacuation of the air in displacement volume 510 during the negative pressure stroke or cycle, as represented in Fig. 29. The negative pressure gradient or force 10 has a lateral component or direction L that is greater than an axial component or direction A. The negative pressure gradient or force 10 and the larger lateral component L causes the nipple 2 to be pulled or sucked laterally more than axially, which has been shown to be significantly more efficient at causing expression of breast milk from the milk ducts 4. The negative pressure gradient or force 10 has also been shown to be more comfortable for the user and more like the sucking of a baby during breast-feeding, due in part to the widening of the nipple 2 as opposed to axially elongating or distending the nipple along axial direction A.

Displacement volume 510 extends almost to the leading edge of housing 500 where the housing is secured to insert 600, which assists in creating the negative pressure gradient or force 10 during the negative pressure stroke or cycle that causes lateral

sucking and lateral movement of the nipple 2 along the lateral component L. As shown in Fig. 29, the negative pressure gradient, vacuum or force 10 extends beyond the outer circumference of the areola 3 and is substantially laterally applied thereto during the negative pressure stroke or cycle, which further assists in creating a force on the nipple 2 with a greater lateral component L than axial component A and thus a widening of the nipple.

The positioning of tubular member 735 helps reduce the negative pressure gradient or force 10 axially from or in front of, the nipple 2 during the negative pressure stroke or cycle, which reduces discomfort associated with axial distention of the nipple. Tubular member 735 has an opening (not shown) formed along the tubular member wall. For softer breasts 1, which are pulled into the tubular member 735 during the negative pressure stroke, the opening allows application of the negative pressure or vacuum to the distal end of the nipple 2.

Referring to Figs. 30 through 31, a contemporary breast cup 20 is shown which is connected to a vacuum source through a vacuum line 21. The contemporary breast cup 20 has a hood 22 that can engage the breast 1 and a cylindrical extension 23 attached to the hood. The cylindrical extension 23 is in fluid communication with the vacuum line 21 and a collection member 24. The vacuum or negative pressure is supplied from the vacuum line through the cylindrical extension 23 and to the areola 2. A separation wall 27 seemingly prevents the breast milk from entering the vacuum line 21. The evacuation of the air in cylindrical extension 23 creates a negative pressure gradient or force 30 during the negative pressure stroke, as represented in Fig. 31.

The negative pressure gradient or force 30 has a greater axial component A than lateral component L during the negative pressure stroke, causing the nipple 2 to be pulled or sucked axially more than laterally, which has been shown to be significantly less efficient at causing expression of breast milk from the milk ducts. The negative pressure

gradient or force 30 having a greater axial component A than lateral component L during the negative pressure stroke, has also been shown to be uncomfortable for the user. The vacuum or negative pressure is supplied axially from or in front of, nipple 2 during the negative pressure stroke or cycle, which causes discomfort associated with axial elongation and distention of the nipple.

While breast cup 400 uses a flexible insert 600 partially defining a displacement volume 510 that applies the negative pressure gradient, vacuum or force 10 to the nipple 2 during the negative pressure stroke or cycle, the embodiment contemplates the use of other designs and arrangements that create the negative pressure gradient, vacuum or force 10. Alternative designs for breast cup 400 that cause greater widening of the nipple along the lateral component L as opposed to elongation or distention of the nipple along the axial component A during the negative pressure stroke or cycle are contemplated. Also, alternative designs for breast cup 400 that apply a negative force to nipple 2 during the negative pressure stroke having an average lateral component L that is greater than the average axial component A are contemplated. Further, alternative designs for breast cup 400 that apply a negative pressure gradient or vacuum to nipple 2 during the negative pressure stroke having an average lateral component L that is greater than the average axial component A are contemplated.

While the preferred embodiment describes the use of a motorized pump 100 that supplies the pressure to breast cup 400, the use of manual pumps for use with breast cup 400 is contemplated, including pumping mechanisms that are affixed to breast cup 400. Additionally, other barrier structures, designs or methods are contemplated which reduce the negative pressure, vacuum or negative force applied to the distal end or front of nipple 2, and/or reduce the axial component A of the negative pressure, vacuum or negative force applied to the nipple 2, as compared to the lateral component L.

It is contemplated that a valve or other known release mechanism (not shown) in fluid communication with displacement volume 510 could be used so that a user could alternatively selectively control the amount of positive or negative pressure at the breast cup 400 rather than only at the breast pump 100. The valve or release mechanism on the breast cup 400 could also be a quick release mechanism as a safety feature in the event of discomfort to the user. The valve or release mechanism could also be used to selectively allow only positive or negative pressure to be generated at the breast cup 400.

The modularity of breast cup 400 through use of three separate pieces that can be easily assembled, i.e., housing 500, insert 600 and holder 700, allows a kit to accommodate breasts of varying sizes and shapes. The kit can include a plurality of differently sized housings 500 and inserts 600, as well as differently shaped housings 500 and inserts 600, to accommodate different sized breasts and different shaped breasts. The plurality of different housings 500 and inserts 600 can all be assembled to holder 700 and can be connected to breast pump 100. An example of the variation in sizes of housings 500 and inserts 600 includes the inner and outer diameters throughout the housings and inserts, as well as the length of the housings and inserts. An example of the variation in shapes of housings 500 and inserts 600 includes varying the taper angle, as well as changing the circular shape of the leading edge of the housing and insert. Additionally, the modularity and interchangeability allows for the use of different shaped or sized massaging members or projections 634 on different inserts 600.

A kit containing a plurality of differently sized or shaped inserts 600 that can all be assembled to housing 500 and holder 700, to form a plurality of different breast cups 400 for use with breast pump 100 is also contemplated. The plurality of differently sized inserts 600 can be used to accommodate different sized breasts and also to change the displacement volume 510. The plurality of differently shaped inserts 600 can be used to accommodate differently shaped breasts, as well as to provide different massaging effects to the breasts, such as, for example, different massaging members 634 formed on the

insert. Examples of some alternative inserts 600 are described more fully in copending U.S. Published Patent No. 20030149398, filed December 27, 2002, the disclosure of which has been incorporated by reference herein in its entirety.

While the preferred embodiment of the breast pump system uses breast cup 400 having a displacement volume 510 in fluid isolation from the user's breast, alternative breast cups can also be used with breast pump 100. The unique features of the breast pump system can be used with other types of breast cups, such as, for example, the control system or the rack and pinion driving mechanism.

Referring to Fig. 34, an alternative embodiment of the breast cup is shown and generally represented by reference numeral 5400. Breast cup 5400 is usable with insert 600. Breast cup 5400 has a funnel shaped housing 5500 that is connected to a cylindrically-shaped holder 5700. Holder 5700 has a handle 5725, a pressure orifice 5750, and a pressure adjuster 5775. Handle 5725 is ergonomically contoured and has a wave-like shape 5730 that provides for different holding angles. Handle 5725 is disposed along holder 5700 on the opposing side from funnel 5500. Handle 5725 is preferably made of, or covered by, a material that facilitates gripping. Handle 5725 can include various textures, projections and/or embossments to sooth the users hand during the pumping process.

Pressure orifice 5750 can be attached to tubing 350 to place breast cup 5400 in fluid communication with breast pump 100. Pressure adjuster 5775 is in fluid communication with pressure orifice 5750 and allows a user to adjust the pressure at the breast cup 5400 without having to make an adjustment at the breast pump 100. In this embodiment, pressure adjuster 5775 is a dial but alternative actuators can also be used.

Referring to Fig. 35, another alternative embodiment of the breast cup is shown and generally represented by reference numeral 6400. Breast cup 6400 is usable with

insert 600. Breast cup 6400 has a funnel 6500 that is connected to a holder 6700. Holder 6700 has handle portions 6725, 6726, a pressure orifice 6750, and a pressure adjuster 6775. Handle portions 6725, 6726 are disposed on opposing sides of holder 6700 and facilitate grasping of the holder. Handle portions 6725, 6726 are preferably made of, or covered by, a material that facilitates gripping. Handle portions 6725, 6726 can include various textures, projections and/or embossments to sooth the users hand during the pumping process.

Referring back to Fig. 12, holder 700 of breast cup 400 provides a first set of threads 701 and a second set of threads 702. First and second threads 701, 702 have different diameters and are sized to fit the two standard sized bottles or holders that are used with infant feeding and breast pumping, i.e., reusable containers and disposable containers. The first and second threads 701, 702 have the same pitch and are concentrically aligned. During the molding process, this allows the steel mold core to be unscrewed from holder 700.

While the embodiment illustrated shows the dual threads, i.e., first and second threads 701, 702 on breast cup 400, the use of the dual threads on other infant care products that require the use of a holder or bottle, such as, for example, a nipple ring or a cap is contemplated. Referring to Figs. 36 and 37, a nipple ring is shown and generally represented by reference numeral 7000. Nipple ring 7000 has a circumferential wall 7100 with an inwardly extending flange 7200 defining an opening 7250. Nipple ring 7000 has the dual threads described above, i.e., a first set of threads 701 and a second set of threads 702. The nipple ring 7000 provides for engagement of nipple 7500 with either reusable containers by way of first threads 701 or disposable containers by way of second threads 702. Preferably, first threads 701 downwardly extend from flange 7200 and second threads 702 are formed along circumferential wall 7100.

Referring to Figs. 38 and 39, a cap is shown and generally represented by reference numeral 8000. Cap 8000 has a circumferential wall 8100 connected to a top wall 8200. Cap 8000 also has the dual threads described above, i.e., a first set of threads 701 and a second set of threads 702. The cap 8000 provides sealing of either reusable containers by way of first threads 701 or disposable containers by way of second threads 702. Preferably, first threads 701 downwardly extend from top wall 8200 and second threads 702 are formed along circumferential wall 8100.

Referring to Fig. 13, T-connector 300 is a triangular shaped valve that allows a user to utilize either a single breast cup 400 or two breast cups through use of a first orifice 310 and a second orifice 320. Breast pump 100 is connected to t-connector 300 through air tubing 350 at inlet 330. The single split valve configuration of t-connector 300 minimizes the amount of tubing 350 necessary for double pumping. T-connector 300 has a plug 340 for closing off either of first or second orifices 310, 320 if single pumping is desired. Preferably, plug 340 is tethered to an outer surface of t-connector 300 to facilitate engagement with first or second orifices 310, 320.

Referring to Fig. 14, a method of expressing breast milk according to the breast pump system, is shown. The user commences the breast pumping operation by turning breast pump 100 "on," as in step 800. This causes power to be supplied to breast pump 100 (step 810). The user then inputs the cycle time and suction level that is desired, as in step 820. In the preferred embodiment, the user has five cycle times and suction levels from which to choose. The cycle time and suction level is inputted by use of button pad 105.

In step 830, PC board 120 sets the motor speed and target piston travel distance according to the user's inputted levels for cycle time and suction. The cycle time and suction level are then displayed to the user, as in step 840. In this embodiment, the cycle time and suction level are indicated by lights 225 with the number of illuminated lights

corresponding to the level. In step 850, motor 125 is actuated causing piston 112 to move toward bottom 175 of cylinder 113. This creates a positive pressure that is supplied to breast cup 400 by air tubing 350.

In step 855, the PC Board monitors the home switch to determine whether it has been triggered by contact with piston 112. In step 860, it is determined whether the home switch has been triggered. If the home switch has been triggered then it is reset as in step 870. In step 880, motor 125 is then reversed causing piston 112 to move toward top 180 of cylinder 113. This creates a negative pressure that is supplied to breast cup 400 by air tubing 350. One of the advantages of the breast pump system is that is supplies both a positive pressure and a negative pressure through the same air tubing 350. This reduces cleaning and simplifies the operation for a user.

To provide the proper amount of suction as inputted by the user, photo-sensors 121 count the number of rack openings 50, as in step 890. In step 900, PC board 120 determines if the number of rack openings 50 that have been counted is the equivalent of the target piston travel distance as inputted by the user. In step 910, it is determined whether breast pump 100 is still "on." If breast pump 100 has been shut off then the pumping operation ends, as in step 915.

In step 920, it is determined whether the user has inputted a new cycle time or suction level. If a new cycle time or suction level has been inputted, then PC Board 120 sets the motor speed and target piston travel distance according to the user's inputted levels for cycle time and suction, reverting back to step 830 and repeating the above described steps. If the user has not inputted a new cycle time or suction level then the motor is again reversed causing piston 112 to move toward bottom 175 of cylinder 113. This creates a positive pressure that is supplied to breast cup 400 by air tubing 350. The process continues with breast pump 100 supplying positive pressure and then negative pressure to breast cup 400 until the breast pump is shut off (step 910).

The breast pump system includes a number of components and can be used in remote locations, such as when a user is traveling. The various components can be disposed within a bag system for ease of use. An example of such a bag system, as well as the components of such a system, is disclosed in the co-pending and commonly owned U.S. Published Patent No. 20030149398, filed December 27, 2002, the disclosure of which is incorporated herein by reference.

The present invention having been thus described with particular reference to the preferred forms thereof, it will be obvious that changes may be made therein without departing from the scope of the present invention as defined in the appended claims.

WHAT IS CLAIMED IS:

1. A breast pump for expressing breast milk from a breast, the pump comprising:

a pressure source having a movable structure for generating pressure during a pressure stroke, said movable structure having a variable pressure volume or variable cycle time; and

a controller operably connected to said pressure source,

wherein said controller regulates said pressure volume based upon a distance traveled by said movable structure and regulates said variable cycle time based upon a speed of said movable structure, and wherein said controller provides substantially real-time monitoring of said distance traveled and said speed.

2. The pump of Claim 1, wherein said controller can regulate said pressure cycle based upon a non-sinusoidal wave signal of said pressure versus said variable cycle time.

3. The pump of Claim 2, wherein said non-sinusoidal wave signal comprises a square curve wave signal.

4. The pump of Claim 1, wherein said controller can regulate said pressure cycle based upon a sine wave signal of said pressure versus said variable cycle time.

5. The pump of Claim 1, wherein said pressure comprises both a positive pressure and a negative pressure.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
ElviePumpPCT		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB2018/051659	15 June 2018 (15-06-2018)	15 June 2017 (15-06-2017)
Applicant		
CHIARO TECHNOLOGY LIMITED		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 9 sheets

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language**, the international search was carried out on the basis of:
      ☒ the international application in the language in which it was filed
      ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☒ **Certain claims were found unsearchable** (See Box No. II)

3. ☒ **Unity of invention is lacking** (see Box No III)

4. With regard to the **title,**
   ☒ the text is approved as submitted by the applicant
   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**
   ☒ the text is approved as submitted by the applicant
   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings,**
   a. the figure of the **drawings** to be published with the abstract is Figure No. 1
      ☒ as suggested by the applicant
      ☐ as selected by this Authority, because the applicant failed to suggest a figure
      ☐ as selected by this Authority, because this figure better characterizes the invention
   b ☐ none of the figures is to be published with the abstract

Form PCT/ISA/210 (first sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2018/051659

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 31-72(completely); 73-158(partially)
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-6, 11-14, 108-119(completely); 158(partially)

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees

Form PCT/ISA/210 (continuation of first sheet (2)) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2018/051659

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M1/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61M F04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2016 010524 A (MURATA MANUFACTURING CO) 21 January 2016 (2016-01-21) abstract figures 1-5,8	1-6, 11-14, 108-119, 158
X	US 2013/023821 A1 (KHALIL GAMAL [CH] ET AL) 24 January 2013 (2013-01-24) cited in the application page 3, paragraph 51-53 page 4, paragraph 66 - paragraph 69 figures 3-5,9-11	1-6, 11-14, 108-119, 158

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 September 2018	04/12/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax. (+31-70) 340-3016	Kempeneers, Johanna

2

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2018/051659

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2017/095599 A1 (KONDO DAISUKE [JP] ET AL) 6 April 2017 (2017-04-06) page 3, paragraph 55 - paragraph 57 page 7, paragraph 146 - page 8, paragraph 175 figures 1,15,16 -----	1,2,4-6, 108, 112-114, 158
A	US 2016/271305 A1 (KURIHARA KIYOSHI [JP] ET AL) 22 September 2016 (2016-09-22) page 3, paragraph 51 - paragraph 56 page 4, paragraph 61 page 6, paragraph 91 - paragraph 93 figures 1,2,6 -----	1,2,14, 118,158

2

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2018/051659

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2016010524 A	21-01-2016	NONE	
US 2013023821 A1	24-01-2013	AU 2012286462 A1	13-02-2014
		BR 112014001185 A2	21-02-2017
		CH 705295 A1	31-01-2013
		CN 103687634 A	26-03-2014
		EP 2734250 A1	28-05-2014
		IL 230280 A	28-06-2018
		JP 6062937 B2	18-01-2017
		JP 2014529312 A	06-11-2014
		KR 20140040232 A	02-04-2014
		MY 166874 A	24-07-2018
		PL 2734250 T3	31-03-2017
		RU 2014104019 A	27-08-2015
		TW 201304827 A	01-02-2013
		US 2013023821 A1	24-01-2013
		WO 2013010286 A1	24-01-2013
US 2017095599 A1	06-04-2017	JP 6213677 B2	18-10-2017
		JP WO2016002606 A1	27-04-2017
		US 2017095599 A1	06-04-2017
		WO 2016002606 A1	07-01-2016
US 2016271305 A1	22-09-2016	EP 3037116 A1	29-06-2016
		JP 6245280 B2	13-12-2017
		JP 2017205654 A	24-11-2017
		JP WO2015115516 A1	23-03-2017
		US 2016271305 A1	22-09-2016
		WO 2015115516 A1	06-08-2015

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-6, 11-14, 108-119(completely); 158(partially)

A wearable breast pump system as in claim 1, including special technical features of the piezo air-pump; A method of expressing and collecting milk, comprising the step of using such a wearable breast pump.

1.1. claims: 2(completely); 158(partially)

A wearable breast pump system as in claim 1, configured as a self-contained wearable device with an internal rechargeable battery; A method of expressing and collecting milk, comprising the step of using such a wearable breast pump

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2. claims: 7-10, 120-127(completely); 158(partially)

A wearable breast pump system as in claim 1, including special technical features of the diaphragm.

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3. claims: 15, 27, 28, 30, 87-95(completely); 158(partially)

A wearable breast pump system as in claim 1, including special technical features of the milk container; A method of expressing and collecting milk, comprising the step of using such a wearable breast pump

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4. claims: 16, 29, 73-86(completely); 158(partially)

A wearable breast pump system as in claim 1, including special technical features of the breast shield; A method of expressing and collecting milk, comprising the step of using such a wearable breast pump

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5. claims: 17-19, 21, 23, 128-157(completely); 158(partially)

A wearable breast pump system as in claim 1, including special technical features related to flow measurement and indication; A method of expressing and collecting milk, comprising the step of using such a wearable breast pump

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6. claims: 22(completely); 158(partially)

A wearable breast pump system as in claim 1, in which the centre of gravity with an empty milk container attached to te housing is at or below (i) the half-way height line of the housing or (ii) the horizontal line passing through a nipple tunnel or filling point on a breast shield (so that

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

the device that is not top-heavy for a woman using the pump); A method of expressing and collecting milk, comprising the step of using such a wearable breast pump

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7. claims: 24(completely); 158(partially)

A wearable breast pump system as in claim 1, including a data sub-system that collects and provides data to a connected device or remote application or remote sensor; A method of expressing and collecting milk, comprising the step of using such a wearable breast pump

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8. claims: 20, 25, 26, 96-107(completely); 158(partially)

A wearable breast pump system as in claim 1, including special technical features of the pump (control); A method of expressing and collecting milk, comprising the step of using such a wearable breast pump

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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 31-72(completely); 73-158(partially)

The present application contains 158 claims, of which 44 are independent.

There is no clear distinction between several of the 44 independent claims because of overlapping scope. Various independent claims directed to subject-matter that does not (completely) overlap do not meet the requirements of unity of invention (Rule 13 PCT).

According to what can be understood from the description, it seems that a protection is sought after for several a spects of a breast pump system:

- wearability (including a housing shaped at least in part to fit inside a bra)
- technical features of the breast shield
- technical features of the milk container
- technical features of the pump and its control to improve user comfort
- the pump is specifically a piezo air-pump (possibly two piezo air-pumps in series or in parallel), and details thereof
- a separate deformable diaphragm to generate negative air pressure inside the breast shield, the diaphragm as such separating the (piezo) air-pump from the breast shield such that the (piezo) air-pump forms part of a closed loop system
- a flow measurement and milk volume indication means

The 44 independent claims are either directed to one of the above aspects, or to what appears to be an aleatory mix and match of two or several of these aspects.

Moreover, from the 114 dependent claims, 85 claims are dependent on any of the 41 independent claims directed to a "system" (as well as on any of the other dependent claims). They too are directed to one of the above aspects, or to what appears to be an aleatory mix and match of two or several of these aspects.

There are thus so many claims, and they are drafted in such a way that the claims as a whole are not in compliance with the provisions of clarity and conciseness of Article 6 PCT, as it is particularly burdensome for a skilled person to establish the subject-matter for which protection is sought.

The non-compliance with the s ubstantive provisions is to such an extent, that the search was performed taking into consideration the non-compliance in determining the extent of the search (PCT Guidelines 9.19 and 9.25).

The search was based on the subject-matter that is expected to be claimed later in the procedure, and the corresponding independent claim 1. Moreover, independent claim 158, directed to a method of expressing and collecting milk, comprising the step of using a system as defined in claim 1, has also been searched. Independent claims 31-72 and independent claim 158 when referring to any of the independent

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

claims 31-72 were not searched. Claims 73-157 when being dependent on any of claims 31-72 were also not searched.
Since the claims dependent on
claim 1 are not complying with unity of invention (Rule 13 PCT) (see non unity reasoning), the extent of the search was further limited to the technical features as claimed in claim 1 in combination with the first and second invention for which protection is sought, namely dependent claim 2 and the dependent claims further specifying details concerning the piezo air-pump (claims 3-6, 11-14, 108-119).

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.

Electronic Patent Application Fee Transmittal					
Application Number:	17203292				
Filing Date:	16-Mar-2021				
Title of Invention:	BREAST PUMP SYSTEM				
First Named Inventor/Applicant Name:	Jonathan O'TOOLE				
Filer:	Kassity L. Mai/Scott Dodge				
Attorney Docket Number:	ELVI-002/14US				
Filed as Small Entity					
Filing Fees for **Utility under 35 USC 111(a)**					
Description		**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:					
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					
Extension-of-Time:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	2806	1	130	130
		Total in USD ($)		**130**

Electronic Acknowledgement Receipt	
EFS ID:	44026357
Application Number:	17203292
International Application Number:	
Confirmation Number:	9955
Title of Invention:	BREAST PUMP SYSTEM
First Named Inventor/Applicant Name:	Jonathan O'TOOLE
Customer Number:	58249
Filer:	Kassity L. Mai/Scott Dodge
Filer Authorized By:	Kassity L. Mai
Attorney Docket Number:	ELVI-002/14US
Receipt Date:	14-OCT-2021
Filing Date:	16-MAR-2021
Time Stamp:	10:37:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$130
RAM confirmation Number	E20210DA38091922
Deposit Account	501283
Authorized User	Scott Dodge
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	ELVI-002-14US_IDS_Transmittal.pdf	109652 d276651d36a532145f2ec74396f3f11c386a1498	no	5
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	ELVI-002_14US_IDS_20211013134421.pdf	111298 f0178d74d495e9d955b324a95ca7adac2544b1f2	no	3
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Foreign Reference	CN101549180A_EFS.pdf	1275076 f514627a3a1fd62e612dcea1ab0f2629f45e1ec73	no	29
Warnings:					
Information:					
4	Foreign Reference	GB2435617B_EFS.pdf	1960765 a0a3627bb157bf6bb2c164b5816636471 4e910b0	no	67
Warnings:					
Information:					
5	Other Reference-Patent/App/Search documents	002-04WO_ISR.pdf	309414 d00a7d0b55be23742a16f08f55945a2ae00c3979	no	9
Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	37821 c7d396dafc2cb29fda4c3cf09aacc4d09273426f	no	2
Warnings:					

Information:	
Total Files Size (in bytes):	3804026

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Docket No.: ELVI-002/14US
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Inventor:	Jonathan O'TOOLE	Confirmation No.:	9955
Application No.:	17/203,292	Group Art Unit:	3783
Filed:	March 16, 2021	Examiner:	Courtney B. FREDRICKSON

For: BREAST PUMP SYSTEM

VA EFS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT
UNDER 37 C.F.R. §§ 1.56, 1.97, AND 1.98

In accordance with the duty of disclosure set forth in 37 C.F.R. §1.56, Applicant hereby submits the following information in conformance with 37 C.F.R. §§1.97 and 1.98. It is respectfully requested that the information be expressly considered during the prosecution of this application, and the references be made of record therein and appear among the "References Cited" on any patent to issue therefrom.

[x] Pursuant to 37 C.F.R. §1.98, a copy of each non-US patent document at cite nos. 026, 028 and 032 on the attached Form used in lieu of PTO/SB/08 is enclosed.

[x] No copies of the foreign patent, foreign patent application, or non-patent literature publications listed on the attached Form used in lieu of PTO/SB/08 are being provided pursuant to 37 C.F.R. §1.98(d) except for cite nos. 026, 028 and 032 because the publications were previously cited by or submitted to the Office in prior Application Serial No(s). 17/181,057 and/or 16/009,547 to which the above-identified application claims priority under 35 U.S.C. §120.

[x] No copies of any U.S. patents or U.S. patent application publications listed on the attached Form used in lieu of PTO/SB/08 are being provided pursuant to 37 C.F.R. §1.98.

[] Publication(s) listed on the attached Form used in lieu of PTO/SB/08 were cited in a foreign search or examination report corresponding to application serial no. and mailed on .

[] Enclosed is a copy of a non-English publication(s) _____ Pursuant to §609 of the M.P.E.P., Applicant submits the attached foreign search or examination report, which cites such non-English language publication(s).

[] Enclosed is a copy of a non-English publication(s) _____ English language publication _____ (copy enclosed) claims priority from this non-English publication.

[] Enclosed is an explanation of non-English publication(s) _____ for which an English translation is not available.

[] Enclosed is an English translation of non-English publication(s) _____ cited on the attached Form used in lieu of PTO/SB/08.

[] Enclosed is an English language Abstract of non-English publication(s) _____ cited on the attached Form used in lieu of PTO/SB/08.

[] Enclosed is a copy of pending patent Application No. _____.

[] In accordance with **37 C.F.R. §1.97(b)**, no additional fee for submission of this Information Disclosure Statement is required, as it is filed within any one of the following time periods:

[] within three months from the filing date of this national application other than a CPA under 37 C.F.R. § 1.53(d);

[] within three months from the date of entry of the national stage as set forth in 37 C.F.R. §1.491 in this international application;

[] before the mailing date of a first Office action on the merits; or

[] before the mailing of a first Office action after the filing of a request for continued examination under 37 C.F.R. § 1.114.

[x] In accordance with **37 C.F.R. §1.97(c)**, this Information Disclosure Statement is filed after the period specified in 37 C.F.R. § 1.97(b), but before the mailing of any of the following: a final action under 37 C.F.R. §1.113; a notice of allowance under 37 C.F.R. §1.311; or an action that otherwise closes prosecution in this application.

In accordance with 37 C.F.R. §1.97(c) also enclosed is:

[] Fee under 37 C.F.R. §1.17(p) in the amount of $260.00;

[x] Fee under 37 C.F.R. §1.17(p) in the amount of $130.00;

[] Fee under 37 C.F.R. §1.17(p) in the amount of $65.00; or

[] Statement as specified in 37 C.F.R. §1.97(e):

[] Each item of information contained in the Information Disclosure Statement cited herein was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing date of the Information Disclosure Statement; or

[] No item of information contained in the Information Disclosure Statement submitted herewith was cited in any communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned, having made a reasonable inquiry, no item of information contained in the Information Disclosure Statement was known to any individual designated in 37 C.F.R. §1.56(c) more than three months prior to the filing date of the Information Disclosure Statement.

[] This Information Disclosure Statement is filed after payment of the issue fee, but before issuance of the patent under the Quick Path Information Disclosure Statement pilot program.

In accordance with the Quick Path Information Disclosure Statement pilot program also enclosed is:

[] Fee under 37 C.F.R. §1.17(p) in the amount of $260.00;

[] Fee under 37 C.F.R. §1.17(p) in the amount of $130.00;

[] Fee under 37 C.F.R. §1.17(p) in the amount of $65.00;

and

[] Statement as specified in 37 C.F.R. §1.97(e):

[] Each item of information contained in the Information Disclosure Statement cited herein was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing date of the Information Disclosure Statement; or

[] No item of information contained in the Information Disclosure Statement submitted herewith was cited in any communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned, having made a reasonable inquiry, no item of information contained in the Information Disclosure Statement was known to any individual designated in 37 C.F.R. §1.56(c) more than three months prior to the filing date of the Information Disclosure Statement.

[] In accordance with **37 C.F.R. §1.97(d)**, this Information Disclosure Statement is filed after the period specified in 37 C.F.R. § 1.97(c), but with or before the payment of the issue fee.

In accordance with 37 C.F.R. §1.97(d) also enclosed is:

[] Fee under 37 C.F.R. §1.17(p) in the amount of $260.00;

[] Fee under 37 C.F.R. §1.17(p) in the amount of $130.00; or

[] Fee under 37 C.F.R. §1.17(p) in the amount of $65.00;

and

[] Statement as specified in 37 C.F.R. §1.97(e):

- [] Each item of information contained in the Information Disclosure Statement cited herein was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing date of the Information Disclosure Statement; or
- [] No item of information contained in the Information Disclosure Statement submitted herewith was cited in any communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned, having made a reasonable inquiry, no item of information contained in the Information Disclosure Statement was known to any individual designated in 37 C.F.R. §1.56(c) more than three months prior to the filing date of the Information Disclosure Statement.

[] In accordance with **37 C.F.R. § 1.704(d)**, Applicant notes that to our knowledge each item of information contained in the information disclosure statement:

- [] was first cited in any communication from a patent office in a counterpart foreign or international application or from the Office, and this communication was not received by any individual designated in § **1.56(c)** more than thirty days prior to the filing of the information disclosure statement.
- [] is a communication that was issued by a patent office in a counterpart foreign or international application or by the Office, and this communication was not received by any individual designated in § **1.56(c)** more than thirty days prior to the filing of the information disclosure statement.

In accordance with 37 C.F.R. § 1.97(g), this Information Disclosure Statement shall not be construed as to mean that a search has been made.

In accordance with 37 C.F.R. § 1.97(h), the filing of this Information Disclosure Statement shall not be construed to be an admission that the information cited in the statement is, or is considered to be material to patentability as defined by 37 C.F.R § 1.56(b).

REMARKS

It is respectfully requested that the Examiner consider the above-noted information and return an initialed copy of the attached Form used in lieu of PTO/SB/08 to the undersigned.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Director is hereby authorized to charge any additional fees which may be required with respect to this communication, or credit any overpayment, to Deposit Account No. 50-1283, under Order No. ELVI-002/14US.

Dated: October 14, 2021

Respectfully submitted,
COOLEY LLP

Electronic signature: /Kassity L. Mai/
Kassity L. Mai
Reg. No. 68,774

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/203,292	03/16/2021	Jonathan O'TOOLE	ELVI-002/14US	9955

58249 7590 11/23/2021

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Suite 700
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EXAMINER	
FREDRICKSON, COURTNEY B	
ART UNIT	PAPER NUMBER
3783	
NOTIFICATION DATE	DELIVERY MODE
11/23/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zIPPatentDocketingMailboxUS@cooley.com

Office Action Summary	Application No. 17/203,292	Applicant(s) O'TOOLE et al.	
	Examiner COURTNEY FREDRICKSON	Art Unit 3783	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 24September 2021.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1,3-10 and 12-32 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1,3-10 and 12-32 is/are rejected.

8) ☑ Claim(s) 29 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 16March2021 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☑ All b)☐ Some** c)☐ None of the:

1.☑ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Information Disclosure Statement

The information disclosure statement (IDS) submitted is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Response to Amendment

This office action is responsive to the amendment filed on September 24, 2021. As directed by the amendment: claims 1, 3, 4, 7, 8, 10, 12-14, 16, 17, 19, 2 1-23, and 26-30 have been amended, claims 2 and 11 have been cancelled, and claims 31 and 32 have been added. Thus, claims 1, 3-10, and 12-32 are presently pending in this application.

Applicant's amendments to the Specification, Drawings, and Claims have overcome each and every objection and 112(b)/(d) rejections previously set forth in the Non-Final Office Action mailed June 24, 2021.

Response to Arguments

Applicant's arguments with respect to claim(s) 1 have been considered but are moot because the new ground of rejection does not rely on any reference applied in the prior rejection of record for any teaching or matter specifically challenged in the argument.

The examiner notes that newly applied Myers discloses all of the claimed limitations in amended claim 1, as discussed in further detail below. It is recommended to amend the claim to re-incorporate the limitation regarding "and seated in a diaphragm holder" to the claim and to file the appropriate terminal disclaimers to overcome the current rejection. As seen in fig. 5 of Myers, the diaphragm 36 is shown to be positioned against holder 40 but not in the diaphragm holder.

Claim Rejections - 35 USC § 112

> The following is a quotation of 35 U.S.C. 112(b):
> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.
>
> The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 24 is rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

Claim 24 recites the limitation "the rechargeable battery" in line 2. There is insufficient antecedent basis for this limitation in the claim. For examination purposes, the limitation is interpreted to mean "the battery".

Claim Rejections - 35 USC § 102

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any

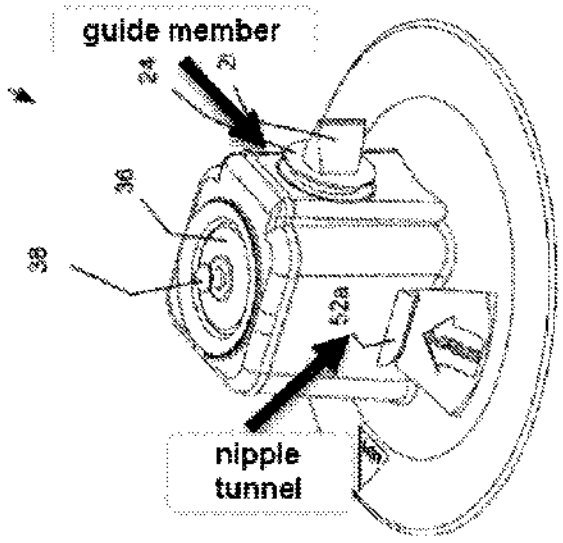
correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale, or otherwise available to the public before the effective filing date of the claimed invention.

Claim(s) 1, 3-6, 8, 9, 13, 14, 23, 25, 31, and 32 is/are rejected under 35 U.S.C. 102(a)(1) as being anticipated by Myers (US 2008027538).

Regarding claim 1, Myers discloses a breast pump device that is configured as a self-contained, in- bra wearable device (10 in fig. 1), the breast pump device comprising a housing (14 in fig. 1) that includes (a) a battery (paragraph 42), and an air pump powered by the battery and generating negative air pressure (50 in fig. 10); a diaphragm configured to prevent milk from reaching the pump (36 in fig. 9A/B); a breast shield (18 in fig. 2) made up of a breast flange and a nipple tunnel (see below) and that is configured to slide out from the housing together with the diaphragm (fig. 9A/B shows the diaphragm monolithic with the shield indicating that the two elements are functionally capable of sliding in/out of the housing); and a milk container that is configured to attach to the housing (28 in fig. 1, 21, and 22 shows the bag operationally attached to the housing).



Regarding claim 3, Myers discloses in which the breast shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto a breast (the shield is functionally capable of rotating around the nipple before being fully latched onto the nipple).

Regarding claim 4, Myers discloses the breast shield is a one piece item that, in use, presents a single continuous surface to a nipple and a breast (fig. 9A).

Regarding claim 5, Myers discloses the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 9A).

Regarding claim 6, Myers discloses the breast flange and the nipple tunnel are a single, integral item with no joining stubs (fig. 9A).

Regarding claim 8, Myers discloses the breast shield is configured to slide in and out from the housing, together with the diaphragm, on guide members in the breast shield (the examiner notes that the "guide members" are not particular well defined; rounded edges below are linearly oriented and would help guide the shield out of the housing).

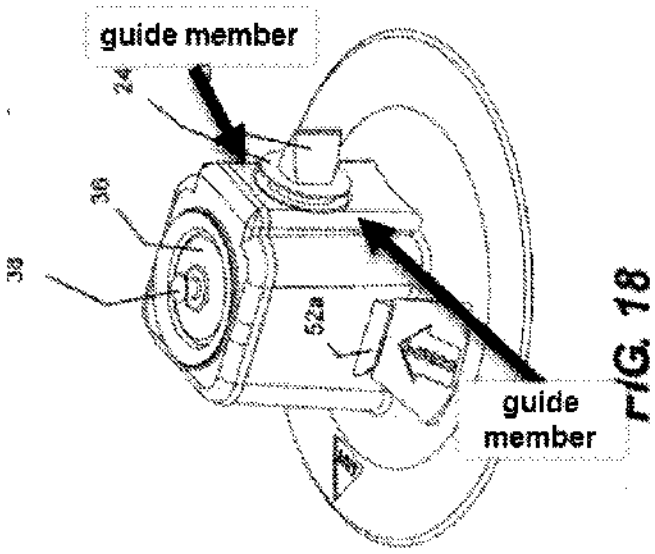


FIG. 18

Regarding claim 9, Myers discloses the housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members (52A in fig. 5).

Regarding claim 13, Myers discloses the diaphragm is a membrane that is seated against a diaphragm holder (fig. 6 shows the diaphragm seated against arm 40), the diaphragm deforming in response to changes in air pressure caused by the air pump to create negative air pressure in the nipple tunnel (figs. 9A/B).

Regarding claim 14, Myers discloses the diaphragm is removable from a diaphragm holder that sits above the breast flange and the nipple tunnel (fig. 6).

Regarding claim 23, Myers discloses the nipple tunnel includes on a lower surface an opening through which expressed milk flows under gravity into the milk container (24 in fig. 9A).

Regarding claim 25, Myers discloses the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (rounded exterior

of 16 in fig. 2), and a rear surface that is shaped to contact, at least in part, the breast shield (19 in fig. 2).

Regarding claim 31, Myers discloses a breast pump device that is configured as a self-contained, in-bra wearable device (10 in fig. 1), the breast pump device comprising: (i) a housing (14 in fig. 1) that includes (a) a battery (paragraph 42), and (b) an air pump powered by the battery and generating negative air pressure (50 in fig. 10); (ii) a breast shield (18 in fig. 2) made up of a breast flange and a nipple tunnel (see below) and that is configured to slide out from the housing on linear guide members (the examiner notes that the "linear guide members" are not particularly defined; the rounded edges shown below are linear and would help guide the); and (iii) a milk container that is configured to attach to the housing (28 in fig. 1, 21, 22).

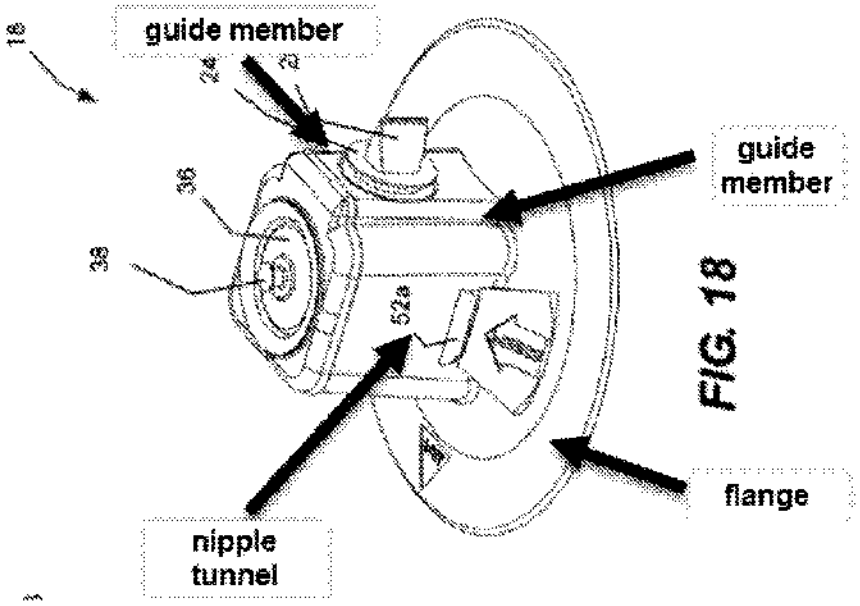


FIG. 18

Regarding claim 32, Myers discloses the air pump is configured to generate negative air pressure with a maximum suction of approximately 240 mmHg (paragraph 62).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claim 10 is/are rejected under 35 U.S.C. 103 as being unpatentable over Myers, as applied to claim 1 above, and further in view of Miller (US 20160325031).

Regarding claim 10, Myers all of the claimed limitations set forth in claim 1, as discussed above. but does not explicitly teach or disclose the breast pump device includes only two parts that are directly removable from the housing in normal use or normal dis-assembly: the breast shield and the milk container.

Miller teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to one of ordinary skill before the effective filing date of the claimed

invention to have modified the device of Myers to include only two parts that are directly removable from the housing in normal use or normal dis-assembly: the breast shield and the milk container, for the purpose of enabling easy cleaning on the shield and container.

Claim 24 is/are rejected under 35 U.S.C. 103 as being unpatentable over Myers, as applied to claim 1 above, and further in view of Makower (US 20170072118).

Regarding claim 24, Myers discloses all of the claimed limitations set forth in claim 1, as discussed above, but does not teach or disclose a wireless data communications system powered by the battery.

Makower is directed towards a substantially similar breast pump device (fig. 1b) having a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the device of Myers to include the wireless data communications system, as taught by Makower, for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).

Claims 26 and 27 is/are rejected under 35 U.S.C. 103 as being unpatentable over Myers, as applied to claim 1 above, and further in view of Makower (US 20160206794), hereinafter referred to as "Makower '794".

Regarding claim 26, Myers all of the claimed limitations set forth in claim 1, as discussed above, but does not teach or disclose the housing includes a visual and/or haptic indicator that indicates whether milk is flowing or not flowing into the milk container.

Makower '794 teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 1; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the display of Myers to be capable of displaying volume and flow rate, as taught by Makower '794. This modification would enable a user to keep track of milk expression data to monitor pumping efficiency over time.

Regarding claim 27, Myers discloses all of the claimed limitations set forth in claim 1, as discussed above, but does not teach or disclose the housing includes a visual and/or haptic indicator that indicates if the pump is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the milk container above its base is increasing above a threshold rate of increase.

Makower '794 teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates if the pumping mechanism is operating correctly to pump

milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the display of Myers to be capable of displaying volume and flow rate, as taught by Makower '794. This modification would enable a user to keep track of milk expression data to monitor pumping efficiency over time.

Claim 28 is/are rejected under 35 U.S.C. 103 as being unpatentable over Myers, as applied to claim 1 above, and further in view of Takeuchi (US 20170043065).

Regarding claim 28, Myers discloses all of the claimed limitations set forth in claim 1, as discussed above, but does not teach or disclose the pump comprises a piezo air pump system.

Takeuchi teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the air pump of

Myers to be a piezo air pump and to have attached the piezoelectric element onto the diaphragm of Myers. This modification would provide the added advantage of reducing motor sound and vibration typically caused by electric motors, as taught by Takeuchi (paragraph 7).

Claim 30 is/are rejected under 35 U.S.C. 103 as being unpatentable over Myers, as applied to claim 1 above, in further view of Baker (US 20090281485).

Regarding claim 30, Myers discloses all of the claimed limitations set forth in claim 1, as discussed above, but does not teach or disclose the breast pump device makes less than 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.

Baker is directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump embodied as a motor (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing and by adding a counter balance to the motor (paragraph 144). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the device of Myers to have the device make less than 20 dB of noise during maximum power for the purpose of making the device for discrete and comfortable for the user and others around the user.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent

and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP § 2146 *et seq.* for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets

all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claims 1, 3-10, 12-28, and 30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over the following copending applications and in view of the teachings below (see table):

Claim 11 of copending Application No. 17/181057

Claim 12 of copending Application No. 17/203050

Claim 20 of copending Application No. 17/203313

Claim 8 of copending Application No. 17/203327

Claim 8 of copending Application No. 17/203355

Claim 8 of copending Application No. 17/203150

Claim 23 of copending Application No. 17/203109

Claim 16 of copending Application No. 17/203179

Claim 8 of copending Application No. 17/203397

Claim 8 of copending Application No. 17/203418

Although the claims at issue are not identical, they are not patentably distinct from each other because all of the elements of the application claims can be found in the application claim. With regard to **claim 1** of the application, the reference claim above of the copending applications claim all of the features of instant claim 1. Further, the reference application includes additional features not recited in the instant application claims, thus the reference claim is more specific. It has been held that the

specific invention anticipates the generic invention. See *In re Goodman*, USPQ2d 2010 (Fed. Cir. 1993).

'292 Claims	'Ref Claims	Teaching
1	See claim referenced no. above	See discussion above
3		Rigert (US 20180028733) teaches a breast shield system (1 in fig. 1) for a breast pump which comprises a shield (10 in fig. 2). Rigert further teaches that the shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto the breast (paragraph 15 discloses that the shield can be rotated to determine the optimal level of comfort for a user depending on breast size and shape; the examiner notes that the shield of Rigert is capable of rotating smoothly since fig. 2 shows the interior of the shield is smooth and the size of the nipple relative to the nipple tunnel is not defined). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application have the claimed feature or the purpose of finding the optimal position for the user's breast shape and size.
4		Khalil (US 20130023821) teaches the breast shield is a one piece item that in use presents a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed; fig. 11 shows that the shield comprises the breast flange and the nipple tunnel and no other stubs are joined). It would have been obvious to have modified the claim of the reference application for the purpose of obviating the need for separate pieces which would increase the risk of leakage.

7		Khalil teaches the breast shield is generally symmetrical about a centre-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical). It would have been obvious to have modified the claim of the reference application for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	12	
9		Guthrie (US 20160220745) teaches a breast pump system (fig. 2A) having a housing (204 in fig. 2A) which is configured to slide onto a breast shield (201 in fig. 2A) when the breast shield has been placed onto a breast using guide members (paragraph 39 discloses a threaded attachment; the examiner notes that the term "sliding" is interpreted to mean "to move smoothly along a surface" using the threads as guide members). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable attachment mechanism for coupling the shield to the housing.
10		Miller (US 20160325031) teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to have modified the claim of the reference application with the claimed limitation for the purpose of enabling easy cleaning of the shield and container.
12		Khalil teaches the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (fig. 5 shows the membrane sealing to holder 2). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
13		Khalil teaches the diaphragm is a membrane that is seated against a diaphragm holder (4 in fig. 11), the diaphragm deforming in response to changes in air pressure caused by the air pump to create negative air pressure in the nipple tunnel (figs. 3 and 4). It would have been obvious to have modified the reference claim since Khalil teaches that the diaphragm holder provides the added advantage of protecting the diaphragm.
14		Khalil teaches the diaphragm is removable from a diaphragm holder (4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this position enables the nipple tunnel to be fluidically connected to the milk container (fig. 10 shows the housing attaching to a milk container).

15		Phillips (US 20160296682) teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of the reference application to be made Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).
16		Thompson (US 7662018) teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the reference application to have the claimed feature since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).
17		Khalil teaches the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the entire device can be held comfortably inside the bra (fig. 9 shows that the entire device is capable of being held in a bra). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature since it provides a hands-free breast pump unit which can be worn inside the bra (paragraph 70)
18		Khalil teaches the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'). Therefore, it would have been obvious to have modified the claim of the reference application to have the claimed feature for the purpose of preventing milk from being sucked back into the pump.

19		Khalil teaches the milk container is attachable to the housing with a mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action (the examiner notes that this limitation is being interpreted to mean a "mechanical or magnetic mechanism" as set forth on pg. 105, lines 1-2 of applicant's specification; locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined). It would have been obvious to have modified the claim of the reference application for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the milk container includes a cap that is removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and a removable valve that enables milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection). It would have been obvious to have modified the claim of the reference application for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Khalil teaches a top of a container which is optically clear (paragraph 69 discloses the container is clear in its entirety). Guthrie (US 20160220743) teaches a system subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie '743 further teaches that this sensor subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling accurate measurement of the milk while milk is being expressed and enabling a user to view the expressed milk.
22		Khalil teaches the milk container is shaped or configured to also serve as a drinking bottle that is readily held by a baby because it is wider than it is tall (fig. 11 shows the container is capable of being used as a drinking bottle since it is shown to be wider than tall). It would have been obvious to have modified the claim of the reference application since Khalil teaches that this configuration helps provide a hands-free pump which can be worn in a bra (paragraph 70).

23		Khalil teaches the nipple tunnel includes on its lower surface an opening through which expressed milk flows under gravity into the milk container (the examiner notes that the term "lower" is a relative direction and is not defined by the claim; fig. 5 of Khalil shows an opening formed in the surface of the nipple tunnel, this surface being it's "lower surface"). It would have been obvious to have modified the claim of the reference application for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Makower (US 20170072118) is directed towards a substantially similar breast pump device (fig. 1b) comprises a wireless data communications system (paragraph 11 discloses that the controller comprises a wireless transceiver to receive/send signals to an external device) which is powered by the battery (since the wireless system is disclosed to be a part of the controller in paragraph 11 and paragraph 12 discloses that the battery powers the controller, the battery must power the wireless system). It would have been obvious to have modified the claim of the reference application for the purpose of enabling data transmission relating to pumping parameters which can assist a user in keeping track of the volume of milk extracted and track efficiency over time, as taught by Makower (paragraph 11).
25		Khalil teaches the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9). It would have been obvious to have modified the claim of the reference application to have the claimed features since Khalil teaches that this configuration assists in providing for a hands-free unit which can be worn in a bra (paragraph 70).
26		Makower (US 20160206794) teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). It would have been obvious to have modified the claim of the reference application to have the claimed features for enabling a user to keep track of milk expression data to monitor pumping efficiency over time.

27		Makower (US 20160206794) teaches having a visual indicator that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of enabling a user to keep track of milk expression data to monitor pumping efficiency over time.
28		Takeuchi (US 20170043065) teaches a device (101) for suctioning bodily fluids from the body (paragraph 3) comprising a piezo air pump (104; paragraph 8, lines 8-10) mounted in a housing (fig. 6) further comprising a piezoelectric element (106) attached to a diaphragm (105). It would have been obvious to have modified the claim of the reference application to have the claimed features for reducing motor sound and vibration (paragraph 7).
30		Baker (US 20090281485) directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing (paragraph 144). It would have been obvious to have modified the claim of the reference application to have the claimed features for the purpose of making the device for discrete and comfortable for the user and others around the user.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Allowable Subject Matter

Excepting for the double patenting rejections above, **claims 7, 12, and 15-22** would be allowable over the prior art of record.

Claim 29 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: The closest piece of prior art is Myers. Myers does not teach or disclose the particulars of the aforementioned dependent claims. Specifically, as seen in figs. 9A/B, Myers does not teach a symmetrical breast shield. Myers teaches that the diaphragm is seated against a diaphragm holder (40 in fig. 5) but does not disclose that the diaphragm self-seals to the diaphragm holder. Additionally, Myers teaches that the container is a bag which hangs below the bra (fig. 1); as such, PHOSITA would not be motivated to modify the bag to be rigid, flat bottomed, or to fit inside a bra.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to COURTNEY FREDRICKSON whose telephone number is (571)270-7481. The examiner can normally be reached on Monday-Friday (9 AM - 5 PM EST).

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NATHAN PRICE can be reached on 571-270-5421. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/COURTNEY B FREDRICKSON/
Examiner, Art Unit 3783

/NATHAN R PRICE/
Supervisory Patent Examiner, Art Unit 3783

Notice of References Cited	Application/Control No. 17/203,292	Applicant(s)/Patent Under Reexamination O'TOOLE et al.	
	Examiner COURTNEY FREDRICKSON	Art Unit 3783	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20080275386-A1	11-2008	Myers; Kenneth E.	A61M1/81	604/74
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/203,292	O'TOOLE et al.
	Examiner	Art Unit
	COURTNEY FREDRICKSON	3783

CPC - Searched*		
Symbol	Date	Examiner
a61m1/06, 1/062, 1/066; a61j13/00; a41c4/04	06/19/2021	cbf

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
see SEARCH history	06/19/2021	cbf
Searched inventors in PALM and SEARCH	06/19/2021	cbf
Consulted parent history	06/19/2021	cbf
Consulted SPE Nathan Price for allowable subject matter	06/19/2021	cbf
Updated search	11/10/2021	cbf

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/COURTNEY B FREDRICKSON/ Examiner, Art Unit 3783	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/203,292	O'TOOLE et al.
	Examiner	Art Unit
	COURTNEY FREDRICKSON	3783

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS										
☐ Claims renumbered in the same order as presented by applicant						☐ CPA		☐ T.D.		☐ R.1.47
CLAIM		DATE								
Final	Original	06/18/2021	11/10/2021							
	1	✓	✓							
	2	✓	-							
	3	✓	✓							
	4	✓	✓							
	5	✓	✓							
	6	✓	✓							
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	29	✓	O							
	30	✓	✓							
	31		✓							
	32		✓							

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	268	a61m1/$.cpc. AND ((breast milk) WITH pump$4) AND ((power$4 battery) WITH (charg$4 recharg$4))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/12 04:05 PM
L2	65	("20020193731"|"20040056641"|"20040074281"|"20040267215"|"20050219302"|"20060122575"|"20070051172"|"20070051727"|"20080262420"|"20120277636"|"20140052056"|"20150217036"|"20150217037"|"20150283311"|"20160000980"|"20160058929"|"20160082165"|"20160082166"|"20160151551"|"20160158424"|"20160206794"|"20160220743"|"20160220745"|"20160287767"|"20160296681"|"20160310650"|"20170021068"|"20170035951"|"20170143879"|"20170220753"|"20180021490"|"2849881"|"4390024"|"5474683"|"5941847"|"5973770"|"6045529"|"6090065"|"6383163"|"6440100"|"6461324"|"6547756"|"6579258"|"6663587"|"6749582"|"7048519"|"7201735"|"7312554"|"7314400"|"7776008"|"8057425"|"8118772"|"8187227"|"8262606"|"8282596"|"8376986"|"8702646"|"8801495"|"8876760"|"8926556"|"9033913"|"9173587"|"9345274"|"9539377"|"D548831").PN.	(US-PGPUB; USPAT)	OR	OFF	OFF	2018/08/07 01:17 PM
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		piezo$9	JPO)				
L5	19	("20040122358" | "20060226108" | "20080077042" | "20080167579" | "20120004603" | "3895533" | "4024856" | "4338953" | "5347656" | "5666104" | "5827191" | "7316653" | "7621797" | "7794425" | "8308648" | "8777864" | "8801658" | "8827911").PN. OR ("8992445").URPN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/07 01:50 PM
L6	7	("5730139" | "6423010" | "6602199" | "7479154" | "8206414" | "8425426" | "8992445").PN. OR ("9192325").URPN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/07 01:59 PM
L7	582	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 02:16 PM
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L9	2787	(a61m1/062 a61m1/066 a61m1/06).cpc. not L7	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 02:58 PM
L10	45	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/07 02:59 PM

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L20	37	L19 and (air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 11:48 AM
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L22	16	L19 and (pump$4 same diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 12:15 PM
L23	1	L19 and piezo	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 12:40 PM
L24	0	a61m1/1058.cpc. and breast and diaphragm	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/10 12:42 PM
L25	5	breast same pump$4 same piezo$8 same air	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/10 12:43 PM
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L29	1	"59563425".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 10:20 AM
L30	87	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 10:26 AM

		20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$).did.					
L31	44	L30 and (air with	(US-PGPUB; USPAT;	OR	OFF	OFF	2018/08/24

		pump$4)	USOCR; FPRS; EPO; JPO)				10:26 AM
L32	17	L30 and (pump$4 with diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 10:27 AM
L33	51	L27 and "air pump"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 11:07 AM
L34	4	"47900902".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 11:13 AM
L35	10	("20030212374" | "20050251089" | "20050283900" | "20070135778" | "20110054389" | "3084691" | "4229029" | "5295957" | "6070659").PN. OR ("9511176").URPN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/24 11:16 AM
L36	2	"51149640".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 11:17 AM
L37	271	L27 and (control$4 same select$4 left same right same breast)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 12:50 PM
L38	3	L30 and (recharg$4 with battery)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 01:04 PM
L39	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:41 PM
L40	9	L39 and ((center centre) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:41 PM
L41	11	L39 and (light with milk with (volume quantity amount height))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:48 PM
L42	0	L39 and (radiation with milk with (volume quantity amount height))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:51 PM
L43	2	L39 and (radiation same milk same (volume quantity amount height))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:51 PM
L44	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:13 PM
L45	10	L44 and ((piezo piezoelectric piezo-electric) same air same pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:13 PM
L46	1	a61m1/1058 and	(US-PGPUB; USPAT;	OR	OFF	OFF	2018/08/24

		(suction$4 vacuum$4 aspirat$4)	USOCR; FPRS; EPO; JPO)				07:23 PM
L47	27	a61m1/1058.cpc. and (suction$4 vacuum$4 aspirat$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:23 PM
L48	23	L44 and (indicator same milk same (express$4 flow$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:26 PM
L49	51	L44 and (air same pressure same sens$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:30 PM
L50	19	L44 and ((indicat$4 record$4) same (right and left))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:38 PM
L51	56	L44 and (pump$4 with series)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:42 PM
L52	77	L44 and (pump$4 with weigh$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:47 PM
L53	87	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 07:59 PM

		20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$).did.					
L54	44	L53 and (air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:59 PM
L55	5	L54 and (air with filter$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:59 PM

L56	3	L44 and (pump$4 with (db decibal?))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:07 PM
L57	6	L44 and ((db decibal?))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:07 PM
L58	26	L44 and (sens$4 with (orientation angle tilt placement))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:16 PM
L59	9	L44 and ((indicat$4 input$4 document$4 record$4) with comfort)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:31 PM
L60	484	a61m$/$.cpc. and ((indicat$4 input$4 document$4 record$4) with comfort)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:32 PM
L61	1	L44 and "social media"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:52 PM
L62	408	a61m$/$.cpc. and ((piezo piezoelectric piezo-electric) same air same pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/25 06:13 PM
L63	3606	a61m$/$.cpc. and (pump$4 with weigh$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/25 06:18 PM
L64	359	a61m$/$.cpc. and ((pump$4 with weigh$4) same (portable lightweight carry$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/25 06:30 PM
L65	1	("20160166745").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/25 07:16 PM
L66	1	("20160058928").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/25 07:23 PM
L67	1	("20110004154").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/26 10:55 AM
L68	96	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/26 11:09 AM

		US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-					

		8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$).did.					
L69	2	L69 and (radiation same (height quantity amount volume))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/26 11:09 AM
L70	96	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/26 12:24 PM

		20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-					

		2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$).did.					
L71	3	L71 and ((diaphragm membrane) with shield)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/26 12:24 PM
L72	3606	a61m$/$.cpc. and (pump$4 with weigh$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:09 PM
L73	137	L73 and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:09 PM
L74	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:10 PM
L75	9	L75 and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:10 PM
L76	19	L75 and (shield with snap$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:16 PM
L77	1	("20110152855").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 01:20 PM
L78	32	L75 and (flow with rate with air)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:33 PM
L79	3	L75 and (stall with pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:56 PM
L80	98	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/27 01:56 PM

		US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$).did. or (WO-2015174330-$ or					

		WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$).did.					
L81	17	L81 and (pressure same (mmhg kpa mbar pa bar))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:57 PM
L82	18	(("7550034") or ("8123502") or ("8297947") or ("8371829") or ("8409160") or ("8646479") or ("8734131") or ("8763633") or ("8821134") or ("9051931") or ("9127665") or ("9239059") or ("9279421") or ("9334858") or ("9506463") or ("9752565") or ("9709042") or ("9777851")).PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 02:08 PM
L83	0	L83 and breast	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:08 PM
L84	10	L83 and (lactat$3 milk)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:08 PM
L85	14	L81 and (piezo piezoelectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:10 PM
L86	5	L75 and ((piezo piezoelectric) with air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:47 PM
L87	230	(((piezo piezoelectric) with air with pump$4) same (miniature small compact lightweight))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:48 PM
L88	6	L88 and (breast milk lactat$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:53 PM

L89	161	a61m$/$.cpc. and ((piezo piezoelectric piezo-electric) with air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:11 PM
L90	0	(2017/0072118).CCLS.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:19 PM
L91	1	("20170072118").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:19 PM
L92	40	(((piezo piezoelectric) with air with pump$4) same (miniature small compact lightweight)) same (vacuum$4 suction$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:22 PM
L93	3	"45513973".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/27 03:23 PM
L94	364	(((piezo piezoelectric) with pump$4) same (miniature small compact lightweight)) same (vacuum$4 suction$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:32 PM
L95	3	"20170035951"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:33 PM
L96	1	L96 and (suction$4 with piezoelectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:34 PM
L97	1	("20130064683").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:38 PM
L98	1	("20170072118").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:39 PM
L99	1	(US-20170172485-$).did.	(US-PGPUB)	OR	OFF	OFF	2018/08/28 04:48 PM
L100	0	L100 and "function of"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 04:48 PM
L101	100	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/28 05:19 PM

		US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-					

		7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L102	0	L102 and ((meaur$4 with milk) same rate)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:20 PM
L103	0	L102 and ((meaur$4 with milk) same (frequency speed))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:20 PM
L104	16	L102 and ((measur$4 with milk) same (frequency speed rate))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:21 PM
L105	0	L102 and ((measur$4 with milk) with "function of")	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:23 PM
L106	6	L102 and (decrease with (rate speed frequency strong))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:10 PM
L107	2	L102 and (latch$4 with adjust$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:22 PM
L108	50	(a61m$/$).cpc. and (wear$4 with pump$4) and ((center centre) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:24 PM
L109	0	(a61m$/$).cpc. and (wear$4 with pump$4) and (((center centre) with gravity) same comfort$5)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:25 PM
L110	83	(a61m$/$).cpc. and (((center centre) with gravity) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:26 PM

		comfort$5)					
L111	101	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 09:43 AM

		US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L112	3	L112 and (shield with (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:43 AM
L113	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:47 AM
L114	86	L114 and ((diapragm housing) with (housing case mount$4) with shield)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:53 AM
L115	9	L114 and ((diapragm membrane) with (housing case mount$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:54 AM

		with shield)					
L116	34	L112 and (diaphragm membrane)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:07 AM
L117	28	L114 and (diaphragm membrane) and (shield with dispos$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:10 AM
L118	28	L114 and ((diaphragm membrane) with (coupl$4 attach$4 mount$4) with shield)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:23 AM
L119	0	a61j16/00.cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:41 AM
L120	409	a61j13/00.cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:42 AM
L121	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:23 PM
L122	23	L122 and (sens$4 same (orient$4 plac$4 situat$4) same (nipple shield))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:23 PM
L123	11	L122 and ((sens$4 accelerometer) with breast with (move moved moving movement))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:32 PM
L124	10	L122 and accelerometer	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:33 PM
L125	1	("20170072118").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/29 02:27 PM
L126	259	L122 and ((lower$4 decrea$4) with (suction$4 intens$4 pain comfort discomfort))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 02:51 PM
L127	45	L122 and ((lower$4 decrea$4) with (intens$4 pain comfort discomfort))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 02:59 PM
L128	11	(a61m$/$.cpc.) and ((miniature compact small) same (piezoelectric piezo-electric piezo) same pump$4 same (suction$4 vacuum$4) same (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 03:40 PM
L129	127	L122 and ((pressure	(US-PGPUB; USPAT;	OR	OFF	OFF	2018/08/29

		suction$4) with (mmhg kpa mbar pa bar))	USOCR; FPRS; EPO; JPO)				05:16 PM
L130	2	"60479361".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 05:29 PM
L131	106	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 05:31 PM

		20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L132	104	L132 and @ad<="20170615"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 05:32 PM
L133	14	(US-20160166745-$ or	(US-PGPUB; USPAT)	OR	OFF	OFF	2018/08/29

		US-20150283311-$ or US-20180110906-$ or US-20140378895-$ or US-20140031744-$ or US-20160220743-$ or US-20160256617-$ or US-20080177224-$ or US-20130023821-$ or US-20160058928-$ or US-20170043065-$ or US-20110004154-$).did. or (US-10039871-$ or US-6358226-$).did.					06:08 PM
L134	1	"52574056".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 06:46 PM
L135	0	("2009024080").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/29 06:53 PM
L136	1	("20090024080").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/29 06:53 PM
L137	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 07:30 PM
L138	203	L138 and ((shield nipple) with (remov$4 replac$4 clean$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 07:30 PM
L139	1	("4535627").PN.	(US-PGPUB; USPAT)	OR	OFF	OFF	2019/01/08 12:52 PM
L140	74	(("20180361040") or ("20180236147") or ("20120277728") or ("7785305") or ("20080208116") or ("7223255") or ("7789865") or ("8118772") or ("20080275385") or ("9956331") or ("8057425") or ("20070219486") or ("20020193731") or ("10046097") or ("20140378946") or ("20180326130") or ("20120316493") or ("8568350") or ("20030191427") or ("8070716") or ("9539377") or ("20160303298") or ("20160206794") or ("9539376") or ("20160310649") or ("20160287769") or ("20160310650") or ("20180001002") or	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/01/08 12:54 PM

		("20090099511") or ("7776008") or ("20090062731") or ("20160296682") or ("20050154349") or ("20030191433") or ("5749850") or ("20100292636") or ("7559915") or ("20080262420") or ("20160325031") or ("20170173232") or ("7749188") or ("6887217") or ("6139521") or ("20180021490") or ("20150065994") or ("20180028732") or ("20150196460") or ("9636282") or ("7758540") or ("8945046") or ("20080243059") or ("20110251552") or ("20170119942") or ("20130023821") or ("6997897") or ("9033913") or ("20150157776") or ("20090254028") or ("5514166") or ("20010038799") or ("20070161947") or ("20130046234") or ("8926556") or ("7255681") or ("7008400") or ("6257847") or ("20100145264") or ("20170151380") or ("20070078383") or ("5542921") or ("20180333523") or ("8075516") or ("20180369464") or ("20110071466")).PN.					
L141	111	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2019/01/08 01:02 PM

		US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or						

		US-20180333523-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L142	35	L142 and (heavy weight "center of gravity" "centre of gravity" mass)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 01:03 PM
L143	3497	(a61m1/062 a61m1/066 a61m1/06).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 01:22 PM
L144	284	L144 and (heavy weight "center of gravity" "centre of gravity")	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 01:22 PM
L145	3497	(a61m1/062 a61m1/066 a61m1/06).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 04:06 PM
L146	18	L146 and (weight with distribut$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2019/01/08 04:06 PM

			JPO)				
L147	1	("4535627").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/03/14 02:19 PM
L148	112	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2019/04/16 03:00 PM

		(US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or US-20180333523-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$ or US-5542921-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					

L149	21	L149 and (pump$4 with (lightweight mass weight heavy))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 03:00 PM
L150	94	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (pump$4 with (weight lightweight))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 03:14 PM
L151	47	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (pump$4 with (mass heavy))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 05:04 PM
L152	26	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (pump$4 with (mass heavy)) not L151	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 05:04 PM
L153	1	("20110274566").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/04/19 01:51 PM
L154	1	("20110274566").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/08/09 12:52 PM
L155	57	(breast with pump) and (noise same pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:04 AM
L156	1	(16/009547).APP.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/08/15 09:08 AM
L157	1	L157 and (pressure same noise)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:08 AM
L158	635	((piezo piezoelectric) with pump) and (noise same pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:10 AM
L159	1	L157 and piezo	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:16 AM
L160	26	(breast with pump) and (mmhg and noise)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:24 AM
L161	1	L157 and (liter litre)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:30 AM
L162	1	((piezo piezoelectric) with pump) and "YIP Ventus"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:33 AM
L163	19	(("7550034") or ("8123502") or ("8297947") or ("8371829") or ("8409160") or ("8646479") or ("8734131") or ("8763633") or	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/08/15 09:36 AM

		("8821134") or ("9051931") or ("9127665") or ("9234518") or ("9239059") or ("9279421") or ("9334858") or ("9506463") or ("9752565") or ("9709042") or ("9777851")).PN.					
L164	5	L164 and (mmhg mbar kpa)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:36 AM
L165	0	L164 and (litre liter)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:37 AM
L166	2	L164 and piezo	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:37 AM
L167	17	L164 and (piezo piezoelectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:37 AM
L168	1	L164 and (piezo piezoelectric) and (noise same pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:38 AM
L169	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:50 AM
L170	1	L170 and gravity	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:50 AM
L171	1	L170 and (gravity same nipple)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:51 AM
L172	61	(breast with pump$4) and ((centre center) with container)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:55 AM
L173	1	L170 and (gravity same container)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:55 AM
L174	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 11:54 AM
L175	1	L176 and (high height)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 11:54 AM
L176	25	(breast with pump$4) and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 12:55 PM
L177	113	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2020/01/09 03:02 PM

		US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or					

		US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or US-20180333523-$ or US-20180361040-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$ or US-5542921-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L178	30	L179 and noise	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 03:02 PM
L179	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2020/01/13 01:45 PM

			JPO)				
L180	1	L181 and gravity	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/13 01:45 PM
L181	1	L181 and length	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/13 01:46 PM
L182	1	L181 and height	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/13 01:48 PM
L183	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:29 PM
L184	1	L185 and "half-way"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:29 PM
L185	113	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2020/01/14 02:36 PM

		20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or US-20180333523-$ or US-20180361040-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$ or US-5542921-$).did. or (WO-2015174330-$ or WO-2016024558-$ or					

		WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L186	3	L187 and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:37 PM
L187	2	L187 and (top with heavy)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:37 PM
L188	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:06 AM
L189	1	L190 and (weight mass)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:06 AM
L190	1	L190 and (housing same battery)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:07 AM
L191	1	L190 and (shield same (mold$4 mould$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:08 AM
L192	1	L190 and (diaphragm same seal$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:09 AM
L193	0	L190 and (diaphragm same tunnel same flange)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:15 AM
L194	0	L190 and (diaphragm same spaced)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:15 AM
L195	0	L190 and (diaphragm same surround)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:15 AM
L196	1	verhoef.inv. and dog and figure	(US-PGPUB)	OR	OFF	OFF	2020/01/15 01:27 PM
L197	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:28 PM
L198	1	L199 and (shield with single)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:28 PM

L199	67	(a61m$/$).cpc. and (wear$4 with pump$4) and ((center centre) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:32 PM
L200	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:32 PM
L201	1	L202 and (shield with single)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:32 PM
L202	1	L202 and (shield with piece)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:33 PM
L203	0	L202 and ((housing diagraphm) with spac$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 03:18 PM
L204	1	L202 and (shield with housing with diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 03:19 PM
L205	1	L202 and ((housing diaphragm) with spac$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 03:19 PM
L206	143	(breast with pump) and (piezo piezoelectric) and (membrane diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 11:42 AM
L207	78	("20030191433" | "20040024351" | "20040101414" | "20050059928" | "20050131332" | "20050234370" | "20060106334" | "20080045888" | "20080177224" | "20080243059" | "20090024080" | "20100010682" | "20100106082" | "20100217148" | "20110071466" | "20110196291" | "20110245763" | "20110270162" | "20120101575" | "20120277728" | "20130023821" | "20130123688" | "20130131588" | "20130177455" | "20140066734" | "20140378895" | "20140378946" | "20150065994" | "20150100016" |	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2020/09/28 12:42 PM

		"20150148709" | "20150196247" | "20150292500" | "20160015876" | "20160256618" | "20160287769" | "20170072118" | "20170080134" | "20170173232" | "4263912" | "4311141" | "4768547" | "4821580" | "5542921" | "5634468" | "5658133" | "5810772" | "5827191" | "6273868" | "6287252" | "6328082" | "6440100" | "6547756" | "6579258" | "6712785" | "6840918" | "7201735" | "7223255" | "7621797" | "7824363" | "7972297" | "7988661" | "8057425" | "8070715" | "8070716" | "8262606" | "8282596" | "8353865" | "8357116" | "8376986" | "8671701" | "8684961" | "8801495" | "9050404" | "9162016" | "9173587" | "9199017" | "9278167" | "D459233").PN. OR ("10625005").URPN.					
L208	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 02:57 PM
L209	1	L210 and 19a	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 02:57 PM
L210	132289	"201" and recess	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:02 PM
L211	0	L210 and recess	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:02 PM
L212	645454	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. diaphragm	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:06 PM
L213	574	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and diaphragm	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:06 PM
L214	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/29 09:51 AM
L215	1	L216 and flat	(US-PGPUB; USPAT;	OR	OFF	OFF	2020/09/29

			USOCR; FPRS; EPO; JPO)				09:51 AM
L216	57377	breast.clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:16 PM
L217	398558	pump$4.clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:16 PM
L218	92405	(piezo piezoelectric).clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:16 PM
L219	72010	diaphragm.clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L220	26553	(db decibal).clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L221	27368	(db decibal).clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L222	2	L218 and L219 and L220 and L221	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L223	2	L218 and L219 and L220 and L224	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L226	32	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((usb "universal serial bus") WITH (charg$4 recharg$4 power$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/18 12:16 PM
L227	0	214 AND (usb SAME socket)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 12:25 PM
L228	2	214 AND socket	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 12:25 PM
L229	2	"61007742".fmid.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; JPO)	OR	ON	ON	2021/05/18 12:34 PM

L230	7	"2015069095".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 12:38 PM
L231	122	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/18 01:00 PM

		20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1					

		OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)				
L232	18	231 AND recharg$5	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 01:00 PM
L233	2	214 AND (rigid SAME	(US-PGPUB; USPAT;	OR	ON	ON	2021/05/18

		shield)	USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				01:05 PM
L234	27173	a61m5/14244,14248.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 01:42 PM
L235	555	234 AND ((power$4 batter$4) WITH (charg$5 recharg$5) WITH (usb "universal serial bus"))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 01:42 PM
L236	82	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND bra AND wireless$4 AND (control$4 processor electronic$4) AND (power$4 battery)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/18 01:53 PM
L237	82	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND bra AND wireless$4 AND (control$4 processor electronic$4) AND (power$4 batter$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/18 01:53 PM
L238	14	231 AND ((charg$5 recharg$5) WITH (power$4 batter$4)) AND wireless$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 03:59 PM
L239	2	"20140275857".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 04:48 PM
L240	12	231 AND (rigid WITH (bottle container))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2021/05/18 04:52 PM

			AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L241	2	214 AND (shield WITH (flexible silicon$4 material soft rubber))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 05:35 PM
L242	2	231 AND (rigid WITH shield)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 05:38 PM
L243	128	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/20 03:05 PM

		US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-					

		A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-					

		2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L244	8	243 AND ((membrane diaphragm) SAME shield)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/20 03:06 PM
L245	88	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH rigid)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:09 PM
L246	0	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH (plastic rigid) WITH steriliz$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:13 PM
L247	7	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH steriliz$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:13 PM
L248	68	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (rigid WITH polypropylene)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:14 PM
L249	25	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((bottle container) WITH steriliz$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:17 PM
L250	19	243 AND ((bottle container) WITH (rigid polypropylene plastic))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:23 PM
L251	21	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((bottle container) WITH magnet$6)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 05:49 PM
L252	2	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 05:57 PM

		((shield nipple flange) WITH guide WITH line)					
L253	207	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield nipple flange) WITH line)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 05:57 PM
L254	5	"6328709".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/20 05:59 PM
L255	91	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (nipple WITH line)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 06:00 PM
L256	130	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/21 12:39 PM

		20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1					

		OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-					

		2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L257	1	256 AND ((bottle container milk) WITH (clear transparent) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 12:39 PM
L258	6	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((bottle container milk) WITH (clear transparent) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:40 PM
L259	6	(breast WITH pump$4) AND ((bottle container milk) WITH (clear transparent) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:41 PM
L260	73	(breast WITH pump$4) AND ((bottle container milk) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:41 PM
L261	11	(breast WITH pump$4) AND ((bottle container milk bag) WITH (polycarbonate tritan)) AND ((bottle container milk storage bag) WITH (clear transparent "see through" see-through))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:45 PM
L262	55	(breast WITH pump$4) AND ((bottle container milk bag) WITH (magnet$6))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 01:09 PM
L263	182	(breast WITH pump$4) AND ((shield flange) WITH (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 01:26 PM
L264	132	((US-6440100-B1 OR US-6547756-B1 OR	(USPAT; US-PGPUB; FPRS; USOCR;	OR	ON	ON	2021/05/21 01:26 PM

		US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1	IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))				

		OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-					

		20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L265	9	264 AND (clear transparent) WITH (container bottle bag)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2021/05/21 01:27 PM

			IBM_TDB)				
L266	4	264 AND (polycarbonate) WITH (container bottle bag)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 01:27 PM
L267	6	(breast WITH pump$4) AND ((bottle container milk) WITH (polycarbonate tritan)) AND ((bottle container milk) WITH dishwash$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 02:28 PM
L268	34	264 AND ((alert$4 indicat$4 light) WITH (milk))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 03:46 PM
L269	19	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH start$4 WITH stop$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:36 PM
L270	21	264 AND (milk WITH (indicat$4 alert$4 display$4) WITH (flow$4 volume))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:39 PM
L271	20	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH (quantity volume) WITH threshold)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:55 PM
L272	95	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH (quantity volume) WITH (predetermin$4 limit level))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:58 PM
L273	38	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH (quantity volume) WITH (predetermin$4 limit level) WITH (increas$4 decreas$4 chang$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:58 PM
L274	4	(a61m1/062 a61m1/066	(US-PGPUB; USPAT;	OR	OFF	OFF	2021/05/21

		a61m1/06 a41c4/04 a61j13/00).cpc. AND (pump$4 WITH alert$4 WITH (correct$4))	USOCR; FPRS; EPO; JPO)				05:00 PM
L275	0	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (operat$4 WITH alert$4 WITH (correct$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 05:00 PM
L276	9	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (alert$4 WITH (correct$4 proper$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 05:00 PM
L277	23	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH rotat$4 WITH position$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 05:44 PM
L278	62	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH slid$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:03 PM
L279	26	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH slid$4 WITH (attach$4 coupl$4 connect$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:04 PM
L280	71	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH thread$4 WITH (attach$4 coupl$4 connect$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:06 PM
L281	26	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((clean$4 disinfect$4 sanitiz$4) WITH (shield flange) WITH (container bottle bag))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:20 PM
L282	111	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (diaphragm WITH (housing holder))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:44 PM
L283	2	"20120277728".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2021/05/21 06:46 PM

			SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L284	7	264 AND (light WITH emit$4)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 06:55 PM
L285	11	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (db decibel)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 07:12 PM
L286	77	(breast WITH pump$4) AND (db decibel)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 07:17 PM
L287	75	willow AND (breast WITH pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 07:26 PM
L288	20047	(a61m a61b).cpcl. AND (pump$ wth piezo piezoelectric) AND (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L289	9898	(a61m a61b).cpcl. AND (pump$ WITH piezo piezoelectric) AND (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L290	892	(a61m a61b).cpcl. AND (pump$ WITH piezo piezoelectric) SAME (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L291	892	(a61m a61b).cpcl. AND (pump$4 WITH piezo piezoelectric) SAME (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L292	24	(a61m a61b).cpcl. AND (pump$4 WITH (piezo	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2021/05/21 07:33 PM

		piezoelectric)) SAME (decibel db)	AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L293	654	(a61m a61b).cpcl. AND (pump$4 WITH (piezo piezoelectric)) AND (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:34 PM
L294	337	(a61m a61b).cpcl. AND (pump$4 WITH (piezo piezoelectric)) AND (decibel db)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2021/05/21 07:34 PM
L295	138	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/22 09:07 AM

		US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-					

		A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1 OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-					

		2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L296	13	295 AND (bar mbar kpa) AND "flow rate"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 09:07 AM
L297	2	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (pressure WITH kpa mmhg mbar bar) AND ((air vacuum$4 suction$4) WITH l/min)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/22 09:21 AM
L298	157	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (pressure WITH (kpa mmhg mbar bar))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/22 09:23 AM
L299	2	16/009547.app. AND (mechanism SAME container SAME housing)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 10:47 AM
L300	2	16/009547.app. AND (mechanism WITH container WITH housing)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO;	OR	ON	ON	2021/05/22 10:47 AM

			JPO; DERWENT; IBM_TDB)				
L301	40	295 AND magnet$6	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 10:50 AM
L302	6	295 AND (magnet$6 WITH (container bag bottle))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 10:51 AM
L303	599	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND diaphragm	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/24 12:04 PM
L304	7	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/24 02:33 PM
L305	140	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2 OR US-8579874-B1).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/06/02 03:38 PM

		OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-					

		20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1					

		OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1 OR US-20090281485-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L306	2	140 AND piezo	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 03:38 PM
L307	14	140 AND piezo$8	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 03:38 PM
L308	32	305 AND piezo$8	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO;	OR	ON	ON	2021/06/02 03:39 PM

			JPO; DERWENT; IBM_TDB)				
L309	6	305 AND piezo$8 AND parallel	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 03:41 PM
L310	14	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((container milk bottle) WITH (angle tilt$4) WITH (sens$4 detect$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:47 PM
L311	14	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH right WITH breast WITH data)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:54 PM
L312	78	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (which WITH breast WITH data)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:57 PM
L313	14	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH breast WITH data)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:57 PM
L314	10	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH breast WITH sens$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:57 PM
L315	11	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH breast WITH select$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:59 PM
L316	33	305 AND (maximum WITH (suction$4 vacuum$4))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 04:02 PM
L317	16	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((icon button) WITH start$4 WITH (stop$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 04:06 PM

		paus$4))					
L318	0	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield flange) WITH tritan)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 04:08 PM
L319	3	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield flange) WITH (transparent clear)) AND ((shield flange) WITH polycarbonate)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 04:08 PM
L321	195	((milk lactat$4 breast) WITH pump$4) AND ((shield flange) WITH magnet$6)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/14 01:25 PM
L322	4	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield flange) WITH (transparent clear)) AND ((shield flange) WITH (tritan polycarbonate))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/15 12:15 PM
L323	250	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) SAME (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/15 01:51 PM
L324	19	("7550034," "8123502," "8297947," "8371829," "8409160," "8646479," "8734131," "8763633," "8821134," "9051931," "9127665," "9234518," "9239059," "9279421," "9334858," "9506463," "9752565," "9709042," "9777851").pn.	(USPAT)	OR	ON	ON	2021/06/16 12:28 PM
L325	9	324 AND stall	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 12:28 PM
L326	19	"stall pressure" WITH (aspirat$4 vacuum$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2021/06/16 12:35 PM

		suction$4)	AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L327	4184	(stall WITH pressure WITH pump$4)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 12:39 PM
L328	3	324 AND mbar	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 01:42 PM
L329	50	(ttp WITH ventus)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 01:54 PM
L330	3	(ttp WITH ventus)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2021/06/16 01:54 PM
L331	252	(ventus)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2021/06/16 01:55 PM
L332	36	((stall WITH pressure WITH pump$4) SAME piezo$10)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 02:28 PM
L333	18	324 AND maximum	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 02:35 PM
L334	52	pump$4 WITH stall WITH piezo$10	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2021/06/16 02:38 PM

			SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L335	220	(breast SAME pump$4 SAME piezo$10)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 03:17 PM
L336	79	(breast WITH pump$4) AND (pressure WITH (stall$4 crack$4 occlusion break$4 block$4) WITH (mmhg kpa mbar bar pa))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 03:35 PM
L337	68	ventus AND piezo$10	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 04:11 PM
L338	11	337 AND stall	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 04:12 PM
L339	11	337 AND (mmhg mbar kpa)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 04:13 PM
L340	0	324 AND l/min	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 03:43 PM
L341	11	324 AND (air WITH flow$4)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2021/06/19 03:43 PM

			SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L342	157	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2 OR US-8579874-B1 OR US-3702623-A).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/06/19 03:48 PM

		A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR					

		US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1 OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1 OR US-20090281485-A1 OR US-20120277636-A1 OR US-20150141761-A1 OR US-20160331879-A1 OR US-20150328380-A1 OR US-20100324477-A1 OR US-20170226994-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR					

		WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1 OR CN-106794291-A OR WO-2020046777-A1 OR WO-2018202556-A1 OR CN-105873631-A OR WO-9622116-A1 OR CN-211835562-U OR KR-20170044650-A OR WO-2020217934-A1 OR JP-2016010524-A).did. AND FTDB.dbnm.) OR ((CN-211835562-U).did. AND DWPI.dbnm.)					
L343	1	342 AND "l/min"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 03:49 PM
L344	6	324 AND (free WITH flow)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 03:49 PM
L345	2	("10881766").pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 06:28 PM
L346	2	("10926011").pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD,	OR	ON	ON	2021/06/19 06:44 PM

			DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L347	157	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2 OR US-8579874-B1 OR US-3702623-A).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/06/19 09:14 PM

		US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-					

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		CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1 OR CN-106794291-A OR WO-2020046777-A1 OR WO-2018202556-A1 OR CN-105873631-A OR WO-9622116-A1 OR CN-211835562-U OR KR-20170044650-A OR WO-2020217934-A1 OR JP-2016010524-A).did. AND FTDB.dbnm.) OR ((CN-211835562-U).did. AND DWPI.dbnm.)					
L348	39	347 AND piezo$10	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 09:14 PM
L349	28	347 AND piezo$10 AND breast	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 09:14 PM
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L351	3	("9,585,998").pn.	(US-PGPUB; USPAT;	OR	ON	ON	2021/06/21

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		2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1 OR CN-106794291-A OR WO-2020046777-A1 OR WO-2018202556-A1 OR CN-105873631-A OR WO-9622116-A1 OR CN-211835562-U OR KR-20170044650-A OR WO-2020217934-A1 OR JP-2016010524-A).did. AND FTDB.dbnm.) OR ((CN-211835562-U).did. AND DWPI.dbnm.)					
L353	8341	a61m1/06-066.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/10/13 09:11 AM
L354	147	353 AND ((shield flange) WITH rib)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/10/13 09:12 AM
L355	5	("5875976").pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2021/10/13 11:12 AM

			IBM_TDB)				
L356	4	345 346	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/10/25 05:20 PM
L357	2	345 346	(USPAT)	OR	ON	ON	2021/10/25 05:20 PM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

Used in Lieu of PTO/SB/08A/B
(Based on PTO 11-07 version)

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 3

Complete if Known	
Application Number	17/203,292
Filing Date	March 16, 2021
First Named Inventor	Jonathan O'TOOLE
Art Unit	3783
Examiner Name	Courtney B. FREDRICKSON
Attorney Docket Number	ELVI-002/14US

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	001	US-7666162	02-23-2010	RENZ; Charles J. et al.	
	002	US-8608685	12-17-2013	TASHIRO; Mitsuo et al.	
	003	US-10881766	01-05-2021	O'TOOLE; Jonathan et al.	
	004	US-10926011	02-23-2021	O'TOOLE; Jonathan et al.	
	005	US-20040087898	05-06-2004	WENIGER; Gotthilf	
	006	US-20090281482	11-12-2009	BAKER; Peter Christensen et al.	
	007	US-20100292636	11-18-2010	RENZ; Charles J. et al.	
	008	US-20120165729	06-28-2012	CUDWORTH; Nicholas	
	009	US-20140263611	09-18-2014	BAUER; Ryan	
	010	US-20160228625	08-11-2016	HOLTZ; Raymond et al.	
	011	US-20180110900	04-26-2018	KORENFELD; Michael S.	
	012	US-20210170080	06-10-2021	O'TOOLE; Jonathan et al.	
	013	US-20210196873	07-01-2021	O'TOOLE; Jonathan et al.	
	014	US-20210196874	07-01-2021	O'TOOLE; Jonathan et al.	
	015	US-20210196875	07-01-2021	O'TOOLE; Jonathan et al.	
	016	US-20210196876	07-01-2021	O'TOOLE; Jonathan et al.	
	017	US-20210205511	07-08-2021	O'TOOLE; Jonathan et al.	
	018	US-20210205512	07-08-2021	O'TOOLE; Jonathan et al.	
	019	US-20210205513	07-08-2021	O'TOOLE; Jonathan et al.	
	020	US-20210205515	07-08-2021	O'TOOLE; Jonathan et al.	
	021	US-20210205516	07-08-2021	O'TOOLE; Jonathan et al.	
	022	US-20210205517	07-08-2021	O'TOOLE; Jonathan et al.	
	023	US-20210205518	07-08-2021	O'TOOLE; Jonathan et al.	
	024	US-20210228789	07-29-2021	O'TOOLE; Jonathan et al.	
	025	US-20210268158	09-02-2021	O'TOOLE; Jonathan et al.	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet 2 of 3

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Application Number	17/203,292
Filing Date	March 16, 2021
First Named Inventor	Jonathan O'TOOLE
Art Unit	3783
Examiner Name	Courtney B. FREDRICKSON
Attorney Docket Number	ELVI-002/14US

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[2]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	026	CN-101549180-A	10-07-2009	PIGEON CORP [JP]	Corresponds to US8608685	☒
	027	EP-0503280-A2	09-16-1992	PIERBURG GMBH [DE]		☒
	028	GB-2435617-B	03-05-2008	PLAYTEX PRODUCTS INC [US]		☐

Examiner Signature	/COURTNEY B FREDRICKSON/	Date Considered	11/10/2021

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 3 of 3

Complete if Known	
Application Number	17/203,292
Filing Date	March 16, 2021
First Named Inventor	Jonathan O'TOOLE
Art Unit	3783
Examiner Name	Courtney B. FREDRICKSON
Attorney Docket Number	ELVI-002/14US

NON-PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author(in CAPITAL LETTERS),title of the article(when appropriate), title of the item (book,magazine,journal,serial,symposium,catalog,etc.),date,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
	029	GB Search Report, dated 15 November 2017, issued in priority GB Application No. GB1709561.3.	☐
	030	GB Search Report, dated 28 November 2017, issued in priority GB Application No. GB1709566.2.	☐
	031	GB Search Report, dated 29 November 2017, issued in priority GB Application No. GB1709564.7.	☐
	032	International Search Report issued in PCT/GB2018/051659 dated December 4, 2018, 9 pages.	☐

Examiner Signature	/COURTNEY B FREDRICKSON/	Date Considered	11/10/2021

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17203292
Filing Date	2021-03-16
First Named Inventor	Jonathan O'Toole
Art Unit	3783
Examiner Name	C. Fredrickson
Attorney Docket Number	373499.00057

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5542921	A	1996-08-06	MEYERS, et al.	
	2	7833190	B1	2010-11-16	HALL	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070135761	A1	2007-06-14	CHENG, et al.	
	2	20170112983	A1	2017-04-27	THORNE, et al.	
	3	20180333523	A1	2018-11-22	CHANG, et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.B.F./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17203292
	Filing Date	2021-03-16
	First Named Inventor	Jonathan O'Toole
	Art Unit	3783
	Examiner Name	C. Fredrickson
	Attorney Docket Number	373499.00057

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/COURTNEY B FREDRICKSON/	Date Considered	11/10/2021

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.B.F./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17203292
	Filing Date	2021-03-16
	First Named Inventor	Jonathan O'Toole
	Art Unit	3783
	Examiner Name	C. Fredrickson
	Attorney Docket Number	373499.00057

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

✓ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

✓ See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Mark D. Simpson/	Date (YYYY-MM-DD)	2021-09-05
Name/Print	Mark D. Simpson	Registration Number	32942

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.B.F./

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.B.F./

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	17/203,292
Filing Date	03/16/2021
First Named Inventor	Jonathan O'TOOLE
Title	BREAST PUMP SYSTEM
Art Unit	3783
Examiner Name	Courtney B. FREDRICKSON
Attorney Docket Number	4944.012000E

SIGNATURE of Applicant or Patent Practitioner

Signature	/Anupma Sahay #78,704/	Date (Optional)	
Name	Anupma Sahay	Registration Number	78,704
Title (if Applicant is a juristic entity)	Attorney for Applicant		
Applicant Name (if Applicant is a juristic entity)	Chiaro Technology Limited		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 09/30/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above.

26111

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

CHIARO TECHNOLOGY LIMITED

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	/Hannah Brunskill/	Date (Optional)	8 December 2021
Name	Hannah Brunskill		
Title	Head of Legal		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt	
EFS ID:	44979803
Application Number:	17203292
International Application Number:	
Confirmation Number:	9955
Title of Invention:	BREAST PUMP SYSTEM
First Named Inventor/Applicant Name:	Jonathan O'TOOLE
Customer Number:	58249
Filer:	Anupma Sahay/Rolonda Lee
Filer Authorized By:	Anupma Sahay
Attorney Docket Number:	ELVI-002/14US
Receipt Date:	11-FEB-2022
Filing Date:	16-MAR-2021
Time Stamp:	18:55:24
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	2022-02-11-Transmittal-Form-4944-012000E.pdf	765963 0951a5a16e9bf7327c7a59f415daa19247f19e0236	no	1

Warnings:

Information:					
2	Authorization for Extension of Time all replies	2022-02-11-EOT-Authorization-4944-012000E.pdf	97868 d993a67c1f467d55b9c0567e118c76f2e92cb0e5	no	1
Warnings:					
Information:					
3	Power of Attorney	2022-02-11-POA-82A-4944-012000E.pdf	516027 75e7817d10baf0bbb3e31843eacb42bd1c626de2	no	1
Warnings:					
Information:					
4	Power of Attorney	2022-02-11-POA-82B-4944-012000E.pdf	511087 9732b9d2438d72cb4804448d1f12d9c4a070e22a	no	1
Warnings:					
Information:					
		Total Files Size (in bytes):	1890945		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: TRAN.LET

Document Description: Transmittal Letter

PTO/SB/21 (07-09)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission

Application Number	17/203,292
Filing Date	03/16/2021
First Named Inventor	Jonathan O'TOOLE
Art Unit	3783
Examiner Name	Courtney B. FREDRICKSON
Attorney Docket Number	4944.012000E

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☑ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
  - ☐ Landscape Table on CD
- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☑ Other Enclosure(s) (please Identify below):

Authorization under 37 CFR 1.136(a)(3)

Remarks

The Office may charge any fee deficiency for any submission made with this transmittal to Deposit Account 19-0036.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Sterne, Kessler, Goldstein & Fox P.L.L.C.		
Signature	/Anupma Sahay #78,704/		
Printed name	Anupma Sahay		
Date	February 11, 2022	Reg. No.	78,704

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature			
Typed or printed name		Date	

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and1.14. This collection is estimated to 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor: Jonathan O'TOOLE	Confirmation No.: 9955
Applicant: Chiaro Technology Limited	Art Unit: 3783
Application No.: 17/203,292	Examiner: Courtney B. FREDRICKSON
Filing Date: 03/16/2021	Atty. Docket: 4944.012000E

Title: **BREAST PUMP SYSTEM**

Authorization to Treat a Reply as Incorporating an Extension of Time Under 37 C.F.R. § 1.136(a)(3)

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Commissioner:

The U.S. Patent and Trademark Office is hereby authorized to treat any concurrent or future reply that requires a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. The U.S. Patent and Trademark Office is hereby authorized to charge all required extension of time fees to our Deposit Account No. 19-0036, if such fees are not otherwise provided for in such reply.

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

/Anupma Sahay #78,704/

Anupma Sahay
Attorney for Applicant
Registration No. 78,704

Date: February 11, 2022

1100 New York Avenue, N.W.
Washington, D.C. 20005-3934
(202) 371-2600

17986993.1

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/203,292	03/16/2021	Jonathan O'TOOLE	ELVI-002/14US

CONFIRMATION NO. 9955

58249
COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

POWER OF ATTORNEY NOTICE

OC000000131862063

Date Mailed: 02/17/2022

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 02/11/2022.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/qtran/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/203,292	03/16/2021	Jonathan O'TOOLE	EL.VI-002/14US

CONFIRMATION NO. 9955

26111
STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.
1100 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005

POA ACCEPTANCE LETTER

OC000000131862105

Date Mailed: 02/17/2022

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 02/11/2022.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/qtran/

Doc code: RCEX
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	17/203,292	Filing Date	2021-03-16	Docket Number (if applicable)	4944.012000E	Art Unit	3783
First Named Inventor	Jonathan O'TOOLE			Examiner Name	FREDRICKSON, Courtney B.		

This Is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

☐ Other _____

☒ Enclosed

☒ Amendment/Reply

☒ Information Disclosure Statement (IDS)

☐ Affidavit(s)/ Declaration(s)

☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

☒ The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 190036

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

X Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/Anupma Sahay #78,704/	Date (YYYY-MM-DD)	2022-05-20
Name	Anupma Sahay	Registration Number	78704

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO AIA/14 Equivalent (01-22)

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	4944.012000E
	Application Number	17/203,292
Title of Invention	BREAST PUMP SYSTEM	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	4944.012000E
	Application Number	17/203,292
Title of Invention	BREAST PUMP SYSTEM	

Inventor 3 Legal Name				
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☐ US Residency ☒ Non US Residency ☐ Active US Military Service

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City	London	**State/Province**	
Postal Code	EC1N 8LE	**Country**	GB

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Anupma Sahay #78,704/			Date (YYYY-MM-DD)	2022-05-20
First Name	Anupma	**Last Name**	Sahay	**Registration Number**	78,704

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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 4

Complete if Known	
Application Number	17/203,292
Filing Date	03-16-2021
First Named Inventor	O'TOOLE; Jonathan
Art Unit	3783
Examiner Name	FREDRICKSON, COURTNEY B
Attorney Docket Number	4944.012000E

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	001	US-D788293-S	05-30-2017	ECKSTEIN et al.	
	002	US-D809646-S	02-06-2018	MASON et al.	
	003	US-D832995-S	11-06-2018	MASON et al.	
	004	US-D888225-S	06-23-2020	ASKEM et al.	
	005	US-7641629-B2	01-05-2010	YUEN; Yat Keung William	
	006	US-10398816-B2	09-03-2019	CHANG et al.	
	007	US-10625005-B2	04-21-2020	CHANG et al.	
	008	US-20040127845-A1	07-01-2004	RENZ; Charles J. et al.	
	009	US-20070219486-A1	09-20-2007	MYERS; Kenneth E. et al.	
	010	US-20070228059-A1	10-04-2007	KARSAN; Chettan	
	011	US-20120021068-A1	01-26-2012	BARNESS; Itzhak et al.	
	012	US-20120035951-A1	02-09-2012	GOETZ; Steven M. et al.	
	013	US-20120043065-A1	02-23-2012	RANNE; Pasi et al.	
	014	US-20120072117-A1	03-22-2012	LODDOCH; Alexander et al.	
	015	US-20120072118-A1	03-22-2012	MANN; Tobias	
	016	US-20120095599-A1	04-19-2012	PAK; H. Ali et al.	
	017	US-20120143879-A1	06-07-2012	STOITSEV; Todor	
	018	US-20120220753-A1	08-30-2012	GERA; Lajos et al.	
	019	US-20150212036-A1	07-30-2015	JIN; Jian et al.	
	020	US-20150212037-A1	07-30-2015	OKAZAKI; Satoshi et al.	
	021	US-20170216505-A1	08-03-2017	KIM; Sang Ha	
	022	US-20180361040-A1	12-20-2018	O'TOOLE; Jonathan et al.	
	023	US-20210030934-A1	02-04-2021	ZHANG; Shu Ting	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet 2 of 4

Complete if Known	
Application Number	17/203,292
Filing Date	03-16-2021
First Named Inventor	O'TOOLE; Jonathan
Art Unit	3783
Examiner Name	FREDRICKSON, COURTNEY B
Attorney Docket Number	4944.012000E

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	001	WO-2005079441-A2	09-01-2005	CHILDRENS HOSP MEDICAL CENTER [US], et al.		☐
	002	WO-2005114113-A2	12-01-2005	ACCU GAUGE LTD [GB], et al.		☐
	003	WO-2016010524-A1	01-21-2016	HEWLETT PACKARD DEVELOPMENT CO [US]		☐

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet 3 of 4

Complete if Known	
Application Number	17/203,292
Filing Date	03-16-2021
First Named Inventor	O'TOOLE; Jonathan
Art Unit	3783
Examiner Name	FREDRICKSON, COURTNEY B
Attorney Docket Number	4944.012000E

NON-PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author(in CAPITAL LETTERS),title of the article(when appropriate), title of the item (book,magazine,journal,serial,symposium,catalog,etc.),date,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
	001	4MD Medical, "Assembling Spctra Breast Pump Parts," YouTube [online], dated November13, 2016, URL: http://www.youtube.com/watch?v=ChV8xQfcBxU.	☐
	002	The Best Hands-Free Breast Pumps, posted at healthline.com, earliest date posted on 08/24/2020, [online], acquired on 10/30/2021, Available on internet. url:https://www.healthline.com/health/parenting/breast-feeding/best-hands-free-breast-pumps#Best-hands-free-breast-pumps (Year: 2020).	☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet	4	of	4

Complete if Known	
Application Number	17/203,292
Filing Date	03-16-2021
First Named Inventor	O'TOOLE; Jonathan
Art Unit	3783
Examiner Name	FREDRICKSON, COURTNEY B
Attorney Docket Number	4944.012000E

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Anupma Sahay #78,704/	Date (YYYY-MM-DD)	2022-05-20
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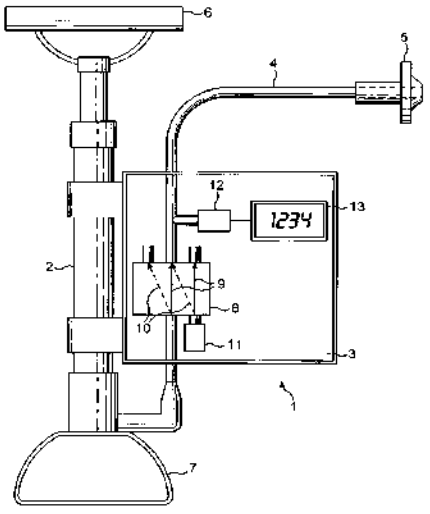
(54) Title: VOLUME METER



(57) Abstract: There is provided a device and methods for determining the volume of air space within a container, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, and means to determine the rate of pressure change within the container while the container is connected to the restrictor means. A particular application is determining a change in the amount of fuel in a fuel tank between the beginning and end of a vehicle rental.

WO 2005/114113 A2

FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

VOLUME METER

The present invention relates to a device to determine a volume of fluid present in a tank or other container. More particularly, but not exclusively, it relates to a device to determine a volume of fuel present in a vehicle fuel tank, for example so as to compare volumes present before and after use, and to a method of use of such a device.

When a car, van or other vehicle is hired out, it is common for a hire agreement to specify that the vehicle should be returned with the same volume of fuel in its fuel tank as was present when it was driven away. Should there be a deficit, the hirer is liable to pay for the vehicle to be refuelled to the initial level.

However, in practice, it is difficult to assess exactly how much fuel is present in a vehicle fuel tank, using only the vehicle's dashboard fuel gauge, which is usually connected to a float sensor within the tank. The gauge can normally be read to no better than the nearest eighth of a tank-full, which will typically represent five to ten litres of fuel. It is thus possible to return a vehicle with significantly less fuel in its tank, without this being clearly indicated by its fuel gauge. Furthermore, in borderline situations, considerations such as good customer relations will often militate against arguing with a customer over whether a fuel gauge needle is nearer to three-eighths of a tank or a quarter of a tank, for example.

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It is estimated that such shortfall causes loss to vehicle hirers of around £250,000 per year in the United Kingdom alone. This could be extrapolated to an annual loss for the entire vehicle hire market of approximately £80 million. There is hence a need for a precise and unequivocal means of measuring how much fuel is present in a vehicle's tank, before and after use.

Such means should, however, preferably not involve modification to the vehicles themselves, on grounds of cost and inconvenience. It should be quick and easy to use, and must be safe for use in the presence of highly inflammable fuel vapours.

Conventional liquid level sensors would not be appropriate, since they would be significantly affected by the exact attitude of the vehicle to the horizontal when the measurements are taken. In any case, it is difficult to access the fuel itself from outside the tank. However, an approach that appears to have received little attention is to measure the volume of the air above the fuel in the tank. In practice, the volume of air above the fuel will include the volume of a filler pipe leading from a filler cap or the like to the fuel tank, so the term "tank" hereinafter should be understood also to comprise such piping. Within this application, the term "air space" is used to refer to the volume within a container (which may include liquid) which is not occupied by the liquid, and is not intended to be limited to a volume occupied by atmospheric air.

Vehicle fuel tanks will be produced to a standard size for any given model. Thus, the volume of fuel in the tank plus the volume of air above it will be constant (strictly speaking, only true at a constant temperature, but such considerations can be allowed for mathematically, or by calibrating at a range of temperatures). In principle, a change of air volume in the tank will indicate a change in fuel volume, and measuring air volume has the advantage that a direct connection with this volume can be established through an existing, unmodified filler cap.

While a particular problem to be addressed is the measurement of fuel volumes within vehicle fuel tanks, as discussed above, there will be many other applications in which quick and accurate measurements of liquid volumes within substantially rigid containers will be required. A device suitable for measuring fuel volumes may well also be applicable to other such measurement needs. For example, such a device would be useful in the brewing industry for determining the amount of liquid in a tank or still.

It is hence an object of some embodiments of the present invention to produce a device to determine the volume of liquid present in a container by measuring the volume of gas in the container, and to provide a method for determining such volumes and changes in such volumes, using said apparatus.

However, some embodiments of the present invention are relevant to applications where it is not necessary to determine the absolute volume of the liquid present in the container. For example, for the purposes of determining whether a customer has brought a rental car back with same amount of fuel as when they rented the vehicle, it will be sufficient only to determine whether there has been a change in the volume of the liquid. By determining the amount of the change in the volume of air space, it is possible to determine the amount by which the volume of fuel has changed and issue a bill accordingly. As changes in the volume of liquid within a container of substantially fixed volume will result in corresponding and opposite changes in the volume of the air space within the container, measuring the change in the air space within the container is sufficient to determine whether the volume of liquid within the container has changed and/or the amount of the change, if appropriate.

According to a first aspect of the present invention, there is provided a device for determining the volume of air space within a container, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means,

valve means to connect the container either to the pressure altering means or to the restrictor means, and means to determine the rate of pressure change within the container while the container is connected to the restrictor means.

The volume of air space within the container can be calculated from the determined rate of pressure change. Where the volume of the container is known, it is possible to determine the volume of liquid within a container by subtracting the air space from the volume of the container. Preferably, the device includes computing means (such as a computer) to calculate the volume of liquid in a container by subtracting the air space from the volume of the container.

There is also provided a device for determining whether the volume of air space within a container has changed between two readings, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, and means to determine the rate of pressure change within the container while the container is connected to the restrictor means.

The device is also suitable for determining whether the volume of liquid within a container has changed between two readings as, provided that the container is of substantially fixed volume, if the volume of air space has not changed between two readings, then the volume of liquid should not have changed. Again, the volume of air space within the container can be calculated from the determined rate of pressure change.

There is also provided a device for determining the change in volume of air space within a container between two readings, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, means to

measure pressure within the container, and means to determine the rate of pressure change within the container while the container is connected to the restrictor means.

The device is also suitable for determining the change in volume of liquid within a container as this will be the opposite of the change in the volume of air space between two readings provided that the volume of the container is substantially fixed. Again, the volume of air space within the container can be calculated from the determined rate of pressure change.

The means to determine the rate of pressure change within the container while the container is connected to the restrictor means preferably includes means to measure pressure within the container (such as a pressure transducer) although it would be possible in principle to use a device which measures the rate of change of pressure, or the flow rate (such as the molecular or volumetric flow rate) of gas through the restrictor means. In these cases it would remain preferable for the device to comprise a means to measure the pressure within the container as the rate of pressure change will in general depend on the pressure within the container.

The means to measure pressure may measure absolute pressure, but preferably measures the pressure difference across the restrictor means. If the restrictor means opens out into ambient air, the pressure difference across the restrictor means will be the pressure difference between the inside of the container and ambient air. It is preferable to measure the pressure difference across the restrictor means because the pressure difference is the predominant factor determining the rate at which gas flows through the restrictor means and so the rate at which pressure tends to ambient pressure within the container. Preferably, therefore, the means to measure pressure within the container comprises a pressure transducer which measures the pressure difference across the restrictor means. The pressure difference across the restrictor means is generally the pressure difference between the interior of the container and ambient air.

Preferably, absolute pressure is taken into account when calculating the volume of the air space (and thus the volume of the liquid, or change in volume of the liquid). This can improve the accuracy of the resulting measurements because the rate of pressure change depends in practice not just on the pressure difference across the restrictor means, but also the absolute pressure difference. Gases of different pressures, and thus different densities, can be expected to flow differently through the restrictor means. One skilled in the art will recognise that the absolute pressure which is taken into account could be the pressure within the container or the ambient pressure.

Thus, in a preferred embodiment, the device further includes means to measure absolute pressure, such as a pressure transducer. This pressure transducer may be a different pressure transducer to that used to measure the pressure within the container, or it might be the same pressure transducer. If it is the same pressure transducer, a valve may be engageable to connect the pressure transducer to the atmosphere. This valve may also constitute or be part of the valve means to connect the container either to the pressure altering means or to the restrictor means. For example, the valve may have three positions, one which connects the pressure transducer to the container, another which connects the pressure transducer to the gas flow restrictor means, and a third which connects the pressure transducer to the atmosphere.

The temperature of the gas within the container or ambient temperature (measured by a temperature transducer such as a thermometer or other temperature gauge) may also be taken into account when calculating the volume of the air space in the container from the rate of change of pressure within the container. However, the effect of temperature is less important than the effect of absolute pressure.

The device (or a separate computing device, if appropriate) may comprise means to determine the effect of absolute pressure (and optionally absolute temperature) on the rate of pressure change while the container is connected to the restrictor means. For example, the device may

comprise calibration data (such as a calibration table) or an implementation of a computing algorithm which enables the data measured while the container is connected to the restrictor means (such as the rate of pressure change within the container, or the period taken for the pressure within the container to change from a first value to a second value, or the change in pressure within the container during a period of time) to be analysed taking into account the atmospheric pressure (and optionally the ambient temperature).

In a preferred embodiment, there is provided a memory storing a calibration table for the restrictor means which allow an estimate of instantaneous molecular flow rate to be computed from the pressure difference across the restrictor means, the ambient pressure (and optionally the ambient temperature).

The means to determine the rate of pressure change within the container may time a period taken for the pressure within the container to change from a first value to a second value while the container is connected to the restrictor means. The first and second values could be predetermined. However, the first and second values could be calculated by calculating means (such as a computer); for example, the first and second values could be calculated by analysing the change in pressure with time while the means to alter the gas pressure within the container alters the gas pressure within the container.

Alternatively, the means to determine the rate of pressure change within the container may determine the change in the pressure within the container during a period of time. The time period may start when the pressure within the container reaches a predetermined value. Again, the pressure may be absolute pressure but is preferably pressure relative to ambient pressure. The period of time may be calculated by analysing the change in pressure with time while the means to alter the gas pressure within the container alters the gas pressure within the container.

The means to determine the rate of pressure change within the container may measure pressure within the container at a plurality of times and analyse the successive pressure values, preferably using calculating means, such as a computer.

The volume of air space within the container can be calculated from the rate of pressure change, the time period or pressure change, as appropriate. If the volume of the container is known, then the volume of liquid within the container can be calculated by subtracting the volume of the air space from the volume of the container. If two successive reading are taken, the change in volume of air space can be determined by storing data from the first reading and comparing it with data from the second reading.

One skilled in the art will recognise that it is not necessary for the device to actually calculate the volume of air space within the container. It is sufficient to determine a parameter which can be related to the volume of air space within the container: for example, the rate of pressure change, the period taken for the pressure within the container to change from the first value to the second value, and/or the pressure difference during a period of time. Such parameters can be related to the volume of air space within the container as and when required. It is possible to determine whether the amount of liquid within the container has changed, or the amount by which it has changed, between two readings without having to actually calculate the respective volumes of air space.

The device preferably comprises one or more of a display to display the determined volume or change in volume or parameter, a memory to store the determined volume, change in volume or parameter, or an interface to transmit the volume, change in volume or parameter to an external computer or storage device. Preferably, the device includes a computer to carry out any necessary calculations. The invention also extends to a system comprising one or more computers and a plurality of devices according to the present invention. Such a system would enable readings carried out at one location (such as a car rental depot from which a car

is rented) to be compared with readings carried out at another location (such as a car rental deport to which a car is returned).

Further preferred features and options correspond to those described below.

According to a second aspect of the present invention, there is provided a method of measuring the volume of a liquid in a container of known volume comprising the steps of altering the pressure of gas within the interior of a container and allowing the pressure within the container to start equilibrating with air of another pressure through gas flow restrictor means whilst carrying out at least one measurement of the rate of change of pressure within the container, thereby calculating the volume of the container which is not occupied by the liquid and thereby calculating the volume of the liquid.

There is also provided a method of determining whether the volume of a liquid in a container of substantially fixed volume has changed between first and second readings, comprising the steps of, for each reading, altering the pressure of gas within the interior of the container and allowing the pressure within the container to start equilibrating with air of another pressure through gas flow restrictor means whilst carrying out at least one measurement of the rate of change of pressure within the container, thereby calculating the volume of the air space within the container, and then comparing the calculated air space volumes. (Air space refers to the volume of the container not occupied by liquid).

There is also provided a method of determining a change in the volume of a liquid in a container of substantially fixed volume between first and second readings, comprising the steps of, for each reading, altering the pressure gas within the interior of the container and allowing the pressure within the container to start equilibrating air of another pressure through gas flow restrictor means whilst carrying out at least one measurement of the rate of change of

pressure within the container, thereby calculating the air space volume, and then calculating the difference in the air space volumes between readings.

Air of another pressure is preferably ambient air.

The provided methods preferably include the step of measuring either or both of absolute pressure (typically absolute ambient pressure) and ambient temperature and taking these measurements into account when calculating one or more of the volume of the air space, whether there has been a change in the volume of the air space, the amount of change in the volume of the air space, the volume of liquid in the container, whether there has been a change in the volume of liquid in the container or whether there has been a change in the volume of liquid in the container.

Values of air space volume or a parameter related thereto (e.g. the rate of pressure change, the period taken for the pressure to change from one value to another, or the pressure change in a particular period) may be stored between the first and second readings.

The step of measuring the rate of change of pressure within the container may comprise measuring the period taken for the pressure within the container to change from a first value to a second value while the container is connected to the restrictor means. The first and second values could be predetermined. However, the first and second values could be calculated; for example, the first and second values could be calculated by analysing the change in pressure with time while the means to alter the gas pressure within the container alters the gas pressure within the container.

Alternatively, the step of measuring the rate of change of pressure within the container may comprise determining the change in the pressure within the container during a period of time. The time period may start when the pressure within the container reaches a predetermined

value. Again, the pressure may be absolute pressure but is preferably pressure relative to ambient pressure. The period of time may be calculated by analysing the change in pressure with time while the means to alter the gas pressure within the container alters the gas pressure within the container.

The step of measuring the rate of change of pressure within the container may comprise measuring the pressure within the container at a plurality of times and analysing the successive pressure values.

Analysis is preferably carried out using calculating means, such as a computer.

According to a third aspect of the present invention, there is provided a method of calculating a charge to be issued in relation to the rental of a vehicle having a fuel tank for containing fuel, the method comprising the steps of, on at least two occasions, determining the volume of air space in the fuel tank, or a parameter related thereto, thereby calculating the change in the amount of fuel between the occasions, and issuing a bill dependant on the calculated change in the amount of fuel.

The volume of air space, or a parameter related thereto, may be calculated using a device according to the first aspect or the fourth aspect. A different device may be used on each occasion.

The volume of air space, or a parameter related thereto, may be calculated according to a method of the second aspect or the fifth aspect.

According to a fourth aspect of the present invention, there is provided a device to measure a volume of liquid held within a container of known volume, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow

restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, means to measure pressure within the container, and means to time a period taken for the pressure within the container to change from a first predetermined value to a second predetermined value while the container is connected to the restrictor means.

There is further provided means to measure the absolute value of pressure (either or both of ambient pressure or pressure within the container) and the device takes this measured value into account when determining the measured volume of liquid.

Preferably, the device is provided with display means to indicate said period.

Alternatively or additionally, the device may be provided with memory means adapted to record said period for future reference, or for subsequent transmission to a separate computing device.

Advantageously, said display means may comprise numeric or alphanumeric display means.

Optionally, said display means comprises a liquid crystal display.

Preferably, the device is provided with electronic control means.

Advantageously, said electronic control means is adapted to operate the valve means.

The electronic control means may be adapted to operate the valve means so as to connect the container to the restrictor means when the pressure in the container has been altered to a third preselected value, further than said first and second values from ambient pressure.

The gas flow restrictor means preferably comprises calibrated orifice means through which gas may flow at a substantially constant rate.

The device may be provided with means to convert said period to a liquid volume within a particular container.

Said conversion means may comprise a set of graphs or tables of said periods against gas volume and/or liquid volume for particular preselected containers.

Alternatively or additionally, the device may be provided with memory means containing data to enable conversion of said periods to gas volumes and/or liquid volumes for particular preselected containers, and the electronic control means is adapted to perform said conversion.

The device may then be provided with display means adapted to indicate a calculated volume.

The pressure-altering means preferably comprises pump means.

Advantageously, the pump means is manually- or pedally-operable.

The pump means may be adapted to raise the pressure within the container above ambient pressure.

Alternatively, the pump means may be adapted to reduce the pressure within the container below ambient pressure.

The pressure-altering means may alternatively comprise a source of gas under pressure, such as a compressed-air line or reservoir vessel containing gas under pressure.

The device may be provided with pressure release means adapted to operate at a pressure differential within the container below that which might damage the container.

The connecting means may be adapted to form a gas-tight connection with a range of different container apertures, for example fuel tank filler pipe openings of different models of vehicle.

Further features or alternative features may correspond to those discussed in relation to the first and second aspects above.

According to a fifth aspect of the present invention, there is provided a method for measuring a volume of liquid held within a container of fixed volume, comprising the steps of providing a device as described in the fourth aspect above, connecting it to an aperture of the container, connecting the pressurising means to the container and raising the pressure therein to above a first predetermined value, connecting the container to the gas flow restrictor means so as to allow gas from the container to exit therethrough, timing the period taken for the pressure within the container to fall from said first predetermined value to a second predetermined value, and calculating from said period a gas volume and hence a liquid volume within the container.

Preferably, the method further comprises the steps of subsequently measuring an altered liquid volume within the container as described above and calculating a change in liquid volume between said measurements.

Further or alternative steps may correspond to those discussed in relation to the second aspect above.

According to a sixth aspect of the present invention there is provided a device to measure a volume of liquid held within a container of known volume, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, means to measure pressure within the container, and measure the change in pressure within the container to change during a period while the container is connected to the restrictor means.

Further preferred features correspond to those discussed in relation to the fourth aspect above.

According to a seventh aspect of the present invention, there is provided a method for measuring a volume of liquid held within a container of fixed volume, comprising the steps of providing a device as described in the sixth aspect above, connecting it to an aperture of the container, connecting the pressurising means to the container and raising the pressure therein to above a first predetermined value, connecting the container to the gas flow restrictor means so as to allow gas from the container to exit therethrough, determining the pressure change within the container during a period and calculating from said pressure change a gas volume and hence a liquid volume within the container.

Further preferred features correspond to those discussed in relation to the fifth aspect above.

An embodiment of the present invention will now be more particularly described by way of example and with reference to the accompanying drawing, in which:

Figure 1 is a frontal elevation of a fuel volume meter embodying the present invention;

Figure 2 is a frontal elevation of a fuel volume meter according to a second embodiment of the present invention; and

Figure 3 is a frontal elevation of a fuel volume meter according to a third embodiment of the present invention.

Referring now to Figure 1, a fuel volume meter 1 comprises a pressuring pump 2 connected to a measurement unit 3, which is in turn linked by means of a flexible pressure hose 4 to a tank connector fitting 5. The tank connector fitting 5 is shaped to form a gas-tight seal with an external opening of a fuel filler pipe leading to a fuel tank of a vehicle. (Where a wide range of different sizes of and/or shapes of openings may be encountered, it may be necessary to provide alternative, exchangeable fittings 5).

The pressuring pump 2 is here a manually-operable stirrup pump, with a reciprocally vertically-moveable pump handle 6 and a stirrup base 7 into which a user may insert a foot in order to stabilize the meter 1 during pumping. Other embodiments may use foot-operated pumps, or even (at the expense of portability) an existing or dedicated compressed-air supply, via a suitable regulator. It would even be possible to use a regulated compressed gas cylinder, for example to provide a source of inert gas for use in connection with extremely flammable fuels or other liquids.

The measuring unit 3 contains a two-position valve 8. In a first position, represented by solid arrows 9, the valve 8 connects the pressurising pump 2 to the pressure hose 4, and hence to the fuel tank. In a second position, represented by broken arrows 10, the pressurising pump 2 is connected to open air, while the pressure hose 4 and fuel tank are connected to a restrictor 11 comprising a calibrated orifice through which air may exit the meter 1. A (first) pressure transducer 12 measures the air pressure within the pressure hose 4 (and hence within the fuel

tank). The measuring unit 3 also contains electronic control apparatus (including a timing circuit), which is adapted to control the valve 8 and to receive data from the pressure transducer 12. The measuring unit 3 is also provided with a display 13, most conveniently a liquid crystal numeric or alphanumeric display, although light emitting diode or analogue displays may also be used. The electronic components are all encapsulated for safety in the presence of highly flammable fuel vapours. The portable meter 1 shown uses a low-voltage dry cell battery as power supply, which is also located within a gas-tight chamber.

To use the meter 1, a filler cap is removed from a fuel filler pipe of a vehicle, and the fitting 5 is securely and sealingly connected to its external opening. The meter 1 is turned on, the valve 8 being it its first position 9. The user pumps the handle 6 of the pressurising pump 2, transferring air through the hose 4 to an interior of the fuel tank.

When the pressure within the fuel tank, the filler pipe and the hose 4 reaches 250 millibars above atmospheric pressure, as indicated by the pressure transducer 12, the electronic control apparatus switches the valve 8 from its first position 9 to its second position 10. The pressurising pump 2 is now connected to the atmosphere, so no more air can be pumped into the fuel tank, which is now linked, via the hose 4, to the restrictor 11. The slightly pressurised air within the fuel tank is now free to bleed out via the calibrated orifice of the restrictor 11, so that the pressure in the fuel tank, etc, begins to fall.

When the pressure transducer 12 registers a first pre-set pressure, for example 200 millibars, the timing circuit begins to run. Air continues to bleed out through the restrictor 11 until a second pre-set pressure is reached, for example 100 millibars, at which point the timing circuit stops. The display 13 indicates an elapsed time between reaching the first and second pre-set pressures, which the user may record. The pressure within the tank is then allowed to return to atmospheric pressure, and the fitting 5 is removed.

In principle, the behaviour of a gas under pressure is governed by the ideal equation:

$$PV = nRT$$

where P is pressure, V is volume, T is temperature, R is the ideal gas constant, and n is the number of moles of gas present. In the course of the above pressurisation and depressurisation sequence, V is the free volume of the fuel tank above the fuel (which includes, as defined, the volume of the filler pipe and the hose 4), which will be substantially constant. Over the range of pressure changes envisaged, it may be assumed that the temperatures T will not vary appreciably, and R is an universal constant. Thus, the pressure is in effect directly related to n, the amount of gas present, and a change in pressure, ΔP, is directly related to a change in the amount of gas present, Δn:

$$\Delta P = \Delta n.RT/V$$

Hence, the larger the value of V, the greater the value of Δn to give a particular value of ΔP.

The calibrated orifice in the restrictor 11 allows gas to escape at a relatively constant rate (for the overpressure ranges in question), i.e. it allows n to change at a substantially constant rate over time. That being said, the number of molecules flowing through the restrictor means and so the rate of pressure change will be a function of the pressure difference across the restrictor means, the absolute pressure, the temperature of the gas, the composition of the gas and so forth. Absolute pressure can be a significant factor. Temperature is less of a factor. Composition of the gas can also be a factor but if air is used, the variation in its composition will usually be minimal, unless perhaps the device is used with a particularly volatile liquid.

Thus, the time t, measured for a specific pressure drop to occur through the restrictor 11 is a measure of the amount of gas that has escaped to produce that pressure drop:

$$\Delta n = k.t, \text{ where } k \text{ is a constant}$$

$$\therefore \Delta P = k.t.RT/V$$

$$\text{or } V = k.t.RT/\Delta P$$

Since k and R are constant, and T is effectively constant and ΔP is predetermined, the free volume V above the fuel in the tank is directly proportional to the time t.

In reality, gas behaviour tends to diverge from ideal gas behaviour, but in a repeatable fashion. Thus, a graph of V versus t may not be a straight line, but it is possible to produce a reliable calibration curve for any given standard fuel tank by part-filling it with a range of known volumes of liquid, and measuring t in each case.

Thus, one may use the meter 1 on a tank of known type containing an unknown volume of fuel, to obtain an accurate assessment of the free volume within the tank, and hence the volume of fuel.

This procedure may be carried out when a vehicle is hired out, repeated when the vehicle is returned, and any difference calculated. If there is a deficit, the hire company may charge the person who has hired the vehicle for the exact shortfall.

In its basic form, the meter 1 indicates only the time taken for the pressure to drop from a first to a second preset value, leaving the user to read off a fuel volume from a calibration curve for the particular vehicle model being used. However, it is envisaged that the meter could be provided with a memory chip or the like containing the calibration curves for a range of vehicles, and a touch-pad or the like allowing the user to select a particular model. The meter display 13 would then show a calculated fuel volume.

Alternatively, the meter could record the time in its memory, and then be connected to a computer, over a standard RS232 connection or the like, in order to transfer this time data. In this case, the computer could hold the calibration curves in its memory and use them to calculate the fuel volume present. It would store the "as hired" fuel volume of each vehicle, compare it with the "as returned" fuel volume of that vehicle, and calculate any refuelling charges automatically.

The meter described will be safe in use, as its electrical components are isolated from any fuel vapour mixed with the air above the fuel in the vehicle's tank. Also, the overpressures used, approximately one-quarter of atmospheric pressure at most, will be well within the range of what a vehicle fuel tank is designed to withstand. If safety regulations require, a pressure relief valve, bursting disc, or the like can be provided to release excess pressure if the valve fails to operate at 250mbar as described above.

It should also be noted that while operation of the meter 1 is described above with the fuel tank, etc, being pressurised to a slight overpressure, it is equally possible to evacuate the tank partially, creating an underpressure that sucks air into the tank through the restrictor 11.

A second embodiment is illustrated in Figure 2. In this embodiment, the meter includes a second pressure transducer 14 which measures ambient pressure, and a memory 15 which stores a calibration table. The calibration table includes data relating the rate at which gas flows through the restrictor 11 to the pressure difference across the restrictor (i.e. the difference in pressure between the inside of the container and ambient pressure), the ambient pressure (and optionally the ambient temperature measured by a temperature transducer). A computer 16 calculates the volume of the fuel tank which is not occupied by liquid taking into account the data stored in the calibration data and the pressure values measured by first pressure transducer 12 and second pressure transducer 14. The computer uses the data in the calibration table to estimate the instantaneous molecular flow rate from the pressure

difference across the restrictor and ambient pressure. (In a further embodiment not shown, the meter also includes a temperature transducer and the computer uses the measured temperature in its calculations). The instantaneous molecular flow rate is evaluated periodically during the measurement process and numerically integrated over time to give an estimate of Δn and thus V.

We have found that the instantaneous molecular flow rate through the restrictor 11 (and hence the rate of change of pressure within the container with time) does not depend only on the pressure measured by the first pressure transducer 12, but also on the absolute value of ambient pressure measured by the second transducer 14. Accordingly, the second embodiment should provide more accurate results than the first embodiment. The second pressure transducer 14 should measure absolute pressure. The first pressure transducer 12 could measure either absolute pressure or the pressure difference between the inside of the container and the ambient air.

A third embodiment is illustrated in Figure 3. In this embodiment, the valve 10 has three positions. The first two positions correspond to the two positions of the first embodiment. The third position connects the first pressure transducer 12 to the surrounding atmosphere. Calculations are carried out as with the second embodiment. An advantage of the third embodiment is that one less pressure transducer is required. This embodiment requires that the pressure transducer measures absolute pressure as it must be able to measure the pressure of ambient air.

Claims

1. A device for determining the volume of air space within a container, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, and means to determine the rate of pressure change within the container while the container is connected to the restrictor means.

2. A device for determining the volume of liquid within a container comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, and means to determine the rate of pressure change within the container while the container is connected to the restrictor means.

3. A device for determining whether the volume of air space within a container has changed between two readings, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, and means to determine the rate of pressure change within the container while the container is connected to the restrictor means.

4. A device for determining whether the volume of liquid within a container has changed between two readings comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or

to the restrictor means, and means to determine the rate of pressure change within the container while the container is connected to the restrictor means.

5. A device for determining the change in volume of air space within a container between two readings, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, means to measure pressure within the container, and means to determine the rate of pressure change within the container while the container is connected to the restrictor means.

6. A device for determining the change in volume of liquid within a container between two readings, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, means to measure pressure within the container, and means to determine the rate of pressure change within the container while the container is connected to the restrictor means.

7. A device according to any one of claims 1 to 6, wherein the means to determine the rate of pressure change comprises a pressure transducer.

8. A device according to claim 7, wherein the pressure transducer measures the pressure difference across the restrictor means.

9. A device according to any one of the preceding claims, further comprising means to measure absolute pressure.

10. A device according to any one of the preceding claims, comprising a pressure transducer for measuring absolute pressure, wherein the valve means is operable to connect the pressure transducer either to the interior of the container or to ambient air.

11. A device according to claim 9 or claim 10, wherein the device or a separate computing device comprises means to determine the effect of absolute pressure (and optionally absolute temperature) on the rate of pressure change while the container is connected to the restrictor means.

12. A device according to any one of the preceding claims, comprising a temperature gauge.

13. A device according to any one of the preceding claims, wherein the means to determine the rate of pressure change within the container determines the period taken for the pressure within the container to change from a first value to a second value while the container is connected to the restrictor means.

14. A device according to claim 13, wherein the first and second values are calculated by calculating means.

15. A device according to any one of claims 1 to 12, wherein the means to determine the rate of pressure change within the container determines the change in the pressure within the container during a period of time.

16. A device according to any one of claims 1 to 12, wherein the means to determine the rate of pressure change within the container measures pressure within the container at a plurality of times and analyses the successive pressure values.

17. A device according to any one of the preceding claims, comprising a display to display at least one determined parameter related to the volume of air space or liquid within the container.

18. A device according to any one preceding claim, comprising a memory to store at least one determined parameter related to the volume of air space or liquid within the container.

19. A device according to any one preceding claim, comprising an interface to interface with an external computer system for storing and processing at least one determined parameter related to the volume of air space or liquid within the container.

20. A device according to any one preceding claim comprising a computer to calculate at least one parameter related to the volume of air space or liquid within the container.

21. A system comprising at least one computer and a plurality of devices according to any one of the preceding claims.

22. A method of measuring the volume of a liquid in a container of known volume comprising the steps of altering the pressure of gas within the interior of a container and allowing the pressure within the container to start equilibrating with air of another pressure through gas flow restrictor means whilst carrying out at least one measurement of the rate of change of pressure within the container, thereby calculating the volume of the container which is not occupied by the liquid and thereby calculating the volume of the liquid.

23. A method of determining whether the volume of a liquid in a container of substantially fixed volume has changed between first and second readings,

comprising the steps of, for each reading, altering the pressure of gas within the interior of the container and allowing the pressure within the container to start equilibrating with air of another pressure through gas flow restrictor means whilst carrying out at least one measurement of the rate of change of pressure within the container, thereby calculating the volume of the air space within the container, and then comparing the calculated air space volumes.

24. A method of determining a change in the volume of a liquid in a container of substantially fixed volume between first and second readings, comprising the steps of, for each reading, altering the pressure gas within the interior of the container and allowing the pressure within the container to start equilibrating air of another pressure through gas flow restrictor means whilst carrying out at least one measurement of the rate of change of pressure within the container, thereby calculating the air space volume, and then calculating the difference in the air space volumes between readings.

25. A method according to any one of claims 22 to 24 wherein air of another pressure is ambient air.

26. A method according to any one of claims 22 to 25 including the step of measuring absolute pressure and taking this measurement into account in calculating the value to be determined.

27. A method according to any one of claims 22 to 26, wherein the step of measuring the rate of change of pressure within the container comprises measuring the period taken for the pressure within the container to change from a first value to a second value while the container is connected to the restrictor means..

28. A method according to any one of claims 22 to 27, wherein the step of measuring the rate of change of pressure within the container comprises determining the change in the pressure within the container during a period of time.

29. A method according to any one of claims 22 to 28, wherein the step of measuring the rate of change of pressure within the container comprises measuring the pressure within the container at a plurality of times and analysing the successive pressure values.

30. A method of calculating a charge to be issued in relation to the rental of a vehicle having a fuel tank for containing fuel, the method comprising the steps of, on at least two occasions, determining the volume of air space in the fuel tank, or a parameter related thereto, thereby calculating the change in the amount of fuel between the occasions, and issuing a bill dependant on the calculated change in the amount of fuel.

31. A device to measure a volume of liquid held within a container of known volume, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, means to measure pressure within the container, and means to time a period taken for the pressure within the container to change from a first predetermined value to a second predetermined value while the container is connected to the restrictor means.

32. A device to measure a volume of liquid held within a container of known volume, comprising means to connect the device to the container, means to alter the gas pressure within the container, gas flow restrictor means, valve means to connect the container either to the pressure altering means or to the restrictor means, means to

measure pressure within the container, and measure the change in pressure within the container to change during a period while the container is connected to the restrictor means.

33. A device according to claim 31 or 32 comprising means to measure absolute pressure, wherein absolute pressure is taken into account in determining the volume of liquid.

34. A method for measuring a volume of liquid held within a container of fixed volume, comprising the steps of providing a device according to claim 31 or claim 33 when dependent on claim 31, connecting it to an aperture of the container, connecting the pressurising means to the container and raising the pressure therein to above a first predetermined value, connecting the container to the gas flow restrictor means so as to allow gas from the container to exit therethrough, timing the period taken for the pressure within the container to fall from said first predetermined value to a second predetermined value, and calculating from said period a gas volume and hence a liquid volume within the container.

35. A method for measuring a volume of liquid held within a container of fixed volume, comprising the steps of providing a device according to claim 32 or claims 33 when dependent on claim 32, connecting it to an aperture of the container, connecting the pressurising means to the container and raising the pressure therein to above a first predetermined value, connecting the container to the gas flow restrictor means so as to allow gas from the container to exit therethrough, measuring the change in pressure within the container during a period and calculating from said change in pressure a gas volume and hence a liquid volume within the container.

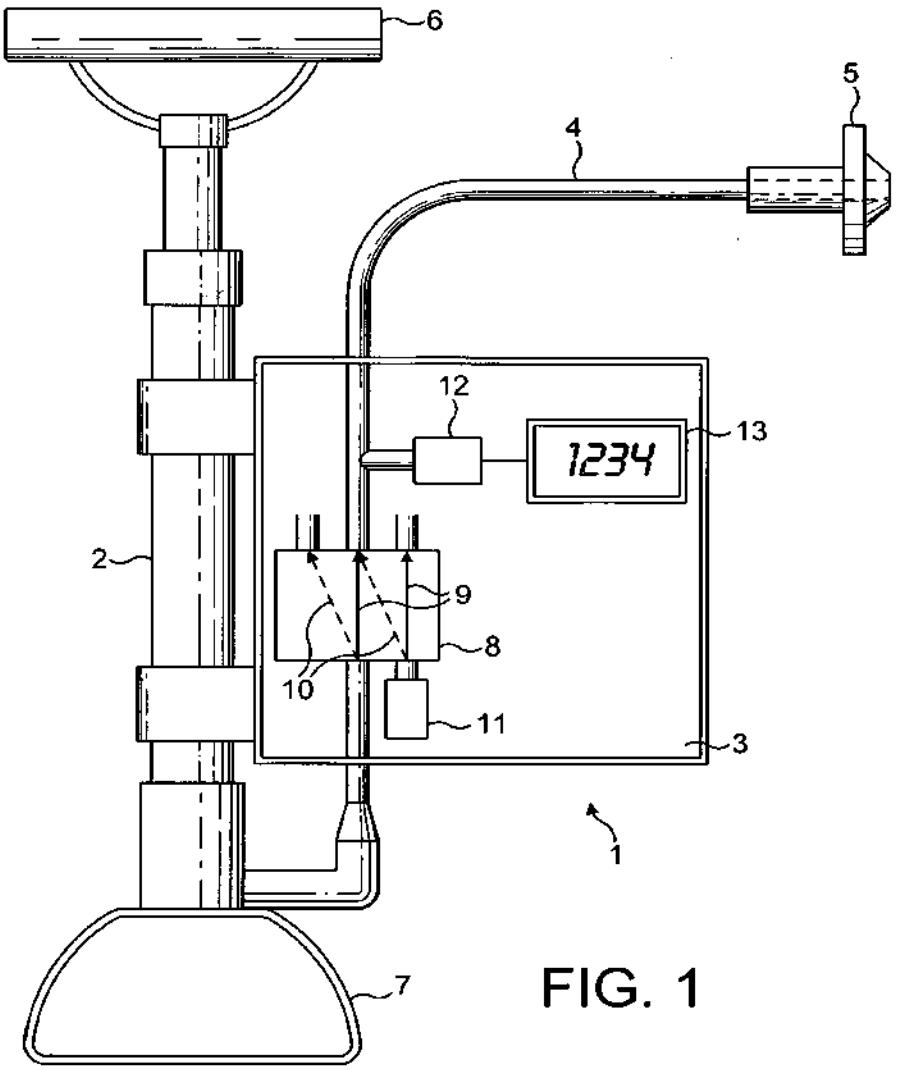

FIG. 1

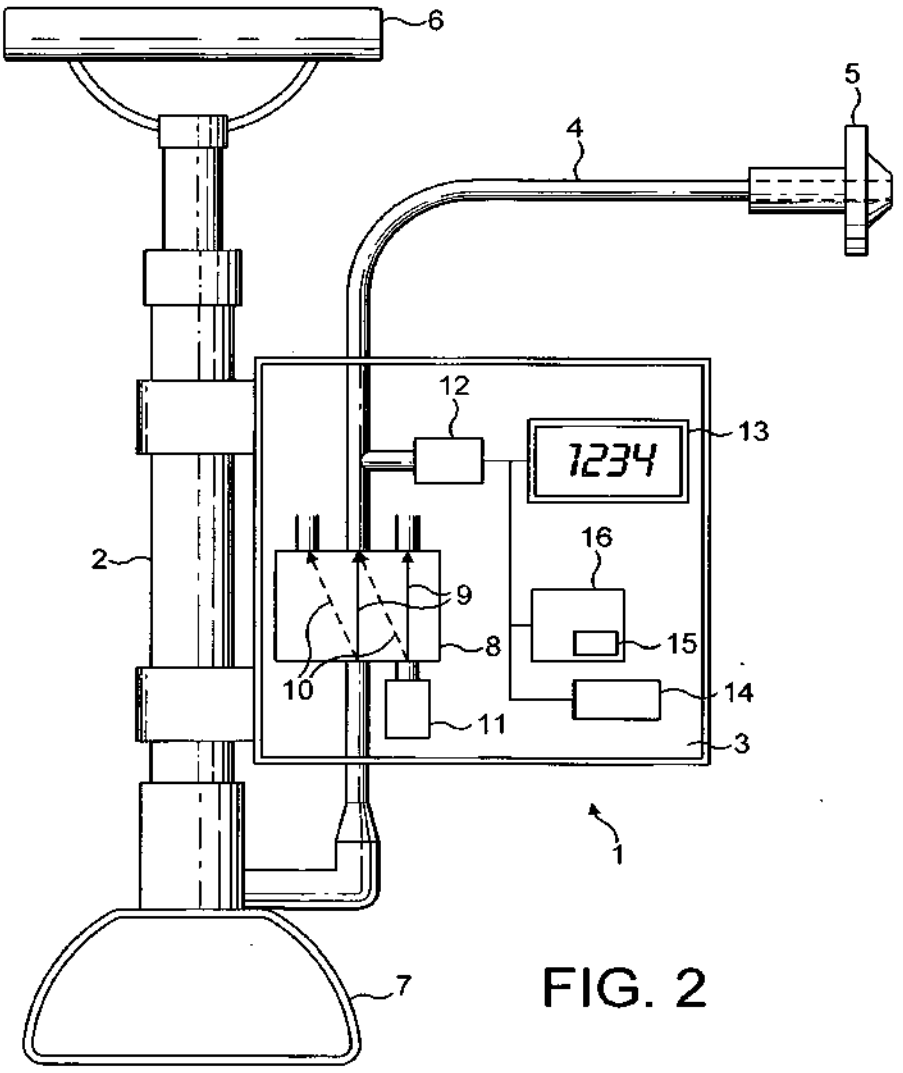

FIG. 2

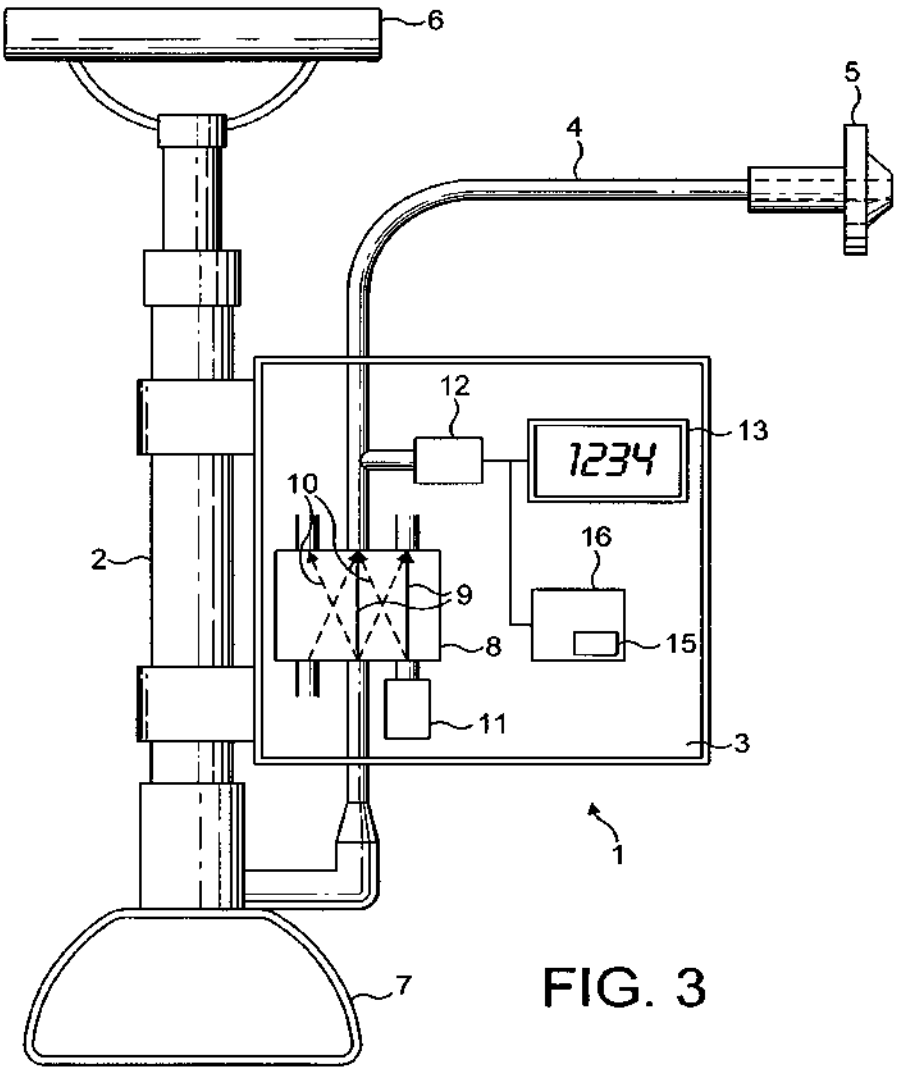

FIG. 3

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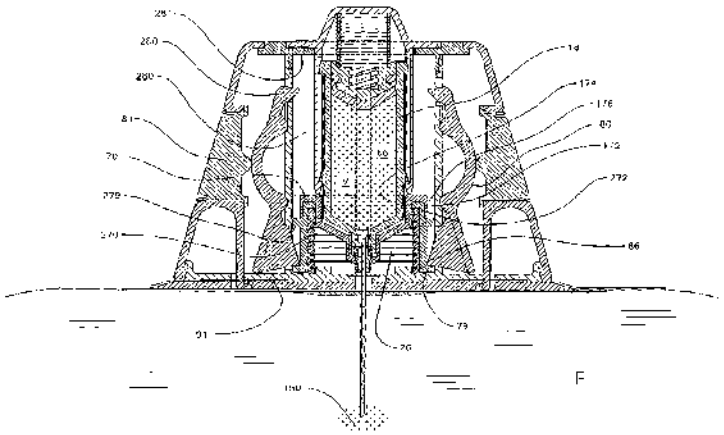
[Continued on next page]

(54) Title: INJECTION DEVICE FOR ADMINISTERING A VACCINE



(57) Abstract: A manually-powered injection device that self-administers a painless injection. The injection device provides a method for substantially painless injections of vaccine and other medication into a patient that does not require the use of an anesthetic, that does not require the medical personnel to spend a substantial amount of time performing the injection procedure, that is relatively simple and inexpensive to perform and operate, and that provides a relatively high degree of safety for both the medical personnel and for the patient. The injection needle can have an outside diameter greater than 0.10 mm and less than about 0.38 mm. The vaccine or other medicament can be injected painlessly through the needle and into the patient at a substantially constant volumetric flow rate of about 0.05 μL/s to about 50 μL/s, typically over a 3- to 5-minute period of time. The injection device is configured for easy handling, and is manuallypowered by the use of the hand or fingers of the medical technician, patient or other person.

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INJECTION DEVICE FOR ADMINISTERING A VACCINE

BACKGROUND OF THE INVENTION

[0001] The present invention relates to the injection of vaccines and other medication and, more particularly, to an injection device that can be used in a method for administering vaccine injections painlessly for a patient.

[0002] Conventional medical injection devices for injecting medication into the muscle or tissue of a patient typically comprise some form of a manual hypodermic syringe. Generally speaking, a hypodermic syringe consists of a cylindrical barrel having a chamber that provides a reservoir for a liquid medication, a distal end adapted to be connected to a hollow hypodermic needle and for placing one end of the needle into flow communication with the medication contained within the chamber, and a proximal end adapted for receiving a stopper and plunger assembly. The stopper and plunger assembly includes a stopper effective for moving along the barrel chamber and an elongated plunger effective for causing movement of the stopper. The needle of the hypodermic syringe is manually inserted into the patient through the skin. The stopper is moved along the barrel chamber by applying axial force to the plunger, thereby forcing the liquid medication out of the barrel chamber, through the hypodermic needle and into the muscle or tissue of the patient.

[0003] Receiving an injection by such a conventional device can be a very traumatic experience, particularly for a child. The child's fears, and that of the child's parent, can become a significant medical problem if it leads to the child not receiving a required vaccination. These fears are predominately caused by pain that is associated with injections given by conventional injection devices and methods.

[0004] We have found that the pain associated with an injection is related to the size of the needle and the flow rate at which the medication is injected. It has been found that the amount of pain or discomfort experienced by a patient increases as the outside diameter of the needle increases. It is believed that high flow rates of medication injection (e.g., about 0.5-2 ml per second) into the patient can tear internal tissue and cause pain. The tearing of tissue is caused by the build-up of excessive pressure within the tissue when the surrounding tissue is unable to quickly absorb the injected medication.

[0005] While the injection of a medication at a relatively slow flow rate is more comfortable for the patient, the increased amount of time the syringe remains in the hand of the medical personnel can make the technique tiring for such personnel as well as the patient. In addition, small vibrations or disturbances of the needle caused by movement of the medical personnel or the patient can result in pain to the patient. It is known that the fluctuation of flow rate of the injection of medication being delivered by a hand-held syringe can vary greatly. It is extremely difficult, if not impossible, to deliver a steady, very slow flow of medication from a hand-operated syringe (the human thumb depressing the syringe plunger) over an extended amount of time.

[0006] It has also been found that the sight of the hypodermic needle by itself is often enough to cause many patients to become anxious and tense. This reaction in turn may cause the patient's muscles to become tight and hard, making needle penetration even more difficult and painful.

[0007] A number of methods and devices have been developed for reducing or eliminating the pain and discomfort associated with medical injections. One such method includes the application of a topical anesthetic to the injection site on the patient's skin prior to the injection, which itself can be painful. While this method has reduced some of the discomfort associated with injections, the topical anesthetic does not substantially penetrate the skin into the deeper skin and muscle tissue, and can take significant time (up to 45 minutes) to show effects. Substantial pain and discomfort with intramuscular injections can remain.

[0008] Another technique for reducing the pain and discomfort associated with medical injections includes the step of injecting an anesthetic at the site of the injection using a fine gauge needle, then inserting the larger medication hypodermic needle through the anesthetized skin to inject the medication at a constant and slow flow rate intramuscularly at the desired depth. Unfortunately, injecting an anesthetic into a patient can be painful, and is not always desirable, and the technique is relatively expensive and impractical for many routine injection procedures.

[0009] In addition to reducing pain or discomfort to the patient, safety has also become a principal concern to medical personnel. Special precautions must be taken to avoid accidental needle sticks that could place a user at serious risk because of the danger from fluid borne pathogens. Despite the taking of special precautions, there still remains the possibility of an accidental needle contact and attendant injury.

Accordingly, medical injection devices should operate to minimize the possibility of injury caused by accidental needle sticks.

[0010] In recent years, increased emphasis has been placed on establishing treatment protocols aimed at providing a patient as well as medical personnel with greater freedom of movement. To this end, there is a great deal of interest in the development of light weight and easy-to-use portable injection devices.

[0011] Accordingly, a need exists for substantially painless method and an apparatus for performing the method of injecting medication into a patient that does not require the use of an anesthetic, that does not require the medical personnel to spend a substantial amount of time performing a particular procedure, that is relatively simple, portable and inexpensive to perform and operate, that permits the patient a relatively high degree of movement during the injection, and that provides a relatively high degree of safety for both the medical personnel and for the patient.

SUMMARY OF THE INVENTION

[0012] The present invention relates to an injection device that is manually-powered and configured for self-administering painlessly an injectable liquid composition, such as a vaccine or medicament. The device can be used in a method for providing a substantially painless injection of the injectable liquid composition to a patient that does not require the use of an anesthetic, that does not require the medical personnel to spend a substantial amount of time performing the injection procedure, that is relatively simple and inexpensive to prepare and operate, and that provides a relatively high degree of safety for both the medical personnel and for the patient.

[0013] The present invention further relates to a manually-powered injection device for self-administering painlessly an inter-muscular injection of an injectable liquid composition contained within a reservoir, comprising a) a housing having a base for semi-permanent attachment to the skin of a patient, b) an injection needle disposed substantially perpendicular to the base and within the housing, the needle having an injection end, and configured for axial movement manually between a first position wherein the injection end is within the housing and a second position wherein the injection end extends outwardly from the base to a distance sufficient for intramuscular insertion thereof, the injection needle having an outside diameter greater than 0.10 mm and less than about 0.38 mm, c) a means for retaining a reservoir for containing an

injectable liquid composition, d) a means for providing liquid communication between the retained reservoir and the injection needle, e) a means for injecting the injectable liquid composition from the retained reservoir through the needle.

[0014] The present invention also relates to a manually-powered injection device for self-administering painlessly an inter-muscular injection of an injectable liquid composition, comprising a) a housing having a base for semi-permanent attachment to the skin of a patient, b) an injection needle disposed substantially perpendicular to the base and within the housing, the needle having an injection end, and configured for axial movement manually between a first position wherein the injection end is within the housing and a second position wherein the injection end extends outwardly from the base to a distance sufficient for intramuscular insertion thereof, the injection needle having an outside diameter greater than 0.10 mm and less than about 0.38 mm, c) a reservoir for containing the injectable liquid composition, d) a means for liquid communication between the reservoir and the injection needle, and e) a means for injecting the injectable liquid composition from the reservoir to the needle.

[0015] The present invention also provides an improved cartridge for use in a self-administering injection device, that comprises separate and spaced-apart filling and dispensing ports, and which allows a dispensing plunger to ascend within the cartridge during the injection in a direction toward the filling port. This can provide a visual signal when the distal end of the plunger approaches the filling end of the cartridge, at the completion of the liquid composition injection.

[0016] In typical embodiments of the present invention, the needle is affixed to a needle carriage that is configured for axial movement between a first position associated with the first position of the injection needle, and a second position associated with the second position of the injection needle, in response to the manual force applied by the person. Upon manual insertion of the needle, a needle insertion securement secures the carriage in the second position the liquid composition is injected. The device is typically employs a manually-powered spring that is compressed during the manual needle insertion, which exerts pressure upon the injectable liquid composition within the retained reservoir. The needle carriage and the reservoir comprise cooperating threads that can engage and retain the reservoir within the carriage, and which can cause penetration of a penetrable membrane in the reservoir by the inlet end of the injection needle to establish liquid communication there between. At the end of the injection

cycle, a needle retracting means can be activated, typically manually, to retract the injection needle, whereby the injection end of the needle is retracted from its second position in the body to a third position wherein the injection end of the needle is within the housing. The needle retracting means can employ a disengagement means configured to disengage the needle insertion securement from the needle carriage, and a power means configured to bias the needle carriage to the third position. An implement, such as a plunger or stem, can be used in place of the finger or hand to apply the manual insertion force to the needle carriage. The device can also comprises a separable base, a base securement means configured for separable securement of the separable base to the housing, and a base separation means configured for separation of the separable base from the housing, wherein the separable base comprising an adhesive for attachment thereof to the skin of the patient.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Figure 1 shows a cross-sectioned elevation view of a housing of a manually-powered painless injection device of the present invention in an extracted position, taken through line 1-1 of the housing shown in Figure 4.

[0018] Figure 2 shows the cross-sectioned elevation view of Figure 1 of the housing in an inserted position.

[0019] Figure 3 shows a cross-sectioned elevation view of the housing shown in Figure 4, taken through line 3-3 of Figure 4.

[0020] Figure 3A shows a detailed cross-sectional view of the housing of Figure 3.

[0021] Figure 4 shows a top plan view of the housing of the manually-powered painless injection device.

[0022] Figure 5 shows a cross-sectioned elevation view of the housing of Figure 4, taken through line 5-5.

[0023] Figure 6 shows a cross-sectioned elevation view of the housing of Figure 4 taken through line 6-6.

[0024] Figure 7 shows a cross-sectioned plan view of the housing of Figure 1, taken through line 7-7.

[0025] Figure 8 shows a cross-sectioned plan view of the housing of Figure 1, taken through line 8-8.

[0026] Figure 9 shows an exploded cross-sectioned elevation view of the elements of the housing of Figure 1.

[0027] Figure 10 shows a cross-sectioned elevation view of a syringe cartridge of a manually-powered painless injection device of the present invention in an extended position, taken through line 10-10 of the syringe cartridge shown in Figure 12.

[0028] Figure 11 shows a cross-sectioned elevation view of the syringe cartridge in an extended position, taken through line 11-11 of Figure 12.

[0029] Figure 12 shows a plan view of the syringe cartridge of Figure 10.

[0030] Figure 13 shows a detailed cross-sectional elevation view of the syringe cartridge of Figure 10.

[0031] Figure 14 shows another detailed cross-sectional elevation view of the syringe cartridge of Figure 10.

[0032] Figure 15 shows a plan view of the syringe cartridge shown in Figure 14.

[0033] Figure 16 shows a cross-sectioned plan view of the syringe cartridge of Figure 11.

[0034] Figure 17 shows a bottom plan view of the syringe cartridge of Figure 11.

[0035] Figure 18 shows an exploded cross-sectioned elevation view of the elements of the syringe cartridge of Figure 10.

[0036] Figure 19 shows a cross-sectioned elevation view of the syringe cartridge of Figure 10 containing an injectable liquid composition in a pressurized position.

[0037] Figure 20 shows a cross-sectioned elevation view of the housing and a separable base assembly prior to its attachment to the housing, and of a syringe cartridge prior to its installation into the housing.

[0038] Figure 21 shows the housing and syringe cartridge of Figure 20, with the housing being affixed to a patient's skin.

[0039] Figure 22 shows the syringe cartridge being installed into the housing of Figure 21.

[0040] Figure 23 shows the syringe cartridge being force into an inserted position within the housing.

[0041] Figure 24 shows the syringe cartridge in the inserted position within the housing, injecting the liquid composition.

[0042] Figure 25 shows the syringe cartridge in the inserted position within the housing, at the completion of the liquid composition injection.

[0043] Figure 26 shows the syringe cartridge in the inserted position within the housing of Figure 25, being manipulated to retract the needle.

[0044] Figure 27 shows the syringe cartridge and housing of Figure 26, with the needle retracted.

[0045] Figure 28 shows the housing and the syringe cartridge of Figure 27 being removed from the separable base that remains attached to the patient.

[0046] Figure 29 shows a top plan view of another embodiment of the invention, of a device having a housing that can accommodate two syringe cartridges.

[0047] Figure 30 shows an elevation view of the device of Figure 29.

[0048] Figure 31 shows a cross-sectioned elevation view of the dual-syringe device of Figure 29 taken through line 31-31.

[0049] Figure 32 shows a separable base assembly having an adhesive flap for use in attaching the device of the present invention to the skin of a patient.

[0050] Figure 33 shows a cross-sectioned elevation view of the separable base assembly of Figure 32 through lines 33-33.

[0051] Figure 34 shows a detailed cross-sectioned elevation view of the separable base assembly of Figure 33.

[0052] Figure 35 shows another detailed cross-sectioned elevation view of the separable base assembly of Figure 33.

[0053] Figure 36 shows a cross-sectional plan view of a base shown in Figure 22 through lines 36-36, which has been modified to provide blocking plate that is in a deployment position to allow needle deployment.

[0054] Figure 37 shows a cross-sectional elevation view of the base of Figure 36.

[0055] Figure 38 shows a cross-sectional plan view of the base of Figure 36, which is in a blocking position to prevent needle deployment.

[0056] Figure 39 shows a cross-sectioned elevation view of an alternative embodiment of the device having an improved means for establishing liquid communication between the injection needle and the reservoir.

[0057] Figure 39A shows a detailed cross-sectional view of the device of Figure 39.

[0058] Figure 40 shows cross-sectioned elevation view of an alternative embodiment of a syringe cartridge in a first configuration.

[0059] Figure 41 shows the syringe cartridge of Figure 40 is a second configuration.

[0060] Figure 42 shows cross-sectioned elevation view of an alternative embodiment of the injection device having a means for selectively restraining the axial movement of the needle carriage.

[0061] Figure 42A shows a detailed cross-sectional view of the device of Figure 42.

[0062] Figure 43 shows cross-sectioned elevation view of another alternative embodiment of a syringe cartridge.

[0063] Figure 44 shows cross-sectioned elevation view of an alternative embodiment of the device having a needle retracting means.

DETAILED DESCRIPTION OF INVENTION

Definitions:

[0064] As used herein, "patient" means a mammal, including a person, including a child or infant, or an animal, typically a mammal, on which the device is attached, and into whom the device injects an injectable liquid composition.

[0065] As used herein, unless specified otherwise, the phrase "manually powered" means that the power provided to the device of the present invention to at least insert the injection needle into the patient's body is provided manually by a person, including a medical technician (a nurse, doctor, or other person who can administer the injection) or a patient, by manipulating the injection device with the hands or fingers, or by manipulating an appropriate implement that interacts with the device.

[0066] As used herein, unless specified otherwise, the term "self-administering" describes the ability of the device of the present invention to be held or to hold itself in a position attached to the skin of a patient by a securement means, without requiring a medical technician, the patient, or other person, to hold the device, during the time that an injectable liquid composition contained within the device is injected into the patient through the injection needle.

[0067] As used herein, unless specified otherwise, the term "upward" means in a direction or oriented away from the patient's skin or the base of the device; the term "downward" means in a direction or oriented toward the patient's skin or the base of the device; the term "inward" means in a direction or oriented toward the centerline of the device, typically the needle; and the term "outward" means in a direction or oriented away from the centerline of the device.

[0068] The manually-powered, self-administering injection device of the present invention typically comprises a housing, an injection needle, a reservoir for containing an injectable liquid composition, such as a vaccine or a medicament, and a plurality of elements associated with and at least semi-permanently attached to the housing. The other associated elements can also include the various means of providing power or energy for the functional operations of the device, such as the insertion and retraction of the injection needle, and the pumping or injecting of vaccine to the injection needle. Typically, these associated elements are contained within the confines of the housing, although these elements can also partially confront or penetrate through the outer surface of the housing.

[0069] In the course of administering most injections of vaccines and other medicaments, the injection can be advantageously administered intramuscularly (that is, into the muscle). The injection is made with an injection needle that is configured for insertion through the outer layer of the patient's skin, and more typically into the muscle tissue of the patient. Typically, the depth of insertion is at least about 5 mm, and typically up to about 35 mm or more, more typically from about 10 mm to about 25 mm, and even more typically from about 15 mm to about 20 mm. For a young child or infant, the depth of insertion is typically from about 10 mm to about 25 mm, more typically from about 12 mm to about 15 mm. Alternatively, some injections can be administered intradermally, or into other internal organs or the general body cavity of the patient.

[0070] Painless injections can be achieved when the size or diameter of the injection needle is minimized, typically by using a needle of gauge size 28 or small (typically up to gauge size 33), and when the injectable liquid composition, such as a vaccine or other medicament, is injected at a volumetric flow rate significantly lower than that of a conventional injection made by hand, typically less than about 50 microliter per second (μL/s) and more typically about 1-4 μL/s. To achieve such low flow rates when administering a typical injection dose of between 0.5 ml to about 1.0 ml, an injection time of about 3 to 5 minutes may be needed. Typically, the human hand, using a conventional syringe, can not accurately or reproducibly control the flow rate within a range that ensures a painless injection. Furthermore, the desired slower injection rate of the medicament would require that the medical technician (or the patient) hold the conventional syringe carefully in place against the skin of the patient, and that the

patient not move the limb or body part that is the site of the injection while the injection is being administered. The present invention overcomes these problems by providing a self-administering device that remains in position on the skin of the patient at the injection site, and administers the injection of the injectable liquid composition, without requiring a medical technician or patient to hold the injecting device in its place by hand, and without requiring that the patient remain still and not move while the injection is being administered. These problems are particularly troublesome when the patient is an infant or young child.

The manually-powered device of the invention is intended to be attached semi-permanently to the skin of the patient before, during or after the injection. The device is typically configured to be attached to the upper arm or to the thigh area, providing access to the larger skeletal muscles (the deltoids and the quadriceps) for intramuscular injection. The attachment is preferably semi-permanent, whereby the device can be removed reasonably easily from the skin. The device is configured to attach to the body of the patient so that it does not move or migrate along the surface of the skin after attachment. In many situations, an adhesive attachment is sufficient. Alternative attachment means can include strapping, such as with a buckle strap or with a "hook and loop" attachment means commonly referred to as "Velcro", or cuffing, as with a sphygmomanometer cuff. In an other alternative embodiment, a portion of the device, such as a bandage associated with the device or a portion of the base of the housing, can be configured to remain affixed to the patient's skin after the housing of the device has been removed.

[0071] A typical adhesive for securing the device directly to the skin is a pressure sensitive adhesive (PSA). The direct-attaching PSA and the base where the PSA is affixed are typically configured whereby the PSA adheres to the device more strongly than the PSA adheres to the skin. The PSA is typically permanently affixed to the device, such that no PSA will remain adhered to the skin of the patient when the device, or at least the housing portion of the device, is removed from the skin. The PSA is also selected for a secure though releasable affixment to the skin. These criteria ensure that the device, or at least the bandage or base portion of the device, can be securely affixed to the skin for the vaccination procedure, and can be safely and efficiently removed from the skin thereafter.

[0072] Typically, the manually-powered device having a skin-attaching PSA will also include a release member, such as a release paper or film, which overlies the adhesive on its skin-contacting side. After the release member is peeled from the PSA, the exposed adhesive layer can be placed against the patient's skin to attach the device thereto.

[0073] A main objective for initiating the development of the present injection was effecting a painless injection of injectable liquid compositions. While pain can be a relative experience, typically the painless device of the present invention will, after having been secured to the skin of the patient, effect the insertion of the injection needle and injection of the injectable liquid composition into the body without a sensation or feeling of pain, and more typically without any sensation or feeling whatsoever. In other words, the patient in most circumstances will have no sensation that the device has inserted a needle into the body, or that the injectable liquid compositions is or has been injected into the body, except perhaps visually observing the device or touching the device with a hand, or feeling the attachment of the device to the outside of the skin.

[0074] Typically the manually-powered device is configured to complete the vaccination or injection of medicament into the patient utilizing a source of power or energy that is external to the device itself. The source of power can be provided by a person, such as a medical technician (a nurse, doctor, or other person who can administer the injection) or the patient, typically by manually (or bodily) manipulating the injection device with the hands or fingers, or by using an appropriate implement, as hereinafter described. The self-administering feature of the device and method of the invention enables injection of injectable liquid compositions without requiring medical personnel to hold the device against the skin of the patient during the time that the injectable liquid composition is in liquid communication with the needle, and is being pumped from the device into the patient. The use of the device that self-administers an injection allows medical personnel to perform other tasks while the injection proceeds. The device also allows the patient to have freedom of movement for the minutes of time that the injection proceeds. Typically, the source of power for arming the manually-powered device from its unarmed configuration comprises a manual power. This can be the use of the hands or fingers of a technician or an adult patient to manipulate the device or elements thereof with force. The manipulating force can also be applied using an implement, such as a key, push rod, or other inanimate object. The manually-applied

kinetic force is stored by a power means within the device as potential energy, which can, upon subsequent activation, power one or more of the functions of the device. Typically, the external force used for the needle insertion function can also be used to store potential energy within the device, such as in a compressed spring or other biased resilient member. The external force can also be stored as electrical power or pneumatic power.

[0075] Typically, the device is manufactured and shipped to a use center, such as a clinic or hospital, with the needle insertion function in a first unarmed configuration. The unarmed configuration provides that the injection needle, which in its first position has it's the distal end or tip of the injection needle wholly within the housing, can not be intentionally or accidentally extended to a second position wherein the injection tip extends through the base of the device and outside of the device. In the unarmed configuration, there is typically no potential energy source, such as a compressed wire spring, available to the needle insertion means for spontaneous insertion of the needle. The unarmed condition can also be termed a fail-safe position, since, in this configuration, even a malfunction of the device will no allow the needle to extend from the housing. By contrast, if the needle insertion means is armed, then the device has potential energy stored on board, such as in a compressed, extended or torsioned spring, or other power means for insertion of the needle. If this armed device is activated, such as when an actuation button is depressed, the potential energy of the power means is released as kinetic energy that can move the needle insertion means from its first position to its second, extended position. If the device is shipped, stored, or handled in an armed configuration, there is a risk of an inadvertent, or even an intentional, activation of the needle insertion means. Consequently, the shipment and handling of the manually-powered device of the present invention in an unarmed configuration can avoid both an intentional and accidental needle sticks prior to its use in administering an injectable liquid composition. This improves the safety and security of the device during, storage, and pre-injection handling. In this configuration, at least the needle extension function (also called the insertion function when the needle tip extends into the skin of the patient) is unarmed.

[0076] Other functions, such as the pumping or injection means (for passing the injectable liquid composition through the injection needle) and the needle retracting means (to withdraw the needle from its second position in the body, back toward its first

position in the housing) can be configured for shipment and storage as either armed or unarmed. Preferably, the power means for the pumping means has an unarmed configuration, to avoid an accidental activation of the pumping of injectable liquid composition from the reservoir, which could prematurely empty the reservoir and render the device useless. Likewise, any needle retracting means is preferably shipped and stored in an unarmed configuration, to avoid the possibility of an unintentional or accidental activation, which in some embodiments may make the opposing needle insertion function inoperable, where the needle retraction is irreversible.

[0077] The power means can be used to provide energy to one or more of the elements of the device, such as insertion and retraction of the injection needle, or pumping of the medicament. Two or more power means can be used to provide energy for different elements, such as where the injection needle is moved from one position to another by a first power means, and an injectable liquid composition is pumped from a reservoir to the injection needle by a different, second power means.

[0078] The device can be at least partially self-controlled, wherein at least one of the elements of the device can initiate operation automatically in response to the operation of another element.

[0079] The typical device of the present invention has a housing comprising a base for placement against the skin of a patient, for attachment of the device. The base can have a contoured surface that generally conforms to the shape of the body (typically, the arm or leg), to maintain the base surface in optimum confronting relationship with the skin. For example, the base of the device can have a slightly concave surface, which arches inwardly toward the interior of the housing.

[0080] The housing is typically made of a thermoplastic material that is light and inexpensive to manufacture, such as by molding, and yet is durable and resilient to gross deformation or breakage. A typical plastic material can include polyethylene, polypropylene and polycarbonate. The housing can be designed with a shape that is both aesthetically pleasing and functional, for example, to allow insertion of the reservoir, to allow activation of one or more of the elements, such as the injection needle and liquid communication means, and other elements of the device. The housing can be made as a single part or as a plurality of parts configured to associate and secure together in both either static or moving relation to one another.

[0081] The housing also provides a visual enclosure for the injection needle that keeps the needle out of sight of the patient at all times during the injection procedure. This can reduce or eliminate the patient's apprehension or fear caused by the sight of a needle, thereby reducing the tendency of the patient's muscles to tighten and harden, which can make needle penetration more difficult and painful for the patient.

[0082] The housing also provides a physical enclosure for the injection needle that helps to avoid accidental needle stick, particularly after an injection, which could place a user at serious risk from fluid-borne pathogens. The device can be configured for use only once (unless completely disassembled and retrofitted), thereby minimizing the likelihood of reuse of a contaminated hypodermic needle. The device can also advantageously be configured wherein some parts or assemblies, such as the housing and it associated elements, can be reused.

[0083] The housing can also be configured to receive and secure the needle and optionally the reservoir of injectable liquid composition as a modular insert into the housing body. The housing can include two or more parts, at least one of which is movable relative to another, which can be configured into an open position wherein either the needle or the reservoir, or both, can be inserted into the body of the housing, or a closed position wherein the needle and/or reservoir are not accessible or retrievable from within the housing. The movable part can be a door or a panel that is movable to provide an access port into the housing. The door or panel can be hinged or removably affixed to the housing, or can be slidable away from the access port.

[0084] The injection needle of the device provides for liquid communication of the injectable liquid composition passing from the reservoir and through other liquid communication means of the device, into the body tissue of the patient, from where the injectable liquid composition can dissipate into the surrounding tissue and throughout the body. The injection needle should be shaped and configured to provide painless insertion and painless injection of the injectable liquid composition. Generally an injection needle having a smooth circular outer surface and an outer diameter D of about 0.36 mm (28 gauge needle) and less can be inserted painlessly through the skin of a patient. For small children, infants and patients having more sensitive skin, an outer diameter D of about 0.30 mm (30 gauge needle) and less (31 gauge to 33 gauge), will typically ensure painless needle insertion.

[0085] Typically the injection needle is configured to be substantially linear or straight, from its distal end or tip, toward the opposed inlet opening. The needle can be configured to be linear completely to its inlet end, or can be configured with a bent or curved portion near the inlet opening.

[0086] The needle size should be sufficiently large to allow passage of the required volume of liquid medicament into the body within a period of time that is suitable to avoid causing pain. For a typical medicament volume of about 0.5 ml to about 1.0 ml, a substantially painless to completely painless injection can be achieved over an injection period of from about 1 minute to about 10 minutes, more typically from about 3 minutes to about 5 minutes. The volumetric flow rate is at least about 0.05 microliter per second (μL/s), and up to about 50 μL/s. Typically, the volumetric flow rate is about 0.5 μL/s to about 20 μL/s, and more typically about 1 μL/s to about 4 μL/s. The injection needle should be sufficiently durable and axially rigid to avoid bending or breaking when inserted into the skin and muscle. Typically, a needle having an outer diameter of from about 0.10 mm (about 36 gauge), more typically of from about 0.23 mm (32 gauge), up to about 0.36 mm (28 gauge), is sufficiently painless, durable, and liquid conductive.

[0087] It is also within the practice of the device and method of the present invention to inject medicament volumes of greater than about 1.0 ml, and to deliver the injection over time periods greater than 10 minutes.

[0088] Typically, the injection needle is pre-installed into the injection device during its manufacture, prior to its distribution to the facility or site where the injection shall occur. Although the device can be configured for installation of the injection needle at the use facility, the small, fine size of the injection needle may make it difficult for a medical technician or patient to manipulate it into position within the device. Likewise, after a vaccination, the injection needle and the housing or assembly thereof into which the needle is secured, can be disposed of in accordance with health and safety regulations and guidelines.

[0089] The injectable liquid composition is typically contained within the cavity of the reservoir, and flows from the reservoir to the injection needle during injection. The reservoir is typically positioned within the housing although the structure of the reservoir can also form a portion of the outer surface of the housing. The reservoir can have a rigid structure having a fixed volume with a moveable member, such as a plunger that defines a variable volume cavity. The reservoir can also have a flexible

structure where its volume can decrease as its content of injectable liquid composition is removed there from. Typical materials for use in making the reservoir include natural and synthetic rubber, polyolefin, and other elastomeric plastics. The selection of the structure and material of construction of the reservoir will depend in part on the specific means of pumping the medicament from the reservoir to the injection needle. Selection of the material of the reservoir should also be chemically stable with the injectable liquid composition. In another typical embodiment, the reservoir can be affixed to the injection needle as part of a injectable liquid composition product, for assembly into the device. A reservoir will generally have a volume sufficient to contain about 0.1 ml to about 10 ml, typically about 0.1 ml to about 3 ml, of medicament. In a more typical embodiment, the reservoir would hold about 0.5 ml to about 1.0 ml of medicament.

[0090] The reservoir comprises an outlet port that is in liquid communication with, or can be brought into liquid communication with, the injection needle. The reservoir outlet can be temporarily sealed, such as with a penetrable membrane that can provide an air-tight and leak-proof seal over the outlet opening of the reservoir during manufacture, shipment and storage of the filled reservoir, and that can provide a self-sealing, leak-proof joint when pierced by the inlet end of the needle or a separate piercing conduit at the time of the injection. A typical reservoir membrane comprises natural or synthetic rubber or a thermoplastic material. Alternatively, a wall of the reservoir can be adapted to allow penetration thereof by the piercing conduit, such as the inlet end of a needle.

[0091] A typical embodiment of a reservoir comprises a reservoir body having a cavity that has been pre-filled with the injectable liquid composition and sealed. The pre-filled reservoir can be assembled into the device during manufacture. In this case, the device is labeled to identify the particular injectable liquid composition that is contained therein.

[0092] More typically, pre-filled reservoir will be configured for installation or insertion into the housing of the injection device at the facility or site where the injection will occur. The technician would typically remove the reservoir from a storage area, such as a refrigerator, and insert it into position within the housing of the device. An identity label associated with the reservoir can be provided that is conveniently transferred to the patient's records.

[0093] Alternatively, a device can have secured within an empty reservoir can be filled by medical personnel with the appropriate quantity and type of medicament, prior to injection. Typically, this embodiment of the reservoir comprises a liquid flow valve that has a self-closing, self-sealing opening to the cavity of the reservoir. The flow valve can be a one-way flow valve, also referred to as a check valve. The liquid composition flow valve is typically an elastomeric or rubber material.

[0094] One type of one-way flow valve is a flapper or so-called duckbill valve (available from MiniValve International Yellow Springs, OH) that allows flow of liquid in one direction, but which self-seals in response to liquid flow or pressure in the opposite direction. Another type of one-way flow valve is a cylindrical member having a slit opening formed axially there through, through which a hypodermic needle of a syringe is inserted to inject a desired dose of the liquid composition into the cavity of the reservoir. When withdrawn, the slit opening closes and seals. When the device is used by medical personnel as supplied from a manufacturer with the reservoir securely inserted within the housing, the device can have a companion flow valve in communication with the reservoir flow valve that is disposed in the outer surface of the housing, or otherwise accessible to the medial personnel. The liquid composition flow value can be inserted into a bore formed in the sidewall of the reservoir that is slightly smaller in diameter than the flow valve.

[0095] If the reservoir is configured so that a portion of the reservoir is integral with the housing, then a single flow valve can be used, with an inlet accessible to the medical technician and an outlet into the cavity of the reservoir. Alternatively, the device can be configured with a second liquid composition flow valve positioned in the housing, disposed adjacent to and aligned with the first flow valve disposed in the reservoir.

[0096] An important requirement of the liquid communication means is to ensure that the liquid composition can flow from the reservoir to the injection needle regardless of the specific orientation of the device. Typically, the attachment of the device to the skin of the patient can position the reservoir and the injection needle into a variety of relative spatial orientations that can sometimes require the liquid composition to flow upward against gravity, or that can position the outlet of the reservoir in an upward position, opposite the pool of liquid composition disposed in the reservoir.

[0097] Consequently, a preferred configuration of the reservoir and liquid communication means provides that the outlet of the reservoir is maintained in

communication with the remaining liquid composition in the reservoir. A typical configuration comprises a collapsible reservoir comprising an outlet that maintains liquid communication with any residual liquid composition present in the reservoir. This reservoir has an upper flexible wall that can be conformed to the volume of the liquid remaining therein. The reservoir typically contains little or no air or gas when filled with the supply of liquid composition and during its displacement and injection operation. Thus, the reservoir collapses to become essentially empty, terminating delivery. In like manner, when a non-flexible material is used for a reservoir, such as a conventional tube-with-plunger syringe, the displacement of the plunger empties the reservoir, which terminates delivery.

[0098] The housing can also comprise an outer support structure that confines and protects the reservoir from outside elements that might puncture it, and which can define the initial shape of the reservoir.

[0099] The reservoir can also be constructed of an elastomeric material that can be expanded in volume when filled with the liquid composition, and holds the liquid composition under pressure. After puncture by a piercing conduit, such as the inlet end of the injection needle or an intermediate member that is in liquid communication, such as via tube, with the injection needle, the expanded reservoir can contract to reduce the effective volume of the reservoir as liquid composition is pumped there from. One or more of the walls of the reservoir can be made of an elastomeric material, while other walls or surfaces are made of other elastic or inelastic rubber or plastic material.

[0100] The reservoir can also comprise an adaptable structure having a means of varying its effective volume, such as a piston-plunger construction or an accordion construction, as in a bellows. In the embodiments described herein, a self-contained reservoir can be replaced with a more conventional syringe and plunger for storing and injecting the liquid composition to the injection needle.

[0101] Non-limiting examples of a reservoir of the present invention are those described in US Patent 5,527,288 (element 10), US Patent 5,704,520 (element 12), and US Patent 5,858,001 (elements 16 and 17), all such publications incorporated herein by reference.

[0102] A first embodiment of the invention is shown in Figures 1-3, 3A, and 4-28. The device includes a housing, shown in Figs. 1-3, 3A, and 4-9, and a cylindrical syringe cartridge shown in Figs. 10-19. The use and operation of the device for

manually self-administering a painless injection is illustrated in Figs. 20-28. A device having a housing for retaining a plurality of cylindrical syringe cartridges is shown in Figures 29-31. Figures 32-25 show a separable base and means for attaching the device to a patient's skin.

[0103] Figures 1-8 show an assembled housing 10 in various views and aspects. Figure 1 shows the housing 10 having an outer body 11, a needle carriage 70, a means for retaining a reservoir for an injectable liquid composition, and a base 12 for placement of the device against the skin of a patient. The carriage 70 is configured for movement along an axial centerline 100 in a direction perpendicular to the base 12. The cylindrical carriage has a cylindrical recess 71 having a tapered bottom 78, that opens to a connector portion 73 having internal female threads, which provide the at least a portion of the retaining means for the reservoir, described below. A needle 40 lies along the centerline 100 and is disposed through the axial center of a needle hub 72 that is secured to the connector 73. The inlet 42 end of the needle 40 extends within the connector portion 73 sufficiently below the opening in the tapered bottom 78 to prevent the sticking of a finger that may probe the recess. A retracting spring 76 is positioned about the centerline 100, having one end disposed within an annular groove 74 in the underside of carriage 70, and the other end disposed around an annular flange 94 projecting up from the base 12. The needle 40 extends downward from the lower end of the needle hub 72 toward the base 12. The needle is completely within the housing when the carriage 70 when in the first retracted position shown in Figure 1.

[0104] As will become more evident, the retracting spring 76 disposed as shown in Figs. 1, 3, and 20 should have an amount of pre-tensioning or compression that is sufficient to completely retract the carriage 70 back to the top of the housing 10 when the needle 40 is retracted from the body.

[0105] In a second inserted position, shown in Fig. 2, the carriage 70 has moved axially toward a position proximate to the base 12 of the device, and the needle 40 extends downwardly and out through the opening 13 in the base. The guide wall 14 comprises an inwardly-projecting, axially-oriented guide, shown as elongated rib 19, that registers along its length with an axially-oriented peripheral groove 77 in the outer wall 75 of the carriage 70, shown in Figure 3, to prevent the carriage 70 from rotating within the guide wall 14. A retainer heel 86 is biased inward from an opening in the cylindrical guide wall 14. As the carriage 70 passes down the guide wall 14, the heel

86 is temporarily biased outward, allowing the carriage to pass. The retracting spring 76 is compressed between the underside of the carriage 70 and the base 12. When the carriage arrives at the fully inserted position shown in Fig. 2, the lower end flange 79 of the carriage has cleared past the heel 86, which returns to its inwardly-biased position, where it can secure the carriage 70 and the needle 40 in the inserted position, and secures the retracting spring 76 in a compressed state. The heel 86 is part of a release arm 80, described herein after.

[0106] Figure 4 shows a plan view of the housing 10 in its first retracted position, with selected cross-sectional views taken as Figures 1, 3, 5, and 6 to illustrate certain elements of the housing. Figures 7 and 8 are sectional views of the housing in Figure 1. An exploded view of the elements of the housing 10 is shown in Fig. 9.

[0107] Figs. 10 and 11 are sectional views of the syringe cartridge 18 taken through perpendicular section lines 10-10 and 11-11 of Fig. 12. Figs. 13-17 provide additional detailed views of the syringe cartridge 18 shown in Figures 10 and 11. Figure 18 shows an exploded view of the elements of the syringe cartridge 18.

[0108] The syringe cartridge 18 shown in Figures 10 and 11 comprises a syringe assembly 20 and a telescoping pressurizing assembly 30, configured as a reservoir having liquid cavity 66 for the injectable liquid composition. The syringe cartridge 18 is configured to be associated with and retained within the housing 10 of the device. In the illustrated embodiment, the cylindrical recess 71 of the needle carriage 70 provides the means for retaining the reservoir of injectable liquid composition, embodied by the syringe cartridge 18. The syringe assembly 20 comprises a syringe body comprising a cylindrical wall 21 that has an open upper end 25 and a tapering base 22 that has, at the lower end, an externally-threaded syringe port 64 having an aperture 23. A cylindrical plunger 24 can be inserted through the opening in the upper end 25 for engagement with the inner surface of the wall 21. The space between the plunger 24 and the syringe body in Fig. 10 defines the reservoir cavity 66. The respective threads of the syringe port 64 of the syringe cartridge and of connector portion 73 of the needle carriage cooperate and engage when the syringe cartridge is placed into the needle carriage and rotated, which secures or locks the syringe cartridge into its retained position within the needle carriage. The cooperating threads also provide liquid communication between the injection needle and the reservoir of the syringe cartridge, as the inlet 42 end of the

needle advances and penetrates a membrane 65 of the membrane plug 67 disposed in the opening of the syringe port 64 (see Figure 14).

[0109] The plunger 24 is typically a flexible, resilient rubber material that can form an effective liquid seal about its periphery with the sidewall 21 of the syringe. The plunger 24 is secured around a rigid plunger plug 26 to maintain its cylindrical shape. As can be seen in greater detail in called-out Fig. 13, the inner surface of the syringe wall 21 has, at its upper end, a slight inwardly-extending rim 38 that can engage the upper end of the outer wall 43 of the plunger 24, which can prevent the plunger 24 from incidentally withdrawing from and falling out of the upper opening of the syringe wall 21. Nevertheless, the plunger wall 43 is sufficiently flexible to be inserted into or extracted out of the syringe opening by force. The threaded bore in the plunger plug 26 is provided for attachment of a stem (not shown) having a mating thread so that the plug 26 and the plunger 24 secured thereto can be manipulated into and out of the syringe opening, and along the length of the syringe.

[0110] The telescoping pressurizing assembly 30 comprises a cylindrical body 31 that is closed at an upper end 34 and has an opening 32 at the opposed lower end. The lower edge of the cylindrical body 31 has a pair of opposed mechanical engaging means shown as inwardly-extending ribs 36 that can engage an outwardly-extending rim 28 disposed on the upper end 25 of the syringe wall 21, to secure the pressurizing assembly 30 to the upper end 25 of the syringe assembly 20 in a first extended position, as shown in Figs. 10 and 13. A pressurizing spring 33 is restrained within the body 31 between an annular groove 35 at the closed end 34, and an annular groove 27 in the plunger plug 26. When the pressurizing assembly 30 is in the extended position shown in Figure 10, the pressurizing spring 33 is typically under minimal compression. Nevertheless, this amount of pre-tensioning or compression of the spring 33 should be sufficient to maintain an adequate rate of flow of liquid composition from the cavity 66 at the end of the injection term, as shown in Fig. 25. Figure 11 shows the same syringe cartridge as in Fig. 10, but with the plunger 24 and the pressurizing spring 33 extended to the bottom of the syringe body 21. In this configuration, a medical technician can fill the syringe assembly. The upper pressurizing assembly 30 and the membrane plug 67 are first removed. Then, using a threaded stem (not shown), the plunger can be pulled upward to draw in injectable liquid composition through the aperture 23. The membrane plug 67 and the upper assembly 30 can then be reinstalled.

[0111] The wall 31 of the pressurizing assembly 30 is configure to telescope axially over the outside of the syringe wall 21 to a second pressurizing position (shown in Figure 19) where the ribs 36 can engage a second set of outwardly-extending rims 29 disposed near the lower end of the syringe wall 21, also shown in Figure 10. This causes the closed upper end 34 of the pressurizing body 31 to compress fully the pressurizing spring 33 against the plunger plug 26, which causes the plunger 24 to move to the bottom 22 of the syringe 21 when no liquid is contained in the cavity 66 of the syringe. The engagement of the ribs 36 with the lower rims 29 retains cylindrical body 31 in the fully pressurized configuration. When the cavity 66 of syringe 21 contains a volume of injectable liquid composition, such as vaccine V as shown in Figure 19, the manual depressing of the syringe cartridge causes the compression of the pressurizing spring 33. The engagement of ribs 36 with rims 29 restrains the compressed pressurizing spring 33, and retains the potential energy within the compressed spring 33 as a means for injecting the liquid composition from the retainer. The manually-powered, compressed spring 33 exerts a downward force upon the plunger 24, which exerts pressure upon the liquid composition in the cavity 66. When the cavity 66 is put into liquid communication with the needle, the pressurized liquid composition can flow out of the cavity 66 under pressure. The pressurizing spring 33 is configured and designed to maintain a relatively constant force, resulting in a relatively constant pressure and liquid composition flow rate through the needle throughout the injection process.

[0112] Optionally, the device 1 of the present invention can comprise a separable base 92, from which the housing 10 can be removed at any time, particularly and advantageously after completion of the injection. The separable base 92 is typically configured for separable securement to the base 12 of the housing by a base securement means, and typically provides the skin-contacting surface of the device 1. A base separation means provides selective separation of the separable base 92 from the device. Figs. 2, 27 and 28 illustrate an embodiment of a separable base 92, as embodied in a separable attachment assembly 93 that removably associates with the base 12 of the housing 10.

[0113] The base securement means can comprise a mechanical engagement, such as a catch 89 formed on a distal end of a release finger 88 that depends downward from a portion of the housing body 11. The distal end of the finger 88 extends through an

opening 95 in an inner base member 91 shown in Fig. 2. The finger 88 further extends through an opening 98 in the removable base 92 when the removable base 92 is positioned against the base 12 of the housing. The finger 88 is configured to bias the catch 89 toward and into engagement with a latch 96 formed in the separable base 92, shown in Figure 27. The separable base 92 remains affixed to the housing of the device provided that the catch 89 remains engaged with the latch 96.

[0114] The base separation means for separating the separable base 92 from the permanent housing base 12 can comprise a mechanically-biased member associated with the housing 10 that is configured for manipulation that forces to disengage the base securement means, specifically in the illustrated embodiment by moving the catch 89 out of engagement with the latch 96. In Figure 27, after the needle 40 and carriage 70 have been retracted, the person can depress the release button 81 even further, thereby causing a toe 87 on a release arm 80 to pivot into engagement with the release finger 88, and to bias the catch 89 out of engagement with latch 96. With the catch 89 disengaged from latch 96, and with the needle 40 fully retracted, the housing can be safely and easily separated from the separable base 92 for post-injection inspection, and for disposal.

[0115] The separable base further comprises a means for attachment to the skin of the patient. Typically, the means for attachment comprises an adhesive means adhered to the skin-contacting surface of the separable base.

[0116] While the figures and associated description describe the separation of the separable base from the housing while the device is attached to the skin of a patient, it can be understood that the separable base can also be removed from the housing while the device is free from attachment to the body.

[0117] In a method of using the device of the invention, a device 1 is provided as shown in Figure 20 comprising a housing 10 having an optional separable attachment assembly 93 comprising a separable case 92, and a syringe cartridge 18. The three members are shown separated to illustrate, that prior to use as an assembled product, the components can be separated and visually inspected.

[0118] The separable attachment assembly 93 can be attached manually to the base 12 of the housing 10 as previously described. Prior to attachment of the device to a person, a release paper 111 that covers the separable base 92 and adhesive flaps 112, is peeled away and disposed of.

[0119] As shown in Fig. 21, the separable attachment assembly 93 of the housing 10 can be attached to an area of the patient's skin on the upper arm or leg of the patient P, designated as the injection site, secured by the adhesive on the underside of the adhesive flap 112 that extends outward from the periphery of the separable base 92.

[0120] After attachment of the device to the skin, a seal 105 is removed that covers the opening to the carriage recess 71 to protect the inlet end 42 of the needle 40 from contamination, as shown in Figures 21 and 22. The syringe cartridge 18 is then inserted into the recess 71 of the carriage 70. The threaded syringe port 64 engages the threaded connector 73, so that manual axial rotation of the syringe cartridge 18 mates the respective threads and secures the syringe cartridge 18 to the carriage 70. As that occurs, a membrane 65 disposed in the opening of the syringe port 64 (see Figure 14) is penetrated by the inlet 42 end of the needle, which establishes liquid communication with the syringe cavity 66. A pair of tabs 45 extending out from the top of the pressurizing body 31 provides a grip for manually rotating the syringe cartridge 18 into the carriage 70. Relative axial rotation between the syringe assembly 20 and the pressurizing assembly 30 is prevented by disposing the outwardly-extending rims 28 of the syringe wall 21 into longitudinal grooves 37 formed in the inner surface of the pressurizing body 31.

[0121] In an alternative method, the syringe cartridge 18 can be provided in its pressurized configuration, as shown in Figure 19, just after the technician has compressed the telescoping pressurizing assembly 30 down onto the syringe assembly 20, and just prior to insertion of the cartridge 18 into the carriage 70, shown in Fig. 22. When the technician inserts the pressurized cartridge 18 into the recess 17 of the carriage 70, and rotates or twists the cartridge 18 to establish liquid communication between the reservoir cavity 66 and the needle 40, liquid composition may begin to flow from the syringe cavity and into and through the needle 40.

[0122] The device can also be configured to prevent rotation and removal of the modular syringe from its position in fluid communication with the needle, once the carriage 70 has been moved to and secured in the injection position. The tabs 45 extending from the closed end 34 of the pressurizing assembly 30 nest within the oblong recess 17 in the top of the housing 10 to inhibit finger access to the assembly, and to prevent manual rotation and removal of the syringe cartridge 18 in the injection

position. This prevents an unwanted exposure of a needle that is penetrating the skin from being open at its inlet 42 end to the atmosphere.

[0123] As shown in Figure 23, the needle 40 is then inserted into the patient by manual force downward on the syringe cartridge 18 to move it into the housing 10 and toward the base 12, thereby inserting the injection needle 40 into the body and initiating the injection. The pressing downward of the syringe cartridge 18 has also compressed the retracting spring 76. Fully manually pressing the syringe cartridge 18 downward causes the carriage 70 to be retained in a second position associated with the second injection position of the injection needle. A needle insertion securement, such as the retainer heel 86 shown in Figure 24, is configured to retain the needle carriage, and the injection needle, in the second, inserted position while the liquid composition is injected. Under the relatively constant force of the pressurizing spring 33, the vaccine V is slowly though constantly expressed out of the syringe cavity 66 and into the targeted body tissue 150. The size of the needle 40 and the force factor of the pressurizing spring 33 can be configured and designed to cause the liquid composition to flow under pressure through the needle within a target volumetric flow rate, to complete the injection within a prescribed period of time.

[0124] At the end of the injection term, shown in Figure 25, the plunger 24 has moved under the force of spring 33 to the bottom 22 of the syringe, and has collapsed the reservoir cavity 66 and driven substantially all of the vaccine out of the syringe cartridge 18.

[0125] An alternative method of inserting the needle 40 can employ the syringe cartridge 18 itself as an implement or plunger for depressing the needle cartridge to its inserted position, without having the needle inlet 42 penetrate the membrane 65 to the syringe cavity and placing the needle into liquid communication with the cavity. The syringe port 64 of syringe cartridge 18 can be rested against the bottom of the carriage 70, as shown by the left-side syringe in Figure 31, and pressed downward without having engaged the threads, or having only partially engaged the threads, of needle hub 72 and connector 73. Alternatively, the syringe port 64 and the connector 73 can be configured to provide a first position wherein the threads partial engage without establishing liquid communication between the needle and the cavity (that is, without rupturing the membrane 65), and a second position wherein the threads further engage

and establish liquid communication by penetration of the membrane by the inlet end of the needle.

[0126] Once the injection has been completed, or at any time during the vaccination, the needle can be retracted from its second or inserted position by activating a needle retracting means. The needle retracting means can comprise a disengagement means that is configured to disengage the needle insertion securement, and a power means configured to bias the needle, and the needle carriage, to respective third positions where the injection end of the needle is disposed within the housing. In the illustrated embodiment of Figure 26, the disengagement means comprises one or more release arms 80 and one or more release buttons 81. The release arm 80 comprises an upper end 82 shown as a ball having an inward flat surface that is secured within a socket 15 formed in the main body 11. The release arm 80 also comprises a pivot 83 that resides in a detent in the outside of the guide wall 14, and a resilient, flexible elbow portion 84 intermediate the ball end 82 and the pivot 83. A lateral bar 85 on the inside of the release button 81 is disposed proximate the elbow 84. In response to an inwardly-directed force on the button 81 that moves the button inward, as shown in Fig. 26, bar 85 causes the release arm 80 to flex inwardly at the elbow 84, causing heel 86 to pivot outwardly and out of engagement with the carriage lower flange 79. As shown in Figure 27, the power means comprises a compressed retracting spring 76 that had been manually disposed into a compressed configuration when the needle was manually inserted, and biases the needle toward a third position. With the needle carriage 70 unsecured by the needle insertion securement, retainer heel 86, the compressed retracting spring 76 can drive the carriage 70 upward from the base 12, and retract the distal end of the needle, needle tip 41, completely out of the body of the patient P and into the third position where the needle tip is within the housing 10. As described earlier, the retracting spring 76 should be disposed within the housing 10 with an amount of pre-tensioning or compression that is sufficient to completely retract the carriage 70 back to the top of the housing 10, so that the needle 40 will be retracted completely back into the housing.

[0127] The needle insertion securement and the disengagement means can function through or comprise the same element of the device (like the release arm 80 which functions to both secure the carriage and to disengage the securement), or can employ distinct elements.

[0128] After retraction of the needle 40, the syringe cartridge 18 can be grasped and removed by oppositely rotating the cartridge to disengage the threaded connection of the cartridge with the carriage. The cartridge assembly 18 can be inspected to confirm that all the liquid composition from the syringe cavity 66 had been injected, and then is disposed. If for any reason a significant amount of the liquid composition remained in the syringe, the syringe cartridge 18 can be reinserted into the carriage 70 and again rotated into liquid communication with the inlet of the needle 40, and the carriage and needle reinserted into the patient to complete the injection.

[0129] The illustrated embodiment shown in Figures 5, 25 and 27 shows that the release button 81 can have a generally cylindrical shape. The button can have a main inner wall 104 and an annular outer wall 101 having an annular periphery that is slightly larger than the annular opening 102 in the housing body 11 in which the button is disposed. The flared outer wall 101 resist movement of the button 81 into the opening 102 until a manual force is applied that is sufficient to bias inward the outer wall 101. As the button 81 is depressed, it biases elbow 84 of the release arm 80. When the force on the button 81 is released, the resilient elbow 84 will spring back against, and move, button 80 outward to its original position. The button 81 can also provided with a small aperture in its face, through which a small hooked implement can be inserted to pull out the button if it should become lodged inwardly.

[0130] In an alternative embodiment of the device, the means for establishing liquid communication can comprise a separate piercing conduit for establishing liquid communication with the reservoir, and which is in liquid communication with the injection needle. Fig. 39 shows a carriage 70 having a connector portion 73 that comprises a piercing needle 120 configured to penetrate a seal or membrane in the syringe cartridge 18 (not shown), and which is in liquid communication with the inlet end 42 of the injection needle 40. Fig. 39A shows in more detail a needle hub 72 positioned within a recessed bore in the end of the connector portion 73. The inlet end 42 of the needle 40 is flared so that the injection needle is retained within the needle hub 72. A conduit hub 121 is securely positioned over the needle hub and retains the piercing needle 120 in position. The distal end 122 of the piercing needle 120 is typically sharpened or pointed to facilitate penetration of the liquid seal or membrane. The piercing needle 120 is typically of a smaller gauge (larger diameter) than the injection needle to ensure penetration of the liquid membrane without crimping or

bending. Alternatively, the injection needle 40 can be made with an integral piercing conduit at the inlet end 42 that has a larger diameter and thickness than the skin-inserted portion of the needle.

[0131] Another alternative embodiment of the device can comprise the syringe cartridge shown in Fig. 40. The syringe cartridge 218 illustrated comprises a body having a cylindrical wall 221, a tapered base portion 222 having an aperture 223, and an upper closed end 234. The syringe cartridge 218 also comprises a plunger 224 that is configured for axial movement along the length of the cylinder wall 221. Figure 40 illustrates the plunger 224 both at a first position prior to filling of the cartridge reservoir with liquid composition, and at the end of the injection when the last amount of liquid composition has been evaluated from the cavity 66. A pressurizing spring 233 is disposed within the cartridge between the plunger 224 and the closed end 234, and is typically pre-tensioned to maintain a minimal force upon the plunger 224 when the plunger is in the first position. The cartridge 218 also comprises an outlet connector 264, comprising a one-way flow valve 267, illustrated as a duckbill valve having confronting flaps 268a and 268b.

[0132] The syringe cartridge 218 shown in Fig. 40 is in its configuration prior to filling. The medical technician or patient can draw the injectable liquid composition from a source, such as a glass vial, into a standard syringe (not shown) fitted with an outlet connector, such as a threaded female luer connector, that can be secured to the outlet 264 of the cartridge 218. After sealably connecting the supply syringe to the outlet port 264 of the cartridge 218, the person depresses the stem of the supply syringe plunger, causing the liquid composition to flow under pressure through the one-way valve 267 and into the cartridge. The pressurized composition moves the plunger 224 toward the closed end 234 and forms the reservoir of liquid composition V within the cavity 66. The pressurized composition also compresses the pressurizing spring 233 back toward the closed end 234. When the force applied to the plunger stem of the supply syringe is released, the pressurized liquid composition within the cavity 66 collapses and closes the one-way valve 267, as shown in Fig. 41. The one-way valve 267 can be positioned so that the inlet end 42 of the needle or the piercing needle 120 can penetrate the flappers 268 sufficiently to establish liquid communication. The filled cartridge 218 can then be inserted into the housing as described herein before.

[0133] In another alternative embodiment of the invention of a dual-port syringe cartridge 318. The dual-port cartridge has a first port 323 at a first end of the cartridge, configured for filling the cartridge with liquid composition V, and a second opposed port 364 at a second end of the cartridge, configured for dispensing the liquid composition from the reservoir to the injection needle 40. The cartridge 318 comprises a plunger 324 disposed in the cartridge for movement toward the first end for dispensing the liquid composition from the cavity 66. The plunger 324 is associated with a liquid dispensing means shown as pressurizing spring 333 for maintaining pressure upon the composition V within the cavity 66 to cause the liquid composition to flow from the cavity. The pressurizing spring it typically pre-tensioned to ensure sufficient force is exerted through the entire length of the plunger travel to maintain adequate liquid flow through the injection needle.

[0134] The cartridge 318 comprises a means to establish liquid communication between the first or filling end of the cartridge, and the second or dispensing end of the cartridge. This liquid communication means can comprise a flow channel 341 in liquid communication between the distal end of the cavity 66 and the dispensing end 364 of the cartridge. In the illustrated embodiment, an tube 342 having the flow channel 341 is secured to the second end 322 of the cartridge, and extends to a distal end 343 that terminates proximate the inlet port 323. The dip tube 342 is preferably aligned along the axial centerline of the cartridge. In the illustrated embodiment, the plunger 324 is configured with an orifice through its longitudinal centerline, and forms an annular liquid seal 326 with the outside surface of the dip tube 342 and a peripheral seal 325 with the inside of the cylindrical wall.

[0135] The filling port 323 can be fitted with a one-way valve 357 and filled as described above. As the reservoir is filled under pressure, the pressurizing spring 333 compresses toward the dispensing end 322. The one-way valve 357 seals inlet port 323 to prevent leakage of the pressurized liquid V within the cavity 66. The membrane seal 367 seals the outlet port 364 and maintains the cavity of the filled cartridge 318 under pressure. The filled cartridge can then be inserted into the housing of a device as described herein. An optional cap 334 can be secured to the filling port 323 after filling to prevent curious fingers form pulling on the cartridge during injection.

[0136] The illustrated cartridge 318 in Fig. 43 provides distinct features that can be advantageous. The cartridge has separate and spaced-apart filling and dispensing ports,

which can allow the cartridge to be filled after it has been positioned and secured to the device. This avoids the need to handle the cartridge after it has been filled. The filling port 323 is typically oriented toward the top of the device. The configuration of the cartridge also provides for the dispensing plunger to ascend within the syringe during the injection in a direction other than downward and toward the base of the device. When the plunger has completed the dispensing of the composition V and has voided the cavity 66, the patient or medical technician will be able to see the distal end of the plunger proximate to the filling end 352 of the cartridge, which serves as a convenient visual signal that the injection is nearing completion or has been completed.

[0137] To assist in installing the separable attachment assembly 93 to the housing of the device, the lower surface of the housing base 12 can optionally be provided with a wide indent 97 surrounding the opening 95 in the inner base 91, and the separable base 92 can be provided with a raised flange 94 that registers with the indent 97, as shown in Fig. 20. Pressing upward on this area assists engaging the catch 89 onto the latch 96 of the separable base 92.

[0138] A top plan view of a typical separable base assembly 93 is shown in Fig. 32, with a sectional view Fig. 33 taken through line 33-33, and detailed sectional views shown in Figures 34-35. The adhesive flap 112 extends outwardly from the periphery of the separable base 92, and is covered on its slower surface with the release paper 111. The adhesive flap 112 comprises a first film layer 114 that is affixed on its upper surface to cover the skin-facing surface of the separable base 92, and extends outward from the peripheral circumference of the base 92. The flap 112 has a PSA on its lower surface (not shown) for attachment to the skin. Flap 112 also comprises a second film layer 115 that is shaped as a ring with an inner circular edge 116 and an outer edge 117. The inner edge 116 extends inwardly and is affixed, typically with PSA, to the upper surface of the separable base 92 inboard of its circumferential edge. The second film layer 115 extends outwardly from the separable base 92, to overlap the first film layer 114 to its periphery, and there beyond to its outer edge 117. Typically, the adhesive flap layers 114 and 115 can be made of a flexible plastic film, and can be optionally vapor permeable or breathable.

[0139] Alternatively, the second film layer 114 can be eliminated, and the underside of the separable base 92 can have a coating of PSA for direct-contact adhesion to the skin.

Optionally a gauze bandage 113 can be secured to the underside of the separable base 92 over the opening 13, as shown in Fig. 35.

[0140] In an alternative embodiment, the base separating means can comprise other mechanical securements, an adhesive securement, and a magnetic securement of the separable bas to the housing of the device. The other mechanical securements could include a mechanical "hook-and-loop" device that can include Velcro®, a hasp, a frangible joint, and a threaded joint). The magnetic securement can comprise a first magnetic member proximate the upwardly-facing surface of the separable base; and a second magnetic member proximate to the base portion and inside of the housing; wherein first magnet member and the second magnetic member have a magnetic attraction that secures the removable base to the housing, and wherein the removable base can be manually separated from the base portion of the housing by a manually-applied force that overcomes the force of the magnetic attraction.

[0141] The separable base provides a means for obtaining a secure attachment of the housing of the device to the patient's skin, by providing for outwardly-extending adhesive flaps that are securely affixed to the relatively rigid structure of the separable base. In most circumstances, the separable base that remains behind on the skin of the patient is well tolerated by the patient, and can be removed at any time, since most vaccinations, particularly with very small needle diameters, leave little wounding of the skin

[0142] The separable base 92 can also be removed for pre-injection inspection of the device, by fully depressing the release button 81, prior to installing the reservoir or the initiating needle insertion. The inner base 91, or a portion thereof, can be made of a transparent thermoplastic material to allow a visual inspection of the needle and the internal assembly prior to use. The separable base 92 can then be easily reaffixed.

As shown in Figure 28, after completing the injection, the syringe cartridge 18 can be removed from the attached housing 10, before the housing is removed from the separable base 92; or, the housing 10 with the syringe cartridge 18 attached can be removed from the separable base 92 as a unit, and then the syringe cartridge can be removed.

[0143] The device can also comprise a means for preventing deployment of the needle through the opening in the base of the housing, particularly after the needle has been inside the skin and body of a person. A typical deployment prevention means for

preventing needle deployment comprises a sliding or rotating plate disposed in the base that can moved between a first position where the needle opening in the base is not covered by the plate, and a second position wherein the plate covers the opening. In the embodiment illustrated in Figs. 36-38, a rotating plate 131 is disposed in an annular recess 130 on the annular flange 94 of the inner base 91. The recess 130 and plate 131 have a center that is positioned off the centerline 100 passing through needle 40, though they overlap the needle opening 13 in the base 12. The plate 131 has an opening 136 disposed between the center of the plate 131 and its periphery. The plate 131 can rotate between a first deployment position shown in Figs. 36 and 37 wherein the plate opening 136 registers with and leaves exposed the opening 13, and a second blocking position shown in Fig. 38 wherein the plate 131 covers the opening 13, and prevents deployment of the needle 40. The plate is movable between the first and second positions by a knob 132 that is attached to the plate by a stem 133. The stem is disposed within arc-shaped stem slot 134. The knob 132 moves along a knob recess 135 formed in the inner surface of the removable base 92, and that lies below the knob slot 134. The knob retains the plate in position, and can be manipulated by finger to move the plate between its first and second positions. Prior to injection, the technician can remove the removable base plate and manipulate the knob 132 to move the plate 131 to its deployment position. After the device is removed from the skin following the injection, and the device has been removed from the separable base 92, the exposed knob 132 can be manipulated to move the plate 131 to its blocking position. This physically closes the opening 13 to ensure that the needle 40 can not be redeployed accidentally and cause an undesired stick.

[0144] In a further embodiment of the present invention, a device can have a plurality of injection needles and reservoirs disposed within the housing. The device can provide for injecting at least two injectable liquid compositions to a patient. Figs. 29 and 30 show a top plan view and an elevation view of a device 1 for injecting at least two liquid compositions from separate reservoirs contained in the housing. As shown in Figure 31, the device 1 can comprise a housing 10 and base 12 for two needle carriages 70a and 70b and two injection needles 40a and 40b, which can be configured to be separately and independently manipulated for insertion, injection and retraction, as described herein above.

[0145] Alternatively, the two needle carriages and needles can be configured for simultaneous insertion, injection, and retraction using shared elements, including a shared, unitary dual-recess needle carriage, and a dual unitary pressurizing assembly.

[0146] If only one injectable liquid composition will be administered, there is a potential for the patient, during the injection procedure, to pick at and possibly poke a finger though the seal 105 that is initially positioned over the cavity recess 71. To prevent this, the seal 105 can be affixed to a cylindrical member 106 that partly supports the underside of the seal 105 layer, as shown in Figure 3A. Alternatively, the seal can be removed and replaced with a "dummy" plunger that has the upper appearance of the active syringe cartridge, but which fits securely in the opening in the housing above the carriage to block any attempt to depress the carriage.

[0147] Another alternative embodiment of the device can comprise a means for selectively positioning and optionally securing the needle carriage 70 to respective positions that either prevent or enable its movement in the axial direction within the housing. This embodiment also is an alternative deployment prevention means. Fig. 42 illustrates this embodiment in the context of the dual-needle device. Each of the carriages 70a and 70b in Fig. 42 are shown in their first axial position, disposed within the carriage passageway 280 proximate the upper end 281. This is also the position in which the syringe cartridge 18 is inserted into or removed from the needle carriage 70. In the first axial position, the carriage can be rotated between a first rotational position wherein the carriage is restrained from movement in the axial direction, and a second rotational position wherein the carriage can move in the axial direction.

[0148] Looking first at the carriage 70a on the left side of the device, which is in the axially restrained configuration, the vertically-oriented guide rib 19 projects outward from the cylindrical wall 14. The toe 79 of the carriage is positioned within a notch 119 formed in the guide rib 19, allowing the carriage to rotate, but preventing the carriage from moving downward axially so long as the toe 19 is disposed within notch 119. The cooperation of the toe 79 of the carriage disposed within the notch 119 of the guide rib 19 provides a means for restraining the movement of the carriage in the axial direction.

[0149] The carriage 70b on the right side of the device is shown in the axially un-restrained configuration. In this configuration, the carriage 70b has been rotated (typically in the clockwise direction) to a position where the gap 179 in the toe 79 registers with the notch 119 in the guide rib 19, which allows the carriage 70b to move

axially toward its second axial position proximate the base of the housing. As the carriage 70b first begins to descend, the gap 179 in the toe 79 slides along the guide rib 19, preventing the carriage from rotating after it has moved axially out of the first axial position.

[0150] The carriage can also comprise a means for registering the rotation of the carriage in a direction that corresponds with either the axially restrained configuration (typically, counter-clockwise direction in the plan view shown in Fig. 29) or with the axially un-restricted configuration (typically clockwise). In the illustrated embodiment, a stop lug 180 is provided to assist registering the gap 179 with the notch 119, by limiting the rotation of the carriage. At the appropriate configuration, a stop lug 80 will engage the upper end 219 of the guide rib 19. The stop lug 180 is shown as a downwardly-extending projection from the outer wall 75 of the carriage 70, over a portion of the wall-contacting periphery of the carriage. As viewed in Fig. 42A, in the top-right of carriage 70b, a first end of the stop lug 180 is engaging the upper end 219 of the guide rib 19 from behind the guide rib, when the carriage is rotated in the clockwise direction. Conversely, as shown in Fig. 42, the stop lug 180 (which is not shown since it is out of the page in front of the section line), a second end of the stop lug 180 is engaging the upper end 219 of the guide rib 19 from in front the guide rib, when the carriage is rotated in the counter-clockwise direction.

[0151] Fig. 44 shows an alternative embodiment of a device having a needle retracting means that comprises a pre-tensioned retracting spring that is associated with a separate member for retracting the needle. As illustrated in Fig. 44, the retracting means comprises an auxiliary retracting carriage 270. The retracting carriage 270 is configured for movement within the housing between a first secured position, shown in Fig. 44 where the retracting carriage is disposed proximate the base 91, and a second position where the retracting carriage is disposed proximate the upper end 281 of the carriage passageway 280. In the first position, the retracting spring 76 is in a fully compressed position, restrained by the retracting carriage 270, the toe 79 of which is restrained by the lower heels 86 of the release arms 80. As described above, when buttons 81 are depressed, heels 86 bias outwardly and out of engagement with toe 79, allowing the retracting spring 76 to move the unrestrained retracting carriage 270 toward and to its second position. It can be understood that depressing of the buttons 81 also bias the upper heels 286 to pivot or move outwardly. The force factor of the

retracting spring 270 can be sufficient to cause the upper toe 279 of the retracting carriage 270 to pass over the upper heels 286 of the release arms 80 and into its second position proximate upper end 281 in the carriage passageway (not shown). Upon releasing of the pressing force upon buttons 81, the upper heels 286 return and are placed into an interference position that can prevent the retracting carriage 270 from being moved axially in a direction back toward its first position shown in Fig. 44. It can also be understood that the retracting carriage 270 can be moved from its second position proximate the upper end 281, to its first position, by sufficiently depressing buttons 81 to release the upper toe 279 from engagement with the upper heels 286, and manually pushing the retracting carriage 270 (and compressing the retracting spring 76) toward the base 91.

[0152] It can also be understood that the needle carriage 70 can move within the carriage passageway 280 separately from the retracting carriage 270. The needle carriage 70 is typically positioned in its first position adjacent the upper end 281 of the carriage passageway 280 (such as shown in Fig. 22) for attachment of the syringe cartridge 18. In this position, the needle carriage can be restrained temporarily from axial movement (the needle carriage's axially restrained configuration, as described in the aforementioned embodiment and illustrated by the left-hand carriage 70a of Fig. 42). Alternatively, the needle carriage can be biased toward its first position by a second mechanical spring (not shown). At the same time, the retracting carriage 270 is typically in its pre-tensioned position shown in Fig. 44, adjacent the base 91. After the syringe cartridge 18 containing the liquid composition V has been secured in place to the needle carriage 70, also as shown in Fig. 22, the needle carriage bearing the injection needle 40 can be rotated from its axially restrained configuration into the axially un-restrained configuration (also described above and illustrated by the right-hand carriage 70b of Fig. 42).

[0153] From its axially un-restrained configuration, the needle carriage 70 can be moved to its second position shown in Fig. 44 by manually pressing downward on the inserted syringe cartridge 18. The annular outer wall of the needle carriage 70 can have cut-out grooves 176 that align axially with the upper heels 286 when the carriage is in the axially un-restrained configuration, to allow free passage of the carriage past the upper heels 286. The needle carriage 70 can have an annular recess formed between the inner wall 174 and the outer annular wall 172. The respective carriages can become

engaged and frictionally coupled together when the upper rim 272 of the retracting carriage 270 is nested within the annular recess of the needle carriage 70, but can be separated by hand. The frictional coupling of the needle carriage 70 to the restrained retracting carriage 270 assists in holding the inserted injection needle 40 within the injection site, as shown in Fig. 44.

[0154] A further embodiment of the invention can comprise a means of indicating the extent of liquid composition dispensed from the reservoir. The indication means can comprise a visual means that allows personnel to actually view the remaining contents of the reservoir. An embodiment of a visual indication means can comprise a transparent section positioned in a portion of the housing adjacent the reservoir, to view the reservoir. Alternatively, the housing can comprise a door or panel that can be opened to permit inspection. Further, the reservoir can be provided with a corresponding transparent portion to permit the medical personnel to see the medication contained within the reservoir. The transparent portion can include a portion of the base or a portion of the housing, or both. The transparent portion can be a small area relative to the total surface area of the housing body, or can be a significant portion of the housing body surface. In a typical embodiment, the transparent portion is positioned on one side of the housing body that, when applied to the patient's arm, can face away for the patient's line of sight. This allows the medical technician to see through the transparent portion, but provides no indication to the patient, typically a small child, that the inside of the device contains something interesting that might arouse the patient's curiosity.

[0155] The indication means can also comprise a signal means that signals the end or the approaching end of medicament dispensing. A signal means can comprise a mechanical or electrical switch that is activated by the plunger member as the last remaining contents of the reservoir is dispensed. The signal can be a flag, a pop-out tab, an illuminated light, or any other well known signal.

[0156] Another embodiment of the invention can comprise a covering or disguise configured for attachment or placement over the injection device either to provide the device with a pleasurable impression, or to direct the patient's attention away from the device. The covering can be formed as a cartoon character, a zoo animal, or the like. In this way, much of the patient's fear that might be caused by the sight of the device can be alleviated.

[0157] In another embodiment of the invention, the housing of the device can be colored coded or have a colored indicator or marking that identifies the particular type or quantity of medication contained within the reservoir. For example, for one certain medication the outer casing may be blue in color. The device can also display various warnings, such as a precaution to avoid needle stick and possible side effects to the medication. The device can also comprise a removable label comprising information about the liquid composition to be administered (such as the type of vaccine or medicament, the manufacturer and lot number, and volume), which can be placed into a medical record or patient chart.

[0158] Another embodiment of the invention, shown in the figures, is an improved injection device for self-administering an injection that does not provide the patient with any convenient fingerhold to grasp the device for jostling or removing the device from the skin during the injection procedure. A preferred design of the device will include an outer surface that has not sharp edges or deep groove with which the patient can get a fingerhold. Preferably, the housing and the base are constructed of a thermoplastic material that has a non-grip or non-sticky surface, and is preferably a resilient material that can flex but not deform in shape. A matte finish on the outside surface can make the housing difficult to grasp, except when properly grasped by a medical technician by its release buttons. Typically, the indentures and grooves in the housing, and including the base, have a breadth not greater than 3 mm, more typically not greater than 1 mm. Typically, external edges can be rounded, maintaining an edge radius of about at least 1 mm, more typically of about at least 3 mm.

[0159] While specific embodiments of the apparatus and method of the present invention have been described, it will be apparent to those skilled in the art that various modifications thereto can be made without departing from the spirit and scope of the present invention as defined in the appended claims.

We claim:

1. A manually-powered injection device for painless inter-muscular injection of an injectable liquid composition from with a reservoir, comprising:

a) a housing having a base for semi-permanent attachment to the skin of a patient,

b) an injection needle disposed substantially perpendicular to the base and within the housing, the needle having an injection end, and configured for axial movement manually between a first position wherein the injection end is within the housing and a second position wherein the injection end extends outwardly from the base to a distance sufficient for intramuscular insertion thereof, the injection needle having an outside diameter greater than 0.10 mm and less than about 0.38 mm,

c) a means for retaining a reservoir containing an injectable liquid composition,

d) a means for providing liquid communication between the retained reservoir and the injection needle, and

e) a means for injecting the injectable liquid composition from the retained reservoir through the needle.

2. The injection device of Claim 1 wherein the means for injecting is a manually-powered spring that is configured to exert pressure upon the injectable liquid composition within the retained reservoir.

3. The injection device of Claim 1, further comprising a needle insertion securement configured to retain the inserted needle in its second position while injecting the liquid composition.

4. The injection device of Claim 3 further comprising a means for retracting the injection needle, whereby the injection end of the needle can be retracted from its second position to a third position wherein the injection end of the needle is within the housing.

5. The injection device of Claim 3 further comprising a needle carriage to which the injection needle is affixed, the needle carriage being configured for axial movement

between a first position associated with the first position of the injection needle, and a second position associated with the second position of the injection needle, in response to a manual force applied by a person.

6. The injection device according to Claim 5 further comprising an implement for use in applying the manual force to the needle carriage.

7. The injection device according to Claim 5 wherein the needle insertion securement is configured to retain the needle carriage in its second position.

8. The injection device according to Claim 7, further comprising a retracting means comprising a disengagement means configured to disengage the needle insertion securement from the needle carriage, and a power means configured to bias the needle carriage to a third position that is associated with a third position of the injection needle wherein the injection end of the needle is within the housing.

9. The injection device according to Claim 1 wherein the device further comprises a separable base, a base securement means configured for separable securement of the separable base to the housing, and a base separation means configured for separation of the separable base from the housing, wherein the separable base comprising an adhesive for attachment thereof to the skin of the patient.

10. A manually-powered injection device for painless inter-muscular injection of an injectable liquid composition, comprising:

a) a housing having a base for semi-permanent attachment to the skin of a patient,

b) an injection needle disposed substantially perpendicular to the base and within the housing, the needle having an injection end, and configured for axial movement manually between a first position wherein the injection end is within the housing and a second position wherein the injection end extends outwardly from the base to a distance sufficient for intramuscular insertion thereof, the injection needle having an outside diameter greater than 0.10 mm and less than about 0.38 mm,

c) a reservoir containing an injectable liquid composition,

d) a means for liquid communication between the reservoir and the injection needle, and

e) a means for injecting the liquid composition from the reservoir to the injection end of the needle.

11. The injection device of Claim 10 wherein the means for injecting is a manually-powered spring that is configured to exert pressure upon the injectable liquid composition within the retained reservoir.

12. The injection device of Claim 10, further comprising a needle insertion securement configured to retain the inserted needle in its second position while injecting the liquid composition.

13. The injection device of Claim 12 further comprising a means for retracting the injection needle, whereby the injection end of the needle can be retracted from its second position to a third position wherein the injection end of the needle is within the housing.

14. The injection device of Claim 12 further comprising a needle carriage to which the injection needle is affixed, the needle carriage being configured for axial movement between a first position associated with the first position of the injection needle, and a second position associated with the second position of the injection needle, in response to a manual force applied by a person.

15. The injection device according to Claim 14 further comprising an implement for use in applying the manual force to the needle carriage.

16. The injection device according to Claim 14 wherein the needle insertion securement is configured to retain the needle carriage in its second position.

17. The injection device according to Claim 16, further comprising a retracting means comprising a disengagement means configured to disengage the needle insertion securement from the needle carriage, and a power means configured to bias the needle

carriage to a third position that is associated with a third position of the injection needle wherein the injection end of the needle is within the housing.

18. The injection device according to Claim 14 wherein the needle carriage comprises threads, and the reservoir comprises cooperating threads that can engage and retain the threads of the reservoir.

19. The injection device according to Claim 18 wherein the reservoir comprises a penetrable membrane, wherein when the cooperating threads of the reservoir and the needle carriage are engaged, a piercing conduit in liquid communication with the injection needlecan penetrate the penetrable membrane to establish liquid communication between the reservoir and the injection needle.

20. The injection device according to Claim 10 wherein the device further comprises a separable base, a base securement means configured for separable securement of the separable base to the housing, and a base separation means configured for separation of the separable base from the housing, wherein the separable base comprising an adhesive for attachment thereof to the skin of the patient.

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Fig. 1

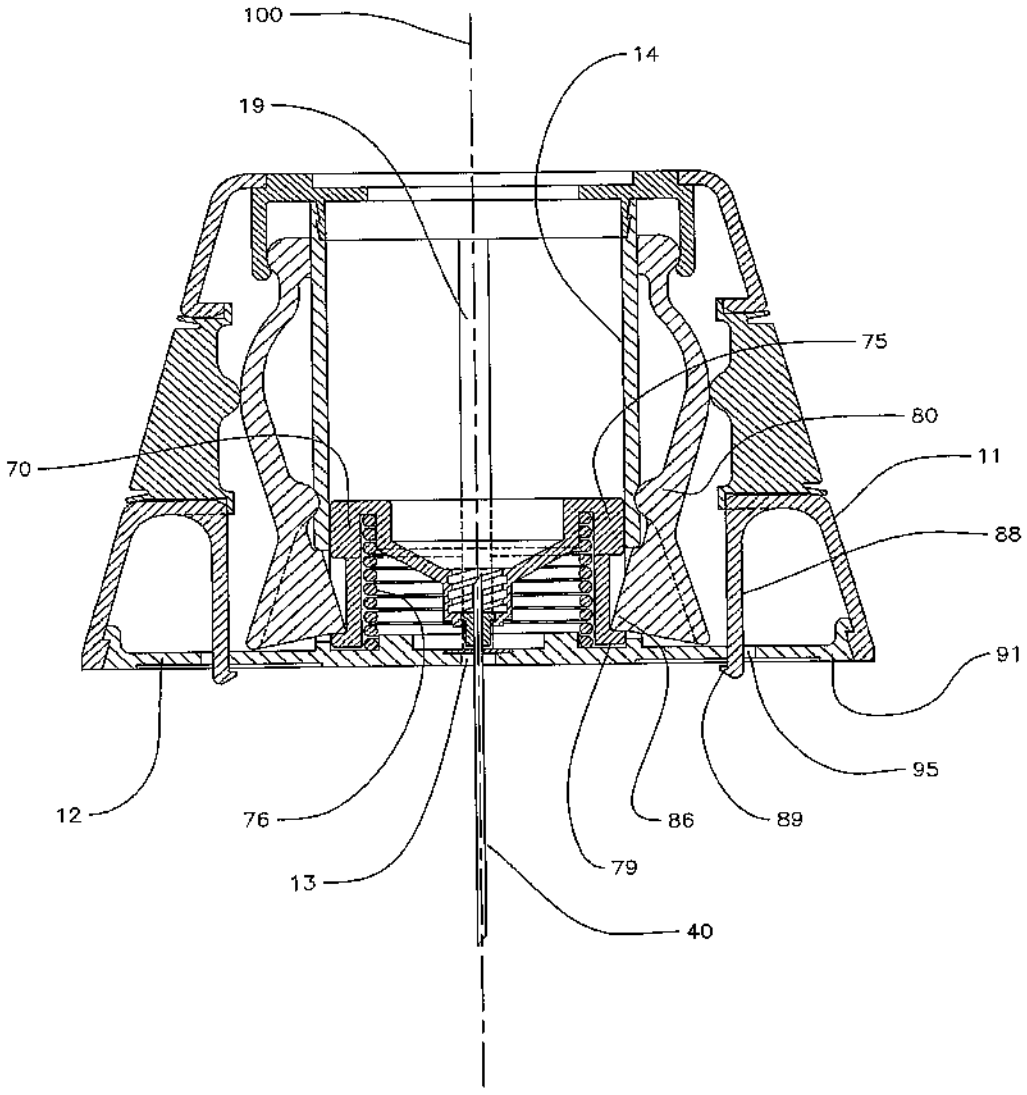

Fig. 2

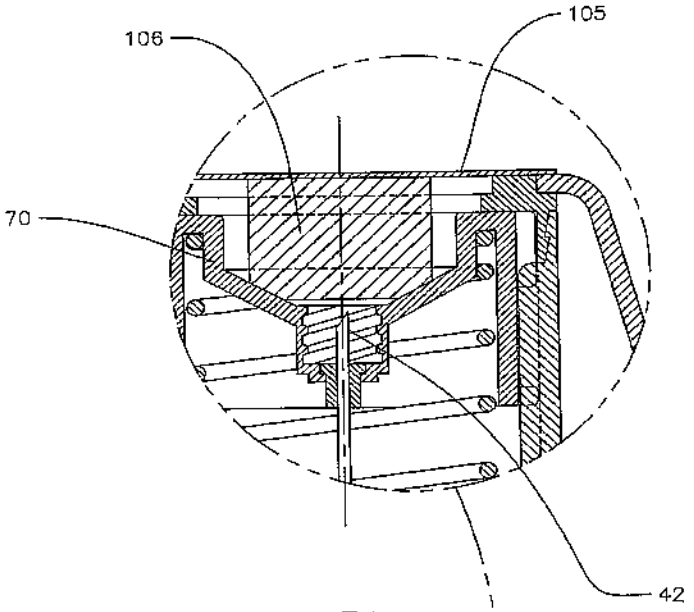

Fig. 3A

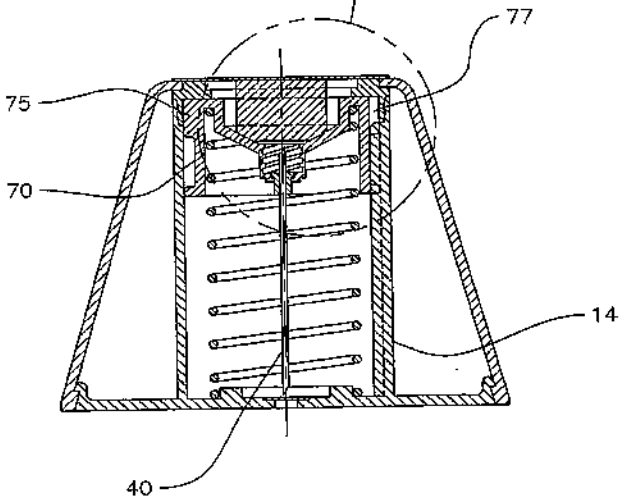

Fig. 3

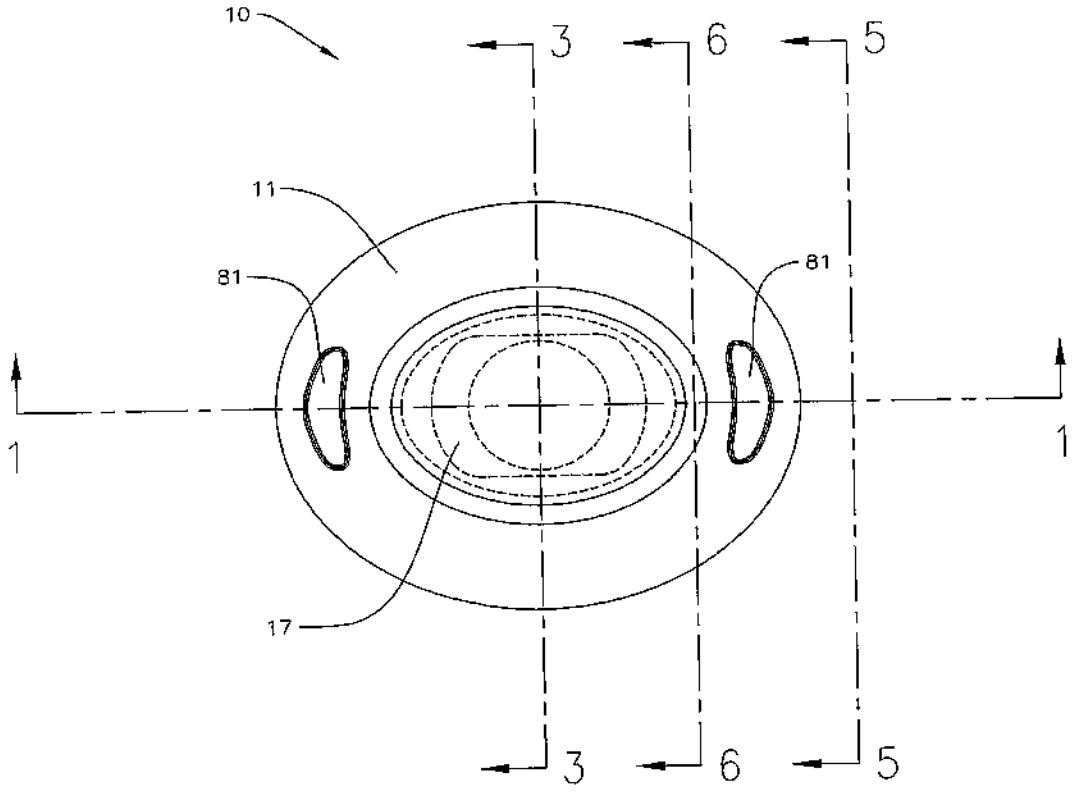

Fig. 4

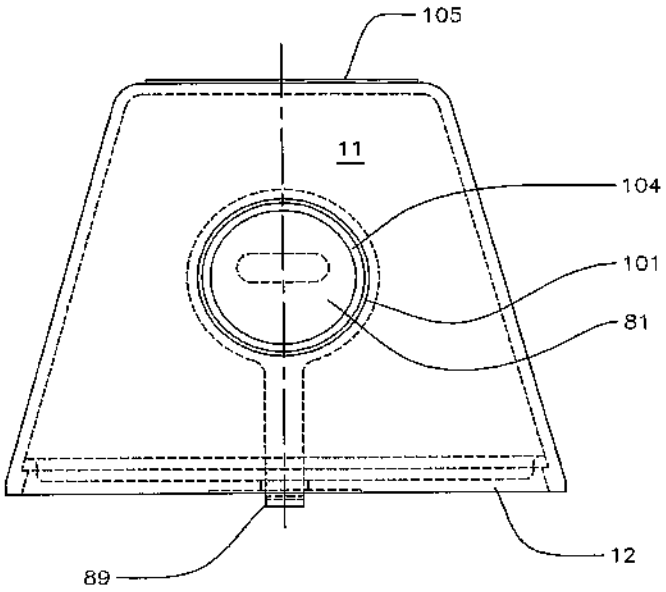

Fig. 5

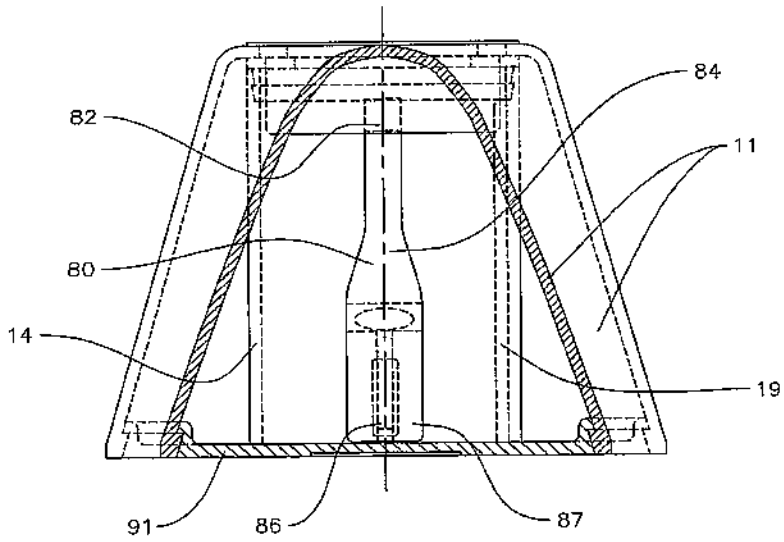

Fig. 6

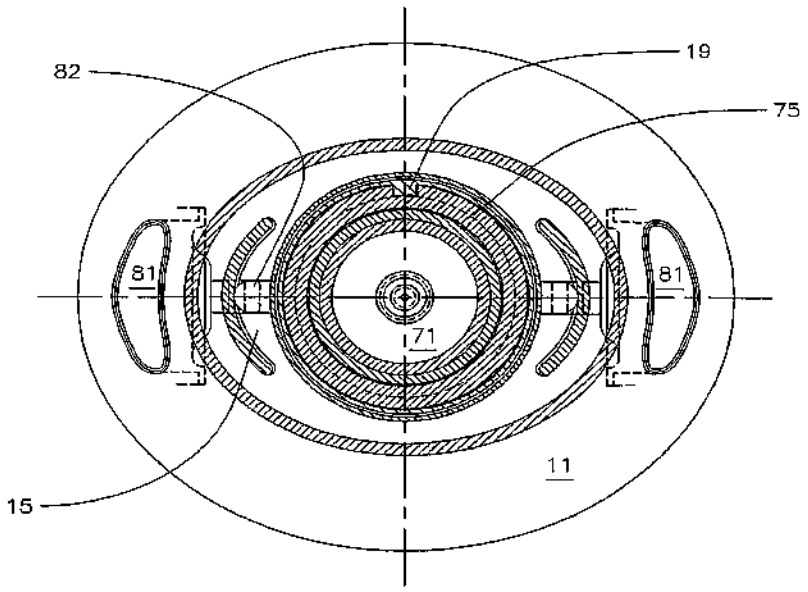

Fig. 7

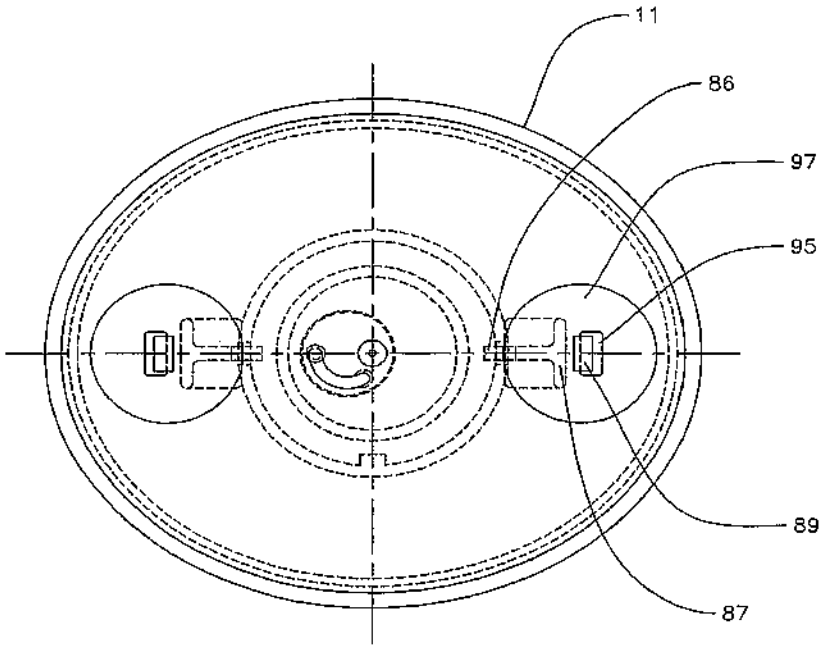

Fig. 8

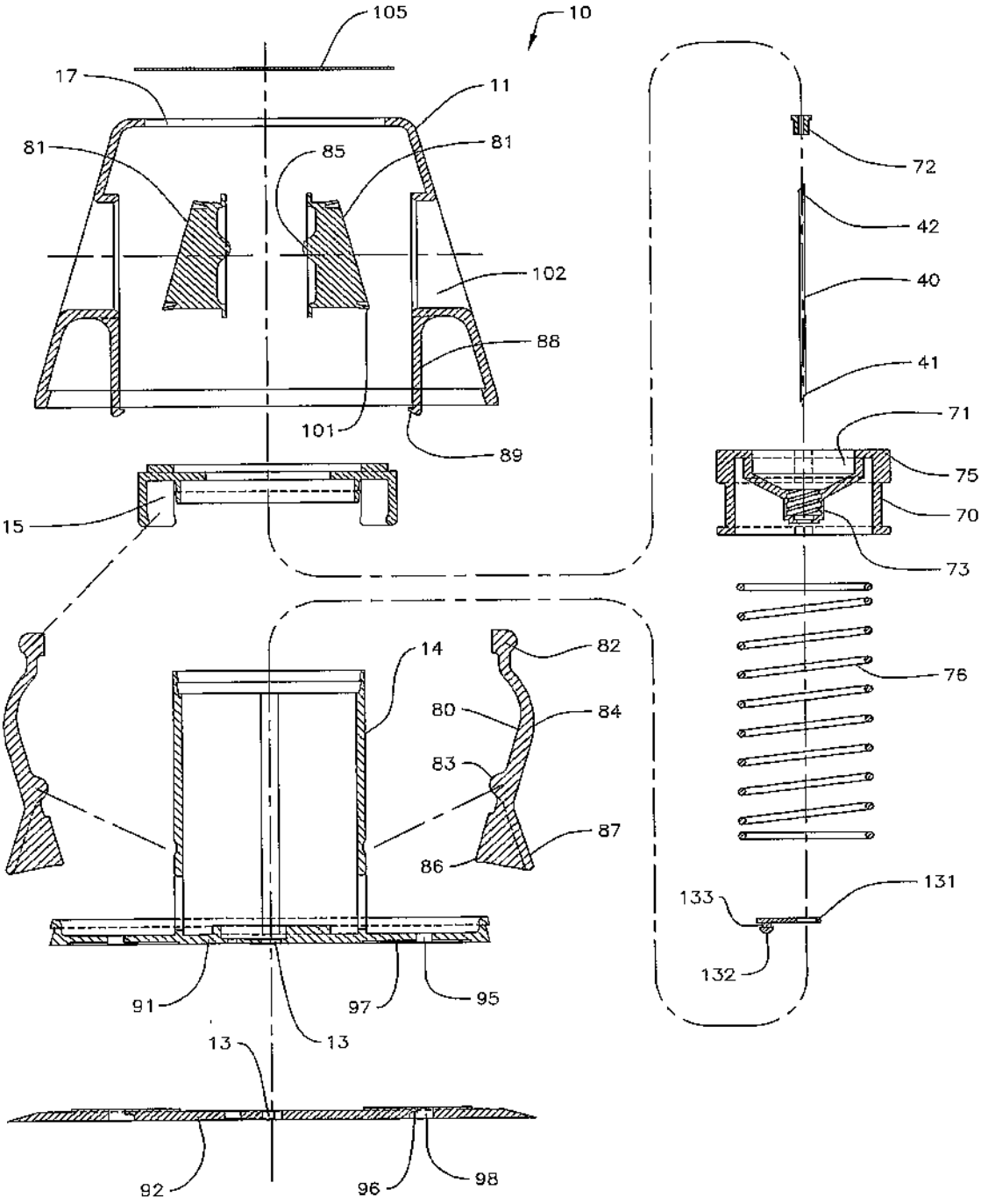
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Fig. 9

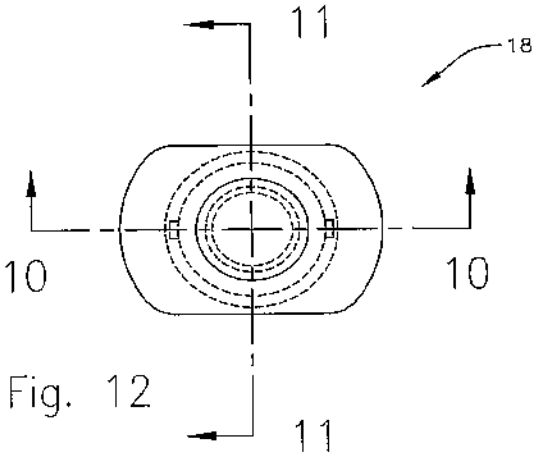

Fig. 12

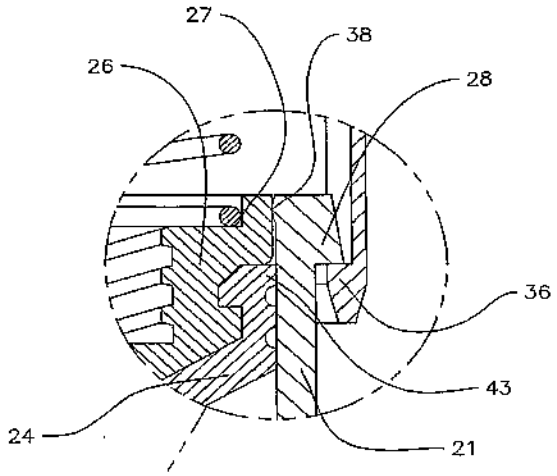

Fig. 13

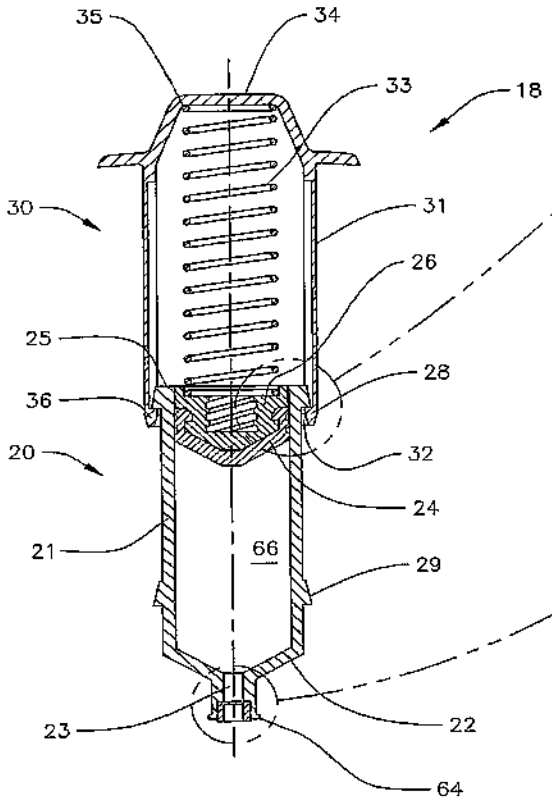

Fig. 10

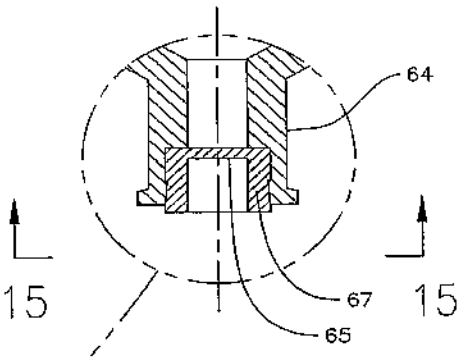

Fig. 14

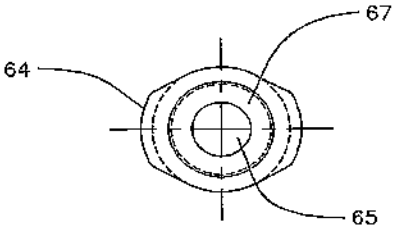

Fig. 15

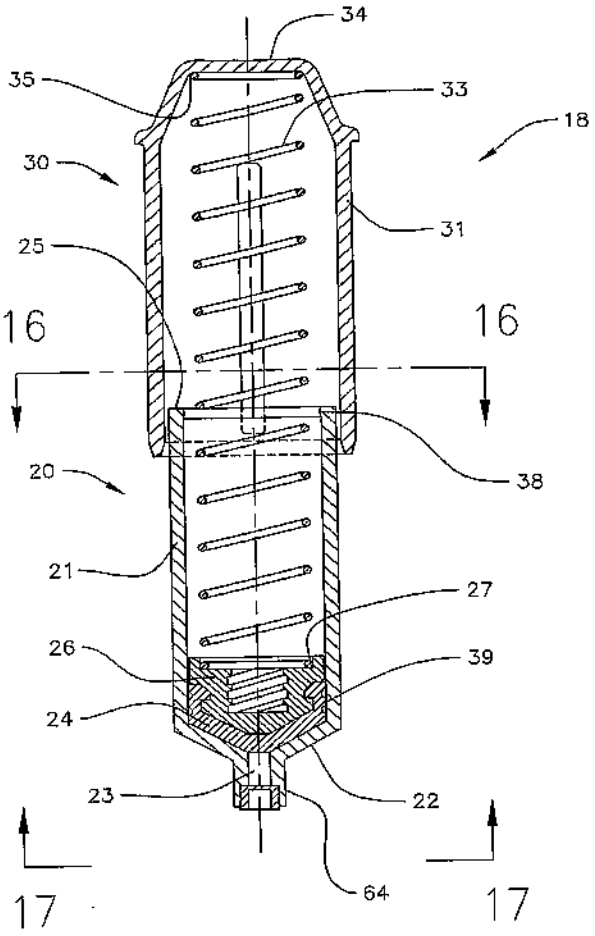

Fig. 11

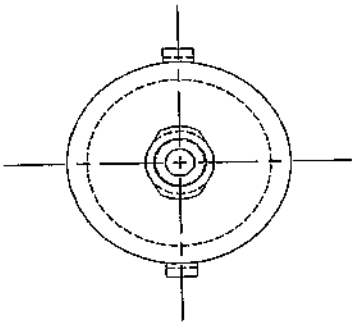

Fig. 17

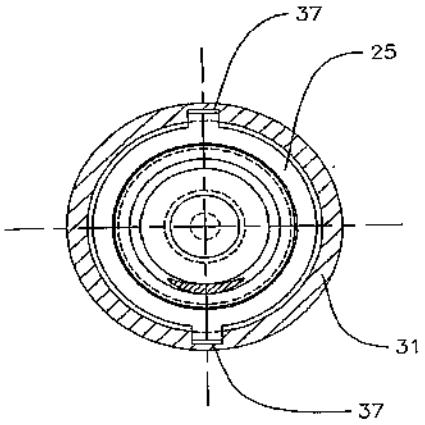

Fig. 16

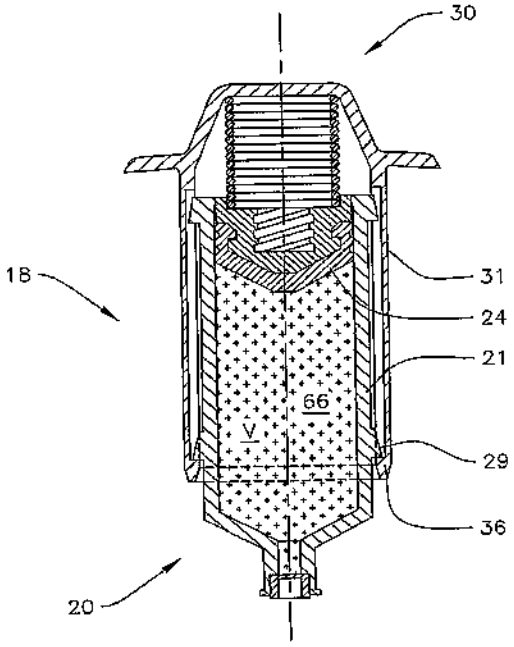

Fig. 19

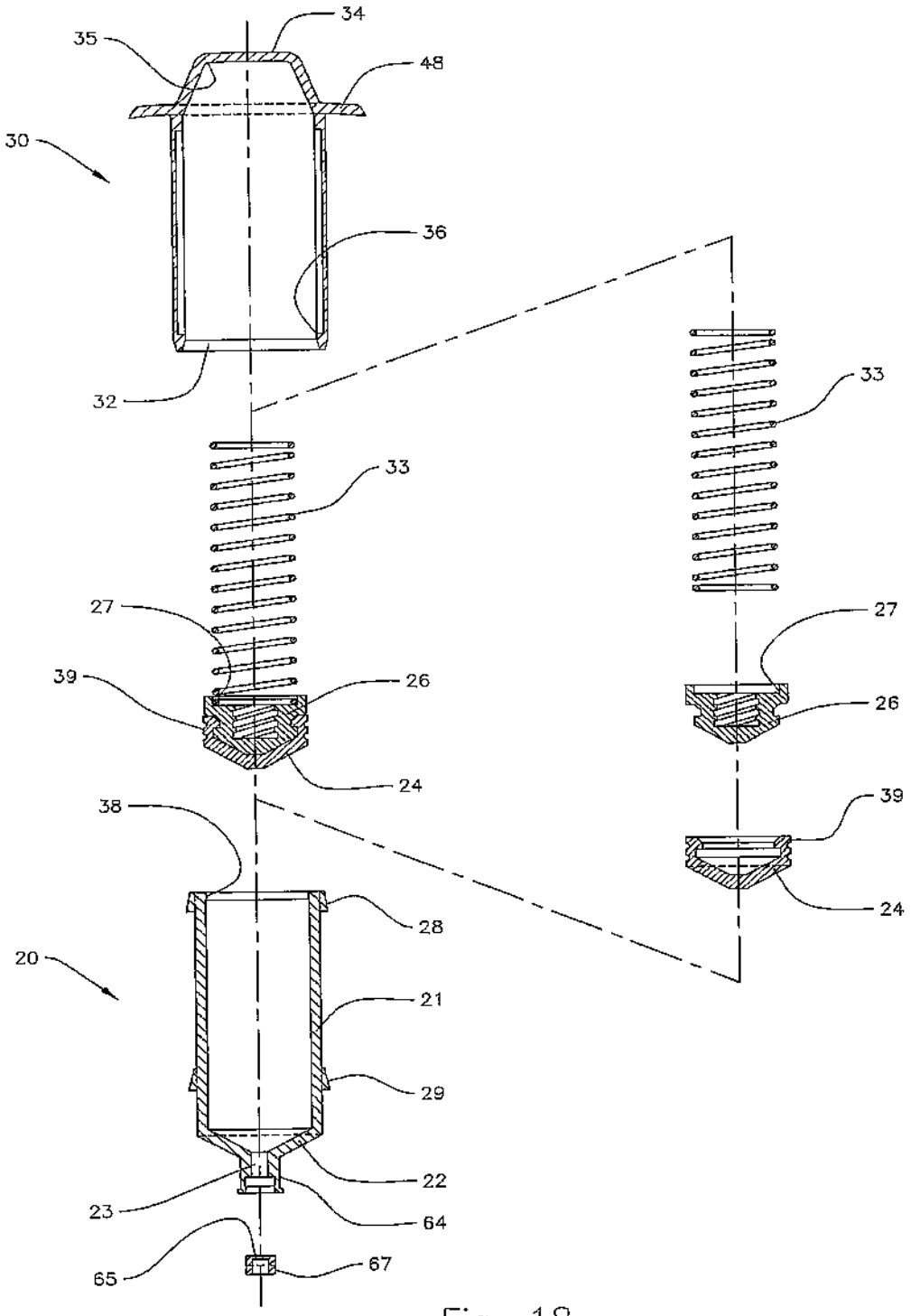
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Fig. 18

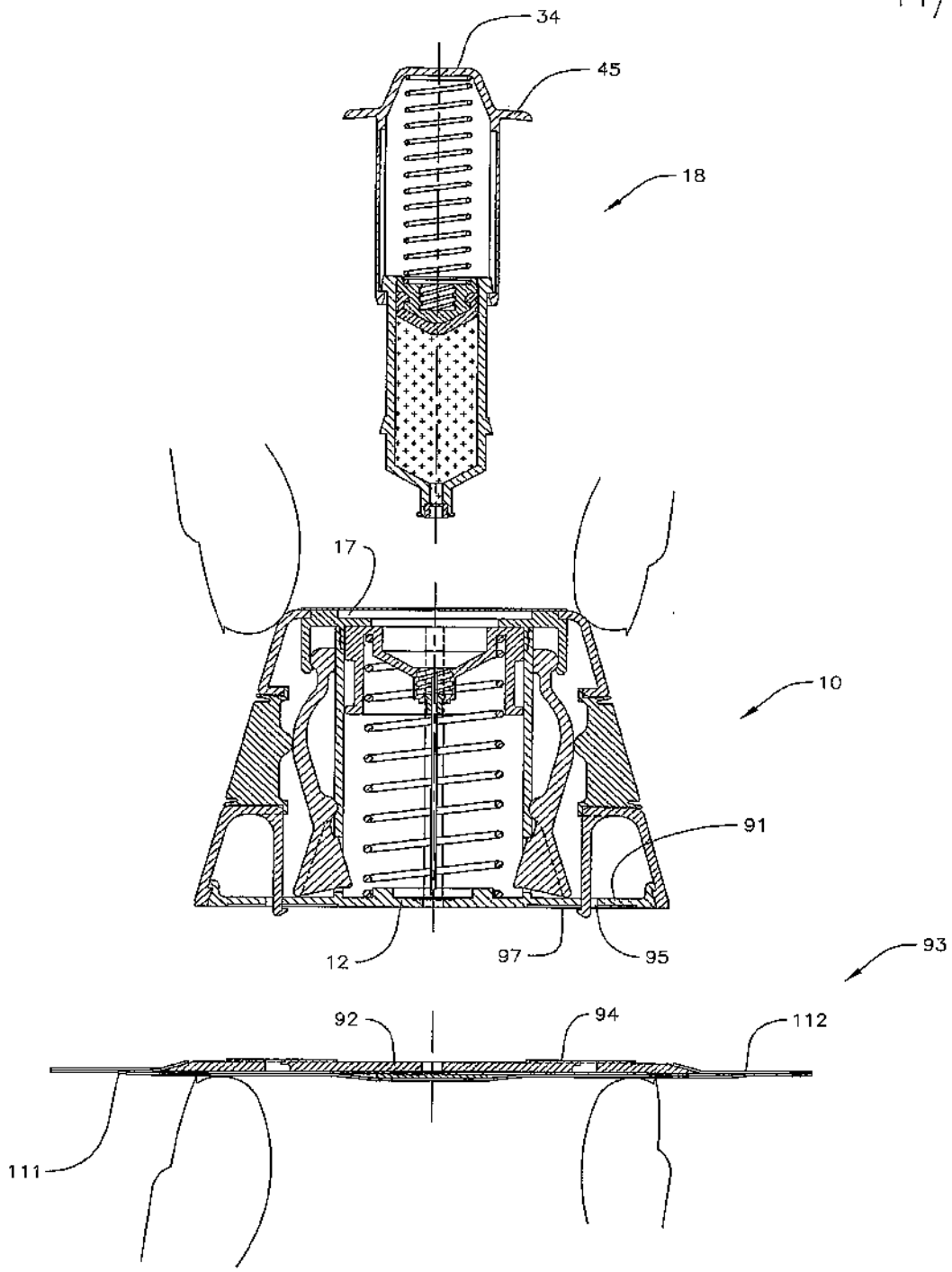

Fig. 20

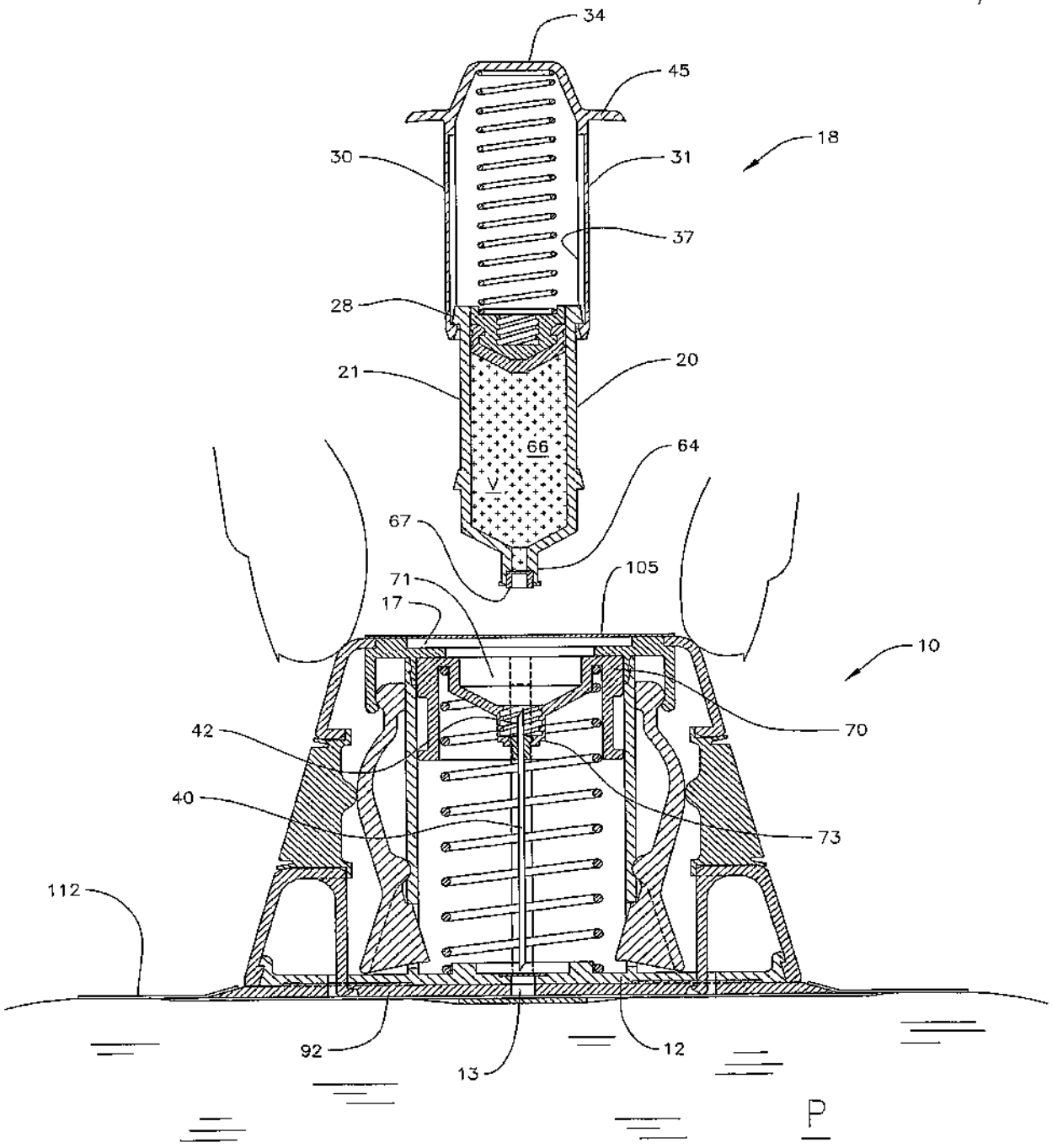
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Fig. 21

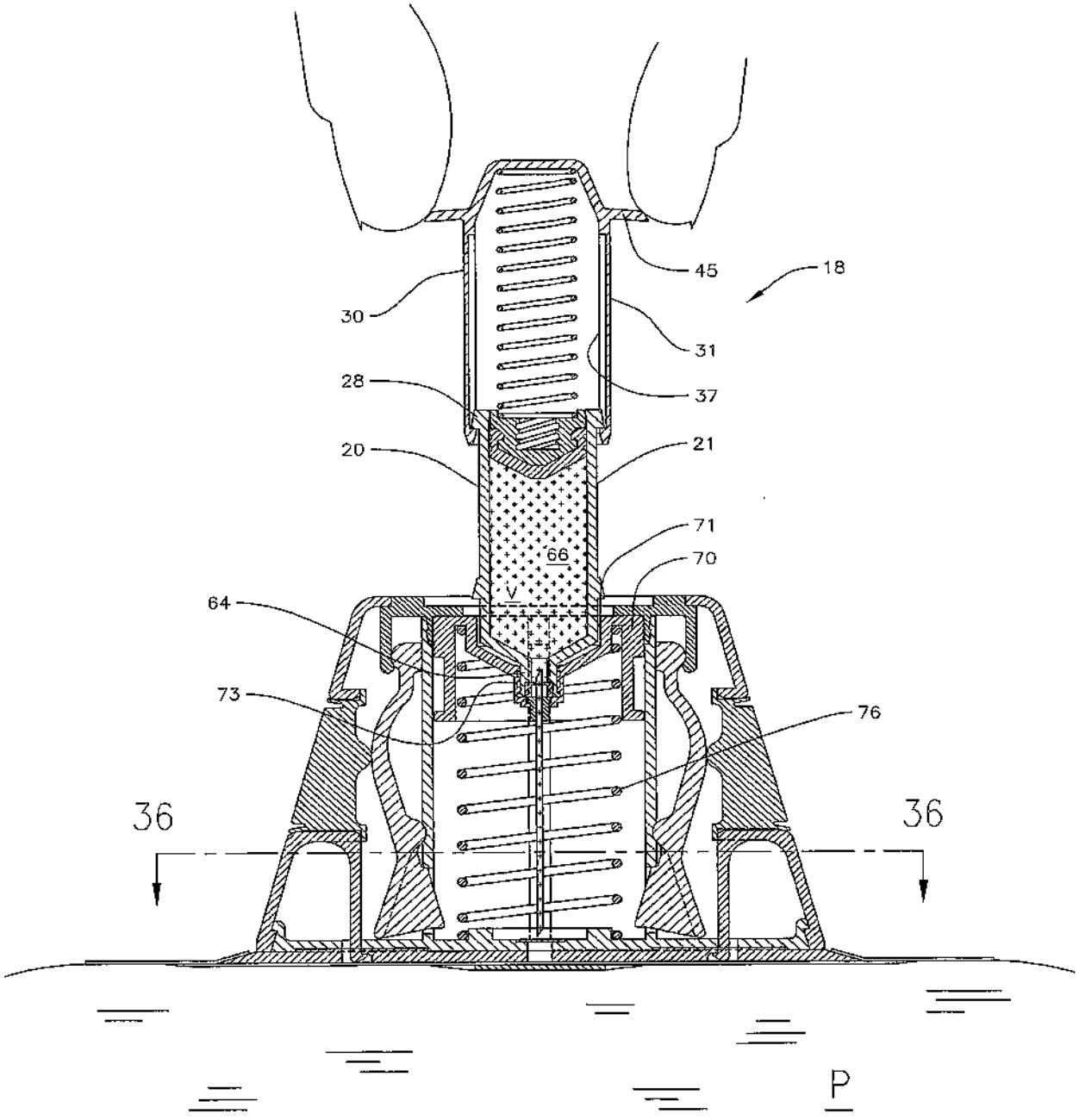

Fig. 22

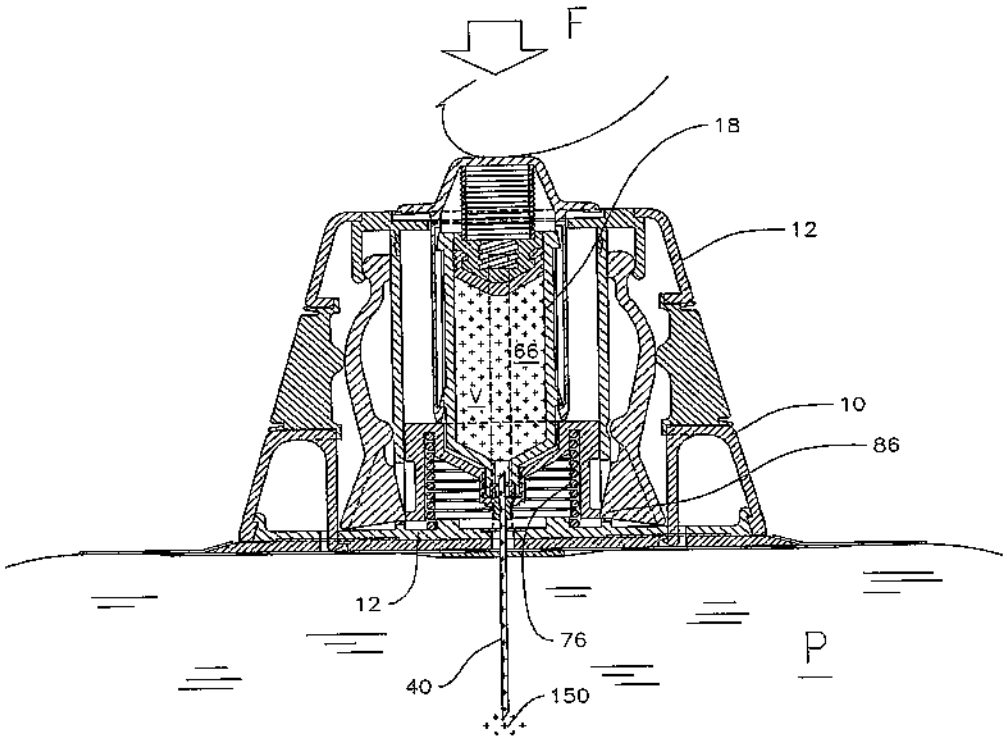

Fig. 23

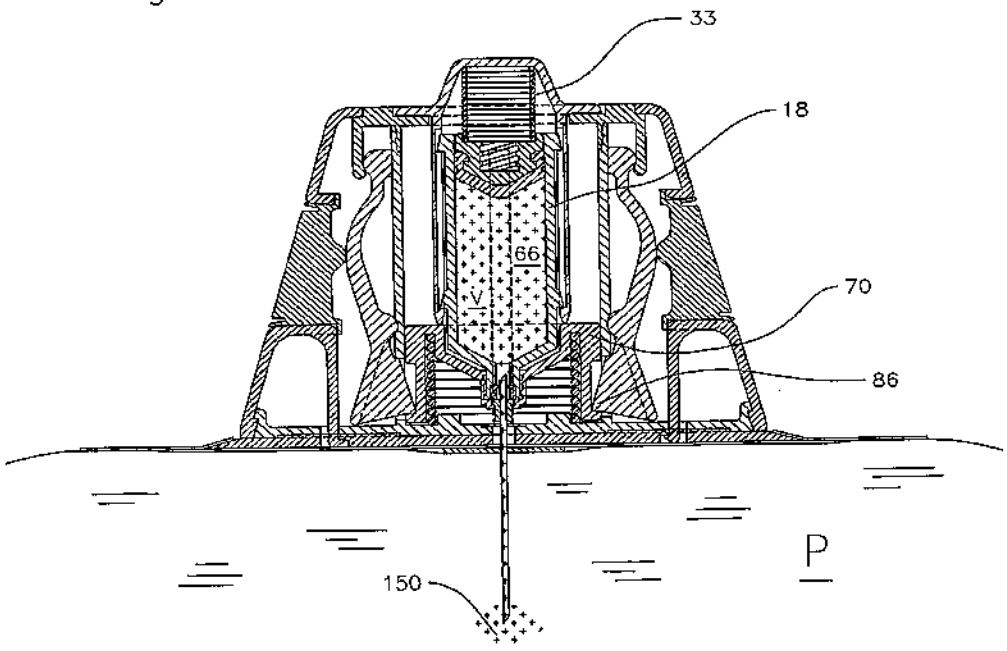

Fig. 24

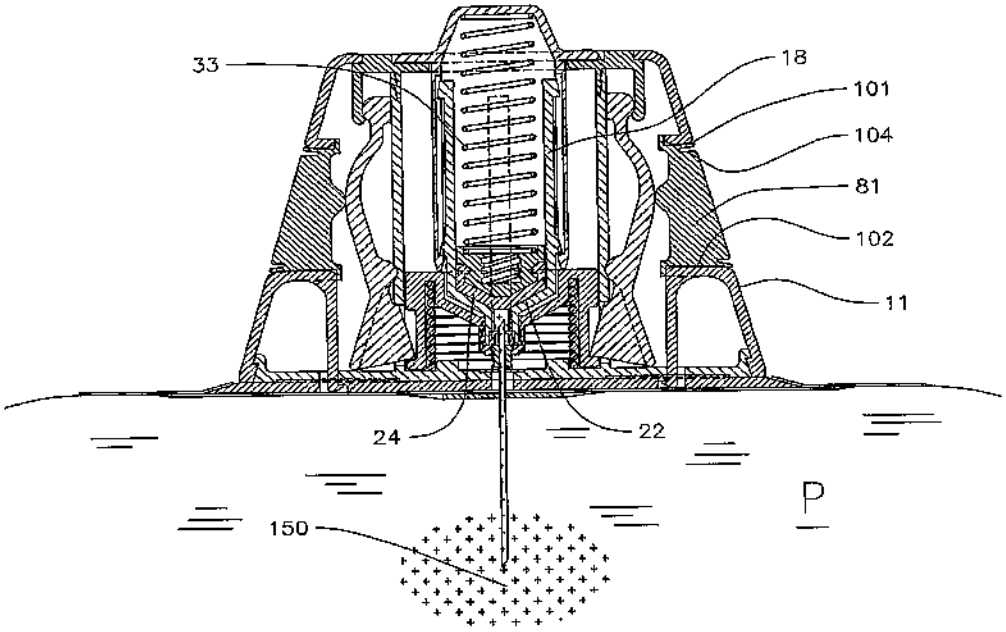
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Fig. 25

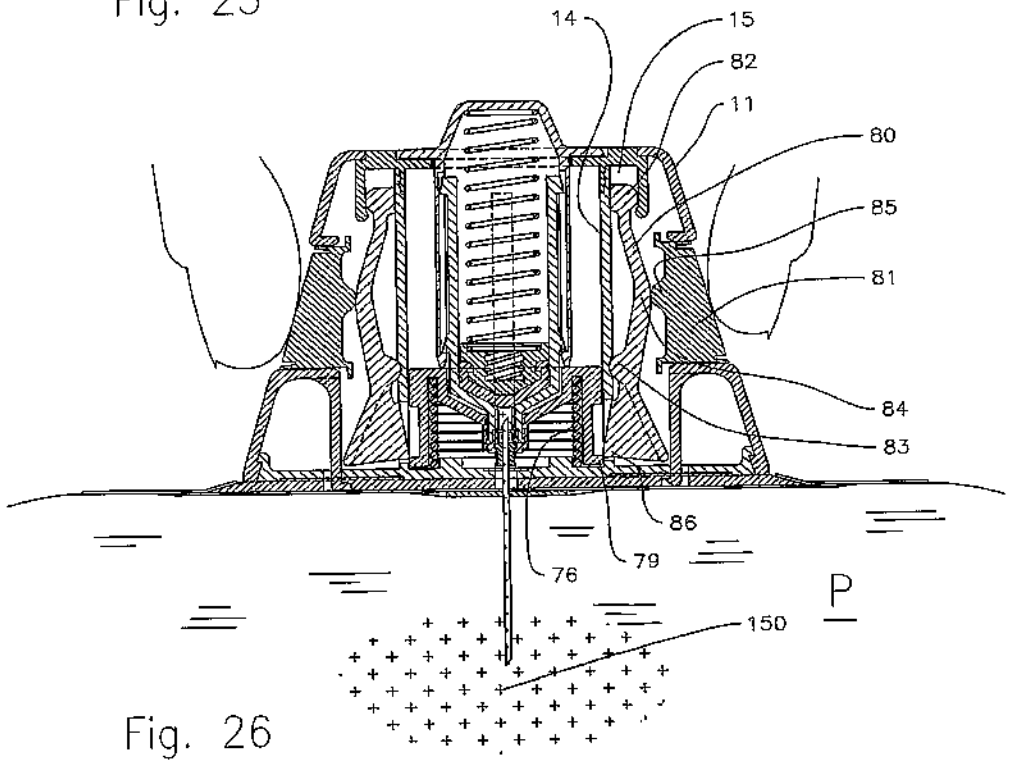
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Fig. 26

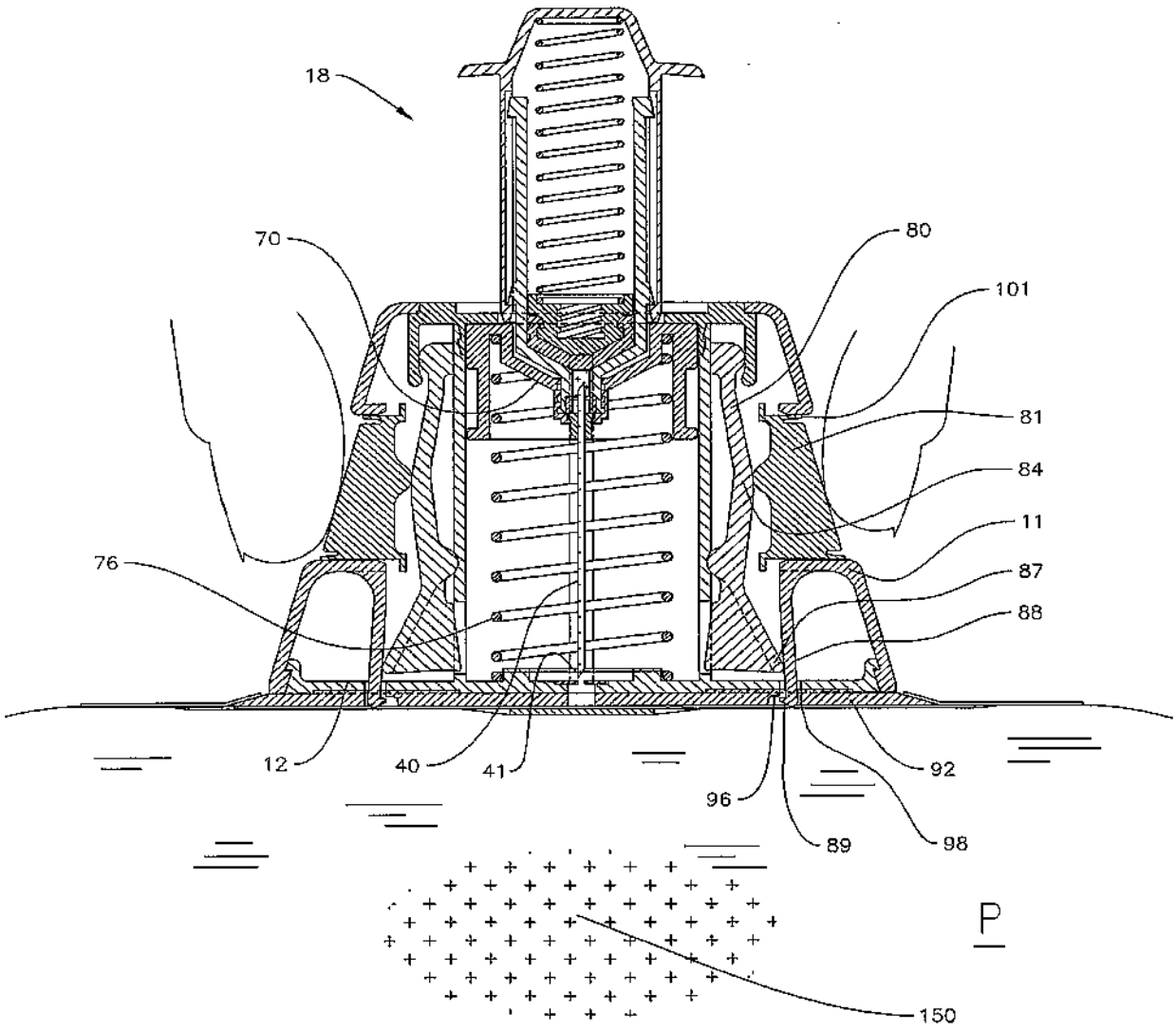

Fig. 27

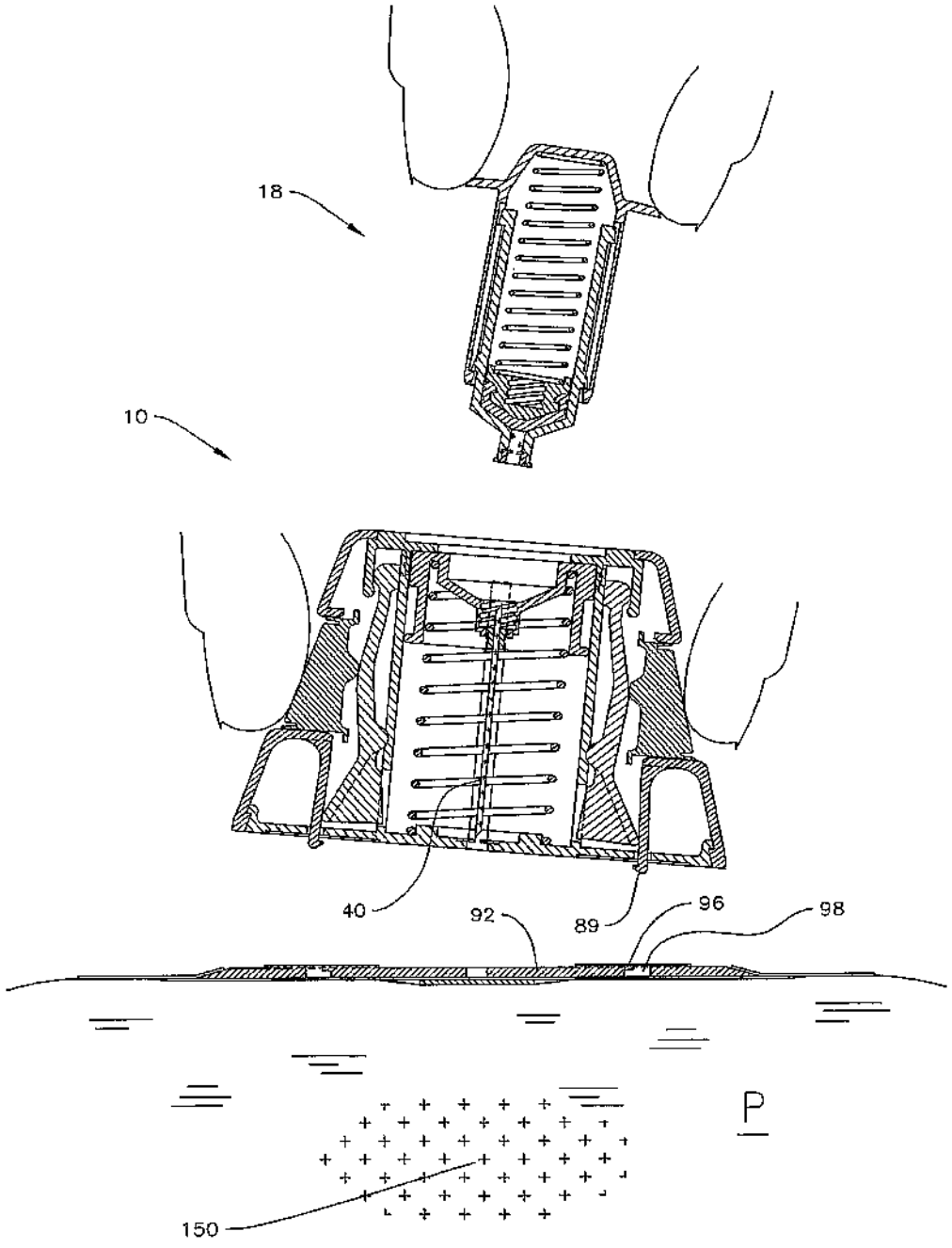

Fig. 28

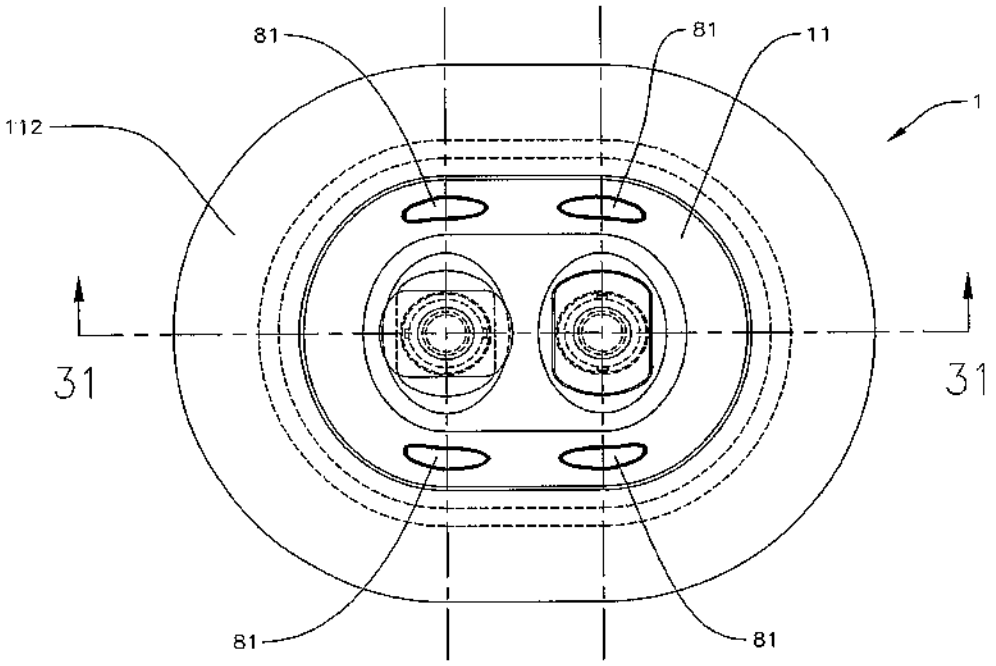

Fig. 29

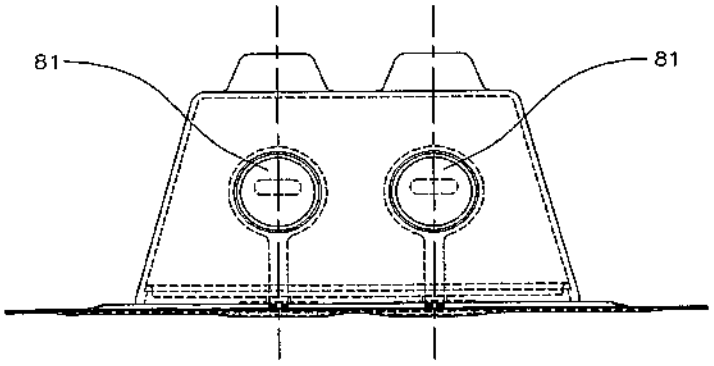

Fig. 30

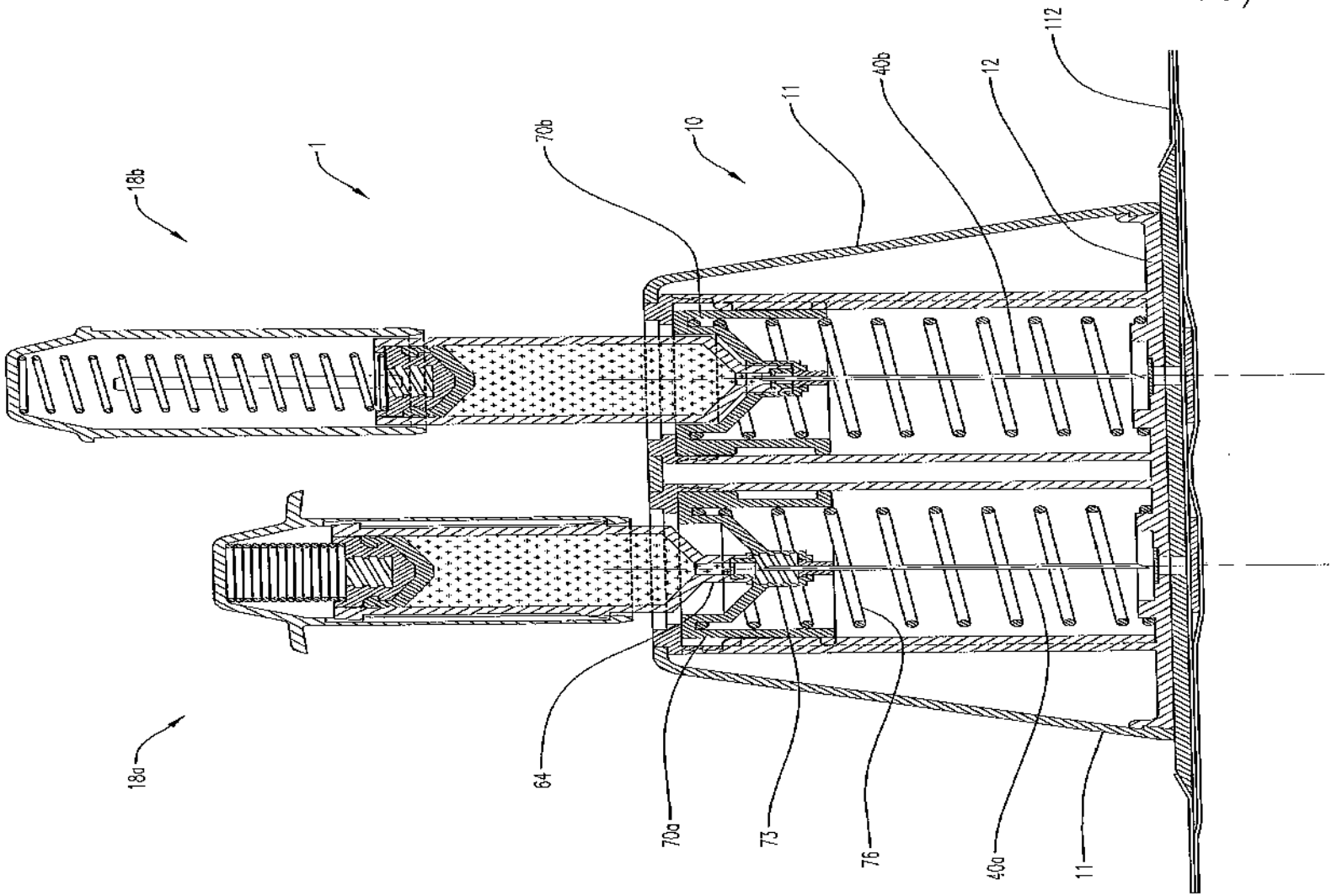

Fig. 31

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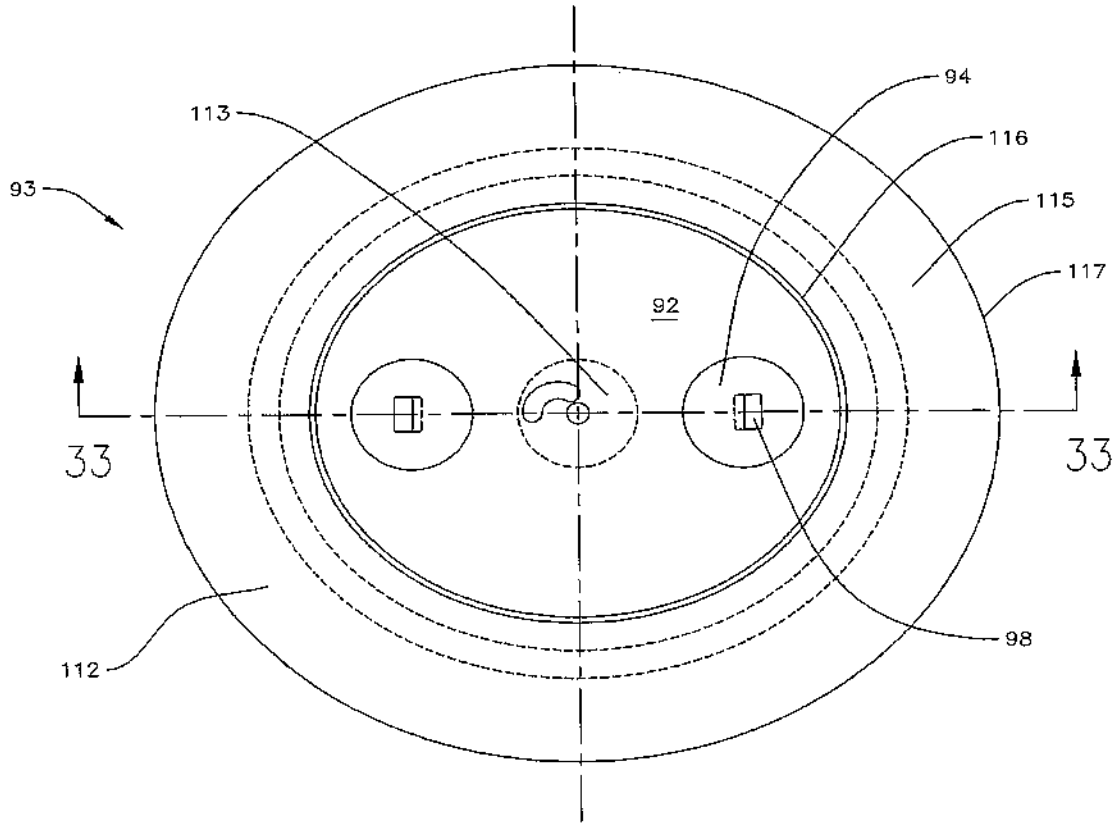

Fig. 32

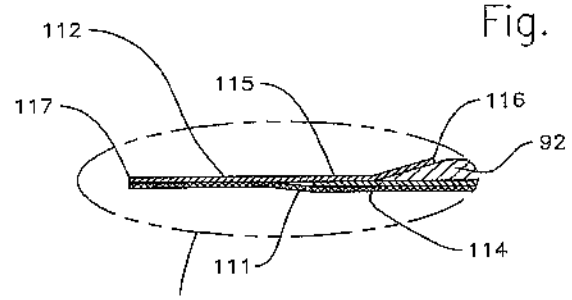

Fig. 34

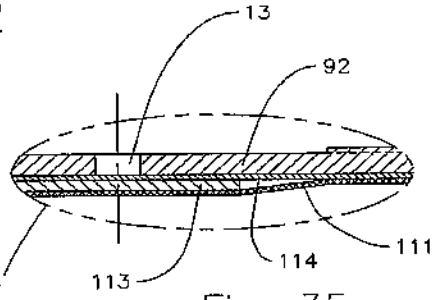

Fig. 35

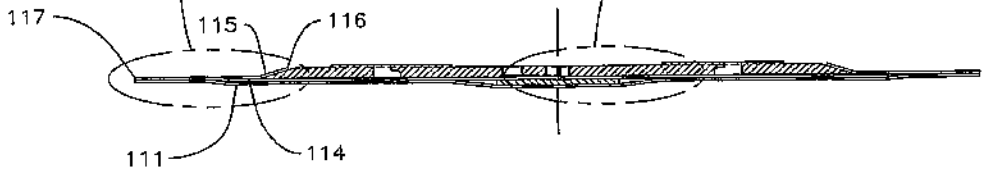

Fig. 33

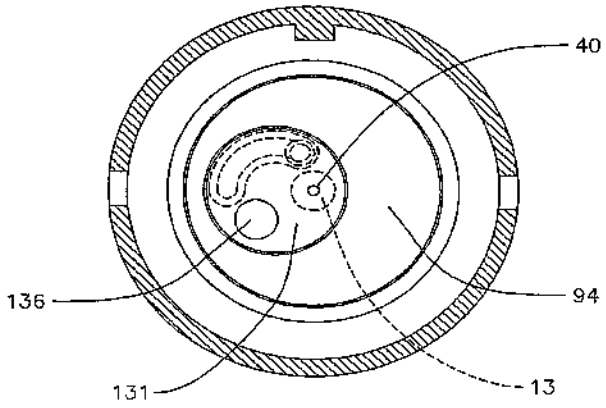

Fig. 38

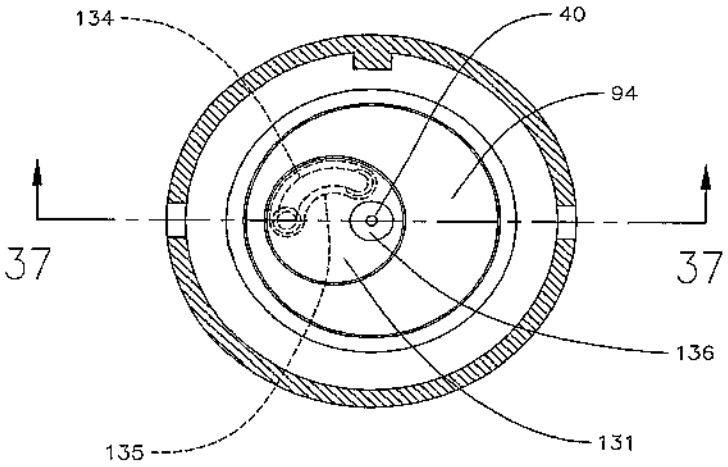

Fig. 36

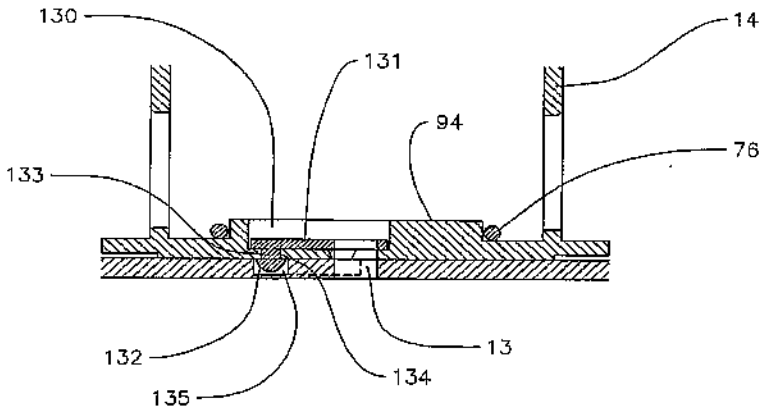

Fig. 37

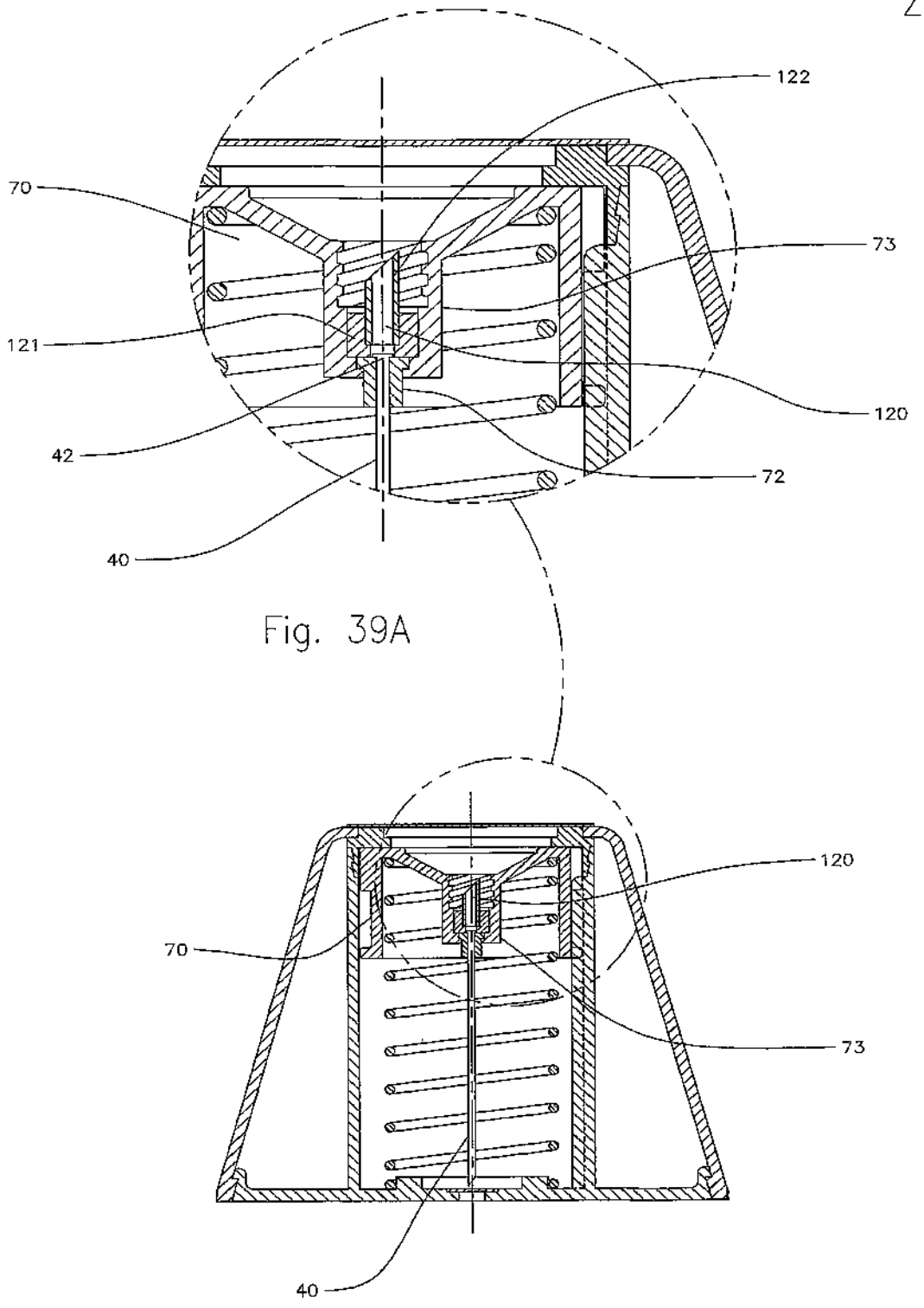

Fig. 39A

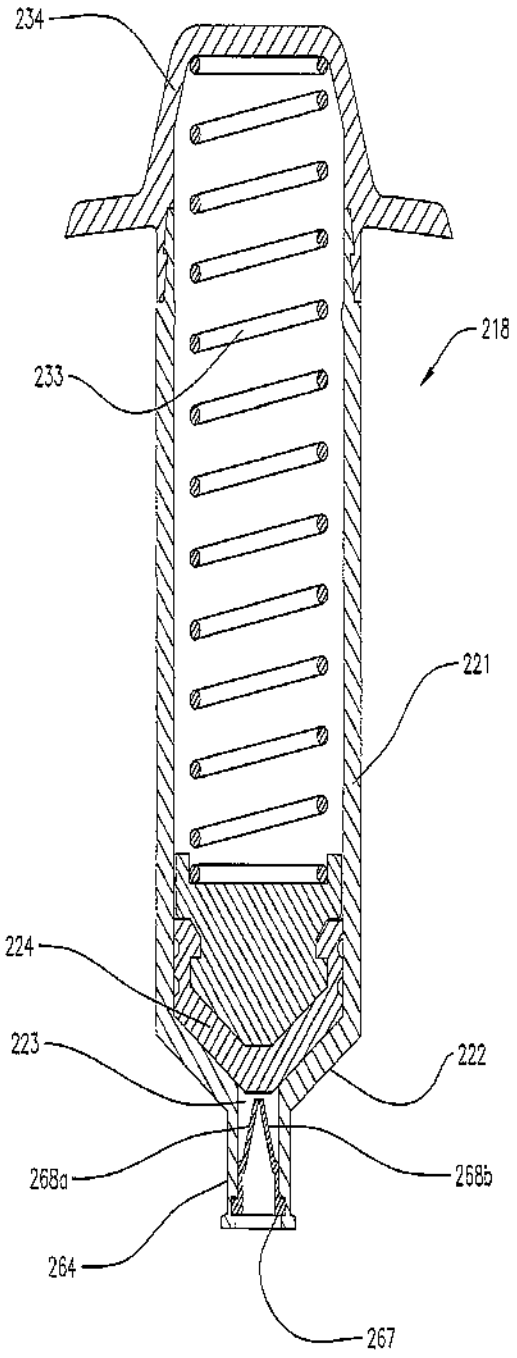
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Fig. 40

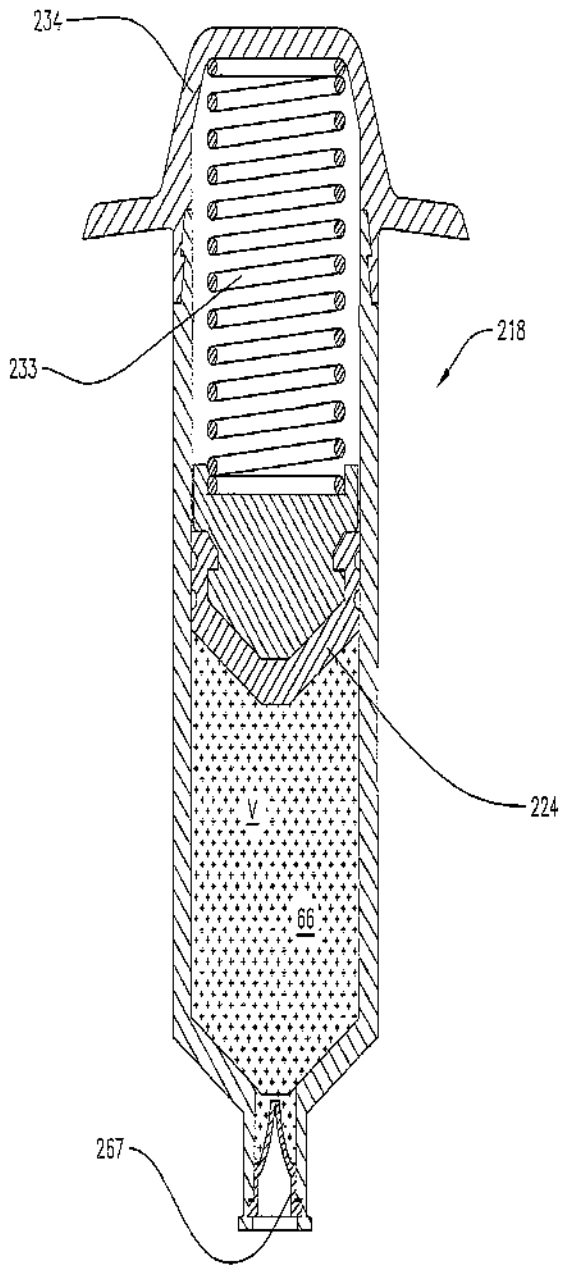
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Fig. 41

Fig. 42

Fig. 42A

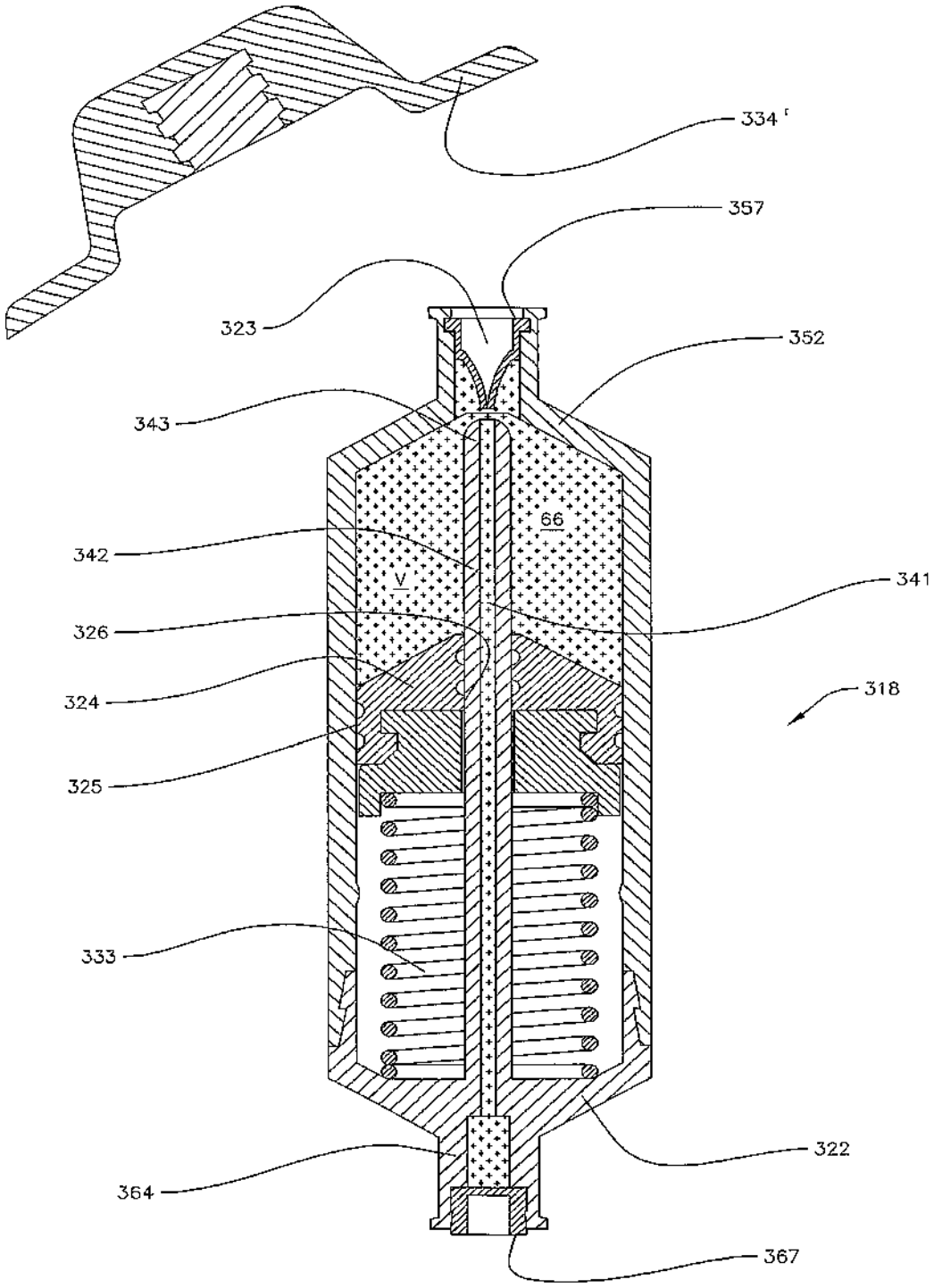

Fig. 43

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Fig. 44

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— *as to the identity of the inventor (Rule 4.17(i))*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

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— *with international search report (Art. 21(3))*

(54) Title: VIRTUAL KEYBOARD

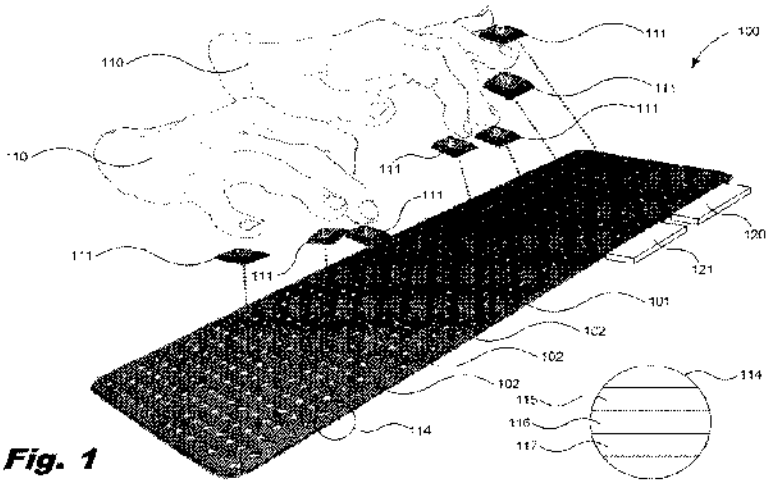

Fig. 1

(57) Abstract: A virtual keyboard includes a pad, a number of motion sensors coupled to the pad to detect the presence of a user's hands over the pad, a processor, and a memory. The memory includes executable code that, when executed by the processor calibrates the virtual keyboard based on a number of criteria of the user's hand upon detection of the user's hands by the motion sensors, in which the criteria comprises the user's unique keyboard profile.

WO 2016/010524 A1

VIRTUAL KEYBOARD

BACKGROUND

[0001] Computer keyboards are typewriter-style devices that use an arrangement of buttons or keys with a number of alphanumeric characters, graphemes, symbols, and other types of characters printed or engraved on the buttons or keys. The buttons and keys act as mechanical levers or electronic switches that cause input of a character to a computing device or otherwise control a computing device to which the keyboard is communicatively coupled. Keyboards, however, are bulky and are not easily mobile. Keyboards also contain mechanical parts that are easily broken. In addition, a user of a keyboard must strike the buttons or keys as they are laid out on the keyboard with no ability to fit the layout of the keyboard to a user. Even if customized keyboards were produced, such customized keyboards would be disadvantageous in shared computing environments such as workshops and call centers were several individuals may use the same keyboard. Further, keyboards provide no form of user authentication to secure and protect data on an associated computing device from unauthorized access. Still further, keyboards increase the potential to suffer from injuries or illnesses such as carpal tunnel syndrome or other repetitive strain injury and illness due to the extensive spread of bacteria.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] The accompanying drawings illustrate various examples of the principles described herein and are a part of the specification. The illustrated

examples are given merely for illustration, and do not limit the scope of the claims.

[0003] Fig. 1 is a perspective view of the virtual keyboard, according to one example of the principles described herein.

[0004] Fig. 2 is a block diagram of a virtual input computing system for processing data obtained from the virtual keyboard of Fig. 1, according to one example of the principles described herein.

[0005] Fig. 3 is a flowchart showing a method of calibrating the virtual keyboard, according to one example of the principles described herein.

[0006] Fig. 4 is a flowchart showing a method of processing signals from the virtual keyboard, according to one example of the principles described herein.

[0007] Fig. 5 is a flowchart showing a method of processing authentication signals from the virtual keyboard, according to one example of the principles described herein.

[0008] Throughout the drawings, identical reference numbers designate similar, but not necessarily identical, elements.

DETAILED DESCRIPTION

[0009] The present systems and methods provide a virtual keyboard that detects user's hands over the virtual keyboard and maps a number of virtual input keys to the user's hands and builds a unique keyboard profile for authentication purposes and character entry. The virtual keyboard is communicatively coupled to a computing device to provide for data input to the computing device control the computing device to which the virtual keyboard is communicatively coupled. The virtual keyboard comprises a pad, a number of motion sensors coupled to the pad to detect the presence of a user's hands over the pad, and a tracking system to track hand and finger movements of the user's hand. In this manner, the user does not touch any hardware device when utilizing the virtual keyboard. Detection of the user's hands by the motion sensors activates the tracking system. The tracking system comprises a

number of wave detectors to detect wavelengths reflected off the user's hands. The wave detectors may, for example, detect electromagnetic wavelengths or acoustical frequencies. The virtual keyboard may be calibrated to a user's hand positioning, hand size, or any other criteria to define a keyboard profile unique to that user. This keyboard profile may be used to identify the user as well as provide a number of security and access controls.

[0010] As used in the present specification and in the appended claims, the term "a number of" or similar language is meant to be understood broadly as any positive number comprising 1 to infinity; zero not being a number, but the absence of a number.

[0011] In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present systems and methods. It will be apparent, however, to one skilled in the art that the present apparatus, systems, and methods may be practiced without these specific details. Reference in the specification to "an example" or similar language means that a particular feature, structure, or characteristic described in connection with that example is included as described, but may not be included in other examples.

[0012] Fig. 1 is a perspective view of the virtual keyboard (100), according to one example of the principles described herein. The user's hands and fingers (110) are depicted in Fig. 1 above the pad (101). A number of keys (111) are depicted in Fig. 1 to depict how movements of the user's hands and fingers (110) over an area of the pad (101) virtually activate the input of a character or otherwise control a computing device to which the pad (101) is communicatively coupled much like activation of keys (111) of a non-virtual keyboard function.

[0013] The pad (101) may be shaped or sized approximately similar to a non-virtual keyboard. In another example, the pad (101) may be larger or smaller than a non-virtual keyboard. A number of sensing devices (102) are included in the pad (101) to detect the presence of the user's hands and fingers (110) over the pad (101), to track the hand and finger movements of the user's hands and fingers (110), and to detect tissue density of the user's hands and

fingers (110), to detect palm and fingerprints of the user's hands and fingers (110), and to create and store a keyboard profile of a user, among other functions as will be described in more detail below.

[0014] The sensing devices (102) may be located along the surface of the pad (101) as depicted in Fig. 1 in a pattern to provide homogeneous and uniform coverage along the surface of the pad (101). The sensing devices (102) are depicted as bumps along the surface of the pad (101). In one example, the sensing devices (102) may be any type of sensor device that can detect the presence of the user's hands and fingers (110) over the pad (101), track the hand and finger movements of the user's hands and fingers (110), and/or detect a keyboard profile of a user, among other functions. The sensing devices (102) may be, for example, video-based devices that capture video data for processing in the manner described herein, image-based devices that capture image data for processing in the manner described herein, electromagnetic-based devices that use electromagnetic waves and light detectors such as, for example, photodiodes to detect movement, acoustic-based devices such as an ultrasonic-based device that produce acoustical waves and detect the acoustical frequencies reflected from an object, backscatter x-ray devices to detect radiation reflected from the hands and fingers (110), or other types of motion and tracking devices.

[0015] As to the ultrasonic-based device, this type of device may detect the position and motion of the user's hands and fingers (110), as well as the tissue density of the user's hands and fingers (110) for authentication and security purposes. As to the electromagnetic-based devices, this type of device may use light-emitting diodes (LEDs), lasers, infrared light emitters, or other types of electromagnetic wave propagation devices.

[0016] In one example, the sensing devices (102) may be protected by a layer of flexible material such as, for example, silicone that allows the pad (101) to be rolled up or folded for storage and mobility. In one example as depicted in the call-out circle (114), the pad (101) may comprise a top layer (115) of silicone, a middle layer (116) in which the sensor devices (102) and associated wiring are disposed, and a bottom layer (117) of silicone. Although the top layer

(115) and bottom layer (117) are described as being made of silicone, any other insulating, flexible material may be used to house the array of sensor devices (102) and associated wiring.

[0017] The pad (101) may further include a communication module (120) to provide communication with a computing device with which the pad (101) interacts with to manipulate the operation of the computing device. In one example, the communication module (120) may be a wired or wireless communication device. The types of communication utilized by the communication module (120) may include, for example, any communication type that supports any Open Systems Interconnection (OSI) model standardized communication type, any communication type that supports any Institute of Electrical and Electronics Engineers (IEEE) standardized communication type, BLUETOOTH communication types developed by the Bluetooth Special Interest Group, Ethernet communication types, WI-FI communication types as defined by the Wi-Fi Alliance, near field communication types, infrared communication types, among many other types of communications and their respective types of networks, or combinations thereof. The communication module (120) may be embedded within the pad (101) or communicatively coupled to the pad (101) as depicted in Fig. 1.

[0018] A power source (121) may also be coupled to the pad (101) to provide electrical power to the pad (101). The power module may provide AC or DC power to the pad. In the example of an AC power source, the power source (121) may be coupled to a wall outlet, the computing device with which the virtual keyboard (100) communicates, or other AC power supply. In the example of a DC power source, the power source may comprise a battery, a rechargeable battery, or other type of DC power supply. The power source (121) may also be a solar panel that directly powers the virtual keyboard (100) or indirectly powers the virtual keyboard (100) through charging a battery, for example.

[0019] In one example, the pad (101) of the virtual keyboard (100) may be built into or installed in a user's desk, a wall, the dashboard of a car, or other fixture.

[0020] Fig. 2 is a block diagram of a virtual input computing system (200) for processing data obtained from the virtual keyboard (100) of Fig. 1, according to one example of the principles described herein. The virtual input computing system (200) may be incorporated into the pad (101) of the virtual keyboard (100), may be a coupled to the virtual keyboard (100), may be a standalone computing device, or may be incorporated into a computing device to which the virtual keyboard (100) is communicatively coupled. In the example where the virtual input computing system (200) is incorporated into a computing device to which the virtual keyboard (100) is communicatively coupled, the various computing elements and resources provided by the virtual input computing system (200) may be part of the computing device, and the modules comprising executable program code used in the implementation of the virtual keyboard (100) and its associated functions may be stored within a data storage device of the computing device.

[0021] The virtual input computing system (200) may be utilized in any data processing scenario including, stand-alone hardware, mobile applications, through a computing network, or combinations thereof. Further, the virtual input computing system (200) may be used in a computing network, a public cloud network, a private cloud network, a hybrid cloud network, other forms of networks, or combinations thereof. In one example, the methods provided by the virtual input computing system (200) are provided as a service over a network by, for example, a third party. In this example, the service may comprise, for example, the following: a Software as a Service (SaaS) hosting a number of applications; a Platform as a Service (PaaS) hosting a computing platform comprising, for example, operating systems, hardware, and storage, among others; an Infrastructure as a Service (IaaS) hosting equipment such as, for example, servers, storage components, network, and components, among others; application program interface (API) as a service (APIaaS), other forms of network services, or combinations thereof. The present systems may be implemented on one or multiple hardware platforms, in which the modules in the system can be executed on one or across multiple platforms. Such modules can run on various forms of cloud technologies and hybrid cloud technologies or

offered as a SaaS (Software as a service) that can be implemented on or off the cloud. In another example, the methods provided by the virtual input computing system (200) are executed by a local administrator.

[0022] To achieve its desired functionality, the virtual input computing system (200) comprises various hardware components. Among these hardware components may be a number of processors (201), a number of data storage devices (202), a number of peripheral device adapters (203), and a number of network adapters (204). These hardware components may be interconnected through the use of a number of busses and/or network connections. In one example, the processor (201), data storage device (202), peripheral device adapters (203), and a network adapter (204) may be communicatively coupled via a bus (205).

[0023] The processor (201) may include the hardware architecture to retrieve executable code from the data storage device (202) and execute the executable code. The executable code may, when executed by the processor (201), cause the processor (101) to implement at least the functionality of detect the presence of the user's hands and fingers (110) over the pad (101), track the hand and finger movements of the user's hands and fingers (110), detect a keyboard profile of a user, and provide security and access controls to a computing device to which the virtual keyboard (100) is coupled among other functions according to the methods of the present specification described herein. In the course of executing code, the processor (201) may receive input from and provide output to a number of the remaining hardware units.

[0024] The data storage device (202) may store data such as executable program code that is executed by the processor (201) or other processing device. As will be discussed, the data storage device (202) may specifically store computer code representing a number of applications that the processor (201) executes to implement at least the functionality described herein.

[0025] The data storage device (202) may include various types of memory modules, including volatile and nonvolatile memory. For example, the data storage device (202) of the present example includes Random Access Memory (RAM) (206), Read Only Memory (ROM) (207), and Hard Disk Drive

(HDD) memory (208). Many other types of memory may also be utilized, and the present specification contemplates the use of many varying type(s) of memory in the data storage device (202) as may suit a particular application of the principles described herein. In certain examples, different types of memory in the data storage device (202) may be used for different data storage needs. For example, in certain examples the processor (201) may boot from Read Only Memory (ROM) (207), maintain nonvolatile storage in the Hard Disk Drive (HDD) memory (208), and execute program code stored in Random Access Memory (RAM) (206).

[0026] The data storage device (202) may comprise a computer readable medium, a computer readable storage medium, or a non-transitory computer readable medium, among others. For example, the data storage device (202) may be, but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing. More specific examples of the computer readable storage medium may include, for example, the following: an electrical connection having a number of wires, a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the foregoing. In the context of this document, a computer readable storage medium may be any tangible medium that can contain, or store computer usable program code for use by or in connection with an instruction execution system, apparatus, or device. In another example, a computer readable storage medium may be any non-transitory medium that can contain, or store a program for use by or in connection with an instruction execution system, apparatus, or device.

[0027] The hardware adapters (203, 204) in the virtual input computing system (200) enable the processor (201) to interface with various other hardware elements, external and internal to the virtual input computing system (200). For example, the peripheral device adapters (203) may provide an interface to input/output devices, such as, for example, display device (209), a

mouse, or a non-virtual keyboard in addition to the virtual keyboard (100). The peripheral device adapters (203) may also provide access to other external devices such as an external storage device, a number of network devices such as, for example, servers, switches, and routers, client devices, other types of computing devices, and combinations thereof.

[0028] The display device (209) may be provided to allow a user of the virtual input computing system (200) to interact with and implement the functionality of the virtual input computing system (200). In one example, an image of a keyboard (250) may be presented to a user of the virtual keyboard (100) on the display device (209). In this example, the user may input data through the user of the virtual keyboard (100), and the processor (201) may execute code to display to the user keystrokes associated with the hand movements of the user on the keyboard (250) displayed on the display device (209). The peripheral device adapters (203) may also create an interface between the processor (101) and the display device (109), a printer, or other media output devices.

[0029] In another example, the display device (209) may display the image of the keyboard (250) on the pad (101). In one example, the image of the keyboard (250) may be displayed on the pad (102) using a projection system to project the image of the keyboard (250) on the pad (101). In another example, a keyboard (250) may not be displayed on the pad (101).

[0030] In another example, the image of the keyboard (250) may be displayed on the pad (102) using a number of LEDs embedded within the pad (101). In this example, the LEDs light up to create a pattern in the pad. In one example, the pattern may be the pattern of a keyboard as arranged within a non-virtual keyboard. In another example, the pattern, although arranged similarly to a non-virtual keyboard, may be sized to fit the user's hand sizes, typing patterns, hand positioning during typing various keystrokes or keystroke combinations, or any hand positioning detected by the virtual keyboard (100) from an initial hand position through any subsequent hand position, keystroke or keystroke combination. Thus, in this example, the image of the keyboard as outlined on the pad (101) through lighting of the LEDs may look significantly

different from the tight and inline layout of a non-virtual keyboard and will fit to a user's distinct hand posturing, hand positioning, and keystroke style.

[0031] In still another example, the image of the keyboard (250) may be displayed on the pad (102) using a number of laser devices embedded within the pad (101) or that project light onto the pad (101). In this example, the laser devices function in a manner similar to the above-described LEDs. In one example, the display of the keyboard (250) on the display device (209) or the pad (101) as described above may be performed only during a keyboard profile calibration and learning phase as will be described in more detail below in order to assist a user in visualizing placement of keystrokes and help with typing while the user's keystrokes are being learned.

[0032] The network adapter (204) may provide an interface to other computing devices within, for example, a network, thereby enabling the transmission of data between the virtual input computing system (200) and other devices located within the network. In an example where the virtual input computing system (200) is incorporated into a computing device to which the virtual keyboard (100) is communicatively coupled, the network adapter (204) provides network connectivity with the virtual keyboard (100).

[0033] The virtual input computing system (200) may, when executed by the processor (101), display the number of graphical user interfaces (GUIs) on the display device (109) associated with the executable program code representing the number of applications stored on the data storage device (102). The GUIs may include aspects of the executable code including the displayed keyboard (250) described above. The GUIs may display, for example, a real time indication of which keys are being selected by a user of the virtual keyboard by presenting those keys in an activated state to the user on the GUI displayed on the display device (209). Examples of display devices (209) include a computer screen, a laptop screen, a mobile device screen, a personal digital assistant (PDA) screen, a tablet screen, and a touch screen, among other display devices (106).

[0034] The virtual input computing system (200) further comprises a number of modules used in the implementation of the virtual keyboard (100).

The various modules within the virtual input computing system (200) comprise executable program code that may be executed separately. In this example, the various modules may be stored as separate computer program products. In another example, the various modules within the virtual input computing system (200) may be combined within a number of computer program products; each computer program product comprising a number of the modules.

[0035] The virtual input computing system (200) may include a gesture calibration and learning module (210) to, when executed by the processor (201), calibrate user interactions with the virtual keyboard (100) and learn gestures used by the user in attempting to input data using the virtual keyboard (100). The a gesture calibration and learning module (210) may prompt a user to perform an initial calibration procedure in which the user is requested to demonstrate a number of keystrokes for detection by the pad (101). For example, the user may be prompted to demonstrate a home row hand gesture where the user places his or her hands above the pad (101) and positions his or her fingers as if the user were placing his or her hands and fingers on a home row of a keyboard. This provides the virtual input computing system (200) with data representing a home row position of the user and orients the home row keys and the remainder of the keys on the virtual keyboard (100) with respect to the home row gesture.

[0036] The gesture calibration and learning module (210) may also request a user to demonstrate a number of individual keystrokes. For example, the gesture calibration and learning module (210) may request a user to demonstrate keystrokes associated with each of the characters displayed on a keyboard or the keyboard (250) displayed on the display device (209). The gesture calibration and learning module (210) may also request a user to demonstrate a number of combination keystrokes where the user is requested to demonstrate instances where the user would simultaneously press two or more keys on a keyboard. For example, the "shift" key along with the "a" key to produce a capital "A." In this manner, the gesture calibration and learning module (210) may calibrate the virtual keyboard (100) for the user. The calibration is unique to that particular user. The gesture calibration and learning

module (210) may also learn a user's distinct hand posturing, hand positioning, and keystroke styles from the outset of that user utilizing the virtual keyboard (100) and throughout the user's use of the virtual keyboard (100). In this manner, the virtual keyboard adapts to the user's potentially changing hand posturing, hand positioning, and keystroke styles.

[0037] The gesture calibration and learning module (210) may perform calibration and learning techniques for a number of users of a particular virtual keyboard (100). This is advantageous in situations where a number of individuals have access to a particular computing device via the virtual keyboard (100) such as, for example, in a classroom setting where may groups of students utilize a set of computing devices. In one example, the gesture calibration and learning module (210) may begin calibration and learning for a particular user once the user logs onto a computing device coupled to the virtual keyboard (100). Thus, each user that logs into the computing device may be prompted to initiate a calibration and learning sequence to prepare and continue to fine-tune each user's individual and unique keyboard profile. Calibration and learning processes will be described in more detail below.

[0038] In one example, the gesture calibration and learning module (210) identifies an initial interaction by the user with the virtual keyboard (100) when the user interacts with any number of sensing devices (102) within the pad (101). The sensing devices (102) of the pad (101) may detect the initial interaction by the user and the gesture calibration and learning module (210) may identify that initial interaction as the position from which the user's keyboard profile is mapped. Thus, if a user presents his or her hands and fingers (110) on a left portion of the pad (101), then the virtual keyboard (100) and gesture calibration and learning module (210) maps the virtual keyboard (100) around the user's hands and fingers (110) from the left portion of the pad (101). In one example, the pad (101) may be larger than a non-virtual keyboard to accommodate for the possibility of this type of off-center initiation.

[0039] The virtual input computing system (200) may include a data input processing module (220) to, when executed by the processor (201), process a number of keystrokes a user performs on the virtual keyboard (100). The data

input processing module (220) receives input data from the virtual keyboard (100), and identifies a number of the inputs or a series of the inputs as being associated with keystrokes based on the calibrated and learned gestures obtained by the calibration and learning module (210). The data input processing module (220) may submit the identified inputs to a computing device to which the virtual keyboard (100) is coupled for controlling the computing device according to the identified inputs and commands.

[0040] The data input processing module (220) of the virtual input computing system (200) may also provide feedback to the user of the virtual keyboard (100). In one example, feedback may be provided to the user as the user types on the virtual keyboard (100). The feedback may be provided in the form of haptic feedback, audio feedback, visual feedback, or other types of feedback that indicate to the user that keystrokes are being made. In the example of haptic feedback, the pad (101) may include a rumble device to provide a tactile response when the user touches a certain portion of the pad (101) if the user were to touch the pad (101) during typing.

[0041] In the example of audio feedback, a speaker or other audio device may provide an audible noise when the user makes a keystroke in the space above the pad (101). In this example, the audible noise may mimic the sound of a key on a non-virtual keyboard being pressed, or make any other noise to indicate to the user that their keystrokes are being received by the virtual keyboard (100) and interpreted by the computing device to which the virtual keyboard (100) is coupled.

[0042] In the example of visual feedback, the computing device to which the virtual keyboard (100) is coupled may display the a keyboard (250) as described above, and provide feedback to the user that the display device (209) may indicate that keystrokes are being received by the virtual keyboard (100) and interpreted by the computing device to which the virtual keyboard (100) is coupled by changing an aspect of the displayed keyboard (250) such as lighting or filling in a key corresponding to the user's keystrokes.

[0043] A keyboard profile module (230) may also be included within the virtual input computing system (200) to, when executed by the processor (201),

identify, refine, amend or build on an individual user's unique keyboard profile. As described above, the user's unique keyboard profile may include information regarding the user's distinct hand posturing, hand positioning, and keystroke style. The keyboard profile module (230) may store each user's keyboard profile in memory such as the data storage device (202) or another data storage associated with the virtual keyboard (100).

[0044] The virtual input computing system (200) may include a security module (240) to, when executed by the processor (201), provide security to a computing device to which the virtual keyboard (100) is communicatively coupled. The security module (240) may detect an initial presence of a user's hands and fingers (110) over the pad (101) and within the detection range of the sensor devices (102). Once the user's hands and fingers (110) are detected, the security module (240) analyzes the user's hand posturing, hand positioning, keystroke style, the tissue density of the user's hands and fingers, the user's palm and fingerprints, other aspects of the movement and characteristics of the user's hands and fingers (110), and combinations thereof. Based on this analysis, the security module (240) compares these collected aspects of the user's hands and fingers (110) with keyboard profiles stored in memory. If the collected aspects of the user's hands and fingers (110) match a keyboard profile stored in memory, then the user is allowed access to the computing resources of the computing device to which the virtual keyboard (100) is communicatively coupled.

[0045] The security module (240) may also lock out a subsequent individual who attempts to gain access to the computing device while a first user is utilizing the virtual keyboard (110) and the computing device. For example, if a first user is logged onto the computing device and walks away from the computing device, the subsequent user's hand posturing, hand positioning, keystroke style, the tissue density of the subsequent user's hands and fingers, the subsequent user's palm and fingerprints, other aspects of the movement and characteristics of the subsequent user's hands and fingers (110) will not be recognized as the first user's keyboard profile and/or will not be recognized as a keyboard profile stored in memory. In this scenario, the virtual keyboard (100)

and the computing device will lock up or otherwise deny access. Once the first user who is authorized to access the computing device via the virtual keyboard (100) once again place his or her hands and fingers (110) over the pad (101) and within the detection range of the sensor devices (102) to compares the first user's collected aspects of the user's hands and fingers (110) with keyboard profiles stored in memory and provides access to the first user. Thus, the security module (240) detects an unauthorized keyboard profile, locks the computing device, and prompts a user to authenticate his or herself.

[0046] The modules described above (210, 220, 230, 240) may utilize a number of technologies to detect and track movement of the user's hands and fingers (110) above or within the vicinity of the pad (101). In one example, the modules (210, 220, 230, 240) may use motion tracking hardware and software developed and distributed by Leap Motion, Inc.

[0047] Software and drivers associated with the modules (210, 220, 230, 240) may be obtained from a network using the network adaptor (204), from a disk, or any other source. More details in connection with the calibration and learning module (210), the data input processing module (220), the keyboard profile module (230), and the a security module (240) will now be described in more detail in connection with Figs. 3 through 5.

[0048] Fig. 3 is a flowchart showing a method (300) of calibrating the virtual keyboard (100), according to one example of the principles described herein. The method of Fig. 3 may include determining (block 301), with the processor (201) executing the gesture calibration and learning module (210), whether the user's hands are detected. This determination (block 301) may be a condition by which waking the virtual keyboard and/or the computing device is achieved. If the user the user's hands are not detected (block 301, determination NO), then the method (300) loops back to determining (block 301) whether the user's hands are detected. If the user's hands are detected (block 301, determination YES), then the processor (201) executing the gesture calibration and learning module (210), determines (block 302) whether the user is a new user of the virtual keyboard (100). If the user is a new user of the virtual keyboard (100) (block 302, determination YES), then the processor (201)

executing the gesture calibration and learning module (210), performs (block 303) an initial calibration of the user's hand posturing, hand positioning, and keystroke style.

[0049] For example, at block 303, the gesture calibration and learning module (210) may prompt a user to demonstrate a home row hand gesture where the user places his or her hands above the pad (101) and positions his or her fingers as if the user were placing his or her hands and fingers on a home row of a keyboard as described above. This provides the virtual input computing system (200) with data representing a home row position of the user and orients the home row keys and the remainder of the keys on the virtual keyboard (100) with respect to the home row gesture. The gesture calibration and learning module (210) may also prompt a user to demonstrate a number of individual keystrokes and a number of combination keystrokes as described above.

[0050] The gesture calibration and learning module (210) may also learn a user's distinct hand posturing, hand positioning, and keystroke styles from the outset of that user utilizing the virtual keyboard (100) and throughout the user's use of the virtual keyboard (100). In this manner, the virtual keyboard adapts to the user's potentially changing hand posturing, hand positioning, and keystroke styles.

[0051] The gesture calibration and learning module (210) may perform calibration and learning techniques for a number of users of a particular virtual keyboard (100). This is advantageous in situations where a number of individuals have access to a particular computing device via the virtual keyboard (100) such as, for example, in a classroom setting where may groups of students utilize a set of computing devices. In one example, the gesture calibration and learning module (210) may begin calibration and learning for a particular user once the user logs onto a computing device coupled to the virtual keyboard (100). Thus, each user that logs into the computing device may be prompted to initiate a calibration and learning sequence to prepare and continue to fine-tune each user's individual and unique keyboard profile. Calibration and learning processes will be described in more detail below.

[0052] The gesture calibration and learning module (210) and keyboard profile module (230), when executed by the processor, may store (block 304) the calibration from block 303 as the user's keyboard profile. The user's keyboard profile may be data representing the detected hand posturing, hand positioning, and keystroke styles, among other aspects of the user's hand movements as detected by the sensing devices (102) of the pad (101). The user's keyboard profile may be stored in the memory located at the virtual keyboard (100), in the data storage device (202) of the virtual input computing system (200), or another storage device accessible by the processor (201), the virtual keyboard (100) or other processing device for use in execution of the various functions of the present systems and methods.

[0053] If the user is a not new user of the virtual keyboard (100) (block 302, determination NO), or after performing an initial calibration (block 303), then the gesture calibration and learning module (210) may determine (block 305) if the user's keyboard profile should be updated. A number of aspects of the user's hand posturing, hand positioning, and keystroke style may change through time as the user becomes more comfortable using the virtual keyboard (100). A number of criteria may indicate that a user's keyboard profile should be updated including, for example, changes in initial home row positioning, changes in keystrokes or keystroke combinations, or other nuanced changes in the user's hand posturing, hand positioning, and keystroke style. Further, the user's keyboard profile may be updated upon identification by the sensing devices (102) that an injury such as a loss of a portion of the user's hand or the loss of a finger has cause the user accommodate in order to make keystrokes or present a particular hand position. Thus, the gesture calibration and learning module (210) continues to learn the user's hand posturing, hand positioning, and keystroke style by performing (block 303) subsequent learning of the user's keyboard profile if it is determined that the user's keyboard profile should be updated (block 305, determination YES).

[0054] The method (300) loops back to blocks 305 and 306 as long as it is determined that the user's keyboard profile should be updated (block 305, determination YES). The method may terminate if it is determined that the

user's keyboard profile should not be updated (block 305, determination NO). In this manner, the user's keyboard profile may be initially created and continually updated to accommodate the user's changing hand posturing, hand positioning, and keystroke style.

[0055] Fig. 4 is a flowchart showing a method (400) of processing signals from the virtual keyboard (100), according to one example of the principles described herein. The method of Fig. 4 may include determining (block 401), with the processor (201) executing the data input processing module (220), whether the user's hands are detected. If the user the user's hands are not detected (block 401, determination NO), then the method (400) loops back to determining (block 401) whether the user's hands are detected. Again, this determination (block 401) may be a condition by which waking the virtual keyboard and/or the computing device is achieved. If the user's hands are detected (block 401, determination YES), then the processor (201), executing the data input processing module (220), determines keystroke identity based on the user's keyboard profile identified in Fig. 3. The keystroke identity identifies the how the user's hand posturing, hand positioning, and keystroke style correlate with input to the computing device to which the virtual keyboard is communicatively coupled.

[0056] Using the keystroke identity, the data input processing module (220), when executed by the processor (201), instructs (block 403) the computing device to process data in accordance with the keystroke identity. In this manner, the user's input at the virtual keyboard (100) is translated into computer readable instructions that are consumed by the computing device in order to perform the tasks the user wishes the computing device to perform such as, for example, typing in a word processing application, or any other application of user input from a keyboard.

[0057] The method may continue by determining (block 404) whether the user is inputting data though the virtual keyboard (100). If the user is still utilizing the virtual keyboard (100), then those keystrokes should be identified and translated into computer readable instructions for consumption by the computing device in order to perform the tasks the user wishes the computing

device to perform. Thus, if the user is inputting data though the virtual keyboard (100), then the method (400) of Fig. 4 may loop back to block 402 for processing as described above. If the user is not inputting data though the virtual keyboard (100), then the method (400) may terminate.

[0058] Fig. 5 is a flowchart showing a method (500) of processing authentication signals from the virtual keyboard (100), according to one example of the principles described herein. As described above, the virtual keyboard (100) may be used to permit access to individuals who are permitted to use a computing device to which the virtual keyboard (100) is communicatively coupled, while denying access to others who are not permitted. The method of Fig. 5 may include determining (block 501), with the processor (201) executing the security module (240), whether the user's hands are detected. Again, this determination (block 501) may be a condition by which waking the virtual keyboard and/or the computing device is achieved. If the user the user's hands are not detected (block 501, determination NO), then the method (500) loops back to determining (block 501) whether the user's hands are detected. If the user's hands are detected (block 501, determination YES), then the processor (201) executing the security module (240), identifies (block 402) an initial hand characteristics of the user attempting to access the computing device via the virtual keyboard (100).

[0059] The method (500) of Fig. 5 may continue by the processor (201) executing the security module (240) to determine (block 503) if the initial hand characteristics match a number of hand characteristics defined by a keystroke identity such as the keystroke identity defined and stored at blocks 303 and 304 of Fig. 3. In one example, the initial hand characteristics may be compared to the keystroke identity of an individual currently logged into the computing device. In this example, a user who is authorized to access the computer, but is not the current user of the computer may still be denied access. In another example, the processor (201) may compare the initial hand characteristics to the keystroke identity of a number of users. If the initial hand characteristics match hand characteristics defined by a keystroke identity (block 503, determination YES), then access to the computing device may be allowed. The method (500)

may loop back to block 501 to ensure that every time a user's hands are detected, that this security measure may be performed. The hand characteristics compared at block 503 may include, hand movements, hand sizes, hand posturing, hand positioning, and keystroke style, tissue density of the user's hands and fingers (110), palm prints, fingerprints, among many other characteristics of the user's hands and fingers as detected by the sensing devices (102), or combinations thereof.

[0060] If, however, the initial hand posture does not match a hand posture defined by a keystroke identity (block 503, determination NO), then the processor (201), executing the security module (240) may deny access (block 505) to the computing device. Denying access to the computing device may include, for example, not registering input from the virtual keyboard (100), locking the computing device, shutting down the computing device, alerting a valid user or an administrator of an unauthorized access to the computing device, requesting the accessing user for additional credentials such as a password or fingerprint identification, other security measures, or combinations thereof. The method (500) of Fig. 5 may terminate, and may be initiated once again when a user's hands are detected at block 501.

[0061] In this manner, the virtual keyboard (100) may be used to provide access control and security to any computing device. These computing devices may include, for example, desktop computers, laptop computers, tablet computers, mobile phone devices, as well as objects or devices that user computing devices such as vehicles, automated teller machines (ATMs), buildings, musical instruments such as keyboards, checkout stands at retail stores, among many other devices and objects.

[0062] Aspects of the present system and method are described herein with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems) and computer program products according to examples of the principles described herein. Each block of the flowchart illustrations and block diagrams, and combinations of blocks in the flowchart illustrations and block diagrams, may be implemented by computer usable program code. The computer usable program code may be provided to a processor of a general

purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the computer usable program code, when executed via, for example, the processor (201) of the virtual input computing system (200) or other programmable data processing apparatus, implement the functions or acts specified in the flowchart and/or block diagram block or blocks. In one example, the computer usable program code may be embodied within a computer readable storage medium; the computer readable storage medium being part of the computer program product. In one example, the computer readable storage medium is a non-transitory computer readable medium.

[0063] The specification and figures describe a virtual keyboard. The virtual keyboard includes a pad, a number of motion sensors coupled to the pad to detect the presence of a user's hands over the pad, and a tracking system to track hand and finger movements of the user's hand. A computing device for processing input from a virtual keyboard is also described. The computing device includes a processor and a memory. The memory includes executable code that, when executed by the processor initiates a tracking system to track hand and finger movements of the user's hand, in response to receiving data from a number of motion sensors coupled to a pad of the virtual keyboard to detect the presence of a user's hands over the pad. The executable code also calibrates the virtual keyboard based on a number of criteria of the user's hand.

[0064] This virtual keyboard may have a number of advantages, including: (1) the virtual keyboard is easy to store by rolling it up, folding it, or laying it on top of a computing device for storage; (2) due to its virtual aspects, a user need not come in physical contact with his or her fingers or hands to operate the virtual keyboard; (3) the virtual keyboard conforms to a user's hand positions and learns from the user's usage patterns to increase comfort and utility; and (4) the virtual keyboard provides increased security to a computing device to which the virtual keyboard is communicatively coupled, among many other advantages.

[0065] The preceding description has been presented to illustrate and describe examples of the principles described. This description is not intended

to be exhaustive or to limit these principles to any precise form disclosed. Many modifications and variations are possible in light of the above teaching.

CLAIMS

WHAT IS CLAIMED IS:

1. A virtual keyboard comprising:

a pad;

a number of motion sensors coupled to the pad to detect the presence of a user's hands over the pad;

a processor; and

a memory, the memory comprising executable code that, when executed by the processor:

calibrates the virtual keyboard based on a number of criteria of the user's hand upon detection of the user's hands by the motion sensors,

in which the criteria comprises the user's unique keyboard profile.

2. The virtual keyboard of claim 1, in which detection of the user's hands by the motion sensors activates the tracking system.

3. The virtual keyboard of claim 1, in which the tracking system comprises a number of wave detectors to detect wavelengths reflected off the user's hands.

4. The virtual keyboard of claim 1, in which the pad is dimensioned to approximate the size of a keyboard.

5. The virtual keyboard of claim 1, further comprising a tracking system to track hand and finger movements of the user's hand.

6. The virtual keyboard of claim 1, in which the user's unique keyboard profile comprises hand position, hand size, hand posturing, keystroke style, or combinations thereof.

7. The virtual keyboard of claim 1, further comprising

a processor; and

a memory, the memory comprising executable code that, when executed by the processor:

builds a hand position profile; and

authenticates the user based on the hand position profile.

8. The virtual keyboard of claim 7, in which access to a computing device to which the pad is communicatively coupled is denied if the hand position profile is not recognized.

9. A computing device for processing input from a virtual keyboard, comprising.

a processor; and

a memory, the memory comprising executable code that, when executed by the processor:

initiates a tracking system to track hand and finger movements of the user's hand in response to receiving data from a number of motion sensors coupled to a pad of the virtual keyboard to detect the presence of a user's hands over the pad; and

calibrates the virtual keyboard based on a number of criteria of the user's hand, the criteria comprising the user's unique keyboard profile,

in which the user's unique keyboard profile comprises hand position, hand size, hand posturing, keystroke style, or combinations thereof.

10. The computing device of claim 9, in which the memory further comprises executable code that, when executed by the processor:

builds a hand position profile; and

authenticates the user based on the hand position profile.

11. The computing device of claim 9, in which the virtual keyboard comprises:

a pad;

a number of motion sensors coupled to the pad to detect the presence of a user's hands over the pad; and

a tracking system to track hand and finger movements of the user's hand.

12. The computing device of claim 9, further comprising:

a display system, in which a number of keys of a keyboard are displayed on the pad using the display system.

13. A computer program product for dynamically learning a user's unique keyboard profile in association with a virtual keyboard, the computer program product comprising:

a computer readable storage medium comprising computer usable program code embodied therewith, the computer usable program code comprising:

computer usable program code to, when executed by a processor, with a number of motion sensors coupled to a pad, detect a user's hands above the pad;

computer usable program code to, when executed by a processor, with a number of lasers, track movements of the hands; and

computer usable program code to, when executed by a processor, based on information transmitted from the motion sensors and the lasers, build a hand position profile for the user.

14. The computer program product of claim 13, further comprising computer usable program code to, when executed by a processor, identify the user as a user authorized to access a computing device to which the pad is communicatively coupled using the hand position profile.

15. The computer program product of claim 14, further comprising computer usable program code to, when executed by a processor, restrict access to computing resources of the computing device if the hand position profile of the individual does not match an authorized hand position profile.

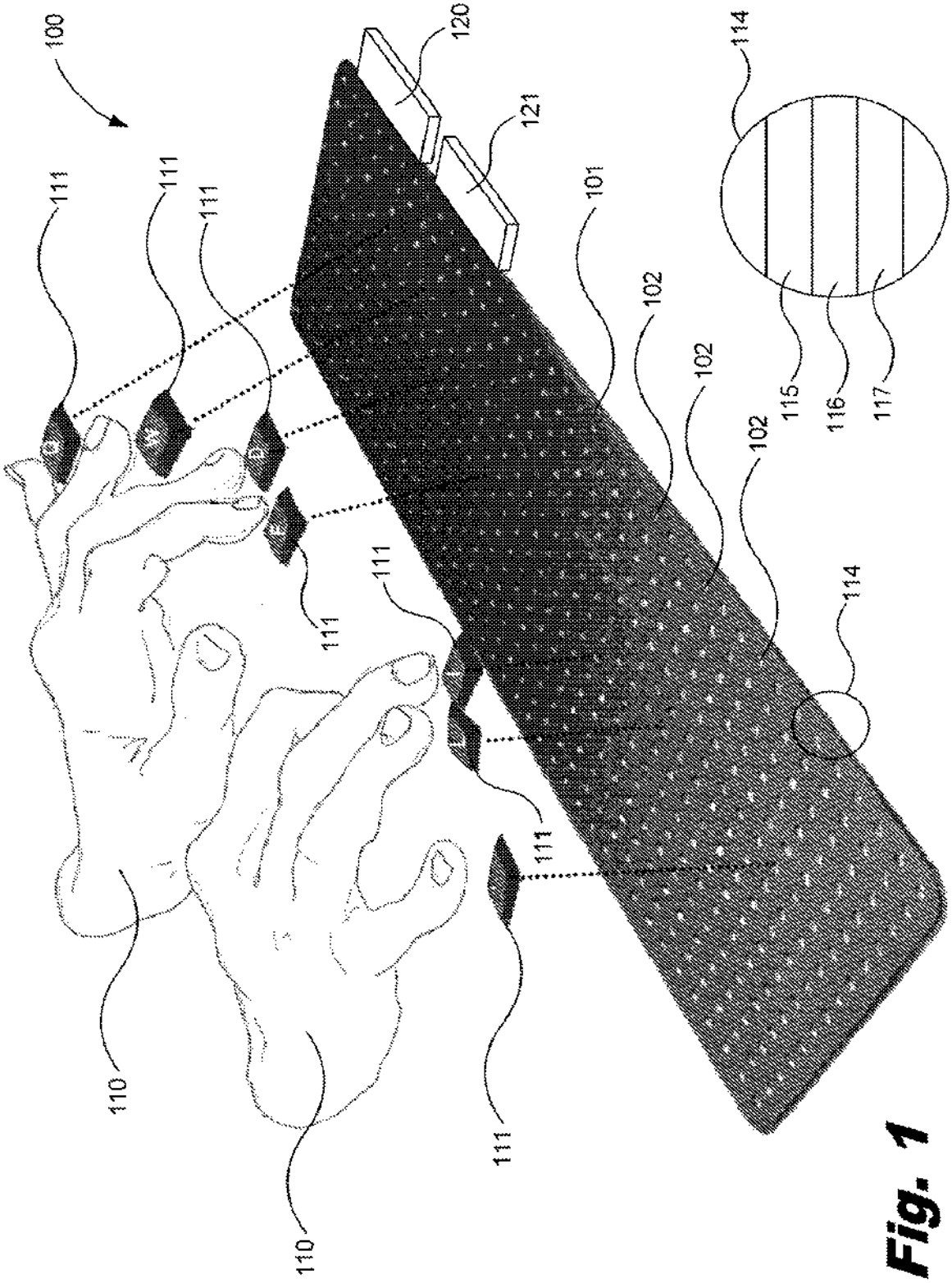
100
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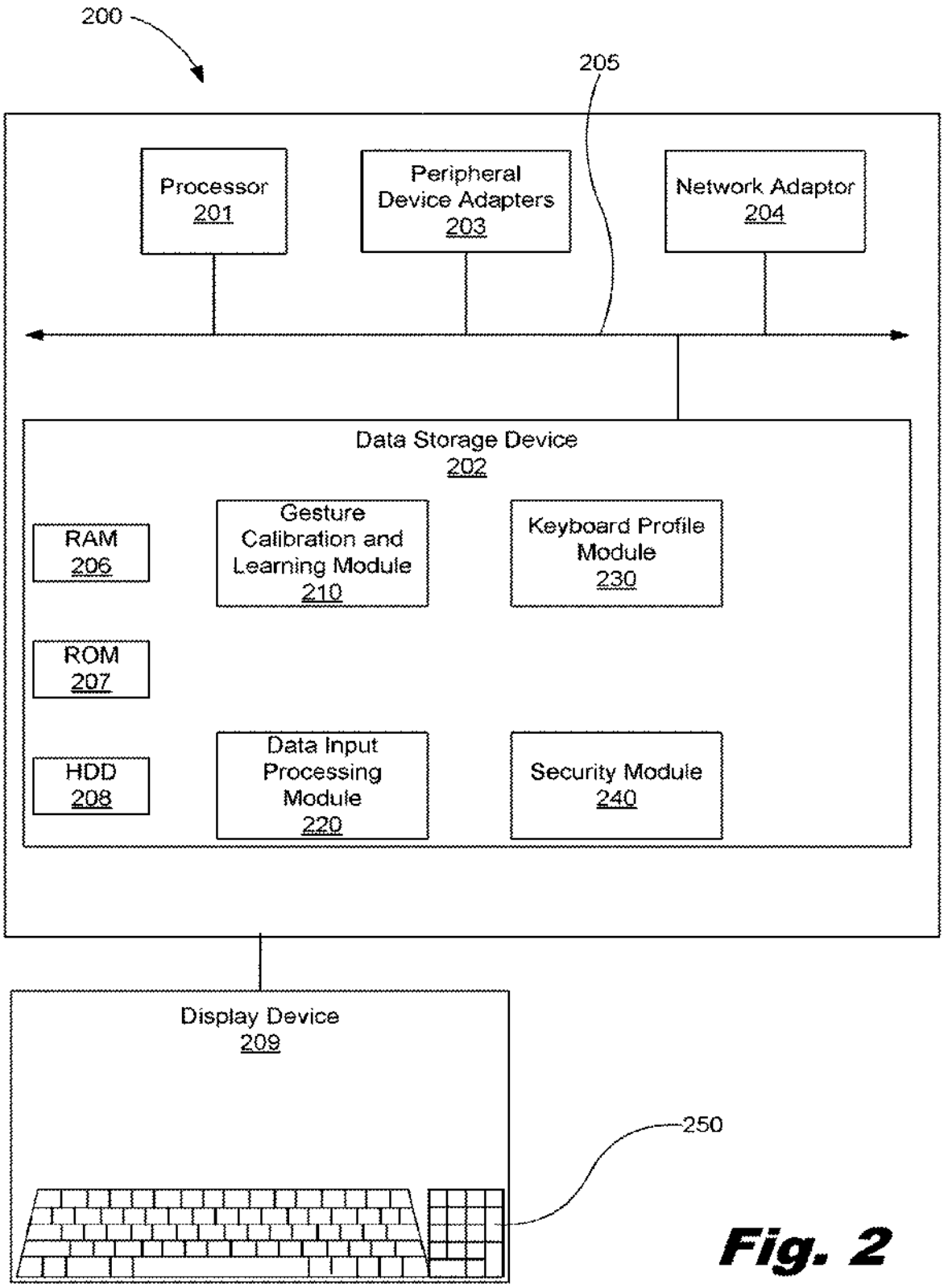
Fig. 1


200
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Processor
201
Peripheral
Device Adapters
203
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RAM
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Gesture
Calibration and
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210
Keyboard Profile
Module
230
ROM
207
HDD
208
Data Input
Processing
Module
220
Security Module
240
Display Device
209
250

Fig. 2

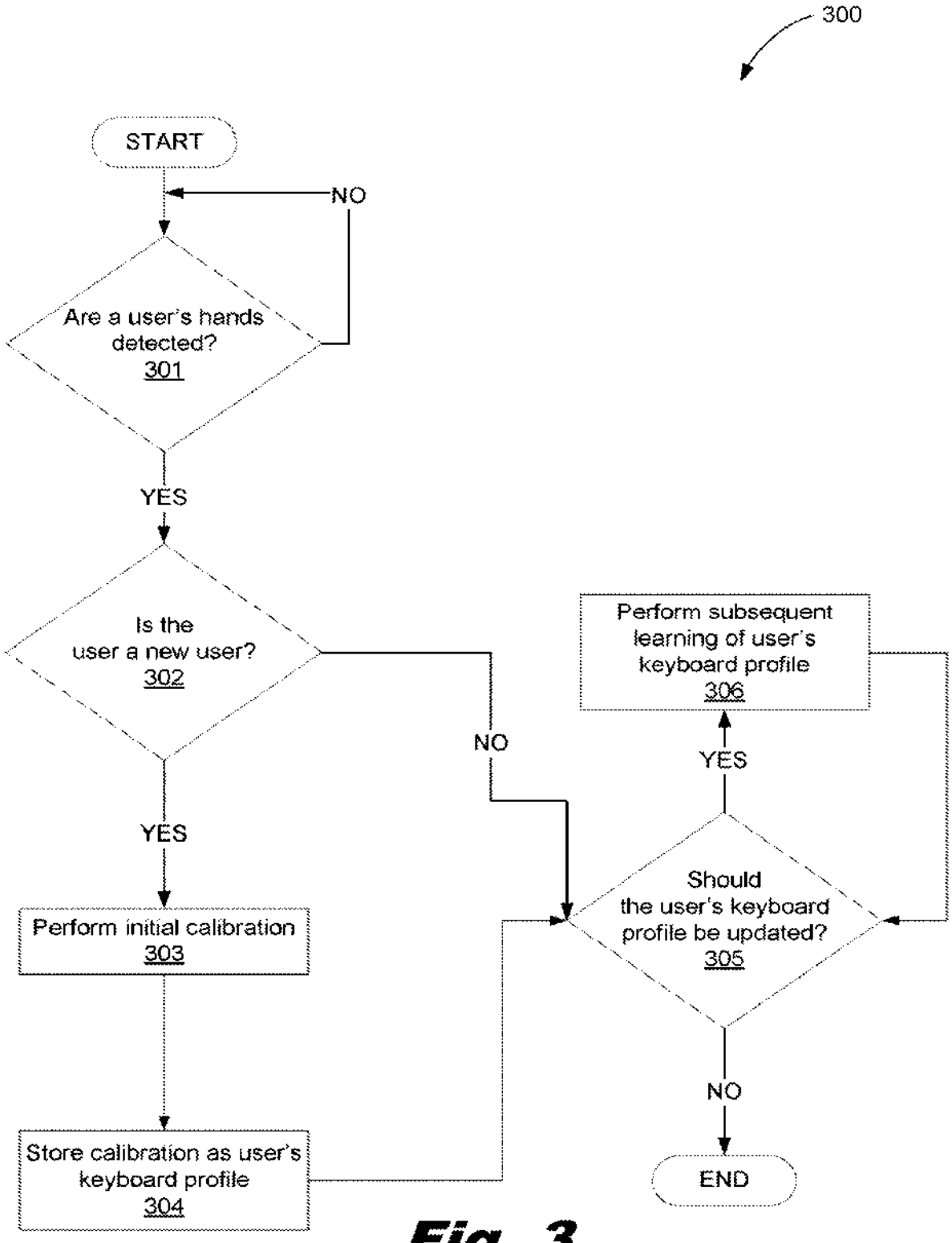
300
START
NO
Are a user's hands detected?
301
YES
Is the user a new user?
302
NO
YES
Perform initial calibration
303
Store calibration as user's keyboard profile
304
Perform subsequent learning of user's keyboard profile
306
YES
Should the user's keyboard profile be updated?
305
NO
END

Fig. 3

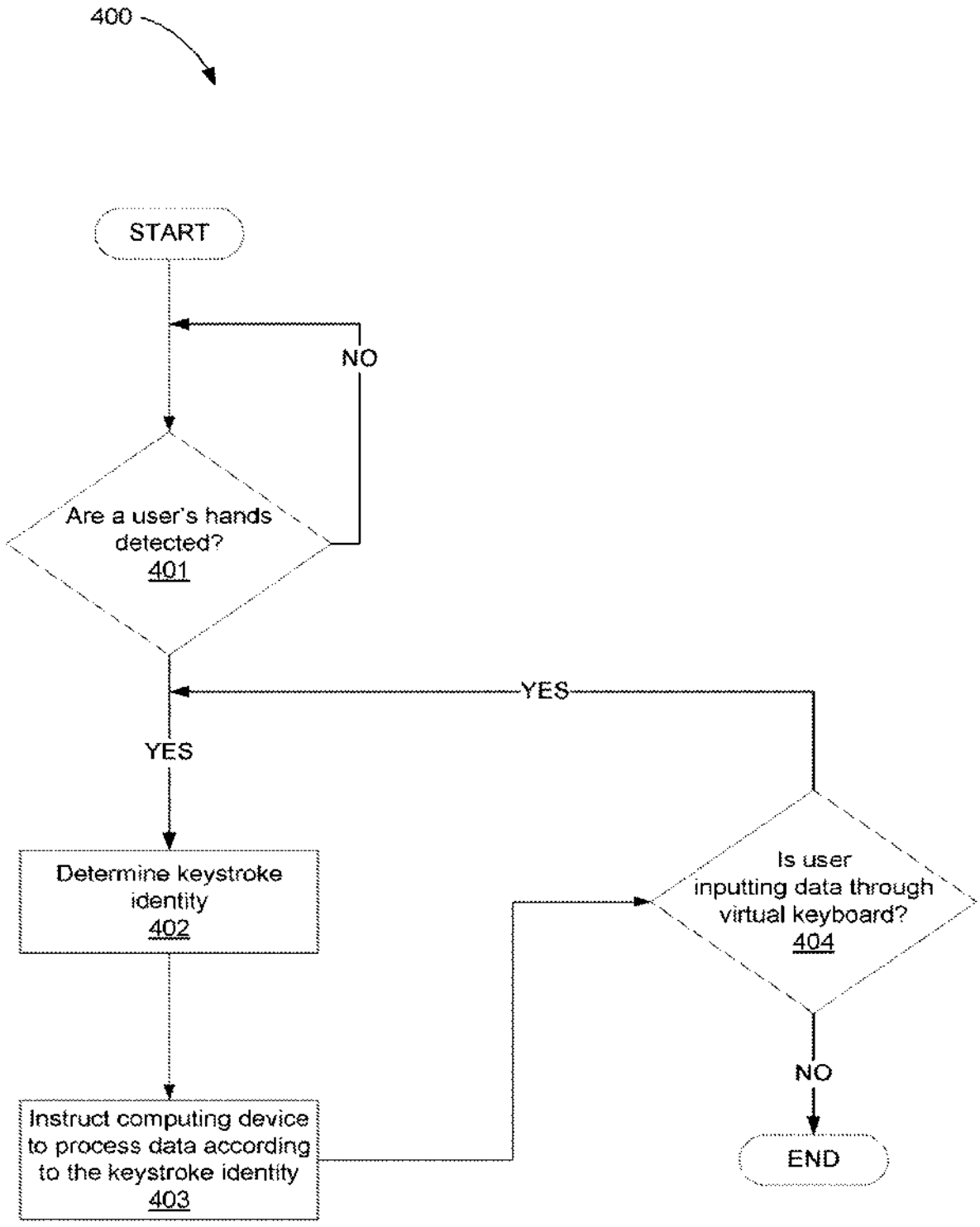
400
START
NO
Are a user's hands detected?
401
YES
YES
Determine keystroke identity
402
Instruct computing device to process data according to the keystroke identity
403
Is user inputting data through virtual keyboard?
404
NO
END

Fig. 4

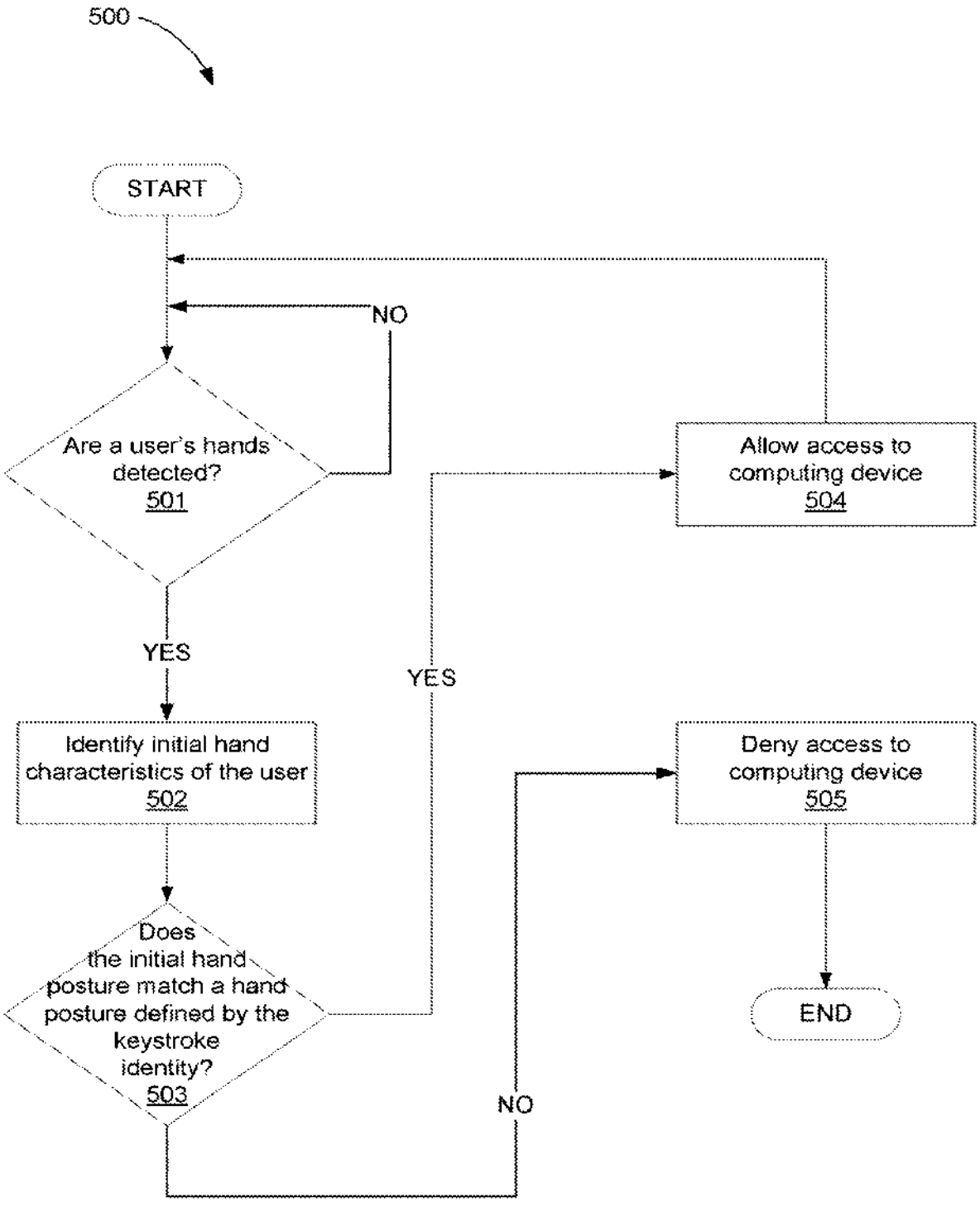
500
START
NO
Are a user's hands detected?
501
YES
Identify initial hand characteristics of the user
502
Does the initial hand posture match a hand posture defined by the keystroke identity?
503
YES
NO
Allow access to computing device
504
Deny access to computing device
505
END

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/046715

A. CLASSIFICATION OF SUBJECT MATTER

G06F 3/02(2006.01)i, G06F 3/048(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F 3/02; G06F 3/048; H04M 1/24; G06F 3/041; G09G 5/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: virtual keyboard, sensor, detect, hand, user, profile, and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012-0260207 A1 (ANTON TRESKUNOV et al.) 11 October 2012 See paragraphs 7, 27-52; claims 1, 16, 29; and figures 1-6B.	1-6,9-13
Y		7-8,14-15
Y	US 2013-0109369 A1 (BABAK FORUTANPOUR et al.) 02 May 2013 See paragraphs 73-74; and figure 7.	7-8,14-15
A	US 2013-0127729 A1 (TIMOTHY J. MOSBY et al.) 23 May 2013 See paragraphs 27-43; and figures 1-4.	1-15
A	US 2009-0303200 A1 (JOEL GRAD) 10 December 2009 See paragraphs 47-63; and figures 2-7.	1-15
A	US 2005-0225538 A1 (WILHELMUS VERHAEGH) 13 October 2005 See paragraphs 18-32; and figures 1-4.	1-15

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 February 2015 (25.02.2015)	**25 February 2015 (25.02.2015)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
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Telephone No. 82-42-481-8262

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2014/046715

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012-0260207 A1	11/10/2012	KR 10-2012-0114139 A	16/10/2012
US 2013-0109369 A1	02/05/2013	CN 103931163 A	16/07/2014
		EP 2772044 A1	03/09/2014
		JP 2014-532915 A	08/12/2014
		US 2014-235225 A1	21/08/2014
		US 8750852 B2	10/06/2014
		WO 2013-062771 A1	02/05/2013
US 2013-0127729 A1	23/05/2013	US 2009-237361 A1	24/09/2009
		US 8358277 B2	22/01/2013
		US 8619036 B2	31/12/2013
US 2009-0303200 A1	10/12/2009	CN 101634932 A	27/01/2010
		EP 2133778 A2	16/12/2009
		EP 2133778 A3	27/01/2010
		GB 0810613 D0	16/07/2008
		GB 2462579 A	17/02/2010
		US 8619034 B2	31/12/2013
US 2005-0225538 A1	13/10/2005	AT 538430 T	15/01/2012
		AU 2004-244973 A1	23/01/2004
		AU 2004-244973 A8	23/01/2004
		CN 00280700 C	18/10/2006
		CN 100666170 A	07/09/2005
		EP 1522007 A2	13/04/2005
		EP 1522007 B1	21/12/2011
		JP 04828826 B2	30/11/2011
		JP 2005-531861 A	20/10/2005
		US 8576173 B2	05/11/2013
		WO 2004-006080 A2	15/01/2004
		WO 2004-006080 A3	02/09/2004

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor: Jonathan O'TOOLE	Confirmation No.: 9955
Applicant: Chiaro Technology Limited	Art Unit: 3783
Application No.: 17/203,292	Examiner: FREDRICKSON, Courtney B.
Filed: March 16, 2021	Atty. Docket: 4944.012000E

Title: **BREAST PUMP SYSTEM**

Amendment and Reply Under 37 C.F.R. § 1.114

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Mail Stop RCE

Commissioner:

Filed concurrently herewith in the captioned application is a Request for Continued Examination (RCE). Prior to examination of the RCE on the merits, please amend the application as directed herein. In reply to the Office Action dated November 23, 2021, Applicant submits the following amendment and remarks.

If extensions of time are necessary to prevent abandonment of this application, then they are petitioned for under 37 C.F.R. § 1.136(a). Any additional fees required to continue prosecution or appeal of this application (including issue fee, fees for net addition of claims or forwarding to appeal) are hereby authorized to be charged to our Deposit Account No. 19-0036.

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Currently amended) A breast pump device ~~that is configured as a self-contained, in-bra wearable device, the breast pump device~~ comprising:

a self-contained, in-bra wearable device comprising:

a diaphragm configured to prevent milk from reaching the pump by forming a seal around its outer edge;

~~(i)~~ a housing that includes:

~~(a)~~ a battery, and

~~(b)~~ an air pump powered by the battery and configured to generate ~~generating~~ negative air pressure by driving the diaphragm;

~~(ii) a diaphragm configured to prevent milk from reaching the pump;~~

~~(iii)~~ a breast shield comprising ~~made up of~~ a breast flange and a nipple tunnel and that is separate from the diaphragm ~~configured to slide out from the housing together with the diaphragm~~; and

~~(iv)~~ a milk container that is configured to attach to the housing.

2. (Canceled)

3. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the breast shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel to provide a correct positioning of the breast shield onto a breast.

4. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the breast shield is a one piece item that, in use, presents a single continuous surface to a nipple and a breast.

5. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the breast shield integrates the breast flange and nipple tunnel as a one-piece item.

6. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the breast flange and the nipple tunnel are a single, integral item with no joining stubs.

7. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the breast shield is generally symmetrical about a centre-line running from a top to a bottom of the breast shield when positioned upright for normal use.

8. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the breast shield is configured to slide in and out from the housing, together with the diaphragm, on guide members in the breast shield.

9. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members.

10. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the breast pump device includes only the breast shield and the milk container that are directly removable from the housing in normal use or normal dis-assembly.

11. (Canceled)

12. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the diaphragm is substantially circular and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing.

13. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the diaphragm is a membrane ~~that is seated against a diaphragm holder~~, the diaphragm deforming in response to changes in air pressure caused by the air pump to create negative air pressure in the nipple tunnel.

14. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the diaphragm is removable from the[[a]] diaphragm holder that sits above the breast flange and the nipple tunnel.

15. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the milk container is substantially rigid.

16. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the milk container is configured to attach to a lower part of the housing and to form a flat bottomed base for the breast pump device.

17. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the milk container has a surface shaped to continue a curved shape of the housing, so that the breast pump device can be held comfortably inside the bra.

18. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the milk container includes a flexible valve that self-seals under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container.

19. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the milk container is attachable to the housing with a mechanical or magnetic mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to the housing with a single push action.

20. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the milk container includes a cap that is removable from the milk container and a removable valve that enables milk to pass into the milk container in one direction.

21. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ a top of the milk container includes an optically clear region that is aligned below one or more light emitters positioned in a base of the housing.

22. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the milk container is wider than the milk container is tall.

23. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the nipple tunnel includes on a lower surface an opening through which expressed milk flows under gravity into the milk container.

24. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the housing includes a wireless data communications system powered by the ~~rechargeable~~ battery.

25. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra, and a rear surface that is shaped to contact, at least in part, the breast shield.

26. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the housing includes at least one of a visual or haptic indicator that indicates whether milk is flowing or not flowing into the milk container.

27. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the housing includes at least one of a visual or haptic indicator that indicates if the pump is operating correctly to pump milk, based on whether a quantity or a height of liquid in the milk container above a base of the milk container is increasing above a threshold rate of increase.

28. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the air pump comprises a piezo air pump system.

29. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which the air pump delivers in excess of 400 mBar (40 kPa) stall pressure and 1.5 litres per minute free air flow and is a lightweight air pump that enables~~ a total mass of the breast pump device, unfilled with milk, is ~~to be~~ less than 250 gm.

30. (Currently amended) The breast pump device of claim ~~Claim~~ 1, wherein ~~in which~~ the breast pump device makes less than 30 dB noise at maximum power and less than 25 dB at normal power, against a 20 dB ambient noise.

31. (Currently amended) A breast pump device ~~that is configured as a self-contained, in-bra wearable device, the breast pump device~~ comprising:

a self-contained, in-bra wearable device comprising:

a diaphragm configured to prevent milk from reaching the pump;

~~(i)~~ a housing that includes:

~~(a)~~ a rechargeable battery, and

~~(b) an air~~ a pump powered by the rechargeable battery and configured to generate ~~generating~~ negative air pressure;

~~(ii)~~ a breast shield comprising ~~made up of~~ a breast flange and a nipple tunnel, the breast shield being separate from the diaphragm and configured to enclose the diaphragm with the housing ~~and that is configured to slide out from the housing on linear guide members~~; and

~~(iii)~~ a milk container that is configured to attach to the housing.

32. (Currently amended) The breast pump device of claim 31, wherein the[[air]] pump is configured to generate negative air pressure with a maximum suction of approximately 240 mmHg.

Remarks

Upon entry of the foregoing amendment, claims 1, 3–10, and 12–32 are pending in the application. Claims 1 and 31 are independent claims. Claims 1, 3–10, and 12–32 are amended. Claims 2 and 11 are canceled. These changes do not introduce any new matter, and Applicant respectfully requests their entry.

Based on the above amendment and the following remarks, Applicant respectfully requests that the Office reconsider and withdraw all outstanding objections and rejections.

Allowable Subject Matter

The Office objects to claim 29 as being dependent upon a rejected base claim. (Office Action dated November 23, 2021, p. 21.) Applicant appreciates the Office's indication that claim 29 would be allowable if rewritten in independent form and that claims 7, 12, and 15–22 would be allowable excepting the double patenting rejections of the same. (*Id.*, 20–21.) For at least the reasons discussed below, all pending claims are allowable over the cited art.

Rejections under 35 U.S.C. § 112

The Office rejects claim 24 under 35 U.S.C. § 112(b) or 35 U.S.C. § 112 (pre-AIA), second paragraph, as allegedly indefinite. (*Id.*, 3.) Specifically the Office alleges that claim 24 reciting "the rechargeable battery" is indefinite. Without acquiescing to the propriety of the rejection and in an effort to expedite prosecution, Applicant amends claim 24 to recite "the battery," as recommended. (*Id.*) Accordingly, claim 24 is not indefinite.

Applicant asks the Office to withdraw the rejection under § 112 of claim 24.

Rejections under 35 U.S.C. § 102

The Office rejects claims 1, 3–6, 8, 9, 13, 14, 23, 25, 31, and 32 under 35 U.S.C. § 102(a)(1) as allegedly anticipated by U.S. Publication No. 2008/0275386 to Myers. (*Id.*, 4.) Without acquiescing to the propriety of the rejection and in an effort to expedite prosecution, Applicant amends claims 1 and 31. For at least the reasons discussed below, Myers does not disclose or suggest the features of claims 1 or 31 as arranged according to the claims, and does not anticipate claims 1 or 31, or their dependents.

Independent Claim 1

Claim 1 recites, in part, "a breast shield made up of a breast flange and a nipple tunnel and that is separate from the diaphragm." The Office relies on Myers's flange top 36 as the claimed diaphragm. (*Id.* (citing Myers, FIGS. 9A–B, ref. 36).) However, Myers's flange top 36 is specifically "at the end of a nipple tunnel 46." (Myers, ¶[0056].) Thus, Myers's flange top 36 is *integral* with its breast cup 18 and nipple tunnel 46 such that it does not disclose or suggest the claimed diaphragm. Indeed, as shown below in Myers's FIG. 9A, Myers's flange top 36 is part of Myers's breast cup 18 and nipple tunnel 46 rather than being "separate," as claimed. (Myers, FIG. 9A.)

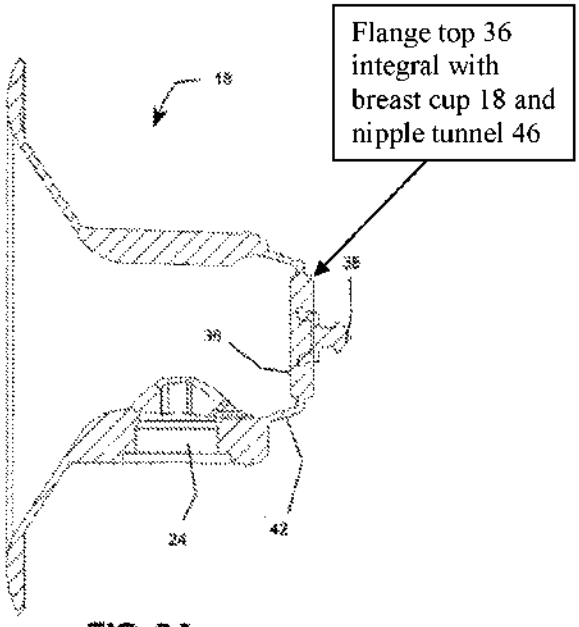

FIG. 9A

Accordingly, Myers fails to disclose or suggest this claimed feature.

Claim 1 also recites, in part, "an air pump powered by the battery and configured to generate negative air pressure by driving the diaphragm." The Office relies on Myers's pump mechanism 50 as allegedly disclosing the claimed air pump. (Office Action dated November 23, 2021, p. 4 (citing Myers FIG. 10, ref. 50).) However, Myers's pump mechanism 50 does not meet the claimed features.

Myers's pump mechanism 50, shown in Myers's FIG. 10, reproduced below, is not an "air pump." (Myers, FIG. 10.)

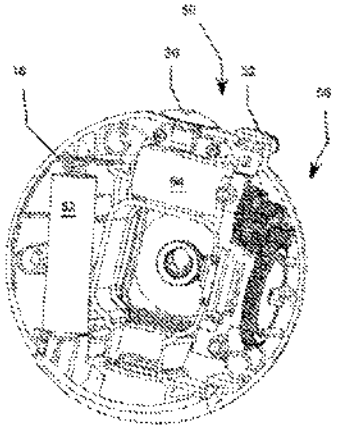

FIG. 10

Indeed, Myers discloses that its pump mechanism 50 "includes a motor 54 and a drive train 56." (*Id.*, ¶[0060].) As shown in Myers' FIGS. 5 and 12, reproduced and annotated below, motor 54 drives a pinion gear, and drive train 56 "translates the rotary motion of the motor 54 to reciprocating linear motion of the actuator arm 34." (*Id.*, ¶[0060], FIGS. 5, 12.) Actuator arm 34, in turn, "pulls the flange top 36 back into its outward position, which causes the bellows structure [42] to increase the volume of the vacuum chamber and thereby create negative pressure or suction within the

vacuum chamber." (*Id.*, ¶[0056], FIGS. 5, 12.) Motion of flange top 36 is translated to bellows structure 42, as flange top 36 is connected to bellows structure 42. (*Id.*; *see also id.*, FIG. 9A.)

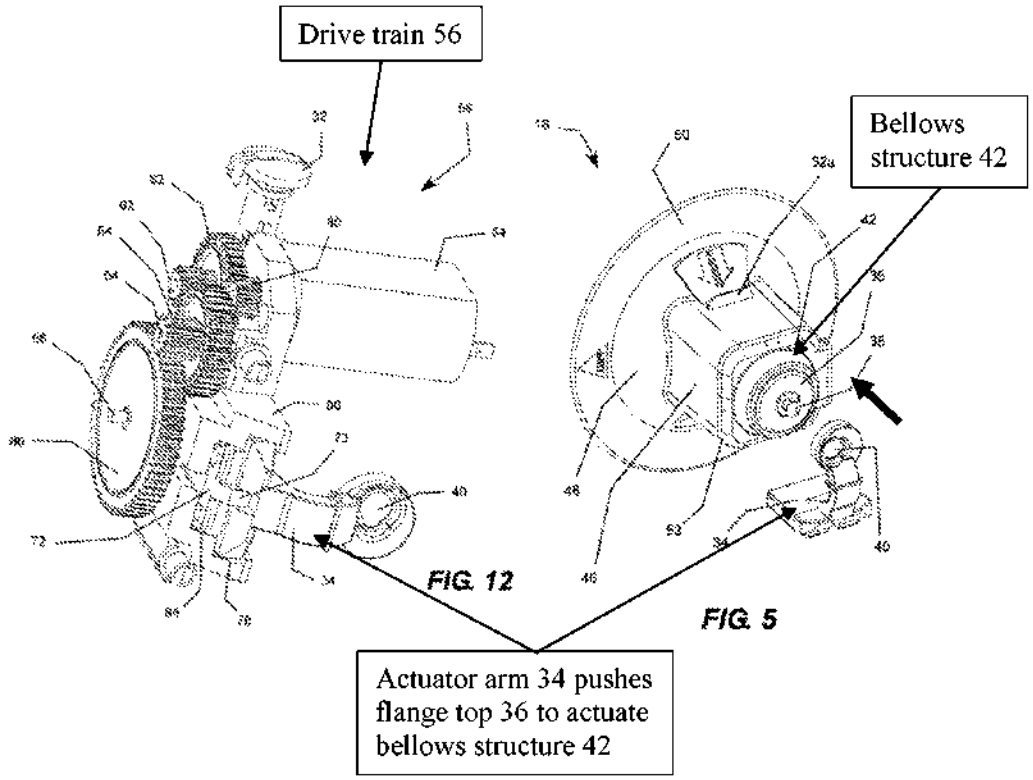

FIG. 12 FIG. 5

However, a pump mechanism that utilizes a bellows structure driven by an actuator arm to generate negative pressure does not disclose or suggest the claimed *air* pump, which is fed by air.

For at least these reasons, Myers fails to disclose or suggest the features of claim 1, and does not anticipate claim 1. Applicant asks the Office to withdraw the § 102 rejection of claim 1.

Independent Claim 31

Claim 31 recites, in part, "a pump powered by the rechargeable battery and configured to generate generating negative air pressure." The Office relies on Myers's pump mechanism 50 as allegedly disclosing the claimed air pump. (Office Action dated November 23, 2021, p. 7 (citing Myers FIG. 10, ref. 50).) Myers discloses that its pump mechanism 50 is "powered by a power source 52," which, in the FIG. 10 embodiment, is "a single AA battery." (Myers, ¶[0060].) But Myers does not disclose that its AA battery is a rechargeable battery, as claimed.

Accordingly, Myers fails to disclose or suggest this claimed feature.

Independent claim 31 also recites, in part, "a diaphragm configured to prevent milk from reaching the pump … a breast shield comprising a breast flange and a nipple tunnel, the breast shield being separate from the diaphragm and configured to enclose the diaphragm with the housing." The Office relies on Myers's breast shield 18 as the claimed breast shield. (*Id.* (citing Myers, FIG. 2, ref. 18).)

However, Myers's breast shield 18 is not separate from any diaphragm, as discussed above for claim 1. Moreover, Myers's breast shield 18 is not configured to enclose any diaphragm of Myers. Indeed, Myers's diaphragm relied on for claim 1, flange top 36, is specifically "at the end of a nipple tunnel 46." (*Id.* (citing Myers, FIGS. 9A–B, ref. 36); Myers, ¶[0056].) As Myers's flange top 36 is at the end of its nipple tunnel 46, nothing is enclosing Myers's flange top 36 from the breast shield 18 end. (*See* Myers, FIGS. 9A–B.) In contrast, the claimed breast shield comprising a nipple tunnel is separate from and "enclose[s] the diaphragm with the housing." Myers does not disclose or suggest this configuration.

Accordingly, Myers fails to disclose or suggest these claimed features.

For at least these reasons, Myers fails to disclose or suggest the features of claim 31 as arranged according to the claim, and does not anticipate claim 31. Applicant asks the Office to withdraw the § 102 rejection of claim 31.

Dependent Claims

Claims 3–6, 8, 9, 13, 14, 23, and 25 depend from and add features to claim 1. Accordingly claims 3–6, 8, 9, 13, 14, 23, and 25 are allowable for the same reasons as claim 1. Applicant asks the Office to withdraw the § 102 rejection of claims 3–6, 8, 9, 13, 14, 23, and 25.

Claim 32 depends from and adds features to claim 31. Accordingly, claim 32 is allowable for the same reasons as claim 31. Applicant asks the Office to withdraw the § 102 rejection of claim 32.

Rejections under 35 U.S.C. § 103

The Office rejects claim 10 under 35 U.S.C. § 103 as allegedly obvious over Myers, as applied to claim 1 above, and further in view of U.S. Publication No. 2016/0325031 to Miller *et al.* (Office Action dated November 23, 2021, p. 8.) Claim 10 depends from and adds

features to independent claim 1. Miller does not overcome the deficiencies discussed above. Accordingly, claim 10 is allowable for at least the reasons that independent claim 1 is allowable. Applicant asks the Office to withdraw the § 103 rejection of claim 10.

The Office rejects claim 24 rejected under 35 U.S.C. § 103 as allegedly obvious over Myers, as applied to claim 1 above, and further in view of U.S. Publication No. 2017/0072118 to Makower *et al.* ("Makower '118"). (*Id.*, 9.) Claim 24 depends from and adds features to independent claim 1. Makower '118 does not overcome the deficiencies discussed above. Accordingly, claim 24 is allowable for at least the reasons that independent claim 1 is allowable. Applicant asks the Office to withdraw the § 103 rejection of claim 24.

The Office rejects claims 26–27 under 35 U.S.C. § 103 as allegedly obvious over Myers, as applied to claim 1 above, and further in view of U.S. Publication No. 2016/0206794 to Makower *et al.* ("Makower '794"). (*Id.*, 10.) Claims 26–27 depend from and add features to independent claim 1. Makower '794 does not overcome the deficiencies discussed above. Accordingly, claims 26–27 are allowable for at least the reasons that independent claim 1 is allowable. Applicant asks the Office to withdraw the § 103 rejection of claims 26–27.

The Office rejects claim 28 under 35 U.S.C. § 103 as allegedly obvious over Myers, as applied to claim 1 above, and further in view of U.S. Publication No. 2017/0043065 to Takeuchi. (*Id.*, 11.) Claim 28 depends from and adds features to independent claim 1. Takeuchi does not overcome the deficiencies discussed above. Accordingly, claim 28 is allowable for at least the reasons that independent claim 1 is allowable. Applicant asks the Office to withdraw the § 103 rejection of claim 28.

The Office rejects claim 30 under 35 U.S.C. § 103 as allegedly obvious over Myers, as applied to claim 1 above, in further view of U.S. Publication No. 2009/0281485 to Baker *et al.* (*Id.*, 12.) Claim 30 depends from and adds features to independent claim 1. Baker does not overcome the deficiencies discussed above. Accordingly, claim 30 is allowable for at least the reasons that independent claim 1 is allowable. Applicant asks the Office to withdraw the § 103 rejection of claim 30.

Double Patenting Rejection

The Office provisionally rejects claims 1, 3–10, 12–28, and 30 on the ground of nonstatutory double patenting as allegedly obvious over co-pending applications. (*Id.*, 14.) Specifically, the

Office rejects claims 1, 3–10, 12–28, and 30 over claim 11 of co-pending U.S. Application No. 17/181,057, claim 12 of co-pending U.S. Application No. 17/203,050, claim 20 of co-pending Application No. 17/203,313, claim 8 of co-pending Application No. 17/203,327, claim 8 of co-pending Application No. 17/203,355, claim 8 of co-pending Application No. 17/203,150, claim 23 of co-pending Application No. 17/203,109, claim 16 of co-pending Application No. 17/203,179, claim 8 of co-pending Application No. 17/203,397, and claim 8 of co-pending Application No. 17/203,418. (*Id.*)

Application No. 17/203,109 issued rendering the rejection with respect to this application moot. Additionally, Applicant respectfully requests that the remaining currently asserted provisional double patenting rejections be held in abeyance until the claimed subject matter is otherwise deemed allowable. After analyzing the final allowed claim scope, Applicant will consider filing a terminal disclaimer if necessary to overcome any obviousness-type double patenting rejections.

Conclusion

All grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Office reconsider and withdraw them. A complete reply has been made to the outstanding Office Action. As such, the present application is in condition for allowance. If the Office believes, for any reason, that personal communication will expedite prosecution of this application, the Office is asked to telephone the undersigned at the number provided. Applicant respectfully requests prompt and favorable consideration of this amendment and reply.

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

/Anupma Sahay #78,704/

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Date: May 20, 2022

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17987010.1

Atty. Dkt. No. 4944.012000E

Electronic Patent Application Fee Transmittal					
Application Number:	17203292				
Filing Date:	16-Mar-2021				
Title of Invention:	BREAST PUMP SYSTEM				
First Named Inventor/Applicant Name:	Jonathan O'TOOLE				
Filer:	Anupma Sahay/Tierra Brown				
Attorney Docket Number:	ELVI-002/14US				
Filed as Small Entity					
Filing Fees for **Utility under 35 USC 111(a)**					
Description		**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:					
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					
Extension-of-Time:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 3 months with $0 paid	2253	1	740	740
Miscellaneous:				
RCE- 1ST REQUEST	2801	1	680	680
		Total in USD ($)		**1420**

Electronic Acknowledgement Receipt	
EFS ID:	45768219
Application Number:	17203292
International Application Number:	
Confirmation Number:	9955
Title of Invention:	BREAST PUMP SYSTEM
First Named Inventor/Applicant Name:	Jonathan O'TOOLE
Customer Number:	26111
Filer:	Anupma Sahay/Tierra Brown
Filer Authorized By:	Anupma Sahay
Attorney Docket Number:	ELVI-002/14US
Receipt Date:	20-MAY-2022
Filing Date:	16-MAR-2021
Time Stamp:	17:10:50
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1420
RAM confirmation Number	E20225JH11092063
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	2022-05-20-Transmittal-Form-4944-012000E.PDF	391303 8a5efce5c82aaad59963c097972a2873ac0d4189	no	1
Warnings:					
Information:					
2	Extension of Time	2022-05-20-EOT-4944-012000E.PDF	173538 fc82235b99df080b5a57a380e5c2ad0078266c755	no	1
Warnings:					
Information:					
3	Request for Continued Examination (RCE)	2022-05-20-RCE-4944-012000E.PDF	1349979 94f6ea03df8a58b75a504c2bc4c2d6e6410a9209a	no	3
Warnings:					
Information:					
4	Application Data Sheet	2022-05-20-Marked-Up-ADS-4944-012000E.PDF	114469 cada894658d3c5660bc34b9affc76f998c90aa04	no	2
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
5	Information Disclosure Statement (IDS) Form (SB08)	2022-05-20-IDS-SB08-4944-012000E.PDF	122486 0f170dbda6647da2695948cacc05368bef2bbfe5	no	4
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
6	Foreign Reference	FP1_WO2005114113A2.PDF	1128129 fc36f8c91e8e19de4c555de16f02f5f256bb385b4	no	33

Warnings:					
Information:					
7	Foreign Reference	FP2_WO2005079441A2.PDF	3510260 1cbab15142798f79b8becb4bc58d11f2ad8587b6	no	69
Warnings:					
Information:					
8	Foreign Reference	FP3_WO2016010524A1.PDF	2679431 2cc0f68f12b62c66f40c29d3a44a697615b59710	no	34
Warnings:					
Information:					
9	Non Patent Literature	NPL1_4MD_MEDICAL_3_2016_EFS.PDF	435766 40a5e5c20aba669620948e4f8130a31cbc0611dd	no	3
Warnings:					
Information:					
10	Non Patent Literature	NPL2_BestHandsFreeBreastPumps_11_2020_EFS.PDF	858447 1f513f3e5a82aeacd71f1eee85427355bb3d864c	no	11
Warnings:					
Information:					
11		2022-05-20-Amendment-Reply-114-4944-012000E.PDF	374805 7987d689de943d1da769fe60a81bfbe834e2f707	yes	13

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Request for Continued Examination (RCE)	1	1
	Claims	2	6
	Applicant Arguments/Remarks Made in an Amendment	7	13

Warnings:					
Information:					

12	Fee Worksheet (SB06)	fee-info.pdf	40385 ebc159d5aadbb4d65077eb2131127b69bb2c1b393	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	11178998	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: TRAN.LET
Document Description: Transmittal Letter

PTO/SB/21 (07-09)
Approved for use through 11/30/2020. OMB 0651-0031
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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission

Application Number	17/203,292
Filing Date	03/16/2021
First Named Inventor	Jonathan O'TOOLE
Art Unit	3783
Examiner Name	FREDRICKSON, Courtney B.
Attorney Docket Number	4944.012000E

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
- ☑ Fee Attached
- ☑ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☑ Extension of Time Request
- ☐ Express Abandonment Request
- ☑ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
  - ☐ Landscape Table on CD
- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☑ Other Enclosure(s) (please identify below):

FP1-FP3; NPL1-NPL2; Request for Continued Examination Transmittal (PTO/SB/30EFS); Marked Up Application Data Sheet

Remarks

Online Credit Card Authorization for $1,420.00 to cover:

$680.00 - Request for Continued Examination Fee (1st request);
$740.00 - 3 Month Extension of Time Fee.

The Office may charge any fee deficiency for any submission made with this transmittal to Deposit Account 19-0036.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Sterne, Kessler, Goldstein & Fox P.L.L.C.		
Signature	/Anupma Sahay #78,704/		
Printed name	Anupma Sahay		
Date	May 20, 2022	Reg. No.	78,704

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature			
Typed or printed name		Date	

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and1.14. This collection is estimated to 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PTO/AIA/22 (10-20)
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 4944.012000E
Application Number 17/203,292	Filed March 16, 2021
For BREAST PUMP SYSTEM	
Art Unit 3783	Examiner FREDRICKSON, Courtney B.

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	Fee	Small Entity Fee	Micro Entity Fee	
☐ One month (37 CFR 1.17(a)(1))	$220	$110	$55	$
☐ Two months (37 CFR 1.17(a)(2))	$640	$320	$160	$
☑ Three months (37 CFR 1.17(a)(3))	$1,480	$740	$370	$ 740.00
☐ Four months (37 CFR 1.17(a)(4))	$2,320	$1,160	$580	$
☐ Five months (37 CFR 1.17(a)(5))	$3,160	$1,580	$790	$

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 19-0036.

☑ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant.

☑ attorney or agent of record. Registration number 78,704.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/Anupma Sahay #78,704/	May 20, 2022
Signature	Date
Anupma Sahay	(202) 371-2600
Typed or printed name	Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☑ * Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

PTO/SB/06 (09-11)
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U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/203,292	Filing Date 03/16/2021	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $240 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	05/20/2022	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 30	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $240 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/ANGELONA D JONES/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/203,292	03/16/2021	Jonathan O'TOOLE	4944.012000E	9955

26111 7590 07/12/2022
STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.
1100 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005

EXAMINER	
FREDRICKSON, COURTNEY B	

ART UNIT	PAPER NUMBER
3783	

NOTIFICATION DATE	DELIVERY MODE
07/12/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

e-office@sternekessler.com

Office Action Summary	Application No. 17/203,292	Applicant(s) O'TOOLE et al.	
	Examiner COURTNEY FREDRICKSON	Art Unit 3783	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 20May2022.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1,3-10 and 12-32 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1,3-10 and 12-32 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 16March2021 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☑ All b)☐ Some** c)☐ None of the:

1.☑ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on May 20, 2022 has been entered.

Information Disclosure Statement

The information disclosure statement (IDS) submitted is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Response to Amendment

This office action is responsive to the amendment filed on May 20, 2022. As directed by the amendment: claims 1, 3-10, and 12-32 have been amended and claims 2 and 11 have been cancelled. Thus, claims 1, 3-10, and 12-32 are presently pending in this application.

Applicant's amendments to the Specification, Drawings, and Claims have overcome each and every 112(b) rejections previously set forth in the Final Office Action mailed November 23, 2021.

Response to Arguments

Applicant's arguments, see pg. 8, filed May 20, 2022, with respect to the rejection(s) of claim(s) 1 under 35 U.S.C 103 have been fully considered and are persuasive, specifically in regards to Myers not teaching or disclosing a breast shield which is separate from the diaphragm, as required by the amended claim. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Applicant's amendments.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 14 is rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

Claim 14 recites the limitation "the diaphragm holder" in line 2. There is insufficient antecedent basis for this limitation in the claim. it is unclear if the claim should be amended to recite "a diaphragm holder" or if the claim intends to be dependent on claim 12. For examination purposes, the first interpretation was used.

Claim Rejections - 35 USC § 103

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claim(s) 1, 3-7, 9, 12-14, 17-20, 22-25, and 31 is/are rejected under 35 U.S.C. 103 as being unpatentable over Khalil (US 20130023821) in view of Chang (US 20180333523).

Regarding claims 1 and 31, Khalil discloses a breast pump device comprising:

a self-contained, in-bra wearable device (the device of fig. 9 is shown to be a self- contained device which is capable of being worn in a bra; paragraph 32) comprising:

a diaphragm configured to prevent milk from reaching the pump by forming a seal around its outer edge (membrane 3 in fig. 11; paragraph 57 discloses the diaphragm is sealed through outer and inner securing beads 30/31 to prevent milk from accessing the pump);

a housing (shell ring and cover 6' and 6" in fig. 9 form a housing) that includes:

a power source (paragraph 51 discloses a power source can be integrated into the housing), and

an air pump powered by a power source and configured to generate negative air pressure by driving the diaphragm (vacuum pump 81 in fig. 11; paragraph 32 discloses that the power supply is integrated into the housing or is connected to the vacuum pump and it is understood that this power supply would power the pump);

a breast shield (breast interface 1 in fig. 11) comprising a breast flange (base part 12 in fig. 7) and a nipple tunnel (stub 10 in fig. 4) and that is separate from the diaphragm (fig. 11 shows that the breast shield and the diaphragm are separate components) and configured to enclose the diaphragm with the housing (figs. 4/5 and 10 shows the diaphragm positioned within the housing and enclosed by the shield and the walls of the housing) [**claim 31**]; and

a milk container that is configured to attach to the housing (milk collection container 7' in fig. 9).

However, Khalil does not teach the power source being a rechargeable battery.

Chang teaches a substantially similar self-contained breast pump system (breast pump system 10 in fig. 1A) having a rechargeable battery (battery 48 in fig. 6A; paragraph 72 discloses that the battery provides a rechargeable power source), and a pump (drivers 44 and 46 in fig. 6A). Chang further teaches that the rechargeable battery powers the pump (paragraph 80 discloses the battery powers the system; paragraph 95 discloses that the battery is electrically connected to the drivers). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the power source to be a rechargeable battery, as taught by Chang, in order for the power source to be reused.

Regarding claim 3, in the modified system of Khalil, Khalil discloses the breast shield is configured to rotate smoothly around a nipple inserted into the nipple tunnel (the shield of Khalil is functionally capable of being rotated smoothly around a nipple since the claim does not require that the shield be fully latched onto the nipple for this rotation to occur).

Regarding claim 4, in the modified system of Khalil, Khalil discloses the breast shield is a one piece item that in use is configured to present a single continuous surface to the nipple and breast (fig. 11 shows the breast shield 1 as a one piece item).

Regarding claim 5, in the modified system of Khalil, Khalil discloses the breast shield integrates the breast flange and nipple tunnel as a one-piece item (fig. 11 shows the breast shield 1 as a one piece item).

Regarding claim 6, in the modified system of Khalil, Khalil discloses the breast flange and the nipple tunnel are a single, integral item with no joining stubs (paragraph 60 discloses that the breast shield comprises the base part and stub integrally formed;

figs. 4 and 6 show that the shield comprises the breast flange 12 and the nipple tunnel 10 and no other stubs are a part of the breast shield).

Regarding claim 7, in the modified system of Khalil, Khalil discloses the breast shield is generally symmetrical about a center-line running from the top to the bottom of the breast shield when positioned upright for normal use (figs. 4 and 11 shows the shield being symmetrical).

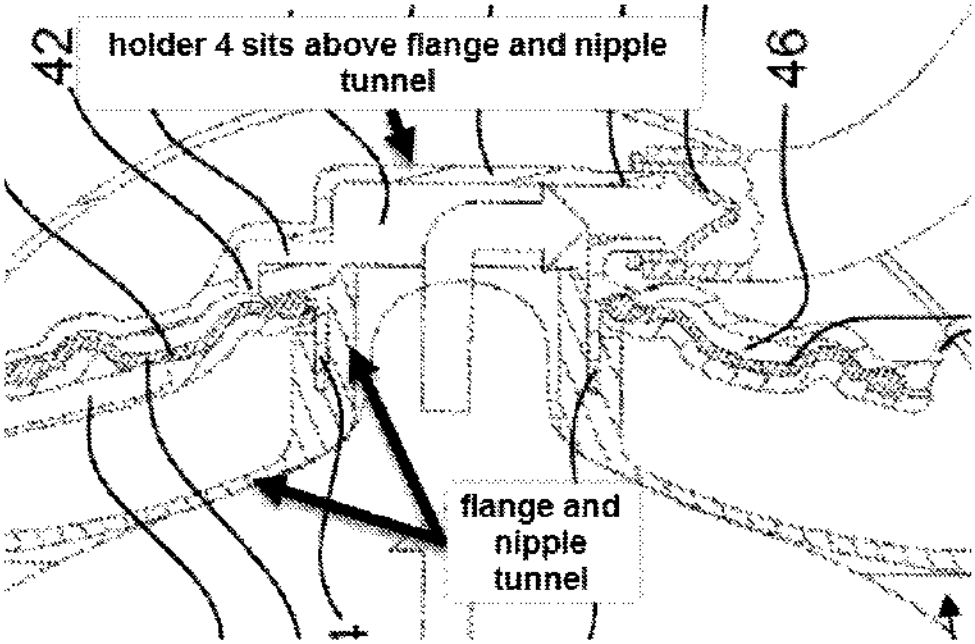
Regarding claim 9, in the modified system of Khalil, Khalil discloses the housing is configured to slide onto the breast shield, when the breast shield has been placed onto a breast, using guide members (stub 44 and groove 100 of the diaphragm holder and breast shield, respectively, help guide the shield into place relative to the housing).

Regarding claim 12, in the modified system of Khalil, Khalil discloses the diaphragm is substantially circular (fig. 11 shows the diaphragm 3 as circular) and is configured to self-seal under the negative air pressure to a substantially circular diaphragm holder that is part of the housing (figs 4/5 shows the diaphragm sealing against diaphragm holders 2 and 4).

Regarding claim 13, in the modified system of Khalil, Khalil discloses the diaphragm is a membrane (element 3 is disclosed as a membrane in paragraph 53), the diaphragm deforming in response to changes in air pressure caused by the air pump to create negative air pressure in the nipple tunnel (figs. 4 and 5 shows the diaphragm deforming).

Regarding claim 14, in the modified system of Khalil, Khalil discloses the diaphragm is configured to be removable from a diaphragm holder (membrane housing part 4 in fig. 11; paragraph 21 discloses that the diaphragm is cleanable indicating that it

must be removable from the holder 4) that sits above the breast flange and the nipple tunnel portion (fig. 4, see below).



Regarding claim 17, in the modified system of Khalil, Khalil discloses the milk container has a surface shaped to continue a curved shape of the housing (fig. 9), so that the breast pump device can be held comfortably inside the bra (paragraph 70).

Regarding claim 18, in the modified system of Khalil, Khalil discloses the milk container comprises a flexible valve that self-seal under negative air pressure against a milk opening in the nipple tunnel and that permits milk to flow into the milk container (non-return valve 5 in figs. 4 and 5; paragraph 69 discloses that the valve is incorporated into the milk collection container 7'; fig. 4 and 5 show the valve flexing when opening).

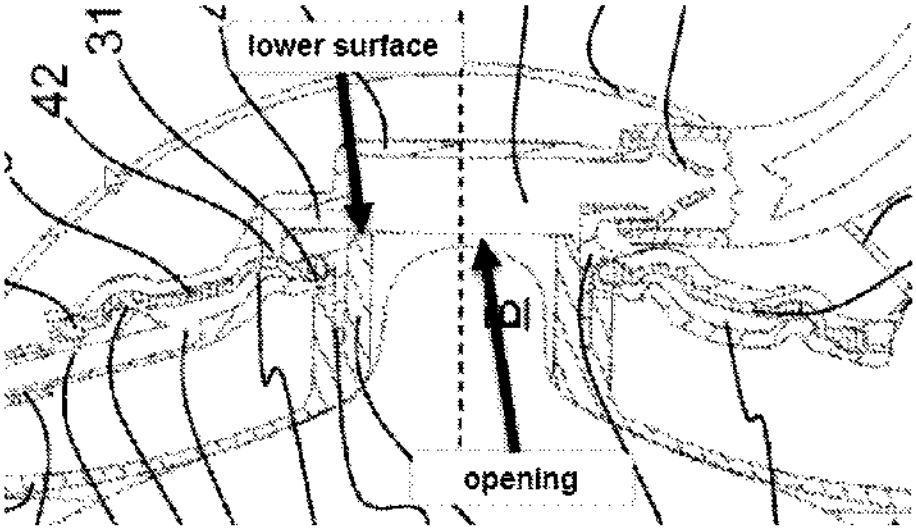
Regarding claim 19, in the modified system of Khalil, Khalil discloses the milk container is configured to be attachable to the housing with a mechanical mechanism that releasably attaches or latches when the milk container is sufficiently pressed on to

the housing with a single push action (locking lug 71 in fig. 11 is a mechanical mechanism and is disclosed to engage a recess in paragraph 69 indicating that it is capable of engaging the recess with single push action since this push action is not further defined).

Regarding claim 20, in the modified system of Khalil, Khalil discloses the milk container comprises a cap configured to be removable from the milk container (coupling part 72 in fig. 11; paragraph 69 discloses that the part includes a non-return valve indicating that the part would necessarily have be removable in order to access the milk after collection) and further comprises a removable valve that is configured to enable milk to pass into the milk container in one direction ("integrated valve" in paragraph 69; the valve would necessarily have to be removable since the valve is a non-return valve and would have to be removed in order to access the milk after collection).

Regarding claim 22, in the modified system of Khalil, Khalil discloses the milk container is wider than it is tall (fig. 11).

Regarding claim 23, in the modified system of Khalil, Khalil discloses the nipple tunnel comprises on a lower surface an opening configured such that expressed milk can flow under gravity into the milk container (the examiner notes that the term "lower" is not positionally defined, the surface designated below is considered the "lower" surface).



Regarding claim 24, modified Khalil teaches all of the claimed limitations set forth in claim 1, as discussed above, but does not teach or disclose the housing further comprises a wireless data communications system configured to be powered by the battery.

As discussed above, Chang teaches a similar breast pump device (fig. 1b) which comprises a wireless data communications system (paragraph 124 discloses incorporating a chip into the controller to communicate with an external computer through Wi-Fi/Bluetooth) which is powered by a battery (paragraphs 80 and 95 discloses the battery being electrically connected to the controller and that the battery powers the system; since paragraph 124 discloses the chip being a part of the controller, the chip would be powered by the battery).

Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the control systems of Khalil to incorporate a wireless data communications systems, as taught by Chang. This

modification would enable data transmission to analyze milk collection trends over time (paragraph 124).

Regarding claim 25, in the modified system of Khalil, Khalil discloses the housing has a front surface that is configured to fit inside a bra and to contact an inner surface of the bra (6" in fig. 9), and a rear surface that is shaped to contact, at least in part, the breast shield (6' in fig. 9).

Claim 10 is/are rejected under 35 U.S.C. 103 as being unpatentable over Khalil in view of Chang, as applied to claim 1 above, and further in view of Miller (US 20160325031).

Regarding claim 10, modified Khalil teaches all of the claimed limitation set forth in claim 1, as discussed above. Modified Khalil teaches the breast shield is configured to be directly removable from the housing in normal use or during normal disassembly (the breast shield would be releasable from the housing by releasing the shield from its magnetic connection with the housing in modified Khalil).

While it appears that the milk container of Khalil is capable of being directly removed from the housing in normal use/disassembly through locking lug (71 in fig. 11). However, modified Khalil does not explicitly teach or disclose the milk container being directly removable from the housing in normal use or during normal disassembly.

Miller teaches a breast pump system (fig. 3A) in which the breast shield and milk container are capable of being disconnected from the rest of the system (paragraph 29). Since Miller teaches that only these components need cleaning (paragraph 29), it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the device of Khalil to include only two parts that are directly

removable from the housing in normal use or normal dis-assembly: the breast shield and the milk container, for the purpose of enabling easy cleaning of the shield and container.

Claim 15 is/are rejected under 35 U.S.C. 103 as being unpatentable over Khalil in view of Chang, as applied to claim 1 above, and further in view of Phillips (US 20160296682).

Regarding claim 15, modified Khalil teaches all of the claimed limitations set forth in claim 1, as discussed above. Although it appears based on fig. 11 of Khalil that the container would be rigid, modified Khalil does not explicitly teach or disclose this limitation.

Phillips teaches a breast pump system (fig. 1) comprising a milk collection container ("collection container" 120 in fig. 1) which is substantially rigid (paragraph 57 discloses the container being made from Tritan; pg. 21 of Applicant's specification discloses that Tritan is a polycarbonate material, which is a known rigid material). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of modified Khalil to be made of Tritan for the purpose of enabling the container to maintain its strength when a vacuum is applied, as taught by Phillips (paragraph 57).

Claim 16 is/are rejected under 35 U.S.C. 103 as being unpatentable over Khalil in view of Chang, as applied to claim 1 above, and further in view of Thompson (US 7662018).

Regarding claim 16, modified Khalil teaches all of the claimed limitations set forth in claim 1, as discussed above. Khalil further discloses that the milk container is

configured to attach to a lower part of the housing (fig. 9). Khalil further appears to disclose the milk container forms a flat bottomed base for the device (figs. 9-11); however, modified Khalil does not explicitly teach this limitation.

Thompson teaches a system (fig. 4) having a milk container (30 in fig. 4) which has a lower surface which is flat (38 in fig. 5) and provides a base that enables the entire system to stand upright (fig. 5; 5:28-34). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the container of modified Khalil to have a lower surface that is flat and provides a base that enables the entire system to stand upright since Thompson teaches that this arrangement is advantageous as it allows the system to be placed on a table (5:28-34).

Claim 21 is/are rejected under 35 U.S.C. 103 as being unpatentable over Khalil in view of Chang, as applied to claim 1 above, and further in view of Guthrie (US 20160220743).

Regarding claim 21, modified Khalil teaches all of the claimed limitations set forth in claim 1, as discussed above. Khalil further discloses the top of the container comprises an optically clear region (paragraph 69 discloses the container is transparent in its entirety). However, modified Khalil does not teach or disclose the top is aligned below one or more light emitters positioned in the base of the housing.

Guthrie teaches a breast pump system (fig. 8) having a milk collection container (810 in fig. 8) and a housing (808 in fig. 8). Guthrie further teaches that the system can include a sensor subsystem comprising at least one light emitter (603 in fig. 6a) to emit a light to at least one light detector (604 in fig. 6a; paragraph 63) for the purpose of calculating milk volume (paragraph 63). Guthrie further teaches that this sensor

subsystem may be placed in the base of the housing so it is aligned with the top of the milk container (fig. 8). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the housing of modified Khalil to include the light emitter and light detector in the base of the housing, as taught by Guthrie, for the purpose of calculating expressed milk volume.

Claims 26 and 27 is/are rejected under 35 U.S.C. 103 as being unpatentable over Khalil in view of Chang, as applied to claim 1 above, and further in view of Makower (US 20160206794).

Regarding claim 26, modified Khalil teaches all of the claimed limitations set forth in claim 1, as discussed above, but does not teach or disclose the housing comprises a at least one of a visual or haptic indicator that is configured to indicate whether milk is flowing or not flowing into the milk container.

Makower teaches a similar breast pump system (100 in fig. 1) having a visual indicator that indicates whether milk is flowing or not flowing into the milk container (250 in fig. 6; paragraph 163 discloses that the display which visually indicates the volume and flow rate of the milk being expressed which is indicative of whether milk is flowing or not flowing). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the display of modified Khalil to be capable of displaying volume and flow rate, as taught by Makower. This modification would enable a user to keep track of milk expression data to monitor pumping efficiency over time.

Regarding claim 27, modified Khalil teaches all of the claimed limitations set forth in claim 1, as discussed above, but does not teach or disclose the housing further

comprises at least one of a visual or haptic indicator that is configured to indicate if the pump is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the milk container above its base is increasing above a threshold rate of increase.

Makower teaches a similar breast pump system (100 in fig. 1) having a visual indicator (display 250 in fig. 6) that indicates if the pumping mechanism is operating correctly to pump milk, based on whether the quantity and/or the height of the liquid in the container above its base is increasing above a threshold rate of increase (the examiner notes the threshold rate of increase has not been defined; as such, paragraph 163 discloses that the display displays a quantity of liquid in the container, i.e. volume of milk volume having been expressed, and paragraph 247 discloses that the display displays this information in real-time - indicating that the display is functionally capable of indicating if the pump is operating correctly based on the quantity of liquid if the container is increasing above a threshold rate of increase as a user would be able to view the data displayed to determine what the rate of increase is). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the display of modified Khalil to be capable of displaying volume and flow rate in real-time, as taught by Makower. This modification would enable a user to keep track of milk expression data to monitor pumping efficiency over time.

Claim 28 is/are rejected under 35 U.S.C. 103 as being unpatentable over Khalil in view of Chang, as applied to claim 1 above, and further in view of Tanaka (US 20170035951).

Regarding claim 28, modified Khalil teaches all of the claimed limitations set forth in claim 1, as discussed above, but does not teach or disclose the pump comprises a piezo air pump system.

Tanaka teaches a breast pump system (fig. 1) which utilizes a piezoelectric pump to drive suction (15 in fig. 1; paragraph 33). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the air pump of Khalil to be a piezo air pump. This modification would provide the added advantage of reducing motor sound typically caused by electric motors, as taught by Tanaka (paragraph 47).

Claim 30 is/are rejected under 35 U.S.C. 103 as being unpatentable over Khalil in view of Chang, as applied to claim 1 above, in further view of Baker (US 20090281485).

Regarding claim 30, modified Khalil teaches all of the claimed limitations set forth in claim 1, as discussed above, but does not teach or disclose the breast pump device makes less than 30dB noise at maximum power and less than 25dB at normal power, against a 20dB ambient noise.

Baker is directed towards a device for removing fluid from a body (fig. 6) using a vacuum pump embodied as a motor (motor 9 in fig. 6; paragraph 243). Baker further teaches that the device makes less than 20 decibel of noise at full power (paragraph 121) by sound proofing the walls of the housing and by adding a counter balance to the motor (paragraph 144). Baker is reasonably pertinent to the problem faced by the inventor in that Baker reduces the decibel level of a medical device used by a user at home to increase patient comfort. Therefore, it would have been obvious to one of

ordinary skill before the effective filing date of the claimed invention to have modified the device of modified Khalil to have the device make less than 20 dB of noise during maximum power for the purpose of making the device for discrete and comfortable for the user and others around the user.

Claim 32 is/are rejected under 35 U.S.C. 103 as being unpatentable over Khalil in view of Chang, as applied to claim 31 above, in further view of Myers (US 20080275386).

Regarding claim 32, modified Khalil teaches all of the claimed limitations set forth in claim 31, as discussed above, but does not teach or disclose the pump is configured to generate negative air pressure with a maximum suction of approximately 240 mmHg.

Myers is directed towards a similar device (fig. 1) in which the pump is configured to generate negative air pressure with a maximum suction of approximately 240 mmHg (paragraph 72). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the pump of modified Khalil to be configured to generate negative air pressure with a maximum suction of approximately 240 mmHg, as taught by Myers, since Myers teaches that this maximum suction is expected to produce acceptable results (paragraph 72).

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double

patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP § 2146 *et seq.* for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For

more information about eTerminal Disclaimers, refer to

www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claims 1, 3-7, 9, 10, 12-28, and 30-32 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-35 of U.S. Patent No. 10,926,011 in view of Khalil and Chang, and the teachings discussed in the table below.

Claim 1 of the issued patent discloses all of the claimed limitations of claims 1 and 31 of the application except a rechargeable battery; the breast shield having a breast flange and nipple tunnel and being separate from the diaphragm and configured to enclose the diaphragm with the housing; the diaphragm being sealed around its edge.

Khalil teaches a breast pump system (fig. 10) having a breast shield (1 in fig. 11) with a flange (12 in fig. 7) and a nipple tunnel (13 in fig. 7) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (figs. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the breast shield to have a flange/nipple tunnel and be configured to enclose the diaphragm with the housing and to have modified the diaphragm to form a seal around its outer edge. This configuration of the breast shield is known in the art and provides for a surface for contacting the breast and receiving the nipple and would allow the shield to be cleaned/replaced separate from the diaphragm. The diaphragm modification would enable the diaphragm to form an effective pumping chamber.

Chang teaches a substantially similar self-contained breast pump system (breast pump system 10 in fig. 1A) having a breast shield (flange 14 in fig. 1A) attached to a housing (housing 12 in fig. 1A), rechargeable battery (battery 48 in fig. 6A; paragraph 72 discloses that the battery provides a rechargeable power source), and a pump (drivers 44 and 46 in fig. 6A). Chang further teaches that the rechargeable battery powers the pump (paragraph 80 discloses the battery powers the system; paragraph 95 discloses that the battery is electrically connected to the drivers and controller).

Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the claim of the issued patent to have a rechargeable battery which powers the pump, as taught by Chang, in order for the battery to be reused and to render the pump operable.

'292 Claims	'011 Claims	Teaching
1	1	Teachings discussed above.
3		Khalil teaches the claimed subject matter as discussed above. It would have been obvious to have modified the reference claim for the purpose of enabling a user to better fit the shield onto the breast.
4	30	
5	30	
6		Khalil teaches the claimed matter of claim 6, as discussed above. It would have been obvious to have modified the claim of '011 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
7		Khalil teaches the claimed matter of claim 7, as discussed above. It would have been obvious to have modified the claim of '011 for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
9		Guthrie teaches the claimed matter of claim 9, as discussed above. It would have been obvious to have modified the claim of '011 for the same reason above.

10	13	
12		Khalil teaches the claimed matter of claim 12, as discussed above. It would have been obvious to have modified the claim of '011 since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14		Khalil teaches the claimed matter of claim 14, as discussed above. It would have been obvious to have modified the claim of '011 for the purpose of enabling the diaphragm to be replaced and/or cleaned.
15	13	
16		Thompson teaches the claimed matter of claim 16, as discussed above. It would have been obvious to have modified the claim of '011 for the same reason as previously given.
17	24	
18		Khalil teaches the claimed matter of claim 18, as discussed above. It would have been obvious to have modified the claim of '011 for the purpose of providing a non-return valve which prevents milk from exiting the container.
19	25	
20		Khalil teaches the claimed matter of claim 20, as discussed above. It would have been obvious to have modified the claim of '011 for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Guthrie teaches the claimed matter of claim 21, as discussed above. It would have been obvious to have modified the claim of '011 for the same reason as previously given.
22	27	
23		Khalil teaches the claimed matter of claim 23, as discussed above. It would have been obvious to have modified the claim of '011 for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Chang teaches the claimed matter of claim 24, as discussed above. It would have been obvious to have modified the issued claim for the same reason as previously given.

25		Khalil teaches the claimed matter of claim 25, as discussed above. It would have been obvious to have modified the claim of '011 for the purpose of providing a complete breast pump unit which is optimized in size.
26	15	
27		Makower teaches the claimed matter of claim 27, as discussed above. It would have been obvious to have modified the issued claim for the same reason as previously given.
28	1	
30	10	Baker teaches the claimed matter of claim 30, as discussed above. It would have been obvious to have modified the claim of '011 for the same reason as previously given.
31	1	See discussion above
32		Myers teaches the claimed matter of claim 30, as discussed above. It would have been obvious to have modified the claim of '011 for the same reason as previously given.

Claims 1, 3-7, 9, 10, 12-28, and 30-32 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-28 of U.S. Patent No. 10,881,766 in view of Khalil.

Claim 1 of the issued patent discloses all of the claimed limitations of claims 1 and 31 except the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of

ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'150 Claims	'766 Claims	Teaching
1	1	Khalil teaching as discussed above.
3		Khalil teaches the claimed subject matter as discussed above. It would have been obvious to have modified the reference claim for the purpose of enabling a user to better fit the shield onto the breast.
4	7	
5	27	
6	27	
7		Khalil teaches the claimed matter of claim 7, as discussed above. It would have been obvious to have modified the claim of '766 for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
9	9	
10	11	
12	13	

13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14		Khalil teaches the claimed matter of claim 14, as discussed above. It would have been obvious to have modified the claim of '766 for the purpose of enabling the diaphragm to be replaced and/or cleaned.
15	1	
16	6	
17		Khalil teaches the claimed matter of claim 17, as discussed above. It would have been obvious to have modified the claim of '766 for the purpose optimizing the size of the breast pump system.
18	5	
19	2	
20		Khalil teaches the claimed matter of claim 20, as discussed above. It would have been obvious to have modified the claim of '766 for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Guthrie teaches all of the claimed matter as discussed above. It would have been obvious to have modified the patent claim for the same reasons given.
22		Khalil teaches the claimed matter of claim 22, as discussed above. It would have been obvious to have modified the claim of '766 since Khalil teaches that these relative dimensions help optimize the size of the breast pump.
23		Khalil teaches the claimed matter of claim 23, as discussed above. It would have been obvious to have modified the claim of '766 for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Chang teaches the claimed matter of claim 24, as discussed above. It would have been obvious to have modified the claim of '766 for the same reason as previously given.

25		Khalil teaches the claimed matter of claim 25, as discussed above. It would have been obvious to have modified the claim of '766 for the purpose of providing a complete breast pump unit which is optimized in size.
26	22	
27	22	
28	18	
30	31	Baker teaches the claimed matter of claim 30, as discussed above. It would have been obvious to have modified the claim of '766 for the same reason as previously given.
31	1	See Khalil teaching above
32		Myers teaches the claimed matter of claim 32, as discussed above. It would have been obvious to have modified the claim of '766 for the same reason as previously given.

Claims 1, 3-10, and 12-32 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1 and 20 of copending Application No. 17/181,057 in view of Khalil, and the teachings in the table below.

The reference claim claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a

seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

292 Claims	'057 Claims	Teaching
1	1	Teachings as discussed above
3	6	
4	7	
5	8	
6		Khalil teaches the claimed matter of claim 6, as discussed above. It would have been obvious to have modified the claim of '057 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
7	9	
8	11	
9		Nesbitt teaches the claimed limitations as discussed above. It would have been obvious to use the magnets as guide members for the purpose of aligning the magnetic mechanism to properly install the shield.

10		Miller teaches the claimed matter of claim 10, as discussed above. It would have been obvious to have modified the claim of '057 for the same reason as previously given.
12		Khalil teaches the claimed matter of claim 12, as discussed above. It would have been obvious to have modified the claim of '057 since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14		Khalil teaches the claimed matter of claim 14, as discussed above. It would have been obvious to have modified the claim of '057 for the purpose of enabling the diaphragm to be replaced and/or cleaned.
15	12	
16	14	Thompson teaches the claimed matter of claim 16, as discussed above. It would have been obvious to have modified the claim of '057 for the same reason as previously given.
17		Khalil teaches the claimed matter of claim 17, as discussed above. It would have been obvious to have modified the claim of '057 for the purpose optimizing the size of the breast pump system.
18		Khalil teaches the claimed matter of claim 18, as discussed above. It would have been obvious to have modified the claim of '057 for the purpose of providing a non-return valve which prevents milk from exiting the container.
19	15	
20		Khalil teaches the claimed matter of claim 20 as discussed above. It would have been obvious to have modified the claim of '057 for the purpose of enabling the container to fluidically attach to the shield and to prevent milk from being suctioned out of the container.
21		Guthrie teaches the claimed matter of claim 21, as discussed above. It would have been obvious to have modified the claim of '057 for the same reason as previously given.
22		Khalil teaches the claimed matter of claim 22, as discussed above. It would have been obvious to have modified the claim of '057 since Khalil teaches that these relative dimensions help optimize the size of the breast pump.

23		Khalil teaches the claimed matter of claim 23, as discussed above. It would have been obvious to have modified the claim of '057 for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Chang teaches the claimed matter of claim 24, as discussed above. It would have been obvious to have modified the claim of '057 for the same reason as previously given.
25		Khalil teaches the claimed matter of claim 25, as discussed above. It would have been obvious to have modified the claim of '057 for the purpose of providing a complete breast pump unit which is optimized in size.
26		Makower teaches the claimed matter of claim 26, as discussed above. It would have been obvious to have modified the claim of '057 for the same reason as previously given.
27		Makower teaches the claimed matter of claim 27, as discussed above. It would have been obvious to have modified the claim of '057 for the same reason as previously given.
28	19	
29	29	
30	28	Baker teaches the claimed matter of claim 30, as discussed above. It would have been obvious to have modified the claim of '057 for the same reason as previously given.
31	1	See teaching above
32		Myers teaches the claimed matter of claim 32, as discussed above. It would have been obvious to have modified the claim of '057 for the same reason as previously given.

This is a provisional nonstatutory double patenting rejection.

Claims 1, 3-10, and 12-32 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-31 of copending Application No. 17/203,397 in view of Khalil.

The reference claim claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is

separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'397 Claims	Teaching
1	1	Khalil teaching as discussed above
3	3	
4		Khalil teaches the claimed matter of claim 4, as discussed above. It would have been obvious to have modified the reference claim for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the claimed matter of claim 5, as discussed above. It would have been obvious to have modified the reference claim for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the claimed matter of claim 6, as discussed above. It would have been obvious to have modified the reference claim for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
7	7	
8	8	
9	9	
10	10	

12	12	
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14	14	
15	15	
16	16	
17	17	
18	18	
19	19	
20	20	
21	21	
22	22	
23	23	
24	24	
25	25	
26	26	
27	27	
28	28	
29	30	
30	31	
31	1	See teaching above
32		Myers teaches the claimed limitation as discussed above and it would have been obvious to have modified the reference claim for the same reasons provided above.

This is a provisional nonstatutory double patenting rejection.

Claims 1, 3-7, 9, 10, 12-28, and 30-32 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1 and 9 of copending Application No. 17/203,384 in view of Nesbitt and the teachings below.

The reference claim claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is

separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'384 Claims	Teaching
1	1	Khalil teaching as discussed above
3		Khalil teaches the claimed subject matter as discussed above. It would have been obvious to have modified the reference claim for the purpose of enabling a user to better fit the shield onto the breast.
4		Khalil teaches the claimed matter of claim 4, as discussed above. It would have been obvious to have modified the claim of '384 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the claimed matter of claim 5, as discussed above. It would have been obvious to have modified the claim of '384 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the claimed matter of claim 6, as discussed above. It would have been obvious to have modified the claim of '384 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
7		Khalil teaches the claimed matter of claim 7, as discussed above. It would have been obvious to have modified the claim of '384 for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.

9		Guthrie teaches the claimed matter of claim 9, as discussed above. It would have been obvious to have modified the claim of '384 for the same reason as previously given.
10		Miller teaches the claimed matter of claim 10, as discussed above. It would have been obvious to have modified the claim of '384 for the same reason as previously given.
12		Khalil teaches the claimed matter of claim 12, as discussed above. It would have been obvious to have modified the claim of '384 since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14		Khalil teaches the claimed matter of claim 14, as discussed above. It would have been obvious to have modified the claim of '384 for the purpose of enabling the diaphragm to be replaced and/or cleaned.
15		Phillips teaches the claimed matter of claim 15, as discussed above. It would have been obvious to have modified the claim of '384 for the same reason as previously given.
16		Thompson teaches the claimed matter of claim 16, as discussed above. It would have been obvious to have modified the claim of '384 for the same reason as previously given.
17		Khalil teaches the claimed matter of claim 17, as discussed above. It would have been obvious to have modified the claim of '384 for the purpose optimizing the size of the breast pump system.
18		Khalil teaches the claimed matter of claim 18, as discussed above. It would have been obvious to have modified the claim of '384 for the purpose of providing a non-return valve which prevents milk from exiting the container.
19		Khalil teaches the claimed matter of claim 19, as discussed above. It would have been obvious to have modified the claim of '384 for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the claimed matter of claim 20, as discussed above. It would have been obvious to have modified the claim of '384 for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21	9	

22		Khalil teaches the claimed matter of claim 22, as discussed above. It would have been obvious to have modified the claim of '384 since Khalil teaches that these relative dimensions help optimize the size of the breast pump.
23		Khalil teaches the claimed matter of claim 23, as discussed above. It would have been obvious to have modified the claim of '384 for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Chang teaches the claimed matter of claim 24, as discussed above. It would have been obvious to have modified the claim of '384 for the same reason as previously given.
25		Khalil teaches the claimed matter of claim 25, as discussed above. It would have been obvious to have modified the claim of '384 for the purpose of providing a complete breast pump unit which is optimized in size.
26		Makower '794 teaches the claimed matter of claim 26, as discussed above. It would have been obvious to have modified the claim of '384 for the same reason as previously given.
27		Makower '794 teaches the claimed matter of claim 26, as discussed above. It would have been obvious to have modified the claim of '384 for the same reason as previously given.
28		Tanaka teaches the claimed matter of claim 28, as discussed above. It would have been obvious to have modified the claim of '384 for the same reason as previously given.
30		Baker teaches the claimed matter of claim 30, as discussed above. It would have been obvious to have modified the claim of '384 for the same reason as previously given.
31	1	See teaching above
32		Myers teaches the claimed matter of claim 32, as discussed above. It would have been obvious to have modified the claim of '384 for the same reason as previously given.

This is a provisional nonstatutory double patenting rejection.

Claims 1, 3-10, and 12-32 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-31 of copending Application No. 17/203,355 in view of Khalil.

The reference claim claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'355 Claims	Teaching
1	1	Khalil teaching as discussed above.
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
10	10	
12	12	
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14	14	

15	15	
16	16	
17	17	
18	18	
19	19	
20	20	
21	21	
22	22	
23	23	
24	24	
25	25	
26	26	
27	27	
28	28	
29	30	
30	31	
31	1	See teaching above
32		Myers teaches the claimed limitation as discussed above. It would have been obvious to have modified the reference claim for the same reason as discussed above.

This is a provisional nonstatutory double patenting rejection.

Claims 1, 3-10, and 12-32 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-31 of copending Application No. 17/203,418 in view of Khalil.

Claim 1 of the reference application and/or patent claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the

diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'418 Claims	Teaching
1	1	Khalil teaching as discussed above.
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
10	10	
12	12	
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14	14	
15	15	
16	16	
17	17	
18	18	
19	19	
20	20	
21	21	
22	22	
23	23	
24	24	
25	25	
26	26	
27	27	

28	28	
29	29	
30	30	
31	1	See teaching above
32		Myers teaches the claimed limitation as discussed above. It would have been obvious to have modified the reference claim for the same reason as give above.

This is a provisional nonstatutory double patenting rejection.

Claims 1, 3-10, and 12-32 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1 and 14-29 of U.S. Patent No. 11311654 (App 17203313) in view of Khalil and the teachings below.

Claim 1 of the reference application and/or patent claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'313 Claims	Teaching
1	1	Khalil teaching as discussed above.
3	17	
4	18	
5	18	
6	18	
7	19	
8	20	
9	21	
10	22	
12	24	
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).

14	26	
15	27	
16		Thompson teaches the claimed matter of claim 16, as discussed above. It would have been obvious to have modified the claim of '313 for the same reason as previously given.
17		Khalil teaches the claimed matter of claim 17, as discussed above. It would have been obvious to have modified the claim of '313 for the purpose optimizing the size of the breast pump system.
18	28	
19	29	
20		Khalil teaches the claimed matter of claim 20, as discussed above. It would have been obvious to have modified the claim of '313 for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21		Guthrie teaches the claimed matter of claim 21, as discussed above. It would have been obvious to have modified the claim of '313 for the same reason as previously given.
22		Khalil teaches the claimed matter of claim 22, as discussed above. It would have been obvious to have modified the claim of '313 since Khalil teaches that these relative dimensions help optimize the size of the breast pump.
23		Khalil teaches the claimed matter of claim 23, as discussed above. It would have been obvious to have modified the claim of '313 for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Chang teaches the claimed matter of claim 24, as discussed above. It would have been obvious to have modified the claim of '313 for the same reason as previously given.

25		Khalil teaches the claimed matter of claim 25, as discussed above. It would have been obvious to have modified the claim of '313 for the purpose of providing a complete breast pump unit which is optimized in size.
26		Makower '794 teaches the claimed matter of claim 26, as discussed above. It would have been obvious to have modified the claim of '313 for the same reason as previously given.
27		Makower '794 teaches the claimed matter of claim 27, as discussed above. It would have been obvious to have modified the claim of '313 for the same reason as previously given.
28	1	
29	14	
30	15	
31	1	See discussion above
32		Myers teaches the claimed matter of claim 32, as discussed above. It would have been obvious to have modified the claim of '313 for the same reason as previously given.

Claims 1, 3-10, and 12-32 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-30 of copending Application No. 17/203,150 in view of Nesbitt.

Claim 1 of the reference application and/or patent claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'150 Claims	Teaching
1	1	Khalil teaching as discussed above.
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
10	10	
12	12	
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14	14	
15	15	
16	16	
17	17	
18	18	
19	19	
20	20	
21	21	
22	22	
23	23	
24	24	

25	25	
26	26	
27	27	
28	28	
29	29	
30	30	
31		
32		Myers teaches all of the claimed limitations as discussed above. It would have been obvious to have modified the reference claim for the same reason as provided above.

This is a provisional nonstatutory double patenting rejection.

Claims 1, 3-7, 9, 10, and 12-32 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1, 15, 18, 19, and 21-30 of US Patent No. 11324866 (Application No. 17/203,259) in view of Khalil and the teachings below.

Claim 1 of the reference application and/or patent claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would

enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'259 Claims	Teaching
1	1	Khalil teaching as discussed above
3		Khalil teaches the claimed subject matter as discussed above. It would have been obvious to have modified the reference claim for the purpose of enabling a user to better fit the shield onto the breast.
4		Khalil teaches the claimed matter of claim 4, as discussed above. It would have been obvious to have modified the claim of '259 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the claimed matter of claim 5, as discussed above. It would have been obvious to have modified the claim of '259 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the claimed matter of claim 6, as discussed above. It would have been obvious to have modified the claim of '259 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
7		Khalil teaches the claimed matter of claim 7, as discussed above. It would have been obvious to have modified the claim of '259 for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
9		Guthrie teaches the claimed matter of claim 9, as discussed above. It would have been obvious to have modified the claim of '259 for the same reason as previously given.
10		Miller teaches the claimed matter of claim 10, as discussed above. It would have been obvious to have modified the claim of '259 for the same reason as previously given.
12		Khalil teaches the claimed matter of claim 12, as discussed above. It would have been obvious to have modified the claim of '259 since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).

14		Khalil teaches the claimed matter of claim 14, as discussed above. It would have been obvious to have modified the claim of '259 for the purpose of enabling the diaphragm to be replaced and/or cleaned.
15	22	
16	23	
17	24	
18	25	
19	26	
20	27	
21	15	
22		Khalil teaches the claimed matter of claim 22, as discussed above. It would have been obvious to have modified the claim of '259 since Khalil teaches that these relative dimensions help optimize the size of the breast pump.
23		Khalil teaches the claimed matter of claim 23, as discussed above. It would have been obvious to have modified the claim of '259 for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Chang teaches the claimed matter of claim 24, as discussed above. It would have been obvious to have modified the claim of '259 for the same reason as previously given.

25		Khalil teaches the claimed matter of claim 25, as discussed above. It would have been obvious to have modified the claim of '259 for the purpose of providing a complete breast pump unit which is optimized in size.
26	18	
27	19	
28	28	
29	29	
30	30	
31	1	See teaching above
32		Myers teaches the claimed matter of claim 32, as discussed above. It would have been obvious to have modified the claim of '259 for the same reasons given above.

Claims 1, 3-7, 9, 10, 12-28, and 30-32 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1 and 6 of US Patent No. 11357894 (Application No. 17/203,216) in view of Khalil and the teachings below.

Claim 1 of the reference application and/or patent claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the

diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'216 Claims	Teaching
1	1	Khalil teaching as discussed above
3		Khalil teaches the claimed subject matter as discussed above. It would have been obvious to have modified the reference claim for the purpose of enabling a user to better fit the shield onto the breast.
4		Khalil teaches the claimed matter of claim 4, as discussed above. It would have been obvious to have modified the claim of '216 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the claimed matter of claim 5, as discussed above. It would have been obvious to have modified the claim of '216 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the claimed matter of claim 6, as discussed above. It would have been obvious to have modified the claim of '216 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
7		Khalil teaches the claimed matter of claim 7, as discussed above. It would have been obvious to have modified the claim of '216 for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
9		Guthrie teaches the claimed matter of claim 9, as discussed above. It would have been obvious to have modified the claim of '216 for the same reason as previously given.
10		Miller teaches the claimed matter of claim 10, as discussed above. It would have been obvious to have modified the claim of '216 for the same reason as previously given.

12		Khalil teaches the claimed matter of claim 12, as discussed above. It would have been obvious to have modified the claim of '216 since Khalil teaches that this shape is sufficient to transfer suction to the nipple.
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14		Khalil teaches the claimed matter of claim 14, as discussed above. It would have been obvious to have modified the claim of '216 for the purpose of enabling the diaphragm to be replaced and/or cleaned.
15		Phillips teaches the claimed matter of claim 15, as discussed above. It would have been obvious to have modified the claim of '216 for the same reason as previously given.
16		Thompson teaches the claimed matter of claim 16, as discussed above. It would have been obvious to have modified the claim of '216 for the same reason as previously given.
17		Khalil teaches the claimed matter of claim 17, as discussed above. It would have been obvious to have modified the claim of '216 for the purpose optimizing the size of the breast pump system.
18		Khalil teaches the claimed matter of claim 18, as discussed above. It would have been obvious to have modified the claim of '216 for the purpose of providing a non-return valve which prevents milk from exiting the container.
19		Khalil teaches the claimed matter of claim 19, as discussed above. It would have been obvious to have modified the claim of '216 for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the claimed matter of claim 20, as discussed above. It would have been obvious to have modified the claim of '216 for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21	6	

22		Khalil teaches the claimed matter of claim 22, as discussed above. It would have been obvious to have modified the claim of '216 since Khalil teaches that these relative dimensions help optimize the size of the breast pump.
23		Khalil teaches the claimed matter of claim 23, as discussed above. It would have been obvious to have modified the claim of '216 for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Chang teaches the claimed matter of claim 24, as discussed above. It would have been obvious to have modified the claim of '216 for the same reason as previously given.
25		Khalil teaches the claimed matter of claim 25, as discussed above. It would have been obvious to have modified the claim of '216 for the purpose of providing a complete breast pump unit which is optimized in size.
26		Makower '794 teaches the claimed matter of claim 26, as discussed above. It would have been obvious to have modified the claim of '216 for the same reason as previously given.
27		Makower '794 teaches the claimed matter of claim 27, as discussed above. It would have been obvious to have modified the claim of '216 for the same reason as previously given.
28		Tanaka teaches the claimed matter of claim 28, as discussed above. It would have been obvious to have modified the claim of '216 for the same reason as previously given.
30		Baker teaches the claimed matter of claim 30, as discussed above. It would have been obvious to have modified the claim of '216 for the same reason as previously given.
31	1	See discussion above
32		Myers teaches the claimed matter of claim 32, as discussed above. It would have been obvious to have modified the claim of '216 for the same reason as previously given.

Claims 1, 3-10, and 12-32 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-30 of copending Application No. 17/203,179 in view of Khalil.

Claim 1 of the reference application and/or patent claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'179 Claims	Teaching
1	1	Khalil teaching as discussed above.
3	11	
4	12	
5	13	
6	14	
7	15	
8	16	
9	17	
10	18	

12	20	
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14	22	
15	10	
16	3	
17	4	
18	5	
19	6	
20	7	
21	8	
22	9	
23	23	
24	24	
25	25	
26	26	
27	27	
28	28	
29	29	
30	30	
31	1	See discussion above
32		Myers teaches the claimed limitation above. It would have been obvious to have modified the reference claim for the same reasons given above.

This is a provisional nonstatutory double patenting rejection.

Claims 1, 3-10, 12-28 and 30-32 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over the claims of copending Application No. 17/203,327 in view of Khalil.

Claim 1 of the reference application and/or patent claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'216 Claims	Teaching
1	1	Khalil teaching as discussed above
3	3	
4	4	
5		Khalil teaches the claimed matter of claim 5, as discussed above. It would have been obvious to have modified the claim of '327 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the claimed matter of claim 6, as discussed above. It would have been obvious to have modified the claim of '327 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
7	7	

8	8	
9		Nesbitt teaches the claimed limitations as discussed above. It would have been obvious to have modified the reference claim to use the magnets to ensure the shield is properly latched.
10	10	
12	12	
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14		Khalil teaches the claimed matter of claim 14, as discussed above. It would have been obvious to have modified the reference claim for the purpose of enabling the diaphragm to be replaced and/or cleaned.
15	15	
16	16	
17	17	
18		Khalil teaches the claimed matter of claim 18, as discussed above. It would have been obvious to have modified the reference claim for the purpose of providing a non-return valve which prevents milk from exiting the container.

19	19	
20		Khalil teaches the claimed matter of claim 20, as discussed above. It would have been obvious to have modified the reference claim for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21	6	
22		Khalil teaches the claimed matter of claim 22, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that these relative dimensions help optimize the size of the breast pump.
23	23	
24		Chang teaches the claimed matter of claim 24, as discussed above. It would have been obvious to have modified the reference claim for the same reason as previously given.
25		Khalil teaches the claimed matter of claim 25, as discussed above. It would have been obvious to have modified the reference claim for the purpose of providing a complete breast pump unit which is optimized in size.
26		Makower '794 teaches the claimed matter of claim 26, as discussed above. It would have been obvious to have modified the reference claim for the same reason as previously given.
27		Makower '794 teaches the claimed matter of claim 27, as discussed above. It would have been obvious to have modified the reference claim for the same reason as previously given.
28		Tanaka teaches the claimed matter of claim 28, as discussed above. It would have been obvious to have modified the claim of the reference app for the same reason as previously given.

30		Baker teaches the claimed matter of claim 30, as discussed above. It would have been obvious to have modified the claim of '327 for the same reason as previously given.
31	1	See discussion above
32		Myers teaches the claimed matter of claim 32, as discussed above. It would have been obvious to have modified the reference claim for the same reason as previously given.

This is a provisional nonstatutory double patenting rejection.

Claims 1, 2-10, and 12-32 are rejected on the ground of nonstatutory double patenting as being unpatentable over the claims of US Patent No 11260151 (Application No. 17/203,109) in view of Khalil and the teachings below.

Claim 1 of the reference application and/or patent claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would

enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	109 Claims	Teaching
1	1	Khalil teaching as discussed above
3	21	
4	22	
5	22	
6	22	
7		Khalil teaches the claimed matter of claim 7, as discussed above. It would have been obvious to have modified the claim of '109 for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
8	23	
9		Nesbitt teaches the claimed limitation as discussed above. It would have been obvious to have used the magnets as guide members to correctly position the shield against the housing.
10	24	
12	26	
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14	28	
15	29	
16		Thompson teaches the claimed matter of claim 16, as discussed above. It would have been obvious to have modified the claim of '109 for the same reason as previously given.
17		Khalil teaches the claimed matter of claim 17, as discussed above. It would have been obvious to have modified the claim of '109 for the purpose optimizing the size of the breast pump system.
18		Khalil teaches the claimed matter of claim 18, as discussed above. It would have been obvious to have modified the claim of '109 for the purpose of providing a non-return valve which prevents milk from exiting the container.
19	30	
20		Khalil teaches the claimed matter of claim 20, as discussed above. It would have been obvious to have modified the claim of '109 for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21	9	

22		Khalil teaches the claimed matter of claim 22, as discussed above. It would have been obvious to have modified the claim of '109 since Khalil teaches that these relative dimensions help optimize the size of the breast pump.
23		Khalil teaches the claimed matter of claim 23, as discussed above. It would have been obvious to have modified the claim of '109 for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Chang teaches the claimed matter of claim 24, as discussed above. It would have been obvious to have modified the claim of '109 for the same reason as previously given.
25		Khalil teaches the claimed matter of claim 25, as discussed above. It would have been obvious to have modified the claim of '109 for the purpose of providing a complete breast pump unit which is optimized in size.
26		Makower '794 teaches the claimed matter of claim 26, as discussed above. It would have been obvious to have modified the claim of '109 for the same reason as previously given.
27		Makower '794 teaches the claimed matter of claim 26, as discussed above. It would have been obvious to have modified the claim of '109 for the same reason as previously given.
28		Tanaka teaches the claimed matter of claim 28, as discussed above. It would have been obvious to have modified the claim of '109 for the same reason as previously given.
29	5	
30	19	
31	1	See teaching above
32		Myers teaches the claimed matter of claim 32, as discussed above. It would have been obvious to have modified the claim of '109 for the same reason as previously given.

Claims 1, 3-7, 9, 10, and 12-32 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-30 of US Patent No. 11357893 (Application No. 17/203,050) in view of Khalil and the teachings below.

Claim 1 of the reference application and/or patent claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to

enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'109 Claims	Teaching
1	1	Khalil teaching as discussed above
3	7	
4	8	
5	9	
6	10	

7	11	
9	13	
10		Miller teaches the claimed matter of claim 10, as discussed above. It would have been obvious to have modified the claim of '109 for the same reason as previously given.
12	16	
13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14		Khalil teaches the claimed matter of claim 14, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
15	19	
16	20	
17	21	
18	22	
19	23	

20	24	
21	25	
22	26	
23		Khalil teaches the claimed matter of claim 23, as discussed above. It would have been obvious to have modified the claim of '109 for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24	27	
25	28	
26	29	
27	30	
28	2	
29	4	
30	5	

31	1	See discussion above
32		Myers teaches the claimed matter of claim 32, as discussed above. It would have been obvious to have modified the reference claim for the same reasons provided above.

Claims 1, 3-7, 9, 10, 12-28, and 30-32 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1 and 11 of US Patent No. 11376352 (Application No. 17/203,079) in view of Khalil and the teachings below.

Claim 1 of the reference application and/or patent claims all of the claimed limitations in claims 1 and 31 of the instant application except in that the reference claim does not claim the breast shield is separate from the diaphragm and is configured to enclose the diaphragm with the housing and the diaphragm forming a seal around its outer edge.

Khalil teaches a breast pump system (fig. 1) having a breast pump (1 in fig. 11) which is separate from the diaphragm (fig. 11) and is configured to enclose the diaphragm with the housing (fig. 9-11). Khalil further teaches the diaphragm forms a seal around its outer edge (fig. 4/5). Therefore, it would have been obvious to one of ordinary skill before the effective filing date of the claimed invention to have modified the reference claim to have the diaphragm be separate from the shield and be enclosed by shield and housing and to form a seal around its outer edge. This modification would enable easy replacement of components and would ensure the diaphragm forms an effective pumping chamber.

'292 Claims	'079 Claims	Teaching
1	1	Khalil teaching as discussed above

3		Khalil teaches the claimed subject matter as discussed above. It would have been obvious to have modified the reference claim for the purpose of enabling a user to better fit the shield onto the breast.
4		Khalil teaches the claimed matter of claim 4, as discussed above. It would have been obvious to have modified the claim of '079 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
5		Khalil teaches the claimed matter of claim 5, as discussed above. It would have been obvious to have modified the claim of '079 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
6		Khalil teaches the claimed matter of claim 6, as discussed above. It would have been obvious to have modified the claim of '079 for the purpose of obviating the need for separate pieces which would increase the risk of leakage.
7		Khalil teaches the claimed matter of claim 7, as discussed above. It would have been obvious to have modified the claim of '079 for the purpose of enabling a user to place the shield on the breast without concern of proper orientation.
9		Nesbitt teaches the claimed limitation as discussed above. it would have been obvious to have modified the patent claim and use the magnets as guide members for the purpose of ensuring the shield is properly latched to the housing.
10		Miller teaches the claimed matter of claim 10, as discussed above. It would have been obvious to have modified the claim of '079 for the same reason as previously given.
12		Khalil teaches the claimed matter of claim 12, as discussed above. It would have been obvious to have modified the claim of '079 since Khalil teaches that this shape is sufficient to transfer suction to the nipple.

13		Khalil teaches the claimed matter of claim 13, as discussed above. It would have been obvious to have modified the reference claim since Khalil teaches that this configuration enables a uniform pump output (paragraph 31).
14		Khalil teaches the claimed matter of claim 14, as discussed above. It would have been obvious to have modified the claim of '079 for the purpose of enabling the diaphragm to be replaced and/or cleaned.
15		Phillips teaches the claimed matter of claim 15, as discussed above. It would have been obvious to have modified the claim of '079 for the same reason as previously given.
16		Thompson teaches the claimed matter of claim 16, as discussed on pg. 18. It would have been obvious to have modified the claim of '079 for the same reason as previously given.
17		Khalil teaches the claimed matter of claim 17, as discussed above. It would have been obvious to have modified the claim of '079 for the purpose optimizing the size of the breast pump system.
18		Khalil teaches the claimed matter of claim 18, as discussed above. It would have been obvious to have modified the claim of '079 for the purpose of providing a non-return valve which prevents milk from exiting the container.
19		Khalil teaches the claimed matter of claim 19, as discussed above. It would have been obvious to have modified the claim of '079 for the purpose of providing a releasable connection between the pump and the container, as taught by Khalil (paragraph 69).
20		Khalil teaches the claimed matter of claim 20, as discussed above. It would have been obvious to have modified the claim of '079 for enabling a user to access the milk after collection and for preventing milk from getting suctioned back into the pump.
21	11	

22		Khalil teaches the claimed matter of claim 22, as discussed above. It would have been obvious to have modified the claim of '079 since Khalil teaches that these relative dimensions help optimize the size of the breast pump.
23		Khalil teaches the claimed matter of claim 23, as discussed above. It would have been obvious to have modified the claim of '079 for the purpose of enabling milk to be expressed from the nipple tunnel to the milk container.
24		Chang teaches the claimed matter of claim 24, as discussed above. It would have been obvious to have modified the claim of '079 for the same reason as previously given.
25		Khalil teaches the claimed matter of claim 25, as discussed above. It would have been obvious to have modified the claim of '079 for the purpose of providing a complete breast pump unit which is optimized in size.
26		Makower '794 teaches the claimed matter of claim 26, as discussed above. It would have been obvious to have modified the claim of '079 for the same reason as previously given.
27		Makower '794 teaches the claimed matter of claim 27, as discussed above. It would have been obvious to have modified the claim of '079 for the same reason as previously given.
28		Tanaka teaches the claimed matter of claim 28, as discussed above. It would have been obvious to have modified the claim of '079 for the same reason as previously given.
30		Baker teaches the claimed matter of claim 30, as discussed above. It would have been obvious to have modified the claim of '079 for the same reason as previously given.
31	1	See discussion above

32		Myers teaches the claimed matter of claim 32, as discussed above. It would have been obvious to have modified the claim of '079 for the same reason as previously given.

Allowable Subject Matter

Excepting for the double patenting rejection(s) above, **claims 8 and 29** is allowable over the prior art of record.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 8, the closest prior art is Khalil. Khalil appears to disclose that the breast shield is configured to slide in/out from the housing with the diaphragm my disconnecting the diaphragm from the vacuum pump through hose 80. However, Khalil does not teach or disclose that the shield is configured to slide in/out from the housing on guide members in the breast shield as required by the claim.

Regarding claim 29, the closest prior art is Khalil which teaches a substantially similar breast pump device (fig. 9) but does not disclose the mass of the device. Myers (US 20020193731) teaches a similar device (fig 1A) but teaches that the device can weigh 2lbs (paragraph 97) which is significantly higher than the claimed mass of the device (less than 250 grams or approximately 0.5 lbs). There is nothing in the prior art of record which suggests an integrated breast pump device with the claimed mass. Additionally, the examiner notes that Applicant has assigned criticality for the claimed

dimension on pg. 12, lines 17-21 of the Specification since the claimed mass enable the breast pump device to be more comfortable for wear and use.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to COURTNEY FREDRICKSON whose telephone number is (571)270-7481. The examiner can normally be reached Monday-Friday (9 AM - 5 PM EST).

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NATHAN PRICE can be reached on 571-270-5421. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/COURTNEY B FREDRICKSON/
Examiner, Art Unit 3783

Notice of References Cited	Application/Control No. 17/203,292	Applicant(s)/Patent Under Reexamination O'TOOLE et al.	
	Examiner COURTNEY FREDRICKSON	Art Unit 3783	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20080275386-A1	11-2008	Myers; Kenneth E.	A61M1/064	604/74
*	B	US-20020193731-A1	12-2002	Myers, Kenneth E.	A61M1/064	206/427
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/203,292	O'TOOLE et al.
	Examiner	Art Unit
	COURTNEY FREDRICKSON	3783

CPC - Searched*		
Symbol	Date	Examiner
a61m1/06, 1/062, 1/066; a61j13/00; a41c4/04	06/19/2021	cbf

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
see SEARCH history	06/19/2021	cbf
Searched inventors in PALM and SEARCH	06/19/2021	cbf
Consulted parent history	06/19/2021	cbf
Consulted SPE Nathan Price for allowable subject matter	06/19/2021	cbf
Updated search	11/10/2021	cbf
Updated search	06/30/2022	cbf

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/COURTNEY B FREDRICKSON/ Examiner, Art Unit 3783	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/203,292	O'TOOLE et al.
	Examiner	Art Unit
	COURTNEY FREDRICKSON	3783

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	06/18/2021	11/10/2021	06/30/2022						
	1	✓	✓	✓						
	2	✓	-	-						
	3	✓	✓	✓						
	4	✓	✓	✓						
	5	✓	✓	✓						
	6	✓	✓	✓						
	7	✓	✓	✓						
	8	✓	✓	✓						
	9	✓	✓	✓						
	10	✓	✓	✓						
	11	✓	-	-						
	12	✓	✓	✓						
	13	✓	✓	✓						
	14	✓	✓	✓						
	15	✓	✓	✓						
	16	✓	✓	✓						
	17	✓	✓	✓						
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	24	✓	✓	✓						
	25	✓	✓	✓						
	26	✓	✓	✓						
	27	✓	✓	✓						
	28	✓	✓	✓						
	29	✓	✓	✓						
	30	✓	✓	✓						
	31		✓	✓						
	32		✓	✓						

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	268	a61m1/$.cpc. AND ((breast milk) WITH pump$4) AND ((power$4 battery) WITH (charg$4 recharg$4))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/12 04:05 PM
L2	65	("20020193731"|"20040056641"|"20040074281"|"20040267215"|"20050219302"|"20060122575"|"20070051172"|"20070051727"|"20080262420"|"20120277636"|"20140052056"|"20150217036"|"20150217037"|"20150283311"|"20160000980"|"20160058929"|"20160082165"|"20160082166"|"20160151551"|"20160158424"|"20160206794"|"20160220743"|"20160220745"|"20160287767"|"20160296681"|"20160310650"|"20170021068"|"20170035951"|"20170143879"|"20170220753"|"20180021490"|"2849881"|"4390024"|"5474683"|"5941847"|"5973770"|"6045529"|"6090065"|"6383163"|"6440100"|"6461324"|"6547756"|"6579258"|"6663587"|"6749582"|"7048519"|"7201735"|"7312554"|"7314400"|"7776008"|"8057425"|"8118772"|"8187227"|"8262606"|"8282596"|"8376986"|"8702646"|"8801495"|"8876760"|"8926556"|"9033913"|"9173587"|"9345274"|"9539377"|"D548831").PN.	(US-PGPUB; USPAT)	OR	OFF	OFF	2018/08/07 01:17 PM
L3	214	(jonathan near3 o'toole).inv. (adam near3 rollo).inv. (andrew near3 carr).inv.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 01:42 PM
L4	63	(a61m1/062 a61m1/066 a61m1/06).cpc. and	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2018/08/07 01:45 PM

		piezo$9	JPO)				
L5	19	("20040122358" | "20060226108" | "20080077042" | "20080167579" | "20120004603" | "3895533" | "4024856" | "4338953" | "5347656" | "5666104" | "5827191" | "7316653" | "7621797" | "7794425" | "8308648" | "8777864" | "8801658" | "8827911").PN. OR ("8992445").URPN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/07 01:50 PM
L6	7	("5730139" | "6423010" | "6602199" | "7479154" | "8206414" | "8425426" | "8992445").PN. OR ("9192325").URPN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/07 01:59 PM
L7	582	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 02:16 PM
L8	3369	(a61m1/062 a61m1/066 a61m1/06).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 02:58 PM
L9	2787	(a61m1/062 a61m1/066 a61m1/06).cpc. not L7	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 02:58 PM
L10	45	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/07 02:59 PM

		20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$).did. or (WO-2015174330-$ or WO-2016024558-$).did.					
L11	14	L10 and (pump$4 same diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/07 02:59 PM
L12	2	"60479361".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/07 03:04 PM
L13	143	a61j13/00.cpc.	(US-PGPUB; USPAT)	OR	OFF	OFF	2018/08/10 10:30 AM
L14	409	a61j13/00.cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 10:30 AM
L15	3369	(a61m1/062 a61m1/066 a61m1/06).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 10:43 AM
L16	582	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 10:44 AM
L17	0	(a61m1/062 a61m1/066 a61m1/06).cpc. not (L16 L15)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 10:44 AM
L18	2665	(a61m1/062 a61m1/066 a61m1/06).cpc. not (L16 L14)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 10:44 AM
L19	71	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/10 11:47 AM

		US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$).did.					

L20	37	L19 and (air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 11:48 AM
L21	4	L19 and ((air with pump$4) same diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 11:50 AM
L22	16	L19 and (pump$4 same diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 12:15 PM
L23	1	L19 and piezo	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/10 12:40 PM
L24	0	a61m1/1058.cpc. and breast and diaphragm	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/10 12:42 PM
L25	5	breast same pump$4 same piezo$8 same air	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/10 12:43 PM
L26	1	("9884172").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/10 01:58 PM
L27	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:40 AM
L28	2	"59563385".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 10:20 AM
L29	1	"59563425".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 10:20 AM
L30	87	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 10:26 AM

		20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$).did.					
L31	44	L30 and (air with	(US-PGPUB; USPAT;	OR	OFF	OFF	2018/08/24

		pump$4)	USOCR; FPRS; EPO; JPO)				10:26 AM
L32	17	L30 and (pump$4 with diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 10:27 AM
L33	51	L27 and "air pump"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 11:07 AM
L34	4	"47900902".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 11:13 AM
L35	10	("20030212374" | "20050251089" | "20050283900" | "20070135778" | "20110054389" | "3084691" | "4229029" | "5295957" | "6070659").PN. OR ("9511176").URPN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/24 11:16 AM
L36	2	"51149640".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 11:17 AM
L37	271	L27 and (control$4 same select$4 left same right same breast)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 12:50 PM
L38	3	L30 and (recharg$4 with battery)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 01:04 PM
L39	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:41 PM
L40	9	L39 and ((center centre) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:41 PM
L41	11	L39 and (light with milk with (volume quantity amount height))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:48 PM
L42	0	L39 and (radiation with milk with (volume quantity amount height))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:51 PM
L43	2	L39 and (radiation same milk same (volume quantity amount height))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 02:51 PM
L44	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:13 PM
L45	10	L44 and ((piezo piezoelectric piezo-electric) same air same pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:13 PM
L46	1	a61m1/1058 and	(US-PGPUB; USPAT;	OR	OFF	OFF	2018/08/24

		(suction$4 vacuum$4 aspirat$4)	USOCR; FPRS; EPO; JPO)				07:23 PM
L47	27	a61m1/1058.cpc. and (suction$4 vacuum$4 aspirat$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:23 PM
L48	23	L44 and (indicator same milk same (express$4 flow$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:26 PM
L49	51	L44 and (air same pressure same sens$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:30 PM
L50	19	L44 and ((indicat$4 record$4) same (right and left))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:38 PM
L51	56	L44 and (pump$4 with series)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:42 PM
L52	77	L44 and (pump$4 with weigh$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:47 PM
L53	87	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/24 07:59 PM

		20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$).did.					
L54	44	L53 and (air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:59 PM
L55	5	L54 and (air with filter$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 07:59 PM

L56	3	L44 and (pump$4 with (db decibal?))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:07 PM
L57	6	L44 and ((db decibal?))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:07 PM
L58	26	L44 and (sens$4 with (orientation angle tilt placement))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:16 PM
L59	9	L44 and ((indicat$4 input$4 document$4 record$4) with comfort)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:31 PM
L60	484	a61m$/$.cpc. and ((indicat$4 input$4 document$4 record$4) with comfort)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:32 PM
L61	1	L44 and "social media"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/24 08:52 PM
L62	408	a61m$/$.cpc. and ((piezo piezoelectric piezo-electric) same air same pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/25 06:13 PM
L63	3606	a61m$/$.cpc. and (pump$4 with weigh$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/25 06:18 PM
L64	359	a61m$/$.cpc. and ((pump$4 with weigh$4) same (portable lightweight carry$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/25 06:30 PM
L65	1	("20160166745").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/25 07:16 PM
L66	1	("20160058928").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/25 07:23 PM
L67	1	("20110004154").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/26 10:55 AM
L68	96	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/26 11:09 AM

		US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-					

		8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$).did.					
L69	2	L69 and (radiation same (height quantity amount volume))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/26 11:09 AM
L70	96	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/26 12:24 PM

		20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-					

		2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$).did.					
L71	3	L71 and ((diaphragm membrane) with shield)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/26 12:24 PM
L72	3606	a61m$/$.cpc. and (pump$4 with weigh$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:09 PM
L73	137	L73 and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:09 PM
L74	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:10 PM
L75	9	L75 and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:10 PM
L76	19	L75 and (shield with snap$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:16 PM
L77	1	("20110152855").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 01:20 PM
L78	32	L75 and (flow with rate with air)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:33 PM
L79	3	L75 and (stall with pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:56 PM
L80	98	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/27 01:56 PM

		US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$).did. or (WO-2015174330-$ or					

		WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$).did.					
L81	17	L81 and (pressure same (mmhg kpa mbar pa bar))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 01:57 PM
L82	18	(("7550034") or ("8123502") or ("8297947") or ("8371829") or ("8409160") or ("8646479") or ("8734131") or ("8763633") or ("8821134") or ("9051931") or ("9127665") or ("9239059") or ("9279421") or ("9334858") or ("9506463") or ("9752565") or ("9709042") or ("9777851")).PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 02:08 PM
L83	0	L83 and breast	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:08 PM
L84	10	L83 and (lactat$3 milk)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:08 PM
L85	14	L81 and (piezo piezoelectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:10 PM
L86	5	L75 and ((piezo piezoelectric) with air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:47 PM
L87	230	(((piezo piezoelectric) with air with pump$4) same (miniature small compact lightweight))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:48 PM
L88	6	L88 and (breast milk lactat$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 02:53 PM

L89	161	a61m$/$.cpc. and ((piezo piezoelectric piezo-electric) with air with pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:11 PM
L90	0	(2017/0072118).CCLS.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:19 PM
L91	1	("20170072118").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:19 PM
L92	40	(((piezo piezoelectric) with air with pump$4) same (miniature small compact lightweight)) same (vacuum$4 suction$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:22 PM
L93	3	"45513973".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/27 03:23 PM
L94	364	(((piezo piezoelectric) with pump$4) same (miniature small compact lightweight)) same (vacuum$4 suction$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:32 PM
L95	3	"20170035951"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:33 PM
L96	1	L96 and (suction$4 with piezoelectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/27 03:34 PM
L97	1	("20130064683").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:38 PM
L98	1	("20170072118").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/27 03:39 PM
L99	1	(US-20170172485-$).did.	(US-PGPUB)	OR	OFF	OFF	2018/08/28 04:48 PM
L100	0	L100 and "function of"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 04:48 PM
L101	100	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/28 05:19 PM

		US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-					

		7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L102	0	L102 and ((meaur$4 with milk) same rate)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:20 PM
L103	0	L102 and ((meaur$4 with milk) same (frequency speed))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:20 PM
L104	16	L102 and ((measur$4 with milk) same (frequency speed rate))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:21 PM
L105	0	L102 and ((measur$4 with milk) with "function of")	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 05:23 PM
L106	6	L102 and (decrease with (rate speed frequency strong))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:10 PM
L107	2	L102 and (latch$4 with adjust$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:22 PM
L108	50	(a61m$/$).cpc. and (wear$4 with pump$4) and ((center centre) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:24 PM
L109	0	(a61m$/$).cpc. and (wear$4 with pump$4) and (((center centre) with gravity) same comfort$5)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:25 PM
L110	83	(a61m$/$).cpc. and (((center centre) with gravity) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/28 06:26 PM

		comfort$5)					
L111	101	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 09:43 AM

		US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L112	3	L112 and (shield with (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:43 AM
L113	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:47 AM
L114	86	L114 and ((diapragm housing) with (housing case mount$4) with shield)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:53 AM
L115	9	L114 and ((diapragm membrane) with (housing case mount$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 09:54 AM

		with shield)					
L116	34	L112 and (diaphragm membrane)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:07 AM
L117	28	L114 and (diaphragm membrane) and (shield with dispos$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:10 AM
L118	28	L114 and ((diaphragm membrane) with (coupl$4 attach$4 mount$4) with shield)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:23 AM
L119	0	a61j16/00.cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:41 AM
L120	409	a61j13/00.cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 10:42 AM
L121	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:23 PM
L122	23	L122 and (sens$4 same (orient$4 plac$4 situat$4) same (nipple shield))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:23 PM
L123	11	L122 and ((sens$4 accelerometer) with breast with (move moved moving movement))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:32 PM
L124	10	L122 and accelerometer	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 01:33 PM
L125	1	("20170072118").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/29 02:27 PM
L126	259	L122 and ((lower$4 decrea$4) with (suction$4 intens$4 pain comfort discomfort))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 02:51 PM
L127	45	L122 and ((lower$4 decrea$4) with (intens$4 pain comfort discomfort))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 02:59 PM
L128	11	(a61m$/$.cpc.) and ((miniature compact small) same (piezoelectric piezo-electric piezo) same pump$4 same (suction$4 vacuum$4) same (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 03:40 PM
L129	127	L122 and ((pressure	(US-PGPUB; USPAT;	OR	OFF	OFF	2018/08/29

		suction$4) with (mmhg kpa mbar pa bar))	USOCR; FPRS; EPO; JPO)				05:16 PM
L130	2	"60479361".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 05:29 PM
L131	106	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 05:31 PM

		20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L132	104	L132 and @ad<="20170615"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 05:32 PM
L133	14	(US-20160166745-$ or	(US-PGPUB; USPAT)	OR	OFF	OFF	2018/08/29

		US-20150283311-$ or US-20180110906-$ or US-20140378895-$ or US-20140031744-$ or US-20160220743-$ or US-20160256617-$ or US-20080177224-$ or US-20130023821-$ or US-20160058928-$ or US-20170043065-$ or US-20110004154-$).did. or (US-10039871-$ or US-6358226-$).did.					06:08 PM
L134	1	"52574056".FMID.	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2018/08/29 06:46 PM
L135	0	("2009024080").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/29 06:53 PM
L136	1	("20090024080").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2018/08/29 06:53 PM
L137	3390	(a61m1/062 a61m1/066 a61m1/06 a61m1/068 a61j/00).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 07:30 PM
L138	203	L138 and ((shield nipple) with (remov$4 replac$4 clean$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2018/08/29 07:30 PM
L139	1	("4535627").PN.	(US-PGPUB; USPAT)	OR	OFF	OFF	2019/01/08 12:52 PM
L140	74	(("20180361040") or ("20180236147") or ("20120277728") or ("7785305") or ("20080208116") or ("7223255") or ("7789865") or ("8118772") or ("20080275385") or ("9956331") or ("8057425") or ("20070219486") or ("20020193731") or ("10046097") or ("20140378946") or ("20180326130") or ("20120316493") or ("8568350") or ("20030191427") or ("8070716") or ("9539377") or ("20160303298") or ("20160206794") or ("9539376") or ("20160310649") or ("20160287769") or ("20160310650") or ("20180001002") or	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/01/08 12:54 PM

		("20090099511") or ("7776008") or ("20090062731") or ("20160296682") or ("20050154349") or ("20030191433") or ("5749850") or ("20100292636") or ("7559915") or ("20080262420") or ("20160325031") or ("20170173232") or ("7749188") or ("6887217") or ("6139521") or ("20180021490") or ("20150065994") or ("20180028732") or ("20150196460") or ("9636282") or ("7758540") or ("8945046") or ("20080243059") or ("20110251552") or ("20170119942") or ("20130023821") or ("6997897") or ("9033913") or ("20150157776") or ("20090254028") or ("5514166") or ("20010038799") or ("20070161947") or ("20130046234") or ("8926556") or ("7255681") or ("7008400") or ("6257847") or ("20100145264") or ("20170151380") or ("20070078383") or ("5542921") or ("20180333523") or ("8075516") or ("20180369464") or ("20110071466")).PN.					
L141	111	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2019/01/08 01:02 PM

		US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or					

		US-20180333523-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L142	35	L142 and (heavy weight "center of gravity" "centre of gravity" mass)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 01:03 PM
L143	3497	(a61m1/062 a61m1/066 a61m1/06).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 01:22 PM
L144	284	L144 and (heavy weight "center of gravity" "centre of gravity")	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 01:22 PM
L145	3497	(a61m1/062 a61m1/066 a61m1/06).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/01/08 04:06 PM
L146	18	L146 and (weight with distribut$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2019/01/08 04:06 PM

			JPO)				
L147	1	("4535627").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/03/14 02:19 PM
L148	112	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2019/04/16 03:00 PM

		(US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or US-20180333523-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$ or US-5542921-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					

L149	21	L149 and (pump$4 with (lightweight mass weight heavy))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 03:00 PM
L150	94	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (pump$4 with (weight lightweight))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 03:14 PM
L151	47	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (pump$4 with (mass heavy))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 05:04 PM
L152	26	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and (pump$4 with (mass heavy)) not L151	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/04/16 05:04 PM
L153	1	("20110274566").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/04/19 01:51 PM
L154	1	("20110274566").PN.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/08/09 12:52 PM
L155	57	(breast with pump) and (noise same pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:04 AM
L156	1	(16/009547).APP.	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/08/15 09:08 AM
L157	1	L157 and (pressure same noise)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:08 AM
L158	635	((piezo piezoelectric) with pump) and (noise same pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:10 AM
L159	1	L157 and piezo	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:16 AM
L160	26	(breast with pump) and (mmhg and noise)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:24 AM
L161	1	L157 and (liter litre)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:30 AM
L162	1	((piezo piezoelectric) with pump) and "YIP Ventus"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:33 AM
L163	19	(("7550034") or ("8123502") or ("8297947") or ("8371829") or ("8409160") or ("8646479") or ("8734131") or ("8763633") or	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2019/08/15 09:36 AM

		("8821134") or ("9051931") or ("9127665") or ("9234518") or ("9239059") or ("9279421") or ("9334858") or ("9506463") or ("9752565") or ("9709042") or ("9777851")).PN.					
L164	5	L164 and (mmhg mbar kpa)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:36 AM
L165	0	L164 and (litre liter)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:37 AM
L166	2	L164 and piezo	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:37 AM
L167	17	L164 and (piezo piezoelectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:37 AM
L168	1	L164 and (piezo piezoelectric) and (noise same pressure)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2019/08/15 09:38 AM
L169	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:50 AM
L170	1	L170 and gravity	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:50 AM
L171	1	L170 and (gravity same nipple)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:51 AM
L172	61	(breast with pump$4) and ((centre center) with container)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:55 AM
L173	1	L170 and (gravity same container)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 10:55 AM
L174	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 11:54 AM
L175	1	L176 and (high height)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 11:54 AM
L176	25	(breast with pump$4) and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 12:55 PM
L177	113	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2020/01/09 03:02 PM

		US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or					

		US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or US-20180333523-$ or US-20180361040-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$ or US-5542921-$).did. or (WO-2015174330-$ or WO-2016024558-$ or WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L178	30	L179 and noise	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/09 03:02 PM
L179	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2020/01/13 01:45 PM

			JPO)				
L180	1	L181 and gravity	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/13 01:45 PM
L181	1	L181 and length	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/13 01:46 PM
L182	1	L181 and height	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/13 01:48 PM
L183	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:29 PM
L184	1	L185 and "half-way"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:29 PM
L185	113	(US-20020193731-$ or US-20040056641-$ or US-20150283311-$ or US-20160000980-$ or US-20160206794-$ or US-20180021490-$ or US-20120004603-$ or US-20170173233-$ or US-20080077042-$ or US-20010044593-$ or US-20030139702-$ or US-20050080376-$ or US-20060270973-$ or US-20070005006-$ or US-20070219486-$ or US-20080275386-$ or US-20090118573-$ or US-20100086419-$ or US-20130123689-$ or US-20140323962-$ or US-20140330200-$ or US-20140378946-$ or US-20150065994-$ or US-20160158424-$ or US-20160287768-$ or US-20160296682-$).did. or (US-20170072118-$ or US-20170173232-$ or US-20180008758-$ or US-20180110906-$ or US-20180126052-$ or US-20160287481-$ or US-20080039781-$ or US-20110301533-$ or US-20110314587-$ or US-20130023821-$ or US-20140142501-$ or US-20140263611-$ or US-20140378895-$ or US-	(US-PGPUB; USPAT; FPRS)	OR	OFF	OFF	2020/01/14 02:36 PM

		20160095967-$ or US-20160183602-$ or US-20180078687-$ or US-20030027491-$ or US-20030191433-$ or US-20040024352-$ or US-20060106334-$ or US-20070161330-$ or US-20080208116-$ or US-20140052056-$ or US-20160082166-$ or US-20160220745-$ or US-20160220743-$ or US-20170312409-$).did. or (US-20140180205-$ or US-20170368244-$ or US-20160228626-$ or US-20170172485-$ or US-20160166745-$ or US-20160058928-$ or US-20110004154-$ or US-20140031744-$ or US-20090206699-$ or US-20180228949-$ or US-20080177224-$ or US-20160135998-$ or US-20170043065-$ or US-20100292632-$ or US-20160256617-$ or US-20110071466-$ or US-20180333523-$ or US-20180361040-$).did. or (US-6440100-$ or US-6547756-$ or US-6749582-$ or US-8057425-$ or US-8118772-$ or US-8801495-$ or US-9033913-$ or US-8992445-$ or US-4024856-$ or US-5827191-$ or US-9192325-$ or US-6699213-$ or US-7662018-$ or US-5571084-$ or US-6227936-$ or US-8414353-$ or US-3840012-$ or US-4270538-$ or US-6358226-$ or US-10039871-$ or US-9155924-$ or US-7223255-$ or US-10046097-$ or US-5542921-$).did. or (WO-2015174330-$ or WO-2016024558-$ or					

		WO-2011012228-$ or EP-2502639-$ or CA-2955939-$ or CA-2955605-$ or WO-2016014488-$ or EP-3058967-$ or WO-2016156173-$ or WO-2016161050-$ or WO-2017139437-$ or WO-2017190024-$ or EP-2388026-$ or CA-2953333-$ or CN-203075300-$ or WO-2015085450-$ or WO-2013029407-$).did.					
L186	3	L187 and ((centre center) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:37 PM
L187	2	L187 and (top with heavy)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/14 02:37 PM
L188	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:06 AM
L189	1	L190 and (weight mass)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:06 AM
L190	1	L190 and (housing same battery)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:07 AM
L191	1	L190 and (shield same (mold$4 mould$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:08 AM
L192	1	L190 and (diaphragm same seal$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:09 AM
L193	0	L190 and (diaphragm same tunnel same flange)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:15 AM
L194	0	L190 and (diaphragm same spaced)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:15 AM
L195	0	L190 and (diaphragm same surround)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 11:15 AM
L196	1	verhoef.inv. and dog and figure	(US-PGPUB)	OR	OFF	OFF	2020/01/15 01:27 PM
L197	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:28 PM
L198	1	L199 and (shield with single)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:28 PM

L199	67	(a61m$/$).cpc. and (wear$4 with pump$4) and ((center centre) with gravity)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:32 PM
L200	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:32 PM
L201	1	L202 and (shield with single)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:32 PM
L202	1	L202 and (shield with piece)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 02:33 PM
L203	0	L202 and ((housing diagraphm) with spac$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 03:18 PM
L204	1	L202 and (shield with housing with diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 03:19 PM
L205	1	L202 and ((housing diaphragm) with spac$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/01/15 03:19 PM
L206	143	(breast with pump) and (piezo piezoelectric) and (membrane diaphragm)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 11:42 AM
L207	78	("20030191433" | "20040024351" | "20040101414" | "20050059928" | "20050131332" | "20050234370" | "20060106334" | "20080045888" | "20080177224" | "20080243059" | "20090024080" | "20100010682" | "20100106082" | "20100217148" | "20110071466" | "20110196291" | "20110245763" | "20110270162" | "20120101575" | "20120277728" | "20130023821" | "20130123688" | "20130131588" | "20130177455" | "20140066734" | "20140378895" | "20140378946" | "20150065994" | "20150100016" |	(US-PGPUB; USPAT; USOCR)	OR	OFF	OFF	2020/09/28 12:42 PM

		"20150148709" | "20150196247" | "20150292500" | "20160015876" | "20160256618" | "20160287769" | "20170072118" | "20170080134" | "20170173232" | "4263912" | "4311141" | "4768547" | "4821580" | "5542921" | "5634468" | "5658133" | "5810772" | "5827191" | "6273868" | "6287252" | "6328082" | "6440100" | "6547756" | "6579258" | "6712785" | "6840918" | "7201735" | "7223255" | "7621797" | "7824363" | "7972297" | "7988661" | "8057425" | "8070715" | "8070716" | "8262606" | "8282596" | "8353865" | "8357116" | "8376986" | "8671701" | "8684961" | "8801495" | "9050404" | "9162016" | "9173587" | "9199017" | "9278167" | "D459233").PN. OR ("10625005").URPN.					
L208	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 02:57 PM
L209	1	L210 and 19a	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 02:57 PM
L210	132289	"201" and recess	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:02 PM
L211	0	L210 and recess	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:02 PM
L212	645454	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. diaphragm	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:06 PM
L213	574	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. and diaphragm	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/28 03:06 PM
L214	1	16/009547.app.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/29 09:51 AM
L215	1	L216 and flat	(US-PGPUB; USPAT;	OR	OFF	OFF	2020/09/29

			USOCR; FPRS; EPO; JPO)				09:51 AM
L216	57377	breast.clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:16 PM
L217	398558	pump$4.clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:16 PM
L218	92405	(piezo piezoelectric).clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:16 PM
L219	72010	diaphragm.clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L220	26553	(db decibal).clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L221	27368	(db decibal).clm.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L222	2	L218 and L219 and L220 and L221	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L223	2	L218 and L219 and L220 and L224	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2020/09/30 03:17 PM
L226	32	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((usb "universal serial bus") WITH (charg$4 recharg$4 power$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/18 12:16 PM
L227	0	214 AND (usb SAME socket)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 12:25 PM
L228	2	214 AND socket	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 12:25 PM
L229	2	"61007742".fmid.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; JPO)	OR	ON	ON	2021/05/18 12:34 PM

L230	7	"2015069095".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 12:38 PM
L231	122	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/18 01:00 PM

		20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1					

		OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)				
L232	18	231 AND recharg$5	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 01:00 PM
L233	2	214 AND (rigid SAME	(US-PGPUB; USPAT;	OR	ON	ON	2021/05/18

		shield)	USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				01:05 PM
L234	27173	a61m5/14244,14248.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 01:42 PM
L235	555	234 AND ((power$4 batter$4) WITH (charg$5 recharg$5) WITH (usb "universal serial bus"))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 01:42 PM
L236	82	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND bra AND wireless$4 AND (control$4 processor electronic$4) AND (power$4 battery)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/18 01:53 PM
L237	82	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND bra AND wireless$4 AND (control$4 processor electronic$4) AND (power$4 batter$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/18 01:53 PM
L238	14	231 AND ((charg$5 recharg$5) WITH (power$4 batter$4)) AND wireless$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 03:59 PM
L239	2	"20140275857".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 04:48 PM
L240	12	231 AND (rigid WITH (bottle container))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2021/05/18 04:52 PM

			AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L241	2	214 AND (shield WITH (flexible silicon$4 material soft rubber))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 05:35 PM
L242	2	231 AND (rigid WITH shield)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/18 05:38 PM
L243	128	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/20 03:05 PM

		US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-					

		A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-					

		2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L244	8	243 AND ((membrane diaphragm) SAME shield)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/20 03:06 PM
L245	88	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH rigid)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:09 PM
L246	0	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH (plastic rigid) WITH steriliz$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:13 PM
L247	7	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH steriliz$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:13 PM
L248	68	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (rigid WITH polypropylene)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:14 PM
L249	25	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((bottle container) WITH steriliz$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:17 PM
L250	19	243 AND ((bottle container) WITH (rigid polypropylene plastic))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 03:23 PM
L251	21	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((bottle container) WITH magnet$6)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 05:49 PM
L252	2	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 05:57 PM

		((shield nipple flange) WITH guide WITH line)					
L253	207	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield nipple flange) WITH line)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 05:57 PM
L254	5	"6328709".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/20 05:59 PM
L255	91	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (nipple WITH line)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/20 06:00 PM
L256	130	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/21 12:39 PM

		20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1					

		OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-					

		2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L257	1	256 AND ((bottle container milk) WITH (clear transparent) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 12:39 PM
L258	6	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((bottle container milk) WITH (clear transparent) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:40 PM
L259	6	(breast WITH pump$4) AND ((bottle container milk) WITH (clear transparent) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:41 PM
L260	73	(breast WITH pump$4) AND ((bottle container milk) WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:41 PM
L261	11	(breast WITH pump$4) AND ((bottle container milk bag) WITH (polycarbonate tritan)) AND ((bottle container milk storage bag) WITH (clear transparent "see through" see-through))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 12:45 PM
L262	55	(breast WITH pump$4) AND ((bottle container milk bag) WITH (magnet$6))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 01:09 PM
L263	182	(breast WITH pump$4) AND ((shield flange) WITH (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 01:26 PM
L264	132	((US-6440100-B1 OR US-6547756-B1 OR	(USPAT; US-PGPUB; FPRS; USOCR;	OR	ON	ON	2021/05/21 01:26 PM

		US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1	IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))				

		OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-					

		20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L265	9	264 AND (clear transparent) WITH (container bottle bag)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2021/05/21 01:27 PM

			IBM_TDB)				
L266	4	264 AND (polycarbonate) WITH (container bottle bag)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 01:27 PM
L267	6	(breast WITH pump$4) AND ((bottle container milk) WITH (polycarbonate tritan)) AND ((bottle container milk) WITH dishwash$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 02:28 PM
L268	34	264 AND ((alert$4 indicat$4 light) WITH (milk))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 03:46 PM
L269	19	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH start$4 WITH stop$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:36 PM
L270	21	264 AND (milk WITH (indicat$4 alert$4 display$4) WITH (flow$4 volume))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:39 PM
L271	20	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH (quantity volume) WITH threshold)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:55 PM
L272	95	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH (quantity volume) WITH (predetermin$4 limit level))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:58 PM
L273	38	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (milk WITH (quantity volume) WITH (predetermin$4 limit level) WITH (increas$4 decreas$4 chang$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 04:58 PM
L274	4	(a61m1/062 a61m1/066	(US-PGPUB; USPAT;	OR	OFF	OFF	2021/05/21

		a61m1/06 a41c4/04 a61j13/00).cpc. AND (pump$4 WITH alert$4 WITH (correct$4))	USOCR; FPRS; EPO; JPO)				05:00 PM
L275	0	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (operat$4 WITH alert$4 WITH (correct$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 05:00 PM
L276	9	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (alert$4 WITH (correct$4 proper$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 05:00 PM
L277	23	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH rotat$4 WITH position$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 05:44 PM
L278	62	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH slid$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:03 PM
L279	26	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH slid$4 WITH (attach$4 coupl$4 connect$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:04 PM
L280	71	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) WITH thread$4 WITH (attach$4 coupl$4 connect$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:06 PM
L281	26	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((clean$4 disinfect$4 sanitiz$4) WITH (shield flange) WITH (container bottle bag))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:20 PM
L282	111	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (diaphragm WITH (housing holder))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 06:44 PM
L283	2	"20120277728".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2021/05/21 06:46 PM

			SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L284	7	264 AND (light WITH emit$4)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 06:55 PM
L285	11	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (db decibel)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 07:12 PM
L286	77	(breast WITH pump$4) AND (db decibel)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 07:17 PM
L287	75	willow AND (breast WITH pump$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/21 07:26 PM
L288	20047	(a61m a61b).cpcl. AND (pump$ wth piezo piezoelectric) AND (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L289	9898	(a61m a61b).cpcl. AND (pump$ WITH piezo piezoelectric) AND (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L290	892	(a61m a61b).cpcl. AND (pump$ WITH piezo piezoelectric) SAME (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L291	892	(a61m a61b).cpcl. AND (pump$4 WITH piezo piezoelectric) SAME (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:32 PM
L292	24	(a61m a61b).cpcl. AND (pump$4 WITH (piezo	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2021/05/21 07:33 PM

		piezoelectric)) SAME (decibel db)	AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L293	654	(a61m a61b).cpcl. AND (pump$4 WITH (piezo piezoelectric)) AND (decibel db)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/21 07:34 PM
L294	337	(a61m a61b).cpcl. AND (pump$4 WITH (piezo piezoelectric)) AND (decibel db)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2021/05/21 07:34 PM
L295	138	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/05/22 09:07 AM

		US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-					

		A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1 OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-					

		2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L296	13	295 AND (bar mbar kpa) AND "flow rate"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 09:07 AM
L297	2	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (pressure WITH kpa mmhg mbar bar) AND ((air vacuum$4 suction$4) WITH l/min)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/22 09:21 AM
L298	157	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (pressure WITH (kpa mmhg mbar bar))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/22 09:23 AM
L299	2	16/009547.app. AND (mechanism SAME container SAME housing)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 10:47 AM
L300	2	16/009547.app. AND (mechanism WITH container WITH housing)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO;	OR	ON	ON	2021/05/22 10:47 AM

			JPO; DERWENT; IBM_TDB)				
L301	40	295 AND magnet$6	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 10:50 AM
L302	6	295 AND (magnet$6 WITH (container bag bottle))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/05/22 10:51 AM
L303	599	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND diaphragm	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/24 12:04 PM
L304	7	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (shield WITH (polycarbonate tritan))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/05/24 02:33 PM
L305	140	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2 OR US-8579874-B1).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/06/02 03:38 PM

		OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-					

		20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1					

		OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1 OR US-20090281485-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1).did. AND FTDB.dbnm.)					
L306	2	140 AND piezo	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 03:38 PM
L307	14	140 AND piezo$8	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 03:38 PM
L308	32	305 AND piezo$8	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO;	OR	ON	ON	2021/06/02 03:39 PM

			JPO; DERWENT; IBM_TDB)				
L309	6	305 AND piezo$8 AND parallel	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 03:41 PM
L310	14	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((container milk bottle) WITH (angle tilt$4) WITH (sens$4 detect$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:47 PM
L311	14	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH right WITH breast WITH data)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:54 PM
L312	78	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (which WITH breast WITH data)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:57 PM
L313	14	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH breast WITH data)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:57 PM
L314	10	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH breast WITH sens$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:57 PM
L315	11	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND (left WITH breast WITH select$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 03:59 PM
L316	33	305 AND (maximum WITH (suction$4 vacuum$4))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/02 04:02 PM
L317	16	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((icon button) WITH start$4 WITH (stop$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 04:06 PM

		paus$4))					
L318	0	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield flange) WITH tritan)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 04:08 PM
L319	3	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield flange) WITH (transparent clear)) AND ((shield flange) WITH polycarbonate)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/02 04:08 PM
L321	195	((milk lactat$4 breast) WITH pump$4) AND ((shield flange) WITH magnet$6)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/14 01:25 PM
L322	4	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((shield flange) WITH (transparent clear)) AND ((shield flange) WITH (tritan polycarbonate))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/15 12:15 PM
L323	250	(a61m1/062 a61m1/066 a61m1/06 a41c4/04 a61j13/00).cpc. AND ((flange shield) SAME (diaphragm membrane))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	OFF	OFF	2021/06/15 01:51 PM
L324	19	("7550034," "8123502," "8297947," "8371829," "8409160," "8646479," "8734131," "8763633," "8821134," "9051931," "9127665," "9234518," "9239059," "9279421," "9334858," "9506463," "9752565," "9709042," "9777851").pn.	(USPAT)	OR	ON	ON	2021/06/16 12:28 PM
L325	9	324 AND stall	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 12:28 PM
L326	19	"stall pressure" WITH (aspirat$4 vacuum$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2021/06/16 12:35 PM

		suction$4)	AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L327	4184	(stall WITH pressure WITH pump$4)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 12:39 PM
L328	3	324 AND mbar	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 01:42 PM
L329	50	(ttp WITH ventus)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 01:54 PM
L330	3	(ttp WITH ventus)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2021/06/16 01:54 PM
L331	252	(ventus)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2021/06/16 01:55 PM
L332	36	((stall WITH pressure WITH pump$4) SAME piezo$10)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 02:28 PM
L333	18	324 AND maximum	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 02:35 PM
L334	52	pump$4 WITH stall WITH piezo$10	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2021/06/16 02:38 PM

			SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L335	220	(breast SAME pump$4 SAME piezo$10)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 03:17 PM
L336	79	(breast WITH pump$4) AND (pressure WITH (stall$4 crack$4 occlusion break$4 block$4) WITH (mmhg kpa mbar bar pa))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 03:35 PM
L337	68	ventus AND piezo$10	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 04:11 PM
L338	11	337 AND stall	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 04:12 PM
L339	11	337 AND (mmhg mbar kpa)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/16 04:13 PM
L340	0	324 AND l/min	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 03:43 PM
L341	11	324 AND (air WITH flow$4)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2021/06/19 03:43 PM

			SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L342	157	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2 OR US-8579874-B1 OR US-3702623-A).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/06/19 03:48 PM

		A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR					

		US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1 OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1 OR US-20090281485-A1 OR US-20120277636-A1 OR US-20150141761-A1 OR US-20160331879-A1 OR US-20150328380-A1 OR US-20100324477-A1 OR US-20170226994-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR					

		WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1 OR CN-106794291-A OR WO-2020046777-A1 OR WO-2018202556-A1 OR CN-105873631-A OR WO-9622116-A1 OR CN-211835562-U OR KR-20170044650-A OR WO-2020217934-A1 OR JP-2016010524-A).did. AND FTDB.dbnm.) OR ((CN-211835562-U).did. AND DWPI.dbnm.)					
L343	1	342 AND "l/min"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 03:49 PM
L344	6	324 AND (free WITH flow)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 03:49 PM
L345	2	("10881766").pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 06:28 PM
L346	2	("10926011").pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD,	OR	ON	ON	2021/06/19 06:44 PM

			DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L347	157	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2 OR US-8579874-B1 OR US-3702623-A).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/06/19 09:14 PM

		US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-					

		A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1 OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1 OR US-20090281485-A1 OR US-20120277636-A1 OR US-20150141761-A1 OR US-20160331879-A1 OR US-20150328380-A1 OR US-20100324477-A1 OR US-20170226994-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR					

		CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1 OR CN-106794291-A OR WO-2020046777-A1 OR WO-2018202556-A1 OR CN-105873631-A OR WO-9622116-A1 OR CN-211835562-U OR KR-20170044650-A OR WO-2020217934-A1 OR JP-2016010524-A).did. AND FTDB.dbnm.) OR ((CN-211835562-U).did. AND DWPI.dbnm.)					
L348	39	347 AND piezo$10	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 09:14 PM
L349	28	347 AND piezo$10 AND breast	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 09:14 PM
L350	2	"10881766".pn.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/06/19 09:39 PM
L351	3	("9,585,998").pn.	(US-PGPUB; USPAT;	OR	ON	ON	2021/06/21

			USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				09:14 AM
L352	157	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2 OR US-8579874-B1 OR US-3702623-A).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1 OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2021/07/14 04:33 PM

		A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR					

		US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1 OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1 OR US-20090281485-A1 OR US-20120277636-A1 OR US-20150141761-A1 OR US-20160331879-A1 OR US-20150328380-A1 OR US-20100324477-A1 OR US-20170226994-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-					

		2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1 OR CN-106794291-A OR WO-2020046777-A1 OR WO-2018202556-A1 OR CN-105873631-A OR WO-9622116-A1 OR CN-211835562-U OR KR-20170044650-A OR WO-2020217934-A1 OR JP-2016010524-A).did. AND FTDB.dbnm.) OR ((CN-211835562-U).did. AND DWPI.dbnm.)					
L353	8341	a61m1/06-066.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/10/13 09:11 AM
L354	147	353 AND ((shield flange) WITH rib)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/10/13 09:12 AM
L355	5	("5875976").pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2021/10/13 11:12 AM

			IBM_TDB)				
L356	4	345 346	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/10/25 05:20 PM
L357	2	345 346	(USPAT)	OR	ON	ON	2021/10/25 05:20 PM
L358	158	((US-6440100-B1 OR US-6547756-B1 OR US-6749582-B2 OR US-8057425-B1 OR US-8118772-B2 OR US-8801495-B1 OR US-9033913-B2 OR US-8992445-B2 OR US-4024856-A OR US-5827191-A OR US-9192325-B2 OR US-6699213-B1 OR US-7662018-B1 OR US-5571084-A OR US-6227936-B1 OR US-8414353-B1 OR US-3840012-A OR US-4270538-A OR US-6358226-B1 OR US-10039871-B2 OR US-9155924-B1 OR US-7223255-B2 OR US-10046097-B2 OR US-5542921-A OR US-10625005-B2 OR US-8579874-B1 OR US-3702623-A).did. AND USPT.dbnm.) OR ((US-20020193731-A1 OR US-20040056641-A1 OR US-20150283311-A1 OR US-20160000980-A1 OR US-20160206794-A1 OR US-20180021490-A1 OR US-20120004603-A1 OR US-20170173233-A1 OR US-20080077042-A1 OR US-20010044593-A1 OR US-20030139702-A1 OR US-20050080376-A1 OR US-20060270973-A1 OR US-20070005006-A1	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	OR	ON	ON	2021/11/10 11:12 AM

		OR US-20070219486-A1 OR US-20080275386-A1 OR US-20090118573-A1 OR US-20100086419-A1 OR US-20130123689-A1 OR US-20140323962-A1 OR US-20140330200-A1 OR US-20140378946-A1 OR US-20150065994-A1 OR US-20160158424-A1 OR US-20160287768-A1 OR US-20160296682-A1 OR US-20170072118-A1 OR US-20170173232-A1 OR US-20180008758-A1 OR US-20180110906-A1 OR US-20180126052-A1 OR US-20160287481-A1 OR US-20080039781-A1 OR US-20110301533-A1 OR US-20110314587-A1 OR US-20130023821-A1 OR US-20140142501-A1 OR US-20140263611-A1 OR US-20140378895-A1 OR US-20160095967-A1 OR US-20160183602-A1 OR US-20180078687-A1 OR US-20030027491-A1 OR US-20030191433-A1 OR US-20040024352-A1 OR US-20060106334-A1 OR US-20070161330-A1 OR US-20080208116-A1 OR US-20140052056-A1 OR US-20160082166-A1 OR US-20160220745-A1 OR US-20160220743-A1 OR US-20170312409-A1 OR US-20140180205-A1 OR US-20170368244-A1 OR US-20160228626-A1 OR US-20170172485-A1 OR US-					

		20160166745-A1 OR US-20160058928-A1 OR US-20110004154-A1 OR US-20140031744-A1 OR US-20090206699-A1 OR US-20180228949-A1 OR US-20080177224-A1 OR US-20160135998-A1 OR US-20170043065-A1 OR US-20100292632-A1 OR US-20160256617-A1 OR US-20110071466-A1 OR US-20180333523-A1 OR US-20180361040-A1 OR US-20170035951-A1 OR US-20170143879-A1 OR US-20110004155-A1 OR US-20160288983-A1 OR US-20170274127-A1 OR US-20190209748-A1 OR US-20200397960-A1 OR US-20070219480-A1 OR US-20100145276-A1 OR US-20110009824-A1 OR US-20210060220-A1 OR US-20170112983-A1 OR US-20140275857-A1 OR US-20070179439-A1 OR US-20160228625-A1 OR US-20050154349-A1 OR US-20060025718-A1 OR US-20180028733-A1 OR US-20160325031-A1 OR US-20120277728-A1 OR US-20190143014-A1 OR US-20050247558-A1 OR US-20090281482-A1 OR US-20090281485-A1 OR US-20120277636-A1 OR US-20150141761-A1 OR US-20160331879-A1 OR US-20150328380-A1 OR US-20100324477-A1 OR US-20170226994-A1					

		OR US-20080243061-A1).did. AND PGPB.dbnm.) OR ((WO-2015174330-A1 OR WO-2016024558-A1 OR WO-2011012228-A1 OR EP-2502639-A1 OR CA-2955939-A1 OR CA-2955605-A1 OR WO-2016014488-A1 OR EP-3058967-A1 OR WO-2016156173-A1 OR WO-2016161050-A1 OR WO-2017139437-A1 OR WO-2017190024-A1 OR EP-2388026-A1 OR CA-2953333-A1 OR CN-203075300-U OR WO-2015085450-A1 OR WO-2013029407-A1 OR WO-2018062986-A1).did. AND FPRS.dbnm.) OR ((WO-2015069095-A1 OR CN-106794291-A OR WO-2020046777-A1 OR WO-2018202556-A1 OR CN-105873631-A OR WO-9622116-A1 OR CN-211835562-U OR KR-20170044650-A OR WO-2020217934-A1 OR JP-2016010524-A).did. AND FTDB.dbnm.) OR ((CN-211835562-U).did. AND DWPI.dbnm.)					
L359	0	L358 AND (shield WITH attach$4 WITH (rib detent protrusion))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/11/10 11:14 AM
L360	0	358 AND (shield WITH attach$4 WITH (detent rib protrusion))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/11/10 11:12 AM
L361	24	(breast WITH pump$4)	(US-PGPUB; USPAT;	OR	ON	ON	2021/11/10

		AND (shield WITH attach$4 WITH (rib detent protrusion))	USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				11:15 AM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	64788	breast.clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/02/10 04:26 PM
N2	429460	pump$4.clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/02/10 04:26 PM
N3	1065320	housing.clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/02/10 04:26 PM
N4	0	shield.clm	(US-PGPUB; USPAT)	OR	ON	ON	2022/02/10 04:26 PM
N5	134217	shield.clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/02/10 04:26 PM
N6	77409	diaphragm.clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/02/10 04:26 PM
N7	485118	recess.clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/02/10 04:27 PM
N8	4238372	surface.clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/02/10 04:27 PM
N9	13	N1 AND N2 AND N3 AND N5 AND N6 AND N7 AND N8	(US-PGPUB; USPAT)	OR	ON	ON	2022/02/10 04:27 PM

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 4

Complete if Known	
Application Number	17/203,292
Filing Date	03-16-2021
First Named Inventor	O'TOOLE; Jonathan
Art Unit	3783
Examiner Name	FREDRICKSON, COURTNEY B
Attorney Docket Number	4944.012000E

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	001	US-D788293-S	05-30-2017	ECKSTEIN et al.	
	002	US-D809646-S	02-06-2018	MASON et al.	
	003	US-D832995-S	11-06-2018	MASON et al.	
	004	US-D888225-S	06-23-2020	ASKEM et al.	
	005	US-7641629-B2	01-05-2010	YUEN; Yat Keung William	
	006	US-10398816-B2	09-03-2019	CHANG et al.	
	007	US-10625005-B2	04-21-2020	CHANG et al.	
	008	US-20040127845-A1	07-01-2004	RENZ; Charles J. et al.	
	009	US-20070219486-A1	09-20-2007	MYERS; Kenneth E. et al.	
	010	US-20070228059-A1	10-04-2007	KARSAN; Chettan	
	011	US-20120021068-A1	01-26-2012	BARNESS; Itzhak et al.	
	012	US-20120035951-A1	02-09-2012	GOETZ; Steven M. et al.	
	013	US-20120043065-A1	02-23-2012	RANNE; Pasi et al.	
	014	US-20120072117-A1	03-22-2012	LODDOCH; Alexander et al.	
	015	US-20120072118-A1	03-22-2012	MANN; Tobias	
	016	US-20120095599-A1	04-19-2012	PAK; H. Ali et al.	
	017	US-20120143879-A1	06-07-2012	STOITSEV; Todor	
	018	US-20120220753-A1	08-30-2012	GERA; Lajos et al.	
	019	US-20150212036-A1	07-30-2015	JIN; Jian et al.	
	020	US-20150212037-A1	07-30-2015	OKAZAKI; Satoshi et al.	
	021	US-20170216505-A1	08-03-2017	KIM; Sang Ha	
	022	US-20180361040-A1	12-20-2018	O'TOOLE; Jonathan et al.	
	023	US-20210030934-A1	02-04-2021	ZHANG; Shu Ting	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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