UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009

CONFIRMATION NO. 5839

164
KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

POWER OF ATTORNEY NOTICE

OC000000099206538

Date Mailed: 05/02/2018

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/19/2018.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. 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**.

/zretta/

GCE - Exhibit 1049, Page 1
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
11/054,341	02/09/2005	Theodore W. Jagger	67853-012 PUS1

CONFIRMATION NO. 5839

26096
CARLSON, GASKEY & OLDS, P.C.
400 WEST MAPLE ROAD
SUITE 350
BIRMINGHAM, MI 48009

POA ACCEPTANCE LETTER

OC00000099206574

Date Mailed: 05/02/2018

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/19/2018.

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**.

/zretta/

Doc Code: PA..

Document Description: Power of Attorney

PTO/AIA/82A (07-12)
Approved for use through 11/30/2014. 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 or equivalent) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5. If the Power of Attorney by Applicant form is not accompanied by this transmittal form or an equivalent, the Power of Attorney will not be recognized in the application.

Application Number	11/054341
Filing Date	02/09/2005
First Named Inventor	Theodore W. Jagger
Title	METHOD OF PROVIDING AMBULATORY OXYGEN
Art Unit	3772
Examiner Name	Patel, Nihir B.
Attorney Docket Number	67853-012 PUS1

SIGNATURE of Applicant or Patent Practitioner

Signature	/Timothy J. Murphy/	Date	04/19/2018
Name	Timothy J. Murphy	Telephone	248 988 8360
Registration Number	64,613		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications.

■ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 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.

PTO/AIA/80 (07-17)
Approved for use through 01/31/2018. OMB 0651-0035
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[X] Practitioners associated with Customer Number: 26096

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number

Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[X] The address associated with Customer Number: 26096

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address: VBOX, INCORPORATED

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature	Date 4/11/18
Name Robert J Folkes	Telephone 612 355 5202
Title CFO	

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 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 ossistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. 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 displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Theodore W. Jagger

Application No./Patent No.: 11/054341 Filed/Issue Date: 02/09/2005

Titled: METHOD OF PROVIDING AMBULATORY OXYGEN

VBOX, Incorporated, a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Jagger, Van Brunt, Kivisto, and Lonnes To: VBOX, Incorporated

The document was recorded in the United States Patent and Trademark Office at

Reel 016390, Frame 0364, or for which a copy thereof is attached.

2. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). 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. 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.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. 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 displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☐ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Timothy J. Murphy/	04/19/2018
Signature	Date
Timothy J. Murphy	64613
Printed or Typed Name	Title or Registration Number

Electronic Acknowledgement Receipt

EFS ID:	32385707
Application Number:	11054341
International Application Number:	
Confirmation Number:	5839
Title of Invention:	METHOD OF PROVIDING AMBULATORY OXYGEN
First Named Inventor/Applicant Name:	Theodore W. Jagger
Customer Number:	164
Filer:	Timothy J. Murphy/Carolyn Hannenberg
Filer Authorized By:	Timothy J. Murphy
Attorney Docket Number:	V180.12-0009
Receipt Date:	19-APR-2018
Filing Date:	09-FEB-2005
Time Stamp:	14:09:52
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	Power_of_Attorney_012PUS1.pdf	277826 b40f8ae7cf776715f45561504a8122924b58f5c2	no	4

Warnings:

Information:	
Total Files Size (in bytes):	277826

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 NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	06/07/2011	7954490	V180.12-0009	5839

164 7590 05/18/2011

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 261 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Theodore W. Jagger, White Bear Lake, MN;
Nicholas P. Van Brunt, White Bear Lake, MN;
John A. Kivisto, Oak Grove, MN;
Perry B. Lonnes, White Bear Lake, MN;

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

164 7590 02/02/2011

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

Larrin Bergman	(Depositor's name)
	(Signature)
April 28, 2011	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

TITLE OF INVENTION: METHOD OF PROVIDING AMBULATORY OXYGEN

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$755	$300	$0	$1055	05/02/2011

EXAMINER	ART UNIT	CLASS-SUBCLASS
PATEL, NIHIR B	3772	128-201210

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Kinney & Lange, P.A.
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: VBOX, INCORPORATED

(B) RESIDENCE: (CITY and STATE OR COUNTRY): White Bear Lake, Minnesota

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☒ Issue Fee
☒ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 11-0982 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature /Larrin Bergman/ Date April 28, 2011

Typed or printed name Larrin Bergman Registration No. 57,153

This collection of information is required by 37 CFR 1.311. 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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.

GCE - Exhibit 1049, Page 10
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

PTO/SB/47 (03-09)
Approved for use through 03/31/2012. OMB 0651-0016
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"FEE ADDRESS" INDICATION FORM

Address to:
Mail Stop M Correspondence
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

- OR -

Fax to:
571-273-6500

INSTRUCTIONS: The issue fee must have been paid for application(s) listed on this form. In addition, only an address represented by a Customer Number can be established as the fee address for maintenance fee purposes (hereafter, fee address). A fee address should be established when correspondence related to maintenance fees should be mailed to a different address than the correspondence address for the application. **When to check the first box below**: If you have a Customer Number to represent the fee address. **When to check the second box below**: If you have no Customer Number representing the desired fee address, in which case a completed Request for Customer Number (PTO/SB/125) must be attached to this form. For more information on Customer Numbers, see the Manual of Patent Examining Procedure (MPEP) § 403.

For the following listed application(s), please recognize as the "Fee Address" under the provisions of 37 CFR 1.363 the address associated with:

☑ Customer Number: 00164

OR

☐ The attached Request for Customer Number (PTO/SB/125) form.

PATENT NUMBER (if known)	APPLICATION NUMBER
	11/054,341

Completed by (check one):

☐ Applicant/Inventor — /Larrin Bergman/ (Signature)

☑ Attorney or Agent of record 57,153 (Reg. No.) — Larrin Bergman (Typed or printed name)

☐ Assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96) — 612-337-9374 (Requester's telephone number)

☐ Assignee recorded at Reel _____ Frame_____ — April 28, 2011 (Date)

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more that one signature is required, see below*.

☑ *** Total of 1 forms are submitted.**

This collection of information is required by 37 CFR 1.363. 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 5 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 COMPLETED FORMS TO THIS ADDRESS.
SEND TO: Mail Stop M Correspondence, 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.

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.

Electronic Patent Application Fee Transmittal

Application Number:	11054341
Filing Date:	09-Feb-2005
Title of Invention:	METHOD OF PROVIDING AMBULATORY OXYGEN
First Named Inventor/Applicant Name:	Theodore W. Jagger
Filer:	Larrin Bergman
Attorney Docket Number:	V180.12-0009

Filed as Small Entity

Utility under 35 USC 111(a) Filing Fees

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:				
Utility Appl issue fee	2501	1	755	755
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1055**

Electronic Acknowledgement Receipt	
EFS ID:	9974224
Application Number:	11054341
International Application Number:	
Confirmation Number:	5839
Title of Invention:	METHOD OF PROVIDING AMBULATORY OXYGEN
First Named Inventor/Applicant Name:	Theodore W. Jagger
Customer Number:	00164
Filer:	Larrin Bergman
Filer Authorized By:	
Attorney Docket Number:	V180.12-0009
Receipt Date:	28-APR-2011
Filing Date:	09-FEB-2005
Time Stamp:	15:23:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1055
RAM confirmation Number	1836
Deposit Account	110982
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 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	Issue Fee Payment (PTO-85B)	2011-04-28-IssueFee-V180-12-9KL.pdf	94545 c4a1996e794415764092ebc027976e07abba20b3	no	1
Warnings:					
Information:					
2	Miscellaneous Incoming Letter	2011-04-28-FeeAddress-V180-12-9.pdf	311987 100287212940d28a6cc8303d1ee473e112914b21	no	2
Warnings:					
Information:					
3	Fee Worksheet (PTO-875)	fee-info.pdf	31944 eee86099aee508e26e47d9ed3303275c78336114	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	438476		

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.

RESPONSE UNDER 37 CFR 1.116
EXPEDITED PROCEDURE
EXAMINING GROUP 3700

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	Confirmation No.: 5839
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihir B. Patel
Docket No.	:	V180.12-0009	

RESPONSE

Mail Stop AF
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

FILED VIA EFS-WEB

August 5, 2010

INTRODUCTION

This is in response to the final Office Action mailed on June 9, 2010.

Please enter the after-final amendment filed on 08/05/2010.

NP
/Nihir Patel/
01.28.2011

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11054341	JAGGER ET AL.
	Examiner	Art Unit
	NIHIR PATEL	3772

SEARCHED			
Class	Subclass	Date	Examiner
128	201.25, 205.11, 205.18, 202.26	07.02.2008	NP
96	121, 130, 133, 147	07.02.2008	NP
95	96-103	07.02.2008	NP

SEARCH NOTES		
Search Notes	Date	Examiner
Search Updated	07.02.2008	NP
Search Updated	06.29.2009	NP
Search Updated	06.04.2010	NP
Search Updated	01.18.2011	NP

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
	See Attached Sheet	01.18.2011	NP

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11054341	JAGGER ET AL.
	Examiner	**Art Unit**
	NIHIR PATEL	3772

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☒ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/02/2008	06/04/2010	01/18/2011						
	1	-	-	-						
	2	-	-	-						
	3	-	-	-						
	4	-	-	-						
1	5	✓	✓	=						
	6	-	-	-						
	7	-	-	-						
	8	-	-	-						
2	9	✓	✓	=						
3	10	✓	✓	=						
	11	-	-	-						
6	12	✓	✓	=						
	13	-	-	-						
	14	-	-	-						
	15	-	-	-						
	16	-	-	-						
7	17	✓	✓	=						
10	18	✓	✓	=						
	19	-	-	-						
	20	-	-	-						
11	21	✓	✓	=						
4	22	✓	✓	=						
5	23	✓	✓	=						
8	24	✓	✓	=						
9	25	✓	✓	=						
12	26	✓	✓	=						
13	27	✓	✓	=						
	1	-								
	2	-								
	3	-								
	4	-								
	5	✓								
	6	✓								
	7	✓								
	8	-								
	9	✓								

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11054341	JAGGER ET AL.
	Examiner	**Art Unit**
	NIHIR PATEL	3772

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☒ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/02/2008	06/04/2010	01/18/2011						
	10	✓								
	11	-								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	-								
	17	✓								
	18	✓								
	19	✓								
	20	✓								
	21	✓								

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
PO Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

Bib Data Sheet

CONFIRMATION NO. 5839

SERIAL NUMBER	FILING OR 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
11/054,341	02/09/2005 RULE	128	3772	V180.12-0009

APPLICANTS

Theodore W. Jagger, White Bear Lake, MN;
Nicholas P. Van Brunt, White Bear Lake, MN;
John A. Kivisto, Oak Grove, MN;
Perry B. Lonnes, White Bear Lake, MN;

** CONTINUING DATA **********

** FOREIGN APPLICATIONS **********

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 03/10/2005 ** SMALL ENTITY **

		STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed	☐ yes ☒ no	MN	19	13 ~~21~~ NP	3 ~~4~~ NP
35 USC 119 (a-d) conditions met	☐ yes ☒ no ☐ Met after Allowance				
Verified and Acknowledged	/Nihir Patel/ Examiner's Signature NP Initials				

ADDRESS
164

TITLE
Method of providing ambulatory oxygen

FILING FEE RECEIVED		
805	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

GCE - Exhibit 1049, Page 21
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

164 7590 02/02/2011

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	
ART UNIT	PAPER NUMBER
3772	

DATE MAILED: 02/02/2011

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

TITLE OF INVENTION: METHOD OF PROVIDING AMBULATORY OXYGEN

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$755	$300	$0	$1055	05/02/2011

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

GCE - Exhibit 1049, Page 22
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

164 7590 02/02/2011

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

TITLE OF INVENTION: METHOD OF PROVIDING AMBULATORY OXYGEN

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$755	$300	$0	$1055	05/02/2011

EXAMINER	ART UNIT	CLASS-SUBCLASS
PATEL, NIHIR B	3772	128-201210

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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.

GCE - Exhibit 1049, Page 23
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 02/02/2011

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	
ART UNIT	PAPER NUMBER
3772	

DATE MAILED: 02/02/2011

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 0 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 0 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

Notice of Allowability	Application No.	Applicant(s)	
	11/054,341	JAGGER ET AL.	
	Examiner	Art Unit	
	NIHIR PATEL	3772	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *appeal brief filed on 11/01/2010*.

2. ☒ The allowed claim(s) is/are *5, 9, 10, 12, 17, 18 and 21-27*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   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)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/Nihir Patel/ Examiner, Art Unit 3772	/Patricia Bianco/ Supervisory Patent Examiner, Art Unit 3772

GCE - Exhibit 1049, Page 25
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

DETAILED ACTION

Response to Arguments

In view of the appeal brlef filed on November 1st, 2010, PROSECUTION IS HEREBY REOPENED. A new office action is set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by signing below:

/Patricia Bianco/

Supervisory Patent Examiner, Art Unit 3772

.

Allowable Subject Matter

Claims **5, 9, 10, 12, 17, 18 and 21-27** are allowed.

Reason for Allowance

The following is an examiner's statement of reasons for allowance:

In reference to claims 5, 9, 10, 12, 17, 18 and 21-27, the prior art does not teach the method steps of pumping the product gas from the separator to a storage reservoir in combination with controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas delivered from the reservoir.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to NIHIR PATEL whose telephone number is (571)272-4803. The examiner can normally be reached on 7:30 to 4:30 every other Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patricia Bianco can be reached on (571) 272-4940. 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 http://pair-direct.uspto.gov. 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.

/Nihir Patel/
Examiner, Art Unit 3772

/Patricia Bianco/

Supervisory Patent Examiner, Art Unit 3772

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	947	128/201.25	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12
L2	675	128/205.11	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12
L3	368	128/205.18	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12
L4	470	128/202.26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12
L5	565	96/121	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12
L6	854	96/130	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12
L7	353	96/133	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12
L8	519	96/147	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12

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L9	1390	95/96	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12
L10	376	95/97	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12
L11	1297	95/98	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12
L12	380	95/99	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:12
L13	798	95/100	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:13
L14	358	95/101	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:13
L15	225	95/102	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:13
L16	337	95/103	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2011/01/18 20:13

1/18/2011 8:13:26 PM
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EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L17	519	vacuum same swing same adsorption	US-PGPUB	OR	ON	2011/01/18 20:14
L18	65549	ambient same air	US-PGPUB	OR	ON	2011/01/18 20:14
L19	236	l17 and l18	US-PGPUB	OR	ON	2011/01/18 20:15
L20	90	l19 and "separator"	US-PGPUB	OR	ON	2011/01/18 20:15
L21	56	l20 and "pumping"	US-PGPUB	OR	ON	2011/01/18 20:16
L22	15	l21 and "patient"	US-PGPUB	OR	ON	2011/01/18 20:16

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Issue Classification

Application/Control No.	Applicant(s)/Patent Under Reexamination
11054341	JAGGER ET AL.
Examiner	**Art Unit**
NIHIR PATEL	3772

ORIGINAL		INTERNATIONAL CLASSIFICATION	
CLASS	SUBCLASS	CLAIMED	NON-CLAIMED
128	201.25	A 6 2 B 7 / 10 (2006.0)	
		A 6 2 B 7 / 00 (2006.0)	
		A 6 1 M 16 / 00 (2006.0)	
		A 6 1 M 15 / 00 (2006.0)	
		B 0 1 D 59 / 26 (2006.0)	

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
128	205.11	205.18	202.26		
96	121	130	133	147	
95	96	97	98	99	100
95	101	102	103		

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☒ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1	7	17												
	2	10	18												
	3		19												
	4		20												
1	5	11	21												
	6	4	22												
	7	5	23												
	8	8	24												
2	9	9	25												
3	10	12	26												
	11	13	27												
6	12														
	13														
	14														
	15														
	16														

/NIHIR PATEL/ Examiner.Art Unit 3772	01/18/2011	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	13	
/PATRICIA M BIANCO/ Supervisory Patent Examiner.Art Unit 3772	01/30/2011	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5

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GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	Confirmation No.: 5839
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihir B. Patel
Docket No.	:	V180.12-0009	

APPEAL BRIEF FOR APPELLANT

Mail Stop Appeal Brief - Patents
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

FILED VIA EFS-WEB

November 1, 2010

INTRODUCTION

This is an appeal from the Final Office Action mailed June 9, 2010.

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Real Party in Interest

The real party in interest is VBox, Incorporated, which/who is the owner of the entire right, title, and interest in the application.

Related Appeals and Interferences

There are no known related appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

Status of the Claims

I. Total number of claims in the application

A.	Claims in the application are:	5, 9, 10, 12, 17, 18, and 21-27

II. Status of all of the claims

A.	Claims canceled:	1-4, 6-8, 11, 13-16, and 19-20
B.	Claims withdrawn but not canceled:	0
C.	Claims pending:	5, 9, 10, 12, 17, 18, and 21-27
D.	Claims allowed:	0
E.	Claims rejected:	5, 9, 10, 12, 17, 18, and 21-27

III. Claims on appeal

A.	The claims on appeal are:	5, 9, 10, 12, 17, 18, and 21-27

Status of Amendments

No amendments have been filed since the mailing of the June 9, 2010, Final Office Action, in which claims 5, 9, 10, 12, 17, 18, and 21 – 27 were rejected. A Response After Final was filed August 5, 2010 in response to the Final Office Action. No amendments to the claims were made in the Response After Final filed August 5, 2010. An Advisory Action mailed August 24, 2010, indicated that the rejections of claims were maintained despite arguments presented in the Response After Final.

Summary of Claimed Subject Matter

Independent claim 5 recites a method of providing concentrated oxygen product gas to a patient (P). The method includes producing product gas with an ambulatory oxygen separator (100) using a vacuum swing adsorption process that includes: (a) introducing ambient air into a first end (132A) of a column (130A) containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end (134A) of the column (130A); (b) evacuating the column (130A) through the first end (132A) to remove adsorbed gas from the column (130A); (c) repressurizing the column (130A) by introducing product gas into the second end (134A) of the column (130A) and ambient air into the first end (132A) of the column (130A), wherein introducing product gas occurs during an initial portion of the repressurization; and (d) repeating steps (a) - (c). (*See FIGS. 5 & 6, Page 11 Line 6 – Page 18 Line 8*). The product gas is pumped from the separator (100) to a storage reservoir (158). (*See Page 27 Lines 7 – 9*). Product gas produced by the vacuum swing absorption process is stored in the reservoir (158) of the ambulatory oxygen separator (100) at a pressure of about 1.0 atm to 2.0 atm. (*See Page 28 Lines 1 – 3*). A fluid is delivered to the patient (P) consisting essentially of the product gas through a dispensing valve (160) that regulates the amount of product gas delivered from the reservoir (158) to the patient (P). (*See Page 26 Lines 10 – 18*). The cycle rate at which steps (a) - (c) are performed is controlled as a function of product gas delivered from the reservoir (158). (*See Page 28 Lines 11 – 22; See also generally Page 36 Line 6 – Page 37 Line 15; FIG. 5*).

Independent claim 12 recites a similar method of providing concentrated oxygen to a patient (P). The method includes producing oxygen-rich product gas with an ambulatory oxygen separator (100) using a vacuum swing adsorption process comprising: (a) introducing ambient air into a first end (132A) of a column (130A) containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end (134A) of the column (130A); (b) evacuating the column (130A) through the first end (132A) to remove adsorbed gas from the column (130A); (c) repressurizing the column (130A) by introducing product gas into the second end (134A) of the column (130A) and ambient air into the first end (132A) of the column (130A), wherein introducing product gas occurs during an initial portion of the repressurization prior to introducing ambient air; and (d) repeating steps (a) - (c). (*See FIGS. 5 & 6, Page 11 Line 6 – Page 18 Line 8*). The product gas is pumped from the separator (100) to a storage reservoir (158). (*See Page 27 Lines 7 – 9*). Product gas of the ambulatory oxygen separator (100) is stored at a pressure of about 1.0 atm to 2.0 atm. (*See Page 28 Lines 1 – 3*). A fluid is delivered to the patient (P) through a dispensing valve (160) that regulates the flow of the fluid from the reservoir (158) amount of product gas delivered from the reservoir (158), the fluid consisting essentially of the stored product gas. (*See Page 26 Lines 10 – 18*). The cycle rate at which steps (a) - (c) are performed is controlled as a function of product gas delivered from the reservoir (158). (*See Page 28 Lines 11 – 22; See also generally Page 36 Line 6 – Page 37 Line 15; FIG. 5*).

Independent claim 18 recites a method of providing concentrated oxygen product gas to a patient (P). The method includes producing the product gas with an ambulatory oxygen separator (100) utilizing a vacuum swing adsorption process. The process comprises the steps of: (a) introducing ambient air at about 1.0 atmosphere (atm) into a first end (132A) of a column (130A) containing an LiLSX adsorbent material and removes product gas out a second end (132A) of the column (130A); (b) evacuating the column (130A) through the first end (132A) to a vacuum level within a range of about 0.1 atm to about 1.0 atm; (c) repressurizing the column (130A) to about 1.0 atm by introducing product gas into the column (130A) through the second end (134A) and introducing ambient air into the column (130A) through the first end (132A); and (d) repeating steps

(a) - (c). (*See FIGS. 5 & 6, Page 11 Line 6 – Page 18 Line 8, and Page 31 Line 24 – Page 32 Line 7).* The product gas is pumped from the separator (100) to a storage reservoir (158). (*See Page 27 Lines 7 – 9*). Product gas of the ambulatory oxygen separator (100) is stored at a pressure of about 1.0 atm to 2.0 atm. (*See Page 28 Lines 1 – 3*). A fluid is delivered to the patient (P) through a dispensing valve (160) that regulates the flow of the fluid, the fluid consisting essentially of the stored product gas. (*See Page 26 Lines 10 – 18*). The cycle rate at which steps (a) - (c) are performed are controlled as a function of delivered fluid from the reservoir (158) to the patient (P). (*See Page 28 Lines 11 – 22; See also generally Page 36 Line 6 – Page 37 Line 15; FIG. 5*).

Dependent claims 17, 23, and 25 all recite that the methods of the independent claims further include sensing the product gas pressure in the reservoir (158); and controlling the speed of the motor (146) that determines the cycle rate. (*See Page 28 Lines 11 – 14*).

Grounds of Rejection to be Reviewed on Appeal

1. Claims 5, 9, 10, 12, 17 and 22-25 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) and further in view of Deane et al. (U.S. Patent No. 7,135,059);

2. Claims 18, 21, 26, and 27 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) and Deane et al. (U.S. Patent No. 7,135,059), and further in view of Dee et al. (U.S. Patent No. 6,544,318).

Argument

Independent claims 5, 12, and 18 all require **pumping the product gas from the separator to a reservoir**. This element is not present in the prior art.

The system disclosed in the application contains two separate pumps. The first is the vacuum pump (144) that is used to run the separation cycle. The second it the product pump (154) that takes the product from the separation cycle and moves it to the reservoir. These are illustrated in FIG. 5.

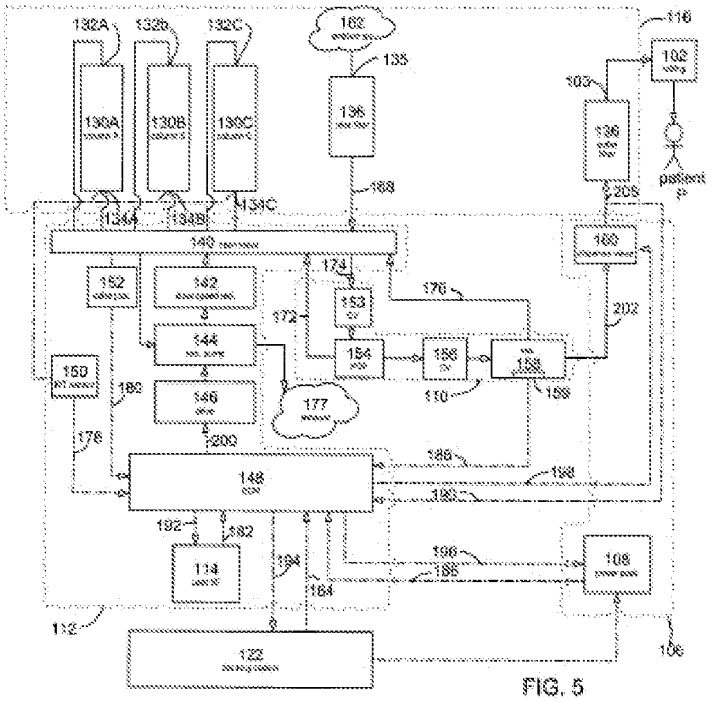


FIG. 5

Col. 4, Lines 32 – 40 of Tedford is cited in the Office Action, and states:

> The first bed 10 is connected with a surge tank 30 by way of a first check valve 32 or other unidirectional valving means. The first check valve 32 permits the primary product gas from the first bed to flow into the surge tank when product gas pressure in the first bed exceeds the pressure of product gas in the surge tank. The first check valve prohibits the product gas from flowing from the surge tank when the pressure in the first bed is lower than the surge tank.

The Office Action states that the cited section of Tedford "**implies** that **inherently** the device is pumping the product gas from the separator to a reservoir" (emphasis added). Applicant respectfully notes that what a reference "implies" is not a standard for examination, but the standard is what a reference teaches as viewed by one of ordinary skill in the art. Similarly, for something to be "inherent", "evidence must make clear that the missing descriptive matter is **necessarily** present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." M.P.E.P. §2131.02 (emphasis added).

"Pumping", defined as to raise, drive, etc., with a pump, requires an affirmative action and structure to complete the required step of the claim. The Tedford reference only teaches that product gas at a higher pressure will flow into a reservoir. This does not meet the limitation as all gases at a higher pressure will flow into a lower pressure system without the use of a pump.

Upon a full reading of the Tedford reference, continuing immediately after the cited text in the Office Action, it is stated: "more specific to the preferred embodiment, the check valve imposes a 1.5 psi bias such that flow is only permitted when the pressure in the first bed exceeds the pressure in the surge tank by 1.5 psi." This illustrates the basic difference between vacuum separation (VSA) used in the current invention and vacuum-pressure separation (VPSA) used by Tedford, which are known to those of skill in the art. VSA and VPSA both achieve a desire result of separating gases, but the two are not interchangeable.

The VSA system of the current disclosure is physically incapable of meeting the operation disclosed in Tedford. Tedford's VPSA requires that gas flow from the bed to the surge tank because the gas is at a higher pressure (above atmospheric pressure). There is no structure required to cause this flow from the separator to the surge tank, and the flow is created by a difference in pressure of the product gas in the separator. In contrast, the current claims on appeal require that a pump be used. The pumping is necessary as the separated gas is obtained at a pressure below 1.0 atm, and the claims require that the gas be stored at a pressure of 1.0 to 2.0 atm. Hence, ***pumping*** the gas is required.

This element of the claims is not taught by Tedford or the other art of record. For the Tedford reference to teach this limitation, a separate pumping structure would have to be present, but would be a redundancy as the gas flows due to a pressure differential between the separator and the reservoir (surge tank). There is no teaching of "pumping the product gas from the separator to a storage reservoir" as required by all of the independent claims on appeal. What is taught by Tedford is a flowing of separated product gas through a check valve to a surge tank. This does not meet the limitation of the claims. One of skill in the art would not imply a pump from the reference, nor is a pump that moves the separated gas from the separator to the reservoir inherent.

Reiss teaches a process for oxygen-enrichment of air by means of vacuum swing

adsorption (VSA) using Ca zeolite A molecular sieves, wherein the adsorbers of the VSA units are filled with Ca zeolite A molecular sieves which have different adsorption characteristics.

Deane et al. teaches a portable gas fractionalization apparatus that provides oxygen rich air to patients. The components are assembled in a housing that is divided into two compartments. One compartment is maintained at a lower temperature than the other compartment. The lower temperature compartment is configured for mounting components that can be damaged by heat. The higher temperature compartment is configured for mounting heat generating components. An air stream is directed to flow from an ambient air inlet to an air outlet constantly so that there is always a fresh source of cooling air. The apparatus utilizes a PSA unit to produce an oxygen enriched product. The PSA unit incorporates a single ended column design in which all flow paths and valves can be co-located on a single integrated manifold.

Dee et al. teaches a pressure swing adsorption process for the recovery of high purity oxygen from a feed gas comprising oxygen, nitrogen, and argon. The process includes a forward flow stage which comprises (a) passing the feed gas into a first adsorption zone containing an adsorbent selective for the adsorption of nitrogen over oxygen and argon, and withdrawing therefrom a nitrogen-depleted intermediate gas; (b) passing the nitrogen-depleted intermediate gas into a second adsorption zone containing an adsorbent which is selective for the adsorption of nitrogen over argon and selective for the adsorption of argon over oxygen; (c) withdrawing an oxygen-enriched product gas from the second adsorption zone; and (d) terminating the passing of feed gas into the first adsorption zone and withdrawing an oxygen-enriched depressurization gas from the second adsorption zone in the same flow direction as (c). During (a) or during (d), nitrogen breakthrough from the first adsorption zone can occur and nitrogen can be adsorbed in the second adsorption zone.

None of these cited references, Reiss, Deane et al., or Dee et al., disclose a pump between a separator and a reservoir, which provides the missing limitation from Tedford. That is, none of the cited references teach "pumping the product gas from the separator to a reservoir". Thus, the combination of Reiss, Tedford Jr., Dee et al., and Deane et al., do not teach all the claims limitations of claims 5, 12, and 18, and the rejection thereof should be withdrawn. If an independent

claim is nonobvious under 35 U.S.C. §103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071; M.P.E.P. §2143.01. Thus, claims 9-10, 17, and 21-27 are also allowable.

The Office Action does not specifically address the limitations of claims 22-27. A motor is present in Tedford (addressing claims 22, 24, and 26), but there is no disclosure of the claim limitations required by claims 23, 25, and 17:

sensing the product gas pressure in the reservoir; and

controlling the speed of the motor that determines the cycle rate.

Nothing in the art of record teaches these limitations as claimed. Thus, in addition to the other reasons presented, claims 23, 25, and 27 are allowable as the art of record does not teach the aforementioned limitations of the claim.

CONCLUSION

All pending claims 5, 9-10, 12, 17-18, and 21-27 are in condition for allowance. Reversal of the rejections of those claims is respectfully requested.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: November 1, 2010

By: /Larrin Bergman/

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB: adj

Claims Appendix

1-4. (Canceled)

5. (Previously Presented) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas with an ambulatory oxygen separator using a vacuum swing adsorption process that includes:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization;

(d) repeating steps (a) - (c);

pumping the product gas from the separator to a storage reservoir;

storing product gas produced by the vacuum swing absorption process in ~~a~~ the reservoir of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas delivered from the reservoir.

6-8. (Canceled)

9. (Previously Presented) The method of claim 5 wherein delivering the fluid is from the reservoir to the patient.

10. (Previously Presented) The method of claim 5 wherein delivering the fluid occurs in response to inhalation by the patient.

11. (Canceled)

12. (Previously Presented) A method of providing concentrated oxygen to a patient, the method comprising:

producing oxygen-rich product gas with an ambulatory oxygen separator using a vacuum swing adsorption process comprising:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization prior to introducing ambient air;

(d) repeating steps (a) - (c);

pumping the product gas from the separator to a storage reservoir;

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient through a dispensing valve that regulates the flow of the fluid from the reservoir, the fluid consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas delivered from the reservoir.

13-16. (Canceled)

17. (Original) The method of claim 12 wherein delivering stored product gas comprises delivering a pulse of product gas to the patient in response to inhalation by the patient.

18. (Previously Presented) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing the product gas with an ambulatory oxygen separator utilizing a vacuum swing adsorption process, the process comprising the steps of:

(a) introducing ambient air at about 1.0 atmosphere (atm) into a first end of a column containing an LiLSX adsorbent material and removes product gas out a second end of the column;

(b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm;

(c) repressurizing the column to about 1.0 atm by introducing product gas into the column through the second end and introducing ambient air into the column through the first end; and

(d) repeating steps (a) - (c);

pumping the product gas from the separator to a storage reservoir;

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient through a dispensing valve that regulates the flow of the fluid, the fluid consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of delivered from the reservoir to the patient.

19-20. (Canceled)

21. (Previously Presented) The method of claim 18 wherein delivering stored product gas comprises delivering a pulse of product gas from the reservoir to the patient in response to an inhalation by the patient.

22. (Previously Presented) The method of claim 5 wherein the ambulatory oxygen separator is driven by a motor.

23. (Previously Presented) The method of claim 22 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

24. (Previously Presented) The method of claim 12 wherein the ambulatory oxygen separator is driven by a motor.

25. (Previously Presented) The method of claim 24 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

26. (Previously Presented) The method of claim 18 wherein the ambulatory oxygen separator is driven by a motor.

27. (Previously Presented) The method of claim 26 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

Evidence Appendix

1. Evidence entered by the Examiner and relied upon by the Appellant:

   None.

2. Evidence relied upon by the Examiner as to grounds of rejection to be reviewed on appeal:

   Reiss, U.S. Patent No. 5,114,440

   Tedford, Jr., U.S. Patent No. 4,449,990

   Deane et al., U.S. Patent No. 7,135,059

   Dee et al., U.S. Patent No. 6,544,318

Related Proceedings Appendix

None.

Table of Authorities Appendix

1. M.P.E.P. §2103.02
2. M.P.E.P. §2143.01.
3. *In re Fine*, 837 F.2d 1071

Electronic Patent Application Fee Transmittal

Application Number:	11054341
Filing Date:	09-Feb-2005
Title of Invention:	Method of providing ambulatory oxygen
First Named Inventor/Applicant Name:	Theodore W. Jagger
Filer:	Larrin Bergman
Attorney Docket Number:	V180.12-0009

Filed as Small Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Filing a brief in support of an appeal	2402	1	270	270
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**270**

Electronic Acknowledgement Receipt	
EFS ID:	8743136
Application Number:	11054341
International Application Number:	
Confirmation Number:	5839
Title of Invention:	Method of providing ambulatory oxygen
First Named Inventor/Applicant Name:	Theodore W. Jagger
Customer Number:	00164
Filer:	Larrin Bergman
Filer Authorized By:	
Attorney Docket Number:	V180.12-0009
Receipt Date:	01-NOV-2010
Filing Date:	09-FEB-2005
Time Stamp:	16:39:18
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$270
RAM confirmation Number	2913
Deposit Account	110982
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Appeal Brief Filed	2010-06-09-AppealBrief-V180-12-9.pdf	105491 294bcae0d3177ea71a55126d67e4de9a7909a843	no	16
Warnings:					
Information:					
2	Fee Worksheet (PTO-875)	fee-info.pdf	29809 d8f5c47df75e180d65fb8f606dcea3ee1a53065f	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	135300		

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<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>
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PTO/SB/31 (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
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NOTICE OF APPEAL FROM THE EXAMINER TO THE BOARD OF PATENT APPEALS AND INTERFERENCES

Docket Number (Optional): V180.12-0009

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" [37 CFR 1.8(a)] on September 3, 2010

Signature: /Larrin Bergman/

Typed or printed name: Larrin Bergman

In re Application of: Theodore W. Jagger

Application Number	Filed
11/054,341	February 9, 2005

For: METHOD OF PROVIDING AMBULATORY OXYGEN

Art Unit	Examiner
3772	Nihir B. Patel

Applicant hereby **appeals** to the Board of Patent Appeals and Interferences from the last decision of the examiner.

The fee for this Notice of Appeal is (37 CFR 41.20(b)(1)) $ 540.00

☑ Applicant claims small entity status. See 37 CFR 1.27. Therefore, the fee shown above is reduced by half, and the resulting fee is: $ 270.00

☐ 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 No. 110982 .

☐ A petition for an extension of time under 37 CFR 1.136(a) (PTO/SB/22) is enclosed.

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/inventor.

☐ assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

☑ attorney or agent of record. Registration number 57,153.

☐ attorney or agent acting under 37 CFR 1.34. Registration number if acting under 37 CFR 1.34. _____

/Larrin Bergman/
Signature

Larrin Bergman
Typed or printed name

612-339-1863
Telephone number

September 3, 2010
Date

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. 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 41.31. 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, 1.14 and 41.6. 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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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.

Electronic Patent Application Fee Transmittal

Application Number:	11054341
Filing Date:	09-Feb-2005
Title of Invention:	Method of providing ambulatory oxygen
First Named Inventor/Applicant Name:	Theodore W. Jagger
Filer:	Larrin Bergman
Attorney Docket Number:	V180.12-0009

Filed as Small Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Notice of appeal	2401	1	270	270
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**270**

Electronic Acknowledgement Receipt	
EFS ID:	8352064
Application Number:	11054341
International Application Number:	
Confirmation Number:	5839
Title of Invention:	Method of providing ambulatory oxygen
First Named Inventor/Applicant Name:	Theodore W. Jagger
Customer Number:	00164
Filer:	Larrin Bergman
Filer Authorized By:	
Attorney Docket Number:	V180.12-0009
Receipt Date:	03-SEP-2010
Filing Date:	09-FEB-2005
Time Stamp:	11:52:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$270
RAM confirmation Number	7926
Deposit Account	110982
Authorized User	
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Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Notice of Appeal Filed	2010-09-01-NoticeofAppeal-V180-12-9.pdf	247553 97d31170ff967d71591f028b74bf8c16ca74bf78	no	2
Warnings:					
Information:					
2	Fee Worksheet (PTO-875)	fee-info.pdf	29940 1104d0e276b341da93214552eb1d11463813042e	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	277493		

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<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.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 08/24/2010

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	
ART UNIT	PAPER NUMBER
3772	

MAIL DATE	DELIVERY MODE
08/24/2010	PAPER

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.

Advisory Action Before the Filing of an Appeal Brief	**Application No.** 11/054,341	**Applicant(s)** JAGGER ET AL.	
	Examiner NIHIR PATEL	**Art Unit** 3772	

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 05 August 2010 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

1. ☒ The reply was filed after a final rejection, but prior to or on the same day as filing a Notice of Appeal. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114. The reply must be filed within one of the following time periods:
   a) ☐ The period for reply expires _____months from the mailing date of the final rejection.
   b) ☒ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.

   Examiner Note: If box 1 is checked, check either box (a) or (b). ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☐ The proposed amendment(s) filed after a final rejection, but prior to the date of filing a brief, will not be entered because
   (a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below);
   (b) ☐ They raise the issue of new matter (see NOTE below);
   (c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
   (d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.

   NOTE: _____. (See 37 CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____.
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☐ For purposes of appeal, the proposed amendment(s): a) ☐ will not be entered, or b) ☐ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.
   The status of the claim(s) is (or will be) as follows:
   Claim(s) allowed: _____.
   Claim(s) objected to: _____.
   Claim(s) rejected: _____.
   Claim(s) withdrawn from consideration: _____.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ The affidavit or other evidence filed after a final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
9. ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
10. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

11. ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: See Continuation Sheet.
12. ☒ Note the attached Information *Disclosure Statement*(s). (PTO/SB/08) Paper No(s). _____
13. ☐ Other: _____.

/Patricia Bianco/
Supervisory Patent Examiner, Art Unit 3772

/Nihir Patel/
Examiner, Art Unit 3772

Continuation of 11. does NOT place the application in condition for allowance because: The applicant argues that Tedford does not teach pumping the product gas from the separator to a reservoir. The examiner disagrees with the applicant's argument. Again the examiner would like to point out that the check valve 32 permits product gas from the first bed to flow into the surge tank when the product gas pressure in the first bed exceeds the pressure of product gas iin the surge tank implies that the device is pumping the product gas from the separator to a reservoir. The applicant further argues that the VSA and VPSA are not interchangeable. The examiner disagrees with the applicant's argument the nDeane reference recites that VSA and VPSA produce the oxygen rich product gas indicates that the devices are interchangeble. The applicant further argues that the references does not teach sensing the product gas pressure in the reservoir and controlling the speed of the motor that determines the cycle rate. The examiner disagrees with the applicant's argument.. Column 6 lines 30-46 teaches a device that senses the product gas pressure in the reservoir; and controlling the speed of the motor that determines the cycle rate.

GCE - Exhibit 1049, Page 61
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

RESPONSE UNDER 37 CFR 1.116
EXPEDITED PROCEDURE
EXAMINING GROUP 3700

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	Confirmation No.: 5839
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihir B. Patel
Docket No.	:	V180.12-0009	

RESPONSE

Mail Stop AF
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

FILED VIA EFS-WEB

August 5, 2010

INTRODUCTION

This is in response to the final Office Action mailed on June 9, 2010.

CURRENTLY PENDING CLAIMS

1. (Canceled)

2. (Canceled)

3. (Canceled)

4. (Canceled)

5. (Previously Presented) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas with an ambulatory oxygen separator using a vacuum swing adsorption process that includes:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization;

(d) repeating steps (a) - (c);

pumping the product gas from the separator to a storage reservoir;

storing product gas produced by the vacuum swing absorption process in ~~a~~ the reservoir of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas delivered from the reservoir.

6. (Canceled)

7. (Canceled)

8. (Canceled)

9. (Previously Presented) The method of claim 5 wherein delivering the fluid is from the reservoir to the patient.

10. (Previously Presented) The method of claim 5 wherein delivering the fluid occurs in response to inhalation by the patient.

11. (Canceled)

12. (Previously Presented) A method of providing concentrated oxygen to a patient, the method comprising:

producing oxygen-rich product gas with an ambulatory oxygen separator using a vacuum swing adsorption process comprising:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization prior to introducing ambient air;

(d) repeating steps (a) - (c);

pumping the product gas from the separator to a storage reservoir;

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient through a dispensing valve that regulates the flow of the fluid from the reservoir, the fluid consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas delivered from the reservoir.

13. (Canceled)

14. (Canceled)

15. (Canceled)

16. (Canceled)

17. (Original) The method of claim 12 wherein delivering stored product gas comprises delivering a pulse of product gas to the patient in response to inhalation by the patient.

18. (Previously Presented) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing the product gas with an ambulatory oxygen separator utilizing a vacuum swing adsorption process, the process comprising the steps of:

(a) introducing ambient air at about 1.0 atmosphere (atm) into a first end of a column containing an LiLSX adsorbent material and removes product gas out a second end of the column;

(b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm;

(c) repressurizing the column to about 1.0 atm by introducing product gas into the column through the second end and introducing ambient air into the column through the first end; and

(d) repeating steps (a) - (c);

pumping the product gas from the separator to a storage reservoir;

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient through a dispensing valve that regulates the flow of the fluid, the fluid consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of delivered from the reservoir to the patient.

19. (Canceled)

20. (Canceled)

21. (Previously Presented) The method of claim 18 wherein delivering stored product gas comprises delivering a pulse of product gas from the reservoir to the patient in response to an inhalation by the patient.

22. (Previously Presented) The method of claim 5 wherein the ambulatory oxygen separator is driven by a motor.

23. (Previously Presented) The method of claim 22 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

24. (Previously Presented) The method of claim 12 wherein the ambulatory oxygen separator is driven by a motor.

25. (Previously Presented) The method of claim 24 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

26. (Previously Presented) The method of claim 18 wherein the ambulatory oxygen separator is driven by a motor.

27. (Previously Presented) The method of claim 26 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

REMARKS

This is in response to the Office Action mailed on June 9, 2010, in which claims 5, 9-10, 12, 17-18, and 21-27 were rejected. Specifically, claims 5, 9, 10, 12, 17 and 22-25 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) and further in view of Deane et al. (U.S. Patent No. 7,135,059); and claims 18, 21, 26, and 27 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) further in view of Deane et al. (U.S. Patent No. 7,135,059) and further in view of Dee et al. (U.S. Patent No. 6,544,318). A copy of the currently pending claims has been reproduced above for reference. In view of the following remarks, reconsideration and allowance of all claims (5, 9-10, 12, 17-18, and 21-27) is requested.

Independent claims 5, 12, and 18 require: **pumping the product gas from the separator to a reservoir**. This language is not present in the prior art.

The Office Action states that a cited section of Tedford "**implies** that **inherently** the device is pumping the product gas from the separator to a reservoir" (emphasis added). Applicant respectfully notes that what a reference "implies" is not a standard for examination, but the standard is what a reference teaches as viewed by one of ordinary skill in the art. Similarly, for something to be "inherent", "evidence must make clear that the missing descriptive matter is **necessarily** present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." M.P.E.P. §2131.02 (emphasis added).

Upon a full reading of the Tedford reference, continuing immediately after the cited text in the Office Action, it is stated: "more specific to the preferred embodiment, the check valve imposes a 1.5 psi bias such that flow is only permitted when the pressure in the first bed exceeds the pressure in the surge tank by 1.5 psi." This illustrates the basic difference between vacuum separation (VSA) and vacuum-pressure separation (VPSA) of gases, which are known to those of skill in the art. VSA and VPSA both achieve a desire result of separating gases, but the two are not interchangeable.

The VSA system of the current disclosure is physically incapable of meeting the disclosure of Tedford. Tedford's VPSA requires that gas flow from the bed to the surge tank because the gas is at a higher pressure (above atmospheric pressure). There is no structure required to cause this flow from the separator to the surge tank, and the flow is created by a difference in pressure of the product gas in the separator. The current claims require that a pump be used. The pumping is necessary as the separated gas is obtained at a pressure below 1.0 atm, and the claims require that the gas be stored at a pressure of 1.0 to 2.0 atm. Hence, pumping the gas is required.

This limitation is not taught by Tedford or the other art of record. For the Tedford reference to teach this limitation, a separate pumping structure would have to be present, but would be a redundancy as the gas flows due to a pressure differential between the separator and the reservoir (surge tank). There is no teaching of "pumping the product gas from the separator to a storage reservoir" as required by all of the independent claims. What is taught is a flowing of separated product gas through a check valve to a surge tank. This does not meet the limitation of the claims. One of skill in the art would not imply a pump from the reference, nor is a pump that moves the separated gas from the separator to the reservoir inherent.

Thus, the combination of Reiss, Tedford Jr., Dee et al., and Deane et al., do not teach all the claims limitations of claims 5, 12, and 18, and the rejection thereof should be withdrawn. If an independent claim is nonobvious under 35 U.S.C. §103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071; M.P.E.P. §2143.01. Thus, claims 9-10, 17, and 21-27 are also allowable.

The Office Action does not specifically address the limitations of claims 22-27. A motor is present in Tedford (addressing claims 22, 24, and 26), but there is no disclosure of the claim limitations required by claims 23, 25, and 17:

sensing the product gas pressure in the reservoir; and

controlling the speed of the motor that determines the cycle rate.

Nothing in the art of record teaches these limitations as claimed. Thus, in addition to the other reasons presented, claims 23, 25, and 27 are allowable as the art of record does not teach the

aforementioned limitations of the claim.

Conclusion

In view of the foregoing, all pending claims 5, 9-10, 12, 17-18, and 21-27 are in condition for allowance. A notice to that effect is respectfully requested.

The Examiner is cordially invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate the allowance of this application.

The Commissioner is hereby authorized to charge any additional fee required under 37 C.F.R. 1.16 and 1.17 and credit any overpayments to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: August 5, 2010

By: /Larrin Bergman/
Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:adj

Electronic Acknowledgement Receipt	
EFS ID:	8161608
Application Number:	11054341
International Application Number:	
Confirmation Number:	5839
Title of Invention:	Method of providing ambulatory oxygen
First Named Inventor/Applicant Name:	Theodore W. Jagger
Customer Number:	00164
Filer:	Larrin Bergman
Filer Authorized By:	
Attorney Docket Number:	V180.12-0009
Receipt Date:	05-AUG-2010
Filing Date:	09-FEB-2005
Time Stamp:	14:33:04
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		2010-06-09-ResponseAF-V180-12-9KL.pdf	35413 98e08f7c8259c5cae714094e0835833d021625cf	yes	9

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment After Final	1	1
	Claims	2	6
	Applicant Arguments/Remarks Made in an Amendment	7	9
Warnings:			
Information:			
	Total Files Size (in bytes):	35413	

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 (07-06)
Approved for use through 1/31/2007. 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	Filing Date	☐ To be Mailed
11/054,341	02/09/2005	

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☒ RATE ($)	SMALL ENTITY ☒ FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
FOR	NUMBER FILED	NUMBER EXTRA					
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 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			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 08/05/2010	(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 ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 13	Minus	** 21	= 0	X $26 =	0	OR	X $ =	
Independent (37 CFR 1.16(h))	* 3	Minus	***4	= 0	X $110 =	0	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	0	OR	TOTAL ADD'L FEE	

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
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 number found in the appropriate box in column 1.

Legal Instrument Examiner:
/Ruby Johnson/

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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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 06/09/2010

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	
ART UNIT	PAPER NUMBER
3772	

MAIL DATE	DELIVERY MODE
06/09/2010	PAPER

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.

Office Action Summary	Application No.	Applicant(s)	
	11/054,341	JAGGER ET AL.	
	Examiner	Art Unit	
	NIHIR PATEL	3772	

-- 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 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *amendment filed on 01/08/2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ 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

4)☒ Claim(s) *5,9,10,12,17,18 and 21-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *5, 9, 10, 12, 17, 18, and 21-27* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☐ All b)☐ Some * c)☐ None of:

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) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed on December 4th, 2008 have been fully considered but they are not persuasive. The applicant argues that Tedford, Jr. does not teach controlling a cycle rate at which steps (a)-(c) are performed as a function of the reservoir pressure. The examiner disagrees with the applicant's argument. Tedford, Jr. does teach controlling a cycle rate at which steps (a)-(c) are performed as a function of the reservoir pressure (see col. 4 lines 32-40); Tedford, Jr. recites "The first bed is connected with a surge tank by way of a first check valve or other unidirectional valving means. The first check valve permits the primary product gas from the first bed to flow into the surge tank when product gas pressure in the first bed exceeds the pressure of product gas in the surge tank" implying that Tedford, Jr. does teach controlling a cycle rate at which steps (a)-(c) are performed as a function of the reservoir pressure.

The applicant further argues that the prior art does not teach method step of pumping the product gas from the separator to a reservoir. The examiner disagrees with the applicant's argument. Column 4 lines 32-40 of the Tedford, Jr. reference recites "The first bed 10 is connected with a surge tank 30 by way of a first check valve 32 or other unidirectional valving means. The first check valve 32 permits the primary product gas from the first bed to flow into the surge tank when product gas pressure in the first bed exceeds the pressure of product gas in the surge tank" implies that inherently the device is pumping the product gas from the separator to a reservoir.

Response to Amendment

2. The examiner acknowledges the amendment filed on January 8th, 2010. The amendment comprises amending claims 5, 12 and 18; and cancelling claims 1-4, 6-8, 11, 13-16, 19 and 20.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) 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.

5. Claims **5, 9, 10, 12, 17 and 22-25** are rejected under 35 U.S.C. 103(a) as being unpatentable over Reiss (US 5,114,440) in view of Tedford, Jr. (US 4,449,990) and further in view of Deane et al. (US 7,135,059).

6. **As to claims 5, 12 and 22-25,** Reiss substantially discloses a method step of (a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column; (b) evacuating the column through the first end to remove adsorbed gas from the

column; (c) re-pressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column; (d) repeating steps (a) -(c) **(see column 2 lines 38-55)** but does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir of the ambulatory separator at a pressure of about 1.0 atm to about 2.0 atm; pumping the product gas from the separator to a storage reservoir and delivering product gas to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient or controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas delivered from the reservoir. Tedford teaches an apparatus that does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm; pumping the product gas from the separator to a storage reservoir **(Column 4 lines 32-40 of the Tedford, Jr. reference recites "The first bed 10 is connected with a surge tank 30 by way of a first check valve 32 or other unidirectional valving means. The first check valve 32 permits the primary product gas from the first bed to flow into the surge tank when product gas pressure in the first bed exceeds the pressure of product gas in the surge tank" implies that inherently the device is pumping the product gas from the separator to a reservoir)** and delivering product gas to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient or controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas pressure in the reservoir **(see column 6 lines 36-45; see response to arguments above)** but does not disclose a reservoir that is of the ambulatory oxygen separator. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify

Reiss invention by providing a method step of storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm; pumping the product gas from the separator to a storage reservoir and delivering product gas to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient or controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas delivered from the reservoir as taught by Tedford so that the patient gets better quality of oxygen and to modify Reiss/Tedford inventions by providing a reservoir that is of the ambulatory oxygen separator as taught by Deane in order to make it easier for the user to move around.

7. **As to claim 9,** Reiss substantially discloses the claimed invention; see rejection of claim 5 above, but does not disclose a method step of delivering the product gas that is from the reservoir to the patient. Tedford discloses an apparatus that does disclose delivering the product gas that is from the reservoir to the patient **(see column 6 lines 36-50)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invention by providing a method step of delivering the product gas that is from the reservoir to the patient as taught by Tedford in order to provide pure oxygen.

8. **As to claims 10 and 17,** Reiss substantially discloses the claimed invention; see rejection of claim 5 above, but does not disclose a method step of delivering a pulse of product gas occurring in response to inhalation by the patient. Tedford discloses an apparatus that does disclose delivering a pulse of product gas occurring in response to inhalation by the patient **(see column 6 lines 36-50)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invention by providing a method step of

delivering a pulse of product gas occurring in response to inhalation by the patient as taught by Tedford in order to provide correct amount of oxygen.

9. Claims **18, 21, 26 and 27** are rejected under 35 U.S.C. 103(a) as being unpatentable over Reiss (US 5,114,440) in view of Tedford, Jr. (US 4,449,990) and further in view of Dee et al. (US 6,544,318) and further in view of Deane et al. (US 7,135,059).

10. **As to claims 18, 21, 26 and 27,** Reiss substantially disclose a method step of (a) introducing ambient air at about 1.0 atm into a first end of a column containing an adsorbent material and removes product gas out a second end of the column; (b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm; (c) repressurizing the column to about 1.0 atm; and repeating steps (a)-(c) **(see column 2 lines 38-50);** but does not disclose that the adsorbent material contains LiLSX or storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to about 2.0 atm; delivering stored product gas to the patient through a dispensing valve that regulates the flow of the fluid; pumping the product gas from the separator to a storage reservoir and controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas delivered from the reservoir to the patient. Tedford teaches an apparatus that does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm; pumping the product gas from the separator to a storage reservoir **(Column 4 lines 32-40 of the Tedford, Jr. reference recites "The first bed 10 is connected with a surge tank 30 by way of a first check valve 32 or other unidirectional valving means. The first check valve 32 permits the primary product gas from the first bed to flow into the surge tank when product gas pressure in the first bed exceeds the pressure of product gas in the surge tank"**

implies that inherently the device is pumping the product gas from the separator to a reservoir); and delivering stored product gas to the patient through a dispensing valve that regulates the flow of the fluid and controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas delivered from the reservoir to the patient **(see column 6 lines 36-45; see response to arguments above),** Deane teaches storing the product gas of the ambulatory oxygen concentrator and Dee teaches an apparatus that uses adsorbent material contains LiLSX **(see example 2 in detailed description).** Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invention by providing an adsorbent material that contains LiLSX as taught by Dee in order to provide pure oxygen to the patient and storing the product gas at a pressure of about 1.0 atm to about 2.0 atm; and delivering stored product gas to the patient through a dispensing valve that regulates the flow of the fluid and controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas delivered from the reservoir to the patient as taught by Tedford in order to provide correct amount of oxygen and to provide a method step of storing the product gas of the ambulatory oxygen separator as taught by Deane in order to make it easier for the user to move around.

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 NIHIR PATEL whose telephone number is (571)272-4803. The examiner can normally be reached on 7:30 to 4:30 every other Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patricia Bianco can be reached on (571) 272-4940. 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 http://pair-direct.uspto.gov. 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.

/Nihir Patel/
Examiner, Art Unit 3772

/Patricia Bianco/
Supervisory Patent Examiner, Art Unit 3772

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	922	128/201.25	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:37
L2	648	128/205.11	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:38
L3	360	128/205.18	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:38
L4	453	128/202.26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:38
L5	524	96/121	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:38
L6	807	96/130	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:38
L7	343	96/133	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:38
L8	495	96/147	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:38

GCE - Exhibit 1049, Page 84
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

L9	1300	95/96	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:38
L10	358	95/97	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:38
L11	1234	95/98	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:38
L12	349	95/99	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:38
L13	764	95/100	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:39
L14	346	95/101	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:39
L15	215	95/102	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:39
L16	321	95/103	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/06/04 10:39

6/4/2010 10:39:27 AM
C:\Documents and Settings\npatel2\My Documents\EAST\Workspaces\10092030.wsp

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11054341	JAGGER ET AL.
	Examiner	Art Unit
	NIHIR PATEL	3772

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/02/2008	06/04/2010							
	1	-	-							
	2	-	-							
	3	-	-							
	4	-	-							
	5	✓	✓							
	6	-	-							
	7	-	-							
	8	-	-							
	9	✓	✓							
	10	✓	✓							
	11	-	-							
	12	✓	✓							
	13	-	-							
	14	-	-							
	15	-	-							
	16	-	-							
	17	✓	✓							
	18	✓	✓							
	19	-	-							
	20	-	-							
	21	✓	✓							
	22	✓	✓							
	23	✓	✓							
	24	✓	✓							
	25	✓	✓							
	26	✓	✓							
	27	✓	✓							
	1	-								
	2	-								
	3	-								
	4	-								
	5	✓								
	6	✓								
	7	✓								
	8	-								
	9	✓								

GCE - Exhibit 1049, Page 86
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11054341	JAGGER ET AL.
	Examiner	**Art Unit**
	NIHIR PATEL	3772

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/02/2008	06/04/2010							
	10	✓								
	11	-								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	-								
	17	✓								
	18	✓								
	19	✓								
	20	✓								
	21	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11054341	JAGGER ET AL.
	Examiner	Art Unit
	NIHIR PATEL	3772

SEARCHED			
Class	Subclass	Date	Examiner
128	201.25, 205.11, 205.18, 202.26	07.02.2008	NP
96	121, 130, 133, 147	07.02.2008	NP
95	96-103	07.02.2008	NP

SEARCH NOTES		
Search Notes	Date	Examiner
Search Updated	07.02.2008	NP
Search Updated	06.29.2009	NP
Search Updated	06.04.2010	NP

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	Confirmation No: 5839
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihir B. Patel
Docket No.	:	V180.12-0009	

AMENDMENT

Mail Stop **Amendment**
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EFS-WEB
January 8, 2010

INTRODUCTION

This is in response to the Office Action mailed on July 8, 2009. Please amend the above-identified application as follows:

AMENDMENTS TO THE CLAIMS

Please amend claims 5, 12 and 18, such that the status of the claims is as follows:

1. (Canceled)

2. (Canceled)

3. (Canceled)

4. (Canceled)

5. (Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas with an ambulatory oxygen separator using a vacuum swing adsorption process that includes:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization;

(d) repeating steps (a) - (c);

pumping the product gas from the separator to a storage reservoir;

storing product gas produced by the vacuum swing absorption process in ~~a~~ the reservoir of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas ~~pressure in~~ delivered from the reservoir.

6. (Canceled)

7. (Canceled)

8. (Canceled)

9. (Previously Presented) The method of claim 5 wherein delivering the fluid is from the reservoir to the patient.

10. (Previously Presented) The method of claim 5 wherein delivering the fluid occurs in response to inhalation by the patient.

11. (Canceled)

12. (Currently Amended) A method of providing concentrated oxygen to a patient, the method comprising:

producing oxygen-rich product gas with an ambulatory oxygen separator using a vacuum swing adsorption process comprising:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization prior to introducing ambient air;

(d) repeating steps (a) - (c);

pumping the product gas from the separator to a storage reservoir;

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient through a dispensing valve that regulates the flow of the fluid from the reservoir, the fluid consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas ~~pressure in~~ delivered from the reservoir.

13. (Canceled)

14. (Canceled)

15. (Canceled)

16. (Canceled)

17. (Original) The method of claim 12 wherein delivering stored product gas comprises delivering a pulse of product gas to the patient in response to inhalation by the patient.

18. (Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing the product gas with an ambulatory oxygen separator utilizing a vacuum swing adsorption process, the process comprising the steps of:

(a) introducing ambient air at about 1.0 atmosphere (atm) into a first end of a column containing an LiLSX adsorbent material and removes product gas out a second end of the column;

(b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm;

(c) repressurizing the column to about 1.0 atm by introducing product gas into the column through the second end and introducing ambient air into the column through the first end; and

(d) repeating steps (a) - (c);

pumping the product gas from the separator to a storage reservoir;

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient through a dispensing valve that regulates the flow of the fluid, the fluid consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of delivered from the reservoir to the patient.

19. (Canceled)

20. (Canceled)

21. (Previously Presented) The method of claim 18 wherein delivering stored product gas comprises delivering a pulse of product gas from the reservoir to the patient in response to an inhalation by the patient.

22. (Previously Presented) The method of claim 5 wherein the ambulatory oxygen separator is driven by a motor.

23. (Previously Presented) The method of claim 22 wherein controlling the cycle rate comprises:

sensing the product gas pressure in the reservoir; and

controlling the speed of the motor that determines the cycle rate.

24. (Previously Presented) The method of claim 12 wherein the ambulatory oxygen separator is driven by a motor.

25. (Previously Presented) The method of claim 24 wherein controlling the cycle rate comprises:

sensing the product gas pressure in the reservoir; and

controlling the speed of the motor that determines the cycle rate.

26. (Previously Presented) The method of claim 18 wherein the ambulatory oxygen separator is driven by a motor.

27. (Previously Presented) The method of claim 26 wherein controlling the cycle rate comprises:

sensing the product gas pressure in the reservoir; and

controlling the speed of the motor that determines the cycle rate.

REMARKS

This is in response to the Advisory Action mailed on July 8, 2009, in which claims 5, 9-10, 12-15, and 17-21 were rejected. Specifically, claims 5, 9, 10, 12, 17 and 22-25 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) and further in view of Deane et al. (U.S. Patent No. 7,135,059); and claims 18, 21, 26, and 27 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) further in view of Deane et al. (U.S. Patent No. 7,135,059) and further in view of Dee et al. (U.S. Patent No. 6,544,318). With this amendment, claims 5, 12, and 18 have been amended. In view of the following remarks, reconsideration and allowance of all claims (5, 9-10, 12, 17-18, and 21-27) is requested.

Independent claims 1, 12, and 18 as amended now require: **pumping the product gas from the separator to a reservoir**. This additional language is presented to clarify that the current system is not controlled in the way that the prior art teaches.

All the independent claims additionally require "controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas delivered from the reservoir" or "controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen delivered from the reservoir to the patient". This accentuates basic differences in the prior art and the current invention. The current invention utilizes parameters, such as the pressure in the reservoir, to control production of a product gas based on that parameter.

In the prior art, the amount of product gas delivered to a patient is independent of controlling the production of the product gas. The current disclosure also discussed this aspect, in the form of a dispensing valve (commonly referred to in the art as an oxygen conservor), which is a separate structural element from the gas separator. The current invention relates to *controlling the rate of production* of oxygen, not just the amount or *rate of delivery from a reservoir* to a patient. These independent structures are not disclosed by the prior art of record.

The Office Action cites to Col. 6 lines 36-45 as support that Tedford, Jr. discloses "an

apparatus that does disclose a method step of controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen used by the patient". This text actually states:

> Referring again to FIG. 1, in the preferred embodiment, the surge tank 30 maintains a reservoir of oxygen at a mininum[sic] pressure of about 18 psi. The surge tank is connected with a pressure regulator 70 for controlling the pressure or flow rate of oxygen to the patient. A flow meter 72 provides a visual indication at the rate at which the patient is receiving oxygen. A humidifier 74 adds moisture to the oxygen primary product to replace the moisture removed by the beds. A breathing apparatus 76 assists in delivering the oxygen to the patient. This disclosure states a pressure for the reservoir (surge tank 30), and a pressure regulator for controlling the pressure or flow rate of oxygen to the patient from the reservoir.

However, there is no teaching *controlling a cycle rate at which steps (a) - (c) are performed as a function of the reservoir pressure,* which is required by the claims. Tedford, Jr. actually discloses a specific timed cycle based on known values for oxygen purity and pressure equalization between the two beds. What is taught is delivering the product gas through a dispensing valve that regulates the amount of product gas delivered to the patient, <u>not</u> controlling the cycle rate as a function of the reservoir pressure. One of skill in the art would read Tedford, Jr. as having a constant production rate that is set to a specific desired result. The system may be controlled, but only as to the amount leaving the reservoir or surge tank. The steps in the production are not controlled, which is specified in each independent claim.

The Office Action also states that Tedford, Jr. teaches this at Col. 4, lines 32-40:

> The first bed 10 is connected with a surge tank 30 by way of a first check valve 32 or other unidirectional valving means. The first check valve 32 permits the primary product gas from the first bed to flow into the surge tank when gas pressure in the first bed exceed the pressure of the product gas in the surge tank. The first check valve prohibits the product gas from flowing from the surge tank when the pressure in the first bed is lower than the surge tank.

From this text, it is physically impossible for Tedford, Jr. to meet the claim limitations. The claimed system and method requires VSA separation- thus all processes are done at less than 1 atm. The storage is required to be between 1 and 2 atm. Thus, by using the teachings of Tedford, Jr., no product gas could ever flow into the pressurized storage reservoir of the claimed system and

method. To further clarify this point, applicant has added that the product gas is pumped to the reservoir. This creates the pressure in the reservoir. The Tedford, Jr. system is only capable of creating a pressurized surge tank as the separation process is PSA.

The Office Action has also cited Dee et al., which discloses a process for the recovery of a product gas from adsorption. This reference alone does not disclose the claimed invention. Nor does the combination of this reference with the other references of record disclose the claimed invention. Thus, the combination of Reiss, Tedford Jr., Dee et al., and Deane et al., do not teach all the claims limitations of claims 1, 12, and 18, and the rejection thereof should be withdrawn. If an independent claim is nonobvious under 35 U.S.C. §103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071; M.P.E.P. §2143.01. Thus, claims 9-10, 17, and 21-27 are also allowable.

Conclusion

In view of the foregoing, all pending claims 5, 9-10, 12, 17-18, and 21-27 are in condition for allowance. A notice to that effect is respectfully requested.

The Examiner is cordially invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate the allowance of this application.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: January 8, 2010

By: /Larrin Bergman/

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:bl

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	Confirmation No: 5839
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihir B. Patel
Docket No.	:	V180.12-0009	

PETITION FOR 3-MONTH EXTENSION OF TIME

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

SENT VIA EFS-WEB
January 8, 2010

Pursuant to 37 C.F.R. 1.136(a), Applicant petitions for a 3-month extension of time to respond to the Office Action dated July 8, 2009.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: January 8, 2010

By: /Larrin Bergman/
Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:bl

Electronic Patent Application Fee Transmittal

Application Number:	11054341
Filing Date:	09-Feb-2005
Title of Invention:	Method of providing ambulatory oxygen
First Named Inventor/Applicant Name:	Theodore W. Jagger
Filer:	Larrin Bergman
Attorney Docket Number:	V180.12-0009

Filed as Small Entity

Utility under 35 USC 111(a) Filing Fees

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:				
Extension - 3 months with $0 paid	2253	1	555	555

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**555**

Electronic Acknowledgement Receipt	
EFS ID:	6774023
Application Number:	11054341
International Application Number:	
Confirmation Number:	5839
Title of Invention:	Method of providing ambulatory oxygen
First Named Inventor/Applicant Name:	Theodore W. Jagger
Customer Number:	00164
Filer:	Larrin Bergman
Filer Authorized By:	
Attorney Docket Number:	V180.12-0009
Receipt Date:	08-JAN-2010
Filing Date:	09-FEB-2005
Time Stamp:	13:56:19
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$555
RAM confirmation Number	150
Deposit Account	110982
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 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		Amendment.pdf	38775 cc1c268b56b8c69b768bba18a8a83229190273bd	yes	9
	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	9	
Warnings:					
Information:					
2	Extension of Time	Extensionoftime.pdf	13663 b968fb232702dba3888fae6385c5f28f44757852	no	1
Warnings:					
Information:					
3	Fee Worksheet (PTO-875)	fee-info.pdf	29807 4cb1d138d5b9d603329bec8c8e07453e6cd37e2a	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	82245		

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 (07-06)
Approved for use through 1/31/2007. 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	Filing Date	☐ To be Mailed
11/054,341	02/09/2005	

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			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 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			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 01/08/2010	(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 ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 13	Minus	** 21	= 0	X $26 =	0	OR	X $ =	
Independent (37 CFR 1.16(h))	* 3	Minus	***4	= 0	X $110 =	0	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	0	OR	TOTAL ADD'L FEE	

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)	OR	RATE ($)	ADDITIONAL FEE ($)
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 number found in the appropriate box in column 1.

Legal Instrument Examiner:
/FLORENCE R. PATTERSON/

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.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 07/08/2009

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	
ART UNIT	PAPER NUMBER
3772	

MAIL DATE	DELIVERY MODE
07/08/2009	PAPER

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.

Office Action Summary	Application No.	Applicant(s)	
	11/054,341	JAGGER ET AL.	
	Examiner	Art Unit	
	NIHIR PATEL	3772	

-- 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* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *04 December 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ 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

4)☒ Claim(s) *5,9,10,12,17,18 and 21-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *5,9,10,12,17,18 and 21-27* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☐ All b)☐ Some * c)☐ None of:

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) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *05.26.2009*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. 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 December 4th, 2008 has been entered.

Response to Arguments

2. Applicant's arguments filed on December 4th, 2008 have been fully considered but they are not persuasive. The applicant argues that Tedford, Jr. does not teach controlling a cycle rate at which steps (a)-(c) are performed as a function of the reservoir pressure. The examiner disagrees with the applicant's argument. Tedford, Jr. does teach controlling a cycle rate at which steps (a)-(c) are performed as a function of the reservoir pressure (see col. 4 lines 32-40; Tedford, Jr. recites "The first bed is connected with a surge tank by way of a first check valve or other unidirectional valving means. The first check valve permits the primary product gas from the first bed to flow into the surge tank when product gas pressure in the first bed exceeds the pressure of product gas in the surge tank" implying that Tedford, Jr. does teach controlling a cycle rate at which steps (a)-(c) are performed as a function of the reservoir pressure.

Response to Amendment

3. The examiner acknowledges the amendment filed on December 4th, 2008. The amendment comprises cancelling claims 1-4, 6-8, 11, 13-16, 19 and 20; amending claims 5, 12

and 18; and adding new claims 22-27.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) 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.

6. Claims **5, 9, 10, 12, 17 and 22-25** are rejected under 35 U.S.C. 103(a) as being unpatentable over Reiss (US 5,114,440) in view of Tedford, Jr. (US 4,449,990) and further in view of Deane et al. (US 7,135,059).

7. **As to claims 5, 12 and 22-25,** Reiss substantially discloses a method step of (a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column; (b) evacuating the column through the first end to remove adsorbed gas from the column; (c) re-pressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column; (d) repeating steps (a) -(c) **(see column**

2 lines 38-55) but does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir of the ambulatory separator at a pressure of about 1.0 atm to about 2.0 atm and delivering product gas to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient or controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas pressure in the reservoir. Tedford teaches an apparatus that does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering product gas to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient or controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas pressure in the reservoir **(see column 6 lines 36-45; see response to arguments above)** but does not disclose a reservoir that is of the ambulatory oxygen separator. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invention by providing a method step of storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering product gas to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient or controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas pressure in the reservoir as taught by Tedford so that the patient gets better quality of oxygen and to modify Reiss/Tedford inventions by providing a reservoir that is of the ambulatory oxygen separator as taught by Deane in order to make it easier for the user to move around.

8. **As to claim 9,** Reiss substantially discloses the claimed invention; see rejection of claim 5 above, but does not disclose a method step of delivering the product gas that is from the reservoir to the patient. Tedford discloses an apparatus that does disclose delivering the product gas that is from the reservoir to the patient **(see column 6 lines 36-50)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invnetion by providing a method step of delivering the product gas that is from the reservoir to the patient as taught by Tedford in order to provide pure oxygen.

9. **As to claims 10 and 17,** Reiss substantially discloses the claimed invention; see rejection of claim 5 above, but does not disclose a method step of delivering a pulse of product gas occurring in response to inhalation by the patient. Tedford discloses an apparatus that does disclose delivering a pulse of product gas occurring in response to inhalation by the patient **(see column 6 lines 36-50)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invnetion by providing a method step of delivering a pulse of product gas occurring in response to inhalation by the patient as taught by Tedford in order to provide correct amount of oxygen.

10. Claims **18, 21, 26 and 27** are rejected under 35 U.S.C. 103(a) as being unpatentable over Reiss (US 5,114,440) in view of Tedford, Jr. (US 4,449,990) and further in view of Dee et al. (US 6,544,318) and further in view of Deane et al. (US 7,135,059).

11. **As to claims 18, 21, 26 and 27,** Reiss substantially disclose a method step of (a) introducing ambient air at about 1.0 atm into a first end of a column containing an adsorbent material and removes product gas out a second end of the column; (b) evacuating the column

through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm; (c) repressurizing the column to about 1.0 atm; and repeating steps (a)-(c) **(see column 2 lines 38-50);** but does not disclose that the adsorbent material contains LiLSX or storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to about 2.0 atm; delivering stored product gas to the patient through a dispensing valve that regulates the flow of the fluid and controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas delivered from the reservoir to the patient. Tedford teaches an apparatus that does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering stored product gas to the patient through a dispensing valve that regulates the flow of the fluid and controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas delivered from the reservoir to the patient **(see column 6 lines 36-45; see response to arguments above),** Deane teaches storing the product gas of the ambulatory oxygen concentrator and Dee teaches an apparatus that uses adsorbent material contains LiLSX **(see example 2 in detailed description).** Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invention by providing an adsorbent material that contains LiLSX as taught by Dee in order to provide pure oxygen to the patient and storing the product gas at a pressure of about 1.0 atm to about 2.0 atm; and delivering stored product gas to the patient through a dispensing valve that regulates the flow of the fluid and controlling a cycle rate at which steps (a)-(c) are performed as a function of product gas delivered from the reservoir to the patient as taught by Tedford in order to provide correct amount of oxygen and to provide a method step of storing the

product gas of the ambulatory oxygen separator as taught by Deane in order to make it easier for the user to move around.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to NIHIR PATEL whose telephone number is (571)272-4803. The examiner can normally be reached on 7:30 to 4:30 every other Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patricia Bianco can be reached on (571) 272-4940. 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 http://pair-direct.uspto.gov. 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.

/Nihir Patel/
Examiner, Art Unit 3772

/Patricia Bianco/

Supervisory Patent Examiner, Art Unit 3772

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11054341	JAGGER ET AL.
	Examiner	Art Unit
	NIHIR PATEL	3772

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/02/2008								
	1	-								
	2	-								
	3	-								
	4	-								
	5	✓								
	6	-								
	7	-								
	8	-								
	9	✓								
	10	✓								
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	5	✓								
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	8	-								
	9	✓								

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	Examiner	**Art Unit**
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=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/02/2008								
	10	✓								
	11	-								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	-								
	17	✓								
	18	✓								
	19	✓								
	20	✓								
	21	✓								

PTO/SB/08a (05-07)
Approved for use through 09/30/2007. 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	11054341
	Filing Date	2005-02-09
	First Named Inventor	Theodore W. Jagger
	Art Unit	3772
	Examiner Name	Patel, Nihir B
	Attorney Docket Number	V180.12-0009

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
/NP/	1	6010555		2000-01-04	Smolarek et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

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
/NP/	1	20020127442		2002-09-12	Connor 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]
	1							☐

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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]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11054341
	Filing Date	2005-02-09
	First Named Inventor	Theodore W. Jagger
	Art Unit	3772
	Examiner Name	Patel, Nihir B
	Attorney Docket Number	V180.12-0009

	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/Nihir Patel/	Date Considered	06/29/2009

*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.

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	877	128/201.25	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:27
L2	610	128/205.11	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:27
L3	346	128/205.18	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:27
L4	429	128/202.26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:27
L5	448	96/121	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:27
L6	751	96/130	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:27
L7	318	96/133	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:27
L8	453	96/147	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:27

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GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

L9	1185	95/96	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:27
L10	338	95/97	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:28
L11	1190	95/98	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:28
L12	326	95/99	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:28
L13	722	95/100	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:28
L14	331	95/101	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:28
L15	206	95/102	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:28
L16	304	95/103	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/29 10:28

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GCE - Exhibit 1049, Page 119
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11054341	JAGGER ET AL.
	Examiner	Art Unit
	NIHIR PATEL	3772

SEARCHED			
Class	Subclass	Date	Examiner
128	201.25, 205.11, 205.18, 202.26	07.02.2008	NP
96	121, 130, 133, 147	07.02.2008	NP
95	96-103	07.02.2008	NP

SEARCH NOTES		
Search Notes	Date	Examiner
Search Updated	07.02.2008	NP
Search Updated	06.29.2009	NP

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	Confirmation No: 5839
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B
Docket No.	:	V180.12-0009	

PETITION TO WITHDRAW NOTICE OF ABANDONMENT PURSUANT TO 37 C.F.R. 1.181

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

SENT VIA EFS-WEB

Petition

Applicants hereby request a withdrawal of the Notice of Abandonment for this matter that was mailed on February 4, 2009.

Reasons

An Advisory Action Before the Filing of an Appeal Brief mailed on October 16, 2008, was received by Applicants on October 20, 2008. In response, Applicants timely submitted a Request for Continued Examination (RCE) on December 4, 2008. This was sent by Express Mail. A copy of the filing is attached hereto as Exhibit A. A Notice of Abandonment was mailed on February 4, 2009. Upon receiving the notice, applicant investigated as to why the notice was sent, as a timely submission of the RCE was filed.

After a review of the file, it was determined that the RCE submission contained a typographical error in the application number. Two digits were transposed, and the application number read 11/054,314 rather than the actual file number of 11/054,341. However, the header contained seven additional identifiers for this case without typographical errors, including the first named inventor, filing date, title, docket number, group art unit, examiner's name, and the

06/19/2009 CKHLUK 00000003 11054341

01 FC:2801 405.00 OP
02 FC:2252 245.00 OP

Adjustment date: 06/19/2009 CKHLUK
12/05/2008 HDESTA1 00000043 11054314
01 FC:2801 -405.00 OP

confirmation number. According to this office, in a notice of November 30, 2000, the purpose of the confirmation number was as follows:

> "The Office plans to issue a four-digit confirmation number for each currently pending and newly filed application. This confirmation number, in combination with the application number, will be used to **verify the accuracy of the application number and avoid misidentification of an application due to a transposition error in the application number**. The Office will assign a confirmation number to each pending application and notify the applicant of the confirmation number by a separate notice for each pending application."

Thus, the error should have been noticed by the office by its own verification procedures. The submitted documents met all other requirements for an appropriate RCE, including the appropriate fee. The arguments and amended claims presented clearly relate to the case of 11/054,341.

Conclusion

In view of the foregoing, Applicants respectfully request that the Notice of Abandonment be withdrawn, and the RCE be entered into application number 11/054,341.

The Director is cordially invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate the allowance of this application.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: March 11, 2009

By: /Larrin Bergman/

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:mdh

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
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JUN 19 2009

OFFICE OF PETITIONS

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS MN 55415-1002

In re Application of :
JAGGER et al. :
Application No. 11/054,341 : DECISION ON PETITION
Filed: 02/09/2005 :
Attorney Docket No. V180.12-0009 :

This is a decision on the petition under 37 CFR 1.181, filed March 11, 2009, to withdraw the holding of abandonment.

On July 9, 2008, the Office mailed a final Office action, which set a three-month shortened statutory period to respond. Extensions of time for response were available. In the apparent absence of a timely and proper response, the application was held abandoned and a Notice of Abandonment was mailed on February 4, 2009.

In the present petition, petitioners assert that they filed a timely and proper response to the final Office action via Express Mail Service on December 4, 2008. A copy of the response in the form of the RCE, amendment, and a request for an extension of time within the second month accompany the petition. Petitioners explain that they incorrectly identified the application number in the heading of the response as 11/054,314, rather than the intended application number of 11/054,341. Further, petitioners assert that the header contained seven additional identifiers for this case without typographical errors, including the first named inventor, filing date, title, docket number, group art unit, examiner's name, and the confirmation number.

After a brief search, the response was located in the file of Application No. 11/054,314. A review of the correspondence indicates that the USPTO received the response on December 4, 2008, but it was not matched with the file due to the incorrect application number.

Under current Office procedure, if a paper having an incorrect application number contains sufficient information to identify the correct application and was timely received at the Office, the holding of

abandonment will be withdrawn. In reviewing the papers, it is concluded that there was sufficient information thereon to associate the papers with the present application file.

For the reasons stated above, the petition is **granted**. The application was not abandoned in fact as the Office timely received a proper reply accompanied by an extension of time for response within the second month.

The Office will transfer the RCE, amendment, request for an extension of time for response within the second month, and the $650.00 payment filed on December 4, 2008, from Application No. 11/054,314 to the intended Application No. 11/054,341.

The matter is being referred to Technology Center Art Unit 3772 for appropriate action on the reply filed December 4, 2008.

Telephone inquiries regarding this decision may be directed to the undersigned at (571) 272-3211. All other questions regarding the status of the application or the examination process should be directed to the Technology Center.

C. T. Donnell

Christina Tartera Donnell
Senior Petitions Attorney
Office of Petitions

PTO/SB/08a (05-07)
Approved for use through 09/30/2007. 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	11054341
	Filing Date	2005-02-09
	First Named Inventor	Theodore W. Jagger
	Art Unit	3772
	Examiner Name	Patel, Nihir B
	Attorney Docket Number	V180.12-0009

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	6010555		2000-01-04	Smolarek et al.	

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	1	20020127442		2002-09-12	Connor et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	11054341
	Filing Date	2005-02-09
	First Named Inventor	Theodore W. Jagger
	Art Unit	3772
	Examiner Name	Patel, Nihir B
	Attorney Docket Number	V180.12-0009

	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	11054341
	Filing Date	2005-02-09
	First Named Inventor	Theodore W. Jagger
	Art Unit	3772
	Examiner Name	Patel, Nihir B
	Attorney Docket Number	V180.12-0009

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.

☐ None

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	/Larrin Bergman/	Date (YYYY-MM-DD)	2009-05-26
Name/Print	Larrin Bergman	Registration Number	57,153

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.**

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.

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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.

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.

Electronic Acknowledgement Receipt

EFS ID:	5389338
Application Number:	11054341
International Application Number:	
Confirmation Number:	5839
Title of Invention:	Method of providing ambulatory oxygen
First Named Inventor/Applicant Name:	Theodore W. Jagger
Customer Number:	00164
Filer:	Larrin Bergman
Filer Authorized By:	
Attorney Docket Number:	V180.12-0009
Receipt Date:	26-MAY-2009
Filing Date:	09-FEB-2005
Time Stamp:	09:29:06
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) Filed (SB/08)	Information_Disclosure_Statement.pdf	601773 2f43e8aa79b74a644871953bfcd862171d5a90fc	no	4

Warnings:	
Information:	

Total Files Size (in bytes):	601773

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	Confirmation No: 5839
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B
Docket No.	:	V180.12-0009	

PETITION TO WITHDRAW NOTICE OF ABANDONMENT PURSUANT TO 37 C.F.R. 1.181

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

SENT VIA EFS-WEB

Petition

Applicants hereby request a withdrawal of the Notice of Abandonment for this matter that was mailed on February 4, 2009.

Reasons

An Advisory Action Before the Filing of an Appeal Brief mailed on October 16, 2008, was received by Applicants on October 20, 2008. In response, Applicants timely submitted a Request for Continued Examination (RCE) on December 4, 2008. This was sent by Express Mail. A copy of the filing is attached hereto as Exhibit A. A Notice of Abandonment was mailed on February 4, 2009. Upon receiving the notice, applicant investigated as to why the notice was sent, as a timely submission of the RCE was filed.

After a review of the file, it was determined that the RCE submission contained a typographical error in the application number. Two digits were transposed, and the application number read 11/054,314 rather than the actual file number of 11/054,341. However, the header contained seven additional identifiers for this case without typographical errors, including the first named inventor, filing date, title, docket number, group art unit, examiner's name, and the

confirmation number. According to this office, in a notice of November 30, 2000, the purpose of the confirmation number was as follows:

> "The Office plans to issue a four-digit confirmation number for each currently pending and newly filed application. This confirmation number, in combination with the application number, will be used to **verify the accuracy of the application number and avoid misidentification of an application due to a transposition error in the application number**. The Office will assign a confirmation number to each pending application and notify the applicant of the confirmation number by a separate notice for each pending application."

Thus, the error should have been noticed by the office by its own verification procedures. The submitted documents met all other requirements for an appropriate RCE, including the appropriate fee. The arguments and amended claims presented clearly relate to the case of 11/054,341.

Conclusion

In view of the foregoing, Applicants respectfully request that the Notice of Abandonment be withdrawn, and the RCE be entered into application number 11/054,341.

The Director is cordially invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate the allowance of this application.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: March 11, 2009

By: /Larrin Bergman/

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:mdh

Exhibit A

Appln. No.: 11/054,341
Docket No.: V180.12-0009

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,314	
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B
Docket No.	:	V180.12-0009	

EXPRESS MAIL COVER SHEET

Mail Stop RCE
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL
Express Mail No.: EM 137649848 US

The following papers are being transmitted via **EXPRESS MAIL** to the U.S. Patent and Trademark Office on the date shown below:

1. Fee Transmittal (in duplicate)
2. Request for Continued Examination (RCE) Transmittal
3. Amendment
4. Check in the amount of $650.00
5. Petition for 2 Month Extension of Time
6. Postcard

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: December 4, 2008

By _____
Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

Exhibit A

FEE TRANSMITTAL

Complete if Known	
Application No.	11/054,314
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Group Art Unit	3772
Examiner Name	Patel, Nihir B
Atty. Docket Number	V180.12-0009

Total Amount of Payment $650.00

METHOD OF PAYMENT (Check One)

1. [X] The Commissioner is hereby authorized to charge any additional fee required under 37 C.F.R. 1.16 and 1.17 and credit any over payments to Deposit Account No.11-0982. Deposit Account Name: Kinney & Lange, P.A.

2. [X] Check Enclosed

FEE CALCULATION

1. BASIC FILING FEE

Appn. Type	FILING FEE FEE/SMALL	SEARCH FEES FEE/SMALL	EXAM FEES FEE/SMALL	FEES PD.
Utility	330 / 165	540 / 270	220 / 110	_
Design	220 / 110	100 / 50	140 / 70	_
Reissue	330 / 165	540 / 270	650 / 325	_
Provisional	220 / 110	-0- / -0-	-0- / -0-	_

Subtotal (1) $-0-

2. EXTRA CLAIM FEES

	Number Claims		Prior		Extra		Fee from Fee Paid Below		
Total	_	-	_	=	_	X	_	=	_
Indep.	_	-	_	=	_	X	_	=	_
Multiple Dependent Claims							_	=	_

Insert 3 and 20, or number previously paid if greater; Reissue see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Description
1202	52	2202	26	Claims in excess of 20
1201	220	2201	110	Independent claims in excess of 3
1203	390	2203	195	Multiple Dependent Claim
1204	220	2204	110	Reissue Independent Claims Over Original Patent
1205	52	2205	26	Reissue claims in excess of 20 and over original patent

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper, the application size fee due is $270 ($135 small) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 C.F.R. 1.16(s). $-0-

Subtotal (2) $-0-

FEE CALCULATION (Continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee paid
1051	130	2051	65	Surcharge - Late filing fee or oath	_
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	_
1053	130	1053	130	Non-English specification	_
1812	2,520	1812	2,520	For Filing a Request for Reexamination	_
1251	130	2251	65	Extension for reply within first month	_
1252	490	2252	245	Extension for reply within second month	245
1253	1,110	2253	555	Extension for reply within third month	_
1254	1,730	2254	865	Extension for reply within fourth month	_
1255	2,350	2255	1,175	Extension for reply within fifth month	_
1402	540	2402	270	Filing a brief in support of an appeal	_
1403	1,080	2403	540	Request for oral hearing	_
1814	140	2814	70	Terminal Disclaimer Fee	_
1452	540	2452	270	Petition to revive - unavoidable	_
1453	1,620	2453	810	Petition to revive - unintentional	_
1501	1,510	2501	755	Utility/Reissue issue fee	_
1502	860	2502	430	Design issue fee	_
1464	130	1464	130	Petitions to the Commissioner	_
1807	50	1807	50	Petitions related to provisional applications	_
1806	180	1806	180	Submission of Information Disclosure Statement	_
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	_
1801	810	2801	405	Request for Continued Examination (RCE)	405

Other fee (specify) _____ _

Subtotal (3) $650.00

Signature _____ Reg. No. 57,153

Larrin Bergman

Date December 4, 2008 Deposit Account No. 11-0982

Exhibit A

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,314	
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B
Docket No.	:	V180.12-0009	

PETITION FOR TWO-MONTH EXTENSION OF TIME

Mail Stop RCE
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL
Express Mail No.: EM 137649848 US

Pursuant to 37 C.F.R. 1.136(a), Applicant petitions for a two-month extension of time to respond to the Office Action dated July 9, 2008.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: December 4, 2008

By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:mdh

Exhibit A

Request for Continued Examination (RCE) Transmittal

Address to:
Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Application Number	11/054,314
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Art Unit	3772
Examiner Name	Patel, Nihir B
Attorney Docket Number	V180.12-0009
Express Mail No.	

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. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. 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).
   - a. ☐ 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.
     - i ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
     - ii. ☐ Other _____
   - b. ☒ Enclosed
     - i. ☒ Amendment/Reply
     - ii. ☐ Information Disclosure Statement (IDS)
     - iii. ☐ Affidavit(s)/ Declaration(s)
     - iv. ☐ Other _____
2. Miscellaneous
   - a. ☐ 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)
   - b. ☐ Other _____
3. Fees The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.
   - a. ☒ The Director is hereby authorized to charge the following fees, any underpayment of fees, or credit any overpayments, to Deposit Account No. 11-0982. I have enclosed a duplicate copy of this sheet.
     - i. ☒ RCE fee required under 37 CFR 1.17(e)
     - ii. ☒ Extension of time fee (37 CFR 1.136 and 1.17)
     - iii. ☐ Other _____
   - b. ☒ Check in the amount of $ 405.00 enclosed
   - c. ☐ Payment by credit card (Form PTO 2038 enclosed)

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.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Signature		Date	**December 4, 2008**
Name (Print/Type)	**Larrin Bergman**	Registration No.	**57,153**

Exhibit A

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,314	Confirmation No: 5839
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B
Docket No.	:	V180.12-0009	

AMENDMENT

Mail Stop **RCE**
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL
Express Mail No.:

INTRODUCTION

This is in response to the Office Action mailed on July 9, 2008, and the Advisory Action mailed on October 16, 2008. Please amend the above-identified application as follows:

Exhibit A

AMENDMENTS TO THE CLAIMS

Please amend claims 5, 12, and 18, and add claims 22-27, such that the status of the claims is as follows:

1.(Canceled)

2.(Canceled)

3.(Canceled)

4.(Canceled)

5.(Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas with an ambulatory oxygen separator using a vacuum swing adsorption process that includes:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization;

(d) repeating steps (a) - (c);

Exhibit A

storing product gas produced by the vacuum swing absorption process in a reservoir of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of ~~oxygen used by the patient~~ product gas pressure in the reservoir.

6.(Canceled)

7.(Canceled)

8.(Canceled)

9.(Previously Presented) The method of claim 5 wherein delivering the fluid is from the reservoir to the patient.

10.(Previously Presented) The method of claim 5 wherein delivering the fluid occurs in response to inhalation by the patient.

11.(Canceled)

12.(Currently Amended) A method of providing concentrated oxygen to a patient, the method comprising:

producing oxygen-rich product gas with an ambulatory oxygen separator using a vacuum swing adsorption process comprising:

Exhibit A

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization prior to introducing ambient air;

(d) repeating steps (a) - (c);

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient through a dispensing valve that regulates the flow of the fluid from the reservoir, the fluid consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of ~~oxygen used by the patient~~ product gas pressure in the reservoir.

13.(Canceled)

14.(Canceled)

15.(Canceled)

16.(Canceled)

17.(Original) The method of claim 12 wherein delivering stored product gas comprises delivering

Exhibit A

a pulse of product gas to the patient in response to inhalation by the patient.

18.(Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing the product gas with an ambulatory oxygen separator utilizing a vacuum swing adsorption process, the process comprising the steps of:

(a) introducing ambient air at about 1.0 atmosphere (atm) into a first end of a column containing an LiLSX adsorbent material and removes product gas out a second end of the column;

(b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm;

(c) repressurizing the column to about 1.0 atm by introducing product gas into the column through the second end and introducing ambient air into the column through the first end; and

(d) repeating steps (a) - (c);

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient <u>through a dispensing valve that regulates the flow of the fluid, the fluid</u> consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of ~~oxygen~~ <u>product gas</u> delivered from the reservoir to the patient.

19.(Canceled)

20.(Canceled)

Exhibit A

21.(Previously Presented) The method of claim 18 wherein delivering stored product gas comprises delivering a pulse of product gas from the reservoir to the patient in response to an inhalation by the patient.

22.(New) The method of claim 5 wherein the ambulatory oxygen separator is driven by a motor.

23.(New) The method of claim 22 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

24.(New) The method of claim 12 wherein the ambulatory oxygen separator is driven by a motor.

25.(New) The method of claim 24 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

26.(New) The method of claim 18 wherein the ambulatory oxygen separator is driven by a motor.

27.(New) The method of claim 26 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

Exhibit A

REMARKS

This is in response to the Advisory Action mailed on October 16, 2008, in which the rejections of claims 5-7, 9-10, 12-15, and 17-21 were maintained from the Office Action mailed on July 9, 2008. Specifically, claims 5-7, 9-10, 12-15, and 17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) and further in view of Deane et al. (U.S. Patent No. 7,135,059); and claims 18-21 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) further in view of Deane et al. (U.S. Patent No. 7,135,059) and further in view of Dee et al. (U.S. Patent No. 6,544,318). With this amendment, claims 5, 12, and 18 have been amended and claims 22-27 have been added. In view of the following remarks, reconsideration and allowance of all claims (5, 9-10, 12, 17-18, and 21-27) is requested.

Independent claim 1 as amended now requires "delivering a fluid to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient". Similar language has been added to independent claims 12 and 18. This additional language is presented to clarify that the current system is not controlled in the way that the prior art teaches.

All the independent claims additionally require "controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas pressure in the reservoir" or "controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen delivered from the reservoir to the patient". This accentuates basic differences in the prior art and the current invention. The current invention utilizes parameters, such as the pressure in the reservoir, to control production of a product gas based on that parameter.

In the prior art, the amount of product gas delivered to a patient is independent of controlling the production of the product gas. The current disclosure also discussed this aspect, in the form of a dispensing valve (commonly referred to in the art as an oxygen conservor), which is a separate structural element from the gas separator. The current invention relates to *controlling*

Exhibit A

the rate of production of oxygen, not just the amount or *rate of delivery from a reservoir* to a patient. These independent structures are not disclosed by the prior art of record.

The Office Action cites to Col. 6 lines 36-45 as support that Tedford, Jr. discloses "an apparatus that does disclose a method step of controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen used by the patient". This text actually states:

> Referring again to FIG. 1, in the preferred embodiment, the surge tank 30 maintains a reservoir of oxygen at a mininum[sic] pressure of about 18 psi. The surge tank is connected with a pressure regulator 70 for controlling the pressure or flow rate of oxygen to the patient. A flow meter 72 provides a visual indication at the rate at which the patient is receiving oxygen. A humidifier 74 adds moisture to the oxygen primary product to replace the moisture removed by the beds. A breathing apparatus 76 assists in delivering the oxygen to the patient. This disclosure states a pressure for the reservoir (surge tank 30), and a pressure regulator for controlling the pressure or flow rate of oxygen to the patient from the reservoir.

However, there is no teaching *controlling a cycle rate at which steps (a) - (c) are performed as a function of the reservoir pressure,* which is required by the claims. Tedford, Jr. actually discloses a specific timed cycle based on known values for oxygen purity and pressure equalization between the two beds. What is taught is delivering the product gas through a dispensing valve that regulates the amount of product gas delivered to the patient, not controlling the cycle rate as a function of the reservoir pressure. One of skill in the art would read Tedford, Jr. as having a constant production rate that is set to a specific desired result. The system may be controlled, but only as to the amount leaving the reservoir or surge tank. The steps in the production are not controlled, which is specified in each independent claim.

The present application clearly illustrates and describes the different functions of the oxygen separator and dispensing valve. Illustrated in Fig. 5 is Dispense Valve 160 connected to outlet filter 136, with Dispense Valve 160 containing a sensor that provides input 190 to the ECM in response to a patient's breathing. This controls the dispensing rate from the reservoir, as is disclosed in Tedford, Jr.

However, also illustrated is reservoir 158 with pressure sensor 159 that provides reservoir

Exhibit A

pressure input 188 to the ECM in response to the pressure of the reservoir 158. The disclosure describes that controlling the rate of production of the product gas can be done as a function of the pressure in the reservoir. The ECM will receive input 188, and then will signal drive 146 to speed up or slow down, and thus adjust the cycle rate of the oxygen separator. Tedford, Jr. simply does not contain a control for controlling production of product gas by the separator as a function of product gas delivered from the reservoir as required by the independent claims, but has a dispensing valve that controls the amount of product gas delivered from the reservoir, which is independent of controlling the rate of production of product gas. The Reiss and Deane et al. references are silent as to this limitation also.

The Office Action has also cited Dee et al., which discloses a process for the recovery of a product gas from adsorption. This reference alone does not disclose the claimed invention. Nor does the combination of this reference with the other references of record disclose the claimed invention. Thus, the combination of Reiss, Tedford Jr., and Deane et al., do not teach all the claims limitations of claims 1, 12, and 18, and the rejection thereof should be withdrawn. If an independent claim is nonobvious under 35 U.S.C. §103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071; M.P.E.P. §2143.01. Thus, claims 9-10, 17, and 21-27 are also allowable.

Conclusion

In view of the foregoing, all pending claims 5, 9-10, 12, 17-18, and 21-27 are in condition for allowance. A notice to that effect is respectfully requested.

The Examiner is cordially invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate the allowance of this application.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Exhibit A

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: Dec 4, 2008

By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:mdh

Exhibit A

KINNEY & LANGE
A PROFESSIONAL ASSOCIATION

1714947

1078 Director of the U.S. PTO 12/04/2008

Inv.Date	Inv.No.	Matter I.D.	Invoice Description	Code	Amount
12-04-08	LB:mdh	V180-012009	RCE	PTO7	405.00
12-04-08	LB:mdh	V180-012009	2 month extension for time	PTO4	245.00

Requested by: mdh Total: $650.00

1714947

KINNEY & LANGE
A PROFESSIONAL ASSOCIATION

THE KINNEY & LANGE BUILDING
312 SOUTH 3RD STREET
MINNEAPOLIS, MINNESOTA 55415-1024
(612) 339-1863

USBANK
17-2-910

1714947

Six Hundred Fifty and No/100 Dollars----------

	DATE	AMOUNT
PAY TO THE ORDER OF Director of the U.S. PTO	12/04/2008	$650.00

Details on back. Security Features Included.

MP

⑈1714947⑈ ⑆091000022⑆ 160234418244⑈

Exhibit A

Receipt is hereby acknowledged by the Assistant Commissioner of Patents of the following items in the patent application of:

RECEIVED
DEC 16 2008
KINNEY & LANGE, P.A.

Applicant : Theodore W. Jagger
Serial No. : 11/054,314
Filed : February 9, 2005
For : METHOD OF PROVIDING AMBULATORY OXYGEN
Docket No. : **V180.12-0009** ME

OIPE
DEC 04 2008
PATENT & TRADEMARK OFFICE

1. Express Mail Cover Sheet
2. Fee Transmittal (in duplicate)
3. Request for Continued Examination (RCE) Transmittal
4. Amendment
5. Check in the amount of $650.00
6. Petition for Two-Month Extension of Time.
7. Postcard

LB:**mdh**
December 4, 2008

Exhibit A

Electronic Acknowledgement Receipt	
EFS ID:	4947223
Application Number:	11054341
International Application Number:	
Confirmation Number:	5839
Title of Invention:	Method of providing ambulatory oxygen
First Named Inventor/Applicant Name:	Theodore W. Jagger
Customer Number:	00164
Filer:	Larrin Bergman
Filer Authorized By:	
Attorney Docket Number:	V180.12-0009
Receipt Date:	11-MAR-2009
Filing Date:	09-FEB-2005
Time Stamp:	16:14:27
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	Petition for review by the Office of Petitions.	V180-12-0009_Petition_to_Withdraw_Notice_of_Abandonment.pdf	77705 044cbc5f3c1f7215712a5e78a2f324689059f893	no	2

Warnings:
Information:

2	Miscellaneous Incoming Letter	V180-12-0009_Exhibit_A.pdf	636289 914deb4eac264d062268028e9adc7695fe87c0c6	no	17
Warnings:					
Information:					
			Total Files Size (in bytes):	713994	

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 NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 02/04/2009

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	
ART UNIT	PAPER NUMBER
3772	

MAIL DATE	DELIVERY MODE
02/04/2009	PAPER

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 Abandonment	Application No.	Applicant(s)	
	11/054,341	JAGGER ET AL.	
	Examiner	Art Unit	
	NIHIR PATEL	3772	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

This application is abandoned in view of:

1. ☒ Applicant's failure to timely file a proper reply to the Office letter mailed on *09 July 2008*.
   (a) ☐ A reply was received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the period for reply (including a total extension of time of _____ month(s)) which expired on _____.
   (b) ☐ A proposed reply was received on _____, but it does not constitute a proper reply under 37 CFR 1.113 (a) to the final rejection.
   (A proper reply under 37 CFR 1.113 to a final rejection consists only of: (1) a timely filed amendment which places the application in condition for allowance; (2) a timely filed Notice of Appeal (with appeal fee); or (3) a timely filed Request for Continued Examination (RCE) in compliance with 37 CFR 1.114).
   (c) ☐ A reply was received on _____ but it does not constitute a proper reply, or a bona fide attempt at a proper reply, to the non-final rejection. See 37 CFR 1.85(a) and 1.111. (See explanation in box 7 below).
   (d) ☒ No reply has been received.

2. ☐ Applicant's failure to timely pay the required issue fee and publication fee, if applicable, within the statutory period of three months from the mailing date of the Notice of Allowance (PTOL-85).
   (a) ☐ The issue fee and publication fee, if applicable, was received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the statutory period for payment of the issue fee (and publication fee) set in the Notice of Allowance (PTOL-85).
   (b) ☐ The submitted fee of $_____ is insufficient. A balance of $_____ is due.
   The issue fee required by 37 CFR 1.18 is $_____. The publication fee, if required by 37 CFR 1.18(d), is $_____.
   (c) ☐ The issue fee and publication fee, if applicable, has not been received.

3. ☐ Applicant's failure to timely file corrected drawings as required by, and within the three-month period set in, the Notice of Allowability (PTO-37).
   (a) ☐ Proposed corrected drawings were received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the period for reply.
   (b) ☐ No corrected drawings have been received.

4. ☐ The letter of express abandonment which is signed by the attorney or agent of record, the assignee of the entire interest, or all of the applicants.

5. ☐ The letter of express abandonment which is signed by an attorney or agent (acting in a representative capacity under 37 CFR 1.34(a)) upon the filing of a continuing application.

6. ☐ The decision by the Board of Patent Appeals and Interference rendered on _____ and because the period for seeking court review of the decision has expired and there are no allowed claims.

7. ☐ The reason(s) below:

/Patricia Bianco/
Supervisory Patent Examiner, Art Unit 3772

/Nihir Patel/
Examiner, Art Unit 3772

Petitions to revive under 37 CFR 1.137(a) or (b), or requests to withdraw the holding of abandonment under 37 CFR 1.181, should be promptly filed to minimize any negative effects on patent term.

OIPE IAP28
DEC 04 2008
PATENT & TRADEMARK OFFICE

12-05-08

RCE IDF

Request for Continued Examination (RCE) Transmittal

Address to:
Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Application Number	11/054,314
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Art Unit	3772
Examiner Name	Patel, Nihir B
Attorney Docket Number	V180.12-0009
Express Mail No.	

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. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. 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).
   - a. ☐ 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.
     - i ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
     - ii. ☐ Other _____
   - b. ☒ Enclosed
     - i. ☒ Amendment/Reply
     - ii. ☐ Information Disclosure Statement (IDS)
     - iii. ☐ Affidavit(s)/ Declaration(s)
     - iv. ☐ Other _____
2. Miscellaneous
   - a. ☐ 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)
   - b. ☐ Other _____
3. Fees The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.
   - a. ☒ The Director is hereby authorized to charge the following fees, any underpayment of fees, or credit any overpayments, to Deposit Account No. 11-0982. I have enclosed a duplicate copy of this sheet.
     - i. ☒ RCE fee required under 37 CFR 1.17(e)
     - ii. ☒ Extension of time fee (37 CFR 1.136 and 1.17)
     - iii. ☐ Other _____
   - b. ☒ Check in the amount of $ 405.00 enclosed
   - c. ☐ Payment by credit card (Form PTO 2038 enclosed)

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.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Signature		Date	December 4, 2008
Name (Print/Type)	Larrin Bergman	Registration No.	57,153

12/05/2008 HDESTA1 00000043 11054314
01 FC:2801 405.00 OP

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OIPE IAP28
DEC 04 2008
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,314	
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B
Docket No.	:	V180.12-0009	

PETITION FOR TWO-MONTH EXTENSION OF TIME

Mail Stop RCE
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL
Express Mail No.: EM 137649848 US

Pursuant to 37 C.F.R. 1.136(a), Applicant petitions for a two-month extension of time to respond to the Office Action dated July 9, 2008.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: December 4, 2008

By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:mdh

12/05/2008 HDESTA1 00000043 11054314
02 FC:2252 245.00 OP

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,314	Confirmation No: 5839
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B
Docket No.	:	V180.12-0009	

AMENDMENT

Mail Stop **RCE**
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL
Express Mail No.:

INTRODUCTION

This is in response to the Office Action mailed on July 9, 2008, and the Advisory Action mailed on October 16, 2008. Please amend the above-identified application as follows:

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AMENDMENTS TO THE CLAIMS

Please amend claims 5, 12, and 18, and add claims 22-27, such that the status of the claims is as follows:

1.(Canceled)

2.(Canceled)

3.(Canceled)

4.(Canceled)

5.(Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas with an ambulatory oxygen separator using a vacuum swing adsorption process that includes:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization;

(d) repeating steps (a) - (c);

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storing product gas produced by the vacuum swing absorption process in a reservoir of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of ~~oxygen used by the patient~~ product gas pressure in the reservoir.

6.(Canceled)

7.(Canceled)

8.(Canceled)

9.(Previously Presented) The method of claim 5 wherein delivering the fluid is from the reservoir to the patient.

10.(Previously Presented) The method of claim 5 wherein delivering the fluid occurs in response to inhalation by the patient.

11.(Canceled)

12.(Currently Amended) A method of providing concentrated oxygen to a patient, the method comprising:

producing oxygen-rich product gas with an ambulatory oxygen separator using a vacuum swing adsorption process comprising:

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(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization prior to introducing ambient air;

(d) repeating steps (a) - (c);

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient through a dispensing valve that regulates the flow of the fluid from the reservoir, the fluid consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of ~~oxygen used by the patient~~ product gas pressure in the reservoir.

13.(Canceled)

14.(Canceled)

15.(Canceled)

16.(Canceled)

17.(Original) The method of claim 12 wherein delivering stored product gas comprises delivering

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a pulse of product gas to the patient in response to inhalation by the patient.

18.(Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing the product gas with an ambulatory oxygen separator utilizing a vacuum swing adsorption process, the process comprising the steps of:

(a) introducing ambient air at about 1.0 atmosphere (atm) into a first end of a column containing an LiLSX adsorbent material and removes product gas out a second end of the column;

(b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm;

(c) repressurizing the column to about 1.0 atm by introducing product gas into the column through the second end and introducing ambient air into the column through the first end; and

(d) repeating steps (a) - (c);

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm;

delivering a fluid to the patient <u>through a dispensing valve that regulates the flow of the fluid, the fluid</u> consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of ~~oxygen~~ <u>product gas</u> delivered from the reservoir to the patient.

19.(Canceled)

20.(Canceled)

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21.(Previously Presented) The method of claim 18 wherein delivering stored product gas comprises delivering a pulse of product gas from the reservoir to the patient in response to an inhalation by the patient.

22.(New) The method of claim 5 wherein the ambulatory oxygen separator is driven by a motor.

23.(New) The method of claim 22 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

24.(New) The method of claim 12 wherein the ambulatory oxygen separator is driven by a motor.

25.(New) The method of claim 24 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

26.(New) The method of claim 18 wherein the ambulatory oxygen separator is driven by a motor.

27.(New) The method of claim 26 wherein controlling the cycle rate comprises:
sensing the product gas pressure in the reservoir; and
controlling the speed of the motor that determines the cycle rate.

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REMARKS

This is in response to the Advisory Action mailed on October 16, 2008, in which the rejections of claims 5-7, 9-10, 12-15, and 17-21 were maintained from the Office Action mailed on July 9, 2008. Specifically, claims 5-7, 9-10, 12-15, and 17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) and further in view of Deane et al. (U.S. Patent No. 7,135,059); and claims 18-21 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) further in view of Deane et al. (U.S. Patent No. 7,135,059) and further in view of Dee et al. (U.S. Patent No. 6,544,318). With this amendment, claims 5, 12, and 18 have been amended and claims 22-27 have been added. In view of the following remarks, reconsideration and allowance of all claims (5, 9-10, 12, 17-18, and 21-27) is requested.

Independent claim 1 as amended now requires "delivering a fluid to the patient consisting essentially of the product gas through a dispensing valve that regulates the amount of product gas delivered from the reservoir to the patient". Similar language has been added to independent claims 12 and 18. This additional language is presented to clarify that the current system is not controlled in the way that the prior art teaches.

All the independent claims additionally require "controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas pressure in the reservoir" or "controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen delivered from the reservoir to the patient". This accentuates basic differences in the prior art and the current invention. The current invention utilizes parameters, such as the pressure in the reservoir, to control production of a product gas based on that parameter.

In the prior art, the amount of product gas delivered to a patient is independent of controlling the production of the product gas. The current disclosure also discussed this aspect, in the form of a dispensing valve (commonly referred to in the art as an oxygen conservor), which is a separate structural element from the gas separator. The current invention relates to *controlling*

Copied from 11054314 on 06/17/2009

the rate of production of oxygen, not just the amount or *rate of delivery from a reservoir* to a patient. These independent structures are not disclosed by the prior art of record.

The Office Action cites to Col. 6 lines 36-45 as support that Tedford, Jr. discloses "an apparatus that does disclose a method step of controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen used by the patient". This text actually states:

> Referring again to FIG. 1, in the preferred embodiment, the surge tank 30 maintains a reservoir of oxygen at a mininum[sic] pressure of about 18 psi. The surge tank is connected with a pressure regulator 70 for controlling the pressure or flow rate of oxygen to the patient. A flow meter 72 provides a visual indication at the rate at which the patient is receiving oxygen. A humidifier 74 adds moisture to the oxygen primary product to replace the moisture removed by the beds. A breathing apparatus 76 assists in delivering the oxygen to the patient. This disclosure states a pressure for the reservoir (surge tank 30), and a pressure regulator for controlling the pressure or flow rate of oxygen to the patient from the reservoir.

However, there is no teaching *controlling a cycle rate at which steps (a) - (c) are performed as a function of the reservoir pressure,* which is required by the claims. Tedford, Jr. actually discloses a specific timed cycle based on known values for oxygen purity and pressure equalization between the two beds. What is taught is delivering the product gas through a dispensing valve that regulates the amount of product gas delivered to the patient, not controlling the cycle rate as a function of the reservoir pressure. One of skill in the art would read Tedford, Jr. as having a constant production rate that is set to a specific desired result. The system may be controlled, but only as to the amount leaving the reservoir or surge tank. The steps in the production are not controlled, which is specified in each independent claim.

The present application clearly illustrates and describes the different functions of the oxygen separator and dispensing valve. Illustrated in Fig. 5 is Dispense Valve 160 connected to outlet filter 136, with Dispense Valve 160 containing a sensor that provides input 190 to the ECM in response to a patient's breathing. This controls the dispensing rate from the reservoir, as is disclosed in Tedford, Jr.

However, also illustrated is reservoir 158 with pressure sensor 159 that provides reservoir

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pressure input 188 to the ECM in response to the pressure of the reservoir 158. The disclosure describes that controlling the rate of production of the product gas can be done as a function of the pressure in the reservoir. The ECM will receive input 188, and then will signal drive 146 to speed up or slow down, and thus adjust the cycle rate of the oxygen separator. Tedford, Jr. simply does not contain a control for controlling production of product gas by the separator as a function of product gas delivered from the reservoir as required by the independent claims, but has a dispensing valve that controls the amount of product gas delivered from the reservoir, which is independent of controlling the rate of production of product gas. The Reiss and Deane et al. references are silent as to this limitation also.

The Office Action has also cited Dee et al., which discloses a process for the recovery of a product gas from adsorption. This reference alone does not disclose the claimed invention. Nor does the combination of this reference with the other references of record disclose the claimed invention. Thus, the combination of Reiss, Tedford Jr., and Deane et al., do not teach all the claims limitations of claims 1, 12, and 18, and the rejection thereof should be withdrawn. If an independent claim is nonobvious under 35 U.S.C. §103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071; M.P.E.P. §2143.01. Thus, claims 9-10, 17, and 21-27 are also allowable.

Conclusion

In view of the foregoing, all pending claims 5, 9-10, 12, 17-18, and 21-27 are in condition for allowance. A notice to that effect is respectfully requested.

The Examiner is cordially invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate the allowance of this application.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Copied from 11054314 on 06/17/2009

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: Dec 4, 2008

By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:mdh

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OIPE IAP28
DEC 04 2008
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,314	
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B
Docket No.	:	V180.12-0009	

EXPRESS MAIL COVER SHEET

Mail Stop RCE
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL
Express Mail No.: EM 137649848 US

The following papers are being transmitted via **EXPRESS MAIL** to the U.S. Patent and Trademark Office on the date shown below:

1. Fee Transmittal (in duplicate)
2. Request for Continued Examination (RCE) Transmittal
3. Amendment
4. Check in the amount of $650.00
5. Petition for 2 Month Extension of Time
6. Postcard

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: December 4, 2008

By _____
Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

Copied from 11054314 on 06/17/2009

FEE TRANSMITTAL

OIPE IAP28 DEC 04 2008 PATENT & TRADEMARK OFFICE

Complete if Known	
Application No.	11/054,314
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Group Art Unit	3772
Examiner Name	Patel, Nihir B
Atty. Docket Number	V180.12-0009

Total Amount of Payment $650.00

METHOD OF PAYMENT (Check One)

1. [X] The Commissioner is hereby authorized to charge any additional fee required under 37 C.F.R. 1.16 and 1.17 and credit any over payments to Deposit Account No.11-0982. Deposit Account Name: Kinney & Lange, P.A.

2. [X] Check Enclosed

FEE CALCULATION

1. BASIC FILING FEE

Appn. Type	FILING FEE FEE/SMALL	SEARCH FEES FEE/SMALL	EXAM FEES FEE/SMALL	FEES PD.
Utility	330 / 165	540 / 270	220 / 110	_
Design	220 / 110	100 / 50	140 / 70	_
Reissue	330 / 165	540 / 270	650 / 325	_
Provisional	220 / 110	-0- / -0-	-0- / -0-	_

Subtotal (1) $-0-

2. EXTRA CLAIM FEES

	Number Claims		Prior		Extra		Fee from Fee Paid Below	
Total	_	-	_	=	_	X	_	= _
Indep.	_	-	_	=	_	X	_	= _
Multiple Dependent Claims							_	= _

Insert 3 and 20, or number previously paid if greater; Reissue see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Description
1202	52	2202	26	Claims in excess of 20
1201	220	2201	110	Independent claims in excess of 3
1203	390	2203	195	Multiple Dependent Claim
1204	220	2204	110	Reissue Independent Claims Over Original Patent
1205	52	2205	26	Reissue claims in excess of 20 and over original patent

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper, the application size fee due is $270 ($135 small) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 C.F.R. 1.16(s). $-0-

Subtotal (2) $-0-

FEE CALCULATION (Continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee paid
1051	130	2051	65	Surcharge - Late filing fee or oath	_
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	_
1053	130	1053	130	Non-English specification	_
1812	2,520	1812	2,520	For Filing a Request for Reexamination	_
1251	130	2251	65	Extension for reply within first month	_
1252	490	2252	245	Extension for reply within second month	245
1253	1,110	2253	555	Extension for reply within third month	_
1254	1,730	2254	865	Extension for reply within fourth month	_
1255	2,350	2255	1,175	Extension for reply within fifth month	_
1402	540	2402	270	Filing a brief in support of an appeal	_
1403	1,080	2403	540	Request for oral hearing	_
1814	140	2814	70	Terminal Disclaimer Fee	_
1452	540	2452	270	Petition to revive - unavoidable	_
1453	1,620	2453	810	Petition to revive - unintentional	_
1501	1,510	2501	755	Utility/Reissue issue fee	_
1502	860	2502	430	Design issue fee	_
1464	130	1464	130	Petitions to the Commissioner	_
1807	50	1807	50	Petitions related to provisional applications	_
1806	180	1806	180	Submission of Information Disclosure Statement	_
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	_
1801	810	2801	405	Request for Continued Examination (RCE)	405

Other fee (specify) _____ _

Subtotal (3) $650.00

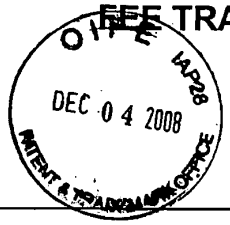
Signature _____ Reg. No. 57,153

Lanin Bergman

Date December 4, 2008 Deposit Account No. 11-0982

Copied from 11054314 on 06/17/2009

FEE TRANSMITTAL



Complete if Known	
Application No.	11/054,314
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Group Art Unit	3772
Examiner Name	Patel, Nihir B
Atty. Docket Number	V180.12-0009

Total Amount of Payment $650.00

METHOD OF PAYMENT (Check One)

1. [X] The Commissioner is hereby authorized to charge any additional fee required under 37 C.F.R. 1.16 and 1.17 and credit any over payments to Deposit Account No.11-0982. Deposit Account Name: Kinney & Lange, P.A.

2. [X] Check Enclosed

FEE CALCULATION

1. BASIC FILING FEE

Appn. Type	FILING FEE FEE/SMALL	SEARCH FEES FEE/SMALL	EXAM FEES FEE/SMALL	FEES PD.
Utility	330 / 165	540 / 270	220 / 110	_
Design	220 / 110	100 / 50	140 / 70	_
Reissue	330 / 165	540 / 270	650 / 325	_
Provisional	220 / 110	-0- / -0-	-0- / -0-	_

Subtotal (1) $-0-

2. EXTRA CLAIM FEES

	Number Claims		Prior		Extra		Fee from Below		Fee Paid
Total	_	-	_	=	_	X	_	=	_
Indep.	_	-	_	=	_	X	_	=	_
Multiple Dependent Claims							_	=	_

Insert 3 and 20, or number previously paid if greater; Reissue see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Description
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1201	220	2201	110	Independent claims in excess of 3
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1204	220	2204	110	Reissue Independent Claims Over Original Patent
1205	52	2205	26	Reissue claims in excess of 20 and over original patent

3. APPLICATION SIZE FEE

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Subtotal (2) $-0-

FEE CALCULATION (Continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee paid
1051	130	2051	65	Surcharge - Late filing fee or oath	_
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	_
1053	130	1053	130	Non-English specification	_
1812	2,520	1812	2,520	For Filing a Request for Reexamination	_
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8021	40	8021	40	Recording each patent assignment per property (times number of properties)	_
1801	810	2801	405	Request for Continued Examination (RCE)	405

Other fee (specify) _____ _

Subtotal (3) $650.00

Signature _____ Reg. No. 57,153

Lanin Bergman

Date December 4, 2008 Deposit Account No. 11-0982

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PTO/SB/06 (07-06)
Approved for use through 1/31/2007. 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	Filing Date	☐ To be Mailed
11/054,341	02/09/2005	

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☒ RATE ($)	SMALL ENTITY ☒ FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
FOR	NUMBER FILED	NUMBER EXTRA					
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 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			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	12/04/2008	(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 ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 13	Minus	** 21	= 0	X $26 =	0	OR	X $ =	
	Independent (37 CFR 1.16(h))	* 3	Minus	***4	= 0	X $110 =	0	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	0	OR	TOTAL ADD'L FEE	

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)	OR	RATE ($)	ADDITIONAL FEE ($)
	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 number found in the appropriate box in column 1.

Legal Instrument Examiner:
/Halley D. Massey/

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.

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 NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 10/16/2008

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	
ART UNIT	PAPER NUMBER
3772	

MAIL DATE	DELIVERY MODE
10/16/2008	PAPER

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.

Advisory Action Before the Filing of an Appeal Brief	**Application No.** 11/054,341	**Applicant(s)** JAGGER ET AL.	
	Examiner NIHIR PATEL	**Art Unit** 3772	

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 09.08.2008 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

1. ☒ The reply was filed after a final rejection, but prior to or on the same day as filing a Notice of Appeal. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114. The reply must be filed within one of the following time periods:
   a) ☐ The period for reply expires _____months from the mailing date of the final rejection.
   b) ☒ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.

   Examiner Note: If box 1 is checked, check either box (a) or (b). ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☐ The proposed amendment(s) filed after a final rejection, but prior to the date of filing a brief, will not be entered because
   (a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below);
   (b) ☐ They raise the issue of new matter (see NOTE below);
   (c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
   (d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.

   NOTE: _____. (See 37 CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____.
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☒ For purposes of appeal, the proposed amendment(s): a) ☐ will not be entered, or b) ☒ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.
   The status of the claim(s) is (or will be) as follows:
   Claim(s) allowed: _____.
   Claim(s) objected to: _____.
   Claim(s) rejected: *5,9,10,12,17,18 and 21*.
   Claim(s) withdrawn from consideration: _____.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ The affidavit or other evidence filed after a final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
9. ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
10. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

11. ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: see attached sheet.
12. ☐ Note the attached Information *Disclosure Statement*(s). (PTO/SB/08) Paper No(s). _____
13. ☐ Other: _____.

/Patricia Bianco/
Supervisory Patent Examiner, Art Unit 3772

GCE - Exhibit 1049, Page 171
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

As stated by the applicant , the amendment comprises amending claims 5, 12 and 18 to include the limitataions of claims 6, 7, 13, 14 and 19. The examiner has considered the applicant's argument however the examiner still stand by the final rejection dated July 9th, 2008. The examiner feels that the newly amended claims are still rejectable over Reiss in view of Tedford and further in view of Deane. Amending independent claims to incldue recitation from dependent claims does not put the current application in condition for allowance. As stated in the final office action in reference to claims 6 and 13 Reiss substnatially discloses a method step of introducing product gas occurs during an initial portions of step (c) (see col. 2 lines 38-55). As stated in the final rejeciton, claim 14 Reiss substantailly discloses the claimed invention but does not disclose storing product gas produced by the vacuum swing adsorption process in a reservoir of the ambulatory separator at a pressure of about 1.0 to about 2.0 atm and delivering product gas to the patient in which Tedford does teach this process in order to make it easier for user to move around. Also stated in the final rejection, claim 7 Reiss substantially discloses the claimed invention with the exception of controlling a cycle rate at which step (a) - (c) are performed as a function of oxygen used by the patient. Tedford does teach this process in order to provide correct amount of oxygen.

GCE - Exhibit 1049, Page 172
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

RESPONSE UNDER 37 CFR 1.116
EXPEDITED PROCEDURE
EXAMINING GROUP 3700

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore w. Jagger	
Appln. No.	:	11/054,314	Confirmation No: 5839
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B
Docket No.	:	V180.12-0009	

AMENDMENT AFTER FINAL

Mail Stop **AF**
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EFS-WEB

INTRODUCTION

This is in response to the Office Action mailed on July 9, 2008. Please amend the above-identified application as follows:

AMENDMENTS TO THE CLAIMS

Please amend claims 5, 12, 18, and 21 and cancel claims 6-7, 13-15, and 19-20, such that the status of the claims is as follows:

1.(Canceled)

2.(Canceled)

3.(Canceled)

4.(Canceled)

5.(Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas with an ambulatory oxygen separator using a vacuum swing adsportion process that includes:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization;

(d) repeating steps (a) - (c);

storing product gas produced by the vacuum swing absorption process in a reservoir of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm; ~~and~~

delivering a fluid to the patient consisting essentially of the product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen used by the patient.

6.(Canceled)

7.(Canceled)

8.(Canceled)

9.(Previously Presented) The method of claim 5 wherein delivering the fluid is from the reservoir to the patient.

10.(Previously Presented) The method of claim 5 wherein delivering the fluid occurs in response to inhalation by the patient.

11.(Canceled)

12.(Currently Amended) A method of providing concentrated oxygen to a patient, the method comprising:

producing oxygen-rich product gas with an ambulatory oxygen separator using a vacuum swing adsorption process comprising:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column, wherein introducing product gas occurs during an initial portion of the repressurization prior to introducing ambient air;

(d) repeating steps (a) - (c);

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm; ~~and~~

delivering a fluid to the patient consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen used by the patient.

13.(Canceled)

14.(Canceled)

15.(Canceled)

16.(Canceled)

17.(Original) The method of claim 12 wherein delivering stored product gas comprises delivering a pulse of product gas to the patient in response to inhalation by the patient.

18.(Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing the product gas with an ambulatory oxygen separator utilizing a vacuum swing adsorption process, the process comprising the steps of:

(a) introducing ambient air at about 1.0 atmosphere (atm) into a first end of a column containing an LiLSX adsorbent material and removes product gas out a second end of the column;

(b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm;

(c) repressurizing the column to about 1.0 atm by introducing product gas into the column through the second end and introducing ambient air into the column through the first end; and

(d) repeating steps (a) - (c);

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm; ~~and~~

delivering a fluid to the patient consisting essentially of the stored product gas; and

controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen delivered from the reservoir to the patient.

19.(Canceled)

20.(Canceled)

21.(Currently Amended) The method of claim 18 wherein delivering stored product gas comprises delivering a pulse of product gas from the reservoir to the patient in response to an inhalation by the patient.

REMARKS

This is in response to the Office Action mailed on July 9, 2008, in which pending claims 5-7, 9-10, 12-15, and 17-21 were rejected. Specifically, claims 5-7, 9-10, 12-15, and 17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) and further in view of Deane et al. (U.S. Patent No. 7,135,059); and claims 18-21 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) further in view of Deane et al. (U.S. Patent No. 7,135,059) and further in view of Dee et al. (U.S. Patent No. 6,544,318). With this amendment, claims 5, 12, and 18 have been amended to include the limitations of claim 6-7, 13-14, and 19, which have all been canceled. Claim 21 has been amended to parallel the amended language of claim 18, from which it depends. In view of the following remarks, reconsideration and allowance of all claims (5, 9-10, 12, 17-18, and 21) is requested.

Applicant believes that these amendments overcome the rejections and place these claims in condition for allowance with respect to these rejections. Entry of this amendment is appropriate under of 37 C.F.R. §1.116(c) and M.P.E.P § 714.13, since the amendments only move dependent claims into independent claims for the purpose of overcoming the prior art, and cancels said dependent claims. No new search need be done as the limitations were already before the Examiner.

Reiss discloses a process for oxygen enrichment of air by means of a vacuum swing adsorption (VSA) process utilizing Ca zeolite molecular sieves that have different adsorption characteristics. The reference does not disclose storing the product gas produced by the vacuum swing adsorption process in a reservoir of about 1.0 atm to about 2.0 atm and delivering product gas to the patient. The reference alone does not disclose the claimed invention. Tedford, Jr. discloses a pair of beds connected by a valve with a source of air under pressure and a vacuum source configured to separate gases and put into a storage reservoir. The reference does not disclose the required steps for separating a product gas. The reference alone does not disclose the claimed invention. Deane et al. discloses a portable gas fractionalization apparatus that provides

oxygen rich air to patients utilizing pressure swing adsorption (PSA). The reference does not disclose the invention as claimed, nor does the combination of the afore mentioned references disclose the invention as claimed by this amendment.

The current invention relates to ambulatory concentrators. Neither Reiss nor Tedford, Jr. are directed to ambulatory methods. Reiss is an oxygen separator for industrial use. This is evidenced by the size of the examples that all include beds of zeolite of over 100 kg. Tedford, Jr. is directed to a medical use, but is not ambulatory. This is evidence by the size disclosed (columns alone are 4 inches in diameter and 15.5 inches in length, and contain 5.5 lbs. of zeolite each) and cycle time used (1 minute per cycle). See Col. 5, lines 1-12. In fact, Reiss now teaches away from the claims as the industrial separator size disclosed could never be used for ambulatory purposes.

Applicant has amended independent claims 5, 12, and 18 have been amended to include the limitations of claim 7, 14, and 20, which have all been canceled. All the independent claims now require "controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen used by the patient" or "controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen delivered from the reservoir to the patient". This accentuates basic differences in the prior art and the current invention. The current invention directs parameters such as speed of the motor to control production of a product gas based on that used by the patient. In the prior art, the amount of product gas delivered to a patient is independent of controlling the production of the product gas. The current disclosure also discussed this aspect, in the form of an oxygen conservor, which is a separate element from the gas separator. The current invention relates to *controlling the rate of production* of oxygen, not just the amount or *rate of delivery from a reservoir* to a patient.

The Office Action cites to Col. 6 lines 36-45 as support that Tedford, Jr. discloses "an apparatus that does disclose a method step of controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen used by the patient". This text actually states:

> Referring again to FIG. 1, in the preferred embodiment, the surge tank 30 maintains a reservoir of oxygen at a mininum[sic] pressure of about 18 psi. The surge tank is connected with a pressure regulator 70 for controlling the pressure or flow rate of oxygen to the patient. A flow meter 72 provides a visual indication at the rate at which the patient is receiving oxygen. A humidifier 74 adds moisture to the oxygen primary product to replace the moisture removed by the beds. A breathing apparatus 76 assists in delivering the oxygen to the patient.

This disclosure states a pressure for the reservoir (surge tank 30), and a pressure regulator for controlling the pressure or flow rate of oxygen to the patient from the reservoir. However, there is no teaching *controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen used by the patient* which is required by the claims.

Tedford, Jr. actually discloses a specific timed cycle based on known values for oxygen purity and pressure equalization between the two beds. The production is not controlled based on a function of oxygen used by a patient. One of skill in the art would read Tedford, Jr. as having a constant production rate that is set to a specific desired result. The system may be controlled, but only as to the amount leaving the reservoir or surge tank. The steps in the production are not controlled.

The present application clearly illustrates and describes the connection between the oxygen separator and the conservor. Illustrated in Fig. 5 is Dispense Valve 160 connected to outlet filter 136, with Dispense Valve 160 containing a sensor that provides input 190 to the ECM in response to a patient's breathing. This disclosure allows for the controlling the rate of production of the product gas as a function used by a patient. Tedford, Jr. simply does not contain a control for controlling production of product gas by the separator as a function of product gas delivered from the reservoir to the patient as required by the independent claims, but has a conserver that controls the amount of product gas delivered from the reservoir, which is independent of controlling the production of product gas. The Reiss and Deane et al. references are silent as to this limitation also.

Examiner has also cited Dee et al., which discloses a process for the recovery of a product gas from adsorption. This reference alone does not disclose the claimed invention. Nor

does the combination of this reference with the other references of record disclose the claimed invention.

Thus, the combination of Reiss, Tedford Jr., and Deane et al., do not teach all the claims limitations of claims 1, 12, and 18, and the rejection thereof should be withdrawn. If an independent claim is nonobvious under 35 U.S.C. §103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071; M.P.E.P. §2143.01. Thus, claims 9-10, 17, and 21 are also allowable.

In view of the foregoing, all pending claims 5, 9-10, 12, 17-18, and 21 are in condition for allowance. A notice to that effect is respectfully requested.

The Examiner is cordially invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate the allowance of this application.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: September 8, 2008

By: /Larrin Bergman/

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

Electronic Acknowledgement Receipt

EFS ID:	3902872
Application Number:	11054341
International Application Number:	
Confirmation Number:	5839
Title of Invention:	Method of providing ambulatory oxygen
First Named Inventor/Applicant Name:	Theodore W. Jagger
Customer Number:	00164
Filer:	Larrin Bergman
Filer Authorized By:	
Attorney Docket Number:	V180.12-0009
Receipt Date:	08-SEP-2008
Filing Date:	09-FEB-2005
Time Stamp:	15:06:31
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		Amendment_After_Final.pdf	41192 714bd76aa2f95326f9effcb0913c434e63bfc3c6	yes	9

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment After Final	1	1
	Claims	2	5
	Applicant Arguments/Remarks Made in an Amendment	6	9
Warnings:			
Information:			
	Total Files Size (in bytes):	41192	

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.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 07/09/2008

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	
ART UNIT	PAPER NUMBER
3772	

MAIL DATE	DELIVERY MODE
07/09/2008	PAPER

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.

Office Action Summary	Application No.	Applicant(s)	
	11/054,341	JAGGER ET AL.	
	Examiner	Art Unit	
	NIHIR PATEL	3772	

-- 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* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *04.08.2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ 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

4)☒ Claim(s) *5-7,9,10,12-15 and 17-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *5-7, 9, 10, 12-15 and 17-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☐ All b)☐ Some * c)☐ None of:

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) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments with respect to claims 5-7, 9, 10, 12-15 and 17-21 have been considered but are moot in view of the new ground(s) of rejection.

Response to Amendment

2. The examiner acknowledges the amendment to the specification dated April 8th, 2008. The examiner also acknowledges the cancellation of claims 1-4, 8, 11 and 16 and amending claims 5, 9, 10, 12 and 18in the amendment filed on April 8th, 2008.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) 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.

5. Claims **5-7, 9, 10, 12-15 and 17** are rejected under 35 U.S.C. 103(a) as being unpatentable over Reiss (US 5,114,440) in view of Tedford, Jr. (US 4,449,990) and further in view of Deane et al. (US 7,135,059).

6. **As to claims 5, 12 and 14,** Reiss substantially discloses a method step of (a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column; (b) evacuating the column through the first end to remove adsorbed gas from the column; (c) re-pressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column; (d) repeating steps (a) -(c) **(see column 2 lines 38-55)** but does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir of the ambulatory separator at a pressure of about 1.0 atm to about 2.0 atm and delivering product gas to the patient. Tedford teaches an apparatus that does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering product gas to the patient **(see column 6 lines 36-45)** but does not disclose a reservoir that is of the ambulatory oxygen separator. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invention by providing a method step of storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering product gas to the patient as taught by Tedford so that the patient gets better quality of oxygen and to modify Reiss/Tedford inventions by providing a reservoir that is of the ambulatory oxygen separator as taught by Deane in order to make it easier for the user to move around.

7. **As to claims 6 and 13,** Reiss substantially discloses a method step of introducing product gas occurs during an initial portion of step (c) **(see column 2 lines 38-55)**.

8. **As to claims 7 and 15,** Reiss substantially discloses the claimed invention; see rejection of claim 5 above, but does not disclose method step of controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen used by the patient. Tedford teaches an apparatus that does disclose a method step of controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen used by the patient **(see column 6 lines 36-60)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invnetion by providing a method step of controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen used by the patient as taught by Reiss in order to provide correct amount of oxygen.

9. **As to claim 9,** Reiss substantially discloses the claimed invention; see rejection of claim 5 above, but does not disclose a method step of delivering the product gas that is from the reservoir to the patient. Tedford discloses an apparatus that does disclose delivering the product gas that is from the reservoir to the patient **(see column 6 lines 36-50)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invnetion by providing a method step of delivering the product gas that is from the reservoir to the patient as taught by Tedford in order to provide pure oxygen.

10. **As to claims 10 and 17,** Reiss substantially discloses the claimed invention; see rejection of claim 5 above, but does not disclose a method step of delivering a pulse of product gas occurring in response to inhalation by the patient. Tedford discloses an apparatus that does disclose delivering a pulse of product gas occurring in response to inhalation by the patient **(see column 6 lines 36-50)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invnetion by providing a method step of

delivering a pulse of product gas occurring in response to inhalation by the patient as taught by Tedford in order to provide correct amount of oxygen.

10. Claims **18-21** are rejected under 35 U.S.C. 103(a) as being unpatentable over Reiss (US 5,114,440) in view of Tedford, Jr. (US 4,449,990) and further in view of Dee et al. (US 6,544,318) and further in view of Deane et al. (US 7,135,059).

11. **As to claims 18-21,** Reiss substantially disclose a method step of (a) introducing ambient air at about 1.0 atm into a first end of a column containing an adsorbent material and removes product gas out a second end of the column; (b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm; (c) repressurizing the column to about 1.0 atm; and repeating steps (a)-(c) **(see column 2 lines 38-50);** but does not disclose that the adsorbent material contains LiLSX or storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to about 2.0 atm; and delivering stored product gas to the patient. Tedford teaches an apparatus that does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering product gas to the patient **(see column 6 lines 36-45),** Deane teaches storing the product gas of the ambulatory oxygen concentrator and Dee teaches an apparatus that uses adsorbent material contains LiLSX **(see example 2 in detailed description).** Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invention by providing an adsorbent material that contains LiLSX as taught by Dee in order to provide pure oxygen to the patient and storing the product gas at a pressure of about 1.0 atm to about 2.0 atm; and delivering stored product gas to the patient as taught by Tedford in order to provide correct amount of oxygen and to provide a method step of storing the product

gas of the ambulatory oxygen separator as taught by Deane in order to make it easier for the user to move around.

The method steps would have been obvious because they would have resulted from the use of the devices of Reiss/Tedford/Dee and Deane.

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 NIHIR PATEL whose telephone number is (571)272-4803. The examiner can normally be reached on 7:30 to 4:30 every other Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patricia Bianco can be reached on (571) 272-4940. 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 http://pair-direct.uspto.gov. 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.

/Nihir Patel/
Examiner, Art Unit 3772

/Patricia Bianco/

Supervisory Patent Examiner, Art Unit 3772

Notice of References Cited	Application/Control No. 11/054,341	Applicant(s)/Patent Under Reexamination JAGGER ET AL.	
	Examiner NIHIR PATEL	Art Unit 3772	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-7,135,059	11-2006	Deane et al.	96/115
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	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.

GCE - Exhibit 1049, Page 192
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11054341	JAGGER ET AL.
	Examiner	Art Unit
	NIHIR PATEL	3772

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/02/2008								
	1	-								
	2	-								
	3	-								
	4	-								
	5	✓								
	6	✓								
	7	✓								
	8	-								
	9	✓								
	10	✓								
	11	-								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	-								
	17	✓								
	18	✓								
	19	✓								
	20	✓								
	21	✓								

GCE - Exhibit 1049, Page 193
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11054341	JAGGER ET AL.
	Examiner	Art Unit
	NIHIR PATEL	3772

SEARCHED			
Class	Subclass	Date	Examiner
128	201.25, 205.11, 205.18, 202.26	07.02.2008	NP
96	121, 130, 133, 147	07.02.2008	NP
95	96-103	07.02.2008	NP

SEARCH NOTES		
Search Notes	Date	Examiner
Search Updated	07.02.2008	NP

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	828	128/201.25	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:14
L2	572	128/205.11	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:14
L3	325	128/205.18	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:14
L4	408	128/202.26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:14
L5	392	96/121	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15
L6	713	96/130	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15
L7	298	96/133	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15
L8	413	96/147	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15

GCE - Exhibit 1049, Page 195
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

L9	1097	95/96	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15
L10	320	95/97	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15
L11	1104	95/98	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15
L12	298	95/99	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15
L13	687	95/100	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15
L14	313	95/101	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15
L15	198	95/102	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15
L16	290	95/103	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/07/02 17:15

7/2/2008 5:16:14 PM
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GCE - Exhibit 1049, Page 196
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

OIPE IAP34
APR 0 8 2008
PATENT & TRADEMARK OFFICE

4-9-08

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD PROVIDING AMBULATORY OXYGEN	Examiner: Nihir B. Patel
Docket No.	:	V180.12-0009	

EXPRESS MAIL COVER SHEET

Mail Stop Amendment
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL
Express Mail No.: EM 117202000 US

The following papers are being transmitted via **EXPRESS MAIL** to the U.S. Patent and Trademark Office on the date shown below:

1. FEE SHEET (Duplicate)
2. AMENDMENT

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: 4-8-08

By _____
Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

FEE TRANSMITTAL

OIPE JAP34 APR 08 2008 PATENT & TRADEMARK OFFICE

Complete if Known	
Application No.	11/054,341
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Group Art Unit	3772
Examiner Name	Nihir B. Patel
Atty. Docket Number	V180.12-0009

Total Amount of Payment $ -0-

METHOD OF PAYMENT (Check One)

1. [X] The Commissioner is hereby authorized to charge any additional fee required under 37 C.F.R. 1.16 and 1.17 and credit any over payments to Deposit Account No.11-0982. Deposit Account Name: Kinney & Lange, P.A. A duplicate copy of this communication is enclosed.

2. [ ] Check Enclosed

FEE CALCULATION

1. BASIC FILING FEE

Appn. Type	FILING FEE FEE/SMALL	SEARCH FEES FEE/SMALL	EXAM FEES FEE/SMALL	FEES PD.
Utility	310 / 155	510 / 255	210 / 105	_
Design	210 / 105	100 / 50	130 / 65	_
Reissue	310 / 155	510 / 255	620 / 310	_
Provisional	210 / 105	-0- / -0-	-0- / -0-	_

Subtotal (1) $ -0-

2. EXTRA CLAIM FEES

	Number Claims		Prior		Extra		Fee from Fee Paid Below		
Total	14	-	20	=	0	x	25	=	-0-
Indep.	3	-	3	=	0	x	105	=	-0-
Multiple Dependent Claims							0	=	-0-

Insert 3 and 20, or number previously paid if greater; Reissue see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Description
1202	50	2202	25	Claims in excess of 20
1201	210	2201	105	Independent claims in excess of 3
1203	370	2203	185	Multiple Dependent Claim
1204	210	2204	105	Reissue Independent Claims Over Original Patent
1205	50	2205	25	Reissue claims in excess of 20 and over original patent

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper, the application size fee due is $260 ($130 small) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 C.F.R. 1.16(s). $ -0-

Subtotal (2) $ -0-

FEE CALCULATION (Continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee paid
1051	130	2051	65	Surcharge - Late filing fee or oath	_
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	_
1053	130	1053	130	Non-English specification	_
1812	2,520	1812	2,520	For Filing a Request for Reexamination	_
1251	120	2251	60	Extension for reply within first month	_
1252	460	2252	230	Extension for reply within second month	_
1253	1,050	2253	525	Extension for reply within third month	_
1254	1,640	2254	820	Extension for reply within fourth month	_
1255	2,230	2255	1,115	Extension for reply within fifth month	_
1402	510	2402	255	Filing a brief in support of an appeal	_
1403	1,030	2403	515	Request for oral hearing	_
1814	130	2814	65	Terminal Disclaimer Fee	_
1452	510	2452	255	Petition to revive - unavoidable	_
1453	1,540	2453	770	Petition to revive - unintentional	_
1501	1,440	2501	720	Utility/Reissue issue fee	_
1502	820	2502	410	Design issue fee	_
1464	130	1464	130	Petitions to the Commissioner	_
1807	50	1807	50	Petitions related to provisional applications	_
1806	180	1806	180	Submission of Information Disclosure Statement	_
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	_
1801	810	2801	405	Request for Continued Examination (RCE)	_

Other fee (specify) _____ _

Subtotal (3) $ -0-

Signature _____ Reg. No. 57,153

Larrin Bergman

Date 4-8-08 Deposit Account No. 11-0982

OIPE IAP34
APR 08 2008
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B.
Docket No.	:	V180.12-0009	

AMENDMENT

Mail Stop Amendment
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL

Express Mail No.: EM 117202000 US

This is in response to the Office Action mailed on January 10, 2008. Please amend the above-identified application as follows:

AMENDMENTS TO THE SPECIFICATION

Please replace the paragraph at page 1, lines 3-18 with the following paragraph:

Reference is hereby made to the following co-pending applications, which were filed on even date with the present application: "Adsorbent Cartridge for Oxygen Concentrator", Theodore W. Jagger et al., Application No. 11/054,615; "Ambulatory Oxygen Concentrator Containing a Three Phase Vacuum Separation Process", Theodore W. Jagger et al., Application No. 11/054,340; "Personal Oxygen Concentrator", Theodore W. Jagger et al., Patent No. 7,121,276, Issued October 17, 2006; "Low Power Ambulatory Oxygen Concentrator", Theodore W. Jagger et al., Application No. 11/054,716; "Ambulatory Oxygen Concentrator With High Efficiency Adsorbent", Theodore W. Jagger et al., Application No. 11/054,367; "Portable Oxygen Concentrator With a Docking Station", Theodore W. Jagger et al., Application No. 11/054,714; "Method of Controlling the Rate of Oxygen Produced by an Oxygen Concentrator", Theodore W. Jagger et al., Application No. 11/054,342; "Product Pump for an Oxygen Concentrator", Theodore W. Jagger et al., Patent No. 7,171,963, Issued February 6, 2007; and "Method and Apparatus for Controlling the Purity of Oxygen Produced by an Oxygen Concentrator", Theodore W. Jagger et al., Application No. 11/054,368.

AMENDMENTS TO THE CLAIMS

Please amend claims 5, 12, and 18, such that the status of the claims is as follows:

1.(Canceled)

2.(Canceled)

3.(Canceled)

4.(Canceled)

5.(Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas with an ambulatory oxygen separator using a vacuum swing adsportion process that includes ~~by~~:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column;

(d) repeating steps (a) - (c);

storing product gas produced by the vacuum swing absorption process in a reservoir of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm; and

delivering a fluid ~~product gas~~ to the patient consisting essentially of the product gas.

6.(Original) The method of claim 5 wherein introducing product gas occurs during an initial portion of step (c).

7.(Original) The method of claim 5 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen used by the patient.

8.(Canceled)

9.(Currently Amended) The method of claim 5 wherein delivering the fluid ~~product gas~~ is from the reservoir to the patient.

10.(Currently Amended) The method of claim 5 wherein delivering the fluid ~~product gas~~ occurs in response to inhalation by the patient.

11.(Canceled)

12.(Currently Amended) A method of providing concentrated oxygen to a patient, the method comprising:

producing oxygen-rich product gas with an ambulatory oxygen separator using a vacuum swing adsorption process comprising:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end

of the column and ambient air into the first end of the column;

(d) repeating steps (a) - (c);

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm; and

delivering a fluid ~~stored product gas~~ to the patient consisting essentially of the stored product gas.

13.(Original) The method of claim 12 and further comprising:

introducing product gas into the column through the second end during a portion of step (c).

14.(Original) The method of claim 13 wherein introducing product gas occurs during an initial portion of step (c) prior to introducing ambient air.

15.(Original) The method of claim 12 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas delivered to the patient.

16.(Canceled)

17.(Original) The method of claim 12 wherein delivering stored product gas comprises delivering a pulse of product gas to the patient in response to inhalation by the patient.

18.(Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing the product gas ~~by~~ with an ambulatory oxygen separator utilizing a vacuum swing adsorption process, the process comprising the steps of:

(a) introducing ambient air at about 1.0 atmosphere (atm) into a first end of a column containing an LiLSX adsorbent material and removes product gas out a second end of the column;

(b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm;

(c) repressurizing the column to about 1.0 atm; and

(d) repeating steps (a) - (c);

storing the product gas of the ambulatory oxygen separator at a pressure of about 1.0 atm to 2.0 atm; and

delivering a fluid ~~stored product gas~~ to the patient consisting essentially of the stored product gas.

19.(Original) The method of claim 18 wherein repressurizing in step (c) comprises:
introducing product gas into the column through the second end; and
introducing ambient air into the column through the first end.

20.(Original) The method of claim 18 and further comprising:
controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen delivered to the patient.

21.(Original) The method of claim 18 wherein delivering stored product gas comprises delivering a pulse of product gas in response to an inhalation by the patient.

REMARKS

This is in response to the Office Action mailed on July 23, 2007, in which pending claims 5-7, 9-10, 12-15, and 17-21 were rejected. Specifically, claims 5-7, 9-10, 12-15, and 17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990); and claims 18-21 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Reiss (U.S. Patent No. 5,114,440) in view of Tedford, Jr. (U.S. Patent No. 4,449,990) and further in view of Dee et al. (U.S. Patent No. 6,544,318). In view of the following remarks, reconsideration and allowance of all claims (5-7, 9-10, 12-15, and 17-21) is requested.

Objection to the Specification

The disclosure was objected to and Examiner stated that the applicant must update the first paragraph. With this amendment, the status of the co-pending applications has been updated where appropriate.

Rejections under 35 U.S.C. § 103(a)

Reiss discloses a process for oxygen enrichment of air by means of a vacuum swing adsorption (VSA) process utilizing Ca zeolite molecular sieves that have different adsorption characteristics. The reference does not disclose storing the product gas produced by the vacuum swing adsorption process in a reservoir at about 1.0 atm to about 2.0 atm and delivering product gas to the patient. The reference alone does not disclose the claimed invention. Tedford, Jr. discloses a pair of beds connected by a valve with a source of air under pressure and a vacuum source configured to separate gases and put into a storage reservoir. The reference does not disclose the required steps for separating a product gas. The reference alone does not disclose the claimed invention.

The current invention relates to ambulatory concentrators. The independent claims 1, 12, and 18 have been amended to reflect this limitation. Neither Reiss nor Tedford, Jr. are directed

to ambulatory methods. Reiss is an oxygen separator for industrial use. This is evidenced by the size of the examples that all include beds of zeolite of over 100 kg. Tedford, Jr. is directed to a medical use, but is not ambulatory. This is evidenced by the size disclosed (columns alone are 4 inches in diameter and 15.5 inches in length, and contain 5.5 lbs. of zeolite each) and cycle time used (1 minute per cycle). See Col. 5, lines 1-12. With the amended claims, the references do not teach each and every limitation of the claims. In fact, Reiss now teaches away from the claims as the industrial separator size disclosed could never be used for ambulatory purposes.

Applicant has also amended the independent claims to state that the fluid delivered to the patient is essentially the product gas. This is direct conflict with the teaching of Tedford, Jr., which contains a humidifier for adding water vapor to the fluid prior to delivery to the patient. The humidifier will add bulk to the oxygen concentrator, thus making the oxygen concentrator less ambulant. Further, this will reduce the quality of the product gas, thus reducing its effectiveness.

Examiner has also cited Dee et al., which discloses a process for the recovery of a product gas from adsorption. This reference alone does not disclose the claimed invention. Nor does the combination of this reference with the other references of record disclose the claimed invention.

Thus, the combination of Reiss and Tedford Jr., do not teach all the claims limitations of claims 1, 12, and 18, and the rejection thereof should be withdrawn. If an independent claim is nonobvious under 35 U.S.C. §103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071; M.P.E.P. §2143.01. Thus, claims 6-7, 9-10, 13-15, 17, and 19-21 are also allowable.

Conclusion

In view of the foregoing, all pending claims 5-7, 9-10, 12-15, and 17-21 are in condition for allowance. A notice to that effect is respectfully requested.

The Examiner is cordially invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate the allowance of this application.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: 4-8-08 By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-658

LB:mdh

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. 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	Filing Date	☐ To be Mailed
11/054,341	02/09/2005	

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			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 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			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 04/08/2008	(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 ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 14	Minus	** 21	= 0	X $25 =	0	OR	X $ =	
Independent (37 CFR 1.16(h))	* 3	Minus	***4	= 0	X $105 =	0	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	0	OR	TOTAL ADD'L FEE	

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)	OR	RATE ($)	ADDITIONAL FEE ($)
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 number found in the appropriate box in column 1.

Legal Instrument Examiner:
/CORALIA BETANCOURT/

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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 01/10/2008

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	
ART UNIT	**PAPER NUMBER**
3772	

MAIL DATE	DELIVERY MODE
01/10/2008	PAPER

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.

Office Action Summary	Application No.	Applicant(s)	
	11/054,341	JAGGER ET AL.	
	Examiner	Art Unit	
	Nihir Patel	3772	

-- 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 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 10.23.2007.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ 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

4)☒ Claim(s) 5-7,9,10,12-15 and 17-21 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 5-7,9,10,12-15 and 17-21 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☐ All b)☐ Some * c)☐ None of:

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) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

GCE - Exhibit 1049, Page 210
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

DETAILED ACTION

Specification

The disclosure is objected to because of the following informalities: The first paragraph on the first page of the specification has not been updated. The applicant must update the first paragraph on the first page of the specification to include any updates on the other co-pending applications.

Appropriate correction is required.

Response to Arguments

1. Applicant's arguments filed on October 23rd, 2007, with respect to claims 5-7, 9, 10, 12-15 and 16-21 have been fully considered and are persuasive. The previous rejection(s) dated July 23rd, 2007 has been withdrawn.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) 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.

4. Claims **5-7, 9, 10, 12-15 and 17** are rejected under 35 U.S.C. 103(a) as being unpatentable over Reiss (US 5,114,440) in view of Tedford, Jr. (US 4,449,990).

5. **As to claims 5, 12 and 14,** Reiss substantially discloses a method step of (a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column; (b) evacuating the column through the first end to remove adsorbed gas from the column; (c) re-pressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column; (d) repeating steps (a) -(c) **(see column 2 lines 38-55)** but does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering product gas to the patient. Tedford teaches an apparatus that does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering product gas to the patient **(see column 6 lines 36-45)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invnetion by providing a method step of storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering product gas to the patient so that the patient gets better quality of oxygen.

6. **As to claims 6 and 13,** Reiss substantially discloses a method step of introducing product gas occurs during an initial portion of step (c) **(see column 2 lines 38-55)**.

7. **As to claims 7 and 15,** Reiss substantially discloses the claimed invention; see rejection of claim 5 above, but does not disclose method step of controlling a cycle rate at which steps (a)-

(c) are performed as a function of oxygen used by the patient. Tedford teaches an apparatus that does disclose a method step of controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen used by the patient **(see column 6 lines 36-60)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invnetion by providing a method step of controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen used by the patient as taught by Reiss in order to provide correct amount of oxygen.

8. **As to claim 9,** Reiss substantially discloses the claimed invention; see rejection of claim 5 above, but does not disclose a method step of delivering the product gas that is from the reservoir to the patient. Tedford discloses an apparatus that does disclose delivering the product gas that is from the reservoir to the patient **(see column 6 lines 36-50)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invnetion by providing a method step of delivering the product gas that is from the reservoir to the patient as taught by Tedford in order to provide pure oxygen.

9. **As to claims 10 and 17,** Reiss substantially discloses the claimed invention; see rejection of claim 5 above, but does not disclose a method step of delivering a pulse of product gas occurring in response to inhalation by the patient. Tedford discloses an apparatus that does disclose delivering a pulse of product gas occurring in response to inhalation by the patient **(see column 6 lines 36-50)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invnetion by providing a method step of delivering a pulse of product gas occurring in response to inhalation by the patient as taught by Tedford in order to provide correct amount of oxygen.

10. Claims **18-21** are rejected under 35 U.S.C. 103(a) as being unpatentable over Reiss (US 5,114,440) in view of Tedford, Jr. (US 4,449,990) and further in view of Dee et al. (US 6,544,318).

11. **As to claims 18-21,** Reiss substantially disclose a method step of (a) introducing ambient air at about 1.0 atm into a first end of a column containing an adsorbent material and removes product gas out a second end of the column; (b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm; (c) repressurizing the column to about 1.0 atm; and repeating steps (a)-(c) **(see column 2 lines 38-50);** but does not disclose that the adsorbent material contains LiLSX or storing the product gas at a pressure of about 1.0 atm to about 2.0 atm; and delivering stored product gas to the patient. Tedford teaches an apparatus that does disclose storing product gas produced by the vacuum swing adsorption process in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering product gas to the patient **(see column 6 lines 36-45)** and Dee teaches an apparatus that uses adsorbent material contains LiLSX **(see example 2 in detailed description).** Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Reiss invention by providing an adsorbent material that contains LiLSX as taught by Dee in order to provide pure oxygen to the patient and storing the product gas at a pressure of about 1.0 atm to about 2.0 atm; and delivering stored product gas to the patient as taught by Tedford in order to provide correct amount of oxygen.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nihir Patel whose telephone number is (571) 272-4803. The examiner can normally be reached on 7:30 to 4:30 every other Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patricia Bianco can be reached on (571) 272-4940. 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 http://pair-direct.uspto.gov. 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.

Art Unit 3772

Nihir Patel

PATRICIA BIANCO
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 3700
1/7/08

Notice of References Cited	Application/Control No. 11/054,341	Applicant(s)/Patent Under Reexamination JAGGER ET AL.	
	Examiner Nihir Patel	Art Unit 3772	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,114,440	05-1992	Reiss, Gerhard	95/96
*	B	US-4,449,990	05-1984	Tedford, Jr., Richard A.	95/26
*	C	US-6,544,318	04-2003	Dee et al.	95/96
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
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	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.

GCE - Exhibit 1049, Page 216
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

Search Notes (continued)

Application/Control No.	Applicant(s)/Patent under Reexamination	
11/054,341	JAGGER ET AL.	
Examiner	**Art Unit**	
Nihir Patel	3772	

SEARCHED			
Class	Subclass	Date	Examiner
Search	Updated	1/3/2008	NP

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
Search Updated; See Previous Search Notes Dated October 31st, 2006	1/3/2008	NP

GCE - Exhibit 1049, Page 217
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
11/054,341	JAGGER ET AL.
Examiner	**Art Unit**
Nihir Patel	3772

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	+	Restricted	I	Interference	O	Objected

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GCE - Exhibit 1049, Page 218
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

OIPE
OCT 23 2007
PATENT & TRADEMARK OFFICE

10-24-07

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B.
Docket No.	:	V180.12-0009	

EXPRESS MAIL COVER SHEET

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

SENT VIA EXPRESS MAIL
Express Mail No.: EV922426599US

The following papers are being transmitted via **EXPRESS MAIL** to the U.S. Patent and Trademark Office on the date shown below:

1. Fee Transmittal (in duplicate);
2. Response;
3. Postcard.

Respectfully submitted,

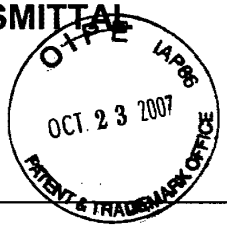
KINNEY & LANGE, P.A.

Date: 10-23-07

By _____
Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:arm

FEE TRANSMITTAL



Total Amount of Payment $0.00

Complete if Known	
Application No.	11/054,341
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Group Art Unit	3772
Examiner Name	Patel, Nihir B.
Atty. Docket Number	V180.12-0009

METHOD OF PAYMENT (Check One)

1. [X] The Commissioner is hereby authorized to charge any additional fee required under 37 C.F.R. 1.16 and 1.17 and credit any over payments to Deposit Account No.11-0982. Deposit Account Name: Kinney & Lange, P.A. A duplicate copy of this communication is enclosed.

2. [ ] Check Enclosed

FEE CALCULATION

1. BASIC FILING FEE

Appn. Type	FILING FEE FEE/SMALL	SEARCH FEES FEE/SMALL	EXAM FEES FEE/SMALL	FEES PD.
Utility	310 / 155	510 / 255	210 / 105	_
Design	210 / 105	100 / 50	130 / 65	_
Reissue	310 / 155	510 / 255	620 / 310	_
Provisional	210 / 105	-0- / -0-	-0- / -0-	_

Subtotal (1) $0.00

2. EXTRA CLAIM FEES

	Number Claims		Prior**		Extra		Fee from Below		Fee Paid
Total	* __	-	* __	=	* __	X	* __	=	* __
Indep.	* __	-	* __	=	* __	X	* __	=	* __
Multiple Dependent Claims							* __	=	* __

**Insert 3 and 20, or number previously paid if greater; Reissue see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Description
1202	50	2202	25	Claims in excess of 20
1201	210	2201	105	Independent claims in excess of 3
1203	370	2203	185	Multiple Dependent Claim
1204	210	2204	105	Reissue Independent Claims Over Original Patent
1205	50	2205	25	Reissue claims in excess of 20 and over original patent

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper, the application size fee due is $260 ($130 small) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 C.F.R. 1.16(s). $-0-

Subtotal (2) $0.00

FEE CALCULATION (Continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee paid
1051	130	2051	65	Surcharge - Late filing fee or oath	_
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	_
1053	130	1053	130	Non-English specification	_
1812	2,520	1812	2,520	For Filing a Request for Reexamination	_
1251	120	2251	60	Extension for reply within first month	_
1252	460	2252	230	Extension for reply within second month	_
1253	1,050	2253	525	Extension for reply within third month	_
1254	1,640	2254	820	Extension for reply within fourth month	_
1255	2,230	2255	1,115	Extension for reply within fifth month	_
1402	510	2402	255	Filing a brief in support of an appeal	_
1403	1,030	2403	515	Request for oral hearing	_
1814	130	2814	65	Terminal Disclaimer Fee	_
1452	510	2452	255	Petition to revive - unavoidable	_
1453	1,540	2453	770	Petition to revive - unintentional	_
1501	1,440	2501	720	Utility/Reissue issue fee	_
1502	820	2502	410	Design issue fee	_
1464	130	1464	130	Petitions to the Commissioner	_
1807	50	1807	50	Petitions related to provisional applications	_
1806	180	1806	180	Submission of Information Disclosure Statement	_
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	_
1801	810	2801	405	Request for Continued Examination (RCE)	_

Other fee (specify) _____ _

Subtotal (3) $0.00

Signature _____ Reg. No. 57,153

Larrin Bergman

Date 10-23-07 Deposit Account No. 11-0982

OIPE IAP96 OCT 23 2007 PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B.
Docket No.	:	V180.12-0009	

RESPONSE

Mail Stop Amendment
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL

Express Mail No.: EV 922426599 US

INTRODUCTION

This is in response to the Office Action mailed on July 23, 2007.

REMARKS

This is in response to the Office Action mailed on July 23, 2007, in which pending claims 5-7, 9-10, 12-15, and 17-21 were rejected. Specifically, claims 5-7, 9, and 12-15 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Agrawal et al. (U.S. Patent No. 5,429,666) in view of Michaels et al. (U.S. Patent No. 5,906,672); claims 10 and 17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Agrawal et al. (U.S. Patent No. 5,429,666) in view of Michaels et al. (U.S. Patent No. 5,906,672), and further in view of Warren (U.S. Patent No. 6,547,851); claims 18-20 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Agrawal et al. (U.S. Patent No. 5,429,666) in view of Michaels et al. (U.S. Patent No. 5,906,672), and further in view of Dee et al. (U.S. Patent App. No. 20020144596) and Smolarek et al. (U.S. Patent No. 6,344,069); and claim 21 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Agrawal et al. (U.S. Patent No. 5,429,666) in view of Michaels et al. (U.S. Patent No. 5,906,672), and further in view of Dee et al. (U.S. Patent App. No. 20020144596), Smolarek et al. (U.S. Patent No. 6,344,069), and Warren (U.S. Patent No. 6,547,851). In view of the following remarks, reconsideration and allowance of all claims (1-21) is requested.

Agrawal, et al., which discloses a vacuum pressure swing adsorption (VPSA) system, does not disclose each and every limitation of the claims. Michaels et al., discloses a gas VPSA separation system for medical use, and does not disclose each and every limitation of the claims. The disclosures teach away from the current invention.

This is evidenced by the Agrawal disclosure of introducing the fluid in the feed phase via a blower (111 of the drawing), and the Michaels disclosure which states that the system is VPSA. This conflicts with the limitation present in independent claims 5, 12, and 18 requiring vacuum swing adsorption for the gas separation process. Specifically, claims 5, 12, and 18 each require that there be an introduction of *ambient air* into the separation column.

Michaels specifically requires that the feed air be pressurized from a compressor. See Col. 5, lns 35-48. Similarly, Agrawal has a feed blower, which acts to pressurize the air entering the separation columns. Although both are using air for separation, the air is not ambient air entering the

respective separation columns as feed gas, but is pressurized prior to its introduction as the feed gas. See Agrawal Col. 7, ln 34-Col. 8 ln 5. (Describing the system process with a feed blower and adsorption pressure of 21 psi); See also Agrawal Cols. 5 and 6 (always requiring that there be and "elevated feed gas" or air from the "feed blower" in the steps); Agrawal Claims 1 and 9 (both requiring "introducing a feed {gas mixture or air} at elevated pressure"). The references specifically teach away from a system that introduces ambient air into the separation columns containing the adsorption material.

Those of skill in the art will recognize the differences between PSA, VSA, and VPSA, and know that the processes are not interchangeable as each process requires a different set of components and steps to achieve the separation of gases. See Col. 8, lns 42-51 of Agrawal explaining the differences in results between the Agrawal disclosure and a VSA system. To obtain the claimed invention, one would have to modify both the Agrawal and Michaels references to remove and/or add different components. Specifically, there is no compressor/blower for pressurizing the feed air present in the current invention, which is a part of both the Agrawal and Michaels references. This shows a teaching away from the current claims by the reference. As such, one of skill in the art would not look to modify the references as the Examiner has suggested, as this would render the Agrawal and Michaels references unable to perform the intended purpose of the disclosures. M.P.E.P. §2143.01.

None of the cited references alone teach each and every limitation as present in the independent claims 5, 12, and 18. As previously stated, there is no motivation to combine the references. As such, nothing in the art of record teaches or suggests the current claimed invention.

Because claims 6-7, 9-10, 13-15, 17, and 19-21 depend from an allowable claim, the claims also are allowable. The present application, including pending claims 5-7, 9-10, 12-15, and 17-21, is now in condition for allowance. Notice to that effect is respectfully requested.

CONCLUSION

In view of the foregoing, all pending claims are in condition for allowance. A notice to that effect is respectfully requested.

The Examiner is cordially invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate the allowance of this application.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: 10-23-07

By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:arm

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 NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 07/23/2007

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	
ART UNIT	**PAPER NUMBER**
3772	

MAIL DATE	DELIVERY MODE
07/23/2007	PAPER

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.

ED

Office Action Summary	Application No.	Applicant(s)	
	11/054,341	JAGGER ET AL.	
	Examiner	Art Unit	
	Nihir Patel	3772	

-- 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 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *June 4th, 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ 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

4)☒ Claim(s) *5-7,9,10,12-15 and 17-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *5-7,9,10,12-15 and 17-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☐ All b)☐ Some * c)☐ None of:

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) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *2.22.2007*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

GCE - Exhibit 1049, Page 226
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

DETAILED ACTION

Allowable Subject Matter

1. The indicated allowability of claims 11 and 16 is withdrawn in view of the newly discovered reference(s). Rejections based on the newly cited reference(s) follow.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) 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.

4. Claims **5-7, 9 and 12-15** are rejected under 35 U.S.C. 103(a) as being unpatentable over Agrawal et al. (US 5,429,666) in view of Michaels et al. (US 5,906,672).

5. **As to claims 5, 9 and 12,** Agrawal substantially discloses a method of producing product gas by (a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen rich product gas out a second end of the column; (b) evacuating the column through the first end to move adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second column end of the column; (d) repeating steps (a)-(c) **(see brief summary of the invention)**, but does not disclose storing product gas in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering the product gas to the patient. Michaels discloses a method step of storing product gas in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering the product gas to the patient **(see figure 1 and column 8 lines 30-40)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Agrawal's invention by providing a method step of storing product gas in a reservoir at a pressure of about 1.0 atm to about 2.0 atm and delivering the product gas to the patient as taught by Michaels in order to appropriate amount of product gas to the patient.

6. **As to claims 6 and 13,** Agrawal substantially discloses a method step of introducing product gas occurs during an initial portion of step (c) **(see brief summary of the invention)**.

7. **As to claims 7 and 15,** Agrawal substantially discloses the claimed invention; see rejection of claims 5 and 12 above, but does not disclose a method step of controlling a cycle rate at which steps (a) – (c) are performed as a function of oxygen used by the patient. Michaels discloses a method step of controlling a cycle rate at which steps (a) – (c) are performed as a function of oxygen used by the patient **(see column 6 lines 45-67)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Agrawal's invention by providing a method step of controlling a cycle rate at which steps (a) – (c) are performed as a function of oxygen used by the patient in order to produce accurate amount of product gas.

8. **As to claim 14,** Agrawal substantially discloses a method step of introducing product gas occurs during an initial portion of step (c) prior to introducing ambient air **(see brief summary of the invention)**.

9. Claims **10 and 17** are rejected under 35 U.S.C. 103(a) as being unpatentable over Agrawal et al. (US 5,429,6660 in view Michaels et al. (US 5,906,672) as applied to claims **5-7, 9 and 12-15** above, and further in view of Warren (US 6,547,851).

10. **As to claims 10 and 17,** Agrawal/Michaels substantially discloses the claimed invention; see rejection of claims 5 and 12 above, but does not disclose a method step of delivering product gas occurs in response to inhalation by the patient. Warren teaches a method step of delivering product gas occurs in response to inhalation by the patient **(see column 10 lines 54-67 and column 11 lines 1-12)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Agrawal/Michaels invention by providing a method step of delivering product gas occurs in response to inhalation by the patient as taught by Warren in order to prevent leakage.

11. Claims **18, 19, 20 and 21** are rejected under 35 U.S.C. 103(a) as being unpatentable over Agrawal et al. (US 5,429,666), Dee et al. (US 20020144596), Smolarek et al. (US 6,344,069) in view of Michaels et al. 9US 5,906,672).

12. **As to claims 18 and 20,** Agrawal substantially discloses an apparatus that comprises a method step of producing the product gas by vacuum swing adsorption process, the process comprises introducing ambient air at about 1.0 atm into a first end of a column and removing product gas out a second end of the column, evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm and repeating steps (a) – (c) but

doesn't disclose a column containing an LiLSX adsorbent material; re-pressurizing the column to about 1.0 atm; storing the product gas at a pressure of about 1.0 atm to about 2.0 atm; delivering stored product gas to the patient and controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen delivered to the patient. Dee discloses an apparatus that does disclose a column containing an LiLSX adsorbent material **(see paragraph [0070])**; Smolarek teaches a method step of re-pressuring the column to about 1.0 atm **(see column 5 lines 1-20)** and Michaels discloses a method step of storing product gas in a reservoir at a pressure of about 1.0 atm to about 2.0 atm, delivering the product gas to the patient and controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen delivered to the patient **(see figure 1 and column 8 lines 30-40; see column 6 lines 45-67).** Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Agrawal's invention by providing a column containing an LiLSX adsorbent material as taught by Dee in order to remove the impurities and to produce clean product gas; re-pressurizing the column to about 1.0 atm as taught by Smolarek in order to improve the purifying process; storing the product gas at a pressure of about 1.0 atm to about 2.0 atm; delivering stored product gas to the patient and controlling a cycle rate at which steps (a)-(c) are performed as a function of oxygen delivered to the patient as taught by Michaels in order to appropriate amount of product gas to the patient.

13. **As to claim 19,** Agrawal substantially discloses a method step of introducing product gas into the column through the second end; and introducing ambient air into the column through the first end **(see brief summary of the invention)**.

14. Claim **21** is rejected under 35 U.S.C. 103(a) as being unpatentable over Agrawal et al. (US 5,429,666), Dee et al. (US 20020144596), Smolarek et al. (US 6,344,069), Michaels et al. 9US 5,906,672) in view of Warren (US 6,547,851).

15. **As to claim 21,** Agrawal, Dee, Smolarek and Michaels substantially discloses the claimed invention; see rejection of claim 18 above, but does not disclose a method step of delivering a pulse of product gas in response to an inhalation by the patient. Warren teaches a method step of delivering product gas occurs in response to inhalation by the patient **(see column 10 lines 54-67 and column 11 lines 1-12)**. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Agrawal, Dee, Smolarek and Michaels invention by providing a method step of delivering product gas occurs in response to inhalation by the patient as taught by Warren in order to prevent leakage.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nihir Patel whose telephone number is (571) 272-4803. The examiner can normally be reached on 7:30 to 4:30 every other Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patricia Bianco can be reached on (571) 272-4940. 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 http://pair-direct.uspto.gov. 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.

Art Unit 3772
Nihir Patel

PATRICIA BIANCO
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 3700
7/19/07

OIPE LAP19 FEB 22 2007 PATENT & TRADEMARK OFFICE

FORM PTO-1449	Atty. Docket No.: V180.12-0009	Application No.: 11/054,341
LIST OF PATENTS AND PUBLICATIONS FOR APPLICANT'S INFORMATION DISCLOSURE STATEMENT	First Named Inventor: Theodore W. Jagger	
	Filing Date: February 9, 2005	Group Art: 3743

U.S. PATENT DOCUMENTS

Examiner Initials		Document No.	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents
/NP/	AA	5,084,075	01-28-1992	Sircar
/NP/	AB	6,802,889	10-12-2004	Graham et al.
	AC			
	AD			
	AE			
	AF			
	AG			
	AH			
	AI			
	AJ			
	AK			

FOREIGN PATENT DOCUMENTS

		Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents	Translation Yes No
	AL				
	AM				
	AN				

OTHER ART (Including Author, Title, Date, Pertinent Pages, Etc.)

	AO	
	AP	
	AQ	

EXAMINER: /Nihir Patel/ DATE CONSIDERED: 07/18/2007

EXAMINER: Initial if citation 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.

Notice of References Cited	Application/Control No. 11/054,341	Applicant(s)/Patent Under Reexamination JAGGER ET AL.	
	Examiner Nihir Patel	Art Unit 3772	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,906,672	05-1999	Michaels et al.	95/12
*	B	US-6,547,851	04-2003	Warren, John Lee	95/21
*	C	US-2002/0144596	10-2002	Dee et al.	95/96
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	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.

GCE - Exhibit 1049, Page 234
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

Search Notes (continued)

Application/Control No.	Applicant(s)/Patent under Reexamination	
11/054,341	JAGGER ET AL.	
Examiner	**Art Unit**	
Nihir Patel	3772	

SEARCHED			
Class	Subclass	Date	Examiner
Search	Updated	7/18/2007	NP

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
Search Updated; See Previous Search Notes Dated October 31st, 2006	7/18/2007	NP

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
11/054,341	JAGGER ET AL.
Examiner	**Art Unit**
Nihir Patel	3772

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date								
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GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

OIPE
JUN 04 2007
PATENT & TRADEMARK OFFICE

06-05-07

AP
IPW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B.
Docket No.	:	V180.12-0009	

EXPRESS MAIL COVER SHEET

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

SENT VIA EXPRESS MAIL
Express Mail No.: EV922425029US

The following papers are being transmitted via **EXPRESS MAIL** to the U.S. Patent and Trademark Office on the date shown below:

1. Fee Transmittal (in duplicate);
2. Amendment After Final;
3. Postcard.

Respectfully submitted,

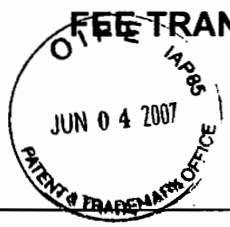
KINNEY & LANGE, P.A.

Date: 6-4-07

By _____
Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:arm

FEE TRANSMITTAL



Complete if Known	
Application No.	11/054,341
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Group Art Unit	3772
Examiner Name	Patel, Nihir B.
Atty. Docket Number	V180.12-0009

METHOD OF PAYMENT (Check One)

1. [X] The Commissioner is hereby authorized to charge any additional fee required under 37 C.F.R. 1.16 and 1.17 and credit any over payments to Deposit Account No.11-0982.

2. [ ] Check Enclosed

FEE CALCULATION

1. BASIC FILING FEE

Appn. Type	FILING FEE FEE/SMALL	SEARCH FEES FEE/SMALL	EXAM FEES FEE/SMALL	FEES PD.
Utility	300 / 150	500 / 250	200 / 100	_
Design	200 / 100	100 / 50	130 / 65	_
Reissue	300 / 150	500 / 250	600 / 300	_
Provisional	200 / 100	-0- / -0-	-0- / -0-	_

Subtotal (1) $0.00

2. EXTRA CLAIM FEES

	Number Claims		Prior		Extra		Fee from Fee Paid Below		
Total	14	-	21	=	0	x	25	=	0
Indep.	3	-	3	=	0	x	100	=	0
Multiple Dependent Claims							0	=	0

Insert 3 and 20, or number previously paid if greater; Reissue see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Description
1202	50	2202	25	Claims in excess of 20
1201	200	2201	100	Independent claims in excess of 3
1203	360	2203	180	Multiple Dependent Claim
1204	200	2204	100	Reissue Independent Claims Over Original Patent
1205	50	2205	25	Reissue claims in excess of 20 and over original patent

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 small) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 C.F.R. 1.16(s). $-0-

Subtotal (2) $0.00

FEE CALCULATION (Continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee paid
1051	130	2051	65	Surcharge - Late filing fee or oath	_
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	_
1053	130	1053	130	Non-English specification	_
1812	2,520	1812	2,520	For Filing a Request for Reexamination	_
1251	120	2251	60	Extension for reply within first month	_
1252	450	2252	225	Extension for reply within second month	_
1253	1,020	2253	510	Extension for reply within third month	_
1254	1,590	2254	795	Extension for reply within fourth month	_
1255	2,160	2255	1,080	Extension for reply within fifth month	_
1402	500	2402	250	Filing a brief in support of an appeal	_
1403	1,000	2403	500	Request for oral hearing	_
1814	130	2814	65	Terminal Disclaimer Fee	_
1452	500	2452	250	Petition to revive - unavoidable	_
1453	1,500	2453	750	Petition to revive - unintentional	_
1501	1,400	2501	700	Utility/Reissue issue fee	_
1502	800	2502	400	Design issue fee	_
1460	130	1460	130	Petitions to the Commissioner	_
1807	50	1807	50	Petitions related to provisional applications	_
1806	180	1806	180	Submission of Information Disclosure Statement	_
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	_
1801	790	2801	395	Request for Continued Examination (RCE)	_
Other fee (specify)					_

Subtotal (3) $0.00

Signature _____ Reg. No. 57,153

Larrin Bergman

Date 6-4-07 Deposit Account No. 11-0982

OIPE IAP85
JUN 04 2007
PATENT & TRADEMARK OFFICE

RESPONSE UNDER 37 CFR 1.116
EXPEDITED PROCEDURE
EXAMINING GROUP 3700

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3772
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Patel, Nihir B.
Docket No.	:	V180.12-0009	

AMENDMENT AFTER FINAL

Mail Stop AF
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL

Express Mail No.: EV 922425029 US

This is in response to the Office Action mailed on April 4, 2007. Please amend the above-identified application as follows:

AMENDMENTS TO THE CLAIMS

Please amend claims 5 and 12, and cancel claims 1-4, 8, 11, and 16, such that the status of the claims is as follows:

1.(Canceled)

2.(Canceled)

3.(Canceled)

4.(Canceled)

5.(Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas by:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column;

(d) repeating steps (a) - (c); ~~and~~

storing product gas produced by the vacuum swing absorption process in a reservoir at a pressure of about 1.0 atm to 2.0 atm; and

delivering product gas to the patient.

6.(Original) The method of claim 5 wherein introducing product gas occurs during an initial portion of step (c).

7.(Original) The method of claim 5 and further comprising:
controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen used by the patient.

8.(Canceled)

9.(Currently Amended) The method of claim [~~8~~] 5 wherein delivering the product gas is from the reservoir to the patient.

10.(Currently Amended) The method of claim [~~8~~] 5 wherein delivering product gas occurs in response to inhalation by the patient.

11.(Canceled)

12.(Currently Amended) A method of providing concentrated oxygen to a patient, the method comprising:
producing oxygen-rich product gas with a vacuum swing adsorption process comprising:
(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;
(b) evacuating the column through the first end to remove adsorbed gas from the column;
(c) repressurizing the column by introducing product gas into the second end

of the column and ambient air into the first end of the column;

(d) repeating steps (a) - (c);

storing product gas at a pressure of about 1.0 atm to about 2.0 atm; and

delivering stored product gas to the patient.

13.(Original) The method of claim 12 and further comprising:

introducing product gas into the column through the second end during a portion of step (c).

14.(Original) The method of claim 13 wherein introducing product gas occurs during an initial portion of step (c) prior to introducing ambient air.

15.(Original) The method of claim 12 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas delivered to the patient.

16.(Canceled)

17.(Original) The method of claim 12 wherein delivering stored product gas comprises delivering a pulse of product gas to the patient in response to inhalation by the patient.

18.(Previously Presented) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing the product gas by a vacuum swing adsorption process, the process comprising the steps of:

(a) introducing ambient air at about 1.0 atmosphere (atm) into a first end of a column containing an LiLSX adsorbent material and removes product gas out a second end of the column;

(b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm;

(c) repressurizing the column to about 1.0 atm; and

(d) repeating steps (a) - (c);

storing the product gas at a pressure of about 1.0 atm to about 2.0 atm; and

delivering stored product gas to the patient.

19.(Original) The method of claim 18 wherein repressurizing in step (c) comprises:

introducing product gas into the column through the second end; and

introducing ambient air into the column through the first end.

20.(Original) The method of claim 18 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen delivered to the patient.

21.(Original) The method of claim 18 wherein delivering stored product gas comprises delivering a pulse of product gas in response to an inhalation by the patient.

REMARKS

This is in response to the Office Action mailed on April 4, 2007, in which pending claims 1-10, 12-15, 17-21 were rejected, and claims 11 and 16 were objected to. The terminal disclaimer filed on December 29, 2006, was accepted to negate the previous rejections of nonstatutory double patenting.

Examiner and Larrin Bergman, counsel for Applicant, conducted a telephone interview on June 4, 2007. The rejections in the Office Action of April 4, 2007, were discussed. Examiner confirmed that claims 11 and 16 were allowable, and stated claim 18 is allowable in its present form. Applicant has moved the limitations of claims 11 and 16, as well as the limitations of all intervening claims, to the base claims from which they depend. Thus, claim 5 has been amended to include the limitations of claims 8 and 11, both of which are now canceled. Similarly, claim 12 has been amended to include the limitations of claim 16, which has been canceled. Rejected claims 1-4 have been canceled.

In view of the foregoing, all pending claims 5-7, 9-10, 12-15, and 18-21 are in condition for allowance. A notice to that effect is respectfully requested.

The Examiner is cordially invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate the allowance of this application.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: 6-4-07

By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-658

LB:arm

PATENT APPLICATION FEE DETERMINATION RECORD
Effective December 8, 2004

11/057,341

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	21	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	21 minus 20=	* 1
INDEPENDENT CLAIMS	4 minus 3 =	* 1
MULTIPLE DEPENDENT CLAIM PRESENT	☐	

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☒		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	150	OR	BASIC FEE	
X$ 25=	25	OR	X$50=	
X100=	100	OR	X200=	
+180=		OR	+360=	
TOTAL	270	OR	TOTAL	

3/21/05

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	=	=
Independent	*	Minus	=	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

8-15-06

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 21	Minus	= 21	= 0
Independent	* 4	Minus	= 4	= 0
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

4/4/07

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 14	Minus	= 21	= —
Independent	* 3	Minus	= 4	= —
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	

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 NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 04/04/2007

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	
ART UNIT	**PAPER NUMBER**
3772	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/04/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

ED

Office Action Summary	Application No.	Applicant(s)	
	11/054,341	JAGGER ET AL.	
	Examiner	Art Unit	
	Nihir Patel	3772	

-- *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 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *01.18.2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ 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

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10,12-15 and 17-21* is/are rejected.

7)☒ Claim(s) *11 and 16* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02.09.2005* 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☐ All b)☐ Some * c)☐ None of:

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) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *12.29.2006*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

GCE - Exhibit 1049, Page 247
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

DETAILED ACTION

Response to Arguments

1. The applicant argues that combining Agrawal et al. reference with either Hill or Smolarek et al. would yield an entirely different system based on a different principles of operation (VSA instead of VPSA). The applicant goes onto to argues that a proposed modification or combination of prior art that changes the principle of operation of the prior art invention being modified are not sufficient to render claims prima facie obvious. The examiner disagree. Hill and Smolarek both disclose VPSA system that use either feed blower to provide pressure. The examiner would like to point out that Agrawal's discloses a VSA system that introduces feed gas mixture at elevated pressure **(see column 2 lines 55-67)** indicating that both system uses some type of blower to provide pressure indicating that systems are similar. Since the systems are similar, Smolarek also teaches that the separation process requires raising the pressure of the separation column about 1.0 atm **(see column 5 lines 1-20; Smolarek gives the values of 9-16 psi when converted its about 0.6-1.06 atm which is approximately 1.0 atm as stated in the claims)**.

In response to applicant's argument that the Agrawal's invention is for an industrial use, a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim.

Therefore claims 1-10, 12-15 and 17-21 are still rejected under 35 U.S.C. 103(a) as being unpatentable over Hill (US 6,471,744) in view of Smolarek et al. (US 6,344,069) further in view

of Agrawal et al. (US 5,429,666) and claims 11 and 16 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form as stated in the previous office action dated October 31st, 2006.

Terminal Disclaimer

2. The terminal disclaimer filed on December 29th, 2006 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of 11/054,713, 11/054,340 and 11/054,342 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Conclusion

THIS ACTION IS MADE FINAL. 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 mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nihir Patel whose telephone number is (571) 272-4803. The examiner can normally be reached on 7:30 to 4:30 every other Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patricia Bianco can be reached on (571) 272-4940. 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 http://pair-direct.uspto.gov. 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.

Art Unit 3772

Nihir Patel

PATRICIA BIANCO
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 3700

4/2/07

FORM PTO-1449	Atty. Docket No.: V180.12-0009	Application No.: 11/054,341
LIST OF PATENTS AND PUBLICATIONS FOR APPLICANT'S INFORMATION DISCLOSURE STATEMENT	First Named Inventor: Theodore W. Jagger	
	Filing Date: February 9, 2005	Group Art: 3772

USPTO PATENT & TRADEMARK OFFICE DEC. 29 2006 OIPE IAP68

U.S. PATENT DOCUMENTS

Examiner Initials		Document No.	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents
/NP/	AA	4,194,890	03-25-1980	McCombs, et al.
	AB	4,472,177	09-18-1984	Sircar
	AC	5,366,541	11-22-1994	Hill, et al.
	AD	5,656,066	08-12-1997	Reiss, et al.
	AE	6,162,283	12-19-2000	Conrad, et al.
	AF	6,217,635	04-17-2001	Conrad, et al.
	AG	6,544,318	04-08-2003	Dee, et al.
	AH	6,712,886	03-30-2004	Kim
	AI	6,805,729	10-19-2004	Lim, et al.
	AJ	6,811,590	11-02-2004	Lee, et al.
	AK	6,866,041	03-15-2005	Hardy, Jr. , et al.
	AL	7,066,985	06-27-2006	Deane, et al.
	AM	US 2002/0053286 A1	05-09-2002	Czabala
	AN	US 2004/0020366 A1	02-05-2004	Walker, et al.
	AO	US 2004/0149133 A1	08-05-2004	McCombs, et al.
/NP/	AP	US 2005/0081713 A1	04-21-2005	Lee, et al.

FOREIGN PATENT DOCUMENTS

		Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents	Translation Yes No
	AQ				
	AR				
	AS				

OTHER ART (Including Author, Title, Date, Pertinent Pages, Etc.)

	AT	
	AU	
	AV	

EXAMINER: /Nihir Patel/ DATE CONSIDERED: 03/30/2007

EXAMINER: Initial if citation 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.

Search Notes (continued)	Application/Control No.	Applicant(s)/Patent under Reexamination
	11/054,341	JAGGER ET AL.
	Examiner	Art Unit
	Nihir Patel	3772

SEARCHED			
Class	Subclass	Date	Examiner
Search	Updated	3/30/2007	NP

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
Search Updated; See Previous Search Notes Dated October 31, 2006	3/30/2007	NP

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
11/054,341	JAGGER ET AL.
Examiner	**Art Unit**
Nihir Patel	3772

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date								
Final	Original	3/30/07								
	1	√								
	2	√								
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GCE - Exhibit 1049, Page 253
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

OIPE
FEB 22 2007
PATENT & TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3743
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihir B. Patel
Docket No.	:	V180.12-0009	

THIRD SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

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

I CERTIFY THAT THIS PAPER IS BEING SENT BY U.S. MAIL, FIRST CLASS, TO THE COMMISSIONER FOR PATENTS, ALEXANDRIA, VA 22313, THIS 20th DAY OF February, 2007.

PATENT ATTORNEY

The enclosed PTO Form-1449 lists patents and publications submitted pursuant to 37 C.F.R. 1.97. Copies of the patents or publications are enclosed as necessary.

TIME OF FILING

The Information Disclosure Statement is being filed:

1. _ with the application or within three months of the filing date of a national application (other than a continued prosecution application under 37 C.F.R. 1.53(d)) or date of entry into the national stage of an international application or, to the best of the undersigned's knowledge, before the mailing date of a first Office action on the merits or a first office action after the filing of a request for continued examination under 37 C.F.R. 1.114, whichever event occurs last. In accordance with 37 C.F.R. 1.97(b), no certification or fee is required.

2. X after the time period specified in paragraph 1 above, but, to the best of the undersigned's knowledge, before the mailing date of a final action under 37 C.F.R. 1.113 or notice of allowance under 37 C.F.R. 1.311, or an action that otherwise closes prosecution of the application. In accordance with 37 C.F.R. 1.97(c), submitted herewith is:

(check either A or B below)

A. X a statement as specified in 37 C.F.R. 1.97(e), no fee is required.

B. _ the fee set forth in 37 C.F.R. 1.17(p) for submission of an Information Disclosure Statement under 37 C.F.R. 1.97(c).

3. _ after the mailing date of either a final action under 37 C.F.R. 1.113 or a Notice of Allowance under 37

C.F.R. 1.311, whichever occurs first, but on or before payment of the issue fee. Applicant petitions for consideration of this Information Disclosure Statement pursuant to 37 C.F.R. 1.97(d)(2). Applicant submits herewith:

A. a statement as specified in 37 C.F.R. 1.97(e); and

B. the fee set forth in 37 C.F.R. 1.17(p).

STATEMENT

(only used if No. 2A or No. 3 above is checked)

The person(s) signing below states:

(check appropriate paragraph)

X 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 this Information Disclosure Statement. 37 C.F.R. 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 statement after making 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 of this Information Disclosure Statement. 37 C.F.R. 1.97(e)(2).

Respectfully submitted,

KINNEY & LANGE, P.A.

By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:arm

OIPE
FEB 22 2007
PATENT & TRADEMARK OFFICE

FORM PTO-1449	Atty. Docket No.: V180.12-0009	Application No.: 11/054,341
LIST OF PATENTS AND PUBLICATIONS FOR APPLICANT'S INFORMATION DISCLOSURE STATEMENT	First Named Inventor: Theodore W. Jagger	
	Filing Date: February 9, 2005	Group Art: 3743

U.S. PATENT DOCUMENTS

Examiner Initials		Document No.	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents
	AA	5,084,075	01-28-1992	Sircar
	AB	6,802,889	10-12-2004	Graham et al.
	AC			
	AD			
	AE			
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	AG			
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	AJ			
	AK			

FOREIGN PATENT DOCUMENTS

		Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents	Translation Yes No
	AL				
	AM				
	AN				

OTHER ART (Including Author, Title, Date, Pertinent Pages, Etc.)

	AO	
	AP	
	AQ	

EXAMINER: DATE CONSIDERED:

EXAMINER: Initial if citation 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.

Application Number	Application/Control No.	Applicant(s)/Patent under Reexamination	
	11/054,341	JAGGER ET AL.	

Document Code - DISQ	Internal Document – DO NOT MAIL

TERMINAL DISCLAIMER	☒ APPROVED	☐ DISAPPROVED
Date Filed : 12/29/06	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:
ANDRE ROBINSON

U.S. Patent and Trademark Office

OIPE
DEC 29 2006
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3743
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihr B. Patel
Docket No.	:	V180.12-0009	

RESPONSE

Mail Stop Amendment
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL
Express Mail No.: EV884207437US

INTRODUCTION

This is in response to the Office Action mailed on October 31, 2006. Please amend the above-identified application as follows:

REMARKS

This is in response to the Office Action mailed on October 31, 2006, in which pending claims 1-10, 12-15, and 17-21 were rejected, and claims 11 and 16 were objected to. Specifically, several claims were rejected under the judicially created doctrine of obviousness-type double patenting; and claims 1-10, 12-15, and 17-21 were rejected pursuant to 35 U.S.C. §103(a).

Claims Rejections – Double Patenting

Examiner noted that the previously filed Terminal Disclaimer contained an error in identifying one of the co-pending applications being disclaimed.

With this Response, a Supplemental Terminal Disclaimer is submitted to correct this error and obviate the rejections in the Office Action dated May 18, 2006. The rejections of claims under the judicially created doctrine of obviousness-type double patenting should accordingly be withdrawn.

Claims Rejections – 35 U.S.C. §102(b)

Claims 1-10, 12-15, and 17-21 were rejected under 35 U.S.C. § 102(b) as being anticipated by Hill (U.S. Patent No. 6,471,744) in view of Smolarek et al. (U.S. Patent No. 6,344,069) further in view of Agrawal et al. (U.S. Patent No. 5,429,666).

Hill discloses a gas vacuum-pressure swing adsorption (VPSA) separation system for medical use. Similarly, Smolarek et al. discloses a VPSA separation system for industrial, not medical use. Both of these references require that the separation process involve the raising the pressure of the separation columns above 1.0 atm. Both references utilize a compressor to create a portion of pressure differential in the separation process (although it is called a "feed blower" in Smolarek). Agrawal et al. discloses a VSA gas separation system for industrial use. Those of skill in the art will recognize the differences between pressure swing adsorption (PSA), vacuum swing adsorption (VSA), and VPSA, and know that the processes are not interchangeable as each process requires a different set of components and steps to achieve the separation of gases. See Background of the Invention, Cols. 1 and 2, Smolarek. As such, one of skill in the art would not look to modify the references as the Examiner has suggested, as

this would render the Hill and Smolarek references unable to perform the intended purpose of the disclosures. M.P.E.P. §2143.01.

The current invention only utilizes vacuum in the separation process, and the feed air that is let into the column is ambient air. Ambient air is approximately 1.0 atm, depending on the altitude of where the user is located. No external pressure force is used in the separation process.

One of skill in the art would know to read the Smolarek reference, which discloses a VPSA system, as disclosing the feed blower as the compressor, as that is the only structure that can create the required pressure for VPSA. As is evident from FIG. 1 of Smolarek, ambient air 39 enters the system and is compressed by the feed blower 22. This is evident from the disclosure in claim 1, wherein the reference states "whereby said feed blower means is caused to operate alternatively in a gas compression mode or in a gas expansion mode". This means that the air entering the column is not ambient air, but pressurized air.

Hill explicitly states at col. 4, llns 19-28, "Air (or another fluid mixture) is brought into the system 10 through the compressor inlet muffler/filter 20 and then enters the compressor 22. The compressor 22 raises the fluid mixture pressure from ambient pressure P.sub.a, which is preferably atmospheric pressure, to an elevated or high pressure P.sub.b. The compressed fluid mixture is directed to two-way inlet valves 24, 30. For process step 1 (FIG. 2) to occur in adsorbent bed 40, valve 24 will open and allow the flow of the compressed fluid mixture into the adsorbent bed 40." Thus, ambient air is not being directed into the column, but rather pressurized air. This disclosure vitiates the applicant's claim language of "introducing ambient air into a first end of a column."

Absent introducing a pressurized gas into a first end of the adsorbent column in both the Hill and Smolarek et al. references, the separation processes would not work. Although Agrawal et al. does disclose this requirement, combining this reference with either Hill or Smolarek et al. would yield an entirely different system based on a different principle of operation (VSA instead of VPSA). A proposed modification or combination of prior art that changes the principle of operation of the prior art invention

being modified are not sufficient to render claims prima facie obvious. M.P.E.P. 2143.01. Examiner's proposed combination would change both of the Hill and Smolarek et al. references to VSA systems, which would require the modification of the systems disclosed, including the deletion of equipment and steps for pressurizing of gas at the feed inlet. The proposed combination would require a modification that would require substantial reconstruction of the systems present in Hill and Smolarek et al. As such, Examiner has not made a prima facie case for obviousness.

Agrawal, et al., a VSA system, does not disclose each and every limitation of the claims. The disclosure relates to industrial use, and not medical use. Those of skill in the art recognize the distinctions of industrial separators compared to medical use separators. There is no motivation to combine this reference with other VPSA systems present in the Hill and Smolarek et al. references. As such, the claims are in condition for allowance.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: 12-29-06

By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:kmm

OIPE
DEC. 29 2006
PATENT & TRADEMARK OFFICE

Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3743
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihir B. Patel
Docket No.	:	V180.12-0009	

SECOND SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

SENT VIA EXPRESS MAIL
Express Mail No.: EV884207437US

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

The enclosed PTO Form-1449 lists patents and publications submitted pursuant to 37 C.F.R. 1.97. Copies of the patents or publications are enclosed as necessary.

TIME OF FILING

The Information Disclosure Statement is being filed:

1. __ with the application or within three months of the filing date of a national application (other than a continued prosecution application under 37 C.F.R. 1.53(d)) or date of entry into the national stage of an international application or, to the best of the undersigned's knowledge, before the mailing date of a first Office action on the merits or a first office action after the filing of a request for continued examination under 37 C.F.R. 1.114, whichever event occurs last. In accordance with 37 C.F.R. 1.97(b), no certification or fee is required.

2. X after the time period specified in paragraph 1 above, but, to the best of the undersigned's knowledge, before the mailing date of a final action under 37 C.F.R. 1.113 or notice of allowance under 37 C.F.R. 1.311, or an action that otherwise closes prosecution of the application. In accordance with 37 C.F.R. 1.97(c), submitted herewith is:

(check either A or B below)

A. __ a statement as specified in 37 C.F.R. 1.97(e), no fee is required.

B. X the fee set forth in 37 C.F.R. 1.17(p) for submission of an Information Disclosure Statement under 37 C.F.R. 1.97(c).

Respectfully submitted,
KINNEY & LANGE, P.A.

01/04/2007 SSITHIB1 00000034 11054341
02 FC:1806
180.00 OP

By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:kmm

FORM PTO-1449	Atty. Docket No.: V180.12-0009	Application No.: 11/054,341
LIST OF PATENTS AND PUBLICATIONS FOR APPLICANT'S INFORMATION DISCLOSURE STATEMENT	First Named Inventor: Theodore W. Jagger	
	Filing Date: February 9, 2005	Group Art: 3772

OIPE IAP68 DEC 29 2006 PATENT & TRADEMARK OFFICE

U.S. PATENT DOCUMENTS

Examiner Initials		Document No.	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents
	AA	4,194,890	03-25-1980	McCombs, et al.
	AB	4,472,177	09-18-1984	Sircar
	AC	5,366,541	11-22-1994	Hill, et al.
	AD	5,656,066	08-12-1997	Reiss, et al.
	AE	6,162,283	12-19-2000	Conrad, et al.
	AF	6,217,635	04-17-2001	Conrad, et al.
	AG	6,544,318	04-08-2003	Dee, et al.
	AH	6,712,886	03-30-2004	Kim
	AI	6,805,729	10-19-2004	Lim, et al.
	AJ	6,811,590	11-02-2004	Lee, et al.
	AK	6,866,041	03-15-2005	Hardy, Jr. , et al.
	AL	7,066,985	06-27-2006	Deane, et al.
	AM	US 2002/0053286 A1	05-09-2002	Czabala
	AN	US 2004/0020366 A1	02-05-2004	Walker, et al.
	AO	US 2004/0149133 A1	08-05-2004	McCombs, et al.
	AP	US 2005/0081713 A1	04-21-2005	Lee, et al.

FOREIGN PATENT DOCUMENTS

		Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents	Translation Yes No
	AQ				
	AR				
	AS				

OTHER ART (Including Author, Title, Date, Pertinent Pages, Etc.)

	AT	
	AU	
	AV	

EXAMINER:	DATE CONSIDERED:

EXAMINER: Initial if citation 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.

OIPE
DEC 29 2006
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3743
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihr B. Patel
Docket No.	:	V180.12-0009	

SUPPLEMENTAL TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION (37 C.F.R. 1.321(b))

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

SENT VIA EXPRESS MAIL
Express Mail No.: EV884207437US

Interest of Person Making This Disclaimer

I, Larrin Bergman, represent that I am

[ ] an inventor of this invention.

[ ] an assignee of this invention.

[X] a representative authorized to sign on behalf of the assignee of this invention.

Identity of Assignee and Title of Disclaimant (If Applicable)

The assignee is VBox, Incorporated, 2342 East County Road J, White Bear Lake, MN 55110. The title of the Disclaimant is Attorney of Record, and the Disclaimant is authorized to sign on behalf of Assignee.

Extent of Interest

The extent of my interest is in

[X] the whole of this invention.

[ ] a sectional interest in this invention as follows: .

01/04/2007 SSITHIB1 00000034 11054341
01 FC:2814 65.00 OP

Disclaimer

I/We hereby disclaim the term of any patent granted on the above-identified application subsequent to

[ ] the full term of United States Patent No. _ as presently shortened by any terminal disclaimer,

or

[X] the term of any patent granted on application number 11/054,713; 11/054,340; and 11/054,342,

and hereby agree that any patent so granted on the above-identified application shall be enforceable only for and during such period that the legal title to said patent shall be the same as the legal title to

[ ] United States Patent No. _,

[X] any patent granted on application number 11/054,713; 11/054,340; and 11/054,342,

this agreement to run with any patent granted on the above-identified application and to be binding upon the grantor, its successors or assigns.

I do not disclaim any terminal part of any patent granted on the above-identified application prior to the expiration date of the full statutory term of

[ ] United States Patent No. PATENT NO., as presently shortened by any terminal disclaimer

[X] any patent granted on application number 11/054,713; 11/054,340; and 11/054,342,

in the event that it later: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid, is statutorily disclaimed in whole or terminally disclaimed under 37 C.F.R. 1.321(a), has all claims canceled by a reexamination certificate, or is otherwise terminated prior to expiration of its statutory term as presently shortened by any terminal disclaimer, except for the separation of legal title stated above.

VBOX, INCORPORATED

By:_____ Date: 12-29-06

Larrin Bergman
Attorney of Record

Fee Status

(37 C.F.R. 1.20(d))

[ ]	other than a small entity	$130.00
[X]	small entity status of this application is/has been asserted. *See* 37 C.F.R. 1.27	$ 65.00

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: 12-29-06 By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:kmm

OIPE
DEC 29 2006
PATENT & TRADEMARK OFFICE

01-03-07

1FW$

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3743
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihr B. Patel
Docket No.	:	V180.12-0009	

EXPRESS MAIL COVER SHEET

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

SENT VIA EXPRESS MAIL
Express Mail No. EV884207437US

The following papers are being transmitted via **EXPRESS MAIL** to the U.S. Patent and Trademark Office on the date shown below:

1. Fee Transmittal (in duplicate) with attached check for $245.00;
2. Supplemental Terminal Disclaimer to Obviate A Double Patenting Rejection;
3. Response; and
4. Second Supplemental Information Disclosure Statement.

Respectfully submitted,
KINNEY & LANGE, P.A.

Date: 12-29-06

By _____
Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:kmm

FEE TRANSMITTAL

OIPE IAP98 DEC 29 2006 PATENT & TRADEMARK OFFICE

Complete if Known	
Application No.	11/054,341
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Group Art Unit	3772
Examiner Name	Nihir B. Patel
Atty. Docket Number	V180.12-0009

Total Amount of Payment $ 245.00

METHOD OF PAYMENT (Check One)

1. [X] The Commissioner is hereby authorized to charge any additional fee required under 37 C.F.R. 1.16 and 1.17 and credit any over payments to Deposit Account No.11-0982. Deposit Account Name: Kinney & Lange, P.A. A duplicate copy of this communication is enclosed.

2. [X] Check Enclosed

FEE CALCULATION

1. BASIC FILING FEE

Appn. Type	FILING FEE FEE/SMALL	SEARCH FEES FEE/SMALL	EXAM FEES FEE/SMALL	FEES PD.
Utility	300 / 150	500 / 250	200 / 100	_
Design	200 / 100	100 / 50	130 / 65	_
Reissue	300 / 150	500 / 250	600 / 300	_
Provisional	200 / 100	-0- / -0-	-0- / -0-	_

Subtotal (1) $-0-

2. EXTRA CLAIM FEES

	Number Claims		Prior		Extra		Fee from Fee Paid Below	
Total	_	-	_	=	_	X	_ =	_
Indep.	_	-	_	=	_	X	_ =	_
Multiple Dependent Claims							_ =	_

Insert 3 and 20, or number previously paid if greater; Reissue see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Description
1202	50	2202	25	Claims in excess of 20
1201	200	2201	100	Independent claims in excess of 3
1203	360	2203	180	Multiple Dependent Claim
1204	200	2204	100	Reissue Independent Claims Over Original Patent
1205	50	2205	25	Reissue claims in excess of 20 and over original patent

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 small) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 C.F.R. 1.16(s). $-0-

Subtotal (2) $-0-

FEE CALCULATION (Continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee paid
1051	130	2051	65	Surcharge - Late filing fee or oath	_
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	_
1053	130	1053	130	Non-English specification	_
1812	2,520	1812	2,520	For Filing a Request for Reexamination	_
1251	120	2251	60	Extension for reply within first month	_
1252	450	2252	225	Extension for reply within second month	_
1253	1,020	2253	510	Extension for reply within third month	_
1254	1,590	2254	795	Extension for reply within fourth month	_
1255	2,160	2255	1,080	Extension for reply within fifth month	_
1402	500	2402	250	Filing a brief in support of an appeal	_
1403	1,000	2403	500	Request for oral hearing	_
1814	130	2814	65	Terminal Disclaimer Fee	65
1452	500	2452	250	Petition to revive - unavoidable	_
1453	1,500	2453	750	Petition to revive - unintentional	_
1501	1,400	2501	700	Utility/Reissue issue fee	_
1502	800	2502	400	Design issue fee	_
1460	130	1460	130	Petitions to the Commissioner	_
1807	50	1807	50	Petitions related to provisional applications	_
1806	180	1806	180	Submission of Information Disclosure Statement	180
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	_
1801	790	2801	395	Request for Continued Examination (RCE)	_

Other fee (specify) _____ _

Subtotal (3) $245.00

Signature _____ Reg. No. 57,153

Larrin Bergman

Date 12-29-06 Deposit Account No. 11-0982

OIPE
DEC 29 2006
PATENT & TRADEMARK OFFICE

01-03-07

IFW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3743
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihr B. Patel
Docket No.	:	V180.12-0009	

EXPRESS MAIL COVER SHEET

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

SENT VIA EXPRESS MAIL
Express Mail No. EV884207437US

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1. Fee Transmittal (in duplicate) with attached check for $245.00;
2. Supplemental Terminal Disclaimer to Obviate A Double Patenting Rejection;
3. Response; and
4. Second Supplemental Information Disclosure Statement.

Respectfully submitted,
KINNEY & LANGE, P.A.

Date: 12-29-06

By _____
Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:kmm

FEE TRANSMITTAL

OIPE IAP98 DEC 29 2006 PATENT & TRADEMARK OFFICE

Complete if Known	
Application No.	11/054,341
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Group Art Unit	3772
Examiner Name	Nihir B. Patel
Atty. Docket Number	V180.12-0009

Total Amount of Payment $ 245.00

METHOD OF PAYMENT (Check One)

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2. [X] Check Enclosed

FEE CALCULATION

1. BASIC FILING FEE

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Design	200 / 100	100 / 50	130 / 65	_
Reissue	300 / 150	500 / 250	600 / 300	_
Provisional	200 / 100	-0- / -0-	-0- / -0-	_

Subtotal (1) $-0-

2. EXTRA CLAIM FEES

	Number Claims		Prior		Extra		Fee from Fee Paid Below	
Total	_	-	_	=	_	X	_ =	_
Indep.	_	-	_	=	_	X	_ =	_
Multiple Dependent Claims							_ =	_

Insert 3 and 20, or number previously paid if greater; Reissue see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Description
1202	50	2202	25	Claims in excess of 20
1201	200	2201	100	Independent claims in excess of 3
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Subtotal (2) $-0-

FEE CALCULATION (Continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee paid
1051	130	2051	65	Surcharge - Late filing fee or oath	_
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	_
1053	130	1053	130	Non-English specification	_
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1254	1,590	2254	795	Extension for reply within fourth month	_
1255	2,160	2255	1,080	Extension for reply within fifth month	_
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1403	1,000	2403	500	Request for oral hearing	_
1814	130	2814	65	Terminal Disclaimer Fee	65
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1501	1,400	2501	700	Utility/Reissue issue fee	_
1502	800	2502	400	Design issue fee	_
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1807	50	1807	50	Petitions related to provisional applications	_
1806	180	1806	180	Submission of Information Disclosure Statement	180
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	_
1801	790	2801	395	Request for Continued Examination (RCE)	_

Other fee (specify) _____ _

Subtotal (3) $245.00

Signature _____ Reg. No. 57,153

Larrin Bergman

Date 12-29-06 Deposit Account No. 11-0982

OIPE
NOV 06 2006
PATENT & TRADEMARK OFFICE
1AP41

KINNEY & LANGE

A PROFESSIONAL ASSOCIATION

PATENT, TRADEMARK,
COPYRIGHT, AND RELATED
INTELLECTUAL PROPERTY LAW

THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MINNESOTA 55415-1002

INFO@KINNEY.COM
FACSIMILE (612) 339-6580
TELEPHONE (612) 339-1863

JO M. FAIRBAIRN
(612) 337-9356
jmfairbairn@kinney.com

November 1, 2006

I HEREBY CERTIFY THAT THIS PAPER IS BEING SENT BY U.S. MAIL, FIRST CLASS, TO MAIL STOP 16, COMMISSIONER OF PATENTS AND TRADEMARKS, P.O. BOX 1450, ALEXANDRIA, VA 22313-1450, THIS

1st DAY OF November, 2006.

J.M. Fairbairn
ATTORNEY

Commissioner of Patents and
Trademarks
P.O. Box 1450
Alexandria, VA 22313-1450

Re: U.S. Patent Application Number 11/054341

Sir:

As requested by Notice Letter of September 7, 2006 in the above matter enclosed is our check number 1710816 in the amount of $115.00 as well as a copy of the Notice Letter The Commissioner of Patents and Trademarks of the USPTO is authorized to charge payment of any additional fees associated with this communication or credit any overpayment to Deposit Account 11-0982. A duplicate copy of this communication is enclosed.

11/07/2006 BABRAHA1 00000001 11054341

01 FC:2051 65.00 OP
02 FC:9101 50.00 OP

Respectfully submitted,

By: J.M. Fairbairn
Jo M. Fairbairn

Enclosures

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

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IAP41

RECEIVED
SEP 11 2006
KINNEY & LANGE, P.A.

September 7, 2006

Kinney & Lange Building
312 South 3rd Street
Minneapolis, Minnesota 55415-1002

V180.129

Attn: Larrin Bergman

Re: 11/054341

The purpose of this communication is to inform you that check number 1710333, dated August 15, 2006 in the amount of $ 65.00 has been returned by the bank as unpaid.

The practice of the Office is to treat such returned checks as though the fee for which they were intended was never received. Therefore, you are required to submit the following fee(s):

X	**$65.00** Terminal Disclaimer
	$65.00 surcharge for a late filing fee
X	**$50.00** fee for processing a returned check

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THE REQUIREMENTS OF THIS NOTICE IS SET TO EXPIRE **TWO MONTHS** FROM THE DATE OF THIS NOTICE.

FAILURE TO RESPOND WITHIN THIS PERIOD WILL RESULT IN ABANDONMENT OF THE APPLICATION.

The filing receipt will not be mailed out until all fees are paid. If the filing receipt has already been mailed out, it is void if all the fees are not paid in a timely manner.

Further correspondence with respect to this matter should include a copy of this notice and be addressed to the following:

Commissioner of Patents and Trademarks
P O Box 1450
Alexandria, VA 22313-1450

Telephone inquiries should be directed to the Office of Initial Patent Examination, Customer Service Center at (571) 272-4000.

Cynthia Streater
Office of Initial Patent Examination

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 NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 10/31/2006

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	

ART UNIT	PAPER NUMBER
3772	

DATE MAILED: 10/31/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	11/054,341	JAGGER ET AL.	
	Examiner	Art Unit	
	Nihir Patel	3772	

-- 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 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *08.24.2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ 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

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10,12-15 and 17-21* is/are rejected.

7)☒ Claim(s) *11 and 16* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☐ All b)☐ Some * c)☐ None of:

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) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

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GCE Gas Control Equipment Inc. v. VBOX, Inc.
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DETAILED ACTION

Terminal Disclaimer

1. The application/patent being disclaimed has been improperly identified since the number used to identify the **11/043,340** being disclaimed is incorrect. The correct number is **11/054,340**.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) 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.

4. Claims **1 through 10, 12-15 and 17 through 21** are rejected under 35 U.S.C. 103(a) as being unpatentable over Hill (US 6,471,744) in view of Smolarek et al. (US 6,344,069) further in view of Agrawal et al. (US 5,429,666).

5. **As to claims 1, 4, 5, 7, 9,10, 12, 15, 17, 18, 20 and 21,** Hill discloses the applicant's invention as claimed with the exception of producing product gas by vacuum swing adsorption process, wherein the process comprising the steps of introducing ambient air into the first end of the column until the vacuum within the column is near 1.0 atmosphere. Agrawal discloses a

vacuum swing adsorption process wherein the process comprises the step of introducing ambient air into the first end of the column **(see column 3 lines 25-35)**, which is well known in the art and Smolarek teaches an apparatus wherein the vacuum within the column is near 1.0 atmosphere **(see column 5 lines 1-20)**, which is also well known in the art. Therefore it would have been obvious to modify Hill's invention by producing product gas by vacuum swing adsorption process, wherein the process comprising the steps of introducing ambient air into the first end of the column until the vacuum within the column is near 1.0 atmosphere as taught by Smolarek and Agrawal in order to improve the absorption process.

6. **As to claims 2, 6 and 13,** Hill teaches a method step of introducing product gas into the column through the second end during a portion of step (c) as stated in claim 1 **(see column 4 lines 25-35; the product fluid entering the absorbent pad 42 is considered to be the second end)**.

7. **As to claim 3,** Hill teaches a method step of introducing product gas occurs during an initial portion of step (c) as stated in claim 1 **(see column 4 lines 25-35)**.

8. **As to claim 8,** Hill teaches a method step of storing a portion of the product gas in a reservoir **52 (see column 4 lines 30-35)**.

9. **As to claim 14,** Hill teaches a method step of introducing product gas occurs during an initial portion of step (c) (as stated in claim 1) prior to introducing ambient air **(see column 4 lines 25-35)**.

10. **As to claim 19,** Hill Teaches a method step of introducing product gas into the column through the second end **(product gas leaving absorbent bed is considered to be the second**

end); and introducing ambient air into the column through the first end **(the ambient air entering the absorbent bed is considered to be the first end).**

Allowable Subject Matter

11. Claims **11 and 16** are 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.

Response to Arguments

12. Applicant's arguments with respect to claims **1-21** have been considered but are moot in view of the new ground(s) of rejection.

13. **The double patenting rejection as stated in the previous office action dating May 18th, 2006 still stands because of the terminal disclaimer being filed incorrect.**

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.

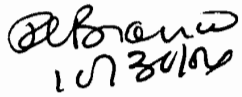
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nihir Patel whose telephone number is (571) 272-4803. The examiner can normally be reached on 7:30 to 4:30 every other Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patricia Bianco can be reached on (571) 272-4940. 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 http://pair-direct.uspto.gov. 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.

Art Unit 3743

Nihir Patel



Notice of References Cited	Application/Control No. 11/054,341	Applicant(s)/Patent Under Reexamination JAGGER ET AL.	
	Examiner Nihir Patel	Art Unit 3772	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,471,744	10-2002	Hill, Theodore B.	95/19
*	B	US-5,429,666	07-1995	Agrawal et al.	95/101
*	C	US-6,344,069	02-2002	Smolarek et al.	95/96
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	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.

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Search Notes

Application/Control No.	Applicant(s)/Patent under Reexamination	
11/054,341	JAGGER ET AL.	
Examiner	**Art Unit**	
Nihir Patel	3743	

SEARCHED

Class	Subclass	Date	Examiner
128	201.25, 205.11, 205.18, 202.26	5/13/2006	NP
96	121, 130	5/13/2006	NP
96	133, 147	5/13/2006	NP
95	96-103	5/13/2006	NP
UPDATED SEARCH		10-23-06	NP

INTERFERENCE SEARCHED

Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)

	DATE	EXMR
Referred to Matthew Savage; Inventor Name Search	5/11/2006	NP
UPDATED SEARCH	10-23-06	NP

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Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
11/054,341	JAGGER ET AL.
Examiner	**Art Unit**
Nihir Patel	3772

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date
Final	Original	10/23/06
	1	√
	2	√
	3	√
	4	√
	5	√
	6	√
	7	√
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	9	√
	10	√
	11	O
	12	√
	13	√
	14	√
	15	√
	16	O
	17	√
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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

September 7, 2006

Kinney & Lange Building
312 South 3rd Street
Minneapolis, Minnesota 55415-1002

Attn: Larrin Bergman

Re: 11/054341

The purpose of this communication is to inform you that check number 1710333, dated August 15, 2006 in the amount of $ 65.00 has been returned by the bank as unpaid.

The practice of the Office is to treat such returned checks as though the fee for which they were intended was never received. Therefore, you are required to submit the following fee(s):

X	**$65.00** Terminal Disclaimer
	$65.00 surcharge for a late filing fee
X	**$50.00** fee for processing a returned check

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THE REQUIREMENTS OF THIS NOTICE IS SET TO EXPIRE **TWO MONTHS** FROM THE DATE OF THIS NOTICE.

FAILURE TO RESPOND WITHIN THIS PERIOD WILL RESULT IN ABANDONMENT OF THE APPLICATION.

The filing receipt will not be mailed out until all fees are paid. If the filing receipt has already been mailed out, it is void if all the fees are not paid in a timely manner.

Further correspondence with respect to this matter should include a copy of this notice and be addressed to the following:

Commissioner of Patents and Trademarks
P O Box 1450
Alexandria, VA 22313-1450

Telephone inquiries should be directed to the Office of Initial Patent Examination, Customer Service Center at (571) 272-4000.

Cynthia Streater
Office of Initial Patent Examination

OIPE
AUG 15 2006
PATENT & TRADEMARK OFFICE
MP14

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3743
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihr B. Patel
Docket No.	:	V180.12-0009	

AMENDMENT

Mail Stop Amendment
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL
Express Mail No.: EV760046953US

INTRODUCTION

This is in response to the Office Action mailed on May 15, 2006. Please amend the above-identified application as follows:

AMENDMENTS TO THE CLAIMS

Please amend claims 1 and 18, such that the status of the claims is as follows:

1.(Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas by a vacuum swing adsorption process, the process comprising the steps of:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing ambient air into the first end of the column until the vacuum within the column is near 1.0 atmosphere;

(d) repeating steps (a) - (c); and

delivering product gas to the patient.

2.(Original) The method of claim 1 and further comprising:

introducing product gas into the column through the second end during a portion of step (c).

3.(Original) The method of claim 2 wherein introducing product gas occurs during an initial portion of step (c).

4.(Original) The method of claim 1 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen delivered to the patient.

5.(Original) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas by:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column;

(d) repeating steps (a) - (c); and

delivering product gas to the patient.

6.(Original) The method of claim 5 wherein introducing product gas occurs during an initial portion of step (c).

7.(Original) The method of claim 5 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen used by the patient.

8.(Original) The method of claim 5 and further comprising:
storing a portion of the product gas in a reservoir.

9.(Original) The method of claim 8 wherein delivering the product gas is from the reservoir to the patient.

10.(Original) The method of claim 8 wherein delivering product gas occurs in response to inhalation by the patient.

11.(Original) The method of claim 8 wherein the reservoir maintains the product gas at a pressure of between about 1.0 atm and about 2.0 atm.

12.(Original) A method of providing concentrated oxygen to a patient, the method comprising:
producing oxygen-rich product gas with a vacuum swing adsorption process comprising:
(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;
(b) evacuating the column through the first end to remove adsorbed gas from the column;
(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column;
(d) repeating steps (a) - (c);
storing product gas produced by the vacuum swing adsorption process; and
delivering stored product gas to the patient.

13.(Original) The method of claim 12 and further comprising:

introducing product gas into the column through the second end during a portion of step (c).

14.(Original) The method of claim 13 wherein introducing product gas occurs during an initial portion of step (c) prior to introducing ambient air.

15.(Original) The method of claim 12 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas delivered to the patient.

16.(Original) The method of claim 12 wherein the product gas is stored at a pressure of about 1.0 atm to about 2.0 atm.

17.(Original) The method of claim 12 wherein delivering stored product gas comprises delivering a pulse of product gas to the patient in response to inhalation by the patient.

18.(Currently Amended) A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing the product gas by a vacuum swing adsorption process, the process comprising the steps of:

(a) introducing ambient air at about 1.0 atmosphere (atm) into a first end of a column containing an LiLSX adsorbent material and removes product gas out a second end of the column;

(b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm;

(c) repressurizing the column to about 1.0 atm; and

(d) repeating steps (a) - (c);

storing the product gas at a pressure of about 1.0 atm to about 2.0 atm; and

delivering stored product gas to the patient.

19.(Original) The method of claim 18 wherein repressurizing in step (c) comprises:

introducing product gas into the column through the second end; and

introducing ambient air into the column through the first end.

20.(Original) The method of claim 18 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen delivered to the patient.

21.(Original) The method of claim 18 wherein delivering stored product gas comprises delivering a pulse of product gas in response to an inhalation by the patient.

REMARKS

This is in response to the Office Action mailed on May 18, 2006, in which pending claims 1-10, 12-15, 17-21 were rejected, and claims 11 and 16 were objected to. Specifically, claims 1-3, 5, 6, 10, 12-14, 17, 18, and 21 were rejected under the judicially created doctrine of obviousness-type double patenting; claims 1-4, 11, 16, and 18-21 were rejected pursuant to 35 U.S.C. §103(a); and claims 5-8, and 12 were rejected pursuant to 35 U.S.C. §102(b).

Claims Rejections – Double Patenting

Claim 1 was rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 1 of co-pending Application No. 11/054,713; claims 1 and 2 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 19 and 20 of co-pending Application No. 11/054,340; and claims 1-3, 5, 6, 10, 12-14, 17, 18, and 21 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-5 of co-pending Application No. 11/054,342.

With this Response, a Terminal Disclaimer is submitted to obviate these rejections. The rejections of claims under the judicially created doctrine of obviousness-type double patenting should accordingly be withdrawn.

Claims Rejections – 35 U.S.C. §103(a)

Claims 1-4, 11, 16, and 18-21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hill (U.S. Patent No. 6,471,744) in view of Smolarek, et al. (U.S. Patent No. 6,344,069).

Hill discloses a gas vacuum-pressure swing adsorption (VPSA) separation system for medical use. Similarly, Smolarek et al. discloses a VPSA separation system for industrial, not medical use. Both of these references require that the separation process involve the raising the pressure of the separation columns above 1.0 atm. Both references utilize a compressor to create a portion of pressure differential in the separation process (although it is called a "feed blower" in Smolarek). Those of skill in

the art will recognize the differences between pressure swing adsorption (PSA), vacuum swing adsorption (VSA), and VPSA, and know that the processes are not interchangeable as each process requires a different set of components and steps to achieve the separation of gases. See Background of the Invention, Cols. 1 and 2, Smolarek. As such, one of skill in the art would not look to modify the references as the Examiner has suggested, as this would render the Hill reference unable to perform its intended purpose. M.P.E.P. §2143.01.

The current invention only utilizes vacuum in the separation process, and the feed air that is let into the column is ambient air. Ambient air is approximately 1.0 atm, depending on the altitude of where the user is located. No external pressure force is used in the separation process. Claims 1 and 18 have been amended to clarify this point.

One of skill in the art would know to read the Smolarek reference, which discloses a VPSA system, as disclosing the feed blower as the compressor, as that is the only structure that can create the required pressure for VPSA. As is evident from FIG. 1 of Smolarek, ambient air 39 enters the system and is compressed by the feed blower 22. This is evident from the disclosure in claim 1, wherein the reference states "whereby said feed blower means is caused to operate alternatively in a gas compression mode or in a gas expansion mode". This means that the air entering the column is not ambient air, but pressurized air.

Additionally, as an explanation, the requirement of claim 18 that the separated product is stored between 1.0 and 2.0 atm does not affect the separation process. The pressurization of the product gas is done after the separation process is complete, which is explained in the detailed description of the current application.

Accordingly, with the amendment to claim 1, and the arguments made herein, the combination of Hill with Smolarek et al. does not disclose each and every limitation of the claims. Further, the references can not be combined as claimed as the combination would render one, if not both, the

references unable to perform as intended. As such, claims 1 and 18 are in condition for allowance. Because claims 2-4 and 19-21 each depend from an allowable claim, the claims are allowable also.

Claims Rejections – 35 U.S.C. §102(b)

Claims 5-8 and 12 were rejected under 35 U.S.C. § 102(b) as being anticipated by Hill (U.S. Patent No. 6,471,744).

Hill explicitly states at col. 4, llns 19-28, "Air (or another fluid mixture) is brought into the system 10 through the compressor inlet muffler/filter 20 and then enters the compressor 22. The compressor 22 raises the fluid mixture pressure from ambient pressure P.sub.a, which is preferably atmospheric pressure, to an elevated or high pressure P.sub.b. The compressed fluid mixture is directed to two-way inlet valves 24, 30. For process step 1 (FIG. 2) to occur in adsorbent bed 40, valve 24 will open and allow the flow of the compressed fluid mixture into the adsorbent bed 40." Thus, ambient is not being directed into the column, but pressurized air. This disclosure vitiates the applicant's claim language of "introducing ambient air into a first end of a column." As such, Hill does not anticipate the current independent claims 5 or 12, which both contain the quoted language.

Accordingly, with the arguments made herein, Hill does not disclose each and every limitation of the claims. As such, claims 5 and 12 are in condition for allowance. Because claims 6-11 and 13-17 each depend from an allowable claim, the dependent claims are also allowable.

CONCLUSION

In view of the foregoing, all pending claims 1-21 are in condition for allowance. A notice to that effect is respectfully requested.

The Examiner is cordially invited to contact the undersigned at the telephone number listed below if such a call would in any way facilitate the allowance of this application.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: 8-15-06

By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:kmm

GIRE WP14
AUG 15 2006
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3743
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihr B. Patel
Docket No.	:	V180.12-0009	

TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION (37 C.F.R. 1.321(b))

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

SENT VIA EXPRESS MAIL
Express Mail No.: EV760046953US

Interest of Person Making This Disclaimer

I, Larrin Bergman, represent that I am

[ ] an inventor of this invention.

[ ] an assignee of this invention.

[X] a representative authorized to sign on behalf of the assignee of this invention.

Identity of Assignee and Title of Disclaimant (If Applicable)

The assignee is VBox, Incorporated, 2342 East County Road J, White Bear Lake, MN 55110. The title of the Disclaimant is Attorney of Record, and the Disclaimant is authorized to sign on behalf of Assignee.

Extent of Interest

The extent of my interest is in

[X] the whole of this invention.

[ ] a sectional interest in this invention as follows: .

08/17/2006 WABDELR1 00000046 11054341
01 FC:2814 65.00 OP

Disclaimer

I/We hereby disclaim the term of any patent granted on the above-identified application subsequent to

[ ] the full term of United States Patent No. _ as presently shortened by any terminal disclaimer,

or

[X] the term of any patent granted on application number 11/054,713; 11/043,340; and 11/054,342,

and hereby agree that any patent so granted on the above-identified application shall be enforceable only for and during such period that the legal title to said patent shall be the same as the legal title to

[ ] United States Patent No. _,

[X] any patent granted on application number 11/054,713; 11/043,340; and 11/054,342,

this agreement to run with any patent granted on the above-identified application and to be binding upon the grantor, its successors or assigns.

I do not disclaim any terminal part of any patent granted on the above-identified application prior to the expiration date of the full statutory term of

[ ] United States Patent No. PATENT NO., as presently shortened by any terminal disclaimer

[X] any patent granted on application number 11/054,713; 11/043,340; and 11/054,342,

in the event that it later: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid, is statutorily disclaimed in whole or terminally disclaimed under 37 C.F.R. 1.321(a), has all claims canceled by a reexamination certificate, or is otherwise terminated prior to expiration of its statutory term as presently shortened by any terminal disclaimer, except for the separation of legal title stated above.

VBOX, INCORPORATED

By: _____ Date: 8-15-06

Larrin Bergman
Attorney of Record

Fee Status

(37 C.F.R. 1.20(d))

[ ]	other than a small entity	$130.00
[X]	small entity status of this application is/has been asserted. *See* 37 C.F.R. 1.27	$ 65.00

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: 8-15-06 By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:kmm

OIPE
AUG 15 2006
PATENT & TRADEMARK OFFICE

08-16-06

IFW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3743
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner: Nihr B. Patel
Docket No.	:	V180.12-0009	

EXPRESS MAIL COVER SHEET

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

SENT VIA EXPRESS MAIL
Express Mail No. EV760046953US

The following papers are being transmitted via **EXPRESS MAIL** to the U.S. Patent and Trademark Office on the date shown below:

1. Fee Transmittal (in duplicate) with attached check for $65.00;
2. Terminal Disclaimer to Obviate a Double Patenting Rejection; and
3. Amendment.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: 8-15-06

By _____
Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:kmm

FEE TRANSMITTAL

OIPE MAP14 AUG 15 2006 PATENT & TRADEMARK OFFICE

Complete if Known	
Application No.	11/054,341
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Group Art Unit	3743
Examiner Name	Nihr B. Patel
Atty. Docket Number	V180.12-0009

Total Amount of Payment $65.00

METHOD OF PAYMENT (Check One)

1. [X] The Commissioner is hereby authorized to charge any additional fee required under 37 C.F.R. 1.16 and 1.17 and credit any over payments to Deposit Account No.11-0982. Deposit Account Name: Kinney & Lange, P.A. A duplicate copy of this communication is enclosed.

2. [X] Check Enclosed

FEE CALCULATION

1. BASIC FILING FEE

Appn. Type	FILING FEE FEE/SMALL	SEARCH FEES FEE/SMALL	EXAM FEES FEE/SMALL	FEES PD.
Utility	300 / 150	500 / 250	200 / 100	_
Design	200 / 100	100 / 50	130 / 65	_
Reissue	300 / 150	500 / 250	600 / 300	_
Provisional	200 / 100	-0- / -0-	-0- / -0-	_

Subtotal (1) $-0-

2. EXTRA CLAIM FEES

	Number Claims		Prior		Extra		Fee from Fee Paid Below	
Total	_	-	_	=	_	X	_ =	_
Indep.	_	-	_	=	_	X	_ =	_
Multiple Dependent Claims							_ =	_

Insert 3 and 20, or number previously paid if greater; Reissue see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Description
1202	50	2202	25	Claims in excess of 20
1201	200	2201	100	Independent claims in excess of 3
1203	360	2203	180	Multiple Dependent Claim
1204	200	2204	100	Reissue Independent Claims Over Original Patent
1205	50	2205	25	Reissue claims in excess of 20 and over original patent

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 small) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 C.F.R. 1.16(s). $-0-

Subtotal (2) $-0-

FEE CALCULATION (Continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee paid
1051	130	2051	65	Surcharge - Late filing fee or oath	_
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	_
1053	130	1053	130	Non-English specification	_
1812	2,520	1812	2,520	For Filing a Request for Reexamination	_
1251	120	2251	60	Extension for reply within first month	_
1252	450	2252	225	Extension for reply within second month	_
1253	1,020	2253	510	Extension for reply within third month	_
1254	1,590	2254	795	Extension for reply within fourth month	_
1255	2,160	2255	1,080	Extension for reply within fifth month	_
1402	500	2402	250	Filing a brief in support of an appeal	_
1403	1,000	2403	500	Request for oral hearing	_
1814	130	2814	65	Terminal Disclaimer Fee	65
1452	500	2452	250	Petition to revive - unavoidable	_
1453	1,500	2453	750	Petition to revive - unintentional	_
1501	1,400	2501	700	Utility/Reissue issue fee	_
1502	800	2502	400	Design issue fee	_
1460	130	1460	130	Petitions to the Commissioner	_
1807	50	1807	50	Petitions related to provisional applications	_
1806	180	1806	180	Submission of Information Disclosure Statement	_
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	_
1801	790	2801	395	Request for Continued Examination (RCE)	_

Other fee (specify) _____ _

Subtotal (3) $65.00

Signature _____ Reg. No. 57,153

Larrin Bergman

Date 8-15-06 Deposit Account No. 11-0982

PATENT APPLICATION FEE DETERMINATION RECORD
Effective December 8, 2004

11/057,341

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	21	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	21 minus 20=	* 1
INDEPENDENT CLAIMS	4 minus 3 =	* 1
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☑		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	100	OR	BASIC FEE	
X$ 25=	25	OR	X$50=	
X100=	100	OR	X200=	
+180=		OR	+360=	
TOTAL	270	OR	TOTAL	

3/21/06

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

8-15-06

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 21	Minus	** 21	= 0
Independent	* 4	Minus	*** 4	= 0
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	

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 NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009	5839

164 7590 05/18/2006

KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

EXAMINER	
PATEL, NIHIR B	

ART UNIT	PAPER NUMBER
3743	

DATE MAILED: 05/18/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	11/054,341	JAGGER ET AL.	
	Examiner	Art Unit	
	Nihir Patel	3743	

-- 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 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *02.09.2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ 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

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10,12-15 and 17-21* is/are rejected.

7)☒ Claim(s) *11 and 16* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☐ All b)☐ Some * c)☐ None of:

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) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *09.21.2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

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 obviousness-type 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); and *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 a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

1. Claim **1** is provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claim **1** of copending Application No. **11/054,713**. Although the conflicting claims are not identical, they are not patentably distinct from each other because the difference between claim 1 of the current application and claim 1 of application '713 lies in the fact that claim 1 of application '713 includes many more elements and is thus much more specific. Thus claim 1 of application '713 is in effect a "species" of the "generic" claim 1 of the current application. It has been held that the generic invention is "anticipated" by the "species". See ***In re Goodman*, 29 USPQ2d 2010 (Fed. Cir. 1993).** Since claim 1 of the current

application is anticipated by claim 1 of application '713, it is not patentably distinct from claim 1 of application '713.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

2. Claims **1 and 2** are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims **19 and 20** of copending Application No. **11/054,340**. Although the conflicting claims are not identical, they are not patentably distinct from each other because the difference between claim 1 of the current application and claim 19 of application '340 lies in the fact that claim 19 of application '340 includes many more elements and is thus much more specific. Thus claim 19 of application '340 is in effect a "species" of the "generic" claim 1 of the current application. It has been held that the generic invention is "anticipated" by the "species". See ***In re Goodman,* 29 USPQ2d 2010 (Fed. Cir. 1993).** Since claim 1 of the current application is anticipated" by claim 19 of the current application, it is not patentably distinct from claim 19 of application '340. **With respect to claim 2 of the current application,** the limitations can be found in claim 20 of application '340.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

3. Claims **1-3, 5, 6, 10, 12-14, 17, 18 and 21** are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims **1-5** of copending Application No. **11/054,342**. Although the conflicting claims are not identical, they are not patentably distinct from each other because it is clear that all the elements of claim 1 of the current application are to be found in claim 2 (as it encompasses claim 1). The difference

between claim 1 of the current application and claim 2 of application '342 lies in the fact that claim 2 of application '342 includes many more elements and is thus much more specific. Thus claim 2 of application '342 is in effect a "species" of the "generic" claim 1of the current application. It has been held that the generic invention is "anticipated" by the "species". See ***In re Goodman*, 29 USPQ2d 2010 (Fed. Cir. 1993).** Since claim 1 of the current application is anticipated by claim 2 of application '342, it is not patentably distinct from claim 2 of application '342. **With respect to claim 2 of the current application,** the limitations can be found in claim 3 of application '342. **With respect to claim 3 of the current application,** the limitations can be found in claim 4 of application '342. **With respect to claim 5 o the current application,** it is clear that all the elements of claim 5 of the current application are to be found in claim 2 (as it encompasses claim 1). The difference between claim 5 of the current application and claim 2 of application '342 lies in the fact that claim 2 includes many more elements and is thus much more specific. Thus claim 2 of application '342 is in effect a "species" of the "generic" claim 5 of the current application. It has been held that the generic invention is "anticipated" by the "species". See ***In re Goodman*, 29 USPQ2d 2010 (Fed. Cir. 1993).** Since claim 5 of the current application is anticipated by claim 2 of application '342, it is not patentably distinct from claim 2 of application '342. **With respect to claim 6 of the current application,** the limitations can be found in claim 4 of application '342. **With respect to claim 10 of the current application,** the limitations can be found in claim 5 of application '342. **With respect to claim 12 of the current application,** it is clear that all the elements of claim 5 of the current application are to be found in claim 2 (as it encompasses claim 1). The difference between claim 12 of the current application and claim 2 of application '342 lies in the fact that

claim 2 includes many more elements and is thus much more specific. Thus claim 2 of application '342 is in effect a "species" of the "generic" claim 12 of the current application. It has been held that the generic invention is "anticipated" by the "species". See ***In re Goodman,* 29 USPQ2d 2010 (Fed. Cir. 1993).** Since claim 12 of the current application is anticipated by claim 2 of application '342, it is not patentably distinct from claim 2 of application '342. **With respect to claim 13 of the current application,** the limitations can be found in claim 3 of application '342. **With respect to claim 14 of the current application,** the limitations can be found in claim 4 of application '342. **With respect to claim 17 of the current application,** the limitations can be found in claim 5 of application '342. **With respect to claim 18 of the current application,** it is clear that all the elements of claim 18 of the current application are to be found in claim 2 (as it encompasses claim 1). The difference between claim 18 of the current application and claim 2 of application '342 lies in the fact that claim 2 includes many more elements and is thus much more specific. Thus claim 2 of application '342 is in effect a "species" of the "generic" claim 18 of the current application. It has been held that the generic invention is "anticipated" by the "species". See ***In re Goodman,* 29 USPQ2d 2010 (Fed. Cir. 1993).** Since claim 18 of the current application is anticipated by claim 2 of application '342, it is not patentably distinct from claim 2 of application '342. **With respect to claim 20 of the current application,** the limitations can be found in claim 5 of application '342.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) 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.

6. Claims **1-4, 11, 16 and 18-21** are rejected under 35 U.S.C. 103(a) as being unpatentable over Hill (US 6,471,744) in view of Smolarek et al. (US 6,344,069).

7. **As to claims 1-4 and 18-21,** Hill discloses the applicant's invention as claimed with the exception of repressurizing the column by introducing ambient air into the first end of the column until the vacuum within the column is near 1.0 atmosphere. Smolarek discloses an apparatus that does repressurize the column by introducing ambient air into the first end of the column until the vacuum within the column is near 1.0 atmosphere **(see column 5 lines 1-20).** Therefore it would have been obvious to modify Hill's invention by repressurizing the column by introducing ambient air into the first end of the column until the vacuum within the column is near 1.0 atmosphere as taught by Smolarek in order to improve the absorption process.

Claim Rejections - 35 USC § 102

8. 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 –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

9. Claim **5-8, 12** are rejected under 35 U.S.C. 102(b) as being anticipated by Hill (US 6,471,744).

10. **As to claims 5 and 12,** Hill teaches a method that comprises producing product gas by (a) introducing ambient air into a first end of a column containing an absorbent material that preferentially adsorbs nitrogen and removes oxygen rich product gas out a second end of the column **(see column 4 lines 20-30)**; (b) evacuating the column through the first end to remove adsorbed gas from the column **(see column 4 lines 20-30)**; (c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column **(see column 5 lines 15-25)**; repeating the steps (a) – (c) **(see column 5 lines 10-15;** delivering product gas to the patient **(see column 1 lines 30-40)**.

11. **As to claims 6 and 13,** Hill teaches a method step wherein introducing product gas occurs during an initial portion of step (c) **(see column 5 lines 10-15)**.

12. **As to claims 7 and 15,** Hill teaches a method step that comprises controlling a cycle rate at which steps (a) – (c) are performed as a function of oxygen used by the patient **(see column 1 lines 30-40)**.

13. **As to claim 8,** Hill teaches a method step that comprises storing a portion of the product gas in a reservoir **(see column 4 lines 10-15)**.

14. **As to claim 9,** Hill teaches a method step wherein delivering the product has is from the reservoir to the patient **(see column 1 lines 30-40)**.

15. **As to claims 10 and 17,** Hill teaches a method step wherein delivering product gas occurs in response to inhalation by the patient **(see column 1 lines 30-40)**.

16. **As to claim 14,** Hill teaches a method step wherein introducing product gas occurs during an initial portion of step (c) prior to introducing ambient air **(see column 5 lines 15-25)**.

Allowable Subject Matter

17. Claims **11 and 16** are 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.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nihir Patel whose telephone number is (571) 272-4803. The examiner can normally be reached on 7:30 to 4:30 every other Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Henry Bennett can be reached on (571) 272-4791. 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 http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Nihir Patel
Art Unit 3743

Henry Bennett
Supervisory Patent Examiner
Group 3700

OIPE
SEP 21 2005
PATENT & TRADEMARK OFFICE

FORM PTO-1449	Atty. Docket No.: V180.12-0007	Application No.: 11/054,340
LIST OF PATENTS AND PUBLICATIONS FOR APPLICANT'S INFORMATION DISCLOSURE STATEMENT	First Named Inventor: Theodore W. Jagger	
	Filing Date: February 9, 2005	Group Art: 3743

U.S. PATENT DOCUMENTS

Examiner Initials		Document No.	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents
NP	AA	US 2005/0072426 A1	04-07-2005	Deane et al.
	AB			
	AC			
	AD			
	AE			
	AF			
	AG			
	AH			
	AI			
	AJ			
	AK			

FOREIGN PATENT DOCUMENTS

		Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents	Translation Yes No
	AL				
	AM				
	AN				

OTHER ART (Including Author, Title, Date, Pertinent Pages, Etc.)

	AO	
	AP	
	AQ	

EXAMINER: Nikhil Patel DATE CONSIDERED: 05·13·2006

EXAMINER: Initial if citation 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.

FORM PTO-1449	Atty. Docket No.: V180.12-0007	Application No.:
LIST OF PATENTS AND PUBLICATIONS FOR APPLICANT'S INFORMATION DISCLOSURE STATEMENT	First Named Inventor: Theodore W. Jagger	
	Filing Date: Herewith	Group Art:

U.S. PATENT DOCUMENTS

Examiner Initials		Document No.	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents
NP	AA	Re. 35,099	11-28-1995	Hill
	AB	4,491,459	01-01-1985	Pinkerton
	AC	4,648,888	03-10-1987	Rowland
	AD	4,813,977	03-21-1898	Schmidt et al.
	AE	4,826,510	05-02-1989	McCombs
	AF	4,925,464	05-15-1990	Rabenau et al.
	AG	4,971,609	11-20-1990	Pawlos
	AH	5,531,807	07-02-1996	McCombs
	AI	5,593,478	01-14-1997	Hill et al.
	AJ	5,730,778	03-24-1998	Hill et al.
	AK	5,827,358	10-27-1998	Kulish et al.
	AL	5,858,062	01-12-1999	McCulloh et al.
	AM	5,893,275	04-13-1999	Henry
	AN	5,893,944	04-13-1999	Dong
	AO	5,928,189	07-27-1999	Phillips et al.
	AP	5,979,440	11-09-1999	Honkonen et al.
	AQ	6,212,904	04-10-2001	Arkharov et al.
	AR	6,287,366	09-11-2001	Derive et al.
	AS	6,302,107	10-16-2001	Richey, II et al.
	AT	6,311,719	11--06-2001	Hill et al.
	AU	6,314,957	11-13-2001	Boissin et al.
	AV	6,346,139	02-12-2002	Czabala
	AW	6,446,630	09-10-2002	Todd, Jr.
	AX	6,457,485	10-01-2002	Hill et al.
NP	AY	6,471,744	10-29-2002	Hill

Examiner Initials		Document No.	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents
NP	AZ	6,478,857	11-12-2002	Czabala
	BA	6,511,526	01-28-2003	Jagger et al.
	BB	6,520,176	02-18-2003	Dubois et al.
	BC	6,551,384	04-22-2003	Ackley et al.
	BD	6,629,525	10-07-2003	Hill et al.
	BE	6,641,644	11-04-2003	Jagger et al.
	BF	6,651,653	11-25-2003	Honkonen et al.
	BG	6,651,658	11-25-2003	Hill et al.
	BH	6,681,764	01-27-2004	Honkonen et al.
	BI	6,691,702	02-17-2004	Appel et al.
	BJ	6,698,423	03-02-2004	Honkonen et al.
	BK	6,712,087	03-30-2004	Hill et al.
NP	BL	6,764,534	07-20-2004	McCombs et al.

FOREIGN PATENT DOCUMENTS

		Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents	Translation Yes No
NP	BM	EP 0 860 646 A2	02-06-1998	McCulloh	Yes
	BN	WO 98/58219	12-23-1998	Honkonen	Yes
NP	BO	WO 03/092817	11-13-2003	Appel	Yes

OTHER ART (Including Author, Title, Date, Pertinent Pages, Etc.)

NP	BP	Recommendations of the Fifth Oxygen Consensus Conference, 1999
NP	BQ	"AirSep lowers boom", www.hmenews.com/2004.12/depts/vendors/vendors1.htm.
	BR	

EXAMINER: Nikhil Patel DATE CONSIDERED: 05·13·2006

EXAMINER: Initial if citation 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.

Notice of References Cited	Application/Control No. 11/054,341	Applicant(s)/Patent Under Reexamination JAGGER ET AL.	
	Examiner Nihir Patel	Art Unit 3743	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,471,744	10-2002	Hill, Theodore B.	95/19
*	B	US-6,344,069	02-2002	Smolarek et al.	95/96
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	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.

GCE - Exhibit 1049, Page 312
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
11/054,341	JAGGER ET AL.
Examiner	**Art Unit**
Nihir Patel	3743

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date
Final	Original	5/13/06
	1	√
	2	√
	3	√
	4	√
	5	√
	6	√
	7	√
	8	√
	9	√
	10	√
	11	O
	12	√
	13	√
	14	√
	15	√
	16	O
	17	√
	18	√
	19	√
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Claim		Date
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Claim		Date
Final	Original	
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GCE - Exhibit 1049, Page 313
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

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

Bib Data Sheet

CONFIRMATION NO. 5839

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
11/054,341	02/09/2005 RULE	128	3743	V180.12-0009

APPLICANTS

Theodore W. Jagger, White Bear Lake, MN;

Nicholas P. Van Brunt, White Bear Lake, MN;
John A. Kivisto, Oak Grove, MN;Perry B. Lonnes, White Bear Lake, MN;

** CONTINUING DATA **********

** FOREIGN APPLICATIONS **********

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** SMALL ENTITY **
** 03/10/2005

Foreign Priority claimed	STATE OR	SHEETS	TOTAL	INDEPENDENT
☐ yes ☑ no	COUNTRY	DRAWING	CLAIMS	CLAIMS
35 USC 119 (a-d) conditions met ☐ yes ☑ no ☐ Met after Allowance	MN	19	21	4
Verified and Acknowledged Examiner's Signature Initials				

ADDRESS
00164
KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS , MN
55415-1002

TITLE
Method of providing ambulatory oxygen

FILING FEE		
RECEIVED 690	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

GCE - Exhibit 1049, Page 314
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

Search Notes

Application/Control No.	Applicant(s)/Patent under Reexamination	
11/054,341	JAGGER ET AL.	
Examiner	**Art Unit**	
Nihir Patel	3743	

SEARCHED			
Class	Subclass	Date	Examiner
128	201.25, 205.11, 205.18, 202.26	5/13/2006	NP
96	121, 130	5/13/2006	NP
96	133, 147	5/13/2006	NP
95	96-103	5/13/2006	NP

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
Referred to Matthew Savage; Inventor Name Search	5/11/2006	NP

GCE - Exhibit 1049, Page 315
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

OIPE
SEP 21 2005
PATENT & TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3743
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner:
Docket No.	:	V180.12-0009	

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

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

I CERTIFY THAT THIS PAPER IS BEING SENT BY U.S. MAIL, FIRST CLASS, TO THE COMMISSIONER FOR PATENTS, ALEXANDRIA, VA 22313, THIS 21st DAY OF September, 2005.

PATENT ATTORNEY

The enclosed PTO Form-1449 lists patents and publications submitted pursuant to 37 C.F.R. 1.97.

TIME OF FILING

The Information Disclosure Statement is being filed, to the best of the undersigned's knowledge, before the mailing date of a first Office action on the merits. In accordance with 37 C.F.R. 1.97(b), no certification or fee is required.

Respectfully submitted,

KINNEY & LANGE, P.A.

By: _____

Larrin Bergman, Reg. No. 57,153
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

LB:bmg

OIPE IAP
SEP 21 2005
PATENT & TRADEMARK OFFICE

FORM PTO-1449	Atty. Docket No.: V180.12-0009	Application No.: 11/054,341
LIST OF PATENTS AND PUBLICATIONS FOR APPLICANT'S INFORMATION DISCLOSURE STATEMENT	First Named Inventor: Theodore W. Jagger	
	Filing Date: February 9, 2005	Group Art: 3743

U.S. PATENT DOCUMENTS

Examiner Initials		Document No.	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents
	AA	US 2005/0072426 A1	04-07-2005	Deane et al.
	AB			
	AC			
	AD			
	AE			
	AF			
	AG			
	AH			
	AI			
	AJ			
	AK			

FOREIGN PATENT DOCUMENTS

		Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents	Translation Yes No
	AL				
	AM				
	AN				

OTHER ART (Including Author, Title, Date, Pertinent Pages, Etc.)

	AO	
	AP	
	AQ	

EXAMINER: DATE CONSIDERED:

EXAMINER: Initial if citation 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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE



First Named Inventor	:	Theodore W. Jagger
Appln. No.	:	11/054,341
Filed	:	February 9, 2005
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN
Docket No.	:	V180.12-0009

RESPONSE TO NOTICE TO FILE MISSING PARTS OF APPLICATION - FILING DATE GRANTED UNDER 37 C.F.R. 1.53(f) AND 1.16(e)

Mail Stop Missing Parts
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL
Express Mail No.: EV 485710826 US

In response to the Notice to File Missing Parts of Application - Filing Date Granted dated March 14, 2005, Applicant encloses the following documents to complete the above-identified patent application filed February 9, 2005:

1. A check in the amount of $690.00 to cover the filing fee of $500.00, additional claims fee of $125.00, and surcharge fee of $65.00, and a check in the amount of $40.00 covering the recording fee;
2. Fee Transmittal (in duplicate);
3. Declaration executed by the inventor(s);
4. Power of Attorney;
5. Executed Assignment of the invention to Vbox, Incorporated , and Recordation Form Cover Sheet;
6. Submission Under 37 C.F.R.3.73(b) with copy of Assignment attached;
7. Notice to File Missing Parts of Application-Filing Date Granted

8. Preliminary Amendment; and

9. Return receipt postcard.

The Commissioner is authorized to charge payment of any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

KINNEY & LANGE, P.A.

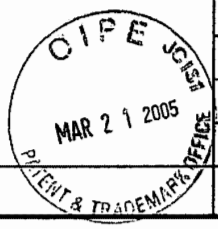
Date: 3/21/05

By: _____

David R. Fairbairn, Reg. No. 26,047
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

DRF:LB:bmg

FEE TRANSMITTAL



Complete if Known	
Application No.	11/054,341
Filing Date	February 9, 2005
First Named Inventor	Theodore W. Jagger
Group Art Unit	3743
Examiner Name	
Atty. Docket Number	V180.12-0009

Total Amount of Payment $730.00

METHOD OF PAYMENT (Check One)

1. [X] The Commissioner is hereby authorized to charge any additional fee required under 37 C.F.R. 1.16 and 1.17 and credit any over payments to Deposit Account No.11-0982. Deposit Account Name: Kinney & Lange, P.A. A duplicate copy of this communication is enclosed.

2. [X] Check Enclosed

FEE CALCULATION

1. BASIC FILING FEE

Appn. Type PD.	FILING FEE FEE/SMALL	SEARCH FEES FEE/SMALL	EXAM FEES FEE/SMALL	FEES
Utility	300 / 150	500 / 250	200 / 100	500
Design	200 / 100	100 / 50	130 / 65	—
Reissue	300 / 150	500 / 250	600 / 300	—
Provisional	200 / 100	-0- / -0-	-0- / -0-	—

Subtotal (1) $500.00

2. EXTRA CLAIM FEES

	Number Claims		Prior**		Extra		Fee from Fee Paid Below
Total	21	-	20	=	1	x	25 = 25
Indep.	4	-	3	=	1	x	100 = 100
Multiple Dependent Claims					*		= *

**Insert 3 and 20, or number previously paid if greater; Reissue see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Description
1202	50	2202	25	Claims in excess of 20
1201	200	2201	100	Independent claims in excess of 3
1203	360	2203	180	Multiple Dependent Claim
1204	200	2204	100	Reissue Independent Claims Over Original Patent
1205	50	2205	25	Reissue claims in excess of 20 and over original patent

Subtotal (2) $125.00

FEE CALCULATION (Continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee paid
1051	130	2051	65	Surcharge - Late filing fee or oath	65
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	*
1053	130	1053	130	Non-English specification	*
1812	2,520	1812	2,520	For Filing a Request for Reexamination	*
1251	120	2251	60	Extension for reply within first month	*
1252	450	2252	225	Extension for reply within second month	*
1253	1,020	2253	510	Extension for reply within third month	*
1254	1,590	2254	795	Extension for reply within fourth month	*
1255	2,160	2255	1,080	Extension for reply within fifth month	*
1402	500	2402	250	Filing a brief in support of an appeal	*
1403	1,000	2403	500	Request for oral hearing	*
1814	130	2814	65	Terminal Disclaimer Fee	*
1452	500	2452	250	Petition to revive - unavoidable	*
1453	1,500	2453	750	Petition to revive - unintentional	*
1501	1,400	2501	700	Utility/Reissue issue fee	*
1502	800	2502	400	Design issue fee	*
1460	130	1460	130	Petitions to the Commissioner	*
1807	50	1807	50	Petitions related to provisional applications	*
1806	180	1806	180	Submission of Information Disclosure Statement	*
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	40
1801	790	2801	395	Request for Continued Examination (RCE)	*
Other fee (specify) _____					*

Subtotal (3) $105.00

Signature _____ Reg. No. 26,047

David R. Fairbairn

Date 3/21/05 Deposit Account No. 11-0982

03-22-05

IFW

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	ATTORNEY DOCKET NUMBER
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009

OIPE JC131 MAR 21 2005 PATENT & TRADEMARK OFFICE

CONFIRMATION NO. 5839

FORMALITIES LETTER

OC000000015440031

00164
KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

Date Mailed: 03/14/2005

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

03/23/2005 MBERHE 00000060 110982 11054341

FILED UNDER 37 CFR 1.53(b)

01 FC:2011 150.00 DA
02 FC:2051 65.00 DA
03 FC:2201 100.00 DA
04 FC:2202 25.00 DA
05 FC:2111 250.00 DA
06 FC:2314 100.00 DA

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
  Applicant must submit $ **150** *to complete the basic filing fee for a small entity.*
- The signature of the following inventor(s) is missing from the oath or declaration:
  Perry B. Lonnes
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(e) of $65 for a small entity in compliance with 37 CFR 1.27, must be submitted with the missing items identified in this letter.

The applicant needs to satisfy supplemental fees problems indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- Additional claim fees of **$125** as a small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is **$690** for a Small Entity

- **$150** Statutory basic filing fee.
- **$65** Late oath or declaration Surcharge.

- The application search fee has not been paid. Applicant must submit **$250** to complete the search fee.

- The application examination fee has not been paid. Applicant must submit **$100** to complete the examination fee for a small entity in compliance with 37 CFR 1.27

- Total additional claim fee(s) for this application is **$125**
  - **$100** for **1** independent claims over 3.
  - **$25** for **1** total claims over 20.

Replies should be mailed to: Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

A copy of this notice MUST be returned with the reply.

/JESSICA/

Customer Service Center
Initial Patent Examination Division (703) 308-1202
PART 2 - COPY TO BE RETURNED WITH RESPONSE

OIPE JC131
MAR 2 1 2005
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:	11/054,341	
Filed	:	February 9, 2005	Group Art Unit: 3743
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner:
Docket No.	:	V180.12-0009	

PRELIMINARY AMENDMENT

Mail Stop Amendment
Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SENT VIA EXPRESS MAIL

Express Mail No.: EV 485710826 US

INTRODUCTION

Prior to an Examiner's first Action in the above-identified application, please enter the following amendments:

AMENDMENTS TO THE SPECIFICATION

Please replace the paragraph at page 1, lines 3-18 with the following paragraph:

Reference is hereby made to the following co-pending applications, which were filed on even date with the present application: "Ambulatory Oxygen Concentrator Containing a Power Pack", Theodore W. Jagger et al., Application No. 11/054,622; "Adsorbent Cartridge for Oxygen Concentrator", Theodore W. Jagger et al., Application No. 11/054,615; "Ambulatory Oxygen Concentrator Containing a Three Phase Vacuum Separation Process", Theodore W. Jagger et al., Application No. 11/054,340; "Personal Oxygen Concentrator", Theodore W. Jagger et al., Application No. 11/04,713; "Low Power Ambulatory Oxygen Concentrator", Theodore W. Jagger et al., Application No. 11/054,716; "Ambulatory Oxygen Concentrator With High Efficiency Adsorbent", Theodore W. Jagger et al., Application No. 11/054,367; "Portable Oxygen Concentrator With a Docking Station", Theodore W. Jagger et al., Application No. 11/054,714; "Method of Controlling the Rate of Oxygen Produced by an Oxygen Concentrator", Theodore W. Jagger et al., Application No. 11/054,342; "Product Pump for an Oxygen Concentrator", Theodore W. Jagger et al., Application No. 11/054,512; and "Method and Apparatus for Controlling the Purity of Oxygen Produced by an Oxygen Concentrator", Theodore W. Jagger et al., Application No. 11/054,368.

REMARKS

This Preliminary Amendment is submitted for entry in the above-identified application prior to an Examiner undertaking a first Action in connection therewith.

The Commissioner is authorized to charge any additional fees associated with this paper or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: 3/21/05 By: _____

David R. Fairbairn, Reg. No. 26,047
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

DRF:LB:bmg

CIPE JC131 MAR 2 1 2005 PATENT & TRADEMARK OFFICE

DECLARATION FOR UTILITY PATENT APPLICATION (37 C.F.R. 1.63)		Attorney Docket No.	V180.12-0009
		First Named Inventor	Theodore W. Jagger
		COMPLETE IF KNOWN	
X Declaration Submitted with Initial Filing	Declaration Submitted after Initial Filing (Surcharge (37 C.F.R. 1.16(e)) Required)	Application Number	
		Filing Date	Herewith
		Group Art Unit	
		Examiner Name	

As a below named inventor, I hereby declare that my residence, post office address, and citizenship are as stated below.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:
METHOD OF PROVIDING AMBULATORY OXYGEN

the specification of which:

X is attached hereto OR

was filed on as United States Application Number or PCT International Application Number and was amended on (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Certified Copy Attached? Yes No

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (*if applicable*)

DIRECT ALL CORRESPONDENCE TO:

Customer Number	00164
Attention	David R. Fairbairn
Telephone	(612) 339-1863
Fax	(612) 339-6580

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Sole or First Inventor:	
Given Name (First and middle (if any))	Family Name or Surname
Theodore W.	Jagger
Inventor's signature	Date:
Residence	White Bear Lake, MN — Citizenship: U.S.A.
Mailing Address	5743 Birch Road
City, State, Country	White Bear Lake, MN 55110, U.S.A.

Second Inventor:	
Given Name (First and middle (if any))	Family Name or Surname
Nicholas P.	Van Brunt
Inventor's signature	Date:
Residence	White Bear Lake, MN — Citizenship: U.S.A.
Mailing Address	One Bald Eagle Island
City, State, Country	White Bear Lake, MN 55110, U.S.A.

GCE - Exhibit 1049, Page 327
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

Third Inventor:		
Given Name (First and middle (if any))		Family Name or Surname
John A.		Kivisto
Inventor's signature	Date:	
Residence	Oak Grove, MN	Citizenship: U.S.A.
Mailing Address	3367 221st Avenue NW	
City, State, Country	Oak Grove, MN 55303, U.S.A.	

Fourth Inventor:		
Given Name (First and middle (if any))		Family Name or Surname
Perry B.		Lonnes
Inventor's signature	Perry B Lonnes	Date: 2-11-05
Residence	White Bear Lake, MN	Citizenship: U.S.A.
Mailing Address	5300 East Bald Eagle Blvd.	
City, State, Country	White Bear Lake, MN 55110, U.S.A.	

GCE - Exhibit 1049, Page 328
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

POWER OF ATTORNEY

Attorney Docket No.

V180.12-0009

CIPE JC131 MAR 21 2005 PATENT & TRADEMARK OFFICE

First Named Inventor : Theodore W. Jagger

Title : METHOD OF PROVIDING AMBULATORY OXYGEN

In the patent application:

X identified above (and submitted to the Patent and Trademark Office herewith).

_ filed on _____ as Application No. _____.

I appoint the attorneys and agents associated with Customer Number 00164 to prosecute the patent application identified above and to transact all business in the Patent and Trademark Office connected therewith, including full power of association, substitution and revocation.

I ratify all prior actions taken by Kinney & Lange, P.A. or the attorneys and agents mentioned above in connection with the prosecution of the above-mentioned patent application.

I authorize Kinney & Lange, P.A. to mark the appropriate space above and to insert the filing date and application number of the application, as appropriate.

I authorize the attorneys and agents named herein to accept and follow instructions from David R. Fairbairn as to any action to be taken in the Patent and Trademark Office regarding this application without direct communication between the attorneys and agents and the undersigned. In the event of a change in the persons from whom instructions may be taken, the attorneys and agents named herein will be so notified by the undersigned.

Please address all correspondence and telephone calls to **Customer Number 00164**, attention David R. Fairbairn, Telephone (612) 339-1863, Fax (612) 339-6580.

VBOX, INCORPORATED

Signature: Nicholas P. Van Brunt Dated: 2-28-05

Nicholas P. Van Brunt

Title: President

ASSIGNMENT

Attorney Docket No.

V180.12-0009

First Named Inventor : Theodore W. Jagger

Title : METHOD OF PROVIDING AMBULATORY OXYGEN

WHEREAS, we, Theodore W. Jagger, of White Bear Lake, MN, Nicholas P. Van Brunt, of White Bear Lake, MN, John A. Kivisto, of Oak Grove, MN, and Perry B. Lonnes, of White Bear Lake, MN have invented certain new and useful improvements as described in an application entitled METHOD OF PROVIDING AMBULATORY OXYGEN for Letters Patent of the United States, the application having been executed on even date herewith, and/or being identifiable in the United States Patent and Trademark Office by Application No. _____, filed _____; and

WHEREAS, Vbox, Incorporated, a corporation organized and existing under the laws of the State of Minnesota, and having offices at 2342 East County Road J, White Bear Lake, MN 55110, ("Assignee") is desirous of acquiring the entire right, title and interest in and to the invention, the application, and any and all Letters Patent or similar legal protection, foreign or domestic, to be obtained therefor;

NOW, THEREFORE, for good and valuable consideration, the receipt and adequacy of which is hereby acknowledged, we transfer to Assignee, its successors and assigns, my entire right, title and interest in and to the invention, the above-identified application, corresponding domestic and foreign applications, all Letters Patent or similar legal protection issuing thereon, and all rights and benefits under any applicable treaty or convention; and we authorize the Commissioner of Patents and Trademarks of the United States or foreign equivalent thereof to issue the Letters Patent or similar legal protection to the Assignee.

We authorize the Assignee, its successors and assigns, to insert in this instrument the filing date and application number of the application when ascertained.

We authorize the Assignee, its successors and assigns, or anyone it may properly designate, to apply for Letters Patent or similar legal protection, in its own name if desired, in any and all foreign countries.

We represent to the Assignee, its successors and assigns, that we have not and shall not execute any writing or do any act whatsoever conflicting with this Assignment. We, our executors or administrators, will at any time upon request, without additional consideration, but at the expense of the Assignee, its successors and assigns, execute such additional writings and do such additional acts as the Assignee, its successors and assigns, may deem desirable to perfect its enjoyment of this grant, and render all assistance in making application for and obtaining, maintaining, and enforcing the Letters Patent or similar legal protection on the invention in any and all countries.

Theodore W. Jagger

STATE OF MINNESOTA)
) ss.
COUNTY OF Ramsey)

LARRIN P BERGMAN
NOTARY PUBLIC—MINNESOTA
My Commission Expires JAN. 31, 2006

Subscribed and sworn to before me, a Notary Public, this 9 day of February, 2005.

Notary Public

(SEAL)

GCE - Exhibit 1049, Page 330
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

Nicholas P. Van Brunt

STATE OF MINNESOTA)
) ss.
COUNTY OF Hennepin)

Subscribed and sworn to before me, a Notary Public, this 9 day of February, 2005.

Notary Public

(SEAL)

John A. Kivisto

STATE OF MINNESOTA)
) ss.
COUNTY OF Hennepin)

Subscribed and sworn to before me, a Notary Public, this 9 day of February, 2005.

Notary Public

(SEAL)

Perry B. Lonnes

STATE OF ~~MINNESOTA~~ FLORIDA)
) ss.
COUNTY OF LEE)

Subscribed and sworn to before me, a Notary Public, this 11 day of feb, 2005.

Notary Public

(SEAL)

SUZANNE K. ADKINS
MY COMMISSION # DD 062951
EXPIRES: October 7, 2005

OIPE JC131
MAR 21 2005
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Theodore W. Jagger	
Appln. No.	:		
Filed	:	Herewith	Group Art Unit:
Title	:	METHOD OF PROVIDING AMBULATORY OXYGEN	Examiner:
Docket No.	:	V180.12-0009	

SUBMISSION UNDER 37 C.F.R. 3.73(b)

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

Vbox, Incorporated, a Minnesota company, is an owner of the patent application identified above by virtue of either:

A. [X] An assignment from the inventor(s) of the patent application identified above. The assignment was recorded in the Patent and Trademark Office at Reel _, Frame __, or a copy of which is attached.

OR

B. [ ] A chain of title from the inventor(s), of the patent application identified above, to the current assignee as shown below:

1. From:_____ To:_____
The document was recorded in the Patent and Trademark Office at Reel_____, Frame_____, or a copy of which is attached.

2. From:_____ To:_____
The document was recorded in the Patent and Trademark Office at Reel_____, Frame_____, or a copy of which is attached.

3. From:_____ To:_____
The document was recorded in the Patent and Trademark Office at Reel_____, Frame_____, or a copy of which is attached.

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature: Nicholas P. Van Brunt Date: 2-28-05

Nicholas P. Van Brunt

Title: President

PATENT APPLICATION FEE DETERMINATION RECORD
Effective December 8, 2004

11/054,341

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	21	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	21 minus 20=	* 1
INDEPENDENT CLAIMS	4 minus 3 =	* 1
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☑		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	100	OR	BASIC FEE	
X$ 25=	25	OR	X$50=	
X100=	100	OR	X200=	
+180=		OR	+360=	
TOTAL	270	OR	TOTAL	

3/21/05 CLAIMS AS AMENDED - PART II

AMENDMENT A	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	

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	ATTORNEY DOCKET NUMBER
11/054,341	02/09/2005	Theodore W. Jagger	V180.12-0009

CONFIRMATION NO. 5839

00164
KINNEY & LANGE, P.A.
THE KINNEY & LANGE BUILDING
312 SOUTH THIRD STREET
MINNEAPOLIS, MN 55415-1002

FORMALITIES LETTER

OC000000015440031

Date Mailed: 03/14/2005

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
  Applicant must submit $ **150** *to complete the basic filing fee for a small entity.*
- The signature of the following inventor(s) is missing from the oath or declaration:
  Perry B. Lonnes
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(e) of $65 for a small entity in compliance with 37 CFR 1.27, must be submitted with the missing items identified in this letter.

The applicant needs to satisfy supplemental fees problems indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

• Additional claim fees of **$125** as a small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is **$690** for a Small Entity

- **$150** Statutory basic filing fee.
- **$65** Late oath or declaration Surcharge.

- The application search fee has not been paid. Applicant must submit **$250** to complete the search fee.

- The application examination fee has not been paid. Applicant must submit **$100** to complete the examination fee for a small entity in compliance with 37 CFR 1.27

- Total additional claim fee(s) for this application is **$125**

  - **$100** for **1** independent claims over 3.
  - **$25** for **1** total claims over 20.

Replies should be mailed to: Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

A copy of this notice MUST be returned with the reply.

Customer Service Center
Initial Patent Examination Division (703) 308-1202

PART 3 - OFFICE COPY

22713 U.S. PTO 020905

UTILITY PATENT APPLICATION TRANSMITTAL

Our Docket No.: **V180.12-0009**	Date: **February 9, 2005**
First Named Inventor: **Theodore W. Jagger**	
Title: **METHOD OF PROVIDING AMBULATORY OXYGEN**	
Express Mail No.: **EV 485708819 US**	

11/05/2004 13010 U.S.PTO 020905

APPLICATION ELEMENTS

ADDRESS TO: **Commissioner for Patents**
P.O. Box 1450
Alexandria, VA 22313-1450

1. [] Fee Calculation Sheet
   (Submit an original and a duplicate for fee processing)
2. [X] Applicant claims small entity status
3. [X] Specification Total Pages **[51]**
   - Descriptive title of the invention
   - Cross References to Related Applications
   - Statement Regarding Fed. Sponsored R&D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings (if filed)
   - Detailed Description
   - Claims
   - Abstract of the Disclosure
4. [X] Drawings (35 U.S.C. 113) Total Sheets **[19]**
5. [X] Oath or Declaration Total Pages **[3]**
   a. [X] Newly Executed (original or copy)
   b. [] Copy from a prior application (37 C.F.R. 1.63(d) - for continuation/divisional with Box 18 completed)
   [Mark Box 5 below]
   I. [] DELETION OF INVENTOR(S)
   Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. 1.63(d)(2) and 1.33(b)
6. [X] Application Data Sheet. See 37 CFR 1.76.
7. [] CD-ROM or CD-R in duplicate, large table or Computer Program (*Appendix*)
8. Nucleotide and/or Amino Acid Sequence Submission (*If applicable, all necessary*)
   a. [] Computer Readable Copy (CRF)
   b. Specification Sequence Listing on:
      i. [] CD-ROM or CD-R (2 copies; or
      ii. [] Paper
   c. [] Statements verifying identify of above copies

ACCOMPANYING APPLICATION PARTS

9. [] Assignment Papers (cover sheet & document(s))
10. [] 37 C.F.R. 3.73(b) Submission
    [X] Power of Attorney
11. [] English Translation Document (*if applicable*)
12. [X] Information Disclosure Statement with copies of Citations as necessary
13. [] Preliminary Amendment Total Pages []
14. [X] Return Receipt Postcard (*Should be specifically itemized*)
15. [] Certified Copy of Priority document(s) (*If foreign priority is claimed*)
16. [] Nonpublication Request under 35 U.S.C. 122(b)(2)(B)(i). Application must attach form PTO/SB/35 or its equivalent
17. [] Other

18. **If a CONTINUING APPLICATION,** *check appropriate box and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:*
[] Continuation [] Division [] Continuation-in-part (CIP) of prior Application No.

Prior Application Information: Examiner _ Group Art Unit __

For CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

19. **CORRESPONDENCE ADDRESS**

ATTY NAME AND REG. NO.	**David R. Fairbairn** 26,047 SIGNATURE:
ADDRESS	**Kinney & Lange, P.A.** **THE KINNEY & LANGE BUILDING** **312 South Third Street** **Minneapolis, MN 55415-1002**
TELEPHONE	**(612) 339-1863** FAX: **(612) 339-6580**

METHOD OF PROVIDING AMBULATORY OXYGEN

CROSS-REFERENCE TO RELATED APPLICATION(S)

Reference is hereby made to the following copending applications, which were filed on even date with the present application: "Ambulatory Oxygen Concentrator Containing a Power Pack", Theodore W. Jagger et al., Application No. _____; "Adsorbent Cartridge for Oxygen Concentrator", Theodore W. Jagger et al., Application No. _____; "Ambulatory Oxygen Concentrator Containing a Three Phase Vacuum Separation Process", Theodore W. Jagger et al., Application No. _____; "Personal Oxygen Concentrator", Theodore W. Jagger et al., Application No. _____; "Low Power Ambulatory Oxygen Concentrator", Theodore W. Jagger et al., Application No. _____; "Ambulatory Oxygen Concentrator With High Efficiency Adsorbent", Theodore W. Jagger et al., Application No. _____; "Portable Oxygen Concentrator With a Docking Station", Theodore W. Jagger et al., Application No. _____; "Method of Controlling the Rate of Oxygen Produced by an Oxygen Concentrator", Theodore W. Jagger et al., Application No. _____; "Product Pump for an Oxygen Concentrator", Theodore W. Jagger et al., Application No. _____; and "Method and Apparatus for Controlling the Purity of Oxygen Produced by an Oxygen Concentrator", Theodore W. Jagger et al., Application No. _____.

BACKGROUND OF THE INVENTION

The field of this invention relates to oxygen concentrators. In particular, the invention relates to wearable oxygen concentration systems utilizing vacuum swing adsorption for creating an oxygen stream for ambulatory respiratory patients.

There is a need for home and ambulatory oxygen systems for use by patients. Supplemental oxygen is required for patients exhibiting symptoms from certain diseases and lung disorders; for example, pulmonary fibrosis, sarcoidosis, or occupational lung disease. For such patients, oxygen therapy is an increasingly beneficial prescription to help the patients live normal and productive lives. While not a cure for

lung disease, prescriptive supplemental oxygen increases blood oxygenation, which reverses hypoxemia. Oxygen prescriptions prevent long-term effects of oxygen deficiency on organ systems, the heart, brain and kidneys. Oxygen treatment is also prescribed for Chronic Obstructive Pulmonary Disease (COPD), heart disease, AIDS, asthma, and emphysema.

Currently, supplemental medical oxygen for therapy is provided to a patient from high pressure gas cylinders; cryogenic liquid in vacuum-insulated containers or thermos bottles commonly called "dewars", and oxygen concentrators. Some patients require in-home oxygen only, while others require in-home as well as ambulatory oxygen depending on the prescription. The three systems are all used for in-home use. However, oxygen concentrators provide a special beneficial advantage because they do not require refilling of dewars or exchange of empty cylinders with full ones. Home oxygen concentrators, however, do have drawbacks. They consume relatively large amounts of electricity; are relatively large and heavy; emit excessive heat and are relatively noisy.

There has been a need for an improved portable device for supplying oxygen to a patient. Only small high pressure gas bottles and small liquid dewars are truly portable enough to be used for ambulatory needs. Either system may be used for both in-home and ambulatory use. A patient using a stationary oxygen system at home (or even a portable system which cannot be readily transported), who travels must opt for small cylinders towed in a wheeled stroller or for portable containers that they carry, typically on a shoulder sling. Both of these options have significant drawbacks.

A major drawback of the cylinder option is that small cylinders only provide oxygen for a short duration. Moreover, these cylinders are maintained at a high pressure, and thus their use is restricted due to safety considerations. Another drawback of the cylinders is the refill requirement after depletion of the contents of the cylinder. Empty cylinders must be refilled at specialized facilities, or in the patient's home using a

commercial oxygen concentrator which extracts oxygen from the air. The latter option requires an on-site compressor to boost the output pressure of the concentrator to meet cylinder refill pressure requirements. Filling of cylinders with oxygen in the home is potentially dangerous due to the physics involved with compressing gas. Another detriment to cylinder usage is fire hazards associated with storage of large volumes of oxygen in the home environment.

Convenience and safety issues are not the only drawbacks associated with the use of cylinders. Another drawback is the cost associated with cylinders. Cylinders require special care, and specialized materials are required for high pressure oxygen compatibility, which in turn drives up the cost of cylinder-based systems.

The liquid oxygen storage system also has drawbacks. The primary drawback is the requirement of a base reservoir which necessitates refilling once a week or more from an outside source. Liquid oxygen is transferred from the base unit to a portable dewar, which is used by an ambulatory patient. However, there is substantial waste, as a certain amount of oxygen is lost during the transfer to the portable containers and from evaporation. Up to twenty percent of the contents of the base cylinder is lost in the course of two weeks because of losses in transfers and normal evaporation. Even without withdrawal by the patient, the base reservoir will typically boil dry over a period of one to two months.

The aforementioned systems all require a refilling station. When the patient is out in public, such stations are not readily available. Upon running low (or out) of oxygen, the patient must return home to a specified place that can refill the system. Such a requirement detracts from the ambulatory usefulness of the systems.

The industry has developed a set of recommendations for systems targeted to provide portable oxygen for ambulatory patients. The Fifth Oxygen Consensus Conference set forth the following standards for long-term oxygen therapy ambulatory equipment: 1) equipment must weigh less than 10 lbs., 2) equipment must

provide the equivalent of 2 liter/min of continuous flow O_2, and 3) the flow rate must be maintained for four hours or more. Thus, ambulatory equipment, or personal oxygen systems (POS), are to be inconspicuous to the public as well as unrestricting to the patient. Cylinders and other liquid oxygen systems tend to be bulky, which interferes with normal daily activities. Similarly, cylinders and liquid oxygen systems are difficult to conceal from public view. Ideally, a POS is small, lightweight, quiet, and flexible which allows the device to be concealed from the public. The present invention, whereby oxygen rich gas is provided to a patient from a wearable oxygen concentrator, meets and exceeds these standards.

BRIEF SUMMARY OF THE INVENTION

An oxygen rich product gas is produced by (a) introducing ambient air a column containing an adsorbent material that preferentially adsorbs nitrogen; (b) evacuating the column to remove adsorbed gas from the column;(c) repressurizing the column by introducing ambient air into the column until the column is near 1.0 atmosphere; and (d) repeating steps (a) - (c). Product gas is delivered as needed to a patient.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of a patient carrying the oxygen concentrator of the present invention.

FIG. 2 is a front perspective view of the oxygen concentrator.

FIG. 3 is a rear perspective view of the oxygen concentrator.

FIG. 4 is a front perspective view of the oxygen concentrator and a docking station.

FIG. 5 is a block diagram showing the components and connections of the oxygen concentrator.

FIG. 6 is a diagram showing rotary valve timing.

FIG. 7 is an exploded view of the oxygen concentrator in which the

power pack and the adsorbent cartridge have been removed.

FIG. 8 is a perspective view of the oxygen concentrator with a portion of the belt removed.

FIG. 9 is a perspective view of the components of the oxygen concentrator without the belt.

FIG. 10 is a perspective view of the components contained within the case portions of the modules and their associated pneumatic and electrical connections of the oxygen concentrator.

FIG. 11 is a perspective view of the components contained within a battery module.

FIG. 12a is a perspective view of an accumulator.

FIG. 12b is a top view of the accumulator.

FIG. 12c is a sectional view of the accumulator.

FIG. 12d is another sectional view of the accumulator.

FIG.13 is a perspective view of a control module.

FIG. 14 is a front view of the interior components of the control module.

FIG. 15 is a perspective view of the cartridge contained within a cartridge module.

FIG. 16 is an exploded view of columns and filters within the cartridge.

FIG. 17 is a rear perspective view of the oxygen concentrator and the docking station.

FIG. 18 is a front perspective view of the docking station.

FIG. 19 is a chart showing the adsorption isotherms for two different adsorbent materials.

DETAILED DESCRIPTION

The current invention relates to separation of gases using vacuum swing adsorption. Specifically, disclosed is an oxygen concentrator for a patient who requires

a source of oxygen. The present invention is further explained with reference to the drawn figures in which like structures are referred to by like numerals throughout the several views.

Overview - Oxygen Concentrator 100 (FIGS. 1-4)

FIG. 1 is a front view showing patient P with oxygen concentrator 100 and oxygen delivery tube 102. Oxygen concentrator 100 is a small unit which utilizes vacuum swing adsorption to separate oxygen from the ambient air around patient P. Oxygen concentrator 100 is compact and light so as not to interfere with the ambulatory movement of patient P, and can produce a product stream of gas containing a range of eighty-five to ninety-five percent oxygen.

Oxygen delivery tube 102 is a polymer tube or similar oxidation resistant structure, which extends from oxygen concentrator 100 to the nose, mouth, or port into the upper airway of patient P. Tube 102 allows delivery of oxygen to patient P for inhalation. In FIG. 1, patient P is about six foot tall to illustrate an approximation of the relative size of oxygen concentrator 100.

FIG. 2 is a perspective view of oxygen concentrator 100. Oxygen concentrator 100 is comprised of belt 104, power module 106 containing power pack 108, reservoir module 110, control module 112 containing user interface 114, and separation cartridge module 116. Oxygen concentrator 100 is a portable oxygen separator used to provide an oxygen rich gas stream to patient P. Belt 104 connects and carries the modules 106, 110, 112, and 116 of oxygen concentrator 100. Belt 104 may contain belt loops (not illustrated), clips, or a pair of straps that contain a buckle and holes or like fastening device for securing oxygen concentrator 100 to patient P. Alternatively, oxygen concentrator 100 may be placed in a purse, fanny pack, or similar personal carrying device for transport with patient P.

Power module 106 provides the necessary power to operate the systems of oxygen concentrator 100. In the embodiment illustrated, power module 106 contains

replaceable power pack 108. Reservoir module 110 stores oxygen rich gas that has been separated from ambient air by cartridge module 116. Control module 112 pilots and regulates the interaction of the power module 106, reservoir module 110, and separation cartridge module 116 of oxygen concentrator 100. User interface 114 on control module 112 is a console which allows patient P to adjust and monitor oxygen concentrator 100.

FIG. 3 is a perspective view of the opposite side of oxygen concentrator 100 as shown in FIG. 2. Illustrated in FIG. 3 are belt 104, power module 106, reservoir module 110, control module 112, and separation cartridge module 116. Belt 104 is constructed to contain belt segments 120 formed by serrations 118. This allows the belt 104 to be flexible and conform to patient P's body while wearing oxygen concentrator 100. Belt 104 is fabricated from a flexible material, such as textile or plastic and contains an inner padding such as foam. Belt 104 also houses the electrical and pneumatic connections of oxygen concentrator 100.

FIG. 4 is a perspective view of the front side of the oxygen concentrator 100 on docking station 122. Illustrated are oxygen concentrator 100 comprising belt 104, power module 106, reservoir module 110, control module 112, and separation cartridge module 116, along with docking station 122 containing power pack chargers 124a and 124b. Belt 104 is flexible and thus rests on the arc shaped docking station 122. Docking station 122 contains power pack chargers 124a (with power pack 108a inserted therein) and 124b, as well as concentrator dock 126 which supports the oxygen concentrator 100 while on the docking station 122. Docking station 122 converts AC power to recharge power packs 108.

Oxygen Concentrator 100 System Components and Connections (FIG. 5)

FIG. 5 is a block diagram of oxygen concentrator 100 illustrating power module 106, reservoir module 110, control module 112, and separation cartridge module 116, along with docking station 122 and showing the components and

connections among the modules and docking station 122. Oxygen concentrator 100 components includes product gas outlet port 103, adsorbent columns 130a-130c (each containing a respective inlet port 132a-132c and a respective outlet port 134a-134c), air inlet port 135, air inlet filter 136, product gas final filter 138, main valve 140, drive reducer 142, vacuum pump 144, drive 146, electric control module (ECM) 148, breakthrough flow sensor 150, valve position sensor 152, product control pump 154, check valve 156, main storage reservoir 158 containing pressure sensor 159, dispensing valve 160, as well as previously identified components tubing 102, power pack 108, user interface 114, and docking station 122.

As shown in FIG. 5, adsorbent cartridge module 116 includes adsorbent columns 130a-130c each containing respective inlet ports 132a-132c and outlet ports 134a-134c, air inlet filter 136, and product gas final filter 138. Ambient air enters air inlet port 135, passes through air inlet filter 136, and enters valve 140 for distribution to adsorbent columns 130a-130c. Product gas passes through final filter 138 and product gas outlet port 103 into tubing 102 for delivery to patient P. Inlet ports 132a-132c of adsorbent columns 130a-130c connect to valve 140 through inlet lines 164a-164c. Similarly, outlet ports 134a-134c connect to valve 140 through outlet lines 166a-166c.

Control module 112 houses main valve 140, drive reducer 142, vacuum pump 144, drive 146, electric control module (ECM) 148, breakthrough flow sensor 150, valve position sensor 152, and contains user interface 114. Main valve 140 is pneumatically connected to adsorbent columns 130a-130c, as well as inlet filter 136 via inlet line 168, vacuum pump 144 via vacuum inlet line 170, product control pump 154 via vacuum line 172 and product gas line 174, and main reservoir 158 via product gas line 176. Valve 140 is actuated by drive 146 through a motor speed reducer 142. Also, valve 140 connects to breakthrough flow sensor 150 and valve position sensor 152 which send electrical inputs 178 and 180 to ECM 148.

ECM 148 is a logic control, such as a PLC (programmable logic

controller), microprocessor, or similar structure which controls operation of oxygen concentrator 100. ECM 148 contains the set of inputs and outputs associated with the modules for regulating oxygen concentrator 100. ECM 148 also receives control setting inputs182 and 184 from user interface 114, and docking station 122, respectively, power pack management input 186 from power pack 108, reservoir pressure input 188 from pressure sensor 159 in main reservoir 158, and nasal pressure input 190 from dispensing valve 160. ECM 148 provides interface output 192 to the user interface114, interface output 194 to docking station 122, power management output 196 to power pack 108, dispensing valve time open output 198 to dispensing valve 160, and motor drive output 200 to drive 146.

User interface 114 contains physical controls such as dials, toggle switches, push button switches, and similar controls, for operating oxygen concentrator 100. The physical controls provide electrical control settings to ECM 148. ECM 148 reads these settings as inputs 182 and provides output 192 to the user interface 114. The status is converted from electric signals to physical output by indicator lights, status display, and similar structures of user interface 114.

Power pack management input 186 and output 196 control the charge and discharge of voltage from power pack 108 to drive 146 via ECM 148. Drive 146 will activate vacuum pump 144, valve 140 through drive speed reducer 142, and any other systems requiring power. Power pack management output 196 will also supply power to indicator lights, status display, audible alarm (if included), and other passive electrical system requirements on user interface 114 through ECM 148.

ECM 148 controls and coordinates the steps of the vacuum swing adsorption cycle through its inputs and outputs. In one embodiment, breakthrough flow sensor 150 provides an input 178 into ECM 148 by measuring air flow rates. The position of valve 140 is detected by valve position sensor 152 to produce input 180. Reservoir 158 contains a sensor to produce reservoir pressure input 188. Dispensing

valve 160 also contains a pressure sensor which provides nasal pressure input 190 in response to differential pressure. ECM 148 reads these inputs to control the cycle by changing outputs, such as motor drive output 200 for drive 146. Drive 146 propels vacuum pump 144. Vacuum pump 144 creates a vacuum that is communicated to valve 140 through vacuum input line 170, while dispelling nitrogen rich gas as exhaust 177. Another output 198 controls the time that dispensing valve 160 is open. In this embodiment, the inputs and outputs are connected to a PLC within ECM 148 which is programmed to control the cycle of oxygen concentrator 100.

Contained within reservoir module 110 is an oxygen-rich gas accumulator comprising reservoir 158, check valve 156, product control pump 154, and check valve 153. Reservoir 158 receives oxygen-rich gas produced by oxygen concentrator 100 and stores it at a low pressure above ambient until it is required for use. A portion of the stored oxygen-rich gas is delivered back to valve 140 by product gas line 176 for use in ordering the nitrogen content in adsorbent columns 130a-130c by moving much of the residual nitrogen held after evacuation near the outlets134a-134c toward inlets 132a-132c of the columns 130a-130c. Reservoir 158 is in communication with dispensing valve 160 through product gas line 202. Check valve 156 opens to allow oxygen into reservoir 158 and closes to prevent backflow of oxygen upon reaching the desired pressure in reservoir 158.

Product control pump 154 is driven by vacuum provided by the vacuum pump 144 through valve 140 via vacuum line 172. Product line 174 is in communication from separation cartridge module 116 to check valve 153, which opens to allow product control pump 154 to transport separated oxygen-rich gas to reservoir 158. Product control pump 154 delivers the product gas to main reservoir 158 through check valve 156.

Dispensing valve 160 and power pack 108 are contained within power module 106. Dispensing valve 160 is used to feed the flow of oxygen-rich gas to the

patient P by delivery of the product gas through final product gas line 205 to product final filter 138. The product gas is obtained from the main reservoir 158 through product gas line 202. Power pack 108 provides the power supply for oxygen concentrator 100 as previously described. Power pack 108 is rechargeable through docking station 122 as represented by power connection 204.

Vacuum Swing Adsorption (VSA) Process- Overview

Oxygen concentrator 100 operates using a vacuum swing adsorption process, which involves a series of cycles that include a feed step or phase, an evacuation step or phase, and a repressurization step or phase. Each of these three phases takes place in one of the three columns 130a-130c at any given time. Each column 130a-130c is in a different phase. For purposes of explanation, the VSA process will be described in reference to "column 130", which is representative of each of the three columns 130a-130c.

In the feed phase, a gas stream of ambient air 162 enters inlet end 132 of column 130 while product gas containing concentrated oxygen is delivered from outlet end 134 of column 130. The slight vacuum in column 130 draws air 162 into column 130 and through an adsorbent material (typically a zeolite) which preferentially retains specific components of air (nitrogen), allowing the desired product (oxygen) to pass through. A mass transfer zone (MTZ), which is a small region in which nitrogen is being adsorbed, is passing through the adsorbent material. The MTZ divides the column 130 into two segments: a nitrogen-rich segment where the MTZ has passed through, and an oxygen-rich segment ahead of the moving MTZ. The MTZ forms at the inlet 132 at the start of the process and gradually moves through the column to the outlet 134 as the process proceeds. Outlet end 134 of column 130 is connected to main reservoir 158 through main valve 140, check valve 153, and product control pump 154, so that oxygen-rich product gas from column 130 is pumped into reservoir 158.

In the evacuation phase, column 130 is brought to a stronger vacuum by

vacuum pump 144, causing the adsorbed component, i.e. nitrogen, to be desorbed. The nitrogen is evacuated from column 130 through main valve 140, and is discharged by vacuum pump 144 as waste exhaust 177.

In the repressurization phase, the previously evacuated column 130 is returned to near 1 atm. Ambient air 162 enters column 130 through inlet end 132, and recycled product gas from product line 176 enters column 130 through outlet end 134. The gases replace the vacuum that was previously drawn in column 130 during the evacuation phase. Just prior to column 130 reaching about 1 atm, the repressurization phase ends and the feed phase of the cycle begins again.

This constitutes the general principles of vacuum swing adsorption (VSA) for gas separation. All phases can be accomplished with a single column, or with a plurality of columns. If a plurality of columns are used, it is preferable to have a multiple of three (illustrated as 130a-130c in FIG. 5) that are sequenced out of phase for the different cycle phases in order to maintain constant product flow.

The Feed Phase- Breakthrough Detection

During the feed phase of the separation cycle, the position of the MTZ within adsorbent column 130 is monitored, determined, and beneficially used to control the termination of the feed phase. The control results in improvements in product purity and recovery with concomitant decrease in energy consumed, as well as system size and system weight for a given volume of product produced.

Breakthrough is defined as the point when the MTZ reaches outlet 134 of adsorbent column 130. At this point, feed gas begins to flow into the separated product gas stream. This is undesirable because the purity of the product stream is reduced by the feed stream gas if the feed is allowed to continue past this point. Conversely, if the feed phase is terminated before the MTZ nears outlet 134 of column 130, product recovery will be reduced because product gas contained in column 130 between the MTZ and outlet 134 of column 130 will be subjected to the evacuation

phase that follows the feed phase in the separation cycle, and much of this remaining product gas will be lost with the desorbed gas in the waste stream.

For a particular column geometry, temperature, adsorbent type and condition, and cycle vacuum levels, there is an optimal time during the feed phase of the cycle to terminate the feed -- before purity requirements are compromised, but after the maximum possible product has been recovered from column 130. This optimal time is determined by the detection of the passage of the mass transfer zone through a specific position relative to outlet end 134 of column 130.

For some combinations of system variables, the optimum feed termination time corresponds to the beginning of breakthrough when the leading edge of the MTZ has just reached outlet end 134 of column 130. This event can be detected by monitoring either or both of the gas flow rates at inlet 132 or outlet 134 to column 130. Before breakthrough, the outlet flow rate is less than the inlet flow rate by an amount equal to the rate of nitrogen gas adsorption of column 130 from the feed gas flow. After breakthrough, column 130 is no longer adsorbing nitrogen from the feed gas, so the inflow and outflow rates of column 130 become equal. Any method of measuring gas flow rates to determine the point in time when these flow rates begin the transition toward equality can be used to detect this beginning of breakthrough.

It has been determined that if the inflow rate of air to column 130 is maintained constant, a simple detection of a significant rise in slope of the outflow rate marks breakthrough. Conversely, if the outflow rate is held fairly steady, then a falling slope of the inflow rate marks the breakthrough. Monitoring the ratio of flow for the inlet and outlet and detecting a significant change in the ratio of flows toward a ratio of 1:1 can mark breakthrough in systems where inflow or outflow may not be steady enough to detect breakthrough by monitoring just one of the flow rates.

For other combinations of system variables, the optimum feed termination time may correspond to the MTZ position prior to breakthrough. In these

cases, it is beneficial for a specific amount of product to be intentionally left in column 130 at the end of a feed phase. Detecting the position of the MTZ before breakthrough can be accomplished by additional methods.

One method used determines the volume of gas passed into or out of adsorbent column 130 up to the point of breakthrough by integrating the flow rate during the time interval between an initial feed and breakthrough while using some breakthrough detection method as previously described. Volume of flow may also be directly measured by physical equivalent methods using displacements of known volumes. Once the volume of gas that passes the column up to the point of breakthrough is determined, the volume of gas flow can be monitored during subsequent feed phases and the feed terminated when the volume reaches a specific value less than that for breakthrough. At any time during the feed phase, the volume of gas passed through column 130 since the beginning of feed divided by the volume of gas at breakthrough will be the same ratio as the position of the mass transfer zone divided by the length of column 130 (assuming a constant cross sectional area along the length). Using this relationship, the position of the MTZ within column 130 can be adequately determined during the feed phase.

The components of oxygen concentrator 100 as previously described are used to complete the cyclical phases of VSA to separate gases. The feed phase operates at a slight vacuum just below ambient (in the range of 0.9 to 1 atm). This provides just enough driving force to pull ambient air 162 into adsorbent column 130 through inlet filter 136. The vacuum is caused by product control pump 154, which is driven by the vacuum drawn by vacuum pump 144. Product control pump 154 is a piston pump or similar structure that meters a volume of gas. Product control pump 154 connects with a volume much greater than the piston displacement volume, such as main reservoir 158.

The feed phase is allowed to proceed until breakthrough is detected. Up to this point, the outflow gas from adsorbent column 130 has been a high purity

oxygen/argon, low percent nitrogen mixture. The MTZ position is controlled to minimize nitrogen into the product gas mixture. The MTZ position is monitored by breakthrough flow sensor 150, which detects a large increase in flow rate associated with breakthrough when the nitrogen no longer is preferentially adsorbed by adsorbent column 130. Breakthrough flow sensor is located near the column inlet 132, column outlet 134, or similar place where the flow rate being measured is accessible. When the increase MTZ flow is detected, a signal is sent to ECM 148, which also receives valve position signal 180 from the valve position sensor 152. The ECM 148 compares the timing of the MTZ breakthrough signal and the valve position signal and makes a minor adjustment to motor speed 200 based on lead, lag, or on-time status to keep the breakthrough time near the end of each feed phase. Alternately, ECM 148 receives a signal from breakthrough flow sensor 150 and immediately terminates the current feed phase in column 130 by signaling valve 140 to rotate to start the next phase. In yet another embodiment, the separation system contains a shut off valve that is signaled to close the feed of ambient air 162 into column 130, or the delivery of product gas from the column upon breakthrough detection.

In another embodiment, the method for determining the position of the mass transfer zone prior to breakthrough is accomplished by placing a small amount of non-adsorbing material within adsorbent column 130 at a particular position. When the mass transfer zone passes through this position, a flow change is detectable as the adsorption of gas is briefly interrupted by the non-adsorbing segment of column 130. The resulting flow change is detectable using the same methods for breakthrough detection previously described.

With larger columns and slower feed phases, the position of the mass transfer zone has been established by measuring temperature rise at positions of interest within column 130. Significant temperature increases result from the heat of adsorption at the MTZ and can be detected by thermistors or similar devices placed within column

130.

The Evacuation Phase

The evacuation phase brings the gas in adsorbent column 130 that was just in the feed phase to a vacuum state. At the end of the feed phase, the adsorbent column 130 is in equilibrium with the air infeed mixture near 1 atm from column inlet 132 up to the MTZ. Hence, if the ending position of the MTZ is established, and the nitrogen, oxygen, and argon isotherms for the chosen adsorbent mass are known, then the quantity of these gases present in adsorbent column 130 at the end of each feed phase is known. Vacuum pump 144 draws a vacuum on adsorbent column 130. This vacuum level is determined and set to a state that will remove a large portion of the gas left in column 130. In one embodiment, this is 0.2 to 0.3 atm. By percentage, the vast majority of gas discharged is nitrogen. The evacuated gas is discharged as waste from exhaust 177 of vacuum pump 144. The preferred embodiment uses a fixed displacement type of vacuum pump 144. During each evacuation phase, the adsorbed gas in column 130 is expanded into a much larger volume made up of the column volume plus the fixed displacement volume of pump 144.

The evacuate phase creates a self regulating effect that compensates for reductions in the amount of nitrogen adsorbed by adsorbent column 130 as the adsorbent degrades (ages). If the adsorbent loses efficiency, less nitrogen will be present in column 130 at the end of the phase, but the volume of the pump that the nitrogen expands into remains the same. A stronger vacuum will result that will remove more nitrogen and therefore allow more air to be fed during the next feed phase. A more constant breakthrough time results and provides a more robust product cycle.

The evacuation is provided by vacuum pump 144, which is controlled and activated by drive 146. The volume removed for each cycle of the vacuum pump 144 will remain constant, but the motor drive output 200 will be controlled by the rate of product gas used by patient P. The amount of oxygen used by patient P depends on

the patient P's on-demand respiratory rate, which is sensed by the device and from a variable position switch which sends an input 192 from user interface 114 to ECM 148, which in turn provides motor drive output 200 to drive 146. This determines the speed of each successive phase and, therefore, the oxygen production rate.

In one embodiment, a purge is applied at the very end of an evacuation phase. While still in the evacuation phase, a purge of product gas (mostly oxygen) introduced through outlet 134 effectively drives out a portion of nitrogen in column 130 through inlet 132. Adding the purge gas of high purity oxygen/argon through outlet 134 desorbs more nitrogen from outlet 134 of column 130, and pushes the nitrogen toward inlet 132 of adsorbent column 130 and creates an ordering of the gases. The purge volume is a function of vacuum level and adsorbent characteristics. A purge portion of the evacuation phase is not a necessary phase for a functioning device, but allows high oxygen purity to be maintained with weaker vacuum levels.

The Repressurization Phase

The repressurization phase brings adsorbent column 130 (just previously evacuated and purged) up to the feed pressure. In one embodiment, the gas used for repressurization is from both the infeed ambient air 162 and a counter stream from the (oxygen-rich) product gas line 176 from the main reservoir 158. Alternately, the repressurization of product gas can be accomplished through valve design negating the need for a separate line. The product gas is dispensed from a stream of product gas from the adsorbent column that is in the feed phase through a vacuum break valve used during repressurization. Repressurization with product gas can be done before, simultaneously, or after partial pressurization with ambient air. Repressurization with product gas is done at the opposite end of column 130 as repressurization with ambient air 162.

The effect of adding the repressurization gas of high purity oxygen/argon through outlet 134 creates a cleaning zone at outlet 134 of adsorbent column 130 where,

during the feed phase that follows next, any stray nitrogen can be preferentially adsorbed and not discharged as product gas. This improves the ordering of gases in the adsorbent column 130. By repeating this phase during successive cycles, the purity will continue to increase in the product output. Weaker vacuums require more oxygen volume returned to column 130 during repressurization if high purity is desired. That is, a stronger vacuum must be drawn on the column 130 to effectuate the same purity of oxygen absent the use of oxygen-rich gas as a back flush for repressurization at the outlet 134 of column 130. At the end of repressurization, the feed phase will proceed.

Valve 140 Timing (FIG. 6)

The VSA cycle comprises three phases: evacuation, repressurization, and feed, which occur sequentially in each column 130a-130c. For clarity, only column 130a will be discussed, although each phase is performed (at different times during a complete cycle) in each of columns 130a-130c.

Starting with the evacuation phase of the cycle, a small amount of oxygen (not illustrated) may flow into outlet 134a of adsorption column 130a to purge adsorption column 130a, while vacuum pump 144 withdraws gas present at inlet 134a of the column, i.e. nitrogen-rich gas.

During the repressurization phase, an amount of previously separated oxygen flows into outlet 134a of adsorption column 130a for a short time, and then air is allowed to enter inlet 132a of column 130a that has been previously evacuated. There may be a slight overlap of the oxygen flow into outlet 134a of adsorption column 130a and the air flow in the opposite direction into inlet 132a. Air freely flows into inlet 132a of adsorption column 130a upon opening of valve 140 as adsorption column 130a has been previously evacuated during the evacuation phase.

During the feed phase, air continues to flow into inlet 132a of adsorption column 130a while oxygen is removed from outlet 134a of column 130a by a pressure differential created by product control pump 154. As the MTZ passes through the

adsorption column and reaches a position at or near outlet 134a, vacuum pump 144 will again begin to evacuate adsorbent column 130a and restart with the evacuation phase. In the embodiment illustrated in FIG. 6, these phases are controlled by main valve 140.

FIG. 6 is a diagram showing timing for main valve 140, which is a rotary valve that moves 360°(one full revolution about a central axis) for each complete cycle of the VSA process. In the embodiment with three columns 130a-130c, the timing for each phase of the cycle is 120°. Each column 130a-130c is present in a different phase for each 120° of rotation of valve 140 that is different from the other two columns to obtain a sequence that creates a steady flow of oxygen as valve 140 keeps rotating.

As shown in the timing diagram, adsorption column 130a is in the feed phase of the cycle at a start point of zero degrees. Air is being let in through inlet filter 136 and column inlet 132a while separated gas consisting of highly concentrated oxygen is being removed through column outlet 134a. A portion of the oxygen-rich product gas is used in the repressurization of column 130b. Adsorption column 130b is in the repressurization phase at a point of rotary valve 140 being in initial position zero degrees. As valve 140 is turned, column outlet 134b is fed with the oxygen-rich gas for a portion of the valve's rotation, preferably less than 120°. After the flow of oxygen-rich gas enters column 130b through the column outlet 134b, air repressurization through the opening of column inlet 132b begins. In the embodiment shown, this takes place at a point after valve 140 has begun its rotation and ends before it reaches a third of its rotation, or a 120° rotation.

While column 130a is in feed phase and column 130b is in the repressurization phase, column 130c is in the evacuation phase. During the evacuation phase, a vacuum is drawn to remove adsorbed gas through inlet 132c, thereby regenerating it for the following feed phase.

In the embodiment shown, each column 130a, 130b, and 130c, is in a different phase of the cycle as one moves vertically down the diagram in FIG. 6. During

the first one hundred twenty degrees of rotation of the rotary valve, column 130a is in the feed phase. Simultaneously, from zero to one hundred twenty degrees of rotation, column 130b is being repressurized, while column 130c is being evacuated.

For the next one hundred twenty degrees of rotation of valve 140 (i.e., from 120° to 240°), adsorption column 130a is in the evacuation phase. At this same time, column 130b is in the feed phase, and column 130c is in the repressurization phase.

Moving horizontally across the diagram for column 130a, during the final one hundred twenty degrees of rotation of valve 140 (i.e., from 240° to 360°), column 130a is repressurized first using separated gas, and then ambient air. Separated gas and ambient air are introduced to the column 130a through column inlet 132a and column outlet 174a at opposite ends of column 130a. During the final one hundred twenty degrees of rotation (i.e. from 240° to 360°) of main valve 140, column 130b is in the evacuation phase, and column 130c is in the feed phase. Upon reaching three hundred sixty degrees, valve 140 is back at its starting position (zero degrees), and the cycles for each column 130a-130c restart from the zero degree position.

Oxygen Concentrator 100 Physical Components (FIGS. 7-16)

FIG. 7 shows an exploded view of the oxygen concentrator 100, which includes belt 104, power module 106 containing removable power pack 108, reservoir module 110, control module 112, and separation cartridge module 116 containing adsorbent cartridge 206. Power pack 108 has been removed from receptacle 210 of power module 106. Adsorbent cartridge 206 has been removed from receptacle 208 of cartridge module 116. Adsorbent cartridge 206 and power pack 108 are easily removable to facilitate replacement.

In this embodiment, power pack 108 is a rechargeable battery. Receptacle 210 contains electrical contacts (not illustrated) for connection to power pack 108. Cartridge 206 contains a quick-connect attachment (not illustrated) for inlet lines 164a-164c, outlet lines 166a-166c, inlet air line 168, and final product gas line 205

(not illustrated) within receptacle 208. Also present on cartridge 206 are air inlet ports 135 which receive ambient air 162 for separation. Adsorbent cartridge 206 contains adsorbent material that deteriorates in efficiency as it is used and ages.

FIG. 8 is a perspective view of oxygen concentrator 100. A portion of belt 104 has been removed revealing back interior surface 211 and inner connections amongst the modules, including utility tubes 212, tube pathways 214, module apertures 216a-216d, and module sockets 218a-218d.

Utility tubes 212 run between the adjacent modules and contain either electrical wiring or pneumatic lines, or comprise pneumatic lines and electrical wiring and associated connections. Tubes 212 are constructed to be flexible and bend as belt 104 is manipulated. If the tubes 212 contain electrical lines, the tubes are constructed from a dielectric material to insulate electrical wires, or similar material commonly used in electrical connections. If the tubes 212 comprise pneumatic lines, they may be air tight, small diameter polyvinyl or PVC tubes to connect the various gas input, gas separation, and gas removal systems of the oxygen concentrator 100. Tubes 212 contain openings or connections as required for electrical and pneumatic communication with each module. The back interior surface 211 of belt 104 contains tube pathways 214. Pathways 214 fabricated on the interior surface 211 of belt 104 allow the utility tubes 212 to extend between the modules 106, 110, 112, and 116. Tube pathways 214 create a semi-partitioned area on back interior surface 211 of belt 104 which support tubes 212.

Belt 104 is fabricated to contain apertures 216a-216d which allow modules 106, 110, 112, and 116 to connect utility tubes 212 of belt 104 through sockets 218a-218d. Apertures 216a-216d and sockets 218a-218d are fabricated as part of modules 106, 110, 112, and 116. Serrations 118 can be seen between the upper and lower edges 220 and 222 of belt 104. When fabrication of belt 104 is completed, padding will be inserted between edges 220 and 222, and material will be wrapped around creating serrations 118 and belt segments 120 to complete belt 104 as illustrated

in FIG. 3. The padding is fabricated over the top of tubes 212 and tube pathways 214, or separately fabricated and fastened to back interior surface 211 during assembly of belt 104. Individual modules allow the device to flex when mounted about a curved surface, such as a belt around patient P's waist. The construction of belt 104 with tubes 212 allows patient P to manipulate the oxygen concentrator 100, such as by bending belt 104 to wear around the waist, place on docking station 122, or folding concentrator 100 in half for transport in a carryall.

FIG. 9 is a perspective view of modules 106, 110, 112, and 116 of oxygen concentrator 100. In this view, belt 104 has been removed to illustrate the positions of sockets 218a-218d containing apertures 216a-216d on each respective module 106, 110, 112, and 116. Each respective module 106, 110, 112, and 116 is constructed from a thermoplastic material such as acrylanitrile butadine styrene (ABS) or high density polyethylene (HDPE), or a lightweight metal or a similar rigid material that is oxidation resistant.

Each module 106, 110, 112, and 116, comprises a case portion 224, 226, 228, and 230, defining the outer volume of each respectively. Bottom padding 232, 234, 236, and 238, covers the lower base portion of each module 106, 110, 112, and 116, respectively. Similarly, top padding 240 extends around the top perimeter of power module 106, while top padding 242 and 244 covers the top portions of modules 110 and 112. Power pack top padding 246 covers the top portion of power pack 108 and cartridge top padding 248 covers the top of separation cartridge 206. Padding 222-248 is a foam or similar lightweight material that adds protection to the modules as well as acts to reduce vibration of oxygen concentrator 100 felt by patient P. Alternately, oxygen concentrator 100 is enclosed in soft, flexible material to further increase comfort and maintain flexibility. In one embodiment, padding 232-248 is fabricated separately from the modules 106, 110, 112, and 116, power pack 108 and cartridge 206. In assembling the oxygen concentrator 100, padding 232-248 and case portions 224, 226,

228, and 230, are merged and secured either using fasteners, adhesives, or a manufacturing process such as ultrasonic welding.

Case portions 224, 226, 228, and 230, of each of the modules 106, 110, 112, and 116, contain sockets 218a-218d fabricated on the surface that contacts belt 104. Socket 218a-218d for each module is constructed to have support paths 250 for electrical wiring and pneumatic tubing similar to those contained within belt 104 represented by tube pathways 214. Sockets 218a-218d are constructed so that support paths 250 on sockets 218a-218d align with tube pathways 214 in belt 104 when each individual module 106, 110 ,112, and 116, is connected to belt 104. In one embodiment, sockets 218a-218d are constructed to allow each individual module 106, 110, 112, and 116, to snap onto belt 104 or attach in a similar quick connect fashion. Utility tubes 212 comprise quick connects at module apertures 216a-216d. Apertures 216a-216d are openings in the case portions 224, 226, 228, and 230, provided for connection of utility tubes 212 to components contained within each module 106, 110, 112, and 116. This allows for removal of a single module 106, 110, 112, or 116 should a specific component require maintenance or replacement. Sockets 218a-218d are constructed from the same material as the case portions 224, 226, 228, and 230.

FIG. 10 is a perspective view of the components contained within modules 106, 110, 112, and 116, and the associated pneumatic and electrical connections of oxygen concentrator 100. Illustrated are power pack 108, valve 140, drive reducer 142, vacuum pump 144, drive 146, oxygen accumulator 252 (comprising product control pump 154, check valves 153 and 156, and reservoir 158), dispensing valve 160 connected to nasal pressure sensor line 190 and dispensing valve open line 198, column inlet lines 164a-164c, column outlet lines 166a-166c, product control pump vacuum line 172, product control pump inlet line 174, product gas line 202, final product gas line 205, adsorbent cartridge 206, and main electrical cable 254.

Main electrical cable 254 contains a set of electrical wires that carry

inputs 178, 180, 182, 188, and 190, outputs 192 and 198, and power lines 186, 198, and 200 shown in FIG. 5. Main electrical cable 254 extends from power pack 108 to ECM 148 (not visible in FIG. 10). Dispensing valve time open output 198 and nasal pressure sensor input 190 are wires that extend between ECM 148 and dispensing valve 160. Similarly, the other inputs and outputs are wired to the appropriate system components as illustrated in FIG 5 (although not specifically illustrated in FIG 10.)

Product gas line 202 connects dispensing valve 160 with reservoir 158 of accumulator 252. Final product gas line 205 connects dispensing valve 160 to product gas outlet port 103 for connection to delivery tube 102 after passing through final filter 136 located in adsorbent cartridge 206 to provide patient P with oxygen rich product gas. Product control pump inlet line 174 extends from main valve 140 to product control pump154, which pumps separated oxygen rich gas into reservoir 158. Vacuum line 172 connects product control pump 154 through valve 140 to a vacuum drawn by vacuum pump 144, and provides the actuation for product control pump 154. Column inlet lines 164a-164c and column outlet lines 166a-166c connect main valve 140 with column inlet ports 132a-132c and column outlet ports 134a-134c of columns 130a-130c, respectively (not illustrated). Inlet air line 168 transports ambient air 162 from separation cartridge 206 to main valve 140, while vacuum inlet line 170 connects vacuum pump 144 to main valve 140. All lines 164a-164c, 166a-166c, 168, 170, 172, 174, 176, 202, and 205, are pneumatic lines or similar structures that allow for the isolated flow of gases between system components.

FIG. 11 is a perspective view of the components contained within power module 106: power pack 108 (comprising cells 256, outer wall 258, and power pack life indicator 260) and dispensing valve 160. In the embodiment illustrated, power pack 108 is a lithium-ion battery pack comprised of five cells 256. Individual cells 256 are contained within outer wall 258, part of which has been removed to show cell 256. Power pack 108 is a battery that is rechargeable and removable from power module

106. Although illustrated as a trapezoid containing five cylindrical cells, the shape and number of cells will vary depending on the shape of power module 106 and power requirements of oxygen concentrator 100.

Power pack 108 is a lithium based battery pack capable of being recharged in a recharging socket or station that connects to an external power supply. Alternatively, power pack 108 comprises a battery or fuel cell. In one embodiment, power pack 108 is a lithium ion battery pack that is constructed from several interconnected lithium-ion batteries. Oxygen concentrator 100 uses a maximum of fifteen watts of power. This results in a battery weight of less than 0.7 pounds (0.3 kg). In this embodiment, patient P taking twenty breaths per minute at a setting of 2 liters per minute equivalent can use oxygen concentrator 100 for a minimum of four hours on a fully charged battery. Power pack 108 is easily exchanged with another similar battery pack, and can be removed with a simple pulling or tugging motion. In another embodiment (not illustrated), oxygen concentrator 100 contains a jack for receiving a power cord which can then be plugged into either a 110 volt wall outlet or a 12 volt power supply system (such as a car utility plug) so that power pack 108 can be charged in place in oxygen concentrator 100.

Power pack life indicator 260 displays the amount of time left that the power pack will operate the oxygen concentrator 100. As illustrated, power pack life indicator 260 is a display, such as a liquid-crystal display (LCD) or light emitting diode (LED) screen, with numeric output of expected life in hours. The LCD or LED screen may also contain a series of bars that act as indicators. Alternately, power pack life indicator 260 is a light or series of lights.

Dispensing valve 160 is contained within power module 106 and is used to feed the flow of oxygen to patient P. Dispensing valve 160 is a valve activated by a change in pressure, such as that caused when a person is inhaling. A sensor in the dispensing valve circuit monitors pressure, and opens dispensing valve 160 when a drop

in pressure is sensed. ECM 148 communicates with dispensing valve 160 through input 190 and output 198 (see FIG. 5). Dispensing valve 160 is in communication with reservoir 158 through product gas line 202. Reservoir 158 is kept at a slight pressure above ambient. Thus, when dispensing valve 160 is opened, oxygen rich gas will flow from reservoir 158 through final product gas line 205, final product filter 138, and product gas outlet port 103 for delivery to patient P through tubing 102. The flow of gas is further assisted by the pressure drop created by patient P's inhaling. Dispensing valve 160 can be set to deliver oxygen rich gas to patient P for the beginning portion of a breath when patient P first inhales rather than the whole breath.

Dispensing valve 160 provides for operating oxygen concentrator 100 in one of two possible modes: pulse flow or continuous flow. When patient P is using the oxygen concentrator 100 in the pulse flow mode, dispensing valve 160 will open intermittently in response to inhalation and will stay open for a pulse time according to the setting of the controls as set by patient P. If continuous flow is desired, dispensing valve 160 is maintained at an open or partially opened state. The product is dispensed to patient P though oxygen delivery tube 102 at a continuous rate, typically in the range of 1-1.5 lpm (liters per minute). The pressure difference corresponding to a dispensing orifice in delivery tube 102 will accommodate the flow rate from the reservoir 158.

FIGS. 12a-12d are various views of components contained inside of reservoir module 110. FIG. 12a is a perspective view of accumulator 252. FIG. 12b is a top view of accumulator 12b. FIGS. 12c and 12d are sectional views corresponding to the section lines in 12b. Contained within reservoir module 110 is oxygen accumulator 252 (comprising reservoir 158, check valves 153 and 156, and product control pump 154), inlet port 261, and outlet port 263. Accumulator 252 receives separated product gas through inlet port 261. Product inlet line 174 (shown in FIG. 10) is connected to inlet port 261 and links product control pump 154 to separation cartridge 206 through main valve 140 to transport oxygen rich gas separated by cartridge 206. Inlet port 261

connects to check valve 153 which allows product gas into product control pump 154.

Product control pump 154 includes piston 262, actuated by spring 264 within pump chamber 265, which pushes separated oxygen-rich product gas into reservoir 158. Check valve 156 opens to allow oxygen into the reservoir 158 and closes to prevent back flow of oxygen-rich gas when the desired pressure in reservoir 158 is attained. The low pressure of reservoir 158 exerts a force on check valve 156 to keep valve 156 closed. Reservoir 158 takes oxygen-rich gas produced by oxygen concentrator 100 and stores it at a low pressure above ambient until the product is required for use by patient P.

Product control pump 154 is driven by vacuum. Product control pump vacuum line 174 is connected to the vacuum drawn by vacuum pump 144 through main valve 140. When a vacuum is drawn, the force draws piston 262 down to compress spring 264 which expands pump chamber 265, and causes check valve 153 to open. Oxygen-rich gas from separation cartridge 206 flows through check valve 153 and enters pump chamber 265 in the volume created by the displacement of piston 262. At the appropriate time in the cycle, valve 140 will interrupt the vacuum to product control pump 154, and spring 264 will force piston 262 upwards. The movement of piston 262 will force oxygen rich gas in pump chamber 265 through check valve 156 and into reservoir 158. At the same time, check valve 153 closes to prevent more gas from entering pump 154. With this embodiment, no additional drive (other than the vacuum to pull piston 262 down and the spring force to move it up) is required for product control pump 154 which adds to the overall efficiency of the system.

In one embodiment, reservoir 158 has a capacity that is about four times larger than the size of the largest pulse provided by oxygen concentrator 100. In one embodiment, extra volume is included to account for separated oxygen used as a back flow in adsorbent columns 130a-130c. Specifically, main storage reservoir 158 for oxygen concentrator 100 can be designed according to the flow rates listed in Table 1.

Storage reservoir 158 is 100cc (cubic centimeters) to 400cc in volume. Main storage reservoir 158 is maintained at a low pressure to provide delivery of the product gas to patient P through outlet 263 which is connected to final product dispensing line 202. In one embodiment, the pressure is between 1 atm (ambient) and 1.5 atm. Also acceptable are pressures less than eight psi (55,158 Pa), with a pressure of two and one half to five psi (17,236 to 34,473 Pa) preferred. The low pressure of reservoir 158 allows oxygen concentrator 100 to be used in most areas where high pressure oxygen is banned. Also, low pressure requires less energy to fill reservoir 158, which adds to the efficiency of the system by requiring a simpler pressurizing mechanism compared to high pressure systems.

Reservoir 158 contains pressure sensor 159 (such as a piezoresistive or capacitive sensor) that sends reservoir pressure signal 188 to ECM 148 (see FIG. 5). ECM 148 adjusts the speed of the motor of drive 146 based on reservoir pressure signal 188 in combination with the current settings on user interface 114. As patient P's respiratory rate increases for the current setting, more oxygen-rich gas from reservoir 158 is dispensed thus lowering the pressure of reservoir 158. The drop in pressure is sensed and the system will react by increasing the production of product gas. Similarly, a decrease in the respiratory rate of patient P at the current setting of oxygen concentrator 100 raises the pressure in reservoir 158. The rise in pressure is sensed and ECM 148 adjusts drive 146 accordingly to maintain a preset pressure range in reservoir 158. Thus, only the amount of oxygen used by patient P is produced by oxygen concentrator 100.

FIG. 13 is a perspective view of the control module 112. Illustrated are the case 228 containing aperture 216c and socket 218c, and padding 236 and 234. Control module 112 contains user interface 114 comprising power switch 266, flow level indicator lights 268, flow setting switches 270a and 270b, boost switch 272, and indicator lights 274 and 276. Power switch 266 is an ordinary toggle or push button

switch capable of turning oxygen concentrator 100 on and off.

Flow settings are dually controlled by patient P utilizing flow setting switches 270. First, continuous or pulse mode is selected by patient P. In a continuous flow mode, oxygen is dispensed at a continuous flow rate such as one to one and a half liters per minute. If oxygen concentrator 100 is set in a pulse mode for controlling flow, oxygen concentrator 100 utilizes dispensing valve 160 to provide pulse dispensing of product gas. The pulse mode is set to meet patient P's needs for the equivalent of one to five liters per minute of continuous oxygen flow. In one embodiment, a dial containing settings of one to five is utilized. In the embodiment illustrated in FIG. 13, flow setting switches are used to adjust the flow rate between various stepped levels. Each setting corresponds to the specific value for continuous flow, or a corresponding pulse volume. For example, settings for a pulse mode are contained in the table below.

TABLE 1

Setting	Total Volume Pulse Range (cc/pulse)	Trigger Time (sec)	Pulse Flow Ramp Rate (sec)	Pulse Duration Max (sec)	Peak Pulse Flow (LPM)
1	10 to 12	.001 to .02	.03 to .07	.15	14
2	20 to 24	.001to .02	.03 to .07	.20	14
3	30 to 36	.001 to .02	.03 to .07	.25	15
4	40 to 48	.001 to .02	.03 to .07	.30	16
5	50 to 60	.001 to .02	.03 to .07	.35	17

When the unit is set in pulse mode, product gas is dispensed only at the beginning of inhalation. In one embodiment, product dispensing valve 160 is only opened between zero and 0.4 seconds of the beginning of a breath of patient P. This controls the amount of oxygen removed from reservoir 158. In another embodiment, oxygen concentrator 100 is shut off if no pressure drop is sensed by nasal pressure sensor 190 for a set amount of time, such as two minutes, which in turn closes dispensing valve 160.

Patient P can temporarily increase (or "boost") the flow rate of oxygen by actuating boost control switch 272 on user interface 114. When boost switch 272 is activated, oxygen concentrator 100 increases the flow rate of oxygen for a set period of time, such as 10 minutes. After timing out, oxygen concentrator 100 returns to the previous setting. The boost function will not work if oxygen concentrator 100 is already operating at the maximum flow rate.

Indicator light 274 indicates power pack 108 is running low. Indicator light 276 indicates that there is a problem with separation cartridge 206, such as a bad connection with receptacle 208. In one embodiment, oxygen concentrator 100 contains three different colored lights: red, yellow, and green. The green light indicates that there are no problems detected with oxygen concentrator 100. A yellow flashing light or a yellow non-flashing light indicates a condition has been sensed that should be addressed. An example of such a condition is a low battery. A red flashing light indicates that a condition has been detected that requires an immediate response. A red non-flashing light indicates that oxygen concentrator 100 has failed, and has shut down. For example, if oxygen concentrator 100 fails to produce a stream of separated gas of eighty-five percent oxygen, oxygen concentrator 100 will detect this problem via breakthrough flow sensor 150. ECM 148 shuts off main valve 140 so no ambient air 162 is being submitted to the gas separation cartridge 206. Product gas is no longer being supplied to reservoir 158. After a few breaths, reservoir 158 will empty, triggering reservoir pressure sensor output 188 (shown in FIG. 5), which communicates to ECM 148 to shut down oxygen concentrator 100, and display the red warning light. This signals patient P that maintenance is needed. In addition to the aforementioned indicator lights, the unit may also contain a boost indicator light to indicate when a boost function is in operation. Similarly, an audible alarm may be included in oxygen concentrator 100 to indicate failure.

FIG. 14 is a front view of the interior components of control module

112. Illustrated are drive 146, vacuum pump 144, drive speed reducer 142, and valve 140. Drive 146 includes a DC motor, driven by battery power pack 108, which supplies the necessary power to operate vacuum pump 144. The motor draws a maximum of 15 watts of power. Vacuum pump 144 is a positive displacement pump. In this embodiment, drive 146 runs both vacuum pump 144 and valve 140. Vacuum pump 144 is run by the motor at one speed, while valve 140 is run off the same motor but at a reduced speed. The reduction in speed is accomplished with gears that comprise drive speed reducer 142 between the motor of drive 146 and valve 140.

Valve 140 is a valve containing a minimum number of ports equal to two times the number of adsorbent beds (columns) in separation cartridge 206. Additionally, main valve 140 contains other ports for the inlet of ambient air 162, vacuum provided by vacuum pump 144, and recycling of product gas used to purge columns 130a-130c during repressurization. In the preferred embodiment, valve 140 is a rotary valve, but may also be a solenoid valve, directional control valve, or series of individual valves in communication with each other and each connected to an adsorbent column 130a-130c.

In an alternate embodiment, drive 146 may contain an independent motor for operating valve 140. If valve 140 is run by an independent motor, that motor is powered by power pack 108 and synchronized with the other motor(s) of drive 146 by ECM 148. As illustrated, drive 146 contains a single motor and valve 140 is connected to a system of gears that comprise drive speed reducer 142. Alternately, drive speed reducer 142 can be any common power transmission components such as pulley and belts, or gears and sprockets.

FIG. 15 is a perspective view of separation cartridge 206 contained within separation cartridge module 116. Illustrated are inlet ports 132a-132c, outlet ports 134a-134c, and casing 230. In the embodiment illustrated, three adsorption columns are contained within casing 230 with one inlet port 132a-132c, and one outlet

port 134a-134c, for each adsorption column 130a-130c. Each adsorption column 130a-130c is a hermetically sealed container containing a bed of adsorption material, preferably a zeolite capable of adsorbing nitrogen gas, such as lithium low silica 13X zeolite. Each bed contains between five and twenty-five cubic centimeters of material, and in one embodiment contains fifteen (plus or minus one) cubic centimeters of material. The adsorbent bead size is a thirty by sixty mesh, wherein thirty mesh is equal to 0.0234 inches (0.0594 cm) and sixty mesh is equal to 0.01 inches (0.0254 cm).

Column inlet ports 132a-134c are connected to receive either ambient air 162 or vacuum, while outlet ports 134a-134c expel product gas or receive purge gas. This arrangement promotes ordering of gases within the columns 130a-130c by having oxygen rich gas always present at one end of the column. This results in improved efficiency as air flow through the columns 130a-130c creates an oxygen rich zone continuously at one end, which allows the vacuum to evacuate and desorb the previously adsorbed nitrogen where it is contained in the greatest concentration.

FIG. 16 is a perspective view of the columns 130a-130c and the filters 136 and 138 within casing 230 of separation cartridge 206. Illustrated are final product filter 138 connected to product gas outlet port 103 which connects to tubing 102, inlet air filter 136, and adsorbent columns 130a-130c each comprising spin inducers 280a-280f, adsorbent material 282a-282c, porous filters 284a-284f, and springs 286a-286c. Springs 286a-286c are coil springs that hold each adsorbent column in compression 130a-130c in place within casing 230 of separation cartridge 206 to prevent movement of adsorbent beads. Spin inducers 280a-280f help force even distribution of gases through columns 130a-130c, which helps to keep the MTZ well defined for more accurate detection.

Adsorbent material 282a-282c is the same as that previously described. Filters 136 and 138 are constructed of common filtering materials and are used to remove dust and other large particulate matter from the air streams to assure that the flow

of oxygen out to patient P is free of such materials. Porous filters 284a-284f are a small section of material commonly used as a particle filter provided at each end of columns 130a-130c. Porous filters 284a-284f act to prevent adsorbent particles from contacting the mechanisms and valving of concentrator 100.

Docking station 122 (FIGS. 17-18)

FIG. 17 is a perspective view of the back side of oxygen concentrator 100 on docking station 122. Illustrated are oxygen concentrator 100 comprising power module 106, reservoir module 110, control module 112, and separation cartridge module 116, belt 104, and docking station 122 containing status display 288. Status display 288 is an LED, LCD, or similar digital display used to provide information to patient P such as time of day, time the concentrator has been used, time of recharging for power pack 108, or similar information. Additionally, docking station 122 may contain other controls (not illustrated) including a boost setting while the concentrator is docked, a mode switch for switching between pulse and continuous flow of oxygen, and indicator lights to show expected battery life, adsorbent column life, gas input, gas output, or gas separation system malfunctions, or other similar items that were previously described as part of user interface 114.

FIG. 18 is a perspective view of the docking station 122 with oxygen concentrator 100 removed. Concentrator dock 126 is visible on docking station 122 with oxygen concentrator 100 removed. Concentrator dock 126 may optionally contain electrical connections (not illustrated) to charge power pack 108 contained within power module 106 while oxygen concentrator 100 is docked. Additionally, docking station 122 contains a power cord (not illustrated) available to connect to a wall socket or other power source such as a car utility plug. Docking station 122 uses power provided through the power cord to operate oxygen concentrator 100 and/or recharge power packs 108. Docking station 122 contains a flat bottom 290 to rest on a level surface and allow oxygen concentrator 100 to be in the docking station without moving. Alternately,

docking station 122 is mountable to a wall in one embodiment, and is a free standing device that is set on a generally flat surface in another embodiment.

In one embodiment, docking station 122 comprises indicator lights and control power switch (not illustrated) in addition to status display 288, power pack chargers 124a and 124b, and concentrator dock 126. Indicator lights provide information to patient P utilizing oxygen concentrator 100. Indicator lights will indicate if oxygen concentrator 100 is functioning properly, requires maintenance, or has failed. Control switch is a master switch for supplying or terminating power or controlling the setting of flow for oxygen concentrator 100. Status display 128 is an LED, LCD or similar digital display that can be used to indicate various information to patient P such as time of day, time oxygen concentrator 100 has been docked, time of recharging for the power pack, or similar information.

Docking station 122 also contains power pack chargers 124a and 124b and concentrator dock 126. Docking station 122 contains a power cord (not illustrated) available to plug into a wall socket or a similar power pack. Docking station 122 converts AC power to recharge power pack 108 in power pack chargers 124a and 124b. Power pack chargers 124a and 124b contain contacts that are used to transfer power to power pack 108 while recharging. Alternatively, a power pack 108 placed in charger 124a or 124b is inductively coupled to recharge the power pack 108. Similarly, power is provided to oxygen concentrator 100 itself while on docking station 122, and to recharge of the power pack 108 (see FIG. 4) still attached to the oxygen concentrator 100. Concentrator dock 126 is shaped to provide a place to set oxygen concentrator 100 while docked, as well as facilitate easy removal of oxygen concentrator 100 for ambulatory use.

In one embodiment, docking station 122 performs several functions with oxygen concentrator 100 docked. First, oxygen concentrator 100 is allowed to run without utilizing power pack 108 while it is docked. Second, a boost setting is available

to increase the delivery rate of oxygen while oxygen concentrator 100 is docked. Boost switch 272 is located on user interface 114 (See FIG. 13). In an alternate embodiment, a boost switch is located on docking station 122. Upon removal of oxygen concentrator 100 from docking station 122, the boost setting is removed and oxygen concentrator 100 operates at a set delivery rate in either a continuous or pulse mode.

Oxygen concentrator 100 contains flow setting switch 270 (FIG. 13), and a mode switch (not illustrated). The mode switch allows patient P to select continuous or pulse flow. In one embodiment, patient P is allowed to adjust the setting of oxygen concentrator 100 only while docked. That is, patient P can reprogram by changing a pulse setting (e.g., from 2 to 3), or continuous flow mode (e.g., from 1.0 to 1.5 liters per minute), only while oxygen concentrator 100 is on docking station 122. Patient P wishing to adjust settings will be required to hold the control switch while adjusting the flow setting dial or mode switch. In another embodiment, docking station 122 contains a switch automatically activated by placing oxygen concentrator 100 in docking station 122 which allows patient P to adjust flow setting. The requirement that settings can only be changed during docking prevents accidental switching of the flow mode of oxygen concentrator 100 during ambulatory use. For example, there is no change in flow if flow setting switch 130 is bumped, which would normally increase oxygen flow. If oxygen concentrator 100 can only be reprogrammed in docking station 122, oxygen concentrator 100 will remain in the preset mode set at docking station 122 and will not increase or decrease flow by a change of the setting. In one embodiment, the flow setting switch and mode switch are located on a user interface located directly on docking station 122.

Another function of docking station 122 is to provide diagnostic features of the system. Docking station 122 may indicate expected battery life, adsorbent column life, or pump malfunctions through the use of indicator lights, or status display 128, or a combination of both. Alternatively, these items are located on user interface 114, or at

a combination of locations of user interface 114 and docking station 122. For example, battery life indicator 142 is located directly on power pack 108 that comprises the battery itself, and battery problem warning light 274 is on user interface 114 also. Similarly, adsorbent cartridge warning light 276 is located on user interface 114, but may also be on either the cartridge module 116 or docking station 122 as well.

Concentrator Efficiency

Oxygen concentrator 100 can produce a stream of product gas containing a range of 85-95 percent oxygen which provides up to 5 liters per minute pulsed equivalent of product gas. By utilizing vacuum swing adsorption, the separation process phases are all performed at less than 1 atm.

Utilizing a vacuum to exhaust unwanted gas from adsorbent columns 130a-130c improves efficiency of the oxygen concentrator 100. Less power is required than pressure swing adsorption (PSA) or vacuum-pressure swing adsorption (VPSA), which results in a smaller battery and thus a lighter weight product. Oxygen concentrator 100 as disclosed weighs less than 3 pounds (1.4kg) and occupies less than 1 liter of volume. Also, the efficiency of the system allows for oxygen concentrator 100 to operate for at least three hours while producing up to 5 liters per minute pulsed equivalent of product gas without requiring patient P to attend to the unit, e.g. changing the battery. Further, the low energy consumption causes less heat transfer. The product gas is discharged from the separation system at a temperature of $\pm$ six degrees Celsius from that of the ambient air. This eliminates the need for heat exchangers which add to the overall weight and reduces system efficiency. The amount of heat generated causes no discomfort to patient P wearing and utilizing the oxygen concentrator 100. Also, upon starting oxygen concentrator 100, the flow of product gas will increase from 21 percent oxygen (ambient) to 85 percent or more oxygen in under two minutes.

Improvements over the prior art are attained by regulating the device to only separate the amount of oxygen needed by patient P at any given time. The prior art

separates a flow of oxygen and delivers that rate to patient P as a steady flow. Patient P is only inhaling this oxygen during about 1/3 of the normal breathing cycle. Within the inhalation portion of the breathing cycle, the volume of gas inhaled last stays in the dead space of the airways and is not presented to the alveoli. Therefore if oxygen is dispensed to patient P only during the early part of inhalation, less than 1/3 the steady flow is actually required. Moreover, prior art devices do not adjust the flow based on a patient P's needs, but operate at the same steady flow. The present concentrator slows down its entire cycle rate producing only the amount of oxygen needed. Thus, oxygen concentrator 100 retains a high oxygen recovery percentage at all product flow rates while minimizing energy consumption and maximizing adsorbent life. Patient P's actual needs vary with real time changes in activity. This causes a corresponding variation in breathing rate. Oxygen concentrator 100 tracks patient P's breathing rate and adjusts oxygen separation and delivery rates proportionally. In combination, these two features allow oxygen concentrator 100 to separate oxygen only at the rate it is being consumed, resulting in a reduction in the amount of oxygen needing to be separated for patient P.

Another improvement over the prior art involves reducing the waste of separated oxygen in the various adsorb and desorb cycle phases. This is typically referred to as maximizing product recovery. The primary system components become larger or smaller as the amount of oxygen separated increases or decreases. Therefore, a dramatic reduction in size and weight of the concentrator requires use of as much separated oxygen as possible by delivering it to patient P rather than losing it to the waste stream. The prior art works by using the Skarstrom cycle well known to those skilled in the art.

During one phase of the Skarstrom cycle in PSA or VPSA, air is pumped into one end of a column of adsorbent pressurizing it above atmospheric pressure while oxygen is flowing out of the opposing end. Nitrogen is being adsorbed as the MTZ propagates toward the oxygen outlet end of the column. This phase is

terminated before the MTZ breaks through into the oxygen stream so that oxygen purity is not diluted by the nitrogen rich air trailing the MTZ. If it is terminated earlier than necessary to maintain purity there will be substantial separated oxygen left in the column in front of the MTZ that is not passed to the patient. During the next cycle phase the column pressure is reduced to a lower cycle pressure desorbing the nitrogen that was adsorbed during the separation phase and it is passed to the waste stream. Some of the oxygen left in the column at higher pressure will also be passed to the waste stream as gas flows from the column when pressure is reduced. Recovery of separated oxygen can therefore be maximized by stopping the previous separation phase just short of breakthrough, leaving minimal oxygen in the column to be lost to the waste stream during the reduced pressure evacuation phase. The position of the MTZ needs to be accurately known to terminate the separation phase for optimal recovery without compromising purity. This position cannot be accurately estimated because its propagation rate is a function of many variables including product oxygen flow rate, high and low cycle pressures, temperature, adsorbent water content and the amount of other contaminants accumulated in the adsorbent. Prior art systems stop the separation phase well short of breakthrough to encompass worst case operating conditions without sacrificing purity and thereby waste separated oxygen in the evacuation phases during most typical non-worst case operating conditions.

Oxygen concentrator 100 determines the position of the MTZ just prior to breakthrough and terminates the flow from outlet 134 for the remainder of the feed phase or adjusts the motor speed, as previously described. Additional oxygen is left in the column at the end of a feed phase and is wasted during the evacuation phases. This is oxygen adsorbed by the adsorbent combined with oxygen present in the interstitial and dead spaces of the adsorbent and column. All adsorbents used in oxygen separators adsorb nitrogen, and also oxygen to some extent. The adsorbent used in oxygen concentrator 100 presents a very high ratio of adsorbed nitrogen to adsorbed oxygen.

As the amount of oxygen adsorbed is minimized through the choice of an adsorbent with a low affinity for oxygen, the amount of adsorbent needed to separate a given amount of nitrogen during a separation phase will decrease as its affinity for nitrogen increases. The less adsorbent needed to adsorb a given amount of nitrogen, the less adsorbent there is to adsorb oxygen and the smaller the column can be with less interstitial and dead space.

For example, a LiLSX adsorbent referred to as Oxysiv MDX from UOP Corporation has a very high ratio of adsorbed nitrogen to adsorbed oxygen in the operating pressure range of oxygen concentrator 100 . The Skarstrom cycle of the prior art uses a purge phase in which separated oxygen is fed back into the product end of the column while nitrogen rich gas is passing out of the opposing end of the column into the waste stream as the pressure transitions to the lower cycle pressure. While this purge can enhance product purity, some of the purge oxygen passes all the way through the column and is lost to the waste stream. Oxygen concentrator 100 using VSA achieves a measured 60% oxygen recovery rate, compared to a typical recovery rate of 30% for the prior art utilizing PSA.

Another improvement over the prior art concerns the choice of adsorbent and operating pressure range. The energy required by the separation process directly defines the weight and size of major components such as the battery, motor and gas pump of a concentrator. Minimizing the amount of adsorbent minimizes the amount of energy needed to separate a given amount of oxygen. Each adsorbent has a characteristic pair of isotherms that show the amount of oxygen and nitrogen a given mass of adsorbent will hold at equilibrium over a range of pressures and vacuums for these gasses at a constant temperature. The cycle phases of the system necessarily include the pumping of gas contained in volumes of adsorbent to produce a change in nitrogen partial pressure between a chosen higher pressure and a chosen lower pressure. The pneumatic energy a pump must deliver in the process of cycling a given volume of gas between a higher and a lower level is in direct proportion to the volume of gas

pumped multiplied by the difference between the high and low vacuum levels. The isotherms for various adsorbent candidates specify the amount of nitrogen contained in a fixed mass of adsorbent at a fixed temperature as a function of nitrogen partial pressure.

An example of the isotherm for the LiLSX adsorbent Oxysiv MDX along with the isotherm for a typical 13X type adsorbent used in the prior art is shown in FIG 19. Having minimized the amount of oxygen needed to be separated from air and having maximized the recovery percent of oxygen as previously disclosed, along with knowing the percentage of oxygen present in air prescribes a specific minimum amount of air that must be moved into the system to produce the needed oxygen. This minimum amount of air minus the maximized separated oxygen must pass out of the system as a minimized volume of waste gas. Oxygen concentrator 100 acts to minimize the flow rates of the air feed stream and the waste stream. This flow must be pumped across a pressure difference defined by the choice of high and low operating pressures requiring a pumping energy that is proportional to both the flow rate and the pressure difference. The gas streams are pumped into or out of the adsorbent during each complete cycle to produce the needed swing in pressure between high and low cycle pressure levels allowing the separation of nitrogen from oxygen. Minimizing the amount of gas being pumped through the system reduces the pumping energy in proportion to reductions in the difference between chosen high and low pressure points that the gas must be pumped across. The isotherm for nitrogen shows that nitrogen is transferred in or out of the adsorbent with the smallest change in pressure where the slope of the isotherm is the steepest. Using typical PSA, a ratio of high to low pressure levels in these systems needs to be 3:1 or greater to maintain the desired oxygen purity. Lower pressure ranges, i.e. sub-atmospheric or vacuum ranges used in VSA, allow this ratio to be maintained with less total difference between the high and low pressure levels.

For example, prior art operates between 1 and 3 atmospheres for a 3:1

ratio and a pressure difference between high and low levels of 2 atmospheres. Oxygen concentrator 100 using VSA operates between 0.3 atmospheres and 1 atmosphere. A ratio of about 3.3:1 is achieved with a pressure difference of only 0.7 atmospheres. Operating on this range of the isotherm as seen in FIG. 19 allows just as much nitrogen to be passed in and out of the LiLSX adsorbent with a 0.7 atmosphere pressure range as a PSA system does with 13X adsorbent and a 2.0 atmosphere pressure range. The LiLSX adsorbent allows a cycle pressure range that is nearly 1/3 that of a PSA system with a proportional reduction in pumping energy.

Oxygen concentrator 100 is a quiet device. When oxygen concentrator 100 is running, it produces a noise level in the range of ten to thirty decibels. Further, with the compact size of the parts, vacuum pump 144 is running continuously and there is very little vibration to affect a person using it docked or wearing it as an ambulatory device. The device of the present invention with the described components weighs less than three pounds (1.36 kg). The compact size (less than about61 cu. in. (1000 cc)) allows for easy portability. Similarly, the small size does not disrupt counter space or storage when used at home. The device does give off some heat, however the outer case is less than 6 degrees Celsius higher than ambient when oxygen concentrator 100 is running on battery power. The device may emit more heat while it is docked and operating on AC power to charge the power pack 108, but is still less than 15 degrees Celsius above ambient.

Based on the foregoing embodiments, the efficiency of the concentrator can be determined. One measure of efficiency is the ratio of oxygen produced to the amount of adsorbent material used to obtain the oxygen, represented by the following:

$$Qp = \text{Liter/min } O_2 \text{ produced}$$

$$Madsorbent = \text{Kg of Adsorbent Material}$$

for example, the disclosed embodiments include adsorbent columns 130a-130c, with each column containing 15 cubic centimeters (cc) of adsorbent material with a density

of 0.66gm/cc. That is:

$$(3columns)\left(\frac{15cc}{column}\right)\left(\frac{0.66gm}{cc}\right) = 30gms \text{ for the system.}$$

The following flow rates (Qp) were obtained by the above disclosed concentrator:

Qp max = 1.5 L/min

Qp min = 0.14 L/min

This results in a range for kilograms of adsorbent material to oxygen flow rate of:

$$0.020 < \frac{Madsorbent}{Qp} < 0.214$$

Similarly, flow rates (Qp) were determined for a system that contains three adsorption columns, each column containing 15cc of adsorbent material. The separation completed in a range of .3 atm to .95 atm. Values were calculated for breakthrough time, work, battery life, and flow rate. The volume of gas contained in a column at the end of a feed phase was 150cc. These constants were used to determine the following measures of efficiency:

Work per evacuation cycle or pneumatic power requirements were determined based on the following calculations:

W (work) = (volume moved) * (vacuum differences);

The vacuum differences are calculated as the vacuum pump is continuously changing gas out, and as vacuum progresses to end point. From this:

V_H = Vacuum upper level

V_L = Vacuum lower level

Vol = Volume of gas in the column at end of feed phase

$$W = Vol*(V_H-V_L)*(1+(V_H/(V_H-V_L))*\ln(V_L/V_H)+\ln(V_H/V_L))$$

Inserting the above constants and converting to joules (multiply by 100.32 to get L*atm to joules) yields:

$$W = 4.81 \text{ joules}$$

Thus, 4.81 joules is required to evacuate the gas which desorbs during the evacuation phase. From experimentation, the following flow rates (LPM is liters per minute) and cycle times were recorded:

Qp (flow rate)	Low = .14 LPM
	Med = .720 LPM
	High = 1.5 LPM
Cycle time	Low = 5.6 sec.
	Med = 1.12 sec.
	High = .54 sec.

Power consumption can be determined by calculating work divided by the time of the cycle.

Low flow power = 4.81 joule/5.6 sec = .85 watts

Medium Flow power = 4.81 joule/1.12 sec = 4.29 watts

High flow power = 4.81 joule/.54 sec = 8.9 watts

From the above, a measure of energy consumed to the flow rate can be made and used as an indicator of the system efficiency:

$$Low: \frac{.85w}{.14LPM} = 6.07w/LPM$$

$$Medium: \frac{4.29w}{.72LPM} = 5.95w / LPM$$

$$High: \frac{8.9w}{1.5LPM} = 5.93w / LPM$$

Another measure of efficiency is the ratio of mass of the power pack (Mpowerpack) compared to the amount of oxygen produced (Qp) over time:

$$\frac{Mpowerpack}{QpT(time)}$$

The following constants are used in the calculation: the battery cell is a type 18650 lithium ion battery with 7.4 watts-hrs, measuring 42 g; motor efficiency is 90 percent; and vacuum pump efficiency is 80 percent.

Pneumatic work = 6W/L/min. Thus,

$$\text{Electric power} = \frac{6W / LPM}{(.9)(.8)} = 8.3W / LPM$$

Battery mass compared to energy consumption is:

$$\frac{42g}{7.4(watt)(hr)}\left(\frac{1Kg}{1000g}\right)\frac{8.3watt}{LPM} = .047\frac{Kg}{LPM(HR)}$$

Total battery mass for the power pack can be determined from this equation. For example, if a patient requires the concentrator to run for four hours at setting of "3" and takes 20 breaths per minute (the medium flow rate):

$$(4hr)*\frac{.047kg}{LPM(hr)}.72LPM = .135kg$$

The mass of the batteries needed is 0.135 Kg. Assuming each battery cell is 42g as previously stated, the number of batteries for the power pack can be calculated:

$$.135kg\left(\frac{1000g}{1kg}\right)\frac{\text{battery cell}}{42g} = 3.2 battery\ cells$$

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention. For example, larger flow rates may be achieved by scaling the concentrator components to achieve desired flow rates at the disclosed efficiencies.

CLAIMS:

1. A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas by:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing ambient air into the first end of the column until the vacuum within the column is near 1.0 atmosphere;

(d) repeating steps (a) - (c); and

delivering product gas to the patient.

2. The method of claim 1 and further comprising:

introducing product gas into the column through the second end during a portion of step (c).

3. The method of claim 2 wherein introducing product gas occurs during an initial portion of step (c).

4. The method of claim 1 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen delivered to the patient.

5. A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing product gas by:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column;

(d) repeating steps (a) - (c); and

delivering product gas to the patient.

6. The method of claim 5 wherein introducing product gas occurs during an initial portion of step (c).

7. The method of claim 5 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen used by the patient.

8. The method of claim 5 and further comprising:

storing a portion of the product gas in a reservoir.

9. The method of claim 8 wherein delivering the product gas is from the reservoir to the patient.

10. The method of claim 8 wherein delivering product gas occurs in response to inhalation by the patient.

11. The method of claim 8 wherein the reservoir maintains the product gas at a pressure of between about 1.0 atm and about 2.0 atm.

12. A method of providing concentrated oxygen to a patient, the method comprising:

producing oxygen-rich product gas with a vacuum swing adsorption process comprising:

(a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column;

(b) evacuating the column through the first end to remove adsorbed gas from the column;

(c) repressurizing the column by introducing product gas into the second end of the column and ambient air into the first end of the column;

(d) repeating steps (a) - (c);

storing product gas produced by the vacuum swing adsorption process; and

delivering stored product gas to the patient.

13. The method of claim 12 and further comprising:

introducing product gas into the column through the second end during a portion of step (c).

14. The method of claim 13 wherein introducing product gas occurs during an initial portion of step (c) prior to introducing ambient air.

15. The method of claim 12 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of product gas delivered to the patient.

16. The method of claim 12 wherein the product gas is stored at a pressure of about 1.0 atm to about 2.0 atm.

17. The method of claim 12 wherein delivering stored product gas comprises delivering a pulse of product gas to the patient in response to inhalation by the patient.

18. A method of providing concentrated oxygen product gas to a patient, the method comprising:

producing the product gas by:

(a) introducing ambient air at about 1.0 atmosphere (atm) into a first end of a column containing an LiLSX adsorbent material and removes product gas out a second end of the column;

(b) evacuating the column through the first end to a vacuum level within a range of about 0.1 atm to about 1.0 atm;

(c) repressurizing the column to about 1.0 atm; and

(d) repeating steps (a) - (c);

storing the product gas at a pressure of about 1.0 atm to about 2.0 atm; and

delivering stored product gas to the patient.

19. The method of claim 18 wherein repressurizing in step (c) comprises:

introducing product gas into the column through the second end; and

introducing ambient air into the column through the first end.

20. The method of claim 18 and further comprising:

controlling a cycle rate at which steps (a) - (c) are performed as a function of oxygen delivered to the patient.

21. The method of claim 18 wherein delivering stored product gas comprises delivering a pulse of product gas in response to an inhalation by the patient.

METHOD OF PROVIDING AMBULATORY OXYGEN

ABSTRACT OF THE INVENTION

Concentrated oxygen product gas is produced and delivered to a patient. Product gas is produced by (a) introducing ambient air into a first end of a column containing an adsorbent material that preferentially adsorbs nitrogen and removes oxygen-rich product gas out a second end of the column; (b) evacuating the column through the first end to remove adsorbed gas from the column;(c) repressurizing the column by introducing ambient air into the first end of the column until the column is near 1.0 atmosphere; and (d) repeating steps (a) - (c). Product gas is delivered as needed to the patient.

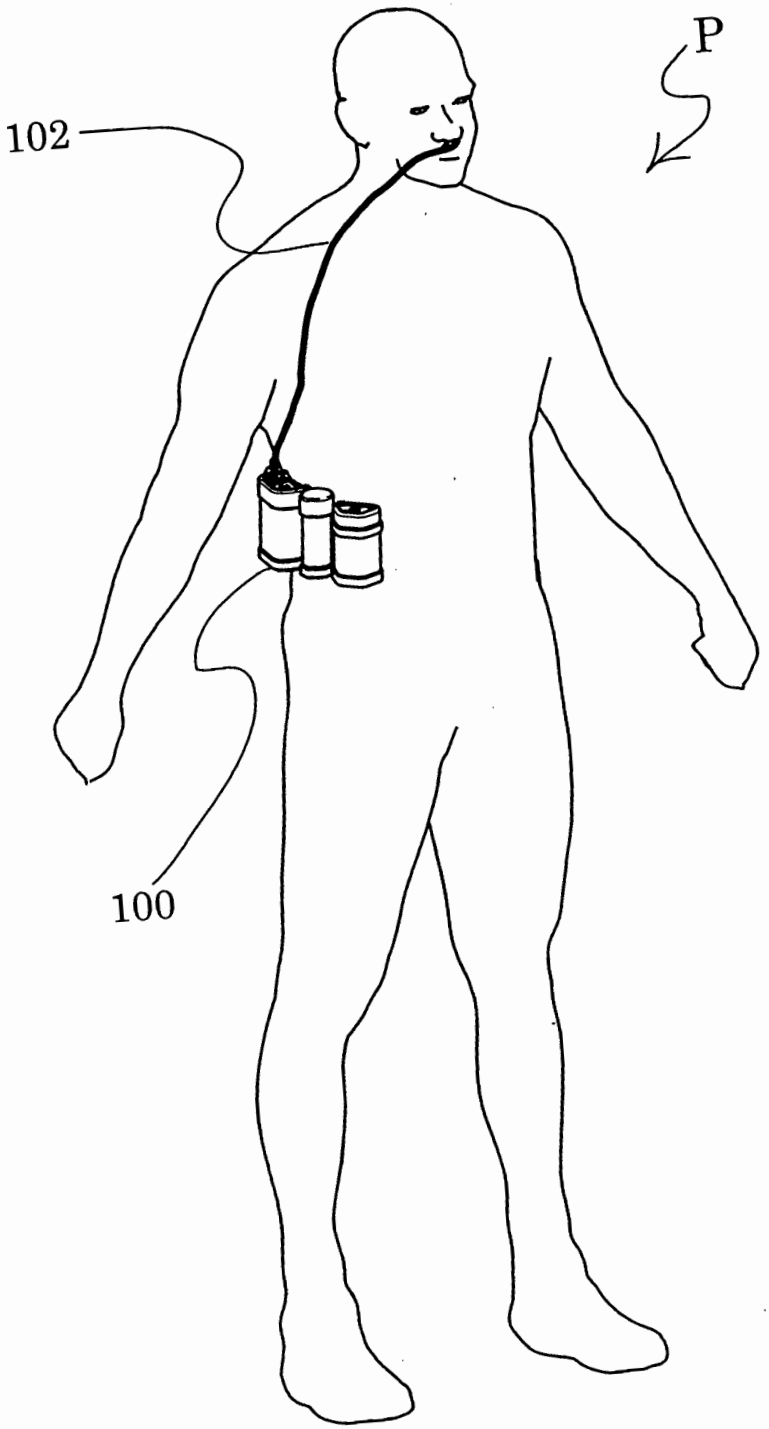


Fig 1

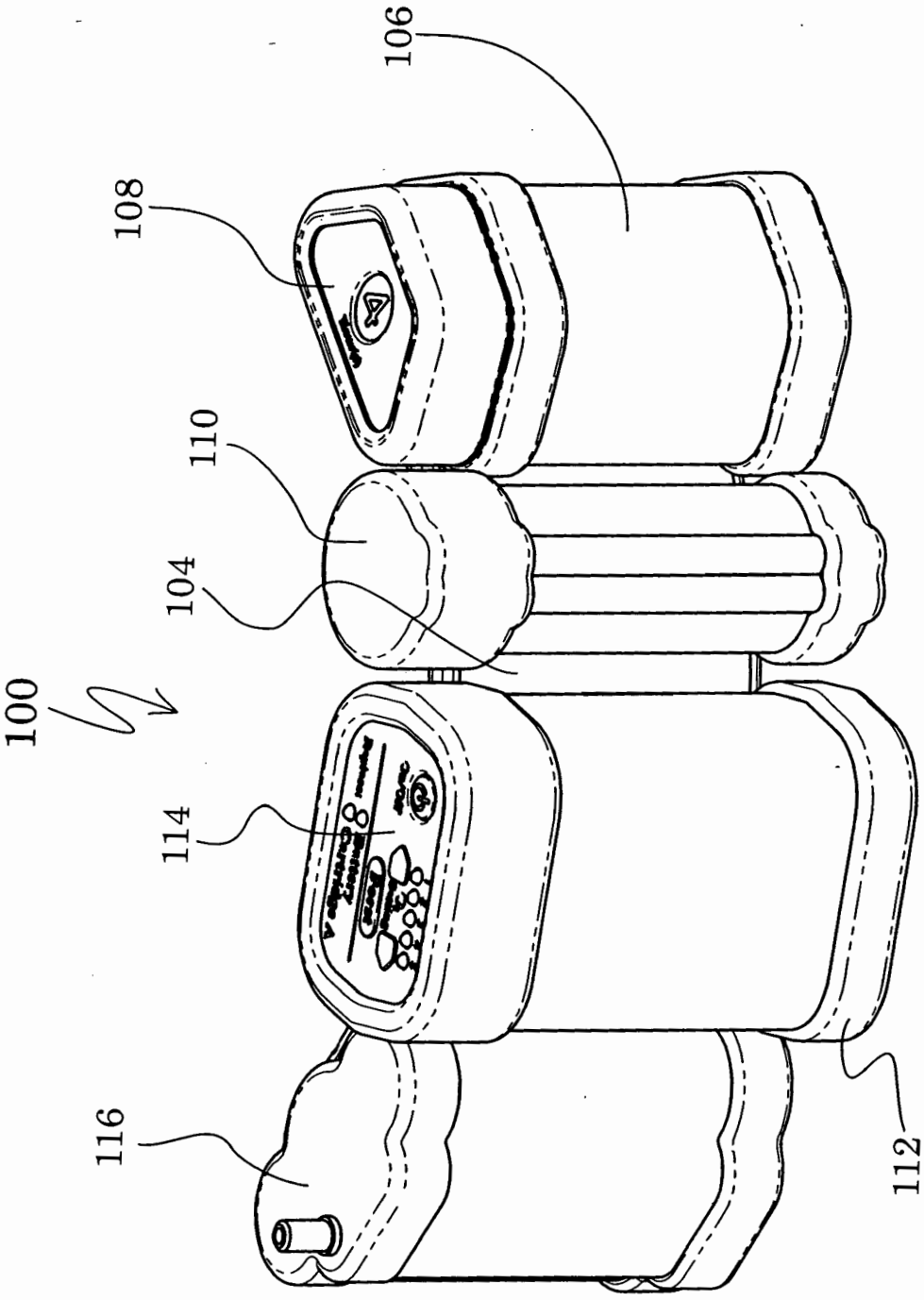


Fig 2

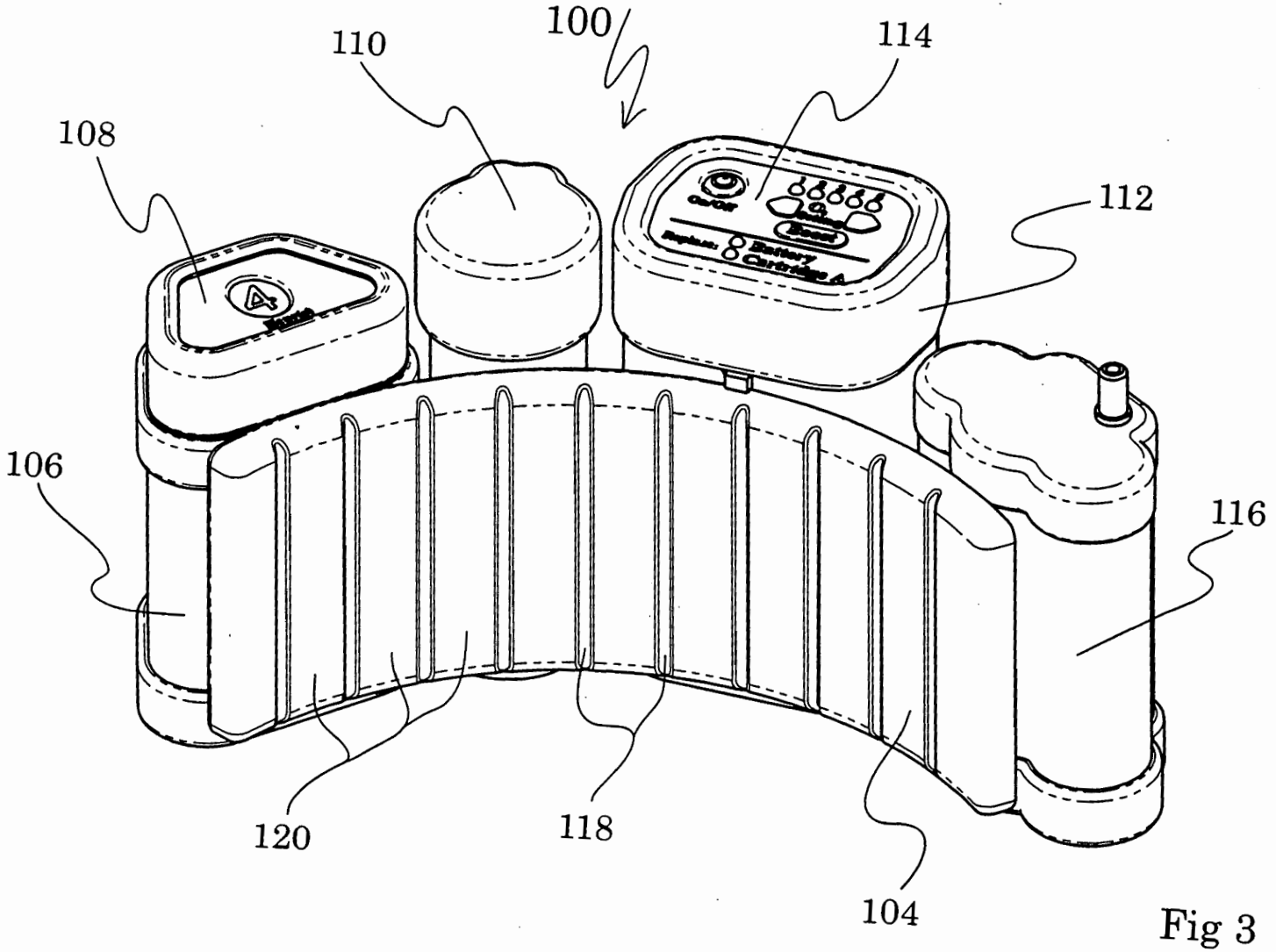


Fig 3

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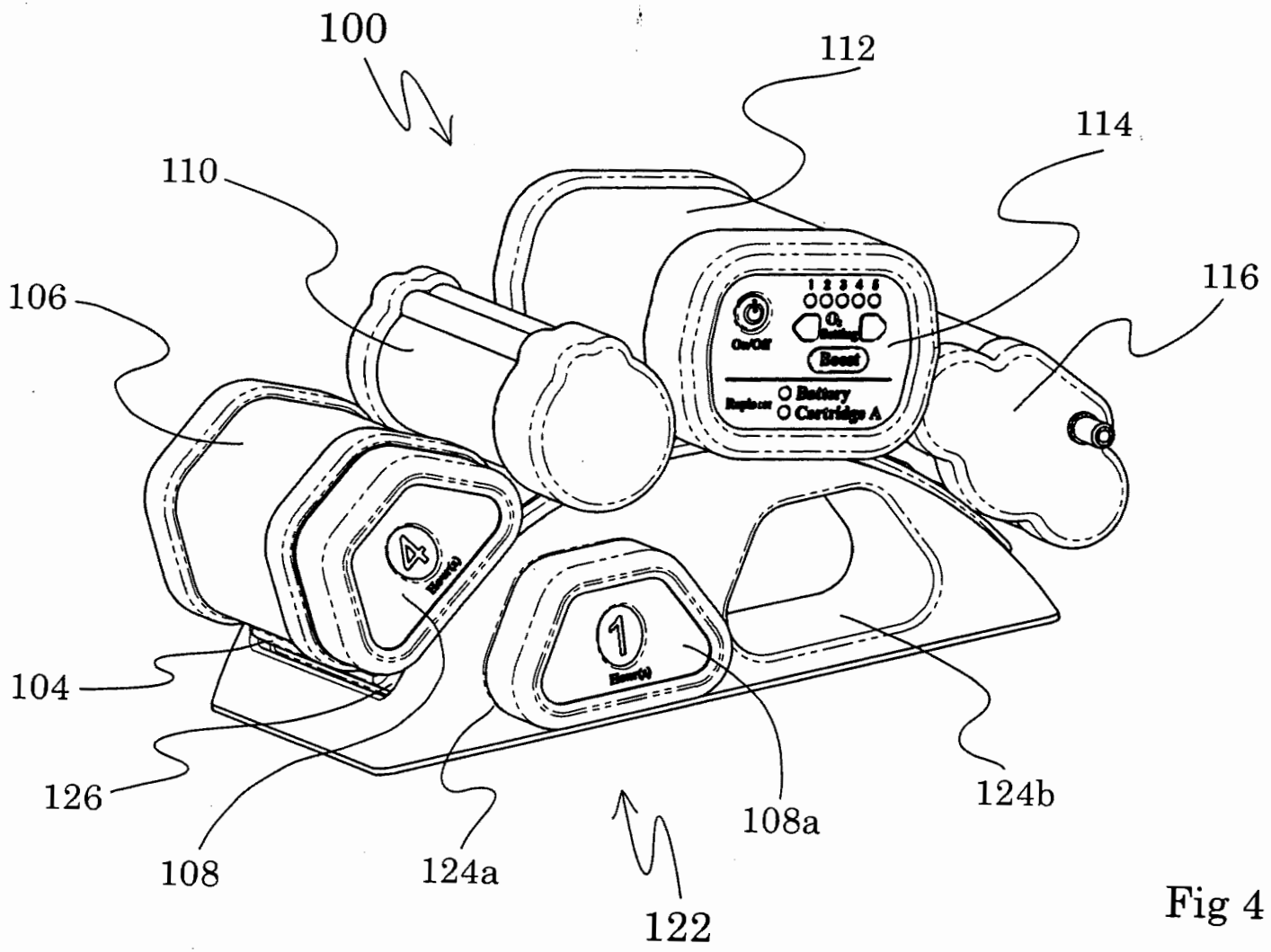


Fig 4

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GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

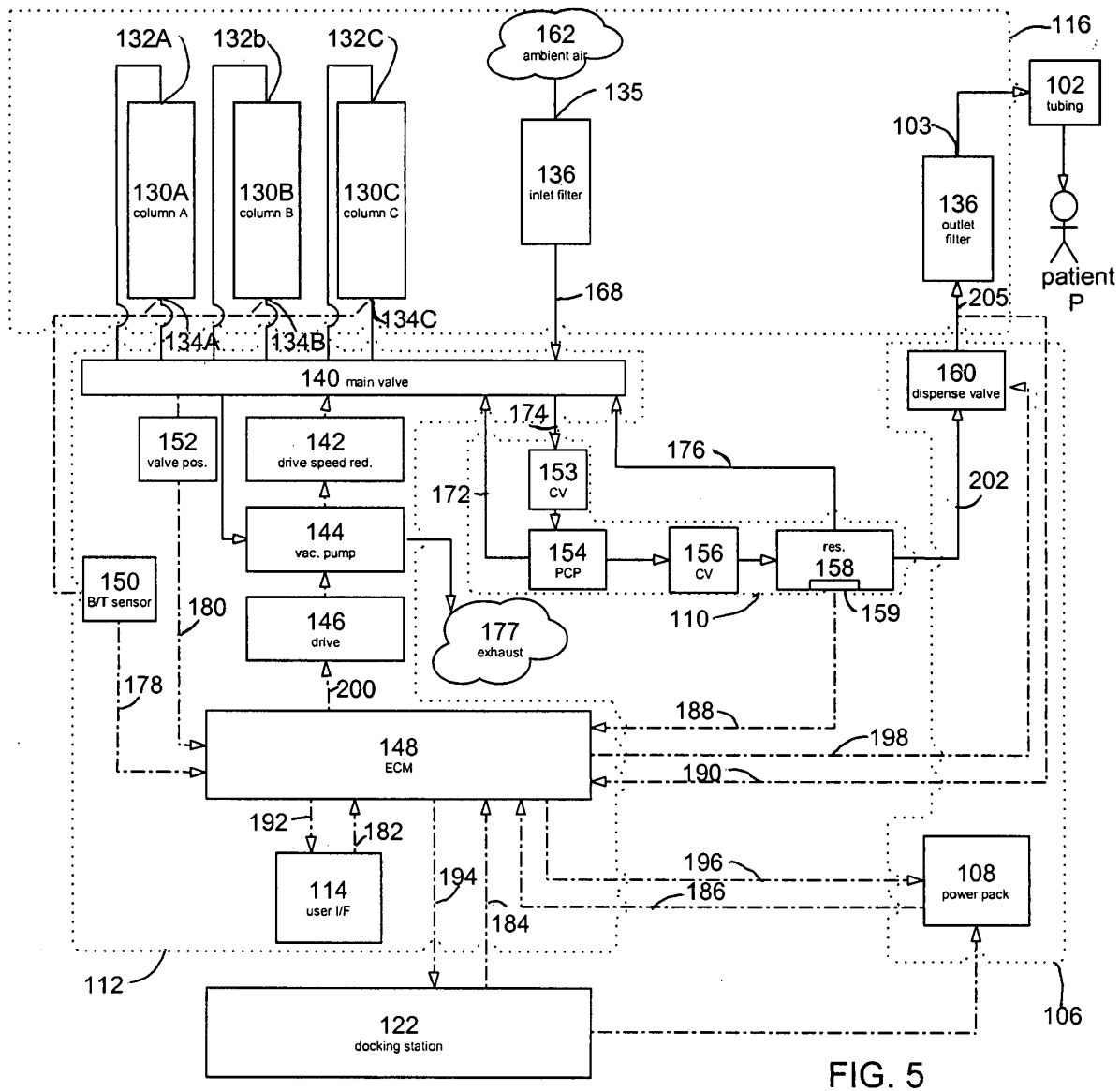

132A
132b
132C
162
ambient air
135
116
102
tubing
103
130A
column A
130B
column B
130C
column C
136
inlet filter
136
outlet
filter
patient
P
168
205
134A
134B
134C
140 main valve
160
dispense valve
174
152
valve pos.
142
drive speed red.
153
CV
176
172
202
144
vac. pump
154
PCP
156
CV
res.
158
150
B/T sensor
180
146
drive
177
exhaust
110
159
178
200
188
148
ECM
198
190
192
182
114
user I/F
194
196
186
184
108
power pack
112
122
docking station
106

FIG. 5

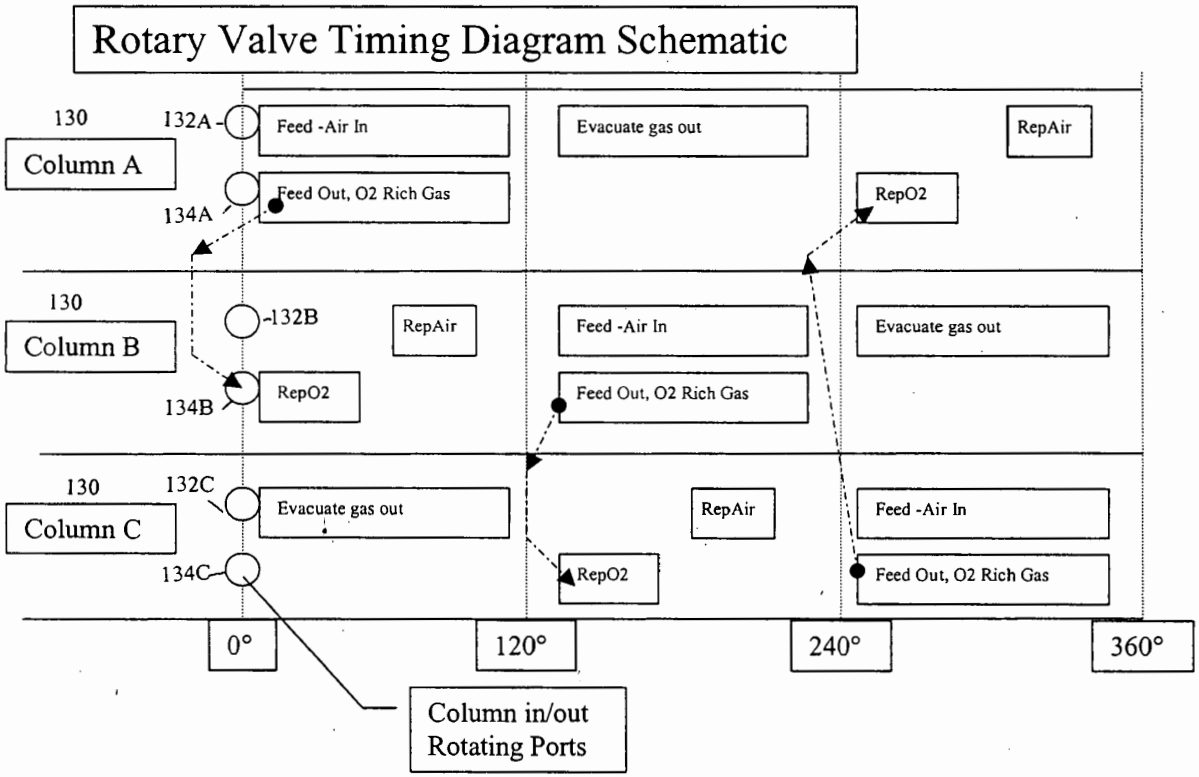

Rotary Valve Timing Diagram Schematic
130
Column A
132A
Feed -Air In
Evacuate gas out
RepAir
Feed Out, O2 Rich Gas
RepO2
134A
130
Column B
132B
RepAir
Feed -Air In
Evacuate gas out
RepO2
Feed Out, O2 Rich Gas
134B
130
Column C
132C
Evacuate gas out
RepAir
Feed -Air In
134C
RepO2
Feed Out, O2 Rich Gas
0°
120°
240°
360°
Column in/out
Rotating Ports

FIG. 6

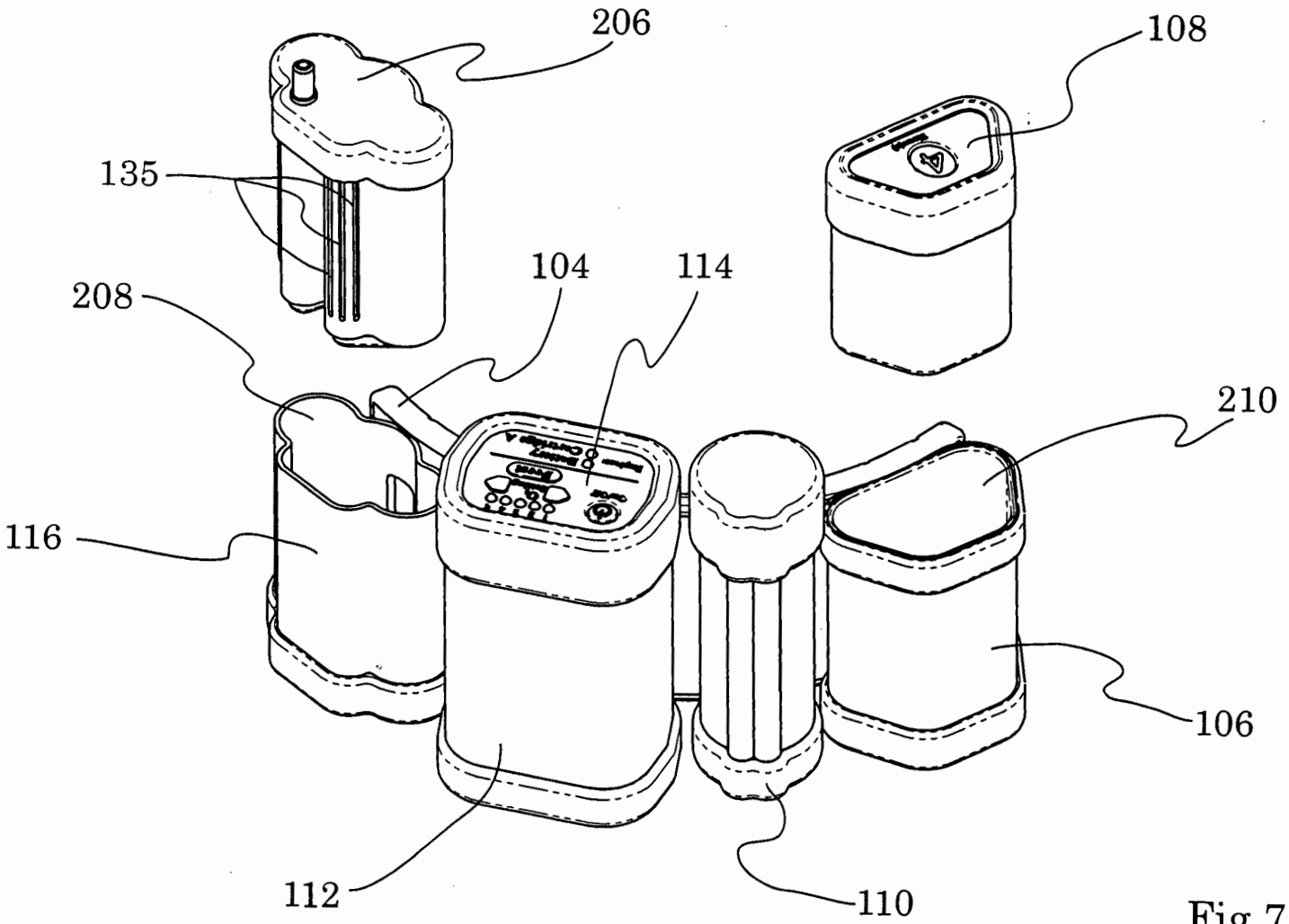


Fig 7

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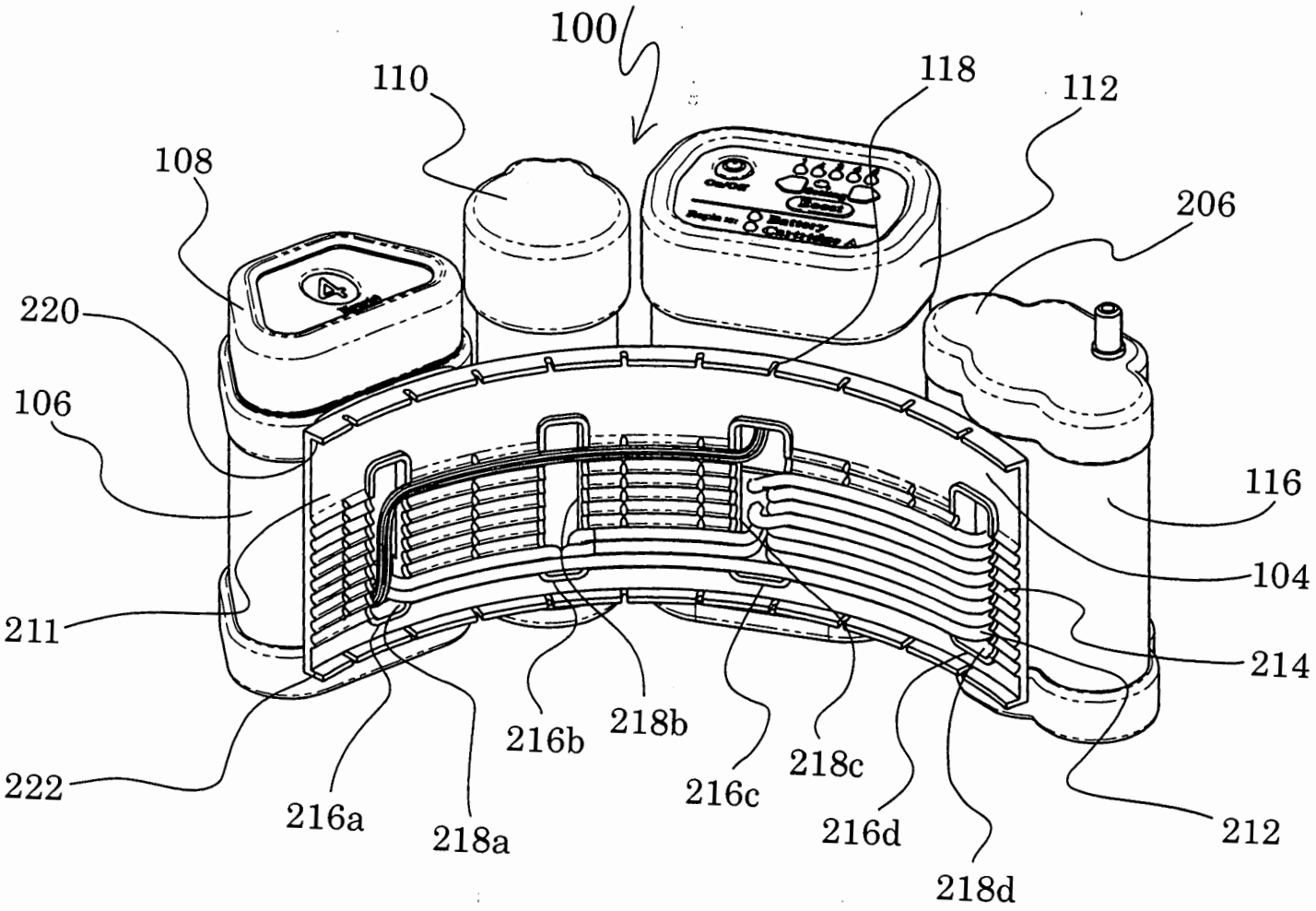

100
110
118
112
108
206
220
106
116
104
211
214
222
216b
218b
216c
218c
216a
218a
216d
212
218d

Fig 8

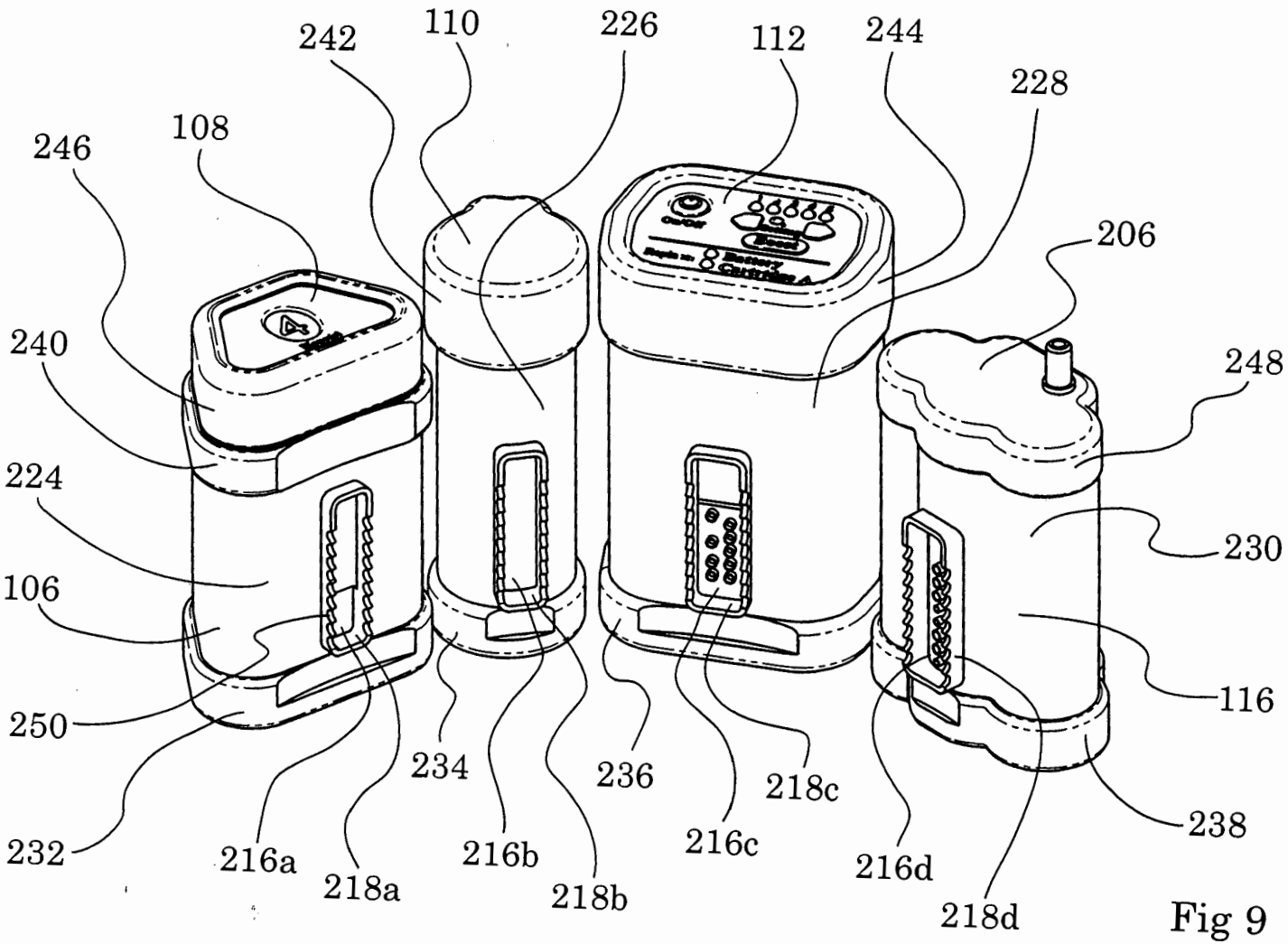

242
110
226
112
244
228
246
108
206
240
248
224
230
106
116
250
234
236
218c
238
232
216a
218a
216b
218b
216c
216d
218d

Fig 9

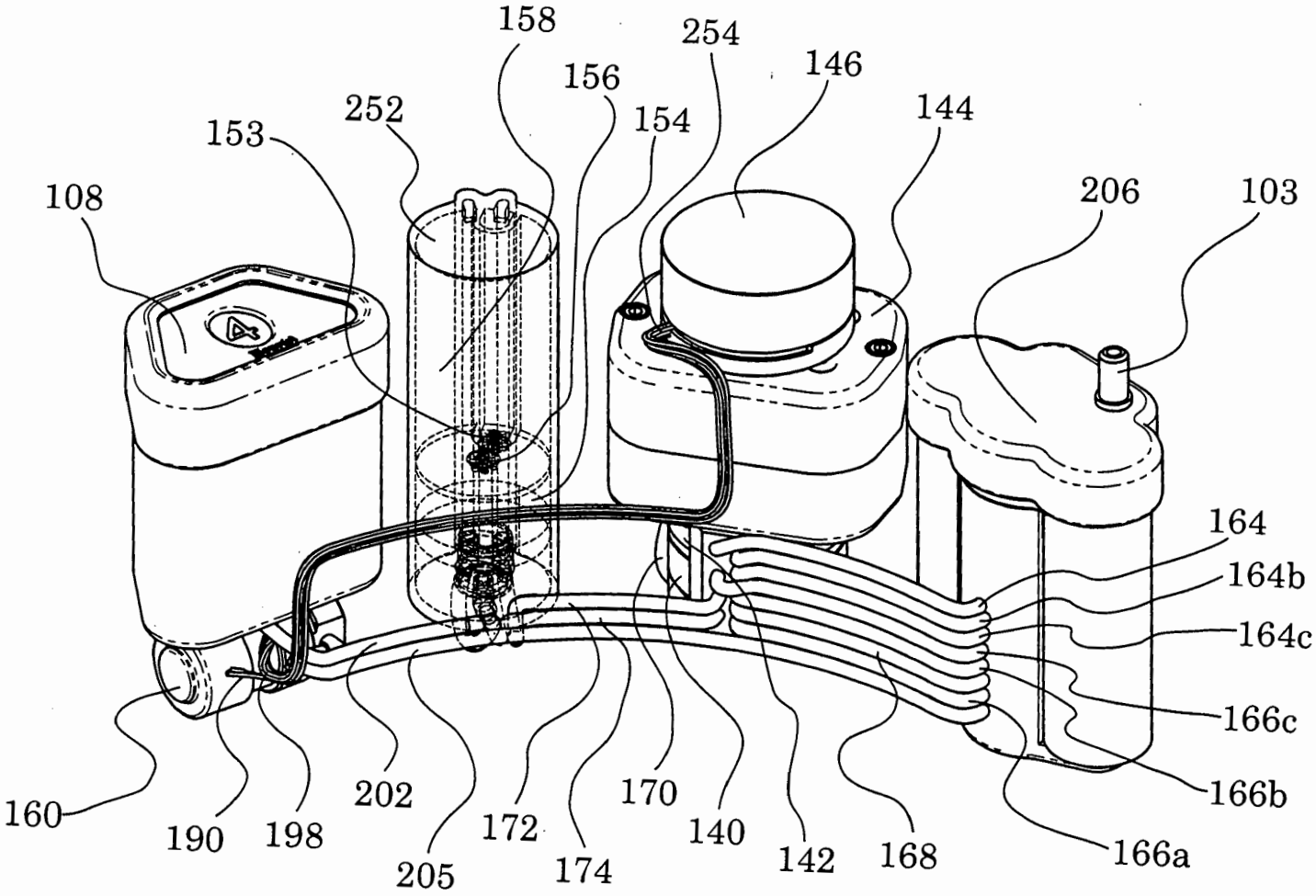

158
254
146
156
252
154
144
153
108
206
103
164
164b
164c
166c
166b
166a
160
190
198
202
205
172
174
170
140
142
168

Fig 10

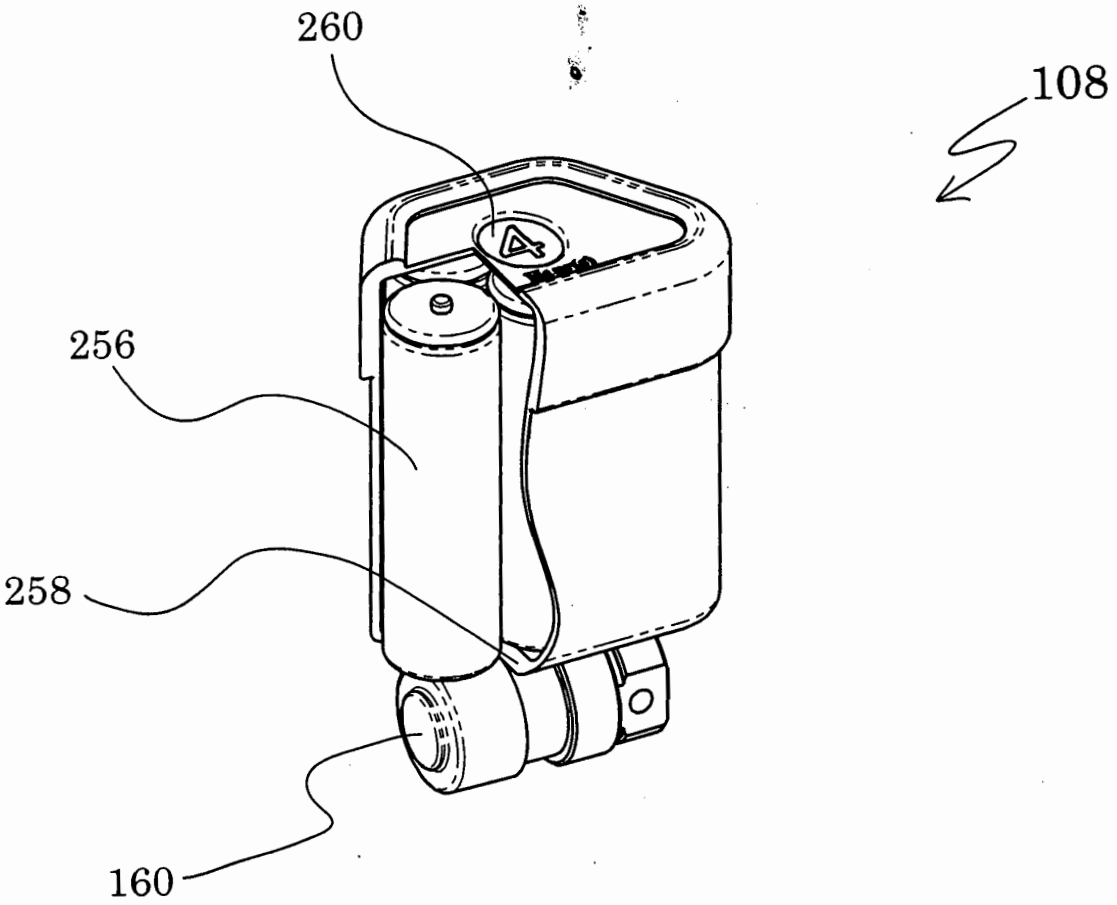


Fig 11

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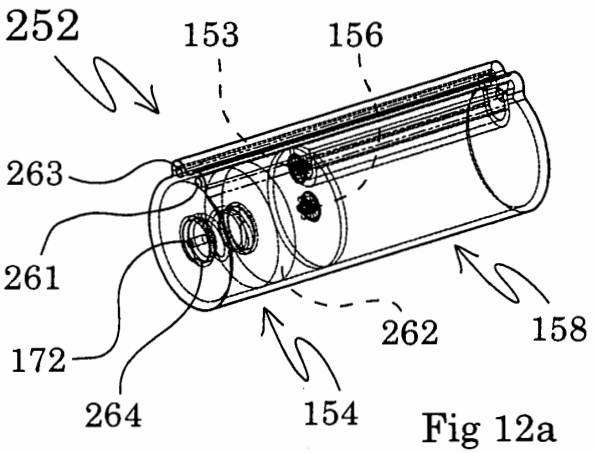
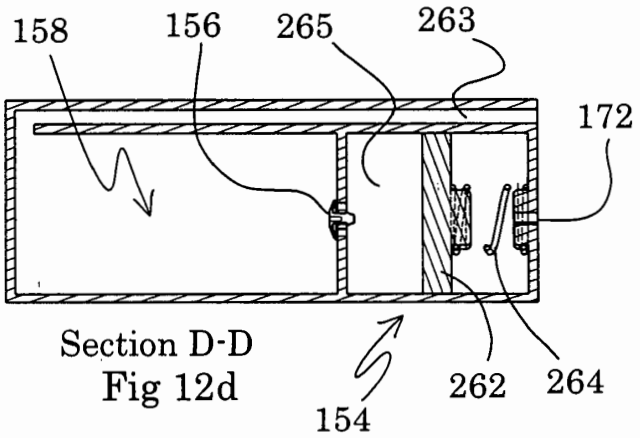


Fig 12a



Section D-D
Fig 12d

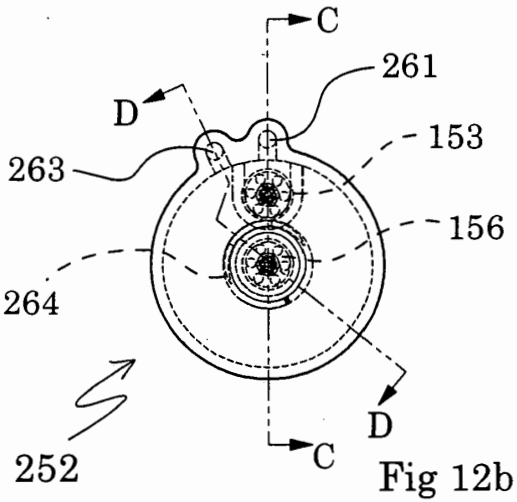
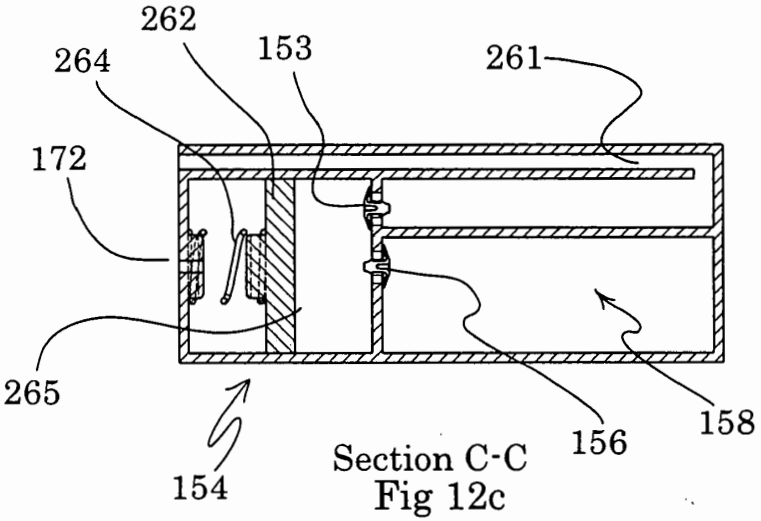


Fig 12b



Section C-C
Fig 12c

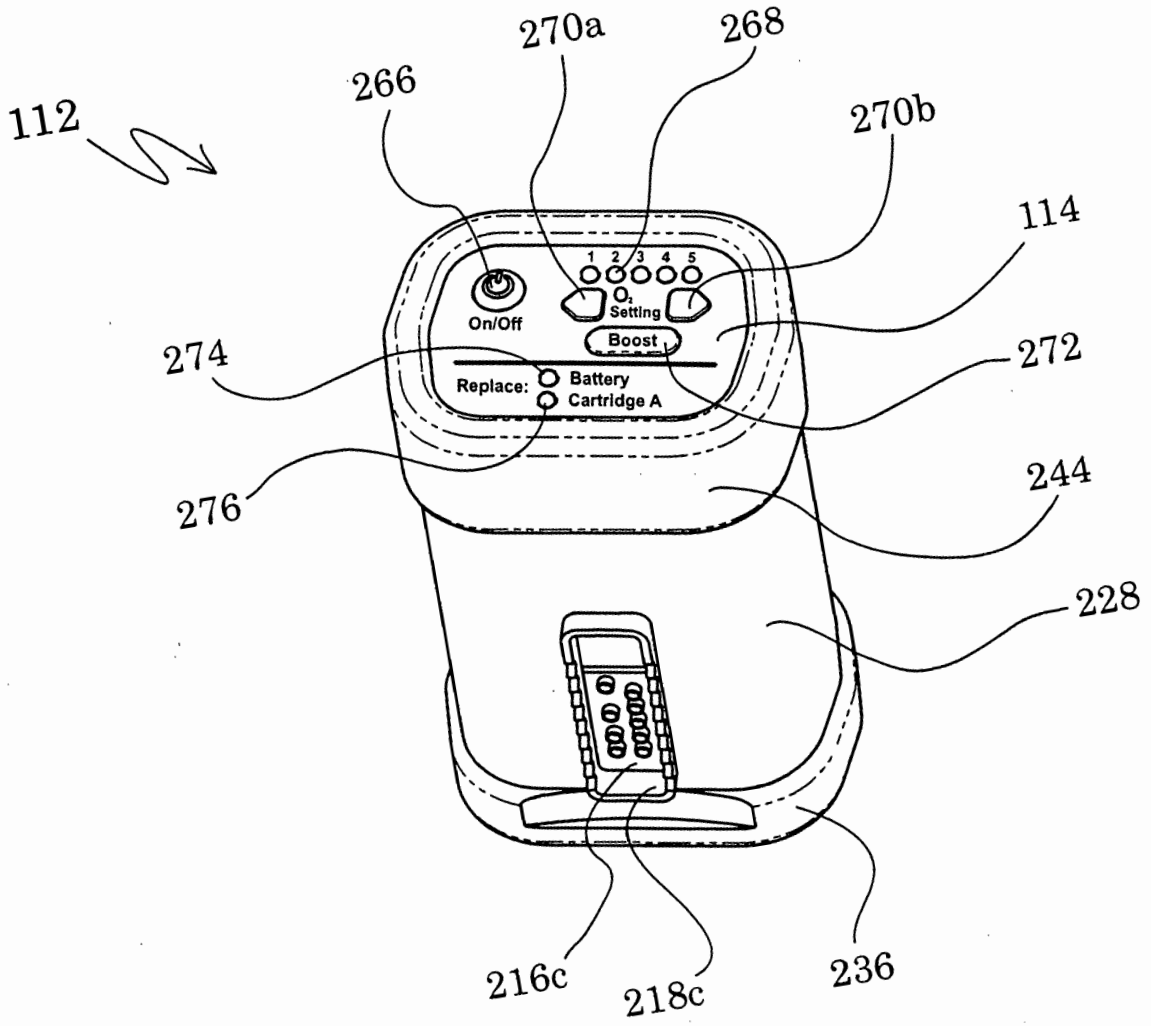

112
266
270a
268
270b
114
274
272
276
244
228
216c
218c
236
On/Off
1 2 3 4 5
O2 Setting
Boost
Replace:
Battery
Cartridge A

Fig 13

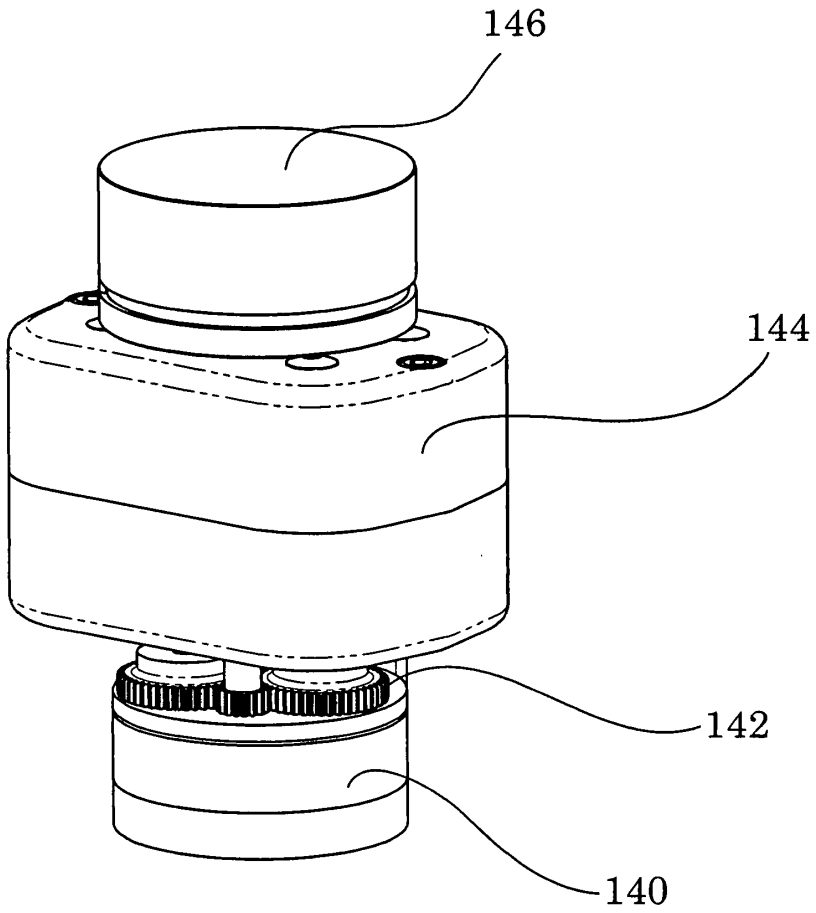


Fig 14

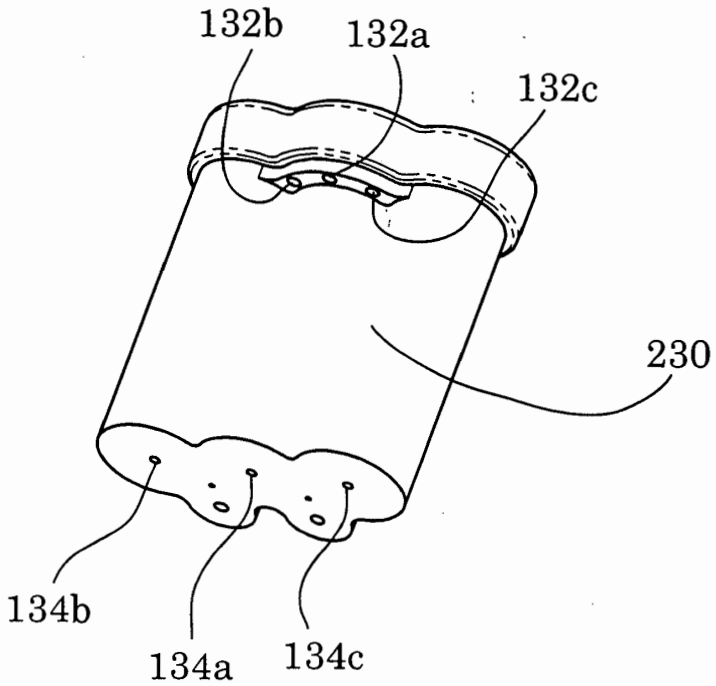


Fig 15

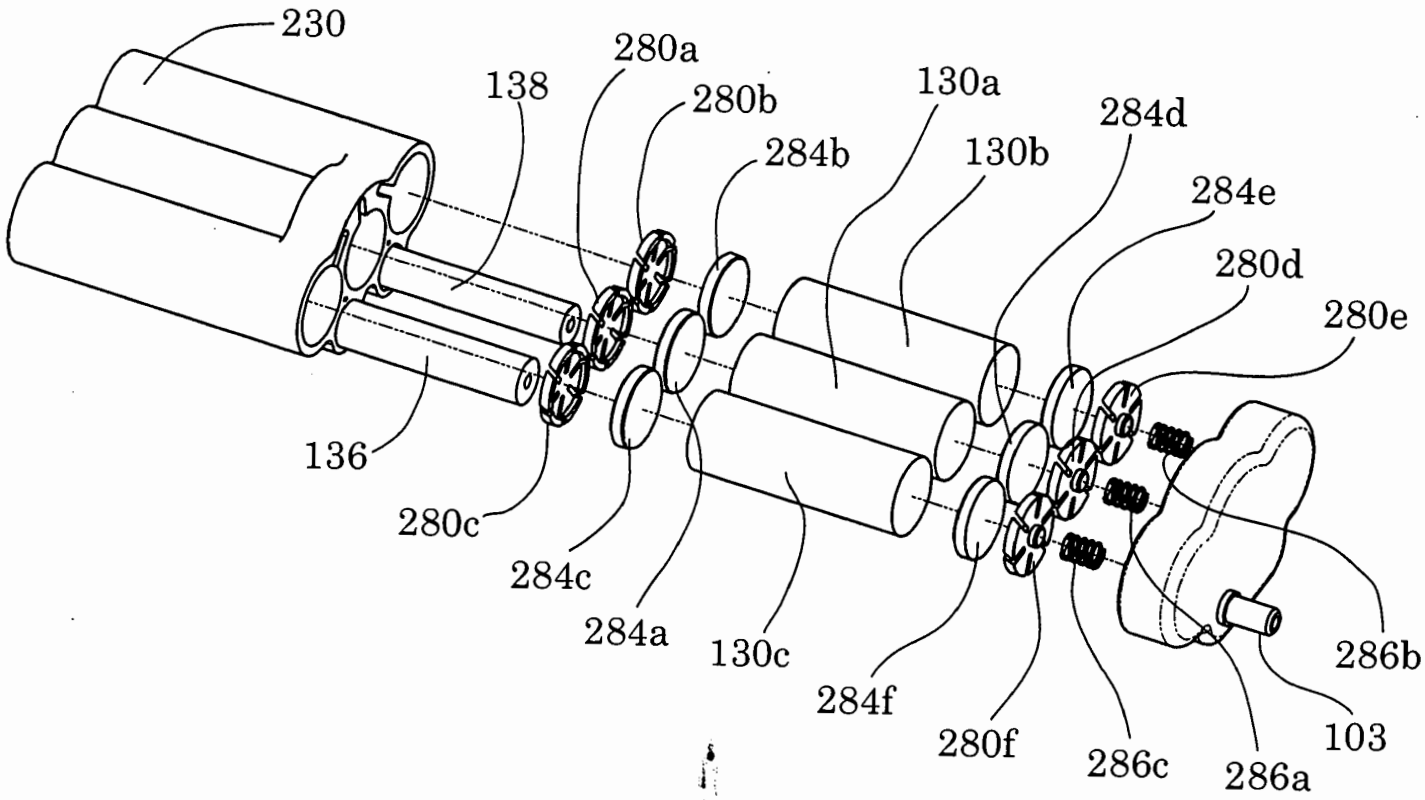

230
138
280a
280b
284b
130a
130b
284d
284e
280d
280e
136
280c
284c
284a
130c
284f
280f
286c
286a
103
286b

Fig 16

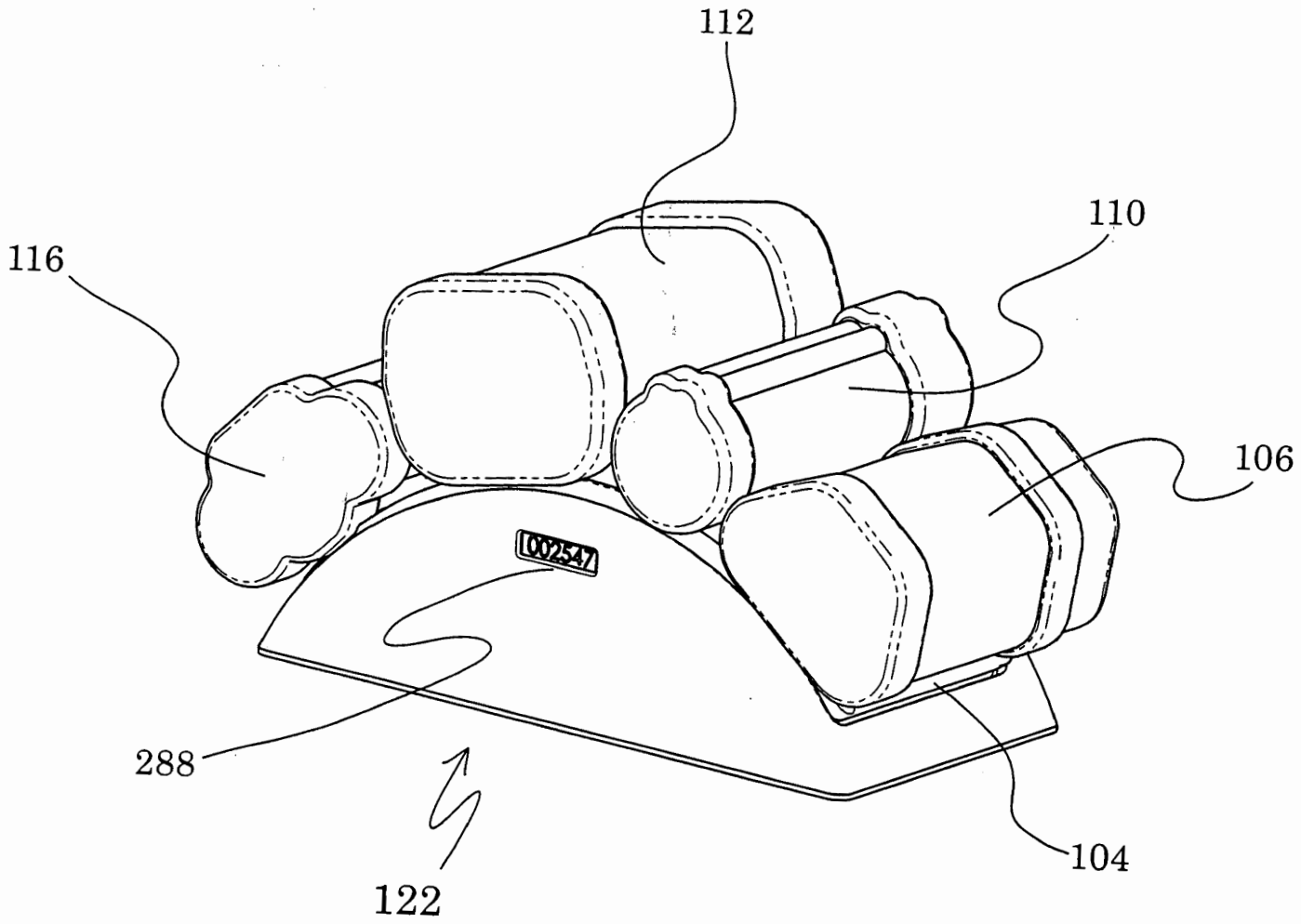


Fig 17

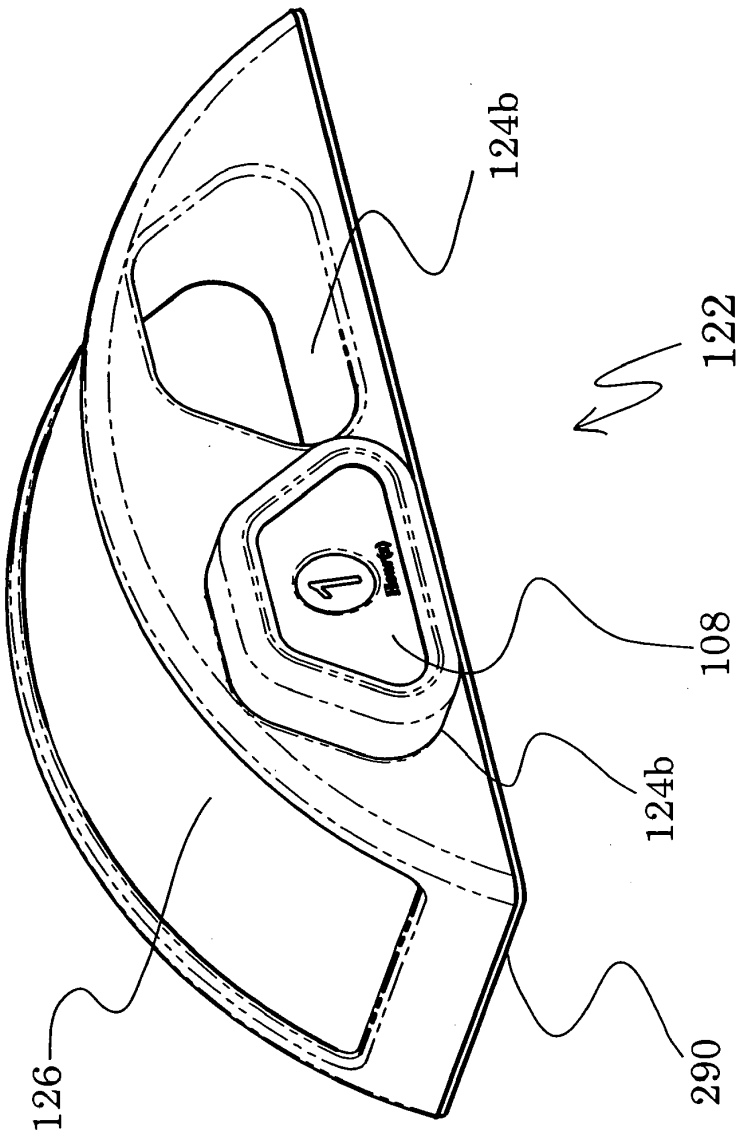


Fig 18

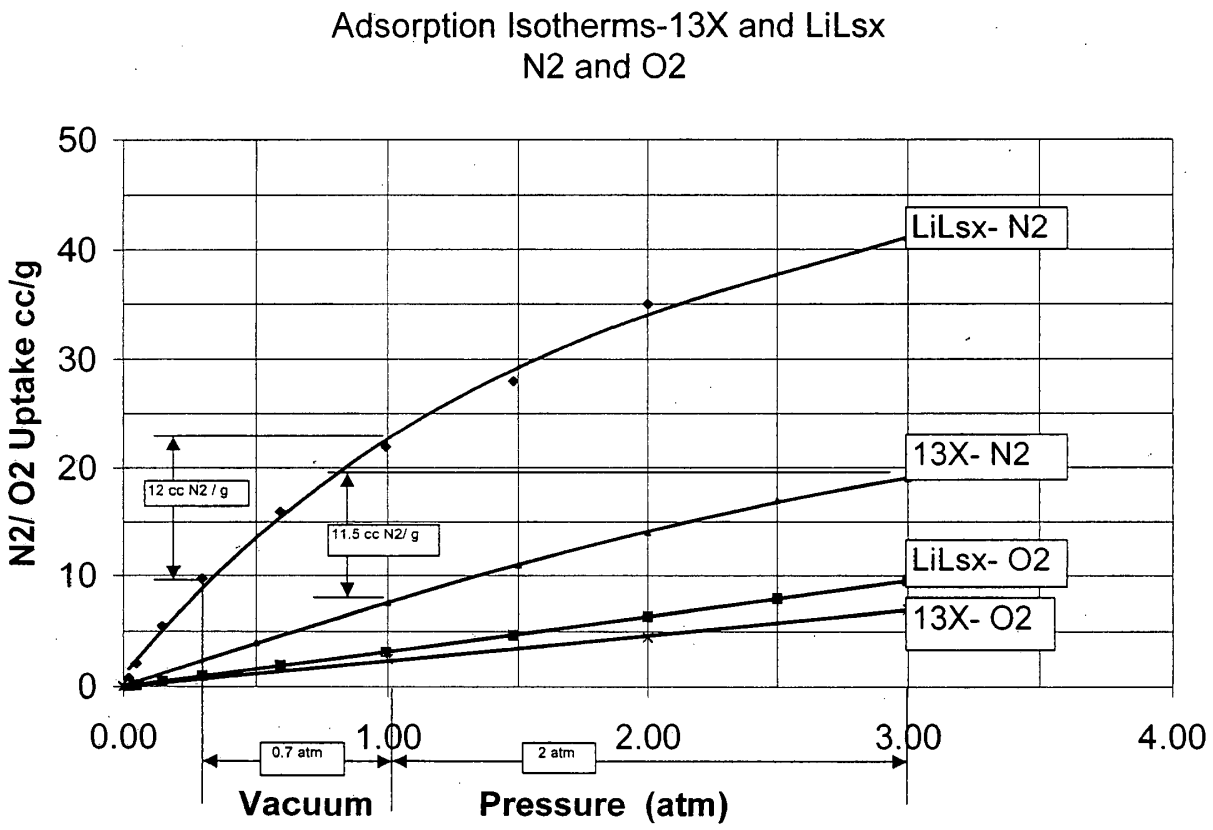

Adsorption Isotherms-13X and LiLsx
N2 and O2
N2/ O2 Uptake cc/g
50
40
30
20
10
0
0.00
1.00
2.00
3.00
4.00
LiLsx- N2
13X- N2
LiLsx- O2
13X- O2
12 cc N2 / g
11.5 cc N2/ g
0.7 atm
2 atm
Vacuum
Pressure (atm)

FIG. 19

DECLARATION FOR UTILITY PATENT APPLICATION (37 C.F.R. 1.63)		Attorney Docket No.	V180.12-0009
		First Named Inventor	Theodore W. Jagger
		COMPLETE IF KNOWN	
X Declaration Submitted with Initial Filing	Declaration Submitted after Initial Filing (Surcharge (37 C.F.R. 1.16(e)) Required)	Application Number	
		Filing Date	Herewith
		Group Art Unit	
		Examiner Name	

As a below named inventor, I hereby declare that my residence, post office address, and citizenship are as stated below.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:
METHOD OF PROVIDING AMBULATORY OXYGEN

the specification of which:

X is attached hereto OR

was filed on as United States Application Number or PCT International Application Number and was amended on (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Certified Copy Attached? Yes No

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

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IPR2023-00527

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (*if applicable*)

DIRECT ALL CORRESPONDENCE TO:

Customer Number	00164
Attention	David R. Fairbairn
Telephone	(612) 339-1863
Fax	(612) 339-6580

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Sole or First Inventor:		
Given Name (First and middle (if any))		Family Name or Surname
Theodore W.		Jagger
Inventor's signature	Theodore Jagger	Date: 2/9/05
Residence	White Bear Lake, MN	Citizenship: U.S.A.
Mailing Address	5743 Birch Road	
City, State, Country	White Bear Lake, MN 55110, U.S.A.	

Second Inventor:		
Given Name (First and middle (if any))		Family Name or Surname
Nicholas P.		Van Brunt
Inventor's signature	Nicholas P. Van Brunt	Date: 2/09/05
Residence	White Bear Lake, MN	Citizenship: U.S.A.
Mailing Address	One Bald Eagle Island	
City, State, Country	White Bear Lake, MN 55110, U.S.A.	

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IPR2023-00527

Third Inventor:		
Given Name (First and middle (if any))		Family Name or Surname
John A.		Kivisto
Inventor's signature		Date: 2/9/05
Residence	Oak Grove, MN	Citizenship: U.S.A.
Mailing Address	3367 221st Avenue NW	
City, State, Country	Oak Grove, MN 55303, U.S.A.	

Fourth Inventor:		
Given Name (First and middle (if any))		Family Name or Surname
Perry B.		Lonnes
Inventor's signature		Date:
Residence	White Bear Lake, MN	Citizenship: U.S.A.
Mailing Address	5300 East Bald Eagle Blvd.	
City, State, Country	White Bear Lake, MN 55110, U.S.A.	

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GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

POWER OF ATTORNEY

Attorney Docket No.

V180.12-0009

First Named Inventor : Theodore W. Jagger

Title : METHOD OF PROVIDING AMBULATORY OXYGEN

In the patent application:

X identified above (and submitted to the Patent and Trademark Office herewith).

_ filed on _____ as Application No. _____.

I appoint the attorneys and agents associated with Customer Number 00164 to prosecute the patent application identified above and to transact all business in the Patent and Trademark Office connected therewith, including full power of association, substitution and revocation.

I ratify all prior actions taken by Kinney & Lange, P.A. or the attorneys and agents mentioned above in connection with the prosecution of the above-mentioned patent application.

I authorize Kinney & Lange, P.A. to mark the appropriate space above and to insert the filing date and application number of the application, as appropriate.

I authorize the attorneys and agents named herein to accept and follow instructions from David R. Fairbairn as to any action to be taken in the Patent and Trademark Office regarding this application without direct communication between the attorneys and agents and the undersigned. In the event of a change in the persons from whom instructions may be taken, the attorneys and agents named herein will be so notified by the undersigned.

Please address all correspondence and telephone calls to **Customer Number 00164**, attention David R. Fairbairn, Telephone (612) 339-1863, Fax (612) 339-6580.

VBOX, INCORPORATED

Signature: Nicholas P. Van Brunt Dated: 2/09/05

Nicholas P. Van Brunt

Title: President

Inventor Information

Inventor One Given Name::	Theodore W.
Family Name::	Jagger
Postal Address Line One::	5743 Birch Road
City::	White Bear Lake
State or Province::	MN
Postal or Zip Code::	55110
Citizenship Country::	U.S.A.
Inventor Two Given Name::	Nicholas P.
Family Name::	Van Brunt
Postal Address Line One::	One Bald Eagle Island
City::	White Bear Lake
State or Province::	MN
Postal or Zip Code::	55110
Citizenship Country::	U.S.A.
Inventor Three Given Name::	John A.
Family Name::	Kivisto
Postal Address Line One::	3367 221st Avenue NW
City::	Oak Grove
State or Province::	MN
Postal or Zip Code::	55303
Citizenship Country::	U.S.A.
Inventor Four Given Name::	Perry B.
Family Name::	Lonnes
Postal Address Line One::	5300 East Bald Eagle Blvd.
City::	White Bear Lake
State or Province::	MN
Postal or Zip Code::	55110
Citizenship Country::	U.S.A.

Correspondence Information

Correspondence Customer Number::	00164
Telephone::	612/339-1863
Fax::	612/339-6580
Electronic Mail::	drfairbairn@kinney.com

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Application Information

Title Line One::	METHOD OF PROVIDING AMBULATORY
Title Line Two::	OXYGEN
Total Drawing Sheets::	Nineteen (19)
Formal Drawings?::	Yes
Application Type::	Utility
Docket Number::	V180.12-0009

Representative Information

Representative Customer Number:: 00164

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The enclosed PTO Form-1449 lists patents and publications submitted pursuant to 37 C.F.R. 1.97. Copies of the patents or publications are enclosed as necessary [if application filing date is after June 30, 2003, copies of U.S. patents and application publications are not required].

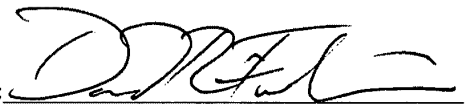
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Respectfully submitted,

KINNEY & LANGE, P.A.

By: 

David R. Fairbairn, Reg. No. 26,047
THE KINNEY & LANGE BUILDING
312 South Third Street
Minneapolis, MN 55415-1002
Telephone: (612) 339-1863
Fax: (612) 339-6580

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	BN	WO 98/58219	12-23-1998	Honkonen	Yes
	BO	WO 03/092817	11-13-2003	Appel	Yes

OTHER ART (Including Author, Title, Date, Pertinent Pages, Etc.)

	BP	Recommendations of the Fifth Oxygen Consensus Conference, 1999
	BQ	"AirSep lowers boom", www.hmenews.com/2004.12/depts/vendors/vendors1.htm.
	BR	

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(71) Applicant: SEQUAL TECHNOLOGIES, INC. [US/US]; 11436 Sorrento Valley Road, San Diego, CA 92121 (US).

(72) Inventors: APPEL, William, S.; 12639 El Camino Real, #6406, San Diego, CA 92130 (US). WINTER, David, P.; 336 Paseo Pacifica, Encinitas, CA 92024 (US). SWARD, Brian; 12742 Torrey Bluff Drive #46, San Diego, CA 92130 (US). SUGANO, Masato; Teijin-Hino-Dormitory, Room 210, 5-20-2 Tamadaira Hino, Tokyo, Tokyo 191-0062 (JP). SALTER, Edmund, L.; 3839 Vista Campana South #75, Oceanside, CA 92057 (US). BIXBY, James, A.; 7878 Revelle Drive, La Jolla, CA 92037 (US).

(74) Agent: BEUERLE, Stephen, C.; Procopio, Cory, Hargreaves & Savitch LLP, 530 B Street; Suite 2100, San Diego, CA 92101-4469 (US).

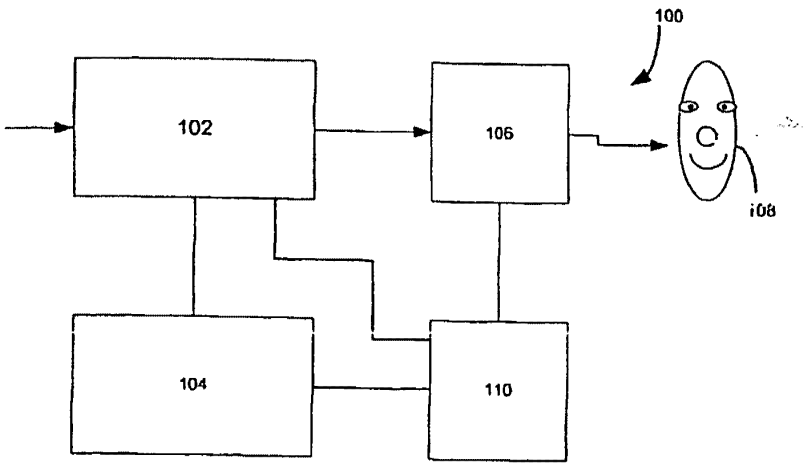
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(54) Title: PORTABLE OXYGEN CONCENTRATION SYSTEM



(57) Abstract: A portable oxygen concentrator system (100) adapted to be readily transported by a user includes a rechargeable energy source (104) and a concentrator (114) powered by the energy source (104). The concentrator (114) converts ambient air into concentrated oxygen gas for the user and includes a plurality of adsorption beds (300) and a rotary valve assembly (310). The rotary valve assembly (310) is relatively rotatable with respect to the plurality of adsorption beds (300) to provide valving action for selectively transferring fluids through the plurality of absorption beds (300) for converting ambient air into concentrated oxygen gas for the user. The ratio of adiabatic power to oxygen flow for the concentrator (114) is in the range of 6.2 W/LPM to 23.0 W/LPM.

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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.

DESCRIPTION

PORTABLE OXYGEN CONCENTRATION SYSTEM

Background of the Invention

[0001] The field of this invention relates, in general, to oxygen concentrators and, in particular, to portable oxygen concentration systems for ambulatory respiratory patients that allow them to lead normal and productive lives.

[0002] There is a burgeoning need for home and ambulatory oxygen. Supplemental oxygen is necessary for patients suffering from lung disorders; for example, pulmonary fibrosis, sarcoidosis, or occupational lung disease. For such patients, oxygen therapy is an increasingly beneficial, life-giving development. While not a cure for lung disease, supplemental oxygen increases blood oxygenation, which reverses hypoxemia. This therapy prevents long-term effects of oxygen deficiency on organ systems -- in particular, the heart, brain and kidneys.

[0003] Oxygen treatment is also prescribed for Chronic Obstructive Pulmonary Disease (COPD), which afflicts about six-hundred million people in the U.S., and for other ailments that weaken the respiratory system, such as heart disease and AIDS. Supplemental oxygen therapy is also prescribed for asthma and emphysema.

[0004] The normal prescription for COPD patients requires supplemental oxygen flow via nasal cannula or mask twenty four hours per day. The average patient prescription is two liters per minute of high concentration oxygen to increase the oxygen level of the total air inspired by the patient from the normal 21% to about 40%. While the average oxygen flow requirement is two liters per minute, the average oxygen concentrator has a capacity of four to six liters of oxygen per minute. This extra capacity is occasionally necessary for certain patients who have developed more severe problems, are not generally able to leave the home (as ambulatory patients) and do not require a portable oxygen supply.

[0005] There are currently three modalities for supplemental medical oxygen: high pressure gas cylinders, cryogenic liquid in vacuum insulated containers or thermos bottles commonly called "dewars," and oxygen concentrators. Some patients require in-home oxygen only while others require in-home as well as ambulatory oxygen depending on their prescription. All three modalities are used for in-home use, although oxygen concentrators are preferred because they do not require dewar refilling or exchange

of empty cylinders with full ones. Home oxygen concentrators, however, do have their drawbacks. They consume relatively large amounts of electricity (350-400 Watts), are relatively large (about the size of a night stand), are relatively heavy (weight about 50 lbs.), emit quite a bit of heat, and are relatively noisy.

[0006] Only small high pressure gas bottles and small liquid dewars are truly portable enough to be used for ambulatory needs (outside the home). Either modality may be used for both in-home and ambulatory use or may be combined with an oxygen concentrator which would provide in-home use.

[0007] As described below, the current oxygen-supplying methods and devices have proven cumbersome and unwieldy and there has been a long-felt need for an improved portable device for supplying oxygen to the user.

[0008] For people who need to have oxygen and operate away from an oxygen-generating or oxygen-storage source such as a stationary oxygen system (or even a portable system which cannot be readily transported), the two most prescribed options generally available to patients are: (a) to carry with them small cylinders typically in a wheeled stroller; and (b) to carry portable containers typically on a shoulder sling. Both these gaseous oxygen and liquid oxygen options have substantial drawbacks, but from a medical view, both have the ability to increase the productive life of a patient.

[0009] The major drawback of the gaseous oxygen option is that the small cylinders of gaseous oxygen can only provide gas for a short duration. Another drawback is that a patient's high-pressure gaseous oxygen cylinders are not allowed in some locations such as airplanes because of safety considerations. A further drawback of the gaseous oxygen option is the refill requirement for oxygen once the oxygen has been depleted from the cylinder. These small gas cylinders must be picked up and refilled by the home care provider at a specialized facility. This requires regular visits to a patient's home by a provider and a substantial investment in small cylinders by the provider because so many are left at the patient's home and refilling facility. Although it is technically possible to refill these cylinders in the patient's home using a commercial oxygen concentrator that extracts oxygen from the air, this task would typically require an on-site oxygen compressor to boost the output pressure of the concentrator to a high level in order to fill the cylinders. Some disadvantages of common on-site oxygen compressors are that they are expensive, loud and emit a lot of heat. Additionally, attempting to

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compress the oxygen in pressurized canisters in the home is potentially dangerous, especially for untrained people.

[0010] This approach of course presents several safety concerns for in-home use. For example, in order to put enough of this gas in a portable container, it must typically be compressed to high pressure (~2000 psi) Compressing oxygen from 5 psi (the typical output of an oxygen concentrator) to 2000 psi will produce a large amount of heat. (Enough to raise the temperature 165 degrees C per stage based on three adiabatic compression stages with intercooling.) This heat, combined with the oxygen which becomes more reactive at higher pressures, sets up a potential combustion hazard in the compressor in the patient's home. Thus, operation of a high-pressure gas system in the patient's home is dangerous and not a practical solution.

[0011] The convenience and safety issues are not the only drawbacks of this compressed oxygen approach. Another drawback is that the compressors or pressure boosters needed are costly because they require special care and materials needed for high pressure oxygen compatibility.

[0012] Turning now to the liquid oxygen storage option, its main drawback is that it requires a base reservoir -- a stationary reservoir base unit within the patient's home about the size of a standard beer keg -- which may be refilled about once a week from an outside source. Liquid oxygen can then be transferred from the patient's base unit to a portable dewar, which can be used by the ambulatory patient. Also, with the liquid oxygen option, there is substantial waste, as a certain amount of oxygen is lost during the transfer to the portable containers and from evaporation. It is estimated that 20% of the entire contents of the base cylinder will be lost in the course of two weeks because of losses in transfer and normal evaporation. These units will typically boil dry over a period of 30 to 60 days even if no oxygen is withdrawn.

[0013] Home refilling systems that produce liquid oxygen and have the capability of refilling portable liquid oxygen dewars have been proposed. However, these devices require the user to perform the task of refilling bottles and add tens of dollars per month to the user's electric bill, which is not reimbursable.

[0014] There are other complications with these portable high-pressure cylinders and liquid dewars. Typically, supplemental oxygen is supplied to the patient by a home care provider, in exchange for which the provider receives a fixed monetary payment from

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insurance companies or Medicare regardless of the modality. Oxygen concentrators are preferred by the provider as the least expensive option for supplying the patient's at-home needs. For outside the home use, however, only small high-pressure gas bottles and small liquid dewars are portable enough to be used for ambulatory needs. Either one of these two modalities may be used for both in-home and ambulatory use or may be combined with an oxygen concentrator, which would provide in-home use. In either case, the home care provider must make costly weekly or biweekly trips to the patient's home to replenish the oxygen. One of the objects of this invention is to eliminate these costly milk runs."

[0015] So-called "portable" oxygen concentrators are commercially available for providing patients with gaseous oxygen by converting ambient air into concentrated gaseous oxygen. However, these devices are only "portable" in the sense that they are capable of being transported to another point of use via an automobile or an airplane. One of these devices is packaged in a suitcase and is billed as a transportable machine rather than a truly portable oxygen concentrator. The device weighs about 37 lbs. without battery and requires 135 Watts of power at a 2 LPM (liters per minute) oxygen flow rate. Operation from an automobile battery is possible when in route in a car, but operation from a separate battery is impractical. Another device is a 3 LPM concentrator mounted on its own cart. It weighs 22 lbs. without battery and also requires about 135 Watts of power. A further device weighs about 28 lbs. without battery and has a similar flow rate and power requirements to the above devices. Even without a battery, these devices are too heavy for the average ambulatory respiratory patient. With the weight of a battery, these prior art devices are not "portable" in the true sense of the word because they can not be readily transported from one point to another. Because these devices have relatively large power consumption requirements, they also require a sizable battery.

[0016] Further, in addition to the weight and power consumption problems with the above oxygen concentrators, none of these prior art concentrators are particularly quiet. They produce noise levels similar to those produced by a home concentrator. In fact, one of these devices specifie's noise production at 60 dBA (decibels), about twice the noise of a home concentrator. Consequently, none of these so-called "portable" oxygen concentrators are suitable for use in environments where low noise is especially important, e.g., restaurants, libraries, churches and theatres.

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[0017] Thus, a long-felt need exists for a truly "portable" oxygen concentration system that eliminates the need for high-pressure gas cylinders and liquid dewars, the constant refilling/replacing requirements associated with high-pressure gas cylinders and liquid dewars, and the need for a separate home oxygen concentration system for ambulatory respiratory patients. A truly "portable" oxygen concentration system would be light enough so that, even with a battery, an average ambulatory respiratory patient could carry the device. Inherently the device would have to be designed to have relatively low power consumption requirements so that a light-weight battery pack or other energy source could be used. Further, the device should be small enough so that it can be conveniently carried by the user, emit a relatively low amount of noise and should only emit a small amount of heat.

Summary of Invention

[0018] An aspect of the present invention involves a portable oxygen concentrator system adapted to be readily transported by a user. The portable oxygen concentrator system includes a rechargeable energy source and a concentrator powered by the energy source. The concentrator converts ambient air into concentrated oxygen gas for the user and includes a plurality of adsorption beds and a rotary valve assembly. The rotary valve assembly is relatively rotatable with respect to the plurality of adsorption beds to provide valving action for selectively transferring fluids through the plurality of adsorption beds for converting ambient air into concentrated oxygen gas for the user. The ratio of adiabatic power to oxygen flow for the concentrator is in the range of 6.2 W/LPM to 23.0 W/LPM.

[0019] Another aspect of the invention involves a rotary valve assembly for a pressure swing adsorption system having a plurality of adsorption beds. The rotary valve assembly includes a valve port plate and a rotary valve shoe having respective engaged surfaces and are relatively rotatable about a common center of rotation to provide valving action for selectively transferring fluids therethrough. The valve port plate includes at least two ports interconnected with at least two adsorption beds. The rotary valve shoe includes a second valve surface opposite the engaged surface with at least one equalization passage to register with the at least two ports of the port plate to equalize pressure between the at least two adsorption beds.

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[0020] Other and further objects, features, aspects, and advantages of the present inventions will become better understood with the following detailed description of the accompanying drawings.

Brief Description of the Drawings

[0021] Figure 1 is a block diagram of a portable oxygen concentration system constructed in accordance with an embodiment of the invention;

[0022] Figure 2 is a block diagram of a portable oxygen concentration system constructed in accordance with another embodiment of the invention, and illustrates, in particular, an embodiment of an air separation device;

[0023] Figure 3A is a perspective, cut-away view of an embodiment of a concentrator that may be used with the portable oxygen concentration system.

[0024] Figure 3B is a perspective, exploded view of the concentrator illustrated in Figure 3A.

[0025] Figure 4 is a top perspective view of an embodiment of a top manifold and multiple adsorption beds that may be used with the concentrator illustrated in Figures 3A and 3B.

[0026] Figures 5A and 5B are a bottom plan view and a top plan view respectively of an embodiment of a rotary valve shoe that may be used with the concentrator illustrated in Figures 3A and 3B.

[0027] Figure 6A is a top plan view of an embodiment of a valve port plate that may be used with the concentrator illustrated in Figures 3A and 3B.

[0028] Figure 6B is a flow chart of an exemplary process cycle for the concentraotor illustrated in Figures 3A and 3B.

[0029] Figures 7A and 7B are a top plan view and a bottom plan view respectively of an embodiment of a media retention cap that may be used with the concentrator illustrated in Figures 3A and 3B.

[0030] Figures 8A and 8B are a top perspective, exploded view and a bottom perspective, exploded view respectively of an embodiment of a rotary valve assembly including a centering pin that may be used with the concentrator illustrated in Figures 3A and 3B.

[0031] Figures 9A and 9B are a bottom perspective, exploded view and a top perspective, exploded view respectively of an embodiment of a rotary valve assembly

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including a centering ring that may be used with the concentrator illustrated in Figures 3A and 3B.

[0032] Figure 10A is a bottom perspective view of an embodiment of a rotary valve shoe, a motor drive, and a pair of elastic chain links that may be used with the concentrator illustrated in Figures 3A and 3B.

[0033] Figures 10B and 10C are a top perspective, exploded view and a bottom perspective, exploded view respectively of the rotary valve shoe, motor drive, and pair of elastic chain links illustrated in Figure 10A.

[0034] Figure 11 is a table of experimental data for a portable oxygen concentration system including the concentrator illustrated in Figures 3A and 3B.

[0035] Figure 12 is a schematic illustration of a further embodiment of the portable oxygen concentration system and an embodiment of a cradle for use with the portable oxygen concentration system;

[0036] Figure 13 is a block diagram of the one or more sensors that may be used with an embodiment of the portable oxygen concentration system;

[0037] Figure 14 is a block diagram of the one or more components that may be controlled by the control unit of the portable oxygen concentration system;

[0038] Figure 15 is a block diagram of a portable oxygen concentration system constructed in accordance with additional embodiment of the invention; and

[0039] Figure 16 is a schematic illustration of another embodiment of a portable oxygen concentration system including a high-pressure reservoir.

Detailed Description of the Preferred Embodiment

I. Portable Oxygen Concentration System

[0040] With reference to Figure 1, a portable oxygen concentration system, indicated generally by the reference numeral 100, constructed in accordance with an embodiment of the invention will now be described. The oxygen concentration system 100 includes an air separation device such as an oxygen gas generator 102 that separates concentrated oxygen gas from ambient air, an energy source such as rechargeable battery, battery pack, or fuel cell 104 that powers at least a portion of the oxygen gas generator 102, one or more output sensors 106 used to sense one or more conditions of the user 108, environment, etc. to determine the oxygen output needed by the user or required from the system 100, and a control unit 110 linked to the output sensor 106, the air separation

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device 102, and the energy source 104 to control the operation of the air separation device 102 in response to the one or more conditions sensed by the one or more output sensors 106.

[0041] In an alternative embodiment, the system 100 may not include the one or more output sensors 106 coupled to the control unit 110. In this embodiment, conditions of the system 100 such as flow rate, oxygen concentration level, etc. may be constant for the system or may be manually controllable. For example, the system 100 may include a user interface 111 (Figure 14) that allows the user, provider, doctor, etc. to enter information, e.g., prescription oxygen level, flow rate, etc. to control the oxygen output of the system 100.

[0042] Each element of the system 100 will now be described in more detail.

A. Air Separation Device

[0043] With reference to Figure 2, the air separation device is preferably an oxygen generator 102 generally including a pump such as a compressor 112 and an oxygen concentrator 114 (OC), which may be integrated.

[0044] The oxygen generator 102 may also include one or more of the elements described below and shown within the segmented boundary line in Figure 2. Ambient air may be drawn through an inlet muffler 116 by the compressor 112. The compressor 112 may be driven by one or more DC motors 118 (M) that run off of DC electrical current supplied by the rechargeable battery 104 (RB). The motor 118 also preferably drives the cooling fan part of the heat exchanger 120. A variable-speed controller (VSC) or compressor motor speed controller 119, which is described in more detail below, may be integral with or separate from the control unit 110 (CU) and is preferably coupled to the motor 118 for conserving electricity consumption. The compressor 112 delivers the air under pressure to the concentrator 114.

[0045] In a preferred embodiment, at a maximum speed air is delivered to the concentrator 114 at 7.3 psig nominal and may range from 5.3 to 12.1 psig. At maximum speed, the flow rate of feed is a minimum of 23.8 SLPM at inlet conditions of 14.696 psi absolute, 70 degrees F, 50% relative humidity.

[0046] A heat exchanger 120 may be located between the compressor 112 and the concentrator 114 to cool or heat the air to a desired temperature before entering the concentrator 114, a filter (not shown) may be located between the compressor 112 and the

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concentrator 114 to remove any impurities from the supply air, and a pressure transducer 122 may be located between the compressor 112 and the, concentrator 114 to get a pressure reading of the air flow entering the concentrator 114.

[0047] The concentrator 114 separates oxygen gas from air for eventual delivery to the user 108 in a well-known manner. One or more of the following components may be located in a supply line 121 between the concentrator 114 and the user 108: a pressure sensor 123, a temperature sensor 125, a pump 127, a low-pressure reservoir 129, a supply valve 160, a flow and purity sensor 131, and a conservation device 190. As used herein, supply line 121 refers to the tubing, connectors, etc. used to connect the components in the line. The pump 127 may be driven by the motor 118. The oxygen (gas may be stored in the low-pressure reservoir 129 and delivered therefrom via the supply line 121 to the user 108. The supply valve 160 may be used to control the delivery of oxygen gas from the low-pressure reservoir 129 to the user 108 at atmospheric pressure.

[0048] Exhaust gas may also be dispelled from the concentrator 114. In a preferred embodiment of the invention, a vacuum generator 124 (V), which may also be driven by the motor 118 and integrated with the compressor 112, draws exhaust gas from the concentrator 114 to improve the recovery and productivity of the concentrator 114. The exhaust gas may exit the system 100 through an exhaust muffler 126. A pressure transducer 128 may be located between the concentrator 114 and the vacuum generator 124 to get a pressure reading of the exhaust flow from the concentrator 114. At maximum rated speed and a flow rate of 20.8 SLPM, the pressure at the vacuum side is preferably -5.9 psig nominal and may range from -8.8 to -4.4 psig.

1. Compressor/Variable Speed Controller

[0049] Example of compressor technologies that may be used for the compressor 112 include, but not by way of limitation, rotary vane, linear piston with wrist pin, linear piston without wrist pin, nutating disc, scroll, rolling piston, diaphragm pumps, and acoustic. Preferably the compressor 112 and vacuum generator 124 are integrated with the motor 118 and are oil-less, preventing the possibility of oil or grease from entering the air flow path.

[0050] The compressor 112 preferably includes, at a minimum, a 3:1 speed ratio, with a low speed of at least 1,000 rpm and a 15,000 hour operating life when run at full speed. Operating temperature surrounding the compressor/motor system is preferably

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32 to 122 degrees F. Storage temperature is preferably -4 to 140 degree F. Relative humidity is preferably 5 to 95% RH noncondensing. Voltage for the compressor 112 is preferably 12 V DC or 24V DC and the electrical power requirements are preferably less than 100 W at full speed and rated flow/nominal pressure and less than 40 W at 1/3 speed and 1/3 flow at rated pressure. A shaft mounted fan or blower may be incorporated with the compressor 112 for compressor cooling and possible complete system cooling. Preferably, the maximum sound pressure level of the compressor 112 may be 46 dBA at a maximum rated speed and flow/pressure and 36 dBA at 1/3 rated speed. Preferably the compressor 112 weighs less than 3.5 pounds.

[0051] It is desirable for the compressor 112 to run at a variety of speeds; provide the required vacuum/pressure levels and flow rates, emit little noise and vibration, emit little heat, be small, not be heavy, and consume little power.

[0052] The variable-speed controller 119 is important for reducing the power consumption requirements of the compressor 112 on the rechargeable battery 104 or other energy source. With a variable-speed controller, the speed of the compressor 112 may be varied with the activity level of the user, metabolic condition of the user, environmental condition, or other condition indicative of the oxygen needs of the user as determined through the one or more output sensors 106.

[0053] For example, the variable-speed controller may decrease the speed of the motor 118 when it is determined that the oxygen requirements of the user 108 are relatively low, e.g., when the user is sitting, sleeping, at lower elevations, etc., and increased when it is determined that the oxygen requirements of the user 108 are relatively high or higher, e.g., when the user stands, when the user is active, when the user is at higher elevations, etc. This helps to conserve the life of the battery 104, reduce the weight and size of the battery 104, and reduce the compressor wear rate, improving its reliability.

[0054] One of the inventors of the present invention was a co-inventor on a variable-speed controller in the past that regulated the compressor speed to operate the compressor only at the speed and power needed to deliver oxygen at the user's prescribed flow rate.

[0055] The variable-speed controller 119 allows the compressor 112 to operate at a low average rate, typically the average rate or speed will be between full speed and 1/6

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full speed of the compressor 112, resulting in an increase in battery life, decrease in battery size and weight, and decrease in compressor noise and emitted heat.

2. Concentrator

[0056] In a preferred embodiment, the concentrator 114 is an Advanced Technology Fractionator (ATF) that may be used for medical and industrial applications. The ATF may implement a pressure swing adsorption (PSA) process, a vacuum pressure swing adsorption (VPSA) process, a rapid PSA process, a very rapid PSA process or other process. If a PSA process is implemented, the concentrator preferably includes a rotary valve assembly to control air flow through multiple sieve beds. In an alternative, less preferred embodiment, the concentrator may include a non-rotating valve mechanism to control air flow through multiple sieve beds. The sieve beds may be tapered so that they have larger diameter where gaseous flow enters the beds and a smaller diameter where gaseous flow exits the beds. Tapering the sieve beds in this manner requires less sieve material and less flow to obtain the same output.

[0057] Although an ATF concentrator 114 is used in a preferred embodiment, it will be readily apparent to those skilled in the art that other types of concentrators or air-separation devices may be used such as, but not by way of limitation, membrane separation types and electrochemical cells (hot or cold). If other types of concentrators or air-separation devices are used, it will be readily apparent to those skilled in the art that some aspects described herein may change accordingly. For example, if the air-separation device is a membrane separation type, pumps other than a compressor may be used to move air through the system.

[0058] The ATF preferably used is significantly smaller that ATFs designed in the past. The inventors of the present invention recognized that reducing the size of the ATF concentrator 114 not only made the system 100 smaller and more portable, it also improved the recovery percentage, i.e., the percentage of oxygen gas in air that is recovered or produced by the concentrator 114 and the productivity (liters per minute/lb. of sieve material) of the concentrator 114. Reducing the size of the ATF decreases the cycle time for the device. As a result, productivity is increased.

[0059] Further, the inventors also determined that finer sieve materials increased recovery rates and productivity. The time constant to adsorb unwanted gases is smaller for finer particles because the fluid path is shorter for the gases than for larger particles. Thus,

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fine sieve materials having small time constants are preferred. The sieve material may be a LithiumX Zeolite that allows for a high exchange of Lithium ions. The bead size may, for example, be 0.2-0.6 mm. In an alternative embodiment, the Zeolite may be in the form of a rigid structure such as an extruded monolith or in the form of rolled up paper. In this embodiment, the Zeolite structure would allow for rapid pressure cycling of the material without introducing significant pressure drop between the feed and product streams.

[0060] The size of the concentrator 114 may vary with the flow rate desired. For example, the concentrator 114 may come in a 1.5 Liter per minute (LPM) size, a 2 LPM size, a 2.5 LPM size, a 3 LPM size, etc.

[0061] The oxygen gas generator 102 may also include an oxygen source in addition to the concentrator 114 such as, but not by way of limitation, a high-pressure oxygen reservoir, as described in more detail below.

[0062] An ATF valve controller 133 may be integral with or separate from the control unit 110 and is coupled with valve electronics in the concentrator 114 for controlling the valve(s) of the concentrator 114.

[0063] The concentrator may have one or more of the following energy saving modes: a sleep mode, a conserving mode, and an active mode. Selection of these modes may be done manually by the user 108 or automatically such as through the described one or more sensors 106 and control unit 110.

[0064] With reference to Figures 3A and 3B, an embodiment of a concentrator 114 that may be used in the oxygen generator 102 will now be described in more detail. Although the concentrator 114 will be described as separating oxygen from air, it should be noted that the concentrator 114 may be used for other applications such as, but not by way of limitation, air separations for the production of nitrogen, hydrogen purification, water removal from air, and argon concentration from air. As used herein, the term "fluids" includes both gases and liquids.

[0065] The concentrator 114 described below includes numerous improvements over previous concentrators that result in increased recovery of the desired component and increased system productivity. Improved recovery is important since it is a measure of the efficiency of the concentrator. As a concentrator's recovery increases, the amount of feed gas required to produce a given amount of product decreases. Thus, a concentrator with higher recovery may require a smaller feed compressor (e.g., for oxygen concentration

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from air) or may be able to more effectively utilize feed gas to recover valuable species (e.g., for hydrogen purification from a reformate stream). Improved productivity is important since an increase in productivity relates directly to the size of the concentrator. Productivity is measured in units of product flow per mass or volume of the concentrator. Thus, a concentrator with higher productivity will be smaller and weigh less than a concentrator that is less productive, resulting in a more attractive product for many applications. Therefore, concentrator improvements in recovery, productivity, or both are advantageous. The specific improvements that lead to improved recovery and productivity are detailed below.

[0066] The concentrator 114 includes five adsorption beds 300, each containing a bed of adsorbent material which is selective for a particular molecular species of fluid or contaminant, a rotary valve assembly 310 for selectively transferring fluids through the adsorption beds 300, an integrated tube-assembly and mainifold "manifold" 320, a product tank cover 330, and a valve assembly enclosure 340.

[0067] The adsorption beds 300 are preferably straight, elongated, molded, plastic vessels surrounded by the product tank cover 330, which is made of metal, preferably aluminum. The molded, plastic adsorption beds 300 surrounded by the metal cover 330 make for a low-cost design without the detrimental effects of water influx that occur with prior-art plastic housings or covers. Plastic adsorption beds have the inherent problem of the plastic being permeable to water. This allows water to penetrate into the adsorbent material, decreasing the performance of the adsorbent material. Surrounding the plastic adsorption beds 300 with the aluminum cover 330, which also may serve as a product accumulation tank, maintains the low cost of the design and does not sacrifice performance.

[0068] Each adsorption bed 300 includes a product end 350 and a feed end 360. With reference additionally to Figure 4, the product ends 350 of the beds 300 communicate with incoming product passages 370 of the manifold 320 through product lines 380 for communication with the rotary valve assembly 310. The feed ends 360 of the beds 300 communicate with outgoing feed passages 390 of the manifold 320 for communication with the rotary valve assembly 310.

[0069] The manifold 320 may also include outgoing product passages 400 that communicate the rotary valve assembly 310 with the interior of the product tank 330, an

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incoming feed passage 410 that communicates the rotary valve assembly 310 with a feed pressure line 420, and a vacuum chamber 430 that communicates the rotary valve assembly 310 with a vacuum pressure line 440. A product delivery line 450, which may be the same as the supply line 121 described above with respect to Figure 2, communicates with the interior of the product tank 330. The vacuum pressure line 440 may communicate directly or indirectly with the vacuum generator 124 for drawing exhaust gas from the concentrator 114.

[0070] In use, air flows from the compressor 112 to the feed pressure line 420, through the incoming feed passage 410 of the manifold 320. From there, air flows to the rotary valve assembly 310 where it is distributed back through outgoing feed passages 390 of the manifold 320. From there, the feed air flows to the feed ends 360 of the adsorption beds 300. The adsorption beds 300 include adsorbent media that is appropriate for the species that will be adsorbed. For oxygen concentration, it is desirable to have a packed particulate adsorbent material that preferentially adsorbs nitrogen relative to oxygen in the feed air so that oxygen is produced as the non-adsorbed product gas. An adsorbent such as a highly Lithium exchanged X-type Zeolite may be used. A layered adsorbent bed that contains two or more distinct adsorbent materials may also be used. As an example, for oxygen concentration, a layer of activated alumina or silica gel used for water adsorption may be placed near the feed end 360 of the adsorbent beds 300 with a lithium exchanged X-type zeolite used as the majority of the bed toward the product end 350 to adsorb nitrogen. The combination of materials, used correctly, may be more effective than a single type of adsorbent. In an alternative embodiment, the adsorbent may be a structured material and may incorporate both the water adsorbing and nitrogen adsorbing materials.

[0071] The resulting product oxygen gas flows towards the products ends 350 of the adsorption beds 300, through the product lines 380, through incoming product passages 370 of the manifold 320, and to the rotary valve assembly 310, where it is distributed back through the manifold 320 via the outgoing product passage 400 and into the product tank 330. From the product tank 330, oxygen gas is supplied to the user 108 through the product delivery line 450 and the supply line 121.

[0072] With reference to Figures 3B, 5A, 5B, 6A, 8A, and 8B, an embodiment of the rotary valve assembly 310 will now be described. The rotary valve assembly 310 includes a rotary valve shoe or disk 500 and a valve port plate or disk 510. The rotary

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valve shoe 500 and valve port plate 510 are both preferably circular in construction and made from a durable material such as ceramic, which can be ground to a highly polished flat finish to enable the faces of the valve shoe 500 and port plate 510 to form a fluid-tight seal when pressed together.

[0073] With reference specifically to FIG. 5A, the rotary valve shoe 500 has a flat, bottom engagement surface 520 and a smooth cylindrical sidewall 530. The valve shoe 500 has several symmetrical arcuate passages or channels cut into the engagement surface 520, all of which have as their center the geometric center of the circular engagement surface 520. The passages or channels include opposite high-pressure feed channels 540, equalization channels 550, opposite low-pressure exhaust passages 560, circular low-pressure exhaust groove 570 which communicates with exhaust passages 560, opposite product delivery channels 580, opposite purge channels 590, a high-presure central feed passage 600, a first annular vent groove 610, and a second annular vent groove 620.

[0074] With reference additionally to Figure 5B, a parallel, top, second valve surface 630 of the rotary valve shoe 500 will now be described. The purge channels 590 of the engagement surface 520 communicate with each other through vertical, cylindrical purge passages 640 and a rainbow-shaped purge groove 650 on the top surface 630. The equalization channels 550 of the engagement surface 520 extend vertically through the valve shoe 500. Pairs of equalization channels 550 communicate through equalization grooves 660 on the top surface 630. The equalization grooves 660 are generally U-shaped and extend around receiving holes 670. Equalization routing via the grooves 660 on the second valve surface 630, in a plane out of and parallel to a plane defined by the engagement surface 520, helps to maintain the relatively small size of the rotary valve shoe 500 while at the same time enabling more complex fluid routing through the valve shoe 500. The equalization grooves allow the secondary valve surface to be used to equalize pressures between adsorption beds 300.

[0075] With reference to Figures 3B, 8A, and 8B, a first valve shoe cover 680 is disposed over the second valve surface 630 to isolate the various grooves and passages on the second valve surface 630. Both the first valve shoe cover 680 and the second valve shoe cover 690 include aligned central holes 691, 692, respectively, for communicating the central feed passage 600 with a high-pressure feed fluid chamber formed around the

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periphery of a cylindrical base 693 of the second valve shoe cover 690. The first valve shoe cover 680 also includes a plurality of holes 694 near its periphery for the purpose of maintaining a balance of pressure during operation on either side of the first valve shoe cover 680 between the cylindrical base 693 and the second valve surface 630. Routing the high-pressure feed fluid into the high-pressure feed fluid chamber on the top or backside of the valve shoe 500 causes pressure balancing on the valve shoe 500 that counteracts the pressure force urging the valve shoe 500 away from the port plate 510. A spring or other type of passive sealing mechanism (not shown) may be used to hold the rotary valve shoe 500 against the port plate 510 when the concentrator 114 is not operating.

[0076] With reference to Figure 5A, to additionally counteract the pressure force that works to unseat the rotary valve shoe 500 from the port plate 510, the exhaust goove 570 is sized such that, when the concentrator 114 is operated at nominal feed and purge (vacuum) pressures, the sealing force due to the vacuum in the exhaust groove 570 subtantially balances this unseating pressure force. This enables the use of relatively small passive sealing mechanisms, reducing the torque and power required to turn the rotary valve shoe 500 and also reduces the weight and size of the concentrator 114.

[0077] With reference to Figure 6A, the valve port plate 510 will now be described in greater detail. The valve port plate 510 has a flat engagement surface 700 that engages the flat engagement surfce 520 of the rotary valve shoe 500 and a smooth cylindrical sidewall 710. With reference additionally to Figure 3B, an underside of the valve port plate 510 is disposed on a manifold gasket 720. The valve port plate 510 includes multiple sets of generally symmetric concentrically disposed ports or openings aligned with openings in the manifold gasket 720 to communicate the ports in the plate 510 with the passages in the manifold 320. The ports extend vertically through the valve port plate 510 in a direction generally perpendicular to the engagement surface 700. In an alternative embodiment, the ports extend vertically through the valve port plate 510 in an angular direction toward the engagement surface 700. Preferably, all of the ports of each concentric set have the same configuration. Each concentric set of ports will now be described in turn.

[0078] A first set of eight circular vacuum ports 730 concentrically disposed at a first radius from the geometric center of the valve port plate 510 communicate with the vacuum chamber 430 of the manifold 320 and the exhaust gas grooves 570 of the valve

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shoe 500. In the prefered embodiment, eight ports are used as they allow sufficient gas flow through the valve without significant pressure drop. In an alternative embodiment, a number of ports different from eight could be used.

[0079] A second set of five round outgoing feed ports 740 concentrically disposed at a second radius from the geometric center of the valve port plate 510 communicate with outgoing feed passages 390 of the manifold 320, the feed channels 540 of the valve shoe 500, and the vacuum ports 730 via the exhaust passages 560 of the valve shoe 500.

[0080] A third set of five generally elliptical incoming product ports 750 concentrically disposed at a third radius from the geometric center of the valve port plate 510 communicate with the incoming product passages 370 of the manifold 320, the equalization channels 550 of the valve shoe 500, the purge channels 590 of the valve shoe 500, and the product delivery channels 580.

[0081] A fourth set of five circular outgoing product ports 760 concentrically disposed at a fourth radius from the geometric center of the valve port plate 510 communicate with the outgoing product passages 400 of the manifold 320 and the incoming product ports 750 via the product delivery channels 580.

[0082] A fifth set of three circular port plate alignment holes 731 concentrically disposed at a fifth radius from the geometric center of the valve port plate 510 align with alignment pins 321 (Figures 3B, 4) on the manifold 320. The alignment holes 731 ensure the port plate 510 will sit in proper alignment with the manifold 320. In an alternative embodiment, two or more alignment holes located at one or more radiuses from the geometric center of the valve port plate 510 may be aligned with an equal number of alignment pins located at set positions on the manifold 320.

[0083] A round central incoming feed port 770 disposed at the geometric center of the valve port plate 510 and the center of rotation of the valve assembly 310 communicates with the incoming feed passage 410 of the manifold 320 and the central feed pasage 600 of the rotary valve shoe 500.

[0084] In the rotary valve assembly 310 described above, a maximum of 1 PSI pressure drop occurs through any port of the valve asembly 310 when the system is producing 3 LPM of oxygen product. At lesser flows, the pressure drop is negligible.

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[0085] With reference additionally to Figure 6B, a single pressure swing adsorption cycle of the concentrator 114 will now be described. During use, the rotary valve shoe 500 rotates with respect to the valve port plate 510 so that the cycle described below is sequentially and continuously established for each adsorption bed 300. The speed of rotation of the rotary valve shoe 500 with respect to the valve port plate 510 may be varied alone, or in combination with a variable-speed compressor, in order to provide the optimal cycle timing and supply of ambient air for a given production of product. To help the reader gain a better understanding of the invention, the following is a description of what occurs in a single adsorption bed 300 and the rotary valve assembly 310 during a single cycle. It should be noted, with each revolution of the rotary valve shoe 500, the adsorption beds 300 undergo two complete cycles. For each cycle, the steps include: 1) pre-pressurization 774, 2) adsorption 776, 3) first equalization down 778, 4) second equalization down 780, 5) co-current blowdown 782, 6) low-pressure venting 784, 7) counter-current purge and low-pressure venting 786, 8) first equalization up 788, and 9) second equalization up 790. Each of these steps will be described in turn below for an adsorption bed 300.

[0086] In the pre-pressurization step 774, air flows from the compressor 112 to the feed pressure line 420, through the incoming feed passage 410 of the manifold 320. From there, air flows through the central incoming feed port 770 of the port plate 510, through the central feed passage 600 and out the feed channels 540 of the valve shoe 500, through the outgoing feed ports 740, and through outgoing feed passages 390 of the manifold 320. From there, the feed air flows to the feed ends 360 of the adsorption beds 300. With reference to Figure 5A, because the feed channel 540 is advanced with respect to the product delivery channel 580 (i.e., initially the feed channel 540 is in communication with outgoing feed port 740 and the product delivery channel 580 is blocked, not in communication with the incoming product port 750), the feed end 360 of the adsorption bed 300 is pressurized with feed gas, i.e., pressurized, prior to the commencement of product delivery. In alternative embodiments, the product end 350 may be pre-pressurized with product gas, or the product end 350 may be pre-pressurized with product gas and the feed end 360 may be pre-pressurized with feed gas.

[0087] In the adsorption step 776, because the product delivery channel 580 is in communication with the incoming product port 750, adsorption of Nitrogen occurs in the

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bed 300 and the resulting product oxygen gas flows towards the product ends 350 of the adsorption beds 300, through the product lines 380, and through incoming product passages 370 of the manifold 320. From there, oxygen gas flows through the incoming product port, into and out of the product delivery channel 580, through outgoing product port 760, through the outgoing product passage 400, and into the product tank 330. From the product tank 330, oxygen gas is supplied to the user 108 through the product delivery line 450 and the supply line 121.

[0088] In the first equalization-down step 778, the product end 350 of the bed 300, which is at a high pressure, is equalized with the product end of another bed, which is at a low pressure, to bring the product end 350 of the bed 300 to a lower, intermediate pressure. The product ends 350 communicate through the product lines 380, the incoming product passages 370, the incoming product ports 750, the equalization channels 550, and the equalization groove 660. As indicated above, equalization routing via the grooves 660 on the second valve surface 630, in a plane out of and parallel to a plane defined by the engagement surface 520, helps to maintain the relatively small size of the rotary valve shoe 500, in order to keep the torque required to turn the valve shoe 500 as low as possible, while at the same time enabling more complex fluid routing through the valve shoe 500. In this step 778 and the equalization steps 780, 788, 790 to be discussed below, the adsorption beds 300 may be equalized at either the feed end 360, the product end 350, or a combination of the feed end 360 and the product end 350.

[0089] In the second equalization-down step 780, the product end 350 of the bed 300, which is at an intermediate pressure, is equalized with the product end of another bed, which is at a lower pressure, to bring the product end 350 of the bed 300 further down to an even lower pressure than in step 778. Similiar to the first equalization-down step 778, the product ends 350 communicate through the product lines 380, the incoming product passages 370, the incoming product ports 750, the equalization channels 550, and the equalization groove 660.

[0090] In the co-current blowdown ("CCB") step 782, oxygen enriched gas produced from the product end 350 of the adsorption bed 300 is used to purge a second adsorption bed 300. Gas flows from the product side of the adsorption bed 300, through product line 380, incoming product passage 370, and incoming product port 750. The gas further flows through purge channel 590, purge passage 640, through the purge groove

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650, out the purge passage 640 on the opposite side of the valve shoe 500, through the purge channel 590, through the incoming product port 750, through the incoming product pasasge 370, through the product line 380, and into the product end 350 of adsorption bed 300 to serve as a purge stream. In an alternative embodiment, in this step 782 and the following step 784, co-current blowdown may be replaced with counter-current blowdown.

[0091] In the low-pressure venting ("LPV") step 784, the adsorption bed 300 is vented to low pressure through the feed end 360 of the adsorption bed 300. The vacuum in the exhaust groove 570 of the rotary valve shoe 500 communicates with the exhaust passage 560 and the feed end 360 of the adsorption bed 300 (via the outgoing feed port 740 and outgoing feed passage 390) to draw the regeneration exhaust gas out of the adsorption bed 300. The low pressure venting step 784 occurs without introduction of oxygen enriched gas because the exhaust passage 560 is in communication with the outgoing feed port 740 and the purge channel 590 is not in communication with the incoming product port 750.

[0092] In the counter-current purge and low-pressure venting ("LPV") step 786, oxygen enriched gas is introduced into the product end 350 of the adsorption bed 300 in the manner described above in step 782 concurrently with the feed end 360 of the adsorption bed 300 being vented to low pressure as was described in the above step 784. Counter-current purge is introduced into the product end 350 of the adsorbent bed 300 through fluid communication with the product end 350 of a second adsorption bed 300. Oxygen enriched gas flows from the product end 350 of the second adsorption bed 300 through the product line 380, incoming product passage 370, incoming product port 750, through purge channel 590, purge passage 640, through the purge groove 650, out the purge passage 640 on the opposite side of the valve shoe 500, through the purge channel 590, through the incoming product port 750, through the incoming product passage 370, through the product line 380, and into the product end 350 of adsorption bed 300. Because the exhaust passage 560 is also in communication with the outgoing feed port 740 during this step 786, oxygen enriched gas flows from the product end 350 to the feed end 360, regenerating the adsorption bed 300. The vacuum in the exhaust groove 570 of the rotary valve shoe 500 communicates with the exhaust passage 560 and the feed end 360 of the adsorption bed 300 (via the outgoing feed port 740 and outgoing feed passage 390) to

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draw the regeneration exhaust gas out of the adsorption bed 300. From the exhaust passage 560, the exhaust gas flows through the vacuum ports 730, into the vacuum chamber 430, and out the vacuum presure line 440. In an alternative embodiment, the vacuum may be replaced with a low-pressure vent that is near atmospheric pressure or another pressure that is low relative to the feed pressure. In another embodiment, product gas from the product tank 330 is used to purge the product end 350 of the adsorbent bed 300.

[0093] In the first equalization-up step 788, the product end 350 of the bed 300, which is at a very low pressure, is equalized with the product end of another bed, which is at a high pressure, to bring the adsorption bed 300 to a higher, intermediate pressure. The product ends 350 communicate through the product lines 380, the incoming product passages 370, the incoming product ports 750, the equalization channels 550, and the equalization groove 660.

[0094] In the second equalization-up step 790, the product end 350 of the bed 300, which is at an intermediate pressure, is equalized with the product end of another bed, which is at a higher pressure, to bring the product end 350 of the bed 300 further up to an even higher pressure than in step 788. Similiar to the first equalization-down step 778, the product ends 350 communicate through the product lines 380, the incoming product passages 370, the incoming product ports 750, the equalization channels 550, and the equalization groove 660.

[0095] It should be noted, in a preferred embodiment, the combined duration of feed steps 774, 776 may be substantially the same as the combined duration of purge steps 782, 784, 786, which may be substantially three times the duration of each equalization step 778, 780, 788, 790. In an alternative embodiment, the relative duration of the feed steps 774, 776, the purge steps 782, 784, 786, and the each equalization step 778, 780, 788, 790 may vary.

[0096] After the second equalization-up step 790, a new cycle begins in the adsorption bed 300 starting with the pre-pressurization step 774.

[0097] The five-bed concentrator 114 and cycle described above has a number of advantages over other-numbered concentrators and cycles used in the past, some of which are described below. The multiple equalization steps 788, 790 at the product ends 350 and the pre-pressurization step 774 contribute to the pre-pressurization of the

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adsorption beds 300 prior to product delivery. As a result, the beds 300 reach their ultimate pressure (substantially equal to the feed pressure) quickly and thereby allow for maximum utilization of the adsorbent media. Additionally, pre-pressurizing the adsorbent beds 300 allows product to be delivered at substantially the same pressure as the feed, thereby retaining the energy of compression in the stream, which makes the product stream more valuable for use in downstream processes. In an alternative embodiment, pre-pressurizing the beds 300 with product before exposing the feed end 360 of the bed 300 to the feed stream eliminates any pressure drop experienced due to the fluid interaction or fluid communication between two or more adsorbent beds 300 on the feed end 360. Additionally, compared to systems with greater numbers of beds, the use of a 5-bed system, reduces the duration and number of beds that are in fluid communication with the feed chanels 540 at the same time, thereby reducing the propensity for fluid flow between adsorption beds. Since fluid flow between adsorption beds is associated with a reversal of the flow direction in the higher pressure bed (resulting in decreased performance), reduction in this effect is advantageous.

[0098] A further advantage of a 5-bed system over many systems is that it includes a small number of adsorption beds 300, allowing the concentrator to be relative small, compact, and light-weight, while delivering sufficient flow and purity and maintaining high oxygen recovery. Other PSA systems, typically those with a small number of adsorption beds, result in deadheading the compressor (resulting in high power use) during a portion of the cycle. Deadheading the compressor eliminates detrimental flow between the feed side 360 of the two or more adsorption beds 300 (as discussed above) but increases system power. The 5-bed system eliminates compressor deadheading and minimizes performance-limiting feed side 360 flow between adsorbent beds 300.

[0099] Use of the multiple pressure equalization steps 778, 780, 788, 790 reduces the amount of energy of compression required to operate the concentrator 114. Equalizing the beds 300 conserves high-pressure gas by moving it to another bed 300 rather than venting it to the atmosphere or to a vacuum pump. Because there is a cost associated with pressurizing a gas, conserving the gas provides a savings and improves recovery. Also, because a bed 300 may contain gas enriched with product, usually at the product end 350 of the bed 300, allowing this gas to move into another bed 300, rather than venting it, conserves product and improves recovery. The number of equalizations

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are preferably between one and four. It should be noted, each equalization represents two equalization steps, an equalization-down step and an equalization-up step. Thus, two equalizations means two down equalizations and two up equalizations, or four total equalizations. The same is true for other-number equalizations. In a preferred embodiment, one to four equalizations (two to eight equalization steps) are used in each cycle. In a more preferred embodiment, one to three equalizations (two to six equalization steps) are used in each cycle. In a most preferred embodiment, two equalizations (four equalization steps) are used in each cycle.

[00100] In alternative embodiments, the concentrator 114 may have other numbers of adsorption beds 300 based on the concentration of the feed stream, the specific gases to be separated, the pressure swing adsorption cycle, and the operating conditions. For example, but not by way of limitation, there also are advantages to four-bed concentrators and six-bed concentrators. When operating a cycle similar to that described above with a four-bed concentrator, the problem of fluid communication between the feed chanels 540 and more than one adsorption bed (at one instant) is completely eliminated. When the feed-end fluid communication is eliminated, the feed steps 774, 776 occur in a more desirable fashion resulting in improved recovery of the desired product.
The advantages of a six-bed system, compared to a five-bed system, are realized when the pressure-swing cycle described above is modified so that there are three equalization up stages and three equalization down stages instead of two equalization up stages and two equalization down stages. A third equalization is advantageous when the feed gas is available at high pressure. The third equalization conserves compressor energy because it allows the equalized beds to obtain substantially 75% of the feed pressure compared to substantially 67% of the feed pressure when two equalization stages are used. In any PSA cycle, whenever an equalization up occurs, there is a corresponding equalization down. The requirement of matching equalization stages inparts some restrictions on the relative timing of the cycle steps. If, for example, the duration of the feed step is substantially the same as the duration of each equalization step, then a six-bed cycle would provide the required matching of equalization stages.

[0100] A number of additional inventive aspects related to the concentrator 114 that increase recovery of a desired component and system productivity will now be described. With reference to Figures 3A, 3B, 7A, and 7B, an embodiment of a media

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retention cap 800 that reduces dead volume in the adsorption beds 300 will now be described. Each media retention cap 800 is located at the product end 350 of the adsorption bed 300 and supports the adsorbent material above the media retention cap 800. A spring 810 located within and below the media retention cap 800 urges the media retention cap 800 upwards to hold the packed bed of adsorbent material firmly in place. The media retention cap 800 has a cylindrical base 820 with first and second annular flanges 830, 840. The second annular flange 840 terminates at its top in a circular rim 850. A top surface 860 of the media retention cap 800 includes a plurality of ribs 870 radiating in a generally sunburst pattern from a central port 880. Adjacent the central port 880, gaps 890 create diffusion zones for purge fluid coming out of the central port 880. The gaps 890 and the radiating ribs 870 cause the purge fluid to be distributed outward from the central port 880, causing a more uniform, improved regeneration of the adsorbent material during a purging step. The radiating ribs 870 also help to channel product gas towards the central port 880 during a product delivery step. In an alternative embodiment, the media retention cap 800 may have a generally non-cylindrical surface to retain media in a generally non-cylindrical adsorbtion bed 300. In a further alternative embodiment, the central port 880 may be located away from the geometric center of the either cylindrical or non-cylindrical media retention cap 800.

[0101] With reference to Figure 7B, on the underside of the media retention cap 800, the cydrical base 820 forms an interior chamber in which the spring 810 is disposed. A central port nipple 900 extends from a bottom surface 910 of the media retention cap 800. An end of the product line 380 connects to the central port nipple 900 for communicating the product end 350 of the adsorption bed 300 with the incoming product passage 370 of the manifold 320.

[0102] In the past, media retention caps may be held in place with a spring that fits inside and above the cap so that the spring is in the fluid flow path between the bottom of the adsorbent material and any exit port, at the product end 350 of the bed 300. The volume in which the spring is housed represents dead volume in the system. As used herein, "dead volume" is system volume that is compressed and purged, but does not contain adsorbent media. The process of filling this volume with compressed feed and then venting that volume represents wasted feed. The improved media retention cap 800 does not add dead volume to the system because the spring 810 is housed outside of the

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fluid flow path. Elimination of any extra volume within the system results directly in more effective utilization of the feed, and, thus, higher recovery of the desired product.

[0103] With reference to Figures 8A and 8B, an embodiment of a centering mechanism for maintaining the rotary valve shoe 500 laterally fixed and centered with respect to the valve port plate 510 will now be described. The centering mechanism may include a centering pin 920 having a hollow cylindrical shape and made of a rigid material. When the engagement surface 520 of the rotary valve shoe 500 is engaged with the engagement surface 700 of the valve port plate 510, the centering pin 920 is partially disposed in the central feed pasage 600 of the rotary valve shoe 500 and the central incoming feed port 770 of the valve port plate 510. In use, the rotary valve shoe 500 rotates around the centering pin 920 and the hollow interior of the centering pin 920 allows high-pressure feed fluid to flow therethrough. The pin 920 maintains the rotating valve shoe in a fixed position relative to the valve port plate 510. In the past, the rotary valve shoe was roughly centered with respect to the valve port plate by the motor that drives the rotary valve shoe. If the rotary valve shoe 500 and the valve port plate 510 are off center with respect to each other, the concentrator 114 will not cycle as intended, inhibiting the productivity, recovery, and efficiency of the concentrator. The precision offered by the centering pin 920 is important when the valve assembly 310 is controlling complex cycles or maintaining very small pressure drops.

[0104] With reference to Figures 9A and 9B, a rotary valve assembly constructed in accordance with another embodiment of the invention includes an alternative centering mechanism to maintain the rotating valve shoe 500 in a fixed position relative to the valve port plate 510. A circular centering ring 930 fits snugly over the smooth cylindrical sidewall 530 of the rotary valve shoe 500 and the smooth cylindrical sidewall 710 of the stationary valve port plate 510. The circular ring 930 centers the rotary valve shoe 500 relative to the valve port plate 510 by holding the rotary shoe 500 in a fixed position relative to the port plate 510 while at the same time allowing the rotary valve shoe 500 to rotate.

[0105] With reference to Figures 10A-10C, an embodiment of an elastic link for coupling the motor 118 to the valve shoe 500 will now be described. A drive mechanism 940 includes a drive shaft 950, a drive wheel 960, and three (two shown) elastic chain links 970. The drive shaft 950 may be connected to the motor 118 for rotating the drive

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wheel 960. With reference to Figure 10C, a lower side 980 of the drive wheel 960 may include downwardly protruding cylindrical support posts 990. Similarly, with reference to Figure 10B, an upper side 1000 of the second valve shoe cover 690 may include upwardly protruding cylindrical support posts 1010. The elastic chain links 970 are preferably made of semi-rigid, elastic material (such as silicon rubber) and have a generally wrench-shaped configuration. Each elastic chain link 970 includes cylindrical receiving members 1020 with central cylindrical bores 1030. The cylindrical receiving members 1020 are joined by a narrow connecting member 1040. The drive wheel 960 is coupled to the second valve shoe cover 690 through the elastic chain links 970. One receiving member 1020 of each elastic chain link receives the support post 990 of the drive wheel 960 and the other receiving member 1020 receives the support post 1010 of the second valve shoe cover 690. In the past, rigid connections were made between the motor and the rotating valve shoe. These rigid connections caused the rotating valve shoe to be affected by vibration or other non-rotational movement of the motor. The elastic chain links 970 absorb the vibration and non-rotational movement of the motor, preventing this detrimental energy from being imparted to the rotating valve shoe 500.

[0106] Figure 11 is a table of experimental data from a concentrator similar to the concentrator 114 shown and described above with respect to Figures 3-10. As shown by this table, the recovery of oxygen from air with the concentrator 114 is 45-71% at about 90% purity. The ratio of adiabatic power (Watts) to oxygen flow (Liters Per Minute) is in the range of 6.2 W/LPM to 23.0 W/LPM. As defined in Marks' Standard Handbook for Mechanical Engineers, Ninth Edition, by Eugene A. Avallone and Theodore Baumeister, the equation for adiabatic power, tanken from the equation from adiabatic work, is as follows:

$$Power = \frac{W}{t} = P_1 V_1 \left(\frac{k}{1-k}\right)\left[\left(\frac{P_2}{P_1}\right)^{\frac{k-1}{k}} - 1\right] C$$

Power = Adiabatic Power (Watts)

W = Adiabatic Work (Joule)

t = time (Second)

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P_1 = Atmospheric Pressure (psia)

P_2 = Compressor / Vacuum pressure (psia)

k = Ratio of Specific Heats = constant = 1.4 (for air)

V_1 = Volumetric flow rate at atmospheric pressure (SLPM)

C = Conversion Factor, added by authors for clarity = 0.114871 Watts / psi / LPM

D. Energy Source

[0107] With reference additionally to Figure 12, in order to properly function as a lightweight, portable system 100, the system 100 must be energized by a suitable rechargeable energy source. The energy source preferably includes a rechargeable battery 104 of the lithium-ion type. It will be readily apparent to those skilled in the art that'. the system 100 may be powered by a portable energy source other than a lithium-ion battery. For example, a rechargeable or renewable fuel cell may be used. Although the system is generally described as being powered by a rechargeable battery 104, the system 100 may be powered by multiple batteries. Thus, as used herein, the word "battery" includes one or more batteries. Further, the rechargeable battery 104 may be comprised of one or more internal and/or external batteries. The battery 104 or a battery module including the battery 104 is preferably removable from the system 100. The system 100 may use a standard internal battery, a low-cost battery, an extended-operation internal battery, and an external secondary battery in a clip-on module.

[0108] The system 100 may have a built-in adapter including battery charging circuitry 130 and one or more plugs 132 configured to allow the system 100 to be powered from a DC power source (e.g., car cigarette lighter adapter) and/or an AC power source (e.g., home or office 110 VAC wall socket) while the battery 104 is simultaneously being charged from the DC or AC power source. The adapter or charger could also be separate accessories. For example, the adapter may be a separate cigarette lighter adapter used to power the system 100 and/or charge the battery 104 in an automobile. A separate AC adapter may be used to convert the AC from an outlet to DC for use by the system 100 and/or charging the battery 104. Another example of an adapter may be an adapter used with wheel chair batteries or other carts.

[0109] Alternatively, or in addition, a battery-charging cradle 134 adapted to receive and support the system 100 may have an adapter including battery charging

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circuitry 130 and a plug 132 that also allow the system 100 to be powered while the battery 104 is simultaneously being charged from a DC and/or AC power source.

[0110] The system 100 and cradle 134 preferably include corresponding mating sections 138, 140 that allow the system 100 to be easily dropped into and onto the cradle 134 for docking the system 100 with the cradle 134. The mating sections 138, 140 may include corresponding electrical contacts 142, 144 for electrically connecting the system 100 to the cradle 134.

[0111] The cradle 134 may be used to recharge and/or power the system 100 in the home, office, automobile, etc. The cradle 134 may be considered part of the system 100 or as a separate accessory for the system 100. The cradle 134 may include one or more additional charging receptacles 146 coupled to the charging circuitry 130 for charging spare battery packs 104. With a charging receptacle 146 and one or more additional battery packs 104, the user can always have a supply of additional fresh, charged batteries 104.

[0112] In alternative embodiments, the cradle 134 may come in one or more different sizes to accommodate one or more different types of systems 100.

[0113] The cradle 134 and/or system 100 may also include a humidifying mechanism 148 for adding moisture to the air flow in the system 100 through appropriate connections 149. In an alternative embodiment of the invention, the humidifying mechanism 148 may be separate from the system 100 and the cradle 134. If separate from the system 100 and cradle 134, the cradle 134 and/or system 100 may include appropriate communication ports for communicating with the separate humidifying mechanism 148. The cradle 134 may also include a receptacle adapted to receive a separate humidifying mechanism 148 for use with the system 100 when the system 100 is docked at the cradle 134.

[0114] The cradle 134 and/or system 100 may also include a telemetry mechanism or modem 151 such as a telephone modem, high-speed cable modem, RF wireless modem or the like for communicating the control unit 110 of the system 100 with one or more remote computers. To this end, the cradle 135 may include a line 153 with a cable adapter or telephone jack plug 155, or a RF antenna 157. In an alternative embodiment of the invention, the telemetry mechanism or modem 151 may be separate from the cradle 134 and to this end, the cradle 134 or system 100 may include one or more

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appropriate communication ports, e.g., a PC port, for directly communicating the telemetry mechanism or modem 151 with the cradle 134 or system 100. For example, the cradle 134 may be adapted to communicate with a computer (at the location of the cradle) that includes the telemetry mechanism or modem 151. The computer may include appropriate software for communicating information described below using the telemetry mechanism or modem 151 with the one or more remote computers.

[0115] The telemetry mechanism or modem 151 may be used to communicate physiological information of the user such as, but not by way of limitation, heart rate, oxygen saturation, respiratory rate, blood pressure, EKG, body temperature, inspiratory/expiratory time ratio (I to E ratio) with one or more remote computers. The telemetry mechanism or modem 151 may be used to communicate other types of information such as, but not by way of limitation, oxygen usage, maintenance schedules on the system 100, and battery usage with one or more remote computers.

[0116] A user ideally uses the system 100 in its cradle 134 at home, at the office, in the automobile, etc. A user may decide to have more than one cradle, e.g., one at home, one at the office, one in the automobile, or multiple cradles at home, one in each room of choice. For example, if the user has multiple cradles 134 at home, when the user goes from room to room, e.g., from the family room to the bedroom, the user simply lifts the system 100 out of its cradle 134 in one room, and walks to the other room under battery operation. Dropping the system 100 in a different cradle 134 in th destination room restores the electrical connection between the system 100 and the AC power source. Since the system's batteries 104 are constantly charging or charged when located in the cradle 134, excursions outside the home, office, etc. are as simple as going from room to room in the user's home.

[0117] Because the system 100 is small and light (2-15 pounds), the system 100 may simply be lifted from the cradle 134 and readily carried, e.g., with a shoulder strap, by an average user to the destination. If the user is unable to carry the system 100, the system 100 may be readily transported to the destination using a cart or other transporting apparatus. For an extended time away from home, office, etc., the user may bring one or more cradles 134 for use at the destination. Alternatively, in the embodiment of the system 100 including the built-in adapter, power may be drawn from power sources such as a car cigarette lighter adapter and/or an AC power outlet available at the destination.

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Further, spare battery Packs 104 may be used for extended periods away from standard power sources.

[0118] If the battery pack 104 includes multiple batteries, the system 100 may include a battery sequencing mechanism to conserve battery life as is well known in the cellphone and laptop computer arts.

C. Output Sensor

[0119] With reference to Figures 1, 2 and 13, one or more output sensors 106 are used to sense one or more conditions of the user 108, environment, etc. to determine the oxygen flow rate needs of the user and, hence, the oxygen flow rate output requirements for the system 100. A control unit 110 is linked to the one or more output sensors 106 and the oxygen gas generator 102 to control the oxygen generator 102 in response to the condition(s) sensed by the one or more output sensors 106. These output sensors include a pressure sensor 150, a position sensor 152, an acceleration sensor 154, as well as a physiological condition or metabolic sensor 156 and an altitude sensor 158.

[0120] The first three sensors 150, 152, 154 (and, in certain circumstances, the physiological condition sensor 156) are activity sensors because these sensors provide a signal representing activity of the user 108. In the delivery of oxygen with a portable oxygen concentration system, it is important to deliver an amount of oxygen gas proportional to the activity level of the user 108 without delivering too much oxygen. Too much oxygen may be harmful for the user 108 and reduces the life of the battery 104. The control unit 110 regulates the oxygen gas generator 102 to control the flow rate of oxygen gas to the user 108 based on the oneor more signals representative of the activity level of the user produced by the one or more sensors 106. For example, if the output sensor(s) 106 indicates that the user 108 has gone from an inactive state to an active state, the control unit 110 may cause the oxygen gas generator 102 to increase the flow rate of oxygen gas to the user 108 and/or may provide a burst of oxygen gas to the user 108 from a high-pressure oxygen reservoir to be described. If the output sensor(s) 106 indicates that the user 108 has gone from an active state to an inactive state, the control unit 110 may cause the oxygen gas generator 102 to reduce the flow rate of oxygen gas to the user.

[0121] In an embodiment of the invention, the amount of oxygen gas supplied is controlled by controlling the speed of the compressor motor 118 via the variable-speed controller 119.

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[0122] Alternatively, or in addition to the variable-speed controller, the supply of oxygen gas may be controlled by the supply valve 160 located in the supply line 121 between the oxygen gas (generator 102 and the user 108. For example, the supply valve 160 may be movable between at least a first position and a second position, the second position allowing a greater flow of concentrated gaseous oxygen through than the first position. The control unit 110 may cause the supply valve 160 to move from the first position to the second position when one or more of the activity level sensors 152, 154, 156 senses an active level of activity of the user 108. For example, the control unit 110 may include a timer, and when an active level is sensed for a time period exceeding a predetermined timed period, the control unit 110 causes the valve 160 to move from the first position to the second position.

[0123] Examples of pressure sensors 150 include, without limitation, a foot switch that indicates when a user is in a standing position compared to a sedentary position, and a seat switch that indicates when a user is in a seated position compared to a standing position.

[0124] A pendulum switch is an example of a position sensor 152. For example, a pendulum switch may include a thigh switch positioned pendulously to indicate one mode when the user is standing, i.e., the switch hangs vertically, and another mode when the user seated, i.e., the thigh switch raised to a more horizontal position. A mercury switch may be used as a position sensor.

[0125] An acceleration sensor 158 such as an accelerometer is another example of an activity sensor that provides a signal representing activity of the user.

[0126] The physiological condition or metabolic sensor 156 may also function as an activity sensor. The physiological condition sensor 156 may be used to monitor one or more physiological conditions of the user for controlling the oxygen gas generator 102 or for other purposes. Examples of physiological conditions that may be monitored with the sensor 156 include, but without limitation, blood oxygen level, heart rate, respiration rate, blood pressure, EKG, body temperature, and I to E ratio. An oximeter is an example of a sensor that is preferably used in the system 100. The oximeter measures the blood oxygen level of the user, upon which oxygen production may be at least partially based.

[0127] An altitude sensor 158 is an example of an environmental or ambient condition sensor that may sense an environmental or ambient condition upon which

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control of the supply of oxygen gas to the user may be at least partially based. The altitude sensor 158 may be used alone or in conjunction with any or all of the above sensors, the control unit 110 and the oxygen gas generator 102 to control the supply of oxygen gas to the user in accordance with the sensed altitude or elevation. For example, at higher sensed elevations, where air is less concentrated, the control unit may increase the flow rate of oxygen gas to the user 108 and at lower sensed elevations, where air is more concentrated, the control unit may decrease the flow rate of oxygen gas to the user 108 or maintain it at a control level.

[0128] It will be readily apparent to those skilled in the art that one or more additional or different sensors may be used to sense a condition upon which control of the supply of oxygen gas to the user may be at least partially based. Further, any or all of the embodiments described above for regulating the amount of oxygen gas supplied to the user 108, i.e., variable-speed controller 119, supply valve 160, (or alternative embodiments) may be used with the one or more sensors and the control unit 110 to control of the supply of oxygen gas to the user 108.

D. Control Unit

[0129] With reference to Figure 14, the control unit 110 may take any well-known form in the art and includes a central microprocessor or CPU 160 in communication with the components of the system described herein via one or more interfaces, controllers, or other electrical circuit elements for controlling and managing the system. The system 100 may include a user interface (Figure 14) as part of the control unit 110 or coupled to the control unit 110 for allowing the user, provider, doctor, etc. to enter information, e.g., prescription oxygen level, flow rate, activity level, etc., to control the system 100.

[0130] The main elements of an embodiment of the system 100 have been described above. The following sections describe a number of additional features, one or more of which may be incorporated into the embodiments of the invention described above as one or more separate embodiments of the invention.

II. Conserving Device

[0131] With reference to Figure 15, a conserving device or demand device 190 may be incorporated into the system 100 to more efficiently utilize the oxygen produced by the oxygen gas generator 102. During normal respiration, a user 108 inhales for about

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one-third of the time of the inhale/exhale cycle and exhales the other two-thirds of the time. Any oxygen flow provided to the user 108 during exhalation is of no use to the user 108 and, consequently, the additional battery power used to effectively provide this extra oxygen flow is wasted. A conserving device 190 may include a sensor that senses the i nhale/exhale cycle by sensing pressure changes in the cannula 111 or another part of the system 100, and supply oxygen only during the inhale portion or a fraction of the inhale portion of the breathing cycle. For example, because the last bit of air inhaled is of no particular use because it is trapped between the nose and the top of the lungs, the conserving device 190 may be configured to stop oxygen flow prior to the end of inhalation, improving the efficiency of the system 100. Improved efficiency translates into a reduction in the 20size, weight, cost and power requirements of the system 100.

[0132] The conserving device 190 may be a stand-alone device in the output line of the system 100, similar to a regulator for scuba diving, or may be coupled to the control unit 110 for controlling the oxygen generator 102 to supply oxygen only during inhalation by the user 108.

[0133] The conserving device 190 may include one or more of the sensors described above. For example, the conserving device may include a sensor for monitoring the respiration rate of the user.

[0134] The system 100 may also include a special cannula retraction device for retracting the cannula ill when not in use. Further, the cannula 111 may come in different lengths and sizes.

III. High-pressure reservoir

[0135] With reference to Figure 16, a high-pressure reservoir 164 may be located in a secondary line 166 for delivering an additional supply of oxygen gas to the user 108 when the oxygen gas generator 102 can not meet the oxygen gas demands of the user 108. Any of the components described below in the secondary line 166 may be coupled to the control unit 110 or a high-pressure reservoir controller 167 (Figure 14) for control thereby. Exemplary situations where this additional oxygen gas need may occur are when a user suddenly goes from an inactive state to an active state, e.g., when getting out of a chair, when the system 100 is turned on, or when the system 100 goes from a conserving mode or sleep mode to an active mode. As used herein, secondary line 166 refers to the tubing, connectors, etc. used to connect the components in the line. A valve

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168 may be controlled by the control unit 110 to allow gaseous oxygen to flow into the secondary line 166. The valve 168 may be configured to allow simultaneous flow to both the supply line 121 and the secondary line 166, flow to only the supply line 121, or flow to only the secondary line 166.

[0136] A pump or compressor 168, which is preferably powered by the motor 118, delivers the oxygen gas at a relatively high pressure, e.g., at least approximately 100 psi, to the high-pressure reservoir 164.

[0137] An oxygen-producing electrochemical cell 171 may be used in conjunction with or instead of the elements described in the secondary line 166 to supply additional oxygen gas to the user 108. For example the electrochemical cell 171 may be used to deliver oxygen gas at a relatively high pressure to the highpressure reservoir 164.

[0138] A pressure sensor 172 is in communication with the high-pressure reservoir 164 and the control unit 110 so that when the pressure in the high-pressure reservoir 164 reaches a certain limit, the control unit 110 causes the valve 168 to direct oxygen to the secondary line 166.

[0139] A regulator 174 may be used to control flow and reduce pressure of the oxygen gas to the user 108.

[0140] A valve 176 may also be controlled by the control unit110 to allow gaseous oxygen from the high-pressure reservoir 164 to flow into the supply line 121 when the user 108 requires an amount of oxygen gas that cannot be met by the oxygen gas generator 102. The valve 176 may be configured to allow simultaneous flow from the oxygen gas generator 102 and the high-pressure reservoir 164, from only the oxygen gas generator 102, or from only the high-pressure reservoir 164.

[0141] The one or more sensors 106 are interrelated with the control unit 110 and the oxygen gas generator 102 so as to supply an amount of oxygen gas equivalent to the oxygen gas needs of the user 108 based at least in part upon one or more conditions sensed by the one or more sensors 106. When the oxygen gas generator 102 cannot meet the oxygen gas demands of the user 108, the control unit 110, based at least in part upon sensing one or more conditions indicative of the oxygen needs of the user, may cause the high-pressure reservoir 164 (via the valve 176) to supply the additional oxygen gas needed.

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[0142] In the scenario where the oxygen gas generator 102 is capable of supplying the full oxygen gas needs of the user 108, but is simply turned off or is in a conserving or sleep mode, the period of time that the high-pressure reservoir 164 supplies the oxygen gas, i.e., the period of time that the valve 176 connects the high-pressure reservoir 164 with the supply line 121, is at least as long as the time required for the oxygen gas generator 102 to go from an off or inactive condition to an on or active condition. In another scenario, the control unit 110 may cause oxygen gas to be supplied to the user from the high-pressure reservoir 164 when the demand for gaseous oxygen by the user exceeds the maximum oxygen gas output of the oxygen gas generator 102. Although the high-pressure reservoir 164 is shown and described as being filled by the oxygen gas generator 102, in an alternative embodiment, the high-pressure reservoir 164 may be filled by a source outside or external to the system.

IV. Global Positioning System

[0143] With reference back to Figure 12, in an alternative embodiment of the invention, the system 100 may include a global positioning system (GPS) receiver 200 for determining the location of the system 100. The location of the receiver 200 and, hence, the user 108 can be transmitted to a remote computer via the telemetry mechanism or modem 151. This may be desirable for locating the user 108 in the event the user has a health problem, e.g., heart attack, hits a panic button on the system, an alarm is actuated on the system, or for some other reason.

V. Additional Options and Accessories

[0144] In addition to the cradle 134, the portable oxygen concentration system 100 may include additional options and accessories. A number of different types of bags and carrying cases such as, but not by way of limitation, a shoulder bag, a backpack, a fanny pack, a front pack, and a split pack in different colors and patterns may be used to transport the system 100 or other system accessories. A cover may be used to shield the system from inclement weather or other environmental damage. The system 100 may also be transported with a rolling trolley/cart, a suit case, or a travel case. The travel case may be designed to carry the system 100 and include enough room to carry the cannulae 111, extra batteries, an adapter, etc. Examples of hooks, straps, holders for holding the system 100 include, but not by way of limitation, hooks for seatbelts in cars, hooks/straps for walkers, hooks/straps, for wheel chairs, hooks/straps for hospital beds, hooks for other

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medical devices such as ventilators, hooks/straps for a golf bag or golf cart, hooks/straps for a bicycle, and a hanging hook. The system 100 may also include one or more alarm options. An alarm of the system 100 may be actuated if, for example, a sensed physiological condition of the user 108 falls outside a pre-defined range. Further, the alarm may include a panic alarm that may be manually actuated by the user 108. The alarm may actuate a buzzer or other sounding device on the system 100 and/or cause a communication to be sent via the telemetry mechanism or modem 151 to another entity, e.g., a doctor, a 911 dispatcher, a caregiver, a family member, etc.

[0145] Although this invention has been described in terms of certain preferred embodiments, other embodiments apparent to those of ordinary skill in the art are also within the scope of this invention. Accordingly, the scope of this invention is intended to be defined only by the claims that follow.

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We claim:

1. A portable oxygen concentrator system adapted to be readily transported by a user, comprising:

a rechargeable energy source;

a concentrator powered by said energy source and adapted to convert ambient air into concentrated oxygen gas for said user, the concentrator including a plurality of adsorption beds and a rotary valve assembly, the rotary valve assembly relatively rotatable with respect to the plurality of adsorption beds to provide valving action for selectively transferring fluids through the plurality of adsorption beds for converting ambient air into concentrated oxygen gas for said user,

wherein the ratio of adiabatic power to oxygen flow for the concentrator is in the range of 6.2 W/LPM to 23.0 W/LPM.

2. The portable oxygen concentrator system of claim 1, wherein the concentrator includes exactly five adsorption beds.

3. The portable oxygen concentrator system of claims 1 or 2, wherein the rotary valve assembly includes a valve port plate and a rotary valve shoe having respective engaged surfaces and relatively rotatable about a common center of rotation to provide valving action for selectively transferring fluids therethrough, and a centering mechanism other than a motor to center the rotary valve shoe relative to the valve port plate.

4. The portable oxygen concentrator system of claim 3, wherein the valve port plate and the rotary valve shoe include respective central holes, and the centering mechanism includes a centering pin disposed in the central holes of the valve port plate and rotary valve shoe to center the rotary valve shoe relative to the valve port plate.

5. The portable oxygen concentrator system of claim 3, wherein the valve port plate and rotary valve shoe include cylindrical sidewalls, and the centering mechanism includes a centering ring disposed around the sidewalls of the valve port plate and the rotary valve shoe to center the rotary valve shoe relative to the valve port plate.

6. The portable oxygen concentrator system of any of claims 1-5, wherein the adsorption beds carry adsorbent material, and include a first end, a second end, an adsorbent media disposed in the adsorption beds between the first end and the second end, a media retention cap disposed between the adsorbent media and the second end, a spring

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to urge the media retention cap against the adsorbent material to hold the adsorbent media in place, and the spring not located in a flow path of the adsorption beds.

7. The portable oxygen concentrator system of claim 6, wherein the media retention cap includes a surface that contacts the adsorbent media, the surface including a central hole and a plurality of ribs radiating from the central hole.

8. The portable oxygen concentrator system of claim 6, wherein the media retention cap includes a bottom base with an interior, and the spring is disposed in the interior of the bottom base.

9. The portable oxygen concentrator system of any of claims 1-8, wherein the rotary valve assembly includes a valve port plate and a rotary valve shoe having respective engaged surfaces and relatively rotatable about a common center of rotation to provide valving action for selectively transferring fluids therethrough, and the portable oxygen concentrator system further includes a motor to rotate the rotary valve shoe, and one or more elastic links to couple the motor to the rotary valve shoe.

10. The portable oxygen concentrator system of claim 9, wherein the motor includes a drive shaft and a drive wheel with one or more protruding support members, the rotary valve shoe includes one or more protruding support members, and the elastic link connects the one or more protruding support members of the drive wheel with the one or more protruding support members of the rotary valve shoe.

11. The portable oxygen concentrator system of any of claims 1-10, wherein the concentrator includes plastic adsorption beds and a metal cover surrounding the plastic adsorption beds.

12. The portable oxygen concentrator system of claim 11, wherein the adsorption beds are, elongated, molded, plastic vessels.

13. The portable oxygen concentrator system of claim 12, wherein the metal cover is made of aluminum and surrounds the adsorption beds to form a product tank.

14. The portable oxygen concentrator system of any of claims 1-13, wherein the rotary valve assembly includes a valve port plate and a rotary valve shoe having respective engaged surfaces and relatively rotatable about a common center of rotation to provide valving action to put the adsorption beds in a pressure swing adsorption cycle, and the pressure swing adsorption cyle includes a number of equalization steps in each adsorption bed ranging from two to eight.

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15. The portable oxygen concentrator system of claim 14, wherein the pressure swing adsorption cyle includes a number of equalization steps in each adsorption bed ranging from two to six.

16. The portable oxygen concentrator system of claim 14, wherein the pressure swing adsorption cyle includes four equalization steps in each adsorption bed.

17. The portable oxygen concentrator system of claim 14, wherein the equalization steps include a first equalization down step, a second equalization down step, a first equalization up step, and a second equalization up step.

18. The portable oxygen concentrator system of claim 14, wherein adsorption beds include a feed end and a product end, and equalization occurs between product ends of adsorption beds.

19. The portable oxygen concentrator system of any of claims 1-18, further including a variable-speed compressor to supply ambient air to the concentrator.

20. The portable oxygen concentrator system of any of claims 1-19, wherein recovery of oxygen from air from the concentrator is 45-71% at about 90% purity.

21. The portable oxygen concentrator system of any of claims 1-20, wherein the rotary valve assembly includes a valve port plate and a rotary valve shoe having respective engaged surfaces and relatively rotatable about a common center of rotation to provide valving action for selectively transferring fluids therethrough, said valve port plate having at least two ports interconnected with at least two adsorption beds, and said rotary valve shoe having a second valve surface opposite said engaged surface with at least one equalization passage to register with said at least two ports of the port plate to equalize pressure in said at least two adsorption beds.

22. The portable oxygen concentrator system of any of claims 1-21, wherein a pressure drop through the rotary valve assembly is no more than 1 PSI when the concentrator is producing 3 LPM of oxygen gas.

23. The portable oxygen concentrator system of any of claims 1-22, wherein the rotary valve assembly includes a valve port plate and a rotary valve shoe having respective engaged surfaces and relatively rotatable about a common center of rotation to provide valving action for selectively transferring fluids therethrough, the rotation speed of the rotary valve shoe with respect to the valve port plate is varied in order to provide desired cycle timing for a given production of product.

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24. The portable oxygen concentrator system of claim 23, further including a variable-speed compressor to supply compressed ambient air to the concentrator, and the rotation speed of the rotary valve shoe with respect to the valve port plate is varied in combination with variation in the speed of the variable-speed compressor in order to provide desired cycle timing and desired supply rate of ambient air to the concentrator for a given production of product.

25. The portable oxygen concentrator system of any of claims 1-24, wherein the rotary valve assembly includes a valve port plate and a rotary valve shoe having respective engaged surfaces and relatively rotatable about a common center of rotation to provide valving action for selectively transferring fluids therethrough, and the rotary valve shoe includes a vacuum sealing mechanism that counteracts a pressure force working to unseat the rotary valve shoe from the valve port plate.

26. A rotary valve assembly for a pressure swing adsorption system having a plurality of adsorption beds, comprising:

a valve port plate and a rotary valve shoe having respective engaged surfaces and relatively rotatable about a common center of rotation to provide valving action for selectively transferring fluids therethrough, said valve port plate having at least two ports interconnected with at least two adsorption beds, and said rotary valve shoe having a second valve surface opposite said engaged surface with at least one equalization passage to register with said at least two ports of the port plate to equalize pressure in said at least two adsorption beds.

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AMENDED CLAIMS

[received by the International Bureau on 07 October 2003 (07.10.2003); original claim 26 cancelled; new claims 27-35 added; remaining claims unchanged (2 pages)]

24. The portable oxygen concentrator system of claim 23, further including a variable-speed compressor to supply compressed ambient air to the concentrator, and the rotation speed of the rotary valve shoe with respect to the valve port plate is varied in combination with variation in the speed of the variable-speed compressor in order to provide desired cycle timing and desired supply rate of ambient air to the concentrator for a given production of product.

25. The portable oxygen concentrator system of any of claims 1-24, wherein the rotary valve assembly includes a valve port plate and a rotary valve shoe having respective engaged surfaces and relatively rotatable about a common center of rotation to provide valving action for selectively transferring fluids therethrough, and the rotary valve shoe includes a vacuum sealing mechanism that counteracts a pressure force working to unseat the rotary valve shoe from the valve port plate.

27. A portable oxygen concentrator system adapted to be readily transported by a user, comprising:

an internal rechargeable energy source;

an air separation device powered by said energy source and adapted to convert ambient air into concentrated oxygen gas for said user, the air separation device including a plurality of adsorber columns and a rotating valve, the rotating valve relatively rotatable with respect to the plurality of adsorber columns to provide valving action for selectively transferring fluids through the plurality of adsorber columns for converting ambient air into concentrated oxygen gas for said user,

wherein the portable oxygen concentrator system weighs 2-15 pounds and the adsorber columns each including a layered adsorbent bed having two or more distinct adsorbent material layers.

28. The portable oxygen concentrator system of claim 27, wherein the adsorber columns each include a feed end and a product end, and the two or more distinct adsorbent material layers include at least a water adsorption layer and a nitrogen adsorption layer, the water adsorption layer located closer to the feed end than the nitrogen adsorption layer.

29. The portable oxygen concentrator system of claim 28, wherein the water adsorption layer is an activated alumina.

30. The portable oxygen concentrator system of claim 28, wherein the water adsorption layer is a silica gel.

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31. The portable oxygen concentrator system of any of claims 28-30, wherein the nitrogen adsorption layer is a lithium exchanged X-type zeolite.

32. A portable oxygen concentrator system adapted to be readily transported by a user, comprising:

an internal rechargeable energy source;

an air separation device powered by said energy source and adapted to convert ambient air into concentrated oxygen gas for said user, the air separation device including a plurality of adsorber columns each including a feed end and a product end and at least one valve operable with respect to the plurality of adsorber columns to provide valving action for selectively transferring fluids through the plurality of adsorber columns for converting ambient air into concentrated oxygen gas for said user,

wherein the portable oxygen concentrator system weighs 2-15 pounds and the adsorber columns each including a layered adsorbent bed having two or more distinct adsorbent material layers, the two or more distinct adsorbent material layers including at least a water adsorption layer and a nitrogen adsorption layer, the water adsorption layer located closer to the feed end than the nitrogen adsorption layer.

33. The portable oxygen concentrator system of claim 32, wherein the water adsorption layer is an activated alumina.

34. The portable oxygen concentrator system of claim 32, wherein the water adsorption layer is a silica gel.

35. The portable oxygen concentrator system of any of claims 32-34, wherein the nitrogen adsorption layer is a lithium exchanged X-type zeolite.

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Statement Under PCT Article 19(1)

New claims have been added to further refine and clarify the claimed invention. Prior pending claims 1-25 have not been amended. Claim 26 has been cancelled.

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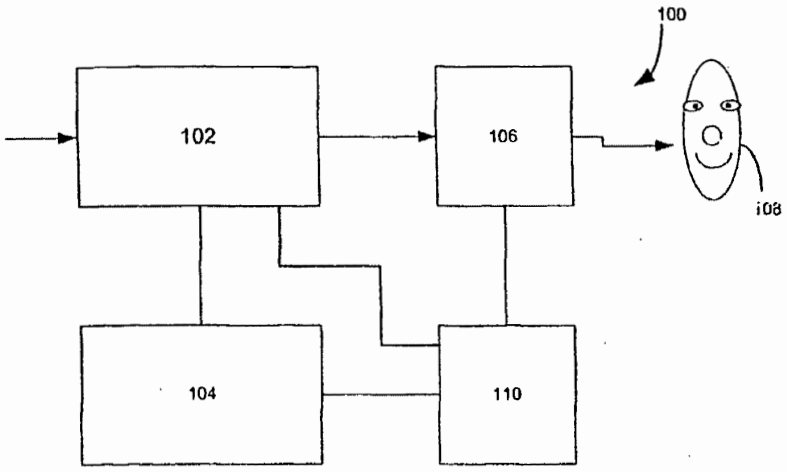


Figure 1

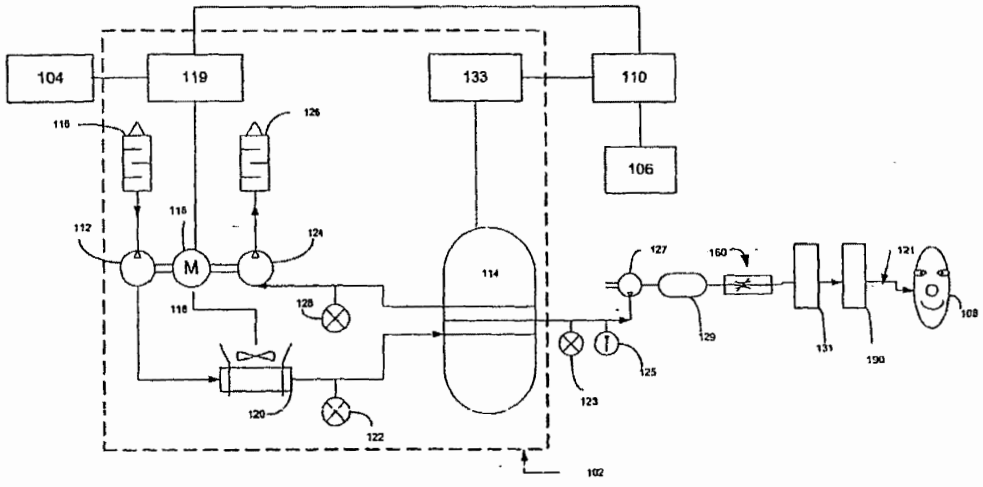


Figure 2

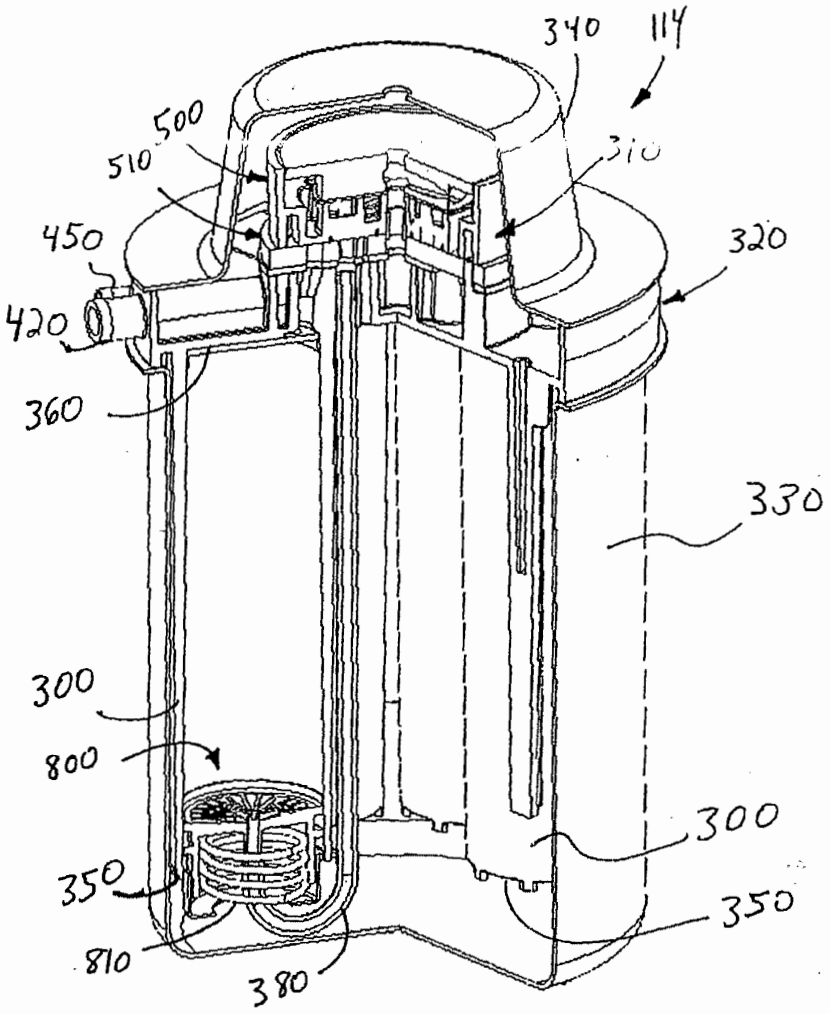

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Figure 3A

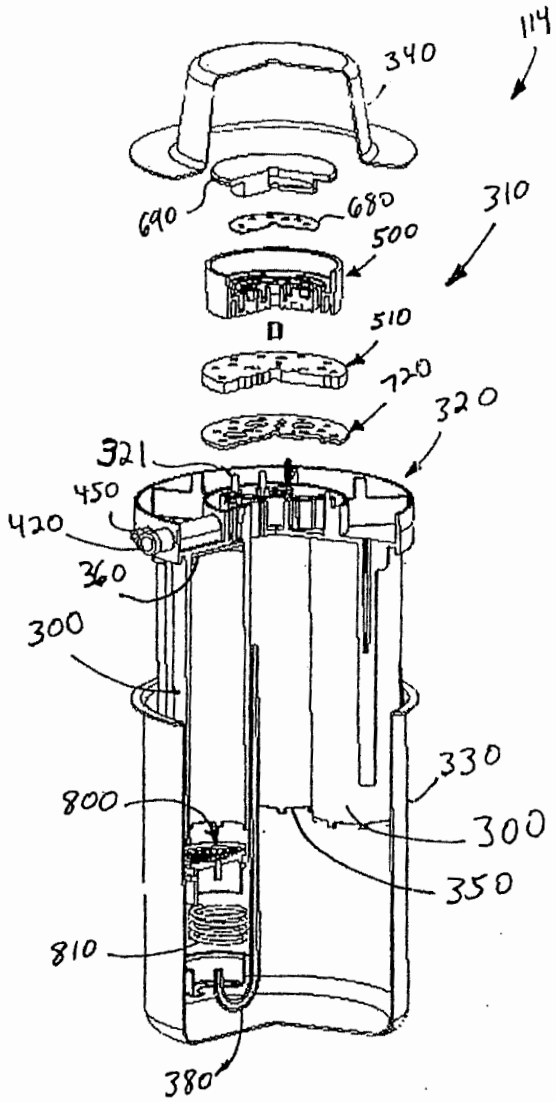

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Figure 3B

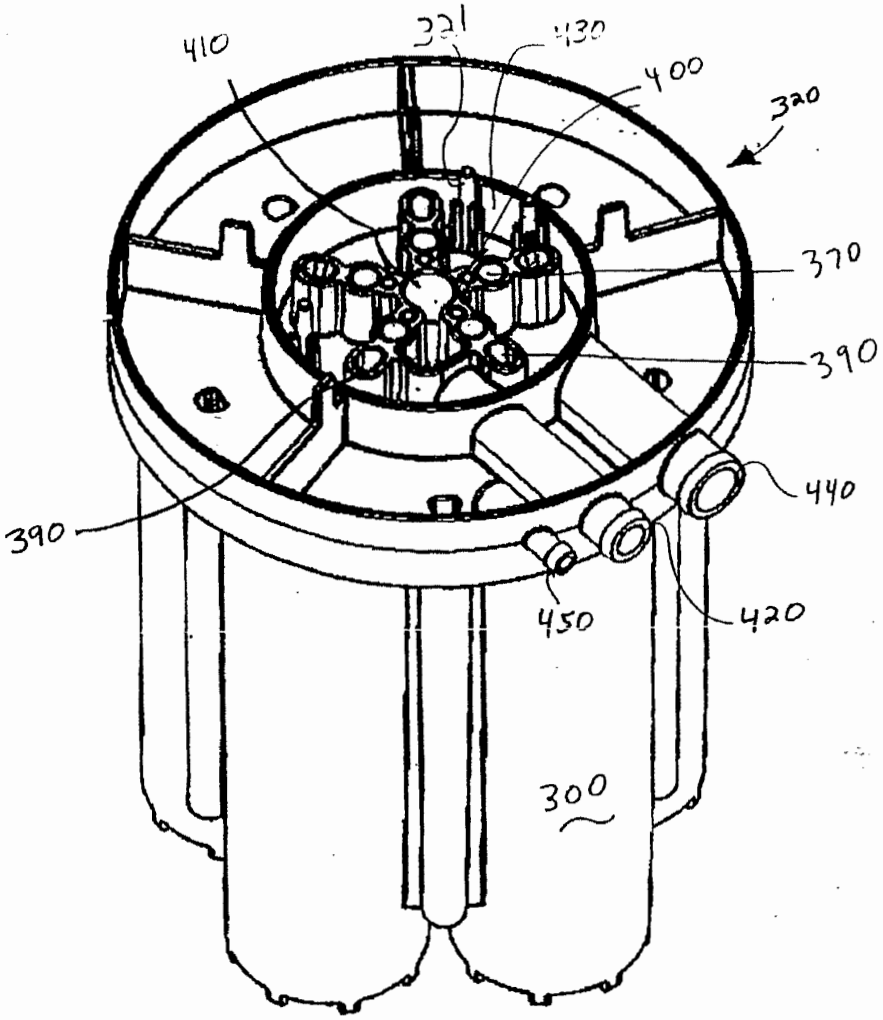


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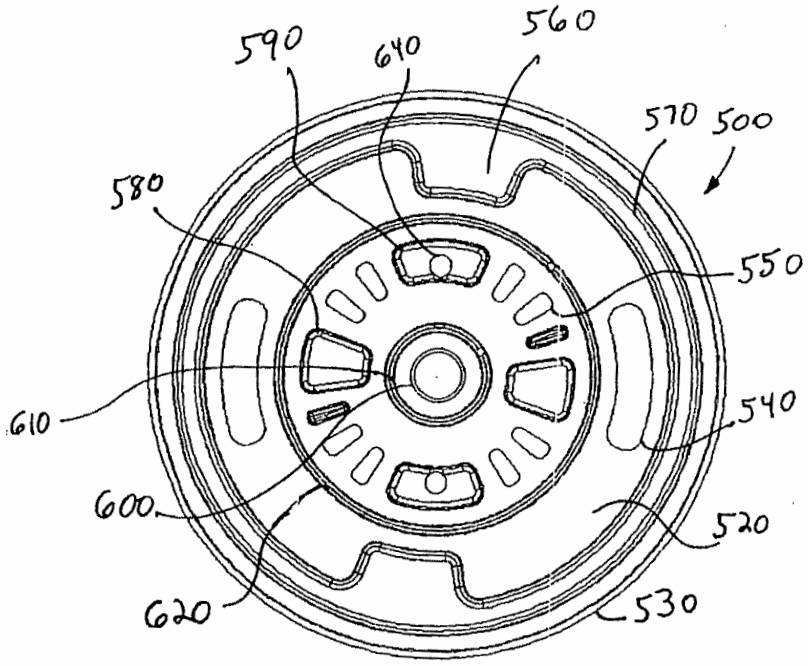


Figure 5A

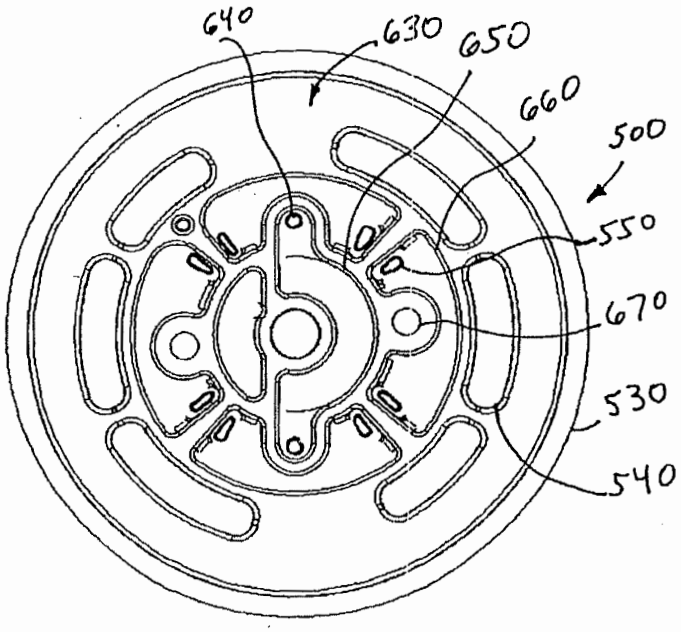


Figure 5B

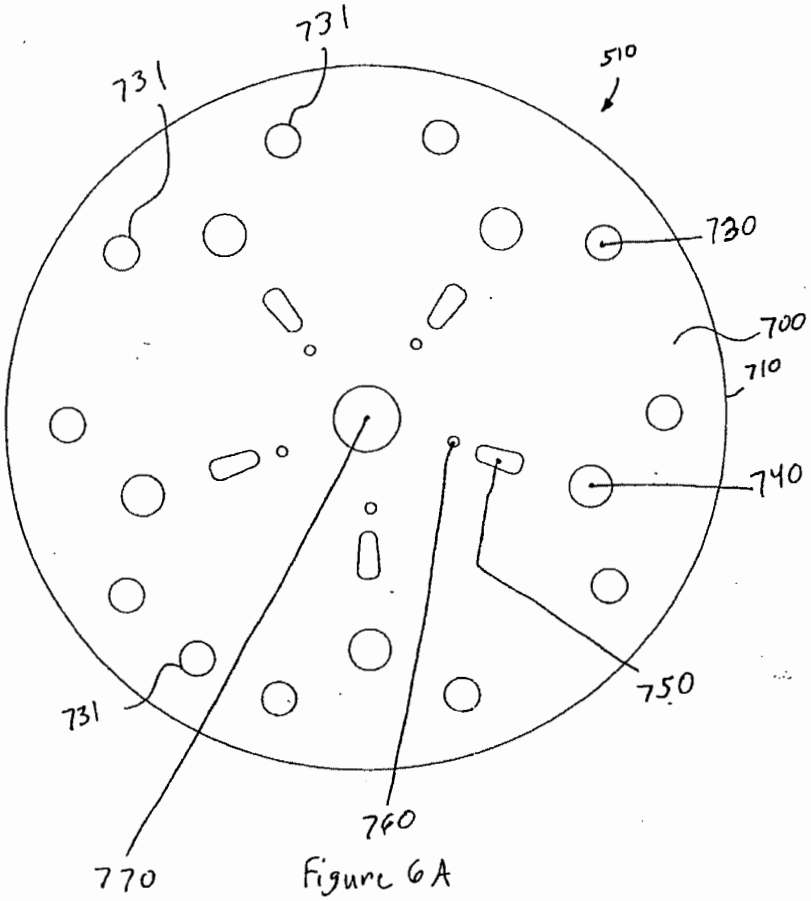


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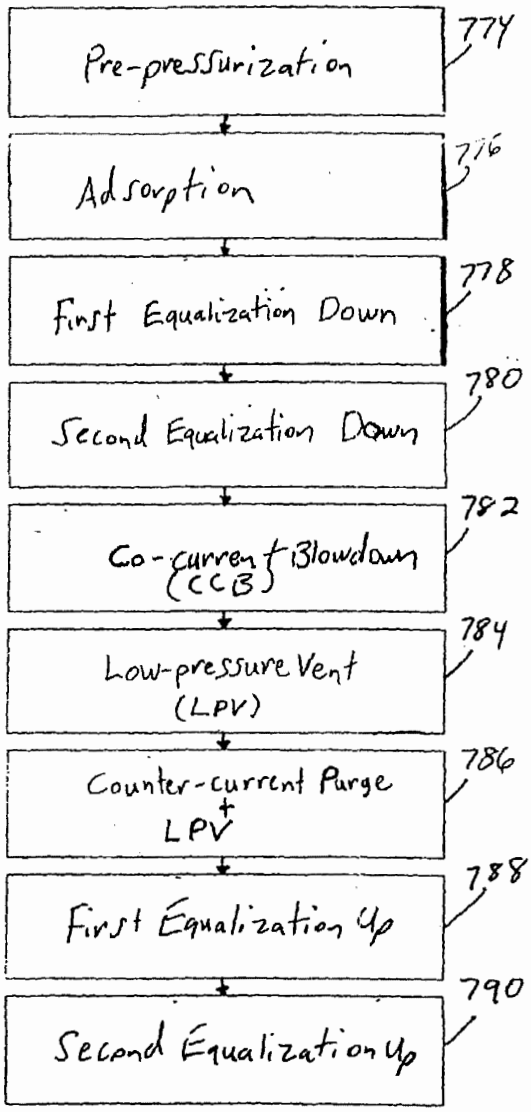

Pre-pressurization
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Adsorption
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First Equalization Down
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Second Equalization Down
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Co-current Blowdown (CCB)
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Low-pressure Vent (LPV)
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Counter-current Purge + LPV
786
First Equalization Up
788
Second Equalization Up
790

Figure 6B

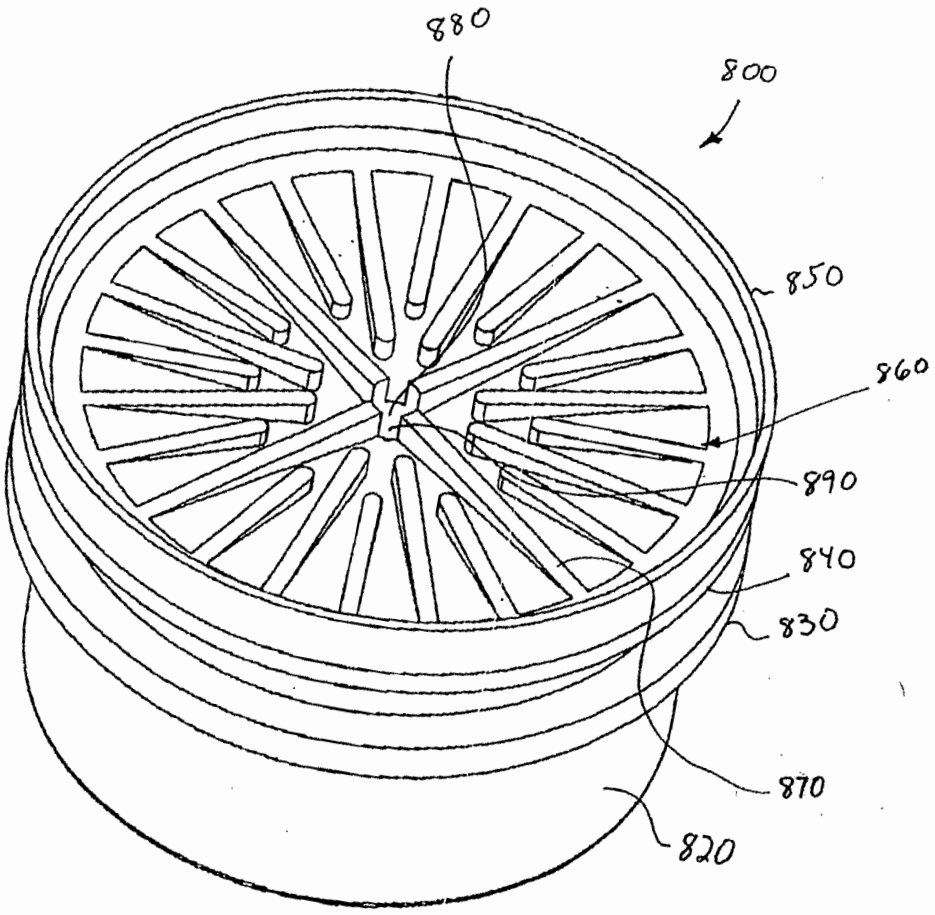


Figure 7A

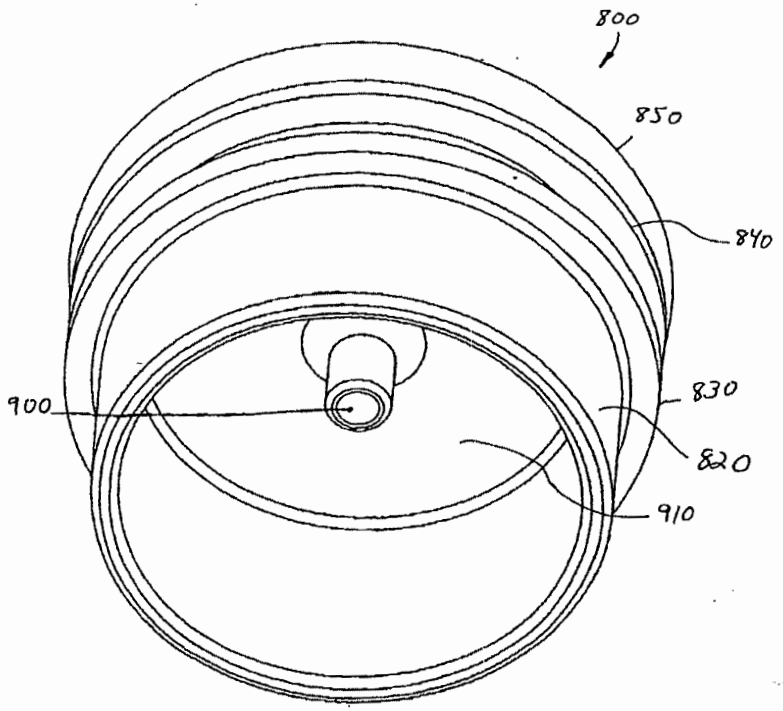


Figure 7B

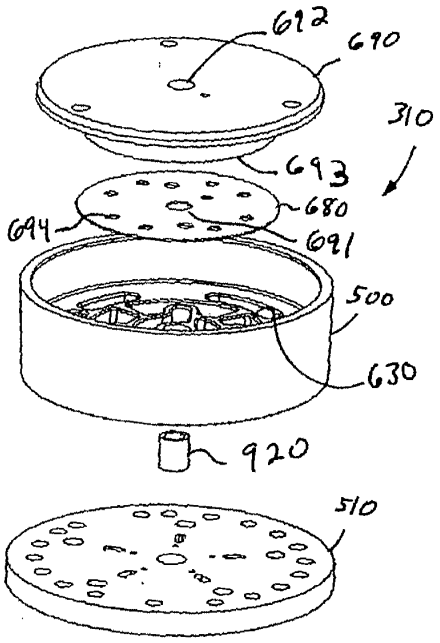


Figure 8A

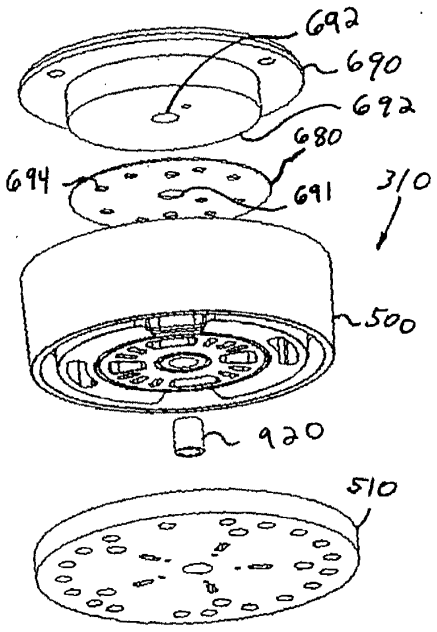


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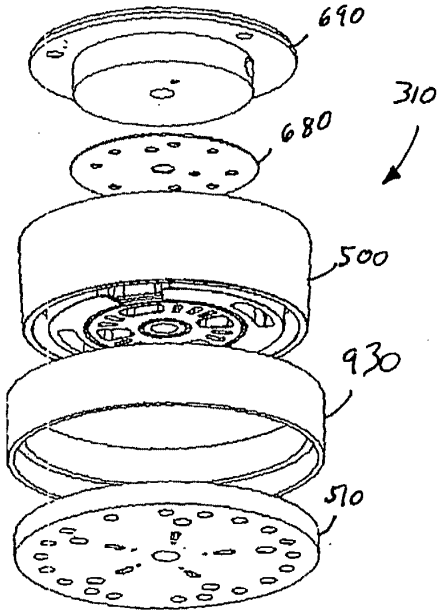


Figure 9A

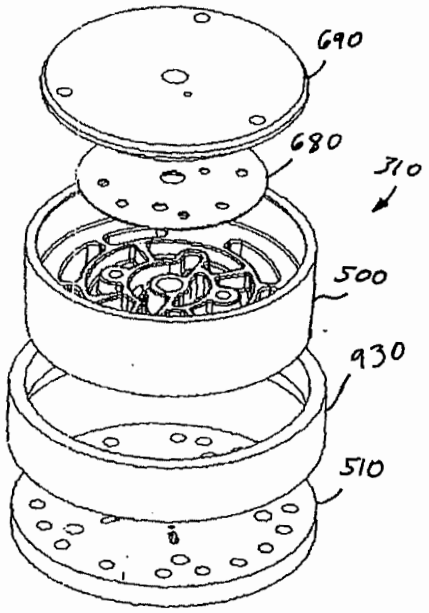


Figure 9B

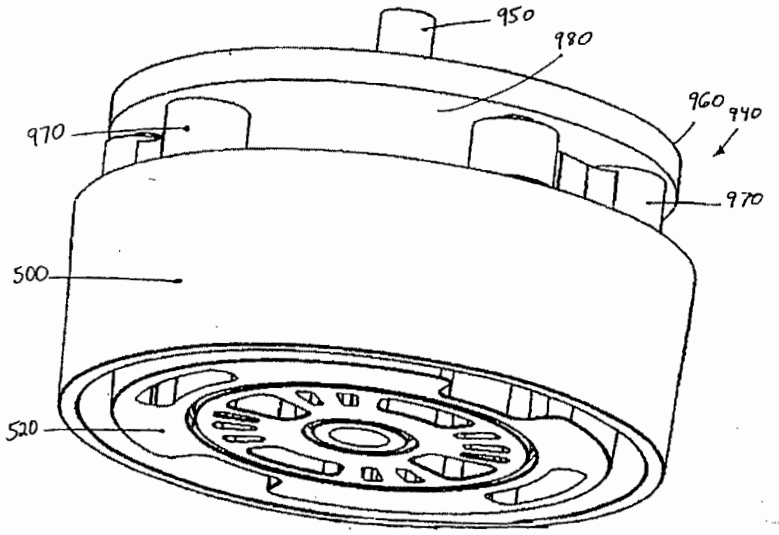


Figure 10A

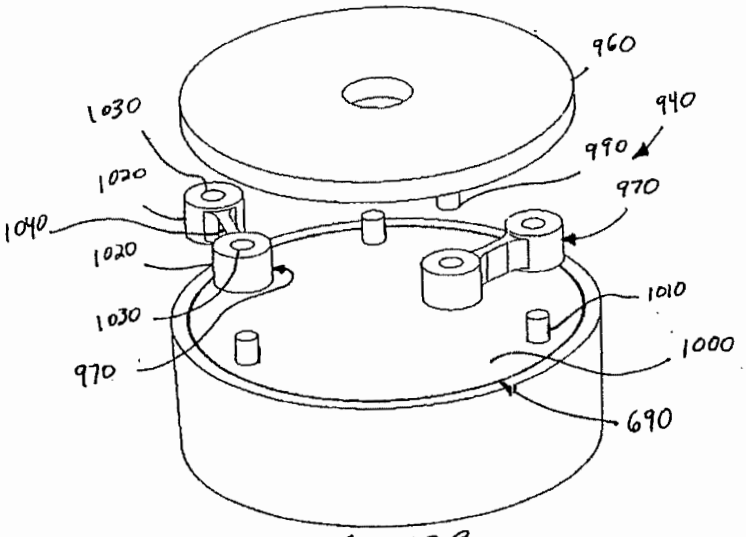


Figure 10 B

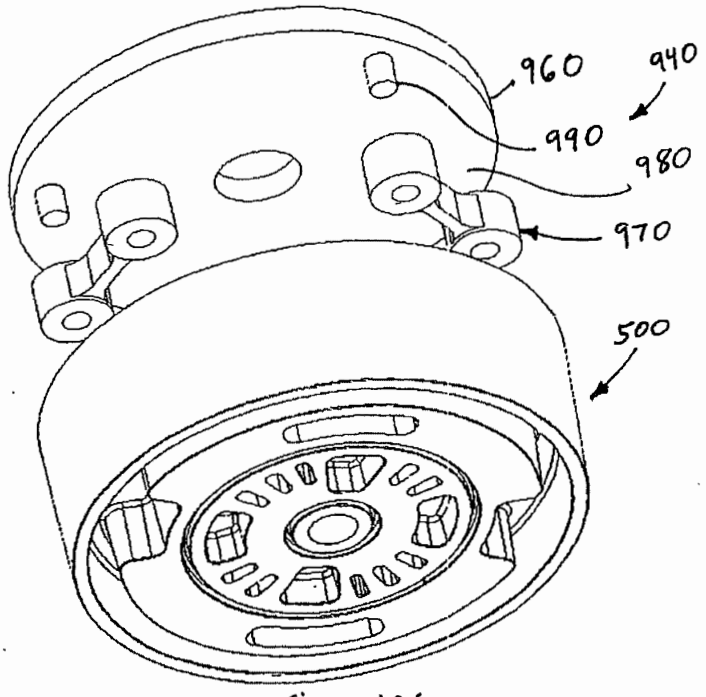


Figure 10C

Product Flow Rate (slpm)	Recovery (%)	Product Purity (%)	Feed Pressure (psig)	Vacuum Pressure (psig)	Flow Rate (slpm)		Adiabatic Work (W)*		
					Comp.	Vacuum	Comp	Vacuum	Total
3.0	55.1	91.7	7.7	-7.0	23.8	20.8	17.9	20.6	38.5
3.0	53.6	90.4	7.2	-7.0	24.1	21.1	17.1	21.2	38.3
3.0	53.6	90.9	7.2	-7.0	24.2	21.2	17.2	21.2	38.4
1.0	54.6	91.6	9.0	-7.0	8.0	7.0	6.9	7.0	13.9
2.0	57.2	92.0	10.6	-7.0	15.3	13.3	15.2	13.3	28.4
3.0	54.9	92.3	9.6	-7.5	24.0	21.0	21.8	22.9	44.7
2.8	51.7	93.6	10.1	-7.4	24.1	21.3	22.9	22.8	45.8
2.5	46.3	94.5	10.3	-7.5	24.3	21.8	23.5	23.8	47.2
3.2	56.3	90.7	9.9	-7.5	24.6	21.4	23.0	23.3	46.3
3.4	58.4	88.0	9.9	-7.0	24.4	21.0	22.8	20.9	43.7
2.0	46.9	94.7	12.1	-7.1	19.3	17.3	21.3	17.5	38.8
2.2	51.3	94.3	11.9	-7.2	19.3	17.1	21.0	17.6	38.6
2.4	55.6	93.6	11.7	-7.3	19.3	16.9	20.8	17.7	38.5
2.5	57.9	92.7	11.1	-7.3	19.1	16.6	19.7	17.4	37.1
2.8	61.8	89.0	11.3	-7.2	19.2	16.4	20.0	16.9	37.0
1.5	58.1	94.3	10.8	-7.2	11.2	9.8	11.3	10.1	21.4
1.5	59.9	94.0	10.8	-7.2	11.2	9.7	11.3	10.0	21.3
1.6	67.3	90.1	10.4	-7.3	11.2	9.4	10.9	9.9	20.8
1.0	64.0	94.1	9.0	-7.2	7.0	6.0	6.1	6.2	12.3
1.2	70.4	86.3	8.5	-7.4	7.0	5.8	5.8	6.2	12.0
1.1	68.1	90.3	8.7	-7.3	7.0	5.9	5.8	6.2	12.0
2.5	45.5	94.4	9.5	-6.1	24.7	22.2	22.3	18.8	41.1
2.8	50.5	93.7	9.7	-6.2	24.8	22.0	22.8	18.9	41.7
3.0	54.1	92.5	10.1	-6.3	24.4	21.4	23.2	18.6	41.8
3.2	56.3	90.7	9.9	-6.4	24.6	21.4	22.9	18.8	41.7
3.5	59.2	87.4	9.7	-6.4	24.6	21.1	22.7	18.8	41.5
1.0	46.0	90.9	5.8	-5.3	9.4	8.4	5.5	5.9	11.5
2.0	47.8	90.5	6.7	-5.4	18.0	16.0	12.0	11.6	23.6
3.0	48.2	90.7	10.1	-5.6	26.9	23.9	25.6	17.9	43.5
1.0	52.3	92.3	5.7	-6.1	8.4	7.4	4.9	6.1	11.0
1.0	51.3	91.1	5.3	-6.0	8.5	7.5	4.6	6.2	10.8
2.0	51.6	92.4	7.3	-5.9	17.1	15.1	12.2	12.2	24.4
2.0	52.4	91.5	7.1	-5.9	16.6	14.6	11.7	11.8	23.5
3.0	48.6	89.9	8.5	-5.8	26.4	23.4	21.8	18.3	40.1
3.0	48.9	90.7	8.8	-5.8	26.5	23.5	22.6	18.4	40.9

Figure 11

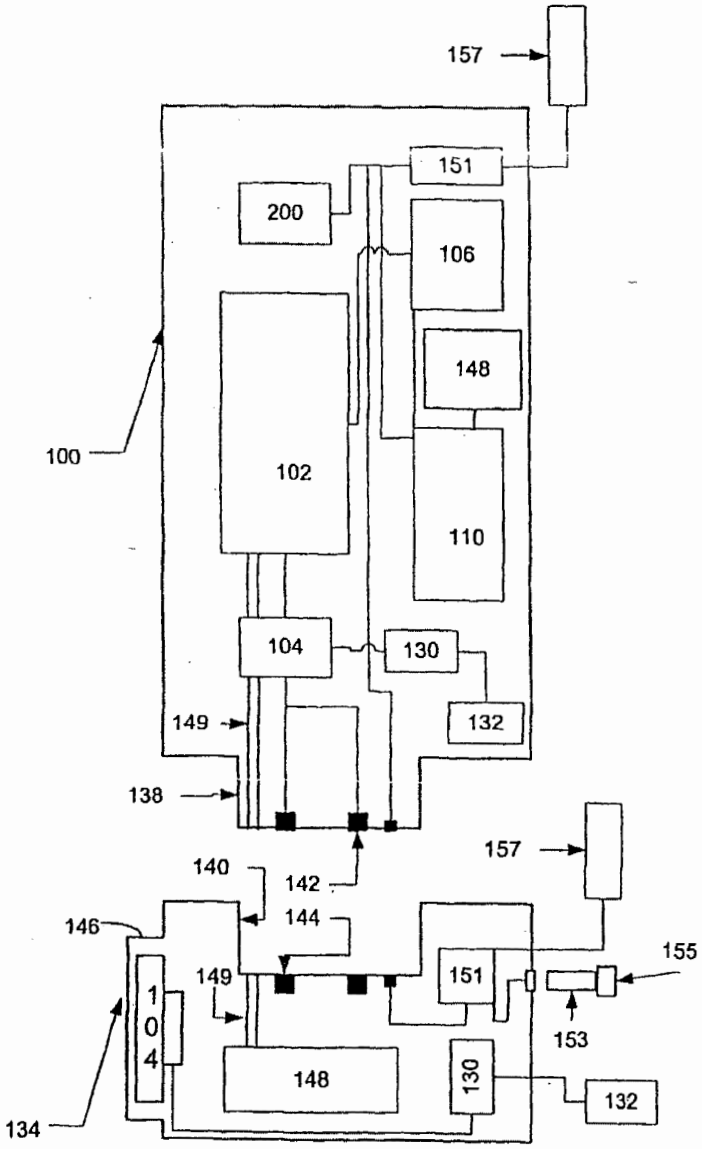

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Figure 12

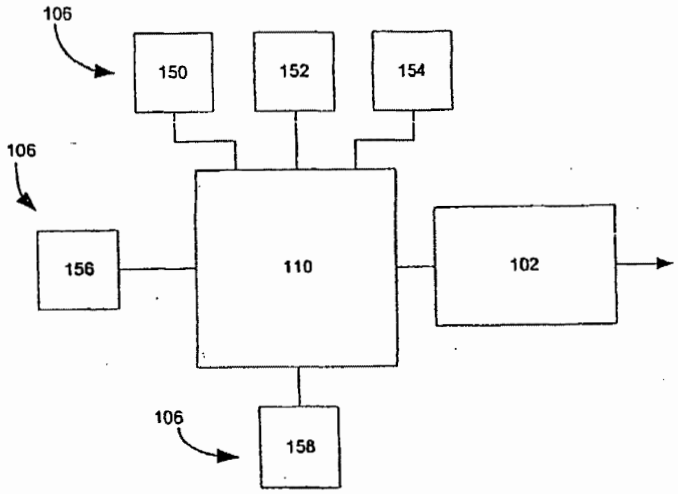


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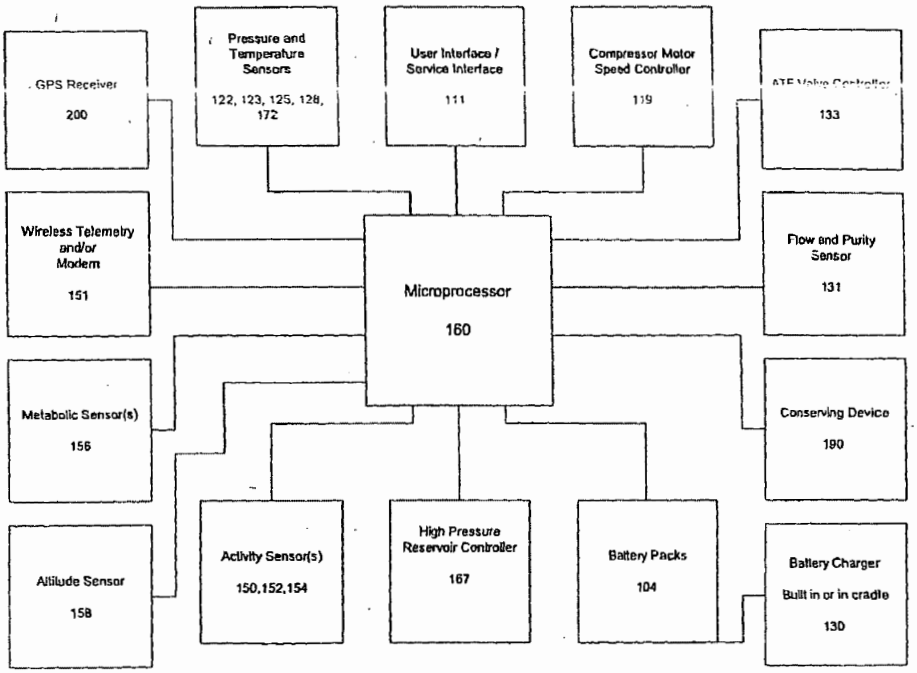


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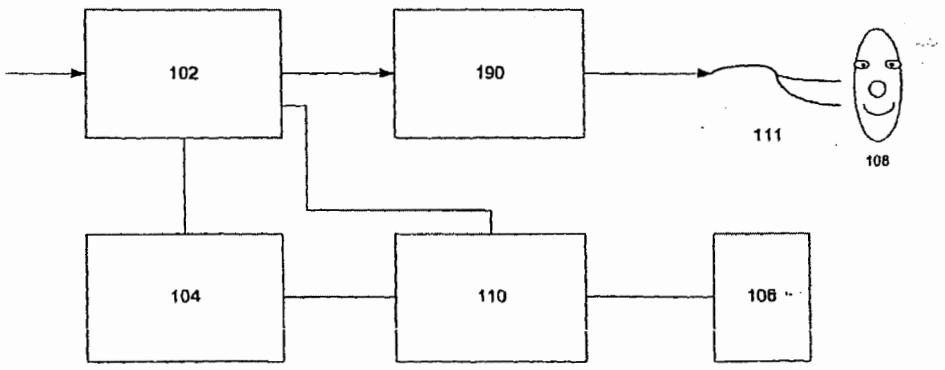


Figure 15

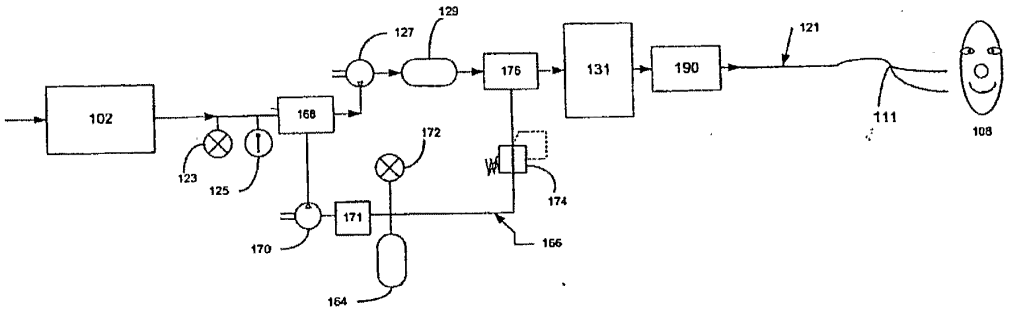

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Figure 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/13496

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : A62B 7/10, 9/00, 19/00, 23/02; A61M 16/00; F24J 3/00; G05B 1/00
US CL : 128/201.25, 204.17, 205.11, 205.18

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)
U.S. : 128/201.25, 204.17, 205.11, 205.18

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5, 268, 021 A (HILL et al) 7 December 1993, see entire document	26
X	US 5, 366, 541 (HILL et al) 22 November 1994, see entire document	26
X	US 5,827, 358 (KULISH et al) 27 October 1998, see entire document	26
A	US 5, 882, 380 A (SIRCAR) 16 march 1999, see entire document	1-26
A	US 6, 056, 804 A (KEEFER et al) 02 May 2000, see entire document	1-26
A	US 4, 576, 616 A (MOTTRAM et al) 18 March 1986, see entire document	1-26

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search
15 September 2003 (15.09.2003)

Date of mailing of the international search report
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(51) International Patent Classification 6 :
F25J 3/06, B01D 8/00, 5/00, F28D 7/10, F25J 3/00

A1

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(21) International Application Number: PCT/US98/11154

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(30) Priority Data:
08/876,970 16 June 1997 (16.06.97) US

(71) Applicant: SEQUAL TECHNOLOGIES, INC. [US/US]; 4886 Seda Drive, San Diego, CA 92121 (US).

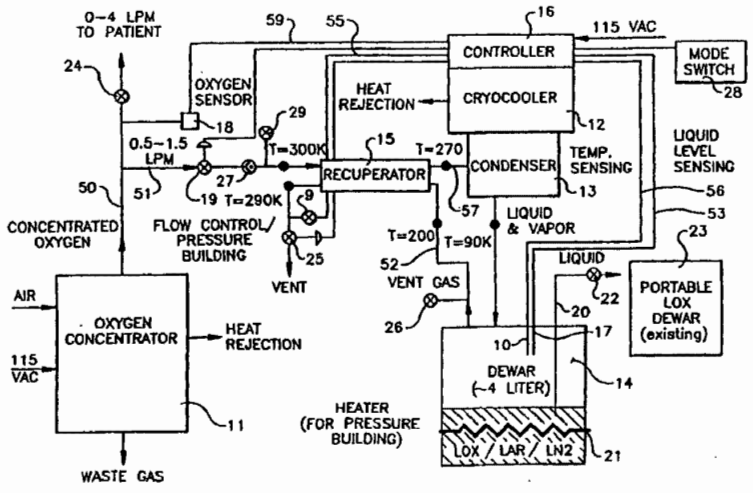
(72) Inventors: HONKONEN, Scott, C.; 5339 Outlook Point, San Diego, CA 92124 (US). HILL, Theodore, B.; 7416 Raven Ridge Point, San Diego, CA 92126 (US). HILL, Charles, C.; 2518 Via Merano, Del Mar, CA 92014 (US). WALKER, Graham; 105–150 Promenade Drive, Nanaimo, British Columbia V9R 6M6 (CA).

(74) Agents: BEUERLE, Stephen, C. et al.; Lyon & Lyon LLP, Suite 4700, 633 West Fifth Street, Los Angeles, CA 90071–2066 (US).

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(57) Abstract

In one preferred embodiment, the present invention splits off some of the excess capacity gas flow from a gas concentrator (11) which is then stored (14) via liquefaction. The stored gas can then be used as a portable supply. A portion of the oxygen gas flow generated by the oxygen concentrator is channeled to a condenser (13) which receives and liquefies the oxygen gas using cryocooler (12). A storage dewar (14) is used for storing the oxygen liquefied by the condenser. Liquid is then selectively transferred to a smaller portable dewar (23). A controller can be used for monitoring the parameters of liquefaction, including oxygen concentration, the amount of liquid oxygen in the dewar, and for controlling the parameters of liquid oxygen generation and transfer.

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DESCRIPTION

METHODS AND APPARATUS TO GENERATE LIQUID AMBULATORY OXYGEN FROM AN OXYGEN CONCENTRATOR

Background of the Invention

The field of this invention relates to using an oxygen concentrator to create a portable supply of supplementary oxygen for ambulatory respiratory patients so that they can lead normal and productive lives -- as the typical primary oxygen sources are too bulky to carry or require excessive power to operate.

There is a burgeoning need for home and ambulatory oxygen. Supplemental oxygen is necessary for patients suffering from lung disorders; for example, pulmonary fibrosis, sarcoidosis, or occupational lung disease. For such patients, oxygen therapy is an increasingly beneficial, life-giving development. While not a cure for lung disease, supplemental oxygen increases blood oxygenation, which reverses hypoxemia. This therapy prevents long-term effects of oxygen deficiency on organ systems -- in particular, the heart, brain and kidneys. Oxygen treatment is also prescribed for Chronic Obstructive Pulmonary Disease (COPD), which afflicts about 25 million people in the U.S., and for other ailments that weaken the respiratory system, such as heart disease and AIDS. Supplemental oxygen therapy is also prescribed for asthma and emphysema.

The normal prescription for COPD patients requires supplemental oxygen flow via nasal cannula or mask twenty four hours per day. The average patient prescription is

two liters per minute of high concentration oxygen to increase the oxygen level of the total air inspired by the patient from the normal 21% to about 40%. While the average oxygen flow requirement is two liters per minute, the average oxygen concentrator has a capacity of four to six liters of oxygen per minute. This extra capacity is occasionally necessary for certain patients who have developed more severe problems but they are not generally able to leave the home (as ambulatory patients) and do not require a portable oxygen supply.

There are currently three modalities for supplemental medical oxygen: high pressure gas cylinders, cryogenic liquid in vacuum insulated containers or thermos bottles commonly called "dewars," and oxygen concentrators. Some patients require in-home oxygen only while others require in-home as well as ambulatory oxygen depending on their prescription. All three modalities are used for in-home use, although oxygen concentrators are preferred because they do not require dewar refilling or exchange of empty cylinders with full ones.

Only small high pressure gas bottles and small liquid dewars are portable enough to be used for ambulatory needs (outside the home). Either modality may be used for both in-home and ambulatory use or may be combined with an oxygen concentrator which would provide in-home use.

As we describe below, the above-described current methods and apparatus have proven cumbersome and unwieldy and there has been a long-felt need for improved means to supply the demand for portable/ambulatory oxygen.

For people who need to have oxygen but who need to operate away from an oxygen-generating or oxygen-storage source such as a stationary oxygen system (or even a portable system which cannot be easily carried), the two most prescribed options generally available to patients are: (a) to carry with them small cylinders typically in a wheeled stroller; and (b) to carry portable containers typically on a shoulder sling. Both these gaseous oxygen and liquid oxygen options have substantial drawbacks. But from a medical view, both have the ability to increase the productive life of a patient.

The major drawback of the gaseous oxygen option is that the small cylinders of gaseous oxygen can only provide gas for a short duration. Oxygen conserving devices that limit the flow of oxygen to the time of inhalation may be used. However, the conserving devices add to the cost of the service and providers have been reluctant to add it because there often is no health insurance reimbursement. Indeed, the insurance reimbursement for medical oxygen treatment appears to be shrinking.

Another drawback of the gaseous oxygen option is the source of or refill requirement for oxygen once the oxygen has been depleted from the cylinder. These small gas cylinders must be picked up and refilled by the home care provider at a specialized facility. This requires regular visits to a patient□s home by a provider and a substantial investment in small cylinders for the provider because so many are left at the patient□s home and refilling facility. Although it is technically possible to refill these cylinders in the patient□s home using a commercial

oxygen concentrator that extracts oxygen from the air, this task would typically require an on-site oxygen compressor to boost the output pressure of the concentrator to a high level in order to fill the cylinders. Additionally, attempting to compress the oxygen in pressurized canisters in the home is dangerous, especially for untrained people. This approach of course presents several safety concerns for in-home use. For example, in order to put enough of this gas in a portable container, it must typically be compressed to high pressure (~2000 psi). Compressing oxygen from 5 psi (the typical output of an oxygen concentrator) to 2000 psi will produce a large amount of heat. (Enough to raise the temperature 165□ C per stage based on three adiabatic compression stages with intercooling.) This heat, combined with the oxygen which becomes more reactive at higher pressures, sets up a potential combustion hazard in the compressor in the patient's home. Thus, utilizing and storing a high pressure gas system in the patient's home is dangerous and not a practical solution.

The convenience and safety issues are not the only drawbacks of this compressed oxygen approach. Another drawback is that the compressors or pressure boosters needed are costly because they require special care and materials needed for high pressure oxygen compatibility. For example, a Rix Industries, Benicia, CA, 1/3 hp unit costs about $10,000 while a Haskel International, Burbank, CA, air-powered booster costs about $2200 in addition to requiring a compressed air supply to drive it. Litton Industries and others also make oxygen pressure boosters.

Turning now to the liquid oxygen storage option, its main drawback is that it requires a base reservoir -- a stationary reservoir base unit about the size of a standard beer keg -- which has to be refilled about once a week. The liquid oxygen can then be obtained from a base unit and transferred to portable dewars which can be used by ambulatory patients. Also, with the liquid oxygen option, there is substantial waste, as a certain amount of oxygen is lost during the transfer to the portable containers and from evaporation. It is estimated that 20% of the entire contents of the base cylinder will be lost in the course of two weeks because of losses in transfer and normal evaporation. These units will typically boil dry over a period of 30 to 60 days even if no oxygen is withdrawn.

There are other complications. Typically, supplemental oxygen is supplied to the patient by a home care provider, in exchange for which it receives a fixed monetary payment from insurance companies or Medicare regardless of the modality. Oxygen concentrators for use in the home are preferred and are the least expensive option for the home care provider. For outside the home use however, only small high pressure gas bottles and small liquid dewars are portable enough to be used for ambulatory needs. One of these two modalities may be used for both in-home and ambulatory use or may be combined with an oxygen concentrator which would provide in-home use. In either case, the home care provider must make costly weekly or biweekly trips to the patient's home to replenish the oxygen. One of the objects of this invention is to eliminate these costly "milk runs."

Portable oxygen concentrators are commercially available for providing patients with gaseous oxygen. These devices are "portable" solely in the sense that they can be carried to another point of use such as in an automobile or in an airplane. At present, there are no home oxygen concentrators commercially available that can provide liquid oxygen. One type of medical oxygen concentrator takes in air and passes it through a molecular sieve bed, operating on a pressure swing adsorption cycle, which strips most of the nitrogen out, producing a stream of ~90% oxygen, for example, as shown in U.S. Patent Nos. 4,826,510 and 4,971,609 (which are incorporated herein by reference). While, as set out in the Information Disclosure Statement, complex oxygen liquefaction systems have been disclosed for use by the military in jet aircraft, and while large-scale commercial plants have been disclosed, this technology has not yet found its way into the home to help individual patients and to benefit the general public. A truly portable oxygen concentrator has not yet been perfected and this event is unlikely, at least in the near future, because the power requirements are too large to be provided by a lightweight battery pack.

Since liquid oxygen requires periodic delivery and home oxygen concentrators are not commercially available that would create liquid oxygen, there has existed a long-felt need for a device or method having the capability to concentrate oxygen from the air, liquefy it, and transfer it into portable dewars in a home environment, and for a home oxygen concentrator unit which allows excess flow capacity from the concentrator to be stored by either compression or liquefaction for later use.

Summary of Invention

The present invention presents a much safer and less expensive way of providing portable oxygen for patients who do not want to be tied to a stationary machine or restricted by present oxygen technology. In one preferred embodiment, the present invention splits off some of the excess capacity gas flow from a PSA (pressure swing adsorption) or membrane gas concentrator which has a relatively stable base load. This small portion of the excess flow capacity, about one liter per minute (□1LPM) is stored via liquefaction. The stored gas can then be used as a portable supply away from the location of the gas concentrator. The daily six hour range capacity for a two liter per minute patient can be accumulated by liquefying a one liter per minute gas flow for less than 24 hours. Therefore, the entire daily requirement for mobility can be produced every day if needed.

A summary of one of the many representative embodiments of the present invention is disclosed including a home liquid oxygen ambulatory system for supplying a portable supply of oxygen, where a portion of the gaseous oxygen output obtained from an oxygen concentrator is condensed into liquid oxygen, comprising: (a) an oxygen concentrator which separates oxygen gas from the ambient air; (b) an outlet flow line to transfer flow of oxygen gas from said oxygen concentrator for patient use; (c) a valve placed in the outlet flow line for splitting off a portion of the oxygen gas flow generated by the oxygen generator; (d) a generally vertically oriented, gravity assisted, condenser for receiving and liquefying the split off portion of the

oxygen gas flow; (e) a cryocooler associated with said condenser; (f) a first storage dewar in fluid communication with said condenser for storing the oxygen liquefied by the condenser, the first storage dewar having an outlet selectively engageable to and in fluid communication with at least one second smaller dewar and a fluid path for supplying liquid oxygen from the first dewar to the second dewar; (g) a heater for heating said first storage dewar; (h) a controller for monitoring (i) oxygen concentration of the oxygen gas flowing from said concentrator, and (j) the amount of liquid oxygen in said first dewar, and for controlling the parameters of liquid oxygen generation and transfer from said first storage dewar.

Another representative embodiment is the feature where the flow rate into the condenser is chosen to exceed the capacity of the condenser. In particular, only 20 to 90% of the incoming flow into the condenser is condensed to minimize the liquefaction of argon, nitrogen and trace gases, and to purge the system.

Additionally, the controller may control condenser parameters so that the condenser temperature varies in the range from approximately 69.2 to 109.7K, the condenser pressure varies from approximately 5 to 65 psia, and the concentrations of gas into the condenser varies with the oxygen range being 80 to 100%, the nitrogen range being 0 to 20%, and the argon range being 0 to 7%.

A unique condenser design is also disclosed where the condenser is in thermal contact with a cryocooler for use in liquefying oxygen and comprises: (a) an inlet conduit

for receiving oxygen; (b) an outer member; (c) an inner member; (d) a passage defined by said outer and inner members; (e) said inner member having radial slots to passages; (f) means for circulating said oxygen in said condenser.

Also disclosed is a representative method for controlling a home ambulatory liquid oxygen system comprised of an oxygen concentrator, a controller having a microprocessor, a condenser, a cryocooler and a storage dewar, where all or only a portion of the oxygen flow is utilized for liquefaction, comprising: (a) providing the microprocessor with a database and control functions; (b) sensing the parameters relating to the concentration and supply of gaseous oxygen, the level of liquid oxygen in the dewar, and the pressure of the condenser; (c) providing the microprocessor with these sensed parameters and having the microprocessor calculate optimal conditions; (d) controlling servomechanisms to regulate the system so that optimal conditions are realized as a function of said calculations.

The feature is also described wherein the liquid dewar will be periodically boiled dry to eliminate any small amounts of water and hydrocarbons that may pass through the gas concentrator.

The above-summarized apparatus and methods, more specifically set out in the claims, fill long-felt needs without posing any new safety issues to the patient in that, for example, there are no potentially dangerous canisters of high pressure compressed oxygen. The end result is that patients can ultimately use equipment with

which they are familiar. For example, patients on liquid oxygen currently perform liquid transfers from large (30-50 liquid liter) dewars to small (0.5-1.2 liquid liter -- corresponding to six hours of support) portable dewars. The present invention will provide a means of supplying ambulatory oxygen for a lower life cycle cost than the conventional method. Unlike industrial or military use liquefiers, which can take up whole rooms, the claimed oxygen liquefier (not including the oxygen concentrator) weighs less than 60 pounds and takes up less than six cubic feet of volume. There are currently about 700,000 patients in the United States using ambulatory oxygen with an average yearly cost of about $1,960 per patient. The estimated annual cost of oxygen per patient with the present invention is about $540.

Brief Description of the Drawings

Figure 1 is a block diagram of the invention in the medical oxygen preferred embodiment where gaseous oxygen is split off and liquefied for storage in a stationary dewar or container.

Figure 2 shows another preferred embodiment of the invention for ambulatory supplemental oxygen using a portable LOX dewar.

Figure 3 shows a typical temperature-composition diagram for oxygen-argon mixtures at typical dewar pressures.

Figure 4 shows a typical temperature-composition diagram for nitrogen-oxygen mixtures at typical dewar pressures.

Figure 5 shows typical oxygen concentration test data for gas streams into the condenser and out of the dewar during liquefaction, and out of the dewar as the

liquid is re-vaporized. (Oxygen source is a PSA oxygen concentrator.)

Figure 6 shows the controller block diagram for operation of the system.

Figures 7A through 7D are flow charts showing the controller logic.

Figure 8 shows the controller input levels and output states for the start-up mode of the preferred embodiment.

Figure 9 shows the controller input levels and output states for the condense mode of the preferred embodiment.

Figure 10 shows the controller input levels and output states for the transfer mode of the preferred embodiment.

Figure 11 shows the controller input levels and output state for the boil dry mode of the preferred embodiment.

Figure 12 illustrates basic components of a pulse tube refrigerator.

Figure 13 illustrates another embodiment of a cryocooler which may be used in the subject invention.

Figure 14 is a side cross-sectional view of the preferred embodiment of the condenser.

Figure 15 is an end cross-sectional view of the preferred embodiment of the condenser corresponding to Figure 14.

Figure 16 shows a side cross-sectional view of another preferred embodiment of the condenser.

Figure 17 shows an end cross-sectional view of another preferred embodiment of the condenser corresponding to Figure 16.

Figure 18 is an isometric view of the embodiment of the condenser shown in Figures 16 and 17.

Detailed Description of the Preferred Embodiment

A flow chart of the preferred embodiment of the invention is set out in Figure 1. Its main components include an oxygen concentrator 11, a cryocooler 12, a condenser 13, and a storage/collection dewar or vacuum insulated container 14. In the preferred embodiment, the oxygen concentrator 11 operates on a pressure swing adsorption cycle and essentially strips all or most of the nitrogen from air along with other minor components such as H_2O, CO_2, CO, NO_x, etc. The result is a stream of dry gas with high oxygen concentration (~92%) flowing in fluid outlet 50. A portion of the gas from this output in fluid outlet 50 is routed to a condenser 13 in association with a cryocooler (or cryogenic refrigerator) 12 through flow lines 51 and 57. The cryocooler provides cooling of the condenser heat exchanger 13 to liquefaction temperatures, causing the oxygen in contact therewith to go from the gaseous to the liquid phase. The condenser 13 typically must be insulated from ambient heating and may in practice even be located inside the dewar 14. In order to lessen the load on the cryocooler 12, a recuperator 15 may be used to pre-cool the incoming stream utilizing the vent flow through line 52 out of the dewar as a cooling medium. In practice, this recuperator 15 may also be located within the dewar 14 to reduce ambient heating.

Controller 16 may be equipped with a microprocessor, adequate memory, software and ancillary equipment comprising a computer which can be used to monitor and control the operation of the system. The controller 16 may be provided with signals from liquid level sensor 17, oxygen sensor 18, pressure transducer 9, and temperature sensor 10 via lines 53, 59, 55 and 56, respectively.

These signals are sensed and processed by the computer, with the controller operating valve 19, valve 25, heater 21, and cryocooler 12, in accordance with predetermined programs.

The controller also provides output indicators for the patient. The liquid level in the dewar is continuously displayed and the patient is alerted when the oxygen concentration is low and when the system is ready for them to transfer liquid to a portable dewar. A modem or wireless link may be included to enable remote monitoring of the key parameters of the system by the home care provider as well as information which is useful for repair, maintenance, billing, and statistical studies of patients for the medical oxygenation market. Key system parameters of interest include the number of liquid transfers performed, the oxygen concentration history, number of run hours on the cryocooler, and time of the last boil-dry as well as number of boil dries performed. The controller may include a computer and/or a microprocessor located either integrally with the liquefaction system claimed herein or remotely therefrom but in communication therewith using either a modem and telephone lines or with a wireless interface. The computer and/or microprocessor may include memory having a database, or may be remotely connected to a memory or database using a network. An Optimal Liquefaction Schedule for optimal operation of the liquefaction system is set out in Figures 7-10 and may be stored in said controller using the memory and database. The controller can sense optimum parameters of the system and optimally control, including by activating servomechanisms, liquefaction and transfer of liquid oxygen.

Dewar 14 is equipped with a dip tube 20 and heater 21. Heater 21 is used to build pressure in the dewar in order to expel liquid out the dip tube 20 when so desired. A quick disconnect valve 22 or other flow control means is located on the end of the dip tube. This allows connection of a portable LOX dewar 23, which can then be carried by the patient requiring a mobile/ambulatory supply of oxygen.

In another embodiment of this system shown in Figure 2, the dewar 14 could be eliminated and replaced with a portable dewar 23 which is modified slightly from those existing today. The new portable dewar would interface with the condenser 13, recuperator 15, and controller 16. This embodiment requires a slightly different control scheme from that given for the preferred embodiment as the transfer and boil-dry modes are eliminated. Any small amount of accumulated water and hydrocarbons are eliminated from the portable dewar 23 after each use by allowing it to warm to room temperature before reuse.

In operation, in the preferred embodiment of Figure 1, where a pressure swing adsorption (□PSA□) system is used, air is drawn into the oxygen concentrator 11, where it is compressed by an oilless compressor, cooled, and passed through molecular sieve beds operating on the pressure swing adsorption cycle, as shown in U.S. Patents 5,366,541; 5,112,367; 5,268,021 and Re. 35,009, which are incorporated herein by reference. This PSA system produces a 5-6 liters per minute (LPM) gas stream with high oxygen concentration at 3-7 pounds per square inch gauge (psig). The composition of this gas stream varies

but is typically 90-95% oxygen, 5-6% argon, 0-4% nitrogen, <15 parts per million (ppm) water vapor, and <1 ppm hydrocarbons. Exhaust from the PSA cycle (80-84% nitrogen, 15-19% oxygen, 0.6-0.8% argon, and trace amounts of water vapor, carbon dioxide and hydrocarbons) is vented into the atmosphere as waste gas. In the preferred embodiment, the high concentration oxygen stream in fluid outlet 50 is split with 0-4 lpm going through control valve 24, for patient consumption, and 0.5-1.5 lpm through line 51 and control valve 19 for liquefaction. Oxygen sensor 18, monitors the oxygen concentration produced by oxygen concentrator 11. If the oxygen concentration falls below 88%, controller 16 will close valve 19 and turn off the cryocooler 12.

Even though 88% oxygen is adequate as supplemental oxygen therapy, if this was liquefied, as will be described below, the initial revaporized stream may have a reduced oxygen content because of the close boiling points of the components of the mixture. The temperature of the split gas stream entering the recuperator 15 is about room temperature. It is cooled to about 270K (or colder) by the vent gas from the dewar flowing through the other side of the recuperator via line 52. The recuperator 15 reduces the load on the cryocooler by using the cold vent gas to pre-cool the oxygen-rich gas stream flowing into the condenser 13. From the recuperator 15 the high oxygen concentration stream flows through a line 57 to the condenser 13, which is cooled to ~90K by the cryocooler 12.

The condenser 13 provides cold surfaces to further cool and condense the flow. It is important to note that

the gas passing through the condenser 13 is a mixture of oxygen, argon, and nitrogen. The normal boiling points of these components are: 90.18K, 87.28K, and 77.36K respectively. Because of the close boiling points of the components of this mixture, there was initial skepticism because of the concern that all the nitrogen and argon would condense along with the oxygen. If this concern was realized, when this liquid mixture was revaporized, the lower boiling point components; i.e., nitrogen and argon, would boil off first, resulting in flow with high concentrations of nitrogen, argon and a much lower oxygen concentration than that which was supplied to the condenser -- which would make the process of oxygen treatment ineffective or a failure.

This concern is explained in Figures 3 and 4 which are temperature composition diagrams for binary mixtures of oxygen-argon and oxygen-nitrogen. In these diagrams taken from K.D. Timmerhaus and T.M. Flynn, *Cryogenic Process Engineering,* Plenum Press, 1989, pp. 296-297, the upper curve at a given pressure defines the dew point and the lower curve defines the bubble point. Looking at Figure 4 for a pressure of 0. 10 1 MPa, if there is a gas mixture with 10 mole percent nitrogen (point 1), condensation will start when the gas has cooled to the dew point curve (point 2g) which is at a temperature of about 89.5K in this case. Because oxygen has a higher boiling point than nitrogen, the initial liquid formed (point 2f) will have only 7.4 mole percent nitrogen. If the temperature is lowered to point 3, the liquid will have the composition of point 3f while the remaining vapor will

have the composition of point 3g. As the temperature is lowered further to point 4f or below, all of the mixture liquefies and the composition is 10 mole percent nitrogen, the same as at point 1. If this liquid is heated, the nitrogen which has a lower boiling point will vaporize first. Thus, the composition of the first vapor formed will be that of point 4g or about 50 mole percent. As the remaining liquid boils, the mole percent of nitrogen in the vapor drops back to 10 mole percent when point 2g is reached. It is believed that the composition swings with a ternary mixture of oxygen, argon and nitrogen will be even more pronounced than those shown in Figures 3 and 4 for binary mixtures. Fortunately, this concern was avoided when the system was set so that only 20 to 90% of the incoming flow to the condenser was actually condensed and when the condenser was controlled in accordance with the parameters as explained herein. This is believed to work because the excess flow operates to purge the vapor with higher impurity concentration from the system and avoid the aforementioned problem. Instead, the results realized were that a high concentration stream of oxygen could be liquefied and stored as set out in the portable ambulatory device claimed herein.

Figure 5 shows typical oxygen concentration test data for condensing and re-vaporizing part of the product outlet stream from the oxygen concentrator 11 in the preferred embodiment. For the first 120 minutes after the system was turned on, the system was cooling down without any net liquid accumulation in the dewar 14. From this point up to about 500 minutes, condensation continued with liquid accumulation. During this time phase, the inlet stream to the condenser 13 had an oxygen concentration of

95%, while the vent flow through line 52 had an oxygen concentration of only 92-93%. After 500 minutes the inlet stream and condenser cooling were stopped. The oxygen concentration of the re-vaporized liquid increased as the liquid boiled off due to the lower boiling point components (argon and nitrogen) boiling off first. This change in oxygen concentration presents no problem for medical ambulatory use because the oxygen concentration remains above 85%.

Because of the aforementioned mixture problem, it is important and even critical not to let the amount of argon and nitrogen in the liquid become too high or when it is revaporized, the oxygen concentration will initially be much lower than that conventionally used in supplemental oxygen therapy (>85%). This can be accomplished by selecting the proper condenser temperature, which is a function of pressure, and by not condensing all of the incoming flow. If only part of the incoming flow (20-90%) is liquefied, the remainder of the flow will purge the vapor with higher impurity concentration from the system. A condenser temperature of about 90K (for □17 psia) minimizes the amount of argon and nitrogen liquefied without overly diminishing the yield of oxygen. Hence there will be both liquid and vapor leaving the condenser. The liquid will fall into the dewar 14 and collect. The vapor which has not condensed is vented to the atmosphere through line 52 and the recuperator 15.

The amount of incoming flow liquefied is controlled by setting the mass flow rate relative to the cooling capacity of the cryocooler. The parameters of the condenser and/or cryocooler can be stored in the memory of

the controller and/or computer and the controller regulating the incoming flow depending on the parameters stored and/or sensed. Having a mass flow rate which exceeds the cooling capacity of the cryocooler/condenser combination, prevents the incoming flow from being completely liquefied. The mass flow rate is controlled by the amount of flow restriction between inlet valve 19 and flow control valve 25. This includes the flow losses of the valves themselves as well as those in the recuperator, condenser, and all of the interconnecting plumbing.

The pressure in the dewar 14 is maintained slightly above ambient pressure while the cryocooler is operating by valve 25. It is desirable to keep the pressure in the condenser as high as possible because this increases the condensation temperature (as shown in figures 3 and 4) which eases the requirements on the cryocooler. Once again this can be controlled by the controller and/or the computer, microprocessor and memory system.

This pressure regulating function of the solenoid on-off valve 25 is accomplished by the pressure transducer 9 and controller 16. Alternately, a back pressure regulating valve (such as a Tescom BB-3 series) or a suitable servomechanism may be used in lieu of the actively controlled solenoid. Liquid keeps accumulating in the dewar 14 until the liquid level sensor 17 signals the controller that the dewar is full or until the oxygen sensor 18 signals that the oxygen concentration of fluid exiting the oxygen concentrator 11 is too low.

In the best mode, operating parameters for optimal operation of the system for the condenser should be that

the condenser surface temperature should be in the range from 69.2-109.7K and pressure should be in the range from 5-65 psia. The gas concentrations into the condenser for medical use should have oxygen in the range of 80-100%, nitrogen from 0-20%, and argon from 0-7%.

In order to transfer liquid from the dewar 14; e.g. to fill a portable LOX dewar 23, the pressure in the dewar 14 must be increased so that liquid can be forced up the dip tube 20. As shown in Figure 1, heater 21 is used for this purpose. Heater 21 may be immersed in the liquid oxygen or attached to the outer surface of the inner vessel. The controller 16 ensures that the cryocooler 12 is turned off and valve 25 is closed before the heater 21 is energized. The heater 21 remains turned on until the pressure, measured by pressure transducer 9, reaches about 22 psig.

In order to eliminate accumulation of solid water and hydrocarbons which may be supplied in trace amounts from the oxygen concentrator, the dewar 14 will be warmed to room temperature periodically (preferably after about 30 fillings of a portable dewar, or every two months). This procedure is accomplished most economically when the inventory of liquid in the storage dewar is low; e.g. shortly after liquid transfer and a portable dewar has been filled. In this □boil-dry□ mode, valve 19 will be closed, the cryocooler 12 is turned-off, valve 25 is open, and heater 21 is energized. The heater will boil-off the remaining liquid in the dewar and with it any trace amounts of water and hydrocarbons which are condensed and solidified in the liquid oxygen or on the cold surfaces. The heater 21 will remain turned on until the dewar

temperature, measured by temperature sensor 10, has warmed to about 300K. Any remaining water vapor will be flushed out by gaseous oxygen during the subsequent cool-down.

At initial start-up or after a periodic boil-dry phase, the dewar, condenser, recuperator, and all associated hardware are at room temperature and must be cooled down. This is accomplished in the □start-up□ mode, where valve 19 (see Figure 1) is open, the heater is off, the cryocooler is on, and valve 25 is modulated to control the pressure/flow rate. It is desired to keep the pressure and hence the density of the gas as high as possible while maintaining the flow rate.

The higher density gas will have better heat transfer with the dewar walls and associated hardware. It is noted that higher flow rates will enhance the convection heat transfer but may exceed the cooling capacity. Based on the cooling characteristics of the cryocooler between room temperature and 90K, the flow rate can be changed to minimize the cool-down time.

The dewar 14 is equipped with at least one relief valve 26 as a safety feature. Another relief valve 29 is provided and in communication with the inlet gas stream 51, before flowing into the recuperator 15. This serves as a back-up for relief valve 26 as well as providing a means to eliminate accumulated water from the recuperator 15 during periods when the cryocooler 12 is off, if valve 25 is closed. A check valve 27 is also provided to prevent backflow into the oxygen concentrator in the event of a malfunction.

Figure 6 provides a block diagram of the controller 16 control system with sensor input value ranges and output states. It also shows interfaces to an indicator and a modem or wireless interface. The mode switch 28 may be used by the patient to request the system to prepare for a liquid transfer to a portable dewar. The indicator then provides a visual signal that the system is building pressure in the dewar. Once the pressure has reached the desired value, a visual and/or audio signal is given to alert the patient that the system is ready to transfer liquid. The controller may also be programmed to perform an unattended liquid transfer. The modem, telephone line or wireless interface connections are optional hardware that may be added to the controller to enable remote monitoring of the system by the home care provider (e.g., to assist with maintenance and repair) or insurance companies or health providers/administrators (e.g., to assess if patients are using enough ambulatory oxygen to justify payments, etc.).

Figures 7A-D show a logic flow chart for the controller for the normal operation modes. This can also be referred to as the □input/output control schedule.□ The mode switch 28 can also be used by a repair or factory technician to put the controller in a calibration mode which serves as a method to check and reset the program. As shown in Figure 6, the indicator provides liquid level readout, transfer request status, and low oxygen concentration information to the patient. All of the sensors are continuously scanned to provide the controller with the latest information. Figures 8 through 11 provide detailed output states as a function

of input levels for the normal operating modes (start-up, condense, transfer, and boil-dry), which can be referred to as the □Optimal Liquefaction Operational Schedule.□

For example, Figure 8 relates to the start-up mode; i.e., when the system is first turned on or after the boil-dry cycle. As shown in Figures 6 through 8 and as depicted in Figure 1, at start-up mode, the liquid sensor 17 shows zero liquid volume in the dewar and, when the oxygen sensor 18 shows an oxygen concentration greater than 88%, valve 19 is open, heater 21 is off, cryocooler 12 is on, and the indicator or the controller indicates a cool-down state. Valve 25 is modulated to control pressure.

Once the system attains a cool enough temperature, steady state or normal operational condense mode is used. As shown in Figure 9, the input to the controller 16 is such that when the oxygen sensor indicates oxygen concentration being greater than 88% and when the other criteria in the left-hand column of Figure 9 are achieved, the output states set out in the right portion of the chart are attained. For example, when the level of the dewar is sensed as being full, the liquid level sensor indicates a level of approximately 100%, causing closure of valves 19 and 25, keeping the heater off, turning the cryocooler off, and having the indicator signal that the dewar is full.

The transfer mode in Figure 10 is the stage where one can fill the portable thermos bottles or dewars 23 from the main storage dewar 14. The top portion of

Figure 10, for example, shows controller readouts where, if the liquid sensor indicates a liquid level of less than 20%, then the conclusion is computed that there is not enough liquid to transfer into the portable dewar from the main dewar as shown. When the operator wants to increase the pressure in the storage dewar to force the liquid oxygen into the portable dewar, the heater is activated, and when the pressure sensor indicates that the pressure exceeds 22 psig, as shown on the last line in the left-hand column of Figure 10, the heater 21 is then turned off and the controller readout or indicator shows that the transfer of liquid oxygen can be made to the portable dewar. Finally, Figure 11 indicates the boil-dry mode, with valve 25 open to allow the vapor to escape, and the various parameters relating thereto.

Figure 12 shows a schematic of a pulse tube refrigerator, the preferred embodiment of the cryocooler 12 in Figure 1. Because the cooling load on the condenser is small (7-15W), the pulse tube refrigerator is preferred for use in the subject ambulatory oxygen system because of its good efficiency with only one moving part, the pressure oscillator. Pulse tube refrigerators are shown in US Patent Nos. 5,488,830; 5,412,952 and 5,295,355 the disclosure of which are hereby incorporated by reference. Figure 11 depicts a pulse tube refrigerator of the double inlet type. Other types of pulse tube refrigerators (PTR) could also be used such as the basic PTR or the inertance tube PTR (Zhu et al., 9th International Cryocooler Conference, NH, June 1996).

The double inlet pulse tube refrigerator as shown in Figure 12 is comprised of a pressure oscillator 30, primary heat rejector 31, regenerator 32, heat acceptor 33, pulse tube 34, orifice rejector 35, bypass orifice 36, primary orifice 37, and reservoir volume 38. The preferred refrigerant gas in the PTR closed and pressurized circuit is helium but various other gases such as neon or hydrogen could also be used. In operation, the PTR essentially pumps heat accepted at low temperature in the heat acceptor 33 to the orifice heat rejector 35 where it is rejected at near ambient temperature. Although Figure 12 depicts a □U-tube□ configuration of the PTR, in-line and coaxial configurations are other possible options. Depicted therein is a piston type pressure oscillator, but other types are possible such as those utilizing diaphragms or bellows.

Figure 13 shows a schematic of another embodiment of the cryocooler. This is a vapor compression cycle cryocooler using a mixed gas refrigerant such as shown in US Patent No. 5,579,654; a 1969 German Patent by Fuderer & Andrija; British Patent No. 1,336,892. Other types of cryocoolers will work as long as they meet the important criteria of small size, convenience and low cost. In Figure 13, the refrigerant is compressed by the compressor to high pressure. Then it is cooled by the aftercooler with heat Qh being rejected to the environment. Oil is separated in the oil separator. Oil flows back to the compressor inlet through a flow restriction. The refrigerant gas flows to a heat exchanger where it is cooled by the returning cold stream. Some components of the mixture may condense in

this process. The liquid/gas refrigerant mixture flows through a throttle valve where its pressure is reduced and its temperature drops. This cold refrigerant enters the evaporator where the heat load Qc is absorbed and some liquid is boiled into vapor. This vapor flows up the cold side of the heat exchanger absorbing heat from the incoming stream. Then it flows back to the compressor. Heat Qc is accepted at cold temperature Tc. This is where the condenser would interface with the cryocooler.

It is noted that with this type of cryocooler, it may be possible to remove some of the heat from the oxygen stream at a temperature warmer than Tc.

One possible geometry of the generally vertically oriented, gravity assisted condenser 13 in Figure 1 is shown in Figures 14 and 15. The incoming gas from the oxygen concentrator flows from conduit 57 to chamber 58 and then is distributed through an annular passage 59 between the outer tube 41 and inner rod 42. The inner rod 42 is made of a high thermal conductivity material such as OFHC (Oxygen Free High Conductivity) copper, to minimize the temperature gradient between the surface on which the oxygen condenses (13) and the cryocooler 12. The cold end of the cryocooler is shown by cross-hatched member 61. Due to surface tension, the axial slots or grooves 43 will draw in liquid as it condenses. This will enhance heat transfer from the incoming gas by preventing a liquid film from forming over the entire condenser surface. Condensed liquid will drip off the bottom of the rod 42 while non-condensed gases flow out the end of the annulus 60. It is possible to liquefy

all of the incoming flow to the condenser provided the cryocooler has sufficient cooling capacity and temperature capability. However, in order to minimize the amount of nitrogen and argon condensed, the preferred embodiment only condenses between 20-90% of the incoming flow. The incoming flow rate can be determined by the appropriate sizing of flow restrictions downstream of and by controlling valve 19. As mentioned previously, the mass flow rate is chosen to exceed the cooling capacity of the condenser/cryocooler so that only part of the incoming flow is liquefied. Also, the pressure in the condenser is maintained as high as possible while maintaining the desired flow rate. The higher pressure increases the condensation temperature which in turn reduces the requirements on the cryocooler.

Figures 16 and 17 show another embodiment of the condenser that allows easier integration with the mixed gas refrigerant cryocooler. This configuration also allows access to the liquid in the dewar through the center of the condenser. The cold end of the cryocooler 45 is in thermal contact with an outer tube 46 and an inner tube 47, both of which are made of a high thermal conductivity material such as OFHC copper and which utilize flanges 62 and 64 to interface with the cryocooler. The inner tube has axial slots or grooves 48 cut into its outer surface (see, Figure 17) to increase the surface area and to wick condensed liquid, preventing a liquid film from forming over its entire surface. Gas enters the condenser through port 63. The liquid and vapor flow down through an annular passage

49. An isometric view of this embodiment is shown in Figure 18.

Thus, an improved home/ambulatory liquid oxygen system is disclosed. While the embodiments and applications of this invention have been shown and described, and while the best mode contemplated at the present time by the inventors has been described, it should be apparent to those skilled in the art that many more modifications are possible, including with regard to scaled-up industrial applications, without departing from the inventive concepts therein. Both product and process claims have been included and in the process claims it is understood that the sequence of some of the claims can vary and still be within the scope of this invention. The invention therefore can be expanded, and is not to be restricted except as defined in the appended claims and reasonable equivalence departing therefrom.

CLAIMS

1. A home liquid oxygen ambulatory system for supplying a portable supply of oxygen, where a portion of the gaseous oxygen output obtained from an oxygen concentrator is condensed into liquid oxygen, comprising:

(a) an oxygen concentrator which separates oxygen gas from the ambient air;
(b) an outlet flow line to transfer flow of oxygen gas from said oxygen concentrator for patient use;
(c) a valve placed in the outlet flow line for splitting off a portion of the oxygen gas flow generated by the oxygen generator;
(d) a condenser for receiving and liquefying the split off portion of the oxygen gas flow;
(e) a cryocooler associated with said condenser;
(f) a first storage dewar in fluid communication with said condenser for storing the oxygen liquefied by the condenser, the first storage dewar having an outlet selectively engageable to and in fluid communication with at least one second smaller dewar and a fluid path for supplying liquid oxygen from the first dewar to the second dewar;
(g) a heater for heating said first storage dewar;

(h) a controller for monitoring (i) oxygen concentration of the oxygen gas flowing from said concentrator, and (ii) the amount of liquid oxygen in said first dewar, and for controlling the parameters of liquid oxygen generation and transfer from said first storage dewar.

2. The liquid oxygen system of claim 1 wherein the oxygen concentrator is a pressure swing adsorption (□PSA□) type oxygen concentrator.

3. The liquid oxygen system of claim 1 wherein the flow rate into the condenser is chosen to exceed the capacity of the condenser.

4. The liquid oxygen system of claim 1 wherein only 20 to 90% of the split off portion flowing into the condenser is condensed to minimize the liquefaction of argon, nitrogen and trace gases.

5. The liquid oxygen system of claim 1 wherein the controller controls condenser parameters so that the condenser temperature varies in the range from approximately 69.2 to 109.7K, the condenser pressure varies from approximately 5 to 65 psia, and the concentrations of gas into the condenser varies approximately as follows:

oxygen: 80 to 100%
nitrogen: 0 to 20%
argon: 0 to 7%

6. The liquid oxygen system of claim 1 wherein vent gas from the first storage dewar is recovered and used to pre-cool the gas into the condenser.

7. The liquid oxygen system of claim 1 wherein the condenser is in thermal contact with the cryocooler and comprises:

(a) an inlet conduit for receiving the split off portion of oxygen;
(b) an outer member;
(c) an inner member having a chamber in communication with said inlet conduit;
(d) a passage defined by said outer and inner members;
(e) said inner member having axial slots; and
(f) means for circulating said oxygen in said passage defined by said inner and outer members;

8. The liquid oxygen system of claim 1 wherein a generally vertically oriented, gravity assisted condenser for use in liquefaction of oxygen from its gaseous to its liquid phase comprises:

(a) an inlet for receiving a stream of gaseous oxygen;
(b) an outer member;
(c) an inner member;
(d) a passage defined by said inner and outer members, the inlet being in communication with said passage;

(e) the inner member having axial slots to enhance heat transfer and to avoid liquid film build-up; and

(f) at least one of said members being in thermal contact with said cryocooler.

9. The liquid oxygen system of claim 1, further comprising a recuperator interfaced between the oxygen concentrator and the condenser.

10. The liquid oxygen system of claim 1, wherein the controller senses pressure in said first dewar and controls said heater in response thereto.

11. The liquid oxygen system of claim 1 wherein the first storage dewar will be periodically boiled dry to eliminate any trace gases that may pass through the gas concentrator.

12. The liquid oxygen system of claim 1, wherein the condenser comprises a generally vertically oriented, gravity assisted, circular housing with an inner center grooved core defining an annulus and with axial slits to wick away the condensed liquid.

13. The liquid oxygen system of claim 1 wherein the controller is located remotely from the oxygen source.

14. The liquid oxygen system of claim 1 wherein the controller monitors the oxygen concentration and amount of liquid oxygen and controls the parameters of

liquid oxygen generation and transfer remotely using a modem.

15. The liquid oxygen system of claim 1 wherein the controller monitors the oxygen concentration and amount of liquid oxygen and controls the parameters of liquid oxygen generation and transfer remotely using a wireless interface.

16. A control system for a home ambulatory liquid oxygen system having an oxygen concentrator, condenser, cryocooler, a heater and a storage dewar, the control system comprising:

(a) an oxygen concentration sensor which senses the concentration of oxygen gas generated by the oxygen concentrator and generates a first signal in response thereto;

(b) a liquid level sensor which senses the liquid level in the dewar and generates a second signal in response thereto;

(c) a temperature sensor which senses the temperature in the dewar and generates a third signal in response thereto;

(d) a microprocessor for receiving the first, second and third signals for computing the flow concentration of gaseous oxygen out of the concentrator and into the condenser, the level of liquid oxygen in the dewar, the temperature in the dewar and for controlling the transfer of liquid oxygen from said storage dewar.

17. The control system in claim 16 wherein the microprocessor is located remotely from the home ambulatory system and connected to the sensors and controllers using a modem.

18. The control system in claim 16 wherein the microprocessor is located remotely from the home ambulatory system and connected to the sensors and controllers using a wireless interface.

19. The control system in claim 16 wherein the actual flow rate into the condenser is chosen to exceed the designed flow capacity of the condenser allowing the excess flow to purge the system.

20. The liquid oxygen system of claim 16 wherein only 20 to 90% of the incoming flow into the condenser is condensed to minimize the liquefaction of argon, nitrogen and trace gases.

21. The apparatus of claim 16 wherein the controller controls condenser parameters so that the condenser temperature varies in the range from approximately 69.2 to 109.7K, the condenser pressure varies from approximately 5 to 65 psia, and the concentrations of gas into the condenser varies approximately as follows:

oxygen: 80 to 100%
nitrogen: 0 to 20%
argon: 0 to 7%

22. An ambulatory liquid oxygen system where liquid oxygen is formed from gaseous oxygen obtained from an oxygen concentrator comprising:

(a) an oxygen concentrator which separates oxygen gas from the air line;

(b) a first output line from said oxygen concentrator for delivering oxygen gas from said concentrator;

(c) a first valve placed in said first output line to control the output flow of oxygen;

(d) a condenser in cooperation with a cryocooler for providing cooling for said condenser;

(e) a second output line in communication between the first valve and the condenser for delivering the oxygen gas from the concentrator output to the condenser for cooling to form liquid oxygen;

(f) a storage dewar for storing liquid oxygen liquefied by the condenser;

(g) a third output line in communication between said condenser and storage dewar for delivering liquid oxygen from the condenser to the storage dewar;

(h) a heater for heating liquid oxygen in said dewar;

(i) an oxygen sensor to measure the oxygen concentration of flow from said concentrator;

(j) a liquid level sensor in said dewar;

(k) a temperature sensor in said dewar;

(l) a pressure sensor in communication with said dewar; and

(m) a controller for receiving output from the oxygen sensor, liquid level sensor, temperature sensor and pressure sensor, and for controlling the flow of input gaseous oxygen to the condenser and for controlling liquefaction and transfer from the storage dewar in accordance with the sensed conditions.

23. The system of claim 22 wherein the oxygen concentrator is of the Pressure Swing Adsorption (□PSA□) type.

24. The system of claim 22 wherein the condenser parameters are maintained as follows:

temperature from approximately 69.2 to 109.7K;
pressure from approximately 5 to 65 psia;
gas concentrations into condenser:
oxygen from approximately 80 to 100%,
nitrogen from approximately 0 to 20%, and
argon from approximately 0 to 7%

25. The system of claim 22 further comprising a recuperator between the oxygen concentrator and condenser for pre-cooling the flow of gas into the condenser.

26. The liquid oxygen system of claim 22 wherein the flow rate into the condenser is chosen to exceed the designated capacity of the condenser.

27. The liquid oxygen system of claim 22 wherein only 20 to 90% of the incoming flow to the condenser is condensed to minimize the liquefaction argon, nitrogen and trace gases.

28. The liquid oxygen system of claim 22 wherein the generally vertically oriented, gravity assisted condenser is in contact with the cryocooler and comprises:

(a) an inlet for receiving gaseous oxygen;
(b) an outer tubular member;
(c) an inner member;
(d) a passage defined by said outer and inner members;
(e) said inner member having axial slots cut into its outer surface;
(f) means for circulating said oxygen in said passage; and
(g) an outlet for releasing liquid oxygen,

wherein when said oxygen gas enters said condenser at said inlet and passes through said passage, condensation takes place causing a transition from gas to liquid phase.

29. The liquid oxygen system of claim 22 where the generally vertically oriented, gravity assisted, condenser comprises:

(a) an inlet for receiving a stream of oxygen;
(b) an outer member;

(c) an inner member;

(d) passage defined by said inner and outer members;

(e) the inner member having axial slots to enhance heat transfer and to avoid liquid film build-up; and

(f) an outlet for the oxygen which is liquefied.

30. The liquid oxygen system in claim 22 wherein the controller is located remotely from the oxygen generator.

31. The liquid oxygen system in claim 22 wherein the controller monitors the oxygen concentration and amount of liquid oxygen and controls the parameters of liquid oxygen generation and transfer remotely using a modem.

32. The liquid oxygen system in claim 22 wherein the controller monitors the oxygen concentration and amount of liquid oxygen and controls the parameters of liquid oxygen generation and transfer remotely using a wireless interface.

33. A method for controlling an ambulatory oxygen generator and oxygen liquefier having an oxygen concentrator, a condenser, a storage dewar and a controller comprising the following steps:

(a) generating a gaseous supply of oxygen using the oxygen concentrator for supplying oxygen to a patient;
(b) splitting off a portion of the gaseous supply to be liquefied;
(c) cooling said split-off supply of oxygen using the condenser to transform the oxygen from gaseous phase to liquid phase;
(d) storing the liquid oxygen in the storage dewar;
(e) sensing a concentration of oxygen being supplied by the oxygen concentrator, the level of liquid oxygen in said dewar and the temperature and pressure in said dewar; and
(f) the controller calculating conditions and controlling the operation of the above system to allow for liquefaction and operative transfer of liquid oxygen to a portable dewar.

34. A method for controlling a home ambulatory liquid oxygen system comprised of an oxygen generator, a controller having a microprocessor, a condenser, a cryocooler and a storage dewar, where all or only a portion of the oxygen flow is utilized for liquefaction, comprising:

(a) providing the microprocessor with a database and control functions;
(b) sensing the parameters relating to the concentration and supply of gaseous

oxygen, the level of liquid oxygen in the dewar, and the pressure of the condenser;

(c) providing the microprocessor with these sensed parameters and having the microprocessor calculate optimal conditions;

(d) controlling servomechanisms to regulate the system so that optimal conditions are realized as a function of said calculations.

35. An ambulatory home oxygen concentrator liquefaction system comprising:

(a) an oxygen concentrator which can isolate oxygen gas from the air;

(b) a first output means from the concentrator to channel the oxygen which is isolated;

(c) a second means to split off all or a portion of the gaseous oxygen from the output means of said concentrator for liquefaction;

(d) a condenser which can cause gaseous oxygen to change phase into liquid oxygen;

(e) means to channel the oxygen stream from said output means to a condenser;

(f) means to liquefy said oxygen stream in said condenser using a cryocooler; and

(g) means to collect the condensed liquid oxygen using a first dewar, wherein said first dewar includes a heater which can

be used to effectuate the transfer of liquid oxygen from the first dewar to a second dewar for storing a quantity of liquid oxygen from which smaller quantities can be transferred for moveable oxygen treatment.

36. The apparatus of claim 35 wherein the oxygen concentrator is a pressure swing adsorption (□PSA□) type oxygen concentrator.

37. The liquid oxygen system of claim 35 wherein the flow rate into the condenser is chosen to exceed the capacity of the condenser.

38. The liquid oxygen system of claim 35 wherein only 20 to 90% of the incoming flow to the condenser is condensed to minimize the liquefaction argon, nitrogen and trace gases.

39. The apparatus of claim 35 wherein the controller controls condenser parameters or ranges so that the condenser temperature varies in the range from approximately 69.2 to 109.7K and the condenser pressure varies from approximately 5 to 65 psia, and the concentrations of gas into the condenser varies approximately as follows:

Oxygen: 80 to 100%
Nitrogen: 0 to 20%
Argon: 0 to 7%

40. The apparatus of claim 35 wherein vent gas from the storage dewar is recovered and used to pre-cool the gas into the condenser.

41. The apparatus of claim 35, further comprising a recuperator interfaced between the oxygen concentrator and the condenser.

42. The apparatus of claim 35, further comprising a controller which senses pressure in the first dewar and controls said heater in response thereto.

43. The system set forth in claim 35 wherein the liquid dewar will be periodically boiled dry to eliminate any trace gases that may pass through the gas concentrator.

44. The apparatus of claim 35, wherein the generally vertically oriented, gravity assisted condenser comprises a circular housing with an inner center grooved core defining an annulus and with axial slits to wick away the condensed liquid.

45. The liquid oxygen system in claim 42 wherein the controller is located remotely from the oxygen generator.

46. The liquid oxygen system in claim 42 wherein the controller monitors the oxygen concentration and amount of liquid oxygen and controls the parameters of liquid oxygen generation and transfer remotely using a modem.

47. The liquid oxygen system in claim 42 wherein the controller monitors the oxygen concentration and amount of liquid oxygen and controls the parameters of liquid oxygen generation and transfer remotely using a wireless interface.

48. A controller for a home ambulatory liquid oxygen system having a computer, an oxygen concentrator, condenser, and storage dewar comprising:

(a) means for sensing the oxygen pressure of flow out of the concentrator;
(b) means for sensing the oxygen concentration of flow out of the concentrator;
(c) means for sensing the liquid level in the dewar;
(d) means for sensing flow parameters at the condenser;
(e) means for sensing the temperature at the dewar;
(f) means for controlling input of gaseous oxygen to the condenser;
(g) means for initiating and controlling the output of liquid oxygen from the storage dewar;
(h) a programmable control means coupled to each means for sensing, said programmable control means to be used for storing at least one required input/output control schedule, for processing the inputted signals and for actuating one or more control means.

49. A system for liquefying oxygen utilizing an oxygen concentrator, condenser, cryocooler and storage dewar comprising:

(a) a first flow control means for channeling off gaseous fluid flow from an oxygen concentrator;

(b) a second flow control means for advancing said gaseous fluid to a condenser;

(c) means for cooling said condenser to change the phase of said oxygen flow from gas to liquid;

(d) a conduit for transferring the liquid oxygen from the condenser to a storage dewar;

(e) a third flow control means for advancing the flow of liquid oxygen out of the storage dewar;

(f) a controller for sensing the oxygen concentration of flow into the condenser, for sensing the liquid level in the storage dewar, and for controlling said first, second, and third flow control means;

(g) programmable control means in said controller coupled to each of said flow control means, for storing flow delivery and liquefaction parameters for use by the controller in optimizing liquefaction of oxygen.

50. The liquid oxygen system of claim 49 wherein the flow rate into the condenser is controlled to exceed the capacity of the condenser.

51. The liquid oxygen system of claim 49 wherein only 20 to 90% of the incoming flow to the condenser is condensed to minimize the liquefaction argon, nitrogen and trace gases.

52. The liquid oxygen system of claim 49 wherein contact with a cryocooler for use in liquefying oxygen comprises:

(a) an inlet for receiving gaseous oxygen;
(b) an outer tubular member;
(c) a generally vertically oriented inner member;
(d) a passage defined by said outer and inner members;
(e) said generally vertically oriented inner member having axial slots cut into its outer surface;
(f) means for circulating said oxygen in said passage; and
(g) an outlet for releasing liquid oxygen;

wherein when said oxygen gas enters said condenser at said inlet and passes through said passage, condensation takes place causing a transition from gas to liquid phase.

53. The liquid oxygen system of claim 49 where the generally vertically oriented, gravity assisted condenser for use in liquefaction of oxygen from its

gaseous to its liquid phase and for use with a cryocooler comprises:

(a) an inlet for receiving a stream of oxygen;
(b) an outer member;
(c) an inner member;
(d) passage defined by said inner and outer members;
(e) the inner member having axial slots to enhance heat transfer and to avoid liquid film build-up
(f) an outlet for the oxygen which is liquefied.

54. A generally vertically oriented, gravity assisted condenser in thermal contact with a cryocooler for use in liquefying oxygen comprising:

(a) an inlet for receiving gaseous oxygen;
(b) an outer tubular member;
(c) an inner member;
(d) a passage defined by said outer and inner members;
(e) said inner member having axial slots cut into its outer surface;
(f) means for circulating said oxygen in said passage; and
(g) an outlet for said liquid oxygen;

wherein when said oxygen gas enters said condenser at said inlet and passes through said passage, condensation takes place causing a transition from gas to liquid phase.

55. A generally vertically oriented, gravity assisted condenser for use in liquefaction of oxygen from its gaseous to its liquid phase and for use with a cryocooler comprising:

(a) an inlet for receiving a stream of oxygen;
(b) an outer member;
(c) an inner member;
(d) passage defined by said inner and outer members;
(e) the inner member having axial slots to enhance heat transfer and to avoid liquid film build-up; and
(f) an outlet for the liquid oxygen to exit the condenser.

56. A home liquefaction system including an oxygen concentrator, controller with a programmable control means, condenser, cryocooler and storage dewar comprising:

(a) an oxygen concentrator which separates oxygen gas from the air;
(b) a first flow line from said oxygen concentrator for delivering oxygen gas from said concentrator;
(c) a first valve placed in said first flow line to control the output flow of oxygen;

(d) a condenser in cooperation with a cryocooler for providing cooling for said condenser;

(e) a second flow line in communication between the first valve and the condenser for delivering the oxygen gas from the concentrator output to the condenser for cooling to form liquid oxygen;

(f) a storage dewar for storing liquid oxygen liquefied by the condenser;

(g) a third flow line in communication between said condenser and storage dewar for delivering liquid oxygen from the condenser to the storage dewar;

(h) a heater for heating liquid oxygen in said dewar;

(i) an oxygen sensor to measure the oxygen concentration of flow from said concentrator;

(j) a liquid level sensor in said dewar;

(k) a temperature sensor in said dewar;

(l) a pressure sensor for sensing pressure in said dewar;

(m) a second valve for regulating flow of liquid oxygen from said dewar;

(n) a controller for receiving output from the oxygen sensor, liquid level sensor, temperature sensor and pressure sensor, and having means for storing at least one parameter from the Optimum Liquefaction Schedule, for controlling the flow of input gaseous oxygen to the condenser, and for optimizing liquefaction and

transfer from the storage dewar in accordance with the sensed conditions.

57. The apparatus of claim 56 wherein said programmable control means including means for storing information relating to optimum condenser parameters and for displaying an indicium of the modes of operation prior to activating any of said flow control means.

58. A system as in claim 56 wherein said programmable control means includes means for scheduling intermittent actuation of one or more of said valves so as to permit the system to be operated in accordance with the Optimum Liquefaction Schedule;

59. A system as in claim 56 including means for adjusting actuation of selected flows and conditions so as to optimize condenser parameters in response to said programmable control means and Optimum Liquefaction Schedule.

60. A system as in claim 56 including means for visually displaying controller parameters.

61. A system in claim 56 including means for transferring said liquid oxygen from said storage dewar to the delivery port at a controllable rate and including means to actuate said means in accordance with a predetermined Optimum Liquefaction Schedule;

62. An oxygen liquefaction system utilizing a concentrator to increase the oxygen concentration of an oxygen enriched product gas comprising:

(a) a first output line for transporting said product gas from said concentrator;

(b) a first valve for selectively withdrawing all or a portion of said product gas from said conduit to be liquefied;

(c) flow rate sensor independent of said first valve for sensing the rate of withdrawal of the product gas from said conduit to be liquefied and for communicating the sensed rate of withdrawal of said product gas to a modem;

(d) an oxygen sensor for sensing the oxygen concentration in said oxygen enriched product gas selectively withdrawn for liquefaction and for communicating the sensed oxygen concentration in said product gas to a first modem;

(e) a condenser for receiving the product gas withdrawn from said first flow control means;

(f) a second output line from said first flow control means oxygen concentrator for delivering oxygen gas from said concentrator for a first use;

(g) a second flow rate sensor in said second output line;

(h) a second oxygen sensor in said second output line;

(i) a cryocooler for providing cooling for said condenser;

(j) a storage dewar for storing liquid oxygen liquefied by the condenser;

(k) a third output line in communication between said condenser and storage dewar for delivering liquid oxygen from the condenser to the storage dewar;

(l) a heater for heating liquid oxygen in said dewar;

(m) a liquid level sensor for sensing the level in said dewar;

(n) a temperature sensor for sensing the temperature in said dewar;

(o) a pressure sensor for sensing the pressure in said dewar;

(p) a second modem for receiving quantitative signals communicated from said flow rate sensing means and said oxygen sensing means and for transmitting said signals to a remote controller; and

(q) a remote controller in telephonic communication with said first and second modems for receiving transmitted signals from said modems and having means for displaying the liquefaction parameters in the liquefaction process.

63. The oxygen liquefaction system of claim 62 wherein the concentrator increases the oxygen concentration of an oxygen enriched product gas recovered therefrom using a plurality of molecular sieve beds for receiving atmospheric air for selectively adsorbing nitrogen therefrom, an electric motor driven compressor including means for providing line voltage

for operating said compressor, and a valve cooperating with said compressor for alternately charging said sieve beds with atmospheric air and timing means for switching said valve to alternately charge said sieve beds according to a timing cycle.

64. The oxygen liquefaction system of claim 62 wherein said flow rate sensors comprise a pressure transducer for measuring product gas pressure therein.

65. The system of claim 64 including a microprocessor cooperating with said pressure transducers and having means for determining the rate of flow of product gas into the condenser in response to pressure sensings therein.

66. The system of claim 65 wherein said test apparatus includes visual display means for displaying the product gas flow rate and the oxygen concentration into the condenser and the pressure and temperature in the storage dewar.

67. The system of claim 62 wherein said remote control apparatus includes means for selectively signaling said modem to transmit said signals from said liquefaction apparatus.

68. The system of claim 62 including a microprocessor having means for receiving the sensed rate of product gas withdrawal and oxygen concentration in said product gas from said oxygen sensor, the pressure, temperature, and liquid level in the storage dewar, and having memory means provided with minimum

selected parameters at different conditions, means for comparing the sensed parameters with the minimum selected parameters, and means for signaling said modem to transmit said signals to said controller when said sensed parameters fall below said minimum selected parameters.

69. The oxygen concentrator of claim 68 wherein said first modem is connected to said microprocessor and said second remote modem is connected to said controller at a remote location, and wherein said modems are in telephonic communication.

70. The concentrator of claim 69 wherein said microprocessor includes means for signaling said first modem to transmit said signals to said controller when said sensed oxygen concentration or liquefaction falls below said minimum selected parameters.

71. The apparatus of claim 70 wherein said microprocessor cooperates with said first means and said second means and wherein said controller includes selective digital display means for displaying liquefaction parameters.

72. The system in claim 70 wherein the entry system not including the oxygen concentrator weighs no more than about 60 pounds and takes up less than about six cubic feet of volume.

73. An ambulatory liquid oxygen system where liquid oxygen is formed from gaseous oxygen obtained from an oxygen concentrator comprising:

(a) an oxygen concentrator which separates oxygen gas from the air;

(b) a first output means from said oxygen concentrator for delivering oxygen gas from said concentrator;

(c) a first valve placed in said first output means to control the output flow of oxygen;

(d) a condenser in cooperation with a cryocooler for providing cooling for said condenser;

(e) a second output line in communication between the first valve and the condenser for delivering the oxygen gas from the concentrator output to the condenser for cooling to form liquid oxygen;

(f) a storage dewar for storing liquid oxygen liquefied by the condenser;

(g) a third output line in communication between said condenser and storage dewar for delivering liquid oxygen from the condenser to the storage dewar;

(h) a heater for heating liquid oxygen in said dewar;

(i) an oxygen sensor to measure the oxygen concentration of flow from said concentrator;

(j) a liquid level sensor in said dewar;

(k) a temperature sensor in said dewar;

(l) a pressure sensor in communication with said dewar;

(m) a controller for receiving output from the oxygen sensor, liquid level sensor, temperature sensor and pressure sensor, and for controlling the flow of input gaseous oxygen to the condenser and for optimizing liquefaction and transfer from the storage dewar in accordance with the sensed conditions.

74. An ambulatory home oxygen concentrator liquefaction system comprising:

(a) an oxygen concentrator which can isolate oxygen gas from the air;
(b) a first output means from the concentrator to channel the oxygen which is isolated;
(c) a second means to split off all or a portion of the gaseous oxygen from the output means of said concentrator for liquefaction;
(d) a condenser which can cause gaseous oxygen to change phase into liquid oxygen;
(e) means to channel the oxygen stream from said output means to a condenser;
(f) means to liquefy said oxygen stream in said condenser using a cryocooler;
(g) means to collect the condensed liquid oxygen using a dewar;
(h) wherein said dewar includes a heater which can be used to effectuate the transfer of liquid oxygen from the dewar

for storing a quantity of liquid oxygen from which smaller quantities can be transferred for moveable oxygen treatment.

75. A system for liquefying oxygen utilizing an oxygen concentrator, condenser, cryocooler and storage dewar comprising:

(a) a first flow control means for channeling off gaseous fluid flow from an oxygen concentrator;
(b) a second flow control means for advancing said gaseous fluid to a condenser;
(c) means for cooling said condenser to change the phase of said oxygen flow from gas to liquid;
(d) a conduit for transferring the liquid oxygen from the condenser to a storage dewar;
(e) a third flow control means for advancing the flow of liquid oxygen out of the storage dewar;
(f) a controller for sensing the oxygen concentration of flow into the condenser, for sensing the liquid level in the storage dewar, and for controlling said first, second, and third flow control means;
(g) programmable control means in said controller coupled to each of said flow control means, for storing flow delivery and liquefaction parameters for use by

the controller in optimizing liquefaction of oxygen.

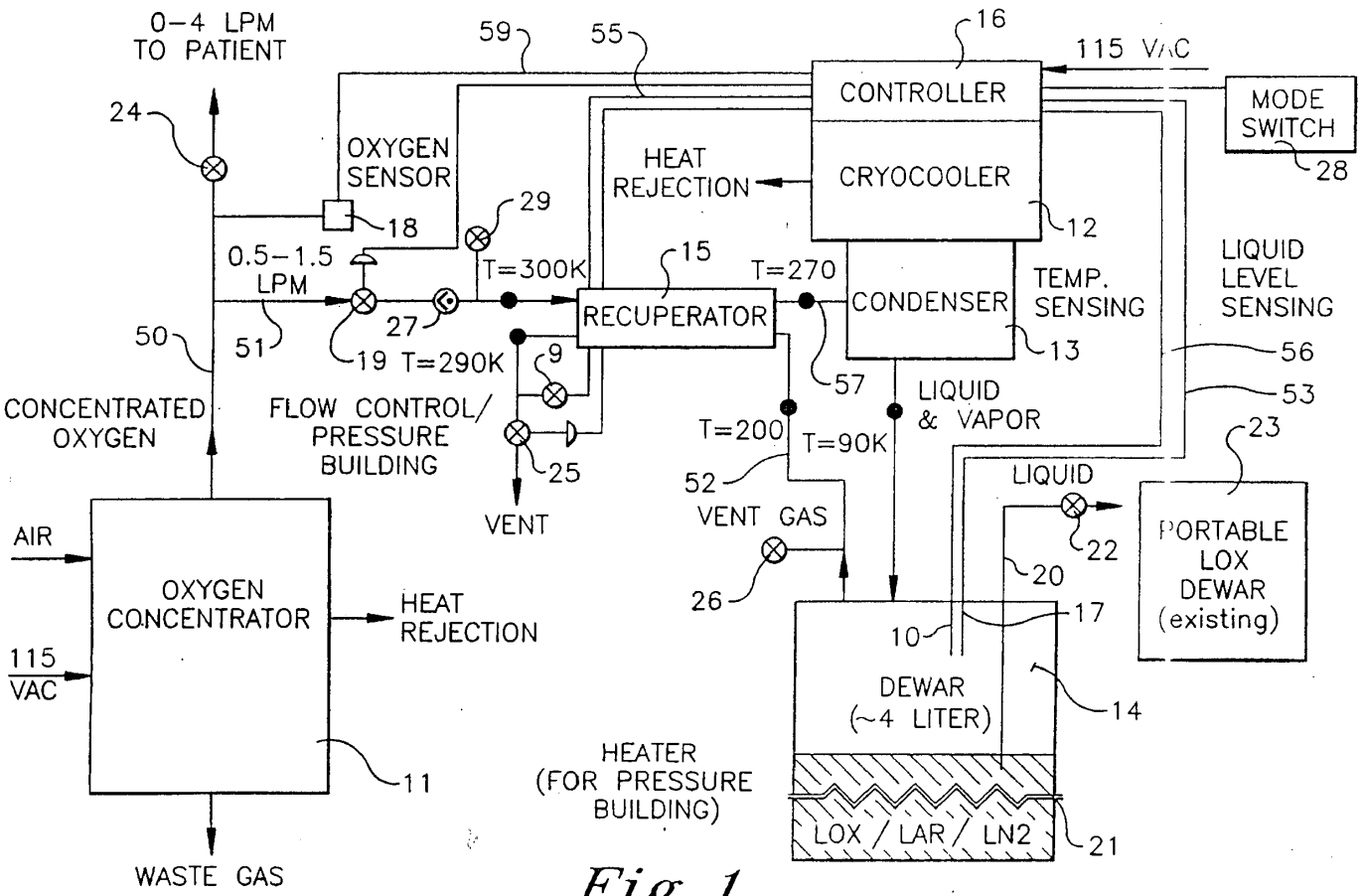


Fig. 1

GCE - Exhibit 1049, Page 547
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

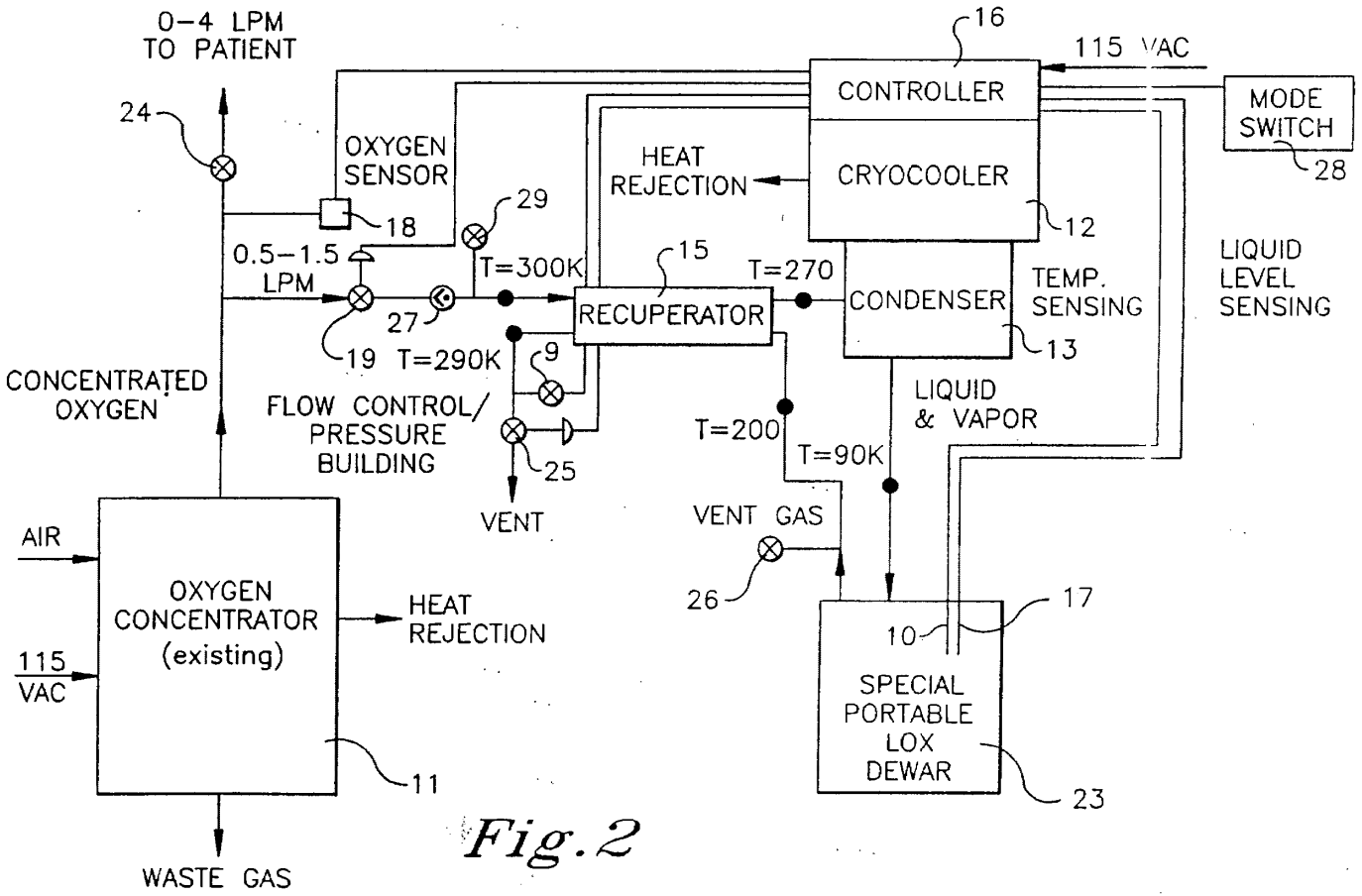
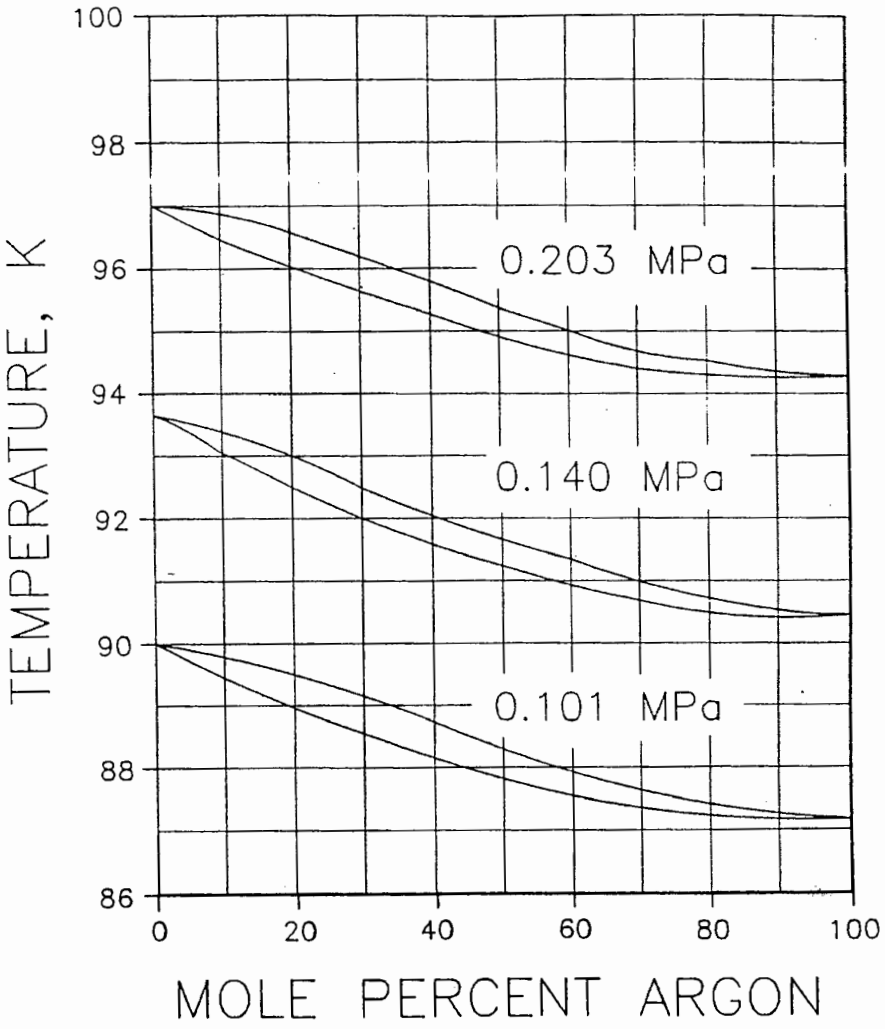

0–4 LPM
TO PATIENT
24
OXYGEN
SENSOR
18
29
0.5–1.5
LPM
T=300K
27
19
T=290K
9
FLOW CONTROL/
PRESSURE
BUILDING
25
VENT
CONCENTRATED
OXYGEN
AIR
115
VAC
OXYGEN
CONCENTRATOR
(existing)
HEAT
REJECTION
11
WASTE GAS
16
115 VAC
CONTROLLER
MODE
SWITCH
28
HEAT
REJECTION
CRYOCOOLER
12
15
T=270
RECUPERATOR
CONDENSER
TEMP.
SENSING
13
LIQUID
LEVEL
SENSING
LIQUID
& VAPOR
T=200
T=90K
VENT GAS
26
10
17
SPECIAL
PORTABLE
LOX
DEWAR
23

Fig. 2



TEMPERATURE – COMPOSITION DIAGRAM
FOR OXYGEN – ARGON MIXTURES

Fig. 3

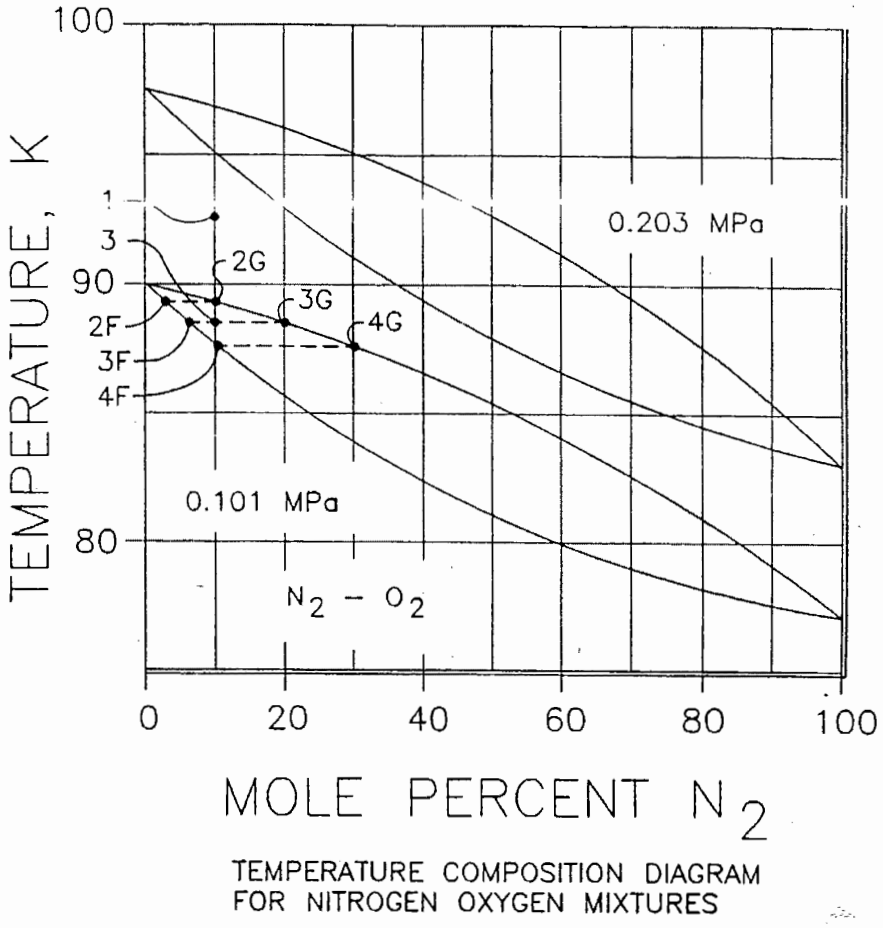
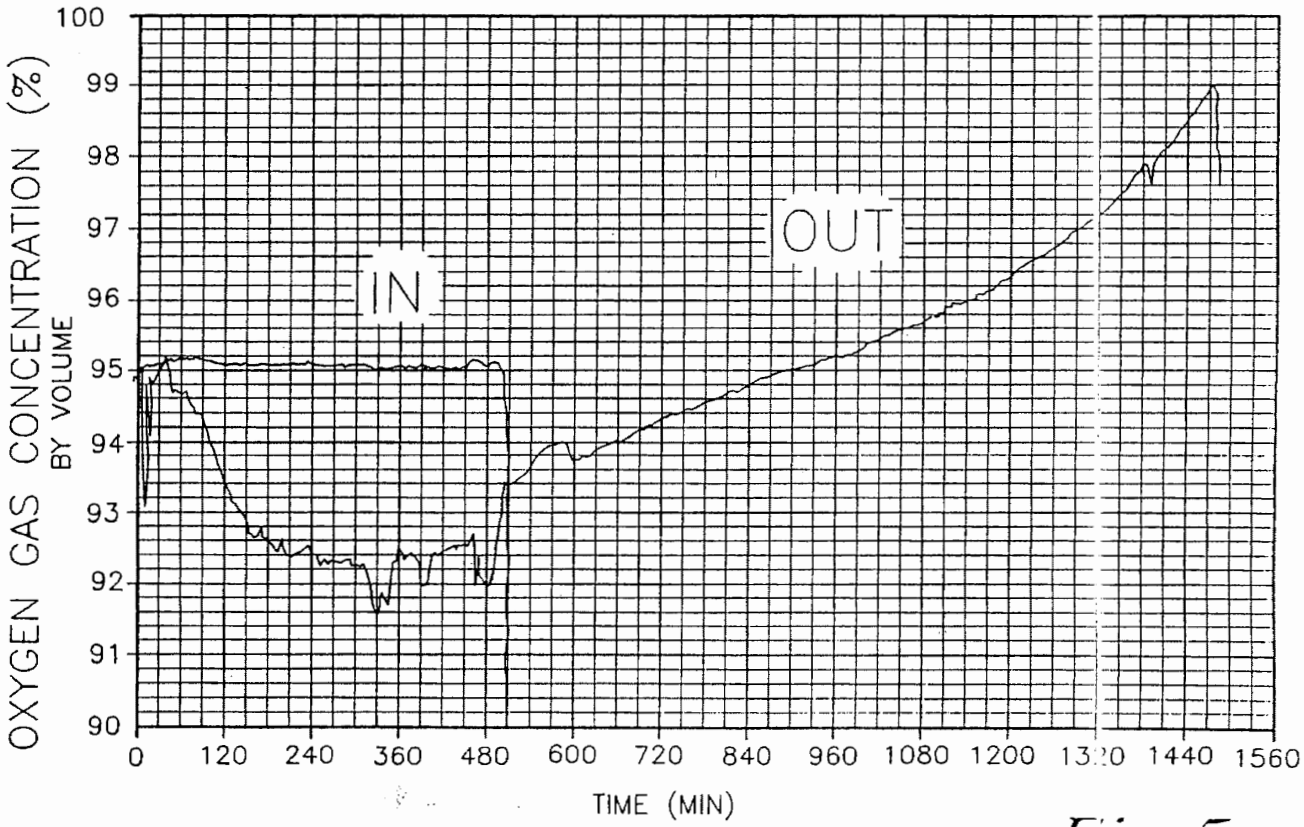
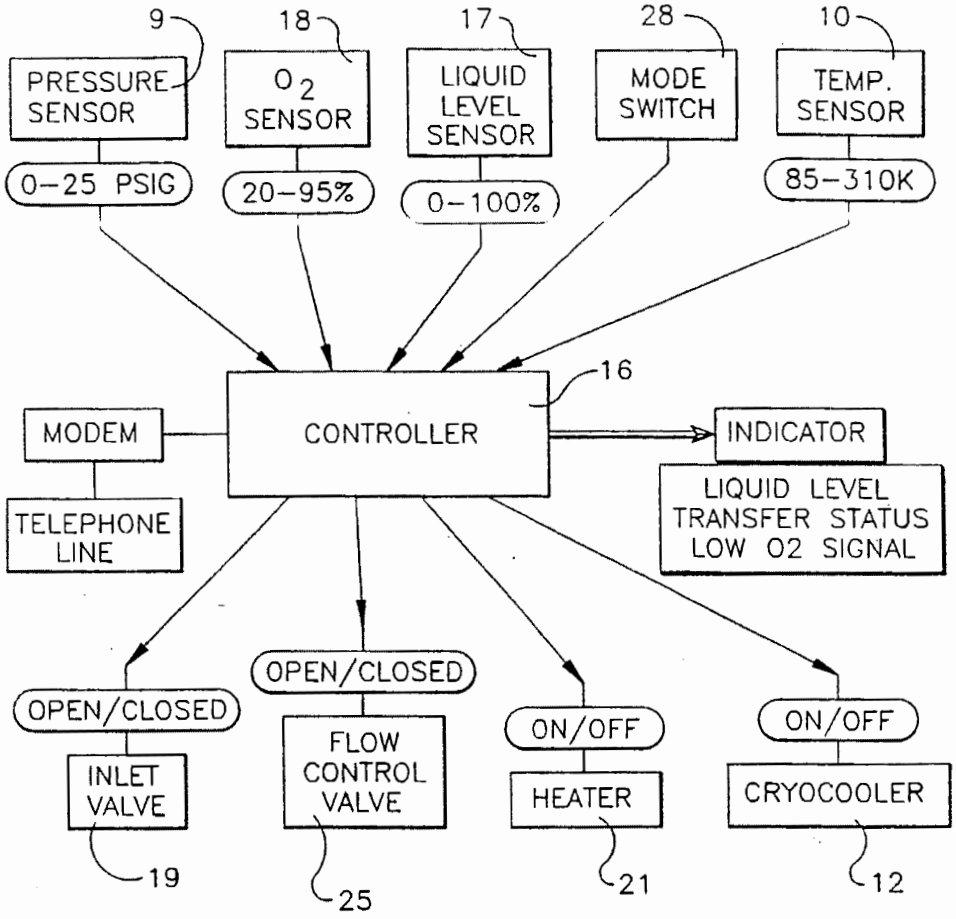

100
90
80
TEMPERATURE, K
1
3
2G
3G
4G
2F
3F
4F
0.203 MPa
0.101 MPa
$N_2 - O_2$
0
20
40
60
80
100
MOLE PERCENT N_2
TEMPERATURE COMPOSITION DIAGRAM
FOR NITROGEN OXYGEN MIXTURES

Fig. 4



OXYGEN CONCENTRATION TEST DATA

Fig. 5



CONTROL BLOCK DIAGRAM

Fig. 6

Fig. 7A

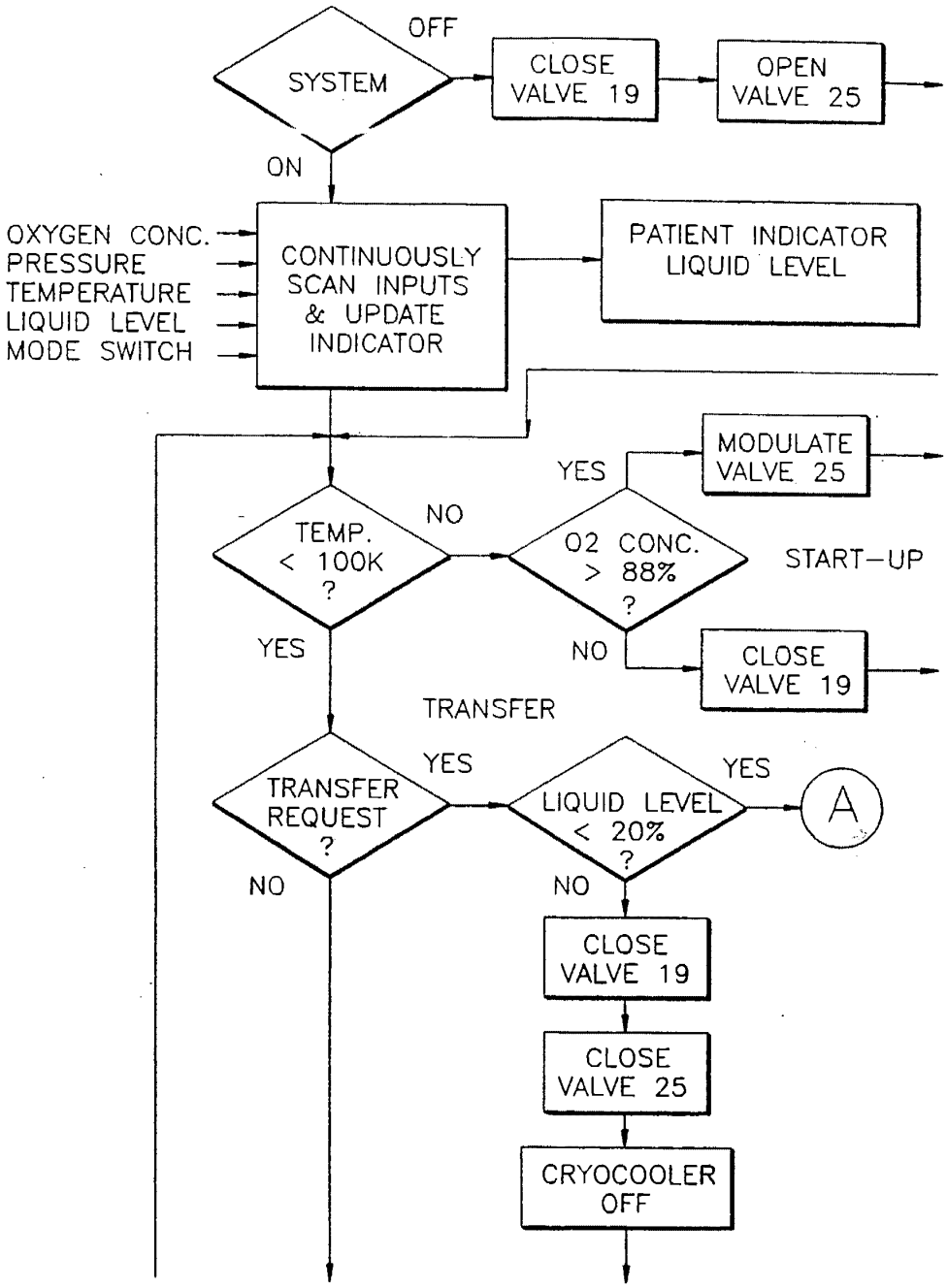
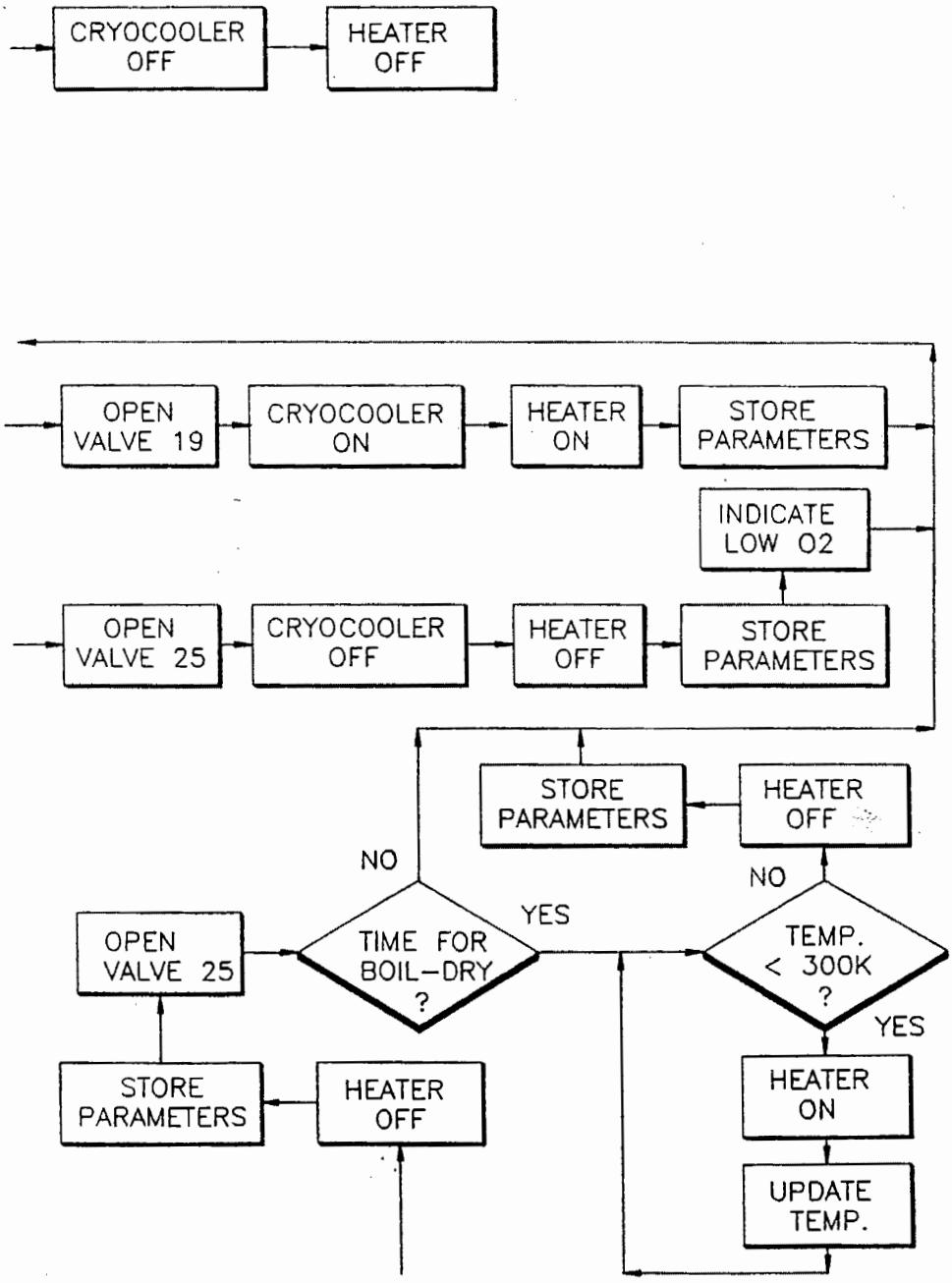

SYSTEM
OFF
CLOSE VALVE 19
OPEN VALVE 25
ON
OXYGEN CONC.
PRESSURE
TEMPERATURE
LIQUID LEVEL
MODE SWITCH
CONTINUOUSLY SCAN INPUTS & UPDATE INDICATOR
PATIENT INDICATOR LIQUID LEVEL
YES
MODULATE VALVE 25
TEMP. < 100K ?
NO
O2 CONC. > 88% ?
START-UP
YES
NO
CLOSE VALVE 19
TRANSFER
TRANSFER REQUEST ?
YES
LIQUID LEVEL < 20% ?
YES
A
NO
NO
CLOSE VALVE 19
CLOSE VALVE 25
CRYOCOOLER OFF

Fig. 7 B


CRYOCOOLER OFF
HEATER OFF
OPEN VALVE 19
CRYOCOOLER ON
HEATER ON
STORE PARAMETERS
INDICATE LOW O2
OPEN VALVE 25
CRYOCOOLER OFF
HEATER OFF
STORE PARAMETERS
STORE PARAMETERS
HEATER OFF
NO
YES
NO
OPEN VALVE 25
TIME FOR BOIL-DRY ?
TEMP. < 300K ?
YES
STORE PARAMETERS
HEATER OFF
HEATER ON
UPDATE TEMP.

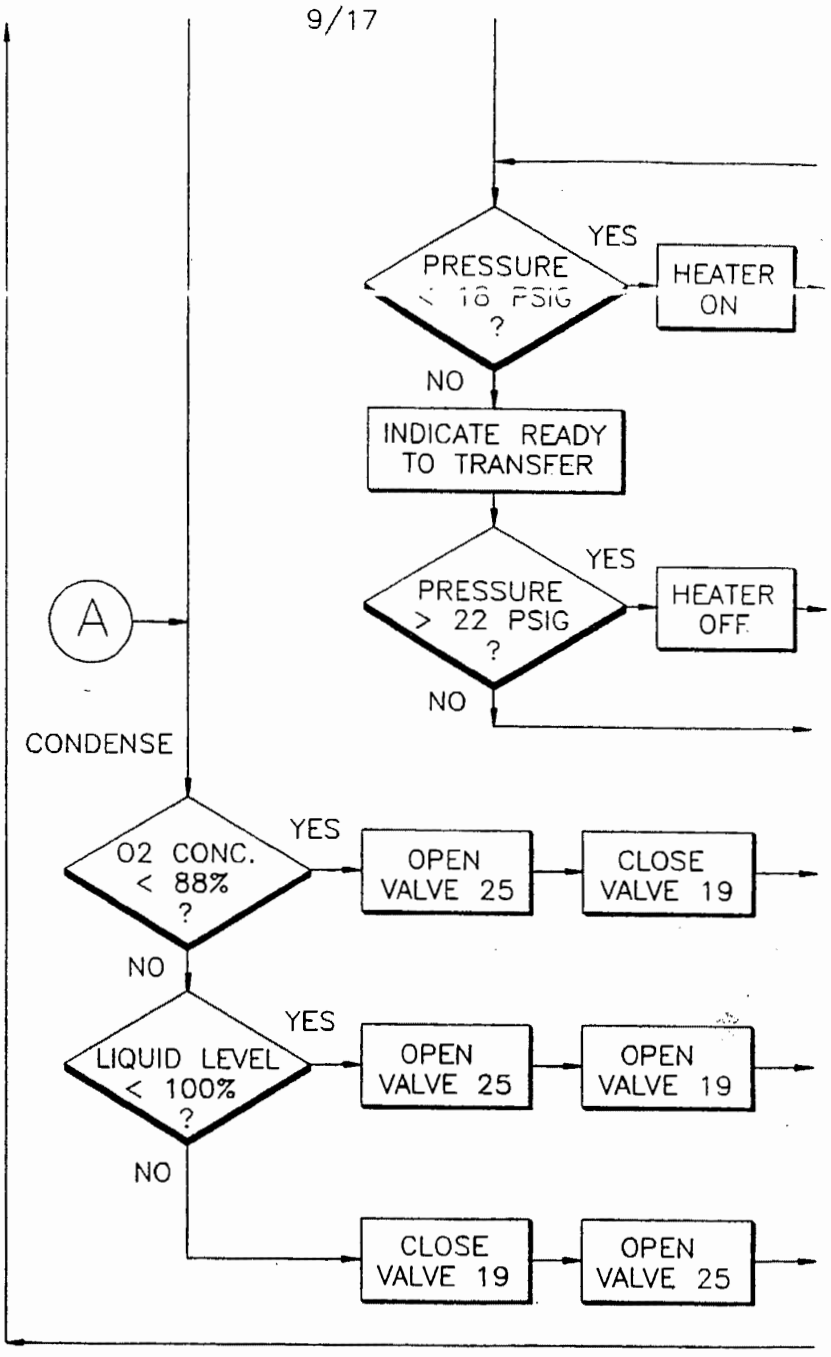

PRESSURE < 16 PSIG ?
YES
HEATER ON
NO
INDICATE READY TO TRANSFER
PRESSURE > 22 PSIG ?
YES
HEATER OFF
NO
A
CONDENSE
O2 CONC. < 88% ?
YES
OPEN VALVE 25
CLOSE VALVE 19
NO
LIQUID LEVEL < 100% ?
YES
OPEN VALVE 25
OPEN VALVE 19
NO
CLOSE VALVE 19
OPEN VALVE 25

Fig. 7C

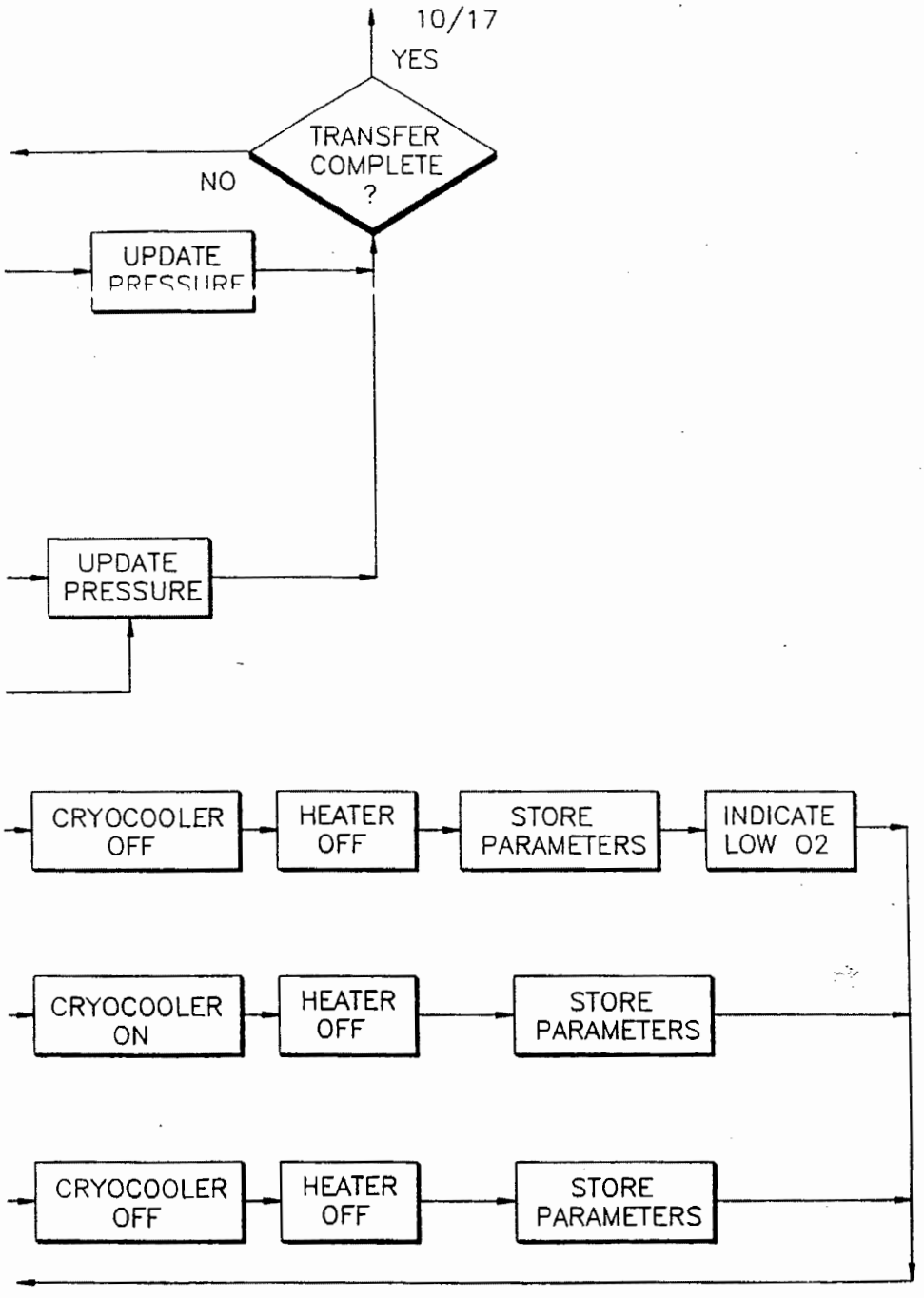

10/17
YES
TRANSFER COMPLETE ?
NO
UPDATE PRESSURE
UPDATE PRESSURE
CRYOCOOLER OFF
HEATER OFF
STORE PARAMETERS
INDICATE LOW 02
CRYOCOOLER ON
HEATER OFF
STORE PARAMETERS
CRYOCOOLER OFF
HEATER OFF
STORE PARAMETERS

Fig. 7D

Fig. 8

START–UP MODE

INPUT LEVELS & OUTPUT STATES

INPUT	LEVEL	OUTPUT	STATE
OXYGEN SENSOR	>88%	VALVE 19	OPEN
LIQUID LEVEL SENSOR	0%	VALVE 25	OPEN/CLOSED *
		HEATER	OFF
		CRYOCOOLER	ON
		INDICATOR	COOLDOWN

* MODULATED TO CONTROL PRESSURE

Fig. 9

CONDENSE MODE

INPUT LEVELS & OUTPUT STATES

INPUT	LEVEL	OUTPUT	STATE
OXYGEN SENSOR	>88%	VALVE 19	OPEN
LIQUID LEVEL SENSOR	<100%	VALVE 25	OPEN
		HEATER	OFF
		CRYOCOOLER	ON
		INDICATOR	CONDENSE
OXYGEN SENSOR	≤88%	VALVE 19	CLOSED
LIQUID LEVEL SENSOR	<100%	VALVE 25	OPEN
		HEATER	OFF
		CRYOCOOLER	OFF
		INDICATOR	O_2 LOW
OXYGEN SENSOR	>88%	VALVE 19	CLOSED
LIQUID LEVEL SENSOR	≥100%	VALVE 25	OPEN
		HEATER	OFF
		CRYOCOOLER	OFF
		INDICATOR	FULL

Fig. 10

TRANSFER MODE

INPUT LEVELS & OUTPUT STATES

INPUT	LEVEL	OUTPUT	STATE
OXYGEN SENSOR	20–95%	VALVE 19	CLOSED
LIQUID LEVEL SENSOR	<20%	VALVE 25	OPEN
		HEATER	OFF
		CRYOCOOLER	OFF
		INDICATOR	LIQ. LOW
OXYGEN SENSOR	20–95%	VALVE 19	CLOSED
LIQUID LEVEL SENSOR	≥20%	VALVE 25	CLOSED
PRESSURE SENSOR	<18 PSIG	HEATER	ON
		CRYOCOOLER	OFF
		INDICATOR	WAIT
OXYGEN SENSOR	20–95%	VALVE 19	CLOSED
LIQUID LEVEL SENSOR	≥20%	VALVE 25	CLOSED
PRESSURE SENSOR	>18 PSIG	HEATER	ON
		CRYOCOOLER	OFF
		INDICATOR	TRANSFER
OXYGEN SENSOR	20–95%	VALVE 19	CLOSED
LIQUID LEVEL SENSOR	≥20%	VALVE 25	CLOSED
PRESSURE SENSOR	>22 PSIG	HEATER	OFF
		CRYOCOOLER	OFF
		INDICATOR	TRANSFER

Fig. 11

BOIL–DRY MODE

INPUT LEVELS & OUTPUT STATES

INPUT	LEVEL	OUTPUT	STATE
OXYGEN SENSOR	20–95%	VALVE 19	CLOSED
LIQUID LEVEL SENSOR	<100%	VALVE 25	OPEN
TEMPERATURE SENSOR	<300K	HEATER	ON
		CRYOCOOLER	OFF
		INDICATOR	BOIL–DRY
OXYGEN SENSOR	20–95%	VALVE 19	CLOSED
LIQUID LEVEL SENSOR	0–100%	VALVE 25	OPEN
TEMPERATURE SENSOR	≥300K	HEATER	OFF
		CRYOCOOLER	OFF
		INDICATOR	WARM

13/17

DOUBLE INLET PULSE TUBE REFRIGERATOR

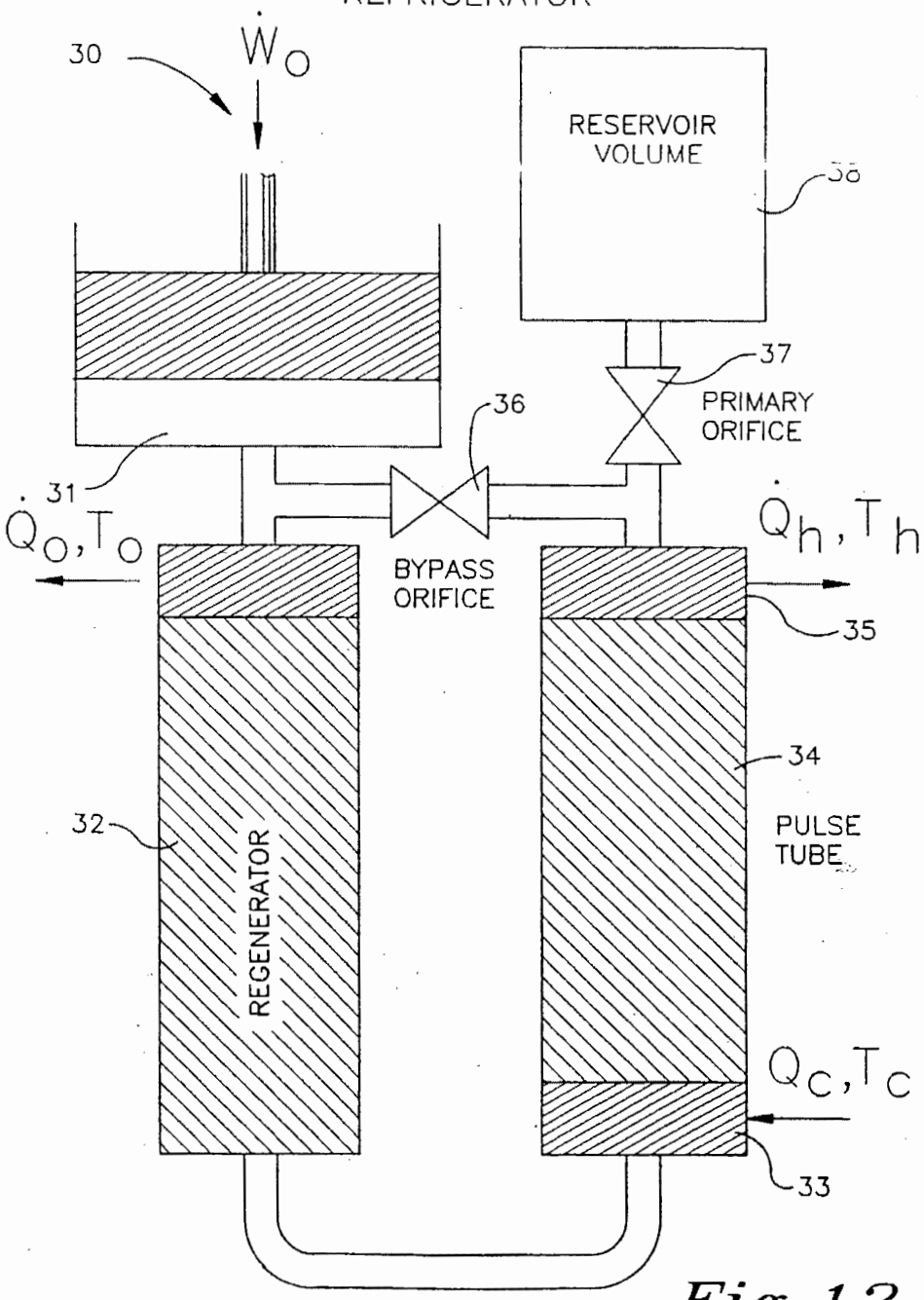


Fig. 12

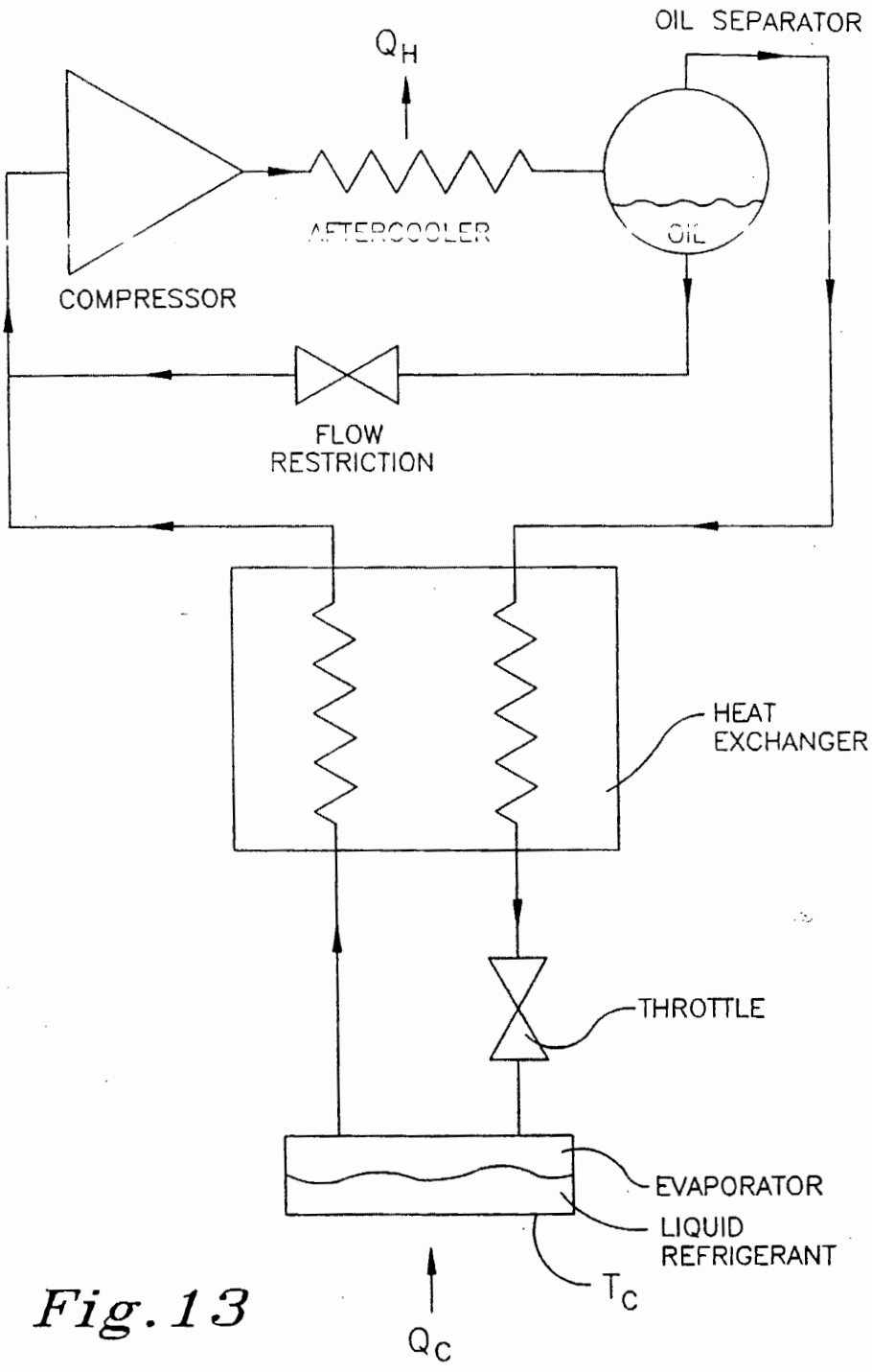
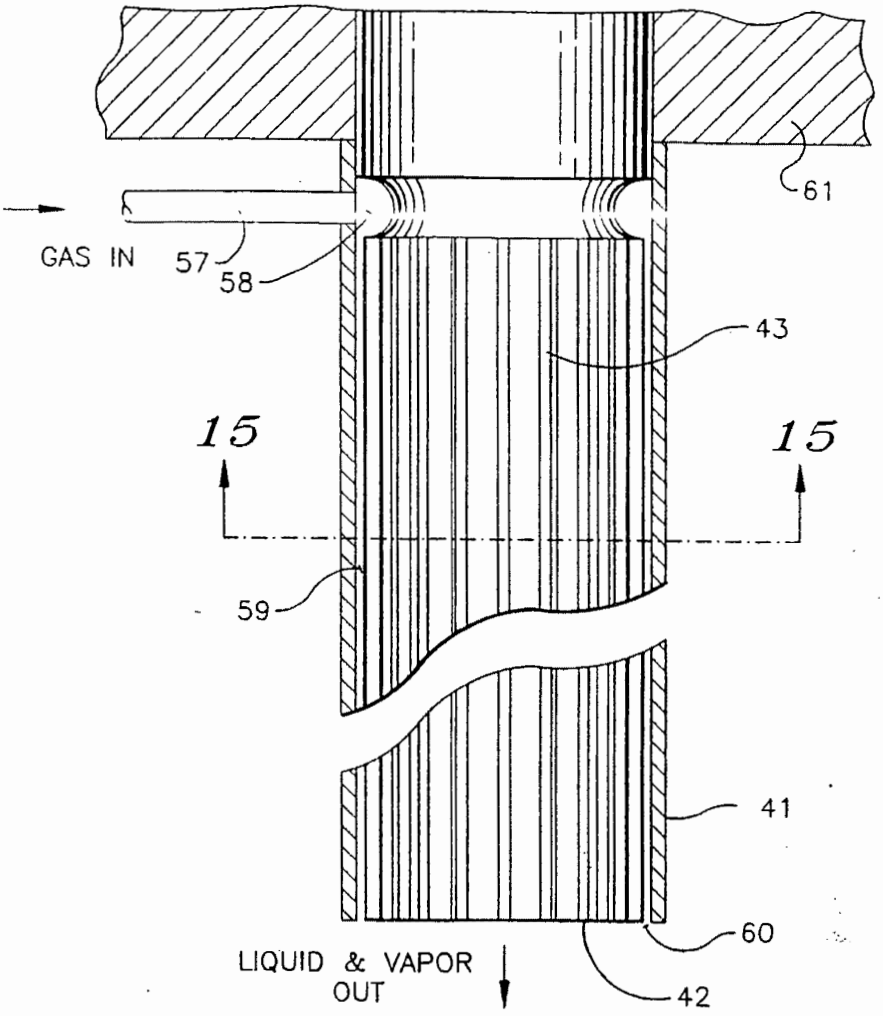

OIL SEPARATOR
Q_H
AFTERCOOLER
OIL
COMPRESSOR
FLOW
RESTRICTION
HEAT
EXCHANGER
THROTTLE
EVAPORATOR
LIQUID
REFRIGERANT
T_C
Q_C

Fig. 13

Fig. 14



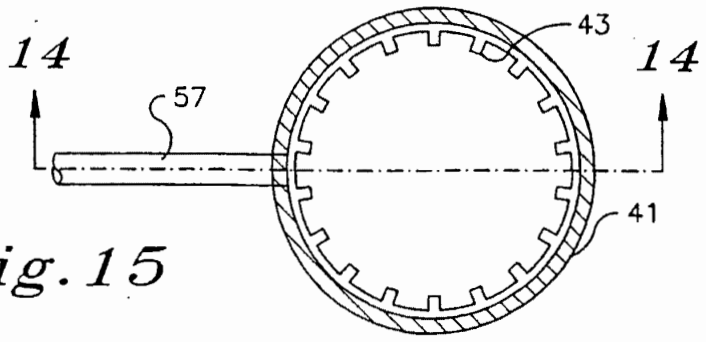


Fig. 15

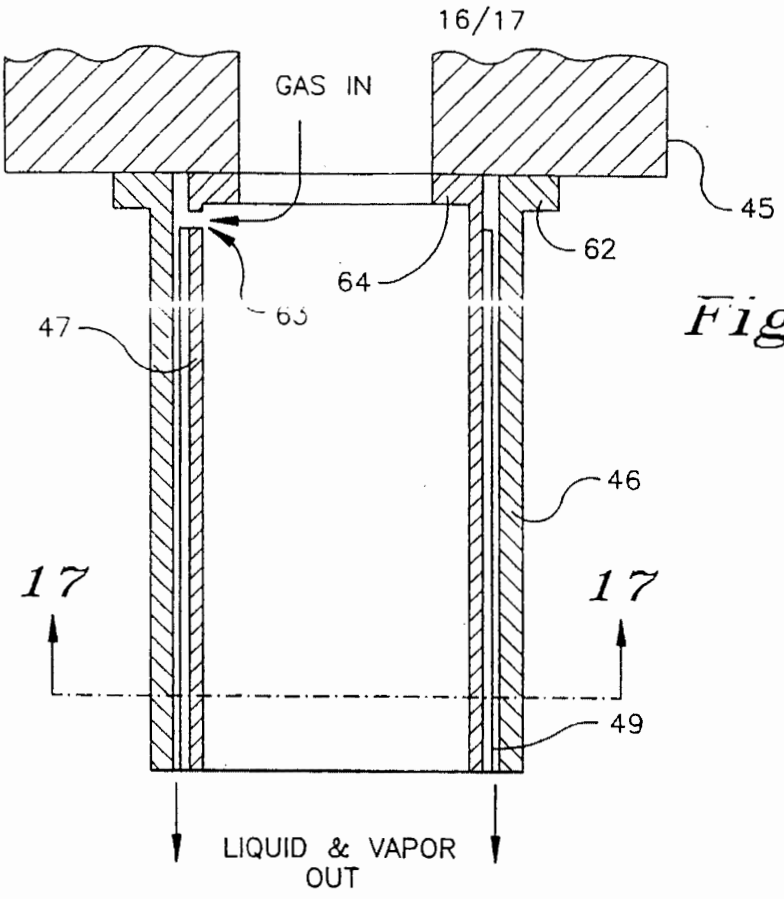

16/17
GAS IN
45
62
64
63
47
46
17
17
49
LIQUID & VAPOR
OUT

Fig. 16

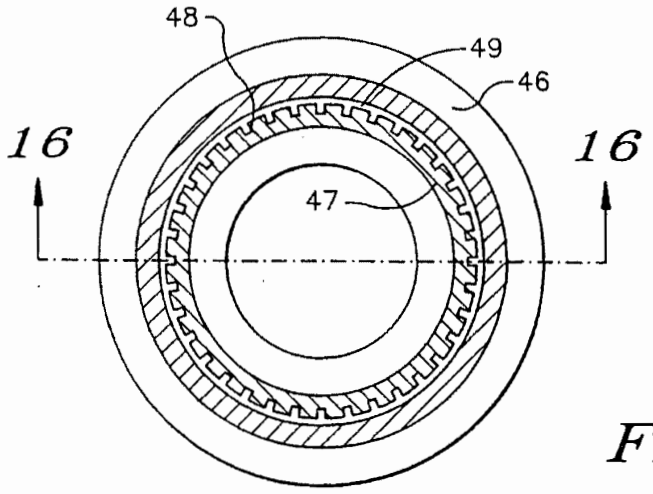

48
49
46
16
16
47

Fig. 17

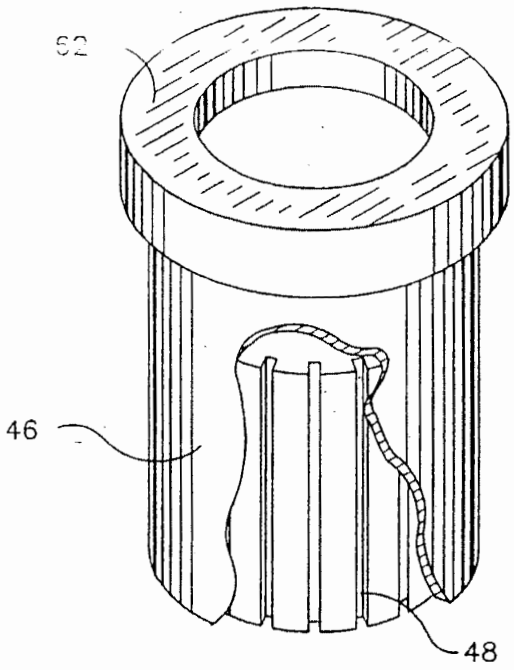


Fig. 18

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 98/11154

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F25J3/06 B01D8/00 B01D5/00 F28D7/10 F25J3/00

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)
IPC 6 F25J B01D F28D F28B F28F

Documentation searched other than minimumdocumentation 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 practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 870 960 A (HRADEK RICHARD W) 3 October 1989 ---	1-48, 56-61, 73,74
A	US 4 627 860 A (ROWLAND ROBERT O) 9 December 1986 ---	1-48, 56-61, 73,74
A	GB 1 416 163 A (BOC INTERNATIONAL LTD) 3 December 1975 ---	49-53, 62-72,75
A	US 5 584 194 A (GARDNER THOMAS W) 17 December 1996 ---	49-53, 62-72,75
A	US 5 163 297 A (YANI MASAYOSHI ET AL) 17 November 1992 --- -/--	54,55

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

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"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

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Date of the actual completion of theinternational search	Date of mailing of the international search report
17 September 1998	25/09/1998

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, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Meertens, J

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IPR2023-00527

INTERNATIONAL SEARCH REPORT

Intern. al Application No
PCT/US 98/11154

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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A	US 4 971 609 A (PAWLOS ROBERT A) 20 November 1990 cited in the application ---	
A	US 4 826 510 A (MCCOMBS NORMAN R) 2 May 1989 cited in the application -----	

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GCE - Exhibit 1049, Page 565
GCE Gas Control Equipment Inc. v. VBOX, Inc.
IPR2023-00527

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern al Application No
PCT/US 98/11154

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(19) Europäisches Patentamt
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(43) Date of publication:
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(71) Applicant: **LITTON SYSTEMS, INC.**
Woodland Hills, California 91367 (US)

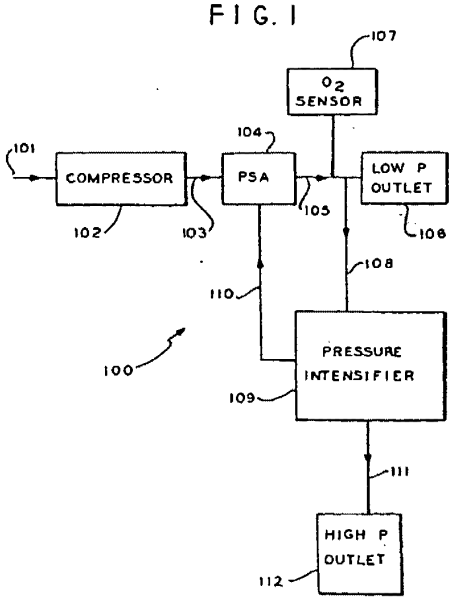
(72) Inventors:
- **McCulloh, Kevin Gene**
  Davenport, IA 52806 (US)
- **Selhost, Dale Louis**
  Moline, IL 61265 (US)
- **Henneman, John**
  Rock Island, IL 61201 (US)
- **Coffield, Kelly**
  Davenport, IA 52806 (US)

(74) Representative: **Godsill, John Kenneth et al**
Haseltine Lake & Co.,
Imperial House,
15-19 Kingsway
London WC2B 6UD (GB)

(54) Oxygen concentrator

(57) An apparatus for providing oxygen-enriched air at a first pressure and at a second pressure, the second pressure being greater than the first pressure. The apparatus comprises, in combination, a pressure swing adsorption system (104) and a pressure intensifier (109). The pressure swing adsorption system (104) for enriching the oxygen content of air has a pressure of at least the first pressure. The pressure swing adsorption system (104) is adapted to provide oxygen-enriched air to a first outlet (106) at the first pressure and to provide oxygen-enriched air to a pressure intensifier (109) at the first pressure. The pressure intensifier (109) pressurizes the oxygen-enriched air and provides the oxygen-enriched air to a second outlet (112) at the second pressure.

FIG. 1



EP 0 860 646 A2

Printed by Jouve, 75001 PARIS (FR)

Description

Field of the Invention

The present invention provides an oxygen concentrator and cylinder recharger and in particular provides a home health care oxygen concentrator and a cylinder recharger that is capable of simultaneously or independently providing oxygen-enriched air at a low pressure and at a high pressure. Such provision of oxygen-enriched air at two different pressures enables the apparatus to be utilized for the provision of oxygen-enriched air at a pressure suitable for use by a patient while at the same time providing oxygen-enriched air at a pressure suitable for recharging of a cylinder, thereby providing the patient with the option to be mobile.

Background of the Invention

There are a number of instances where the provision of oxygen-enriched air, sometimes referred to as oxygen, is required to be provided at a low pressure. One particular situation where such low pressure oxygen-enriched air is required is in the health care field, both in the health care field within various institutions as well as within a patient's home. In such situations, it may be necessary to provide a continuous flow of low pressure oxygen-enriched air to a patient on an on-going basis. While such patients may be able to withstand the absence of the flow of oxygen-enriched air for short periods of time, such patients frequently are unable to withstand the absence of such a flow of oxygen-enriched air for longer periods of time without suffering major health problems. In particular, such patients are normally not able to move from one location to another without oxygen-enriched air.

Systems for the provision of a flow of low pressure oxygen-enriched air include distillation processes, adsorption separation processes and membrane separation processes. One such process is a so-called pressure swing adsorption (PSA) process which has the advantage of being able to provide oxygen-enriched air in a short period of time after the supply of a suitable feed gas e.g. compressed air, to the apparatus. An example of a pressure swing adsorption process is described in U.S. Patent 4,948,391 of Y. Noguchi, which issued August 14, 1990.

A typical pressure swing adsorption process applied to the provision of oxygen-enriched air could comprise the following steps:

a) introducing air under pressure into a cylinder having an adsorption column of an adsorbent which selectively adsorbs nitrogen,
b) continuing the introduction of the air into the cylinder such that a zone of the adsorbed gas (nitrogen) moves forward through the cylinder,
c) collecting the desired gas (oxygen) that passes from the cylinder,
d) terminating the introduction of air to the cylinder,
e) terminating the collection of oxygen from the cylinder,
f) discharging a portion of the pressurized gas remaining in the cylinder, and
g) returning a portion of the oxygen back into the cylinder to flow through the column in the opposite direction to desorb the gas (nitrogen) adsorbed on the adsorbent and to purge the desorbed gas (nitrogen) from the cylinder.

Steps (a)-(e) effect the separation of nitrogen from the air so as to provide oxygen-enriched air, whereas steps (f) and (g) effect regeneration of the column used in the process. This permits continuous and long-term use of the pressure swing adsorption process to provide oxygen-enriched air.

One of the disadvantages of known processes for the supply of oxygen-enriched air at low pressure is that such processes lack the flexibility to allow the patient to be located at a fixed location but also to be able to move from that location with relative ease with an assurance that the source of oxygen-enriched air is sufficient. For instance, the patient may wish or need to be able to move from a bed or other similar location, e.g. to use toilet facilities, prepare meals, go to another room or change locations for other reasons. Such mobility with existing processes generally requires a patient to be disconnected from a first source of low pressure oxygen-enriched air and to be re-connected to a second system for provision of such air and which is mobile e.g. a cylinder of oxygen-enriched air. The patient would want an assurance that the source of oxygen-enriched air is sufficient, which would be of particular concern if the patient wished to be mobile for an extended period of time e.g. a day or weekend, without having to re-fill the mobile, or ambulatory, cylinder at a dealer or distributor.

Summary of the Invention

Apparatus has now been found that is capable of simultaneously providing low pressure oxygen-enriched air for use by a patient as well as high pressure oxygen-enriched air for the filling of a pressure cylinder.

Accordingly, one aspect of the present invention provides an apparatus for providing oxygen-enriched air comprising, in combination:

a low pressure oxygen enriched air separation system for enriching the oxygen content of inlet air, said air separation system adapted to provide oxygen-enriched air to a first outlet at a first pressure, said air separation system adapted to provide oxygen-enriched air to a second outlet at approximately said first pressure;
a pressure intensifier connected to said second outlet of the air separation system to pressurize said

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oxygen-enriched air and to provide said oxygen-enriched air to an outlet of the pressure intensifier at a second pressure; and

wherein said air separation system is capable of simultaneously providing oxygen-enriched air to said first outlet and said second outlet such that a flow of oxygen-enriched air can be supplied to said first outlet while said pressure intensifier is pressurizing said oxygen-enriched air to said second pressure.

In another aspect, the present invention provides a method for providing oxygen-enriched air at a first pressure and at a second pressure, said second pressure being greater than the first pressure, said method comprising:

feeding air to an air separation system;

providing oxygen-enriched air from said air separation system to a first outlet at said first pressure and controlling the flow of oxygen-enriched air at said first outlet;

providing oxygen-enriched air from said air separation system to a pressure intensifier at approximately said first pressure, increasing the pressure of said oxygen-enriched air to said second pressure using said pressure intensifier; and

wherein said air separation system is capable of simultaneously providing oxygen-enriched air to said first outlet and said second outlet such that a flow of oxygen-enriched air can be supplied to said first outlet while said pressure intensifier is pressurizing said oxygen-enriched air to said second pressure.

In a further aspect, the present invention provides apparatus for providing oxygen-enriched air comprising, in combination:

an air compressor, a low pressure oxygen-enriched air separation system and a pressure intensifier;

said air compressor being adapted to provide compressed air to said air separation system;

said air separation system being adapted to provide oxygen-enriched air to a first outlet at a first pressure, said first outlet having a controller to control the flow of oxygen-enriched air at a first outlet;

said air separation system further providing oxygen-enriched air to the pressure intensifier at said first pressure, said pressure intensifier being adapted to provide oxygen-enriched air at said second pressure;

wherein said air separation system is capable of simultaneously providing oxygen-enriched air to said first outlet and said second outlet such that a flow of oxygen-enriched air can be supplied to said first inlet while said pressure intensifier is pressurizing said oxygen-enriched air to said second pressure.

In embodiments of the apparatus and method of the present invention, the air separation system is a pressure swing absorption system, and the oxygen-enriched air from the pressure swing adsorption system is provided either simultaneously or independently to said pressure intensifier.

In another embodiment, the apparatus further comprises an air compressor for providing air to said pressure swing adsorption system, said air compressor having an inlet and exhaust air sound suppression system.

Brief Description of the Drawings

The present invention is illustrated by the embodiments shown in the drawings in which:

Figure 1 is a schematic representation in block format of apparatus of the invention;

Figure 2 is a schematic representation of the apparatus of Figure 1;

Figure 3 is a schematic representation of a fill port adaptor body;

Figure 4 is a schematic representation of a plan view of the fill port adaptor body;

Figure 5 is a schematic representation of a cross section of the fill port adaptor body through lines A-A of Figure 4;

Figure 6 is a schematic representation of a cross section of the fill port adaptor body through lines D-D of Figure 4;

Figure 7 is a schematic representation of a cross section of a part of the fill port adaptor of Figure 6, through B-B;

Figure 8 is a schematic representation of a perspective view of a flow controller body;

Figure 9 is a schematic representation of an end view of the flow controller body of Figure 8;

Figure 10 is a schematic representation of a cross section of the flow controller body of Figure 9 through line A-A;

Figure 11A is a schematic representation of a compressor system; and

Figure 11B is a schematic representation of a compressor sound suppression system, through line B-B of Figure 11A.

Detailed Description of the Invention

The low pressure oxygen-enriched air separation system may be an oxygen generator, a distiller, an air separator or a membrane separator, but it will be described herein with reference to the preferred embodiment in which it is a pressure swing absorption system.

Fig. 1 shows apparatus of the invention, generally indicated by 100, in block format. Ambient air 101 is connected to compressor 102. Outlet 103 from compressor 102 is connected to pressure swing adsorber (PSA) 104 and pressure intensifier 109 (see Fig. 2). Outlet 105 from pressure swing adsorber 104 is connected to oxygen

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sensor 107, low pressure outlet 106, and through tubing 108, to pressure intensifier 109. Pressure intensifier 109 is connected by tubing 111 to high pressure outlet 112, as well as being interconnected by tubing 110 to pressure swing adsorber 104.

In operation, ambient air enters air inlet 101 and is pressurized in compressor 102. The pressurized air is fed to pressure swing adsorber 104, as well as being fed to pressure intensifier 109 when the latter is energized (see Fig. 2). The oxygen-enriched air from pressure swing adsorber 104 is monitored by oxygen sensor 107, as well as fed to low pressure outlet 106 for use by a patient. In addition, oxygen-enriched air is fed to pressure intensifier 109. Pressurized oxygen-enriched air is fed from pressure intensifier 109 to high pressure outlet 112 where it may be used to re-charge a cylinder of oxygen-enriched air.

Fig. 2 shows an embodiment of an apparatus of the invention, generally indicated by 200, in greater detail. Apparatus 200 has inlet 101 connected in turn to particulate filter 201, tuned resonator 202 and to the inlet to compressor 203. Compressor 203 is driven by motor 204, and has relief valve 205. The outlet from compressor 203 is connected to a heat exchanger, generally indicated by 206, which has heat exchanger section 207 and cooling fan 208. Outlet tubing 209 from heat exchanger 207 is connected to two solenoid valves, 210 and 211, which are in a parallel relationship.

Solenoid valves 210 and 211 are connected to a tuned resonator 212. Each of solenoid valves 210 and 211 is connected to a sieve bed, 213 and 214 respectively, which are also in a parallel relationship. Sieve beds 213 and 214 are molecular sieve beds. Each of the outlets of sieve bed 213 and 214 is connected to a check valve, 215 and 216 respectively. In addition, sieve bed 213 and 214 are interconnected through orifice 217, the interconnection being located between the outlet of each of sieve bed 213 and 214 and each of check valves 215 and 216.

The outlets from each of check valves 215 and 216 are joined together, and connected to oxygen plenum 220. Oxygen plenum 220 is connected through orifice 221 to oxygen sensor 222 and filter 223, which is vented to the atmosphere. Oxygen plenum 220 is also connected to low pressure switch 237. The outlet of oxygen plenum 220 is connected in turn to pressure regulator 231, through orifice 232, filter 233, check valve 234, flow meter 235 to patient outlet 236. Patient outlet 236 is a low pressure outlet i.e. the pressure would normally be only a few inches of water, as will be understood by persons skilled in the art.

The outlet of the oxygen plenum 220 is also connected to a pressure intensifier generally indicated by 240. Pressure intensifier 240 has a first stage cylinder 241 and a second stage cylinder 242, with drive air cylinder 243 located therebetween. The opposed sides of drive cylinder 243 are connected through solenoid valves 244 and 245 to tubing between solenoid valve 210 and sieve bed 213, and tubing between solenoid valve 211 and sieve bed 214, respectively, of the pressure swing adsorber. Check valve 247 is located between oxygen plenum 220 and first stage cylinder 241. First stage cylinder 241 is also connected through check valve 248 and check valve 250 to second stage cylinder 242. Rupture disc 246 is attached to first stage cylinder 241 and rupture disc 251 is attached to second stage cylinder 242. Filters 252 and 253 are connected to first stage cylinder 241 and second stage cylinder 242, respectively, and vented to the atmosphere.

Check valve 249 is connected to filter 260, pressure switch 261 and pressure connection 262, which is the high pressure connection.

In an example of a typical operation of the embodiment of Figure 2, air enters air compressor 203 through inlet 101, particulate filter 201 and tuned resonator 202. Tuned resonator 202 is for sound suppression of compressor 203. The air is compressed to the operating pressure e.g. a pressure ranging from 20 to 30 psig. The compressed air obtained is routed through a fan cooled tube and fin heat exchanger 206 which cools the air before it enters the molecular sieve beds 213 and 214. The cooling of the air from the compressor optimizes performance of the molecular sieve beds as well as cooling the oxygen-enriched air obtained from the beds before it reaches the patient. Air flow into and out of the beds is controlled by two solenoid valves (valve 210 and valve 211) which allow compressed air to either enter the bed or to be vented from the bed to atmosphere.

A normal three phase cycle is (i) a first filling phase to fill bed 213 and exhaust bed 214, (ii) an intermediate overlap phase and (iii) a second filling phase to fill bed 214 and exhaust bed 213.

In phase (i), solenoid valve 210 allows compressed gas to enter bed 213 while valve 211 is venting gas from bed 214 to atmosphere. The molecular sieve in bed 213 adsorbs water vapour and nitrogen from the compressed air, allowing oxygen and argon to pass through the sieve. A portion of the gas is used as product gas which is delivered to the patient as low pressure oxygen-enriched air. The remainder of the oxygen-enriched air passes through an orifice, 217, and purges nitrogen and water vapour out of bed 214 as it is vented to atmosphere through solenoid valve 211. At the end of this phase, which in a typical embodiment of the invention lasts approximately 8 seconds, the pressure in bed 213 is typically approximately 30 psig and in bed 214 it is typically slightly above zero psig. At this time, bed 213 is almost saturated with nitrogen and continued flow through this bed without purging would result in nitrogen breakthrough and loss of purity in the product gas.

In overlap phase (ii), there is an overlap of approximately 1.6 seconds in which both solenoid valves 210 and 211 are switched to allow flow into both molecular sieve beds. This allows the air from sieve bed 213, initially at approximately 30 psig, as discussed above, to back flow through solenoid valve 210 into bed 214 which

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is initially at a low pressure. The crossflow of air in addition to the air from compressor provides a quick charge of bed 214, thereby reducing the compressor flow requirements and improving the efficiency of the system. At the end of the overlap cycle, the pressure in both beds is typically approximately 20 psig.

At the end of the overlap phase i.e. in phase (iii), solenoid valve 210 is switched to the vent position allowing bed 213 to vent to atmosphere until the pressure is only slightly above zero. Venting the bed to atmosphere plus back filling with product gas from bed 214 purges nitrogen and water vapour from bed 213 in preparation for the next cycle. At the same time bed 214 is providing product gas to the patient and purging bed 213. At the end of this phase, the entire cycle is repeated.

The oxygen-enriched air from the sieve beds passes through check valves 215 and 216 into the product storage (oxygen plenum 220). From oxygen plenum 220, the oxygen-enriched air passes into pressure regulator 231, through flow control orifice 232, HEPA filter 233 and check valve 234 to flow meter 235. Regulator 231 reduces the pressure from, for example, 30 psig in the oxygen storage plenum 220 to a constant pressure e.g. 6 psig, at the inlet of flow meter 235. Flow meter 235 is adjustable by the patient to provide the prescribed flow rate of oxygen at very low pressure.

A small amount of gas from the plenum e.g. typically less than 250 cc per minute, is continuously monitored by the oxygen sensor to ensure that the oxygen purity is above a predetermined value e.g. 90%. If the purity is below the predetermined or threshold value, a microprocessor energizes a warning light to alert the patient that an equipment malfunction has occurred and to prevent cycling of the pressure intensifier.

Pressure intensifier 240 may be standard two-stage device with a drive air cylinder and first and second stage product gas cylinders. The intensifier is turned on by opening solenoid valve 244 and 245 and which are either both open or both closed. A typical pressure intensifier cycle is as follows:

1. In the first step of the cycle, drive air enters drive air cylinder 243 through solenoid valve 244 beginning at the start of the overlap cycle of the molecular sieve beds discussed above, which occurs just before bed 213 starts charging, and continuing through the bed 213 charging cycle. This causes the piston to shuttle, drawing product gas into first stage cylinder 241 through check valve 247 and compressing the oxygen-enriched air in the second stage cylinder 242 which exits through check valve 249.
2. The drive air cylinder supply is common to the sieve bed supply and controlled by the sieve bed solenoid valves. Thus, the air in drive air cylinder 243 also helps precharge the sieve beds during the overlap phase which further increases the efficiency of the system. In this step during the overlap phase, the air in the drive air cylinder 243 back flows through solenoid valve 244, backflows through solenoid valve 210 and back into bed 214 through solenoid valve 211.
3. When the bed solenoid valves cycle, ambient air enters drive air cylinder 243 through solenoid valve 245 causing the piston to shuttle compressing the oxygen enriched air in the first stage cylinder 241. This gas then passes through check valves 248 and 250 and enters the second stage cylinder. The drive air, entering through solenoid valve 245 in this side of the drive air cylinder 243 aids in precharging bed 213 during the overlap cycle, as previously described.

After leaving the pressure intensifier, the gas passes through a filter 260 and the high pressure coupling 262 before entering a pressure vessel (not shown). The pressure intensifier will continue to operate until the pressure is high enough to activate a pressure switch 261 in the product line which signals the controller to close solenoid valves 244 and 245.

An example of apparatus for monitoring gaseous oxygen concentration is shown in U.S. Patent 5,402,665 of R.F. Hart et al, which issued April 4, 1995. An example of a pressure swing adsorber system having a pneumatically driven booster compressor is shown in U.S. Patent 5,354,361 of K.M. Coffield, which issued October 11, 1994.

In embodiments of the present invention, the first pressure is in the range of 5-10 psi and the second pressure is in the range of up to 3000 psi. The apparatus of the present invention is particularly adapted to be capable of providing both first and second pressures simultaneously.

The oxygen content of the oxygen-enriched air may be varied over a wide range but is preferably at least 85% by volume. In preferred embodiments, the oxygen content is at least 90% by volume, especially in the range of 92-94% by volume.

The oxygen concentrator described herein utilizes a pressure intensifier to raise the pressure of a portion of the oxygen-enriched air to a suitable pressure e.g. 2000 psig, for storage in pressure vessels e.g. a cylinder, for use by ambulatory patients. It will be understood that when the cylinder is empty, the pressure intensifier will provide oxygen-enriched air at a relatively low pressure, for instance, about the pressure in the storage plenum e.g. 30 psig, but that this pressure will rise as the cylinder fills e.g. to the aforementioned 2000 psig.

While the oxygen concentrator may be operated so as to produce oxygen-enriched air having a content of, for example, 93% oxygen, and thereby meet certain regulations relating to the provision of oxygen-enriched air for patients, such oxygen-enriched air may not meet the specifications for a medical-grade oxygen. Thus cylinders with adaptors meeting regulations for medical-

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grade oxygen may not be able to be used with the oxygen concentrator. Nonetheless, a unique integrated high pressure fitting and flow controller is preferred, that allows the patient to easily and safely fill their cylinders with oxygen-enriched air e.g. 93% oxygen, from the concentrator. Such a high pressure fitting and flow controller is shown in Figures 3-11.

Figure 3 shows a perspective view of a fill port adaptor body, generally indicated by 300. Fill port adaptor body 300 has a housing 301 with integral cradle 302, handle 303, locking clip 304 and adaptor housing 305. Cradle 302 of housing 301 is adapted to accept the flow controller body described herein below. Cradle 302 has fill port adaptor 306 therein, which is further shown in Figure 5. Fill port adaptor 306 is connected to handle 303, and is movable into cradle 302 using handle 303. Adaptor 307 extends from housing 301 from the opposed side thereof to fill port adaptor 306, and is interconnected therewith as shown in Figure 5.

Locking clip 304 is intended to retain the flow controller body within cradle 302, as described below. Latching of the flow controller body into cradle 302 occurs automatically when the flow controller body of a cylinder is placed in the cradle. However, an operator must manually move locking clip 304 into a release position to remove the cylinder. Similarly, handle 303 must be moved before the flow controller body of a cylinder may be placed in cradle 302 or removed therefrom, to reduce risk of damage to fill port adaptor 306.

Adaptor housing 305 is open on its upper face, as illustrated, and has housing window 308 on the opposed side thereof. The end of adaptor housing 305 opposed to cradle 302 has housing slot 309 therein.

Figure 4 is a plan view of fill port adaptor port 300. Handle 303 is located on housing 301, and is adjacent to cradle 302. Locking clip 304 is shown as extending into cradle 302. Cradle 302 has adaptor housing 305 extending therefrom and in an aligned relationship. Adaptor housing 305 has housing window 308 therein, with housing slot 309 in the end thereof. Figure 4 shows that adaptor 307 is connected to gear rack 401 which extends into housing 301.

Figure 5 shows a cross section of fill port adaptor body 300 through line A-A. Locking clip 304 is pivoted about locking clip pivot 501. Locking clip spring 504 located within housing 301 biases locking clip base 503 in an outwards direction so that locking clip lip 502 is biased into to cradle 302 to lock the flow controller body therein.

A fill port adaptor, generally indicated by 505 in Figure 5, is on the opposed side of cradle 302 to locking clip 304.

Fill port adaptor extends from adaptor 307 to adaptor pin 511. Adaptor 307 is connected to adaptor channel 506 which is located within adaptor channel housing 507 which in turn is located within adaptor housing 512. Gear rack 401, shown in Fig. 4 and Fig. 6 is machined into adaptor housing 512. As discussed herein, adaptor housing 512 is movable with respect to housing 301. Adaptor channel 506 connects with spring chamber 513 in which is located adaptor spring 508 and check valve base 509. Check valve base 509 extends through check valve seat 510 and terminates in adaptor pin 511. In the retracted position as shown in Fig. 5, adaptor pin 511 is within housing 301, but in the engaged position the adaptor pin extends into cradle 302.

Figure 6 shows a cross section of the adaptor body shown in Figure 4, through D-D. Handle 303 is located on housing 301. Shaft 605 extends downward from handle 303 and connects handle 303 to pinion 601; pinion 601 is more clearly seen in Figure 7, and is attached to shaft 605 by screw 604. Rotation of handle 303 causes rotation of pinion 601. Handle 303 has, on its lower side, handle projection 608, which is shown as being located in indent 609 in housing 301. Indent 609, and a similar indent that is not shown, serve to position and retain handle 303 in predetermined locations.

In a preferred embodiment, indent 609 has an adjustable screw therein (not shown), such screw being tapered or having a shoulder thereon. Projection 608 contacts the adjustable screw, on said taper or shoulder. Adjustment of the position of the screw adjusts the location of the taper or shoulder, and hence radially adjusts the position at which handle 303 is positioned and retained. This permits precise adjustment of the positioning of the fill port adaptor.

Figure 7 shows the rack and pinion, generally indicated by 600. Rack and pinion 600 has pinion 601 with pinion cogs 602. Pinion 601 rotates about pinion shaft 603, which extends down from handle 303, forming part thereof, as discussed above. Pinion 601 is located within pinion housing 606 which is part of housing 301. Pinion cogs 602 intermesh with ratchet slots 607 of ratchet 401. Ratchet 401 forms part of adaptor channel housing 507 illustrated in Figure 5.

Figure 8 illustrates the flow controller body, generally indicated by 700. Flow controller body 700 has pressure gauge 701, rupture disc housing 709, outlet fitting 706, and flow restrictor 704. Outlet fitting 706 is adapted to receive a flexible hose. The body is adapted to be threaded onto a high pressure cylinder by threaded port 705, flow restrictor 704, being located within threaded port 705. Flow controller body 700 has an integral cradle housing 702 which is shaped and dimensioned to fit precisely in the cradle 302 (see Figure 3). A flow control (ON/OFF) knob 703 with mechanical alignment/interlock bar 708 is attached to flow controller body 700 at the end opposed to the threaded port 705. Fill port adaptor inlet 707 is located in integral cradle housing 702.

Figure 9 shows an end view of flow controller body 700. Flow controller body 700 has flow restrictor 704 in the end thereof. Pressure gauge 701 and outlet port 706 are shown at an angle.

Figure 10 shows a cross section of flow controller body 700 through line A-A of Figure 9. Adaptor inlet 707 has inlet valve 800. Inlet valve 800 has inlet valve stem

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801 located within inlet valve chamber 802, but it will be noted that as illustrated inlet valve stem 801 does not extend fully to the end of inlet valve chamber 802. Inlet valve stem 801 has inlet valve spring 803 which biases valve end 804 towards valve seat 805 thereby biasing the valve toward a closed position.

In operation, flow controller body 700 is attached to a cylinder, not shown, through threaded cylinder port 705. Flow controller body 700 would normally be located on a cylinder, and remain thereon although it can be removed if desired. The cylinder with flow controller body 700 thereon is placed into fill port adaptor body 300 which forms part of the oxygen concentrator. Cradle housing 702 is adapted to fit within cradle 302 of fill port adaptor body 300. Alignment/interlock bar 708 on flow controller body 700 fits into housing slot 309 on adaptor housing 305. Flow controller knob 703 must be in the OFF position in order to insert alignment/interlock bar 708 into housing slot 309. This locates the rupture disk opposite housing window 308, but also locates inlet valve 800 opposite fill port adaptor 306. In order to insert flow controller body 700 into cradle 302, it is necessary to move locking clip 304 away from fill port adaptor 300, but after flow controller body 700 has been inserted into cradle 302, locking clip 304 biases back and locks flow controller body 700 in position.

Handle 303 is then tilted, rotated and locked in position, with handle projection 608 of handle 303 engaging in indent 609 in housing 301, at which time adaptor 306 moves inwards into cradle 302. In doing so, fill port adaptor 306 is inserted into adaptor inlet 707, with adaptor pin 511 contacting valve end 804. This moves valve end 804 away from valve seat 805, thereby opening the valve. However the amount of movement of valve end 804 is limited, thereby also causing check valve 509 to open. This forms a channel for the flow of oxygen-enriched air from the oxygen concentrator through fill port adaptor body 300, flow controller body 700, and out of cylinder port 704 into the cylinder. The cylinder cannot be removed without moving handle 303 such that fill port adaptor 306 becomes retracted. This disconnects the fill port adaptor so that the oxygen concentrator is not connected to the cylinder, and closes both the cylinder and the oxygen concentrator check valves 804 and 509, to prevent the flow or leakage of gas therefrom. In particular, the check valve in the fill port adaptor, 509, prevents gas from oxygen plenum 220 from escaping to atmosphere through check valves 247-250 in the pressure intensifier when the pressure intensifier is not in operation. A single movement of handle 303 opens or closes the channels for flow of high pressure air to the cylinder.

It will be appreciated that the flow controller body permits the use of cylinders of various sizes to be filled using the concentrator described herein.

It is to be understood that the oxygen concentrator described herein may be operated in a mode in which oxygen-enriched air is only supplied to a patient. Alternatively, the oxygen concentrator may be operated in a mode in which oxygen-enriched air is only supplied for the re-charging or filling of a cylinder. However, the oxygen concentrator also may be operated in a dual mode, supplying oxygen-enriched air to a patient and simultaneously supplying oxygen-enriched air for re-charging or filling of a cylinder.

Figure 11A shows a compressor system, generally indicated by 820. Compressor system 820 has compressor 821 mounted on base 822. Base 822 also has an integral sound suppressor 823 for suppressing noise from both air drawn into the compressor and air exhausted from the concentrator. The integral sound suppressor assists in reducing the size and complexity of the compressor system and permits the suppressors to be mounted in the base, thus reducing the manufacturing steps required in the fabrication of the oxygen concentrator. Sound suppressor 823 is more clearly shown in cross-section, through B-B, in Figure 11B.

Figure 11B illustrates air compressor sound suppressor, generally indicated by 900. Sound suppressor 900 has compressor base 901 into which two outer silencer tubes 902 and 903 have been moulded, utilizing the natural contour of the air compressor. End caps 904 and 905 along with inner silencer tubes 906 and 907 are attached to each end of the compressor base silencer tubes 902 and 903. Compressor port 910 is adapted to be connected to an air compressor.

Operation of the sound suppressor can be described as follows:

As air is drawn into an air compressor, valve noise and air noise is generated. In more general terms, noise is generated when compressed air is exhausted to atmosphere in any pneumatic device.

In air compressor sound suppressor 900, compressor port 910 is connected to an air compressor and air is drawn into silencer tube chamber 908, which is moulded into the compressor base 901, via inlet port 911 in the end cap 904. The air travels through inner silencer tube 906 and into the inlet silencer chamber 908. Noise coming from the air compressor is muffled, because as sound travels from the air compressor and into compressor port 910, the noise is absorbed and deflected through outlet silencer chamber 909 by the outer silencer tube 902 and the inner silencer tube 906 before exiting through outlet 911. By varying the diameter and length of outer silencer tube 902 and inner silencer tub 906, sound compressor 900 can be tuned to minimize the unwanted noise from the compressor.

The concentrator exhaust silencer operates in a similar manner as the inlet silencer except exhaust air noise is minimized. Air enters the silencer tube 903 through exhaust inlet 913 in end cap 905. Noise coming from the exhaust air is muffled, because as air travels through inlet exhaust inlet 913, the exhaust air noise is absorbed and deflected by the inner silencer tube 907 and outer silencer tube 903 before exiting through outlet 912. By varying the diameter and length of the outer si-

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lencer tube 903 and inner silencer tube 907, sound suppressor 900 can be tuned to minimize the unwanted exhaust air noise.

It is understood that the air compressor may be mechanically or an electrically driven compressor, or any other mechanism that compresses air for introduction into the oxygen enrichment portion of the apparatus.

The apparatus described herein may be used to fill cylinders of a variety of different sizes and configurations by providing suitable adaptors to the oxygen fill port adaptor, including use of adaptors to fill stationary cylinder which would not otherwise fit into the fill port. For example, a flow controller body may be adapted to fit in the fill port adaptor 300 and to be connected via a high pressure hose to a flow controller body 700 on a cylinder which is not, itself, contained with the fill port adaptor. The substitute flow controller body may be used to otherwise mimic the functions of a flow controller body when installed in the fill port adaptor to permit gas from the oxygen concentrator to be used to replenish a large (for example, stationary) cylinder which would not otherwise fit within the fill port adaptor body 300. Lastly, it is be noted that outlet port 706 may be used to connect via tubing (not shown) the cylinder to which the flow controller body is attached to the patient so that a patient may breathe oxygen enriched air contained in the cylinder by adjusting the flow rate of oxygen enriched air by means of the flow control knob 703. Pressure gauge 701 may be used by the patient to monitor the gas remaining in the cylinder.

Claims

1. An apparatus for providing oxygen-enriched air comprising, in combination:

   a low pressure oxygen enriched air separation system for enriching the oxygen content of inlet air, said air separation system adapted to provide oxygen-enriched air to a first outlet at a first pressure, said air separation system adapted to provide oxygen-enriched air to a second outlet at approximately said first pressure;
   a pressure intensifier connected to said second outlet of the air separation system to pressurize said oxygen-enriched air and to provide said oxygen-enriched air to an outlet of the pressure intensifier at a second pressure; and
   wherein said air separation system is capable of simultaneously providing oxygen-enriched air to said first outlet and said second outlet such that a flow of oxygen-enriched air can be supplied to said first outlet while said pressure intensifier is pressurizing said oxygen-enriched air to said second pressure.

2. The apparatus of Claim 1 further comprising a compressor, said compressor being adapted to provide compressed air to said air separation system.

3. The apparatus of Claim 1 or Claim 2 further comprising a compressor, said compressor being adapted to provide compressed air to said pressure intensifier.

4. The apparatus of any one of Claims 1-3 in which the first pressure is provided to a flow meter and is suitable for patient respiration and said second pressure is suitable for filling high pressure cylinders or storage plenums.

5. The apparatus of any one of Claims 1-4 in which the first pressure is up to about 10 psi and the second pressure is up to about 3000 psi.

6. The apparatus of Claim 2 in which the air separation system and the pressure intensifier are interconnected and are adapted to cycle cooperatively.

7. The apparatus of any one of Claims 1-6 wherein the outlet to the pressure intensifier is adapted to accept an ambulatory pressure vessel using a securing mechanism.

8. The apparatus of any one of Claims 1-7 further comprising an oxygen concentration monitoring system to prevent cycling of the pressure intensifier if the oxygen concentration of the oxygen-enriched air falls below a predetermined value.

9. The apparatus of any one of Claims 1-8 in which the flow rate of the oxygen-enriched air to the first outlet may be adjusted independent of the pressure intensifier.

10. The apparatus of any one of Claims 1-9 which further includes a rupture disc in the pressure intensifier to prevent the pressure exceeding a predetermined value.

11. The apparatus of Claim 2 having a sound suppression system to suppress inlet noise to said compressor and exhaust noise from said air separation system.

12. The apparatus of Claim 11 in which the sound suppression system is located in a base of said compressor, said sound suppression system comprising inlet and exhaust air silencer tubes integrally incorporated into said base, said tubes being tuned to minimize noise associated with intake of air into the compressor and exhaustion of air from the concentrator.

13. The apparatus of Claim 12 in which said tubes have

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a variable length and a variable diameter, said tubes being tuned to suppress said noise by varying the diameter and length of said tubes.

14. The apparatus of any one of Claims 1-13, wherein said low pressure oxygen-enriched air separation system is an oxygen generator.

15. The apparatus of Claim 14, wherein said oxygen generator is a pressure swing adsorption system.

16. The apparatus of any one of Claims 1-13, wherein said air separation system is one of a distiller, an air separator and a membrane separator.

17. The apparatus of any one of Claims 1-13, wherein said pressure intensifier includes:

a first stage cylinder, a second stage cylinder and a drive air cylinder located therebetween.

18. A method for providing oxygen-enriched air at a first pressure and at a second pressure, said second pressure being greater than the first pressure, said method comprising:

feeding air to an air separation system;
providing oxygen-enriched air from said air separation system to a first outlet at said first pressure and controlling the flow of oxygen-enriched air at said first outlet;
providing oxygen-enriched air from said air separation system to a pressure intensifier at approximately said first pressure, increasing the pressure of said oxygen-enriched air to said second pressure using said pressure intensifier; and
wherein said air separation system is capable of simultaneously providing oxygen-enriched air to said first outlet and said second outlet such that a flow of oxygen-enriched air can be supplied to said first outlet while said pressure intensifier is pressurizing said oxygen-enriched air to said second pressure.

19. The method of Claim 18 in which said air separation system and said pressure intensifier are interconnected such that cycling of the air separation system and said pressure intensifier are coordinated.

20. The method of Claim 18 or Claim 19 in which the oxygen-enriched air has an oxygen content of at least 90% by volume.

21. The method of any one of Claims 18-20, wherein said low pressure oxygen-enriched air separation system is an oxygen generator.

22. The method of Claim 21, wherein said oxygen generator is a pressure swing adsorption system.

23. Apparatus for providing oxygen-enriched air comprising, in combination:

an air compressor, a low pressure oxygen-enriched air separation system and a pressure intensifier;
said air compressor being adapted to provide compressed air to said air separation system;
said air separation system being adapted to provide oxygen-enriched air to a first outlet at a first pressure, said first outlet having a controller to control the flow of oxygen-enriched air at a first outlet;
said air separation system further providing oxygen-enriched air to the pressure intensifier at said first pressure, said pressure intensifier being adapted to provide oxygen-enriched air at said second pressure;
wherein said air separation system is capable of simultaneously providing oxygen-enriched air to said first outlet and said second outlet such that a flow of oxygen-enriched air can be supplied to said first inlet while said pressure intensifier is pressurizing said oxygen-enriched air to said second pressure.

24. The apparatus of Claim 23 in which said air separation system and said pressure intensifier being interconnected such that cycling of the air separation system and said pressure intensifier are coordinated.

25. The apparatus of Claim 23 or Claim 24 in which said compressor is adapted to provide compressed air to said pressure intensifier.

26. The apparatus of any one of Claims 23-25 in which the first pressure is provided to a flow meter and is suitable for patient respiration and said second pressure is suitable for filling high pressure cylinders or storage plenums.

27. The apparatus of any one of Claims 23-26 in which the first pressure is up to about 10 psi and the second pressure is up to about 3000 psi.

28. The apparatus of any one of Claims 23-27 adapted to accept an ambulatory pressure vessel to said second outlet using a securing mechanism.

29. The apparatus of any one of Claims 23-28 in which there is an oxygen concentration monitoring system to prevent cycling of the pressure intensifier if the oxygen concentration of the oxygen-enriched air falls below a predetermined value.

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30. The apparatus of any one of Claims 23-29 in which the flow rate of the oxygen-enriched air to the first outlet may be adjusted independent of the pressure intensifier.

31. The apparatus of any one of Claim 23-30 which further includes a rupture disc in the pressure intensifier to prevent the pressure exceeding a predetermined value.

32. The apparatus of any one of Claims 23-31 having a sound suppression system to suppress inlet noise to said air compressor and exhaust noise from said concentrator.

33. The apparatus of Claim 32 in which the sound suppression system located in a base of said compressor, said sound suppression system comprising inlet and exhaust air silencer tubes integrally incorporated into said base, said tubes being tuned to minimize noise associated with intake of air into the compressor and exhaustion of air from the air separation system.

34. The apparatus of Claim 33 in which said tubes have a variable length and a variable diameter, said tubes being tuned to suppress said noise by varying the diameter and length of said tubes.

35. The apparatus of Claim 28 further comprising an ON/OFF flow controller adapted to prevent flow of oxygen-enriched air through said second outlet when said second outlet is disconnected from said ambulatory pressure vessel.

36. The apparatus of any one of Claims 23-35, wherein said low pressure oxygen-enriched air separation system is an oxygen generator.

37. The apparatus of Claim 36, wherein said oxygen generator is a pressure swing adsorption system.

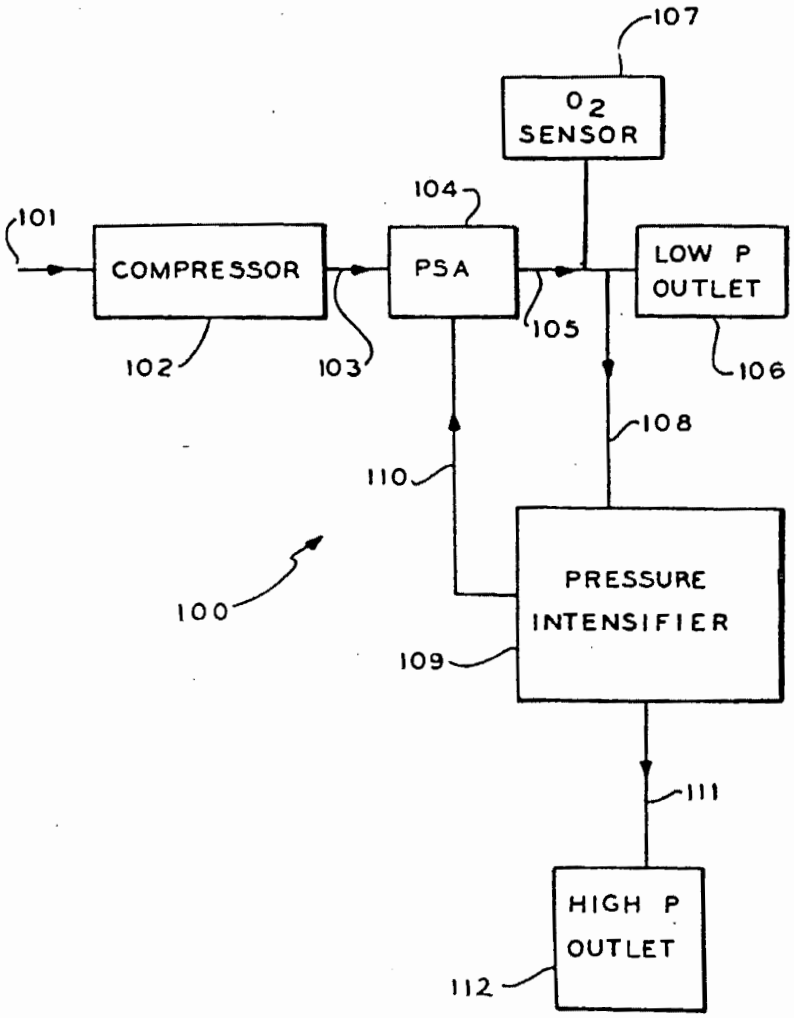
38. The apparatus of any one of Claims 23-35, wherein said air separation system is one of a distiller, an air separator and a membrane system.

39. The apparatus of any one of Claims 23-35, wherein said pressure intensifier includes:

a first stage cylinder, a second stage cylinder and a drive air cylinder located therebetween.

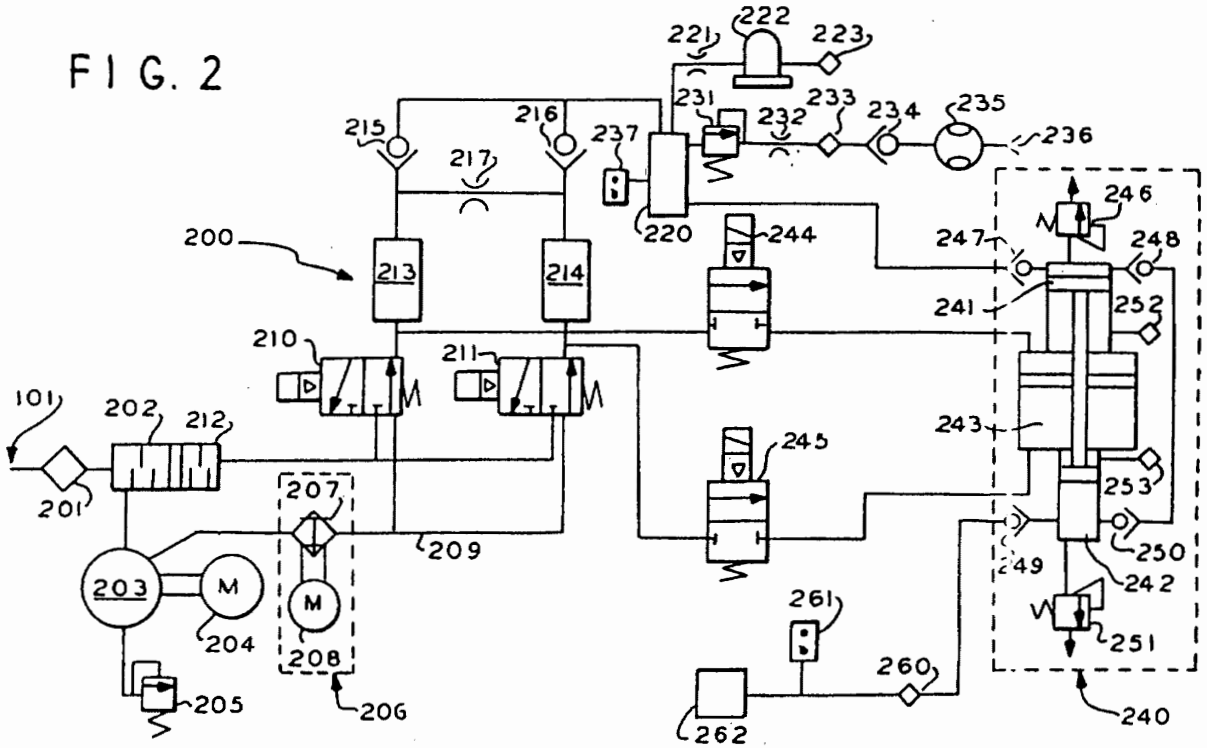
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FIG. 1



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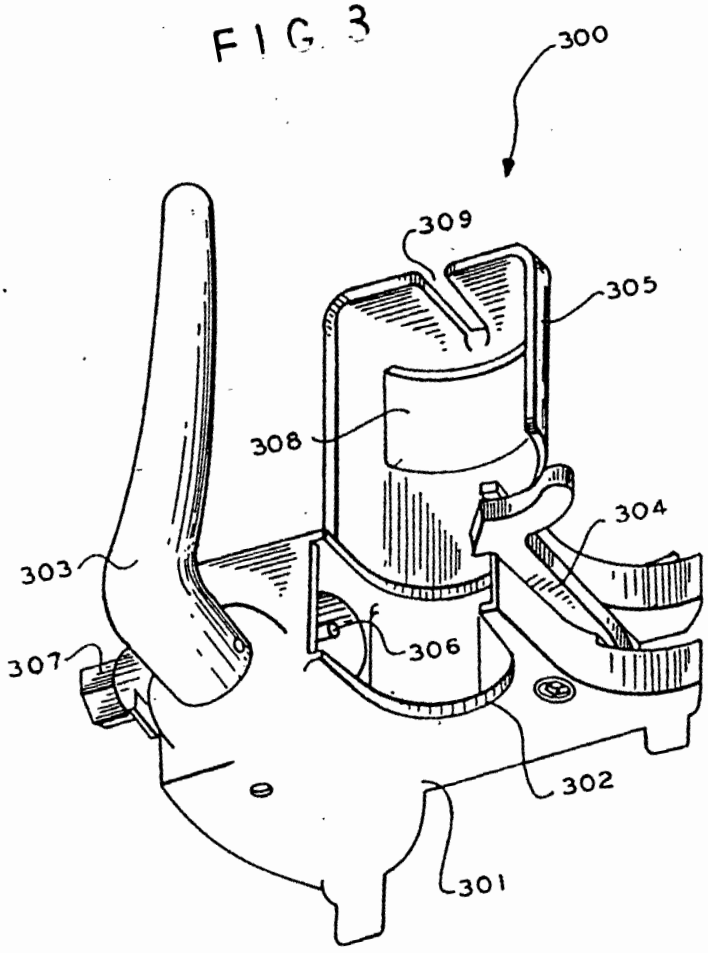
FIG. 2



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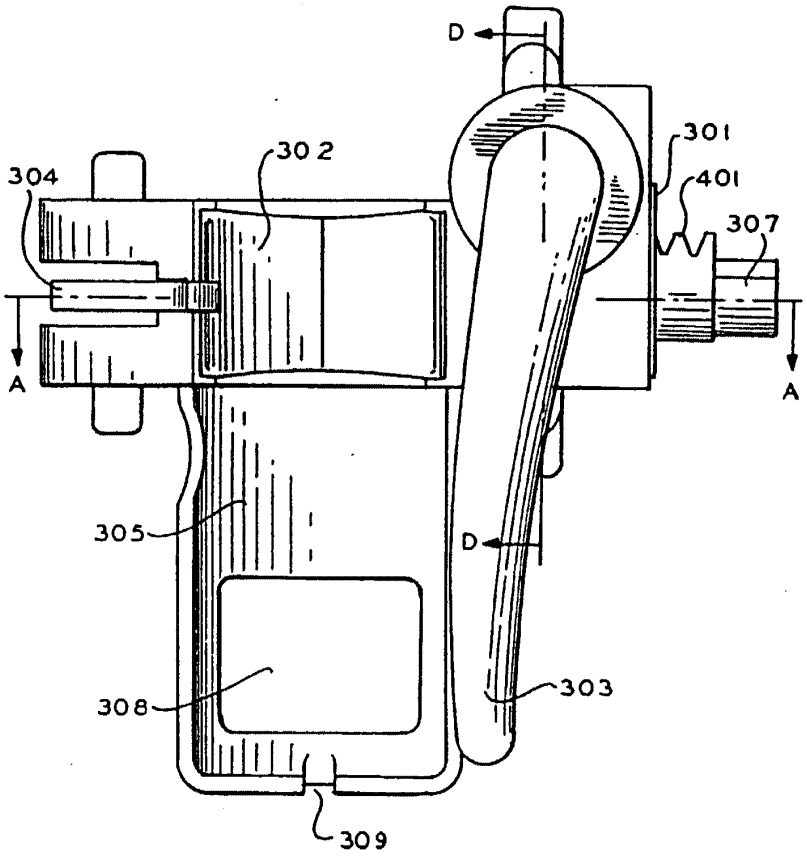
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FIG. 3



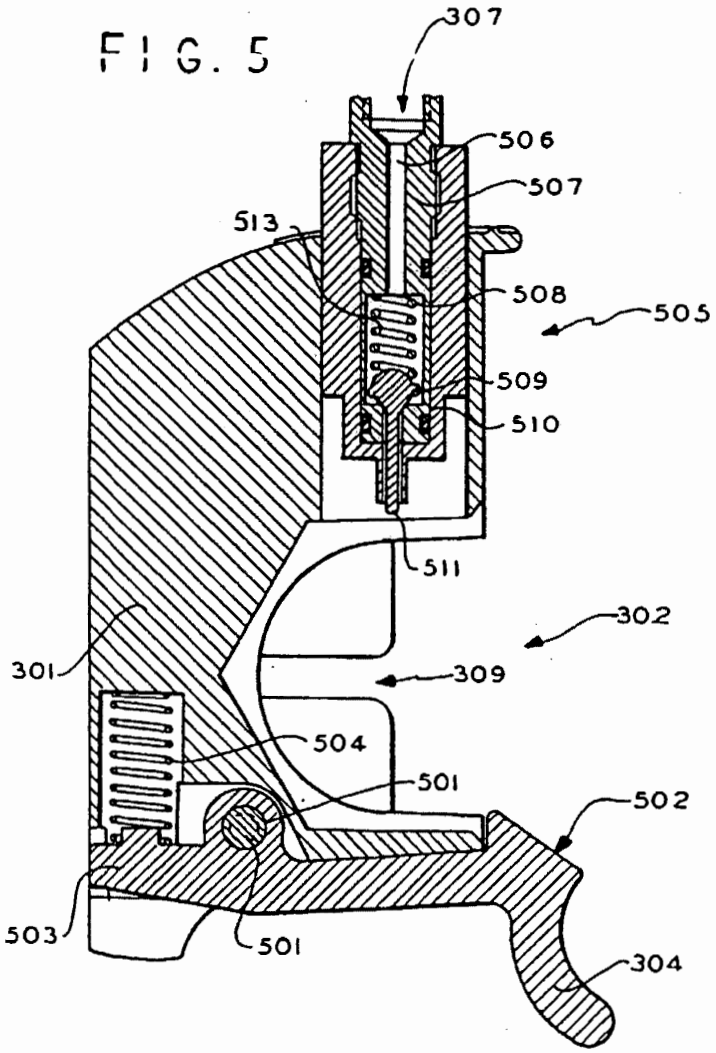
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FIG. 4



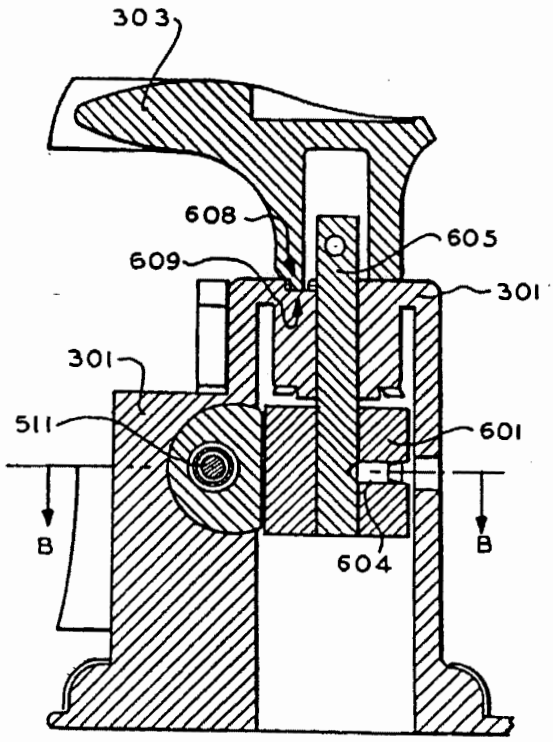
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FIG. 5



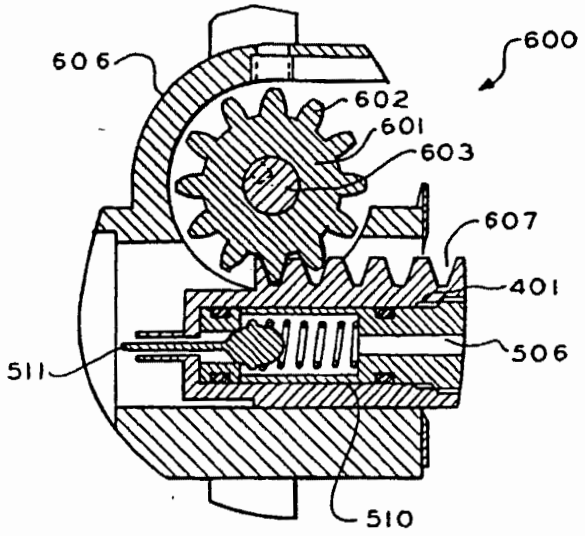
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FIG. 6



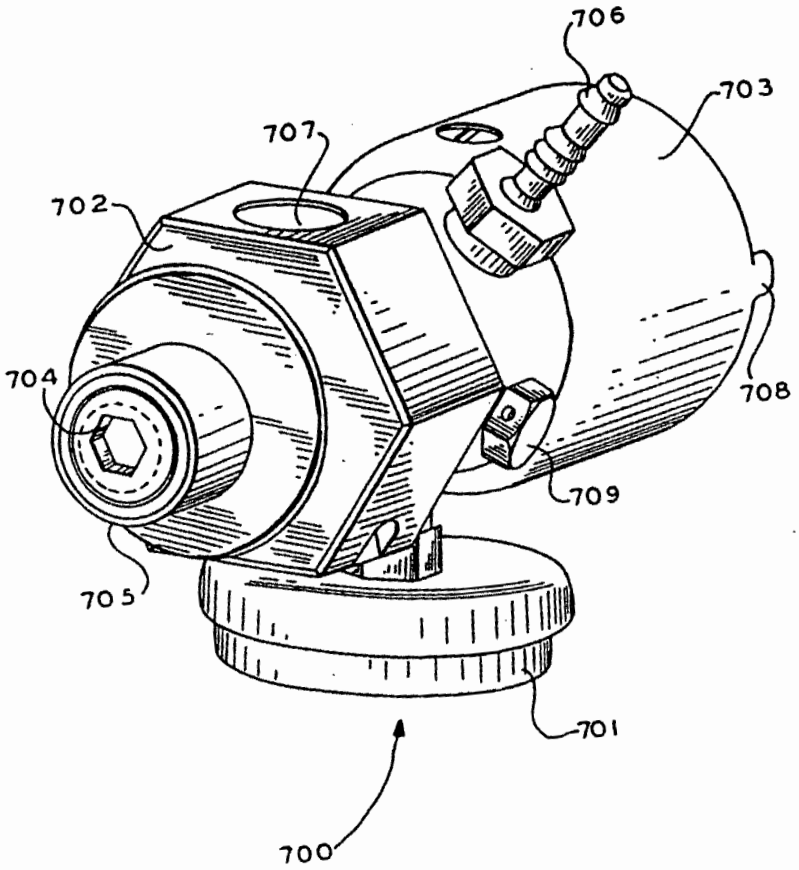
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FIG. 7



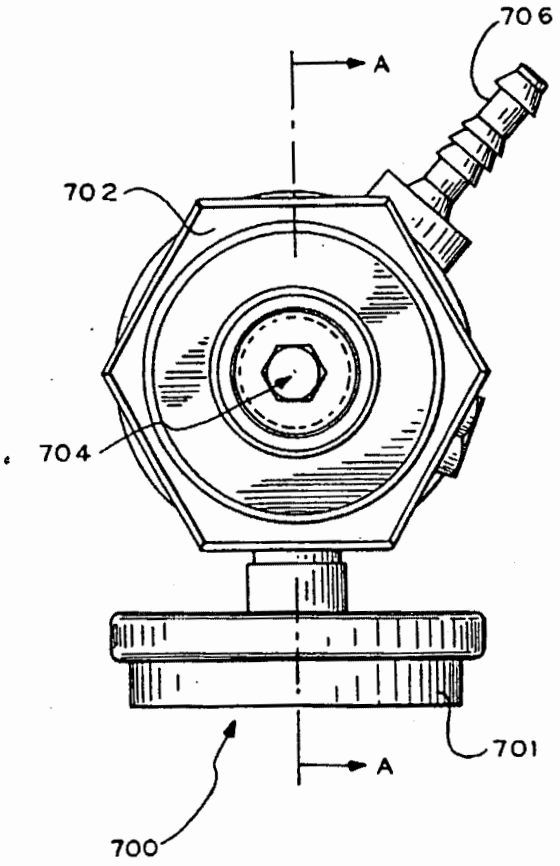
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FIG. 8



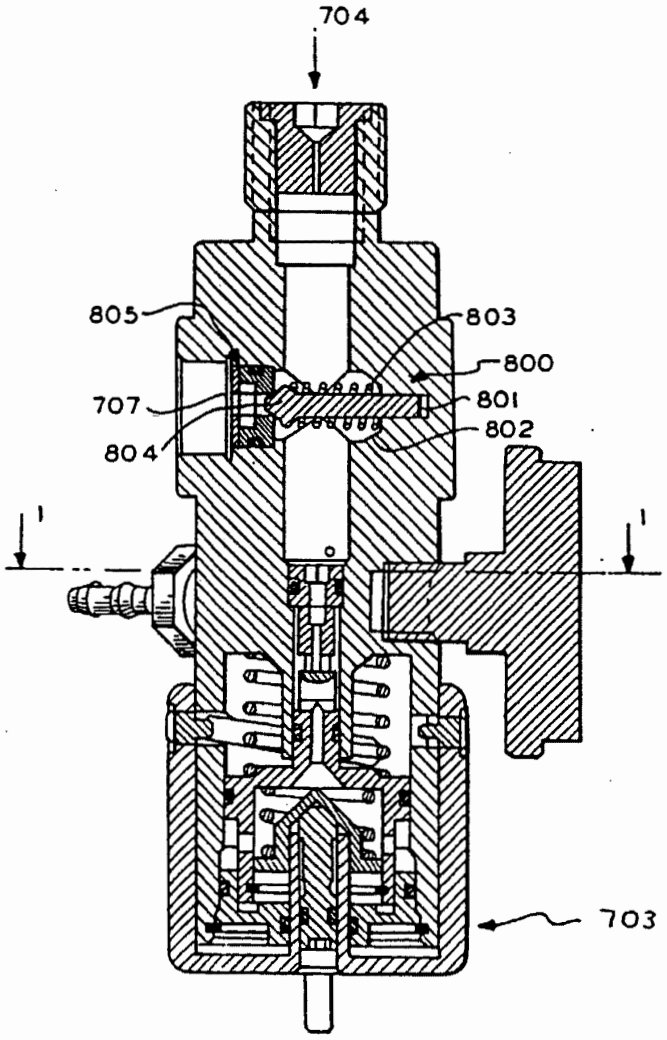
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FIG. 9



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FIG. 10



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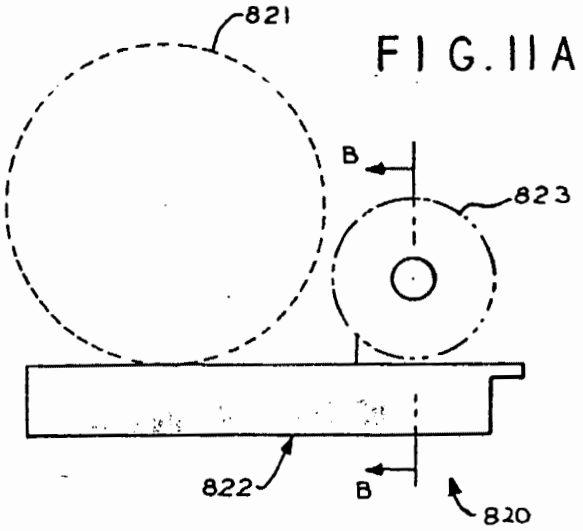
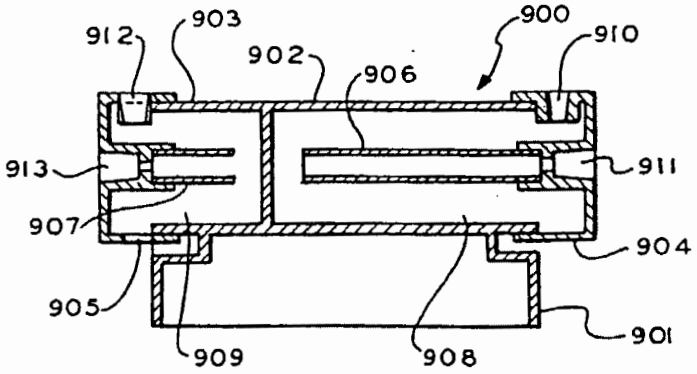


FIG. 11A

FIG. 11B



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PATENT APPLICATION FEE DETERMINATION RECORD
Effective December 8, 2004

11/057,341

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	21	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	21 minus 20=	* 1
INDEPENDENT CLAIMS	4 minus 3 =	* 1
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☑		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	180	OR	BASIC FEE	
X$ 25=	25	OR	X$50=	
X100=	100	OR	X200=	
+180=		OR	+360=	
TOTAL	270	OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 25=		OR	X$50=	
X100=		OR	X200=	
+180=		OR	+360=	