

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	41507-725.101
		Application Number	
Title of Invention	APPARATUS AND METHODS FOR CLOT ASPIRATION		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

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

Inventor 1				
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
	Robyn		Shaffer	
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service				
City	San Francisco	State/Province	CA	Country of Residence ⁱ US
Mailing Address of Inventor:				
Address 1		3649 Market Street, #404		
Address 2				
City	San Francisco	State/Province	CA	
Postal Code	94131	Country ⁱ	US	
Inventor 2				
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
	Stephen		Pons	
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service				
City	Alameda	State/Province	CA	Country of Residence ⁱ US
Mailing Address of Inventor:				
Address 1		1623 Clinton Avenue		
Address 2				
City	Alameda	State/Province	CA	
Postal Code	94501	Country ⁱ	US	
Inventor 3				
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
	Kyle		West	

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Imperative Care v. Inari Medical
IPR2026-00169
Imperative Care Ex. 1023

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Residence Information (Select One)		☒ US Residency		☐ Non US Residency		☐ Active US Military Service	
City	Pleasant Hill	State/Province	CA	Country of Residence ⁱ	US		

Mailing Address of Inventor:							
Address 1		431 Coleman Court					
Address 2							
City	Pleasant Hill	State/Province		CA			
Postal Code	94523	Country ⁱ		US			

Inventor 4							
Legal Name							
Prefix	Given Name	Middle Name		Family Name		Suffix	
	Alex			Rabkin			
Residence Information (Select One)		☒ US Residency		☐ Non US Residency		☐ Active US Military Service	
City	San Francisco	State/Province	CA	Country of Residence ⁱ	US		

Mailing Address of Inventor:							
Address 1		666 Ivy Street					
Address 2							
City	San Francisco	State/Province		CA			
Postal Code	94102	Country ⁱ		US			

Inventor 5							
Legal Name							
Prefix	Given Name	Middle Name		Family Name		Suffix	
	Sharice	Quan		Handa			
Residence Information (Select One)		☒ US Residency		☐ Non US Residency		☐ Active US Military Service	
City	San Ramon	State/Province	CA	Country of Residence ⁱ	US		

Mailing Address of Inventor:							
Address 1		1920 Whitetail Lane					
Address 2							
City	San Ramon	State/Province		CA			
Postal Code	94583	Country ⁱ		US			

Inventor 6							
Legal Name							
Prefix	Given Name	Middle Name		Family Name		Suffix	
	Robert	A.		Riccomini			

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Residence Information (Select One)		☒ US Residency		☐ Non US Residency		☐ Active US Military Service	
City	Saratoga	State/Province	CA	Country of Residence ⁱ	US		

Mailing Address of Inventor:							
Address 1		20180 Orchard Meadow Drive					
Address 2							
City	Saratoga	State/Province		CA			
Postal Code	95070	Country ⁱ		US			

Inventor 7							
Legal Name							
Prefix	Given Name	Middle Name		Family Name		Suffix	
	Daniel	K.		Harden			
Residence Information (Select One)		☒ US Residency		☐ Non US Residency		☐ Active US Military Service	
City	Palo Alto	State/Province	CA	Country of Residence ⁱ	US		

Mailing Address of Inventor:							
Address 1		760 Northampton Drive					
Address 2							
City	Palo Alto	State/Province		CA			
Postal Code	94303	Country ⁱ		US			

Inventor 8							
Legal Name							
Prefix	Given Name	Middle Name		Family Name		Suffix	
	Michael	C.		Makay			
Residence Information (Select One)		☒ US Residency		☐ Non US Residency		☐ Active US Military Service	
City	Santa Clara	State/Province	CA	Country of Residence ⁱ	US		

Mailing Address of Inventor:							
Address 1		2152 Santa Cruz Avenue					
Address 2							
City	Santa Clara	State/Province		CA			
Postal Code	95051	Country ⁱ		US			

Inventor 9							
Legal Name							
Prefix	Given Name	Middle Name		Family Name		Suffix	
	Cole	J.		Derby			

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Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	East Palo Alto	State/Province	CA	Country of Residence ⁱ	US
Mailing Address of Inventor:					
Address 1	245 OKeefe Street, #21				
Address 2					
City	East Palo Alto	State/Province	CA		
Postal Code	94303	Country ⁱ	US		
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.					Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).	
☐ An Address is being provided for the correspondence information of this application.	
Customer Number	21971
Email Address	Add Email Remove Email

Application Information:

Title of the Invention	APPARATUS AND METHODS FOR CLOT ASPIRATION		
Attorney Docket Number	41507-725.101	Small Entity Status Claimed	☐
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	6	Suggested Figure for Publication (if any)	
Filing By Reference:			
Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").			
For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).			
Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country	

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Publication Information:

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

Representative Information:

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

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	21971		
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Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the application number blank.

Prior Application Status				Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	

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Foreign Priority Information:

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	41507-725.101
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This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ¹	Filing Date (YYYY-MM-DD)	Access Code ¹ (if applicable)

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

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

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Authorization or Opt-Out of Authorization to Permit Access:

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

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

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

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

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

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

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Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.			
Applicant 1			
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.			
Clear			
☐ Assignee	☐ Legal Representative under 35 U.S.C. 117	☐ Joint Inventor	
☒ Person to whom the inventor is obligated to assign.		☐ Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:			
Name of the Deceased or Legally Incapacitated Inventor:			
If the Applicant is an Organization check here. ☒			
Organization Name	Penumbra, Inc.		
Mailing Address Information For Applicant:			
Address 1	One Penumbra Place		
Address 2			
City	Alameda	State/Province	CA
Country ¹	US	Postal Code	94502
Phone Number		Fax Number	
Email Address			
Additional Applicant Data may be generated within this form by selecting the Add button.			

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		Application Number	
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Assignee Information including Non-Applicant Assignee Information:

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Assignee 1			
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.			
If the Assignee or Non-Applicant Assignee is an Organization check here. ☒			
Organization Name	Penumbra, Inc.		
Mailing Address Information For Assignee including Non-Applicant Assignee:			
Address 1		One Penumbra Place	
Address 2			
City	Alameda	State/Province	CA
Country i	US	Postal Code	94502
Phone Number		Fax Number	
Email Address			
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.			

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	41507-725.101
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Signature:

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

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

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

Signature	/James M. Heslin/			Date (YYYY-MM-DD)	
First Name	James	Last Name	Heslin	Registration Number	29541
Additional Signature may be generated within this form by selecting the Add button.					

PROVISIONAL PATENT APPLICATION

APPARATUS AND METHODS FOR CLOT ASPIRATION

Inventor(s): Robyn Shaffer, a citizen of The United States, residing at
3649 Market Street, # 404, San Francisco, CA, 94131

Stephen Pons, a citizen of The United States, residing at
1623 Clinton Avenue, Alameda, CA, 94501

Kyle West, a citizen of The United States, residing at
431 Coleman Court, Pleasant Hill, CA, 94523

Alex Rabkin, a citizen of The United States, residing at
666 Ivy Street, San Francisco, CA, 94102

Sharice Quan Handa, a citizen of The United States, residing at
1920 Whitetail Lane, San Ramon, CA, 94583

Robert A. Riccomini, a citizen of The United States, residing at
20180 Orchard Meadow Drive, Saratoga, CA, 95070

Daniel K. Harden, a citizen of The United States, residing at
760 Northampton Drive, Palo Alto, CA, 94303

Michael C. Makay, a citizen of The United States, residing at
2152 Santa Cruz Avenue, Santa Clara, CA, 95051

Cole J. Derby, a citizen of The United States, residing at
245 O'Keefe Street, #21, East Palo Alto, CA, 94303

Assignee: Penumbra, Inc.
One Penumbra Place
Alameda, CA 94502

Entity: Large Entity



Wilson Sonsini Goodrich & Rosati
PROFESSIONAL CORPORATION

650 Page Mill Road
Palo Alto, CA 94304
(650) 493-9300 (Main)
(650) 493-6811 (Facsimile)

FILED ELECTRONICALLY ON: JUNE 7, 2017

APPARATUS AND METHODS FOR CLOT ASPIRATION

BACKGROUND OF THE INVENTION

[001] 1. Field of the Invention. The present invention relates generally to the field of medical devices and methods. More specifically, the invention described herein relates to devices and methods for aspirating clot removed from a patient's vasculature by thrombectomy.

[002] Stroke is a significant cause of disability and death, and a growing problem for global healthcare. More than 700,000 people in the United States alone suffer a stroke each year, and of these, more than 150,000 people die. Of those who survive a stroke, roughly 90% will suffer long term impairment of movement, sensation, memory, or reasoning, ranging from mild to severe. The total cost to the U.S. healthcare system is estimated to be over \$50 billion per year.

[003] Stroke may be caused by a blockage in a cerebral artery resulting from a thromboembolism (referred to as an "ischemic stroke"), or by a rupture of a cerebral artery (referred to as a "hemorrhagic stroke"). Hemorrhagic stroke results in bleeding within the skull, limiting blood supply to brain cells, and placing harmful pressure on delicate brain tissue. Blood loss, swelling, herniation of brain tissue, and pooling of blood that results in formation of clot mass inside the skull all rapidly destroy brain tissue. Hemorrhagic stroke is a life-threatening medical emergency with limited treatment options.

[004] Aside from cerebral stroke, thromboembolism throughout the vasculature, in both arterial and venous circulation, is characteristic of numerous common, life-threatening conditions. Examples of potentially fatal diseases resulting from thrombotic occlusion include pulmonary embolism, deep vein thrombosis, and acute limb ischemia. Acute pulmonary embolism is a significant cause of death in the United States, with roughly 300,000 patients dying each year. Pulmonary embolism can be a complication from deep vein thrombosis, which has an annual incidence of 1% in patients 60 years and older. All of the aforementioned diseases are examples of conditions in which treatment may include aspiration or evacuation of clot and/or blood.

[005] Of particular interest to the present invention, the Penumbra System® mechanical thrombectomy system is a fully-integrated system designed specifically for mechanical thrombectomy by aspiration. It is intended for revascularization of patients with acute ischemic stroke secondary to intracranial large vessel occlusion. The Penumbra System is commercially available at the time of filing the present provisional patent application and includes reperfusion catheters, aspiration tubing, and an aspiration pump console (sold under the tradename: Pump

MAX[™] aspiration pump) for connection to the aspiration tubing and reperfusion catheters. As illustrated in Fig. 1, the Pump MAX[™] aspiration pump 10 includes a base unit 12 which encloses a vacuum pump (not shown) which operates off line current. The base unit has an on-off switch 14 and a separate knob 16 for adjusting the level of vacuum provided by the pump. The vacuum level can be read on a pressure gauge 18. Blood and clot are drawn into a collection canister 20 from an aspiration tube 22 (shown in broken line) which is connected to a reperfusion catheter (not illustrated) which has been introduced to the cerebral vasculature of a patient to aspirate clot. The blood and clot are drawn into the collection canister by a partial vacuum which is provided by a vacuum connector 28 on the base unit 12 which is connected to the vacuum pump, not shown. The vacuum from vacuum connector 28 is applied to a vacuum port 24 on a removable lid 26. The vacuum connector 28 is connected to the vacuum port 24 by an external vacuum tube 30.

[006] Although very effective, the use of the Pump MAX[™] aspiration pump as part of the Penumbra System® has certain shortcomings. First, the external vacuum tube 30 required by the presently available Pump MAX[™] aspiration pump can become entangled with the aspiration tube 22 and is also subject to accidental disconnection during a procedure. Second, the pressure measurement shown on gauge 18 is measured in an internal line connected to the vacuum connector 28, and can be affected by ambient pressure which can differ based on elevation above sea level. Should that line become clogged, the pressure reading which is supposed to represent the pressure within the canister will be inaccurate. Third, the canister 20 is clear to allow the physician to view the nature and amount of clot being removed. It can be difficult, however, to visually distinguish the clot from the blood that is also being removed, particularly in a darkened cath lab.

[007] In order to evaluate clot material removed, the clinician is often required to remove canister 20 from its connection to base unit 12, so that the extracted contents can be poured out, and any clot material poured onto gauze or similar material, for viewing. The foregoing steps can be messy, inconvenient, and require careful manipulation to avoid increased risk of aseptic contact with blood.

[008] Therefore, it would be desirable to provide improved pumping consoles and apparatus and methods for clot extraction, and at least some of these objectives discussed above will be met by the inventions described herein below. These systems should be suitable for use with clot extraction systems intended for use with patients suffering pulmonary embolism, deep vein thrombosis, peripheral artery disease, and other conditions as well as stroke.

[009] 2. Description of the Background Art. The Penumbra System® as it is commercially available at the time of filing this provisional patent application is described in a brochure entitled “Science of Aspiration: The Penumbra System® Approach.”

SUMMARY OF THE INVENTION

[0010] The present invention provides improved vacuum systems including a vacuum console and a collection canister for use with mechanical thrombectomy systems, such as with reperfusion catheters of the type which are used in the Penumbra System®, the Indigo® Aspiration System mechanical thrombectomy system, and other systems used for the therapeutic extraction of clot and/or blood and other fluids. Use of the vacuum console and collection canister of the present invention, however, is not limited to any particular thrombectomy system, and the vacuum systems can find use with any thrombectomy, embolectomy, atherectomy, or other catheter or probe system where blood and clot are withdrawn wholly or partially by application of a vacuum to the proximal end of any reperfusion, aspiration catheter or probe for the purpose of clot extraction.

[0011] The vacuum consoles and collection canisters of the present invention provide a number of advantages over previous vacuum systems. For example, the vacuum console of the present invention provides a direct connection between a vacuum pump within the console and an interior of a removable canister which collects the clot and blood from the associated catheter. Such a design simplifies connection and routing of the catheter to the vacuum console. In particular, since there is no external vacuum tube, entanglement of the aspiration tube with external vacuum tubes on the vacuum console is eliminated. Additionally, the vacuum consoles and associated clot collection canisters of the present invention provide for improved pressure sensing within the interior of the canister. By providing a pressure sensor which measures vacuum pressure directly in the collection canister, the risk of clogging of the pressure pathway is greatly reduced. Still further, the vacuum console of the present invention provides improved visibility of clot which is being collected within the collection canister. Additional features of the improved design include improved lighting and a quick connect fitting for attachment of the catheter.

[0012] In a first aspect, the present invention provides a clot collection or other canister assembly for removably mounting on or in a mounting region on a vacuum console which has a vacuum connector configured to be connected to a vacuum pump and a pressure sensing connector configured to be connected to a pressure sensor. The canister comprises a clear canister body with an interior and an open top. A lid is removably attachable over the open top of the clear canister,

and the clear canister has a vacuum port and a pressure sensing port each formed in a wall of the canister. The vacuum port on the clear canister aligns with the vacuum connector on the vacuum console when the canister assembly is mounted on or in the mounting region of the vacuum console. Similarly, the pressure sensing port on the clear canister aligns with a pressure sensing connector on the vacuum console when the canister assembly is mounted on the mounting region of the vacuum console. In this way, reliable connections are formed between the connectors on the vacuum console and the ports on the clear canister simply by mounting the canister on the vacuum console. The absence of external tubing connecting the vacuum console to the vacuum canister reduces clutter and the risk of entanglement with the catheter or other intermediate tubing, such as aspiration tubes. The absence of external tubing also saves time by eliminating the need to make two connections both during both installation and removal of the canister. Additionally, the separate connections provided for drawing a vacuum within the clear canister and for sensing pressure within the clear canister allow the pressure sensor to operate reliably even when the vacuum pathway may be partially or totally clogged with clot or other debris.

[0013] In specific embodiments, an aspiration port for connection to the catheter or other intermediate tubing is provided on the removable lid. The aspiration port may take a variety of forms. For example, the port may be a simple tubular, typically male, connector for coupling directly or indirectly to the catheter, e.g. through an aspiration tube. Additionally or alternatively, the aspiration port may include a threaded connector for mating to a threaded connector on the proximal end of the catheter or aspiration tube. In further embodiments, the aspiration port may include both a tubular connection portion and a threaded connector portion allowing connection to corresponding connectors on the catheter or aspiration tube. Still more particularly, threaded connectors of the present invention may also have mating detents on the connector in order to interface with detents on the proximal end of a catheter or other intermediate tubing, so that a user may tactilely sense when the connection is complete.

[0014] In other specific embodiments of the canister assembly, a filter plate may be suspended in the interior of the clear canister at any location. In specific embodiments, the filter plate may be positioned in the upper half of the canister so that it will not become submerged in blood. In the illustrated embodiment, the filter plate is located mid-way between the open top and a bottom of the canister. By “mid-way” this meant that the filter plate will usually be in the middle one-third of the clear canister between the top and bottom. The filter plate will typically be perforated or formed as a woven or other screen or similar barrier which allows the liquid blood to flow through

the plate while retaining all or substantial portions of the clot entrained in the blood on an upper surface of the plate. The filter plate will usually extend across substantially an entire cross-section of the interior of the canister, but will often leave an open portion for blood overflow should the oncoming blood flow rate exceed the flow through the filter plate itself. In specific examples, the filter plate will be inclined at an angle relative to horizontal so that one edge of the plate is lower than the other. An open space left will typically be left between an upper end of the plate and the interior wall of the canister so that clot will flow downwardly and collect at the lower edge and blood may overflow at the upper edge, reducing the risk that the clot will overflow in the open space left within the canister. In such designs, the lower edge of the plate will typically seal against the interior wall of the canister, reducing the risk of clot flowing past that edge and diverting blood flow to the open region at the upper end of the plate. The lower edge typically also has an upwardly extending lip that helps contain the clot on the upper surface of the filter plate.

[0015] In still further specific embodiments of the canister assembly, the vacuum port and the pressure sensing port are each formed in the wall at a location mid-way between the open top and a bottom of the vacuum canister. In particular, the vacuum port and the pressure sensing port will each comprise riser tubes which are open at their upper ends so that the vacuum is drawn and the pressure is sensed near the top of the canister. This design is advantageous since it further reduces the risk that clot or blood entering the canister will flow into either the vacuum port or the pressure sensing port and interfere with operation of the vacuum console and also increases the usable volume of the canister. Optionally, at least the vacuum port will have a filter element in a lumen thereof, typically a lumen within the riser, in order to still further reduce the risk of blood or clot entering the vacuum pump and vacuum console.

[0016] In a second aspect, the present invention provides a canister assembly for removable mounting on a mounting region of the vacuum console which has a vacuum connector connected to a vacuum pump and a pressure sensing connected to a pressure sensor. The canister assembly comprises a clear canister with an interior and an open top. A lid is removably attachable over the open top of the clear canister, and the clear canister has filter plate configured to be suspended in the interior of the clear canister typically at a location mid-way between the open top and a bottom.

[0017] Details of the construction and design of the filter plate are described above in connection with the first aspect of the present invention. The canister assembly having the filter plate may further optionally comprise a vacuum port and a pressure sensing port each formed in a wall of the canister. The design of these vacuum ports in connection with the vacuum connectors

on the vacuum console, are also fully described above in connection with the first aspect of the present invention.

[0018] In a third aspect, the present invention provides a vacuum console for removably receiving a canister assembly including a clear canister with an interior and open top and a lid removably attachable over the open top of the clear canister. The vacuum console comprises an enclosure having a mounting region for removably receiving the canister assembly. A vacuum pump and a pressure sensor are disposed within the enclosure, and a vacuum connector is connected to the vacuum pump and a pressure sensing connector is connected to the pressure sensor, where both connectors are located on the enclosure at a location in or adjacent to the mounting region. When the canister assembly is received within the mounting region of the vacuum console, the vacuum connector will align with a vacuum port formed in a wall of the canister and the pressure sensing connector will align with a pressure sensing port formed in a wall of the canister.

[0019] In specific embodiments of the vacuum console, the vacuum connector and the pressure connector are located within the mounting region of the enclosure so that the connectors are covered by the clear canister assembly when the canister is received in the mounting region of the vacuum region of the vacuum console. At least one light is preferably provided within the mounting region, where the light is oriented to direct light across the clear canister when the canister is received in the mounting region. The illustrated embodiment includes two lights, one on a right side of the canister and one on a left side of the canister and both oriented to direct light inwardly to illuminate the interior of the canister. Such light will illuminate the contents of the clear canister which is of particular advantage when procedures are performed in a darkened fluoroscopy suite. The vacuum console may further comprise a light bar display on the top of the enclosure, where the light bar display indicates a percentage of pressure detected by the pressure sensor in the canister assembly. Typically, the light bar display will be circular and segmented into quadrants.

[0020] Additionally, the vacuum systems of the present invention will typically provide the ability to measure vacuum as a percentage ambient pressure. A first sensor measures ambient pressure external to the enclosure and a second sensor measures the reduced pressure inside the canister. By having both pressures, the system can calculate and display “vacuum in the canister” as a percentage of ambient pressure. This normalized value is not affected by ambient pressure, which can differ based on elevation above sea level.

[0021] In further aspects of the present invention, systems may be provided including both vacuum consoles as described above in combination with canister assemblies as described above. The systems may have any of the permutations and combinations of features as described previously.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Fig. 1 illustrates the vacuum console and collection canister of the Penumbra System® mechanical thrombectomy system as described in detail in the Background of the Invention above.

[0023] Fig. 2 is a perspective view of a vacuum console and a blood and clot collection canister constructed in accordance with the principals of the present invention with the collection canister received in a mounting region of the vacuum console.

[0024] Fig. 3A is a view of the vacuum console of the present invention shown with the collection canister removed.

[0025] Fig. 3B is a detailed view of the on-off switch and a vacuum display region on a top surface of the vacuum console of Fig. 3, shown with the power off.

[0026] Fig. 3C is a schematic representation of the internal components of the vacuum console of Figs. 1 to 3A.

[0027] Fig. 4 illustrates a collection canister constructed in accordance with the principles of the present invention.

[0028] Fig. 5 illustrates the embodiment of the collection canister of Fig. 4, shown in an inverted or “upside down” view.

[0029] Fig. 6 is an exploded view of the vacuum canister of Figs. 4 and 5.

DETAILED DESCRIPTION OF THE INVENTION

[0030] Some embodiments of the inventions of the present application are described below. For clarity, not all features of each actual implementation are described in this specification. In the development of an actual device, some modifications may be made that result in an embodiment that still falls within the scope of the invention.

[0031] Referring to Fig. 2, a vacuum system 40 constructed in accordance with the principles of the present invention includes a vacuum console 42 and a blood/clot collection canister 44. The vacuum console 42 comprises of an enclosure having a recess 48 which is shaped to removably receive the collection canister 44 as will be described in more detail below.

[0032] Referring to Figs. 3A-3C, the vacuum console 42 is shown with the vacuum canister 44 removed. A post 50 which forms a contiguous portion of the outer surface or wall of the enclosure 46 is formed within the recess 48 and extends upwardly from a bottom plate 56 which acts as a support for the collection canister 44 when it is received within the recess. A vacuum connector 52 and a pressure sensing connector 54 are formed in or on an upper surface of the post 50 and are located so that they will align with a pressure sensing port 104 and a vacuum port 102 (Fig. 5) on the vacuum canister 44 when it is received within the recess 48. One light 58 is located on a wall surface of the enclosure 44 within the recess 48 and is located so that it will illuminate the contents of the collection canister 44 when the system is in use. A second light (not visible in Fig. 3A) is present on the opposite wall of the recess 48. The vacuum console 42 also has an on-off switch 60 on its upper surface. The on-off switch 60 illuminates when it is on (as shown in Figs. 2 and 3A) and is not illuminated when the system is off (Fig. 3B). Additionally, a pressure display 62 is provided on the upper surface of the enclosure 46. As shown in Figs. 2 and 3A, the display may be a circular light, e.g. having four segments which are sequentially illuminated as the vacuum level within the canister increases. Each quadrant represents the measured vacuum as a percentage of ambient pressure.

[0033] The internal components of the vacuum console 42 are schematically illustrated in Fig. 3C. The primary internal components of the vacuum console include a pressure sensor 64, a pump 68, a power supply 72, and a microprocessor controller 74. The pump 68 has an inlet connected to the vacuum connector 52 on the post 50 of the enclosure 46. Similarly, the pressure sensor 64 is connected to the pressure sensing connector 54 on the post 50. The pump can be turned on by the switch 60 and will draw vacuum through the connector 52 and release removed gas into an interior of the console. The console in turn is vented by a vent 70 on a bottom surface of the enclosure 46.

[0034] The functions of the pump will be controlled by the microprocessor controller 74, and the pressure output from sensor 64 will also go through the microprocessor controller 74. Each of the light 58, switch 60, and display 62 will be connected to the microprocessor controller 74 which is powered by the power supply 72. The power supply 72 is powered through line current connector 72A. The USB connector 72B is powered by microprocessor controller 74. The pump is plugged into an outlet via a power cord that is supplied with the pump. The power supply converts the AC current from the wall outlet to 24V DC which is what the microprocessor controller uses to power the pump, switch, lights, USB connector, etc.

[0035] In specific examples, pressure sensor 64 is connected to the microprocessor controller 74 and measures vacuum pressure in the canister through the pressure sensing connector 54. A second pressure sensor (not shown) is also connected to the microprocessor controller 74 and measures ambient pressure outside of the pump enclosure through an internal tube that is routed to a vent in the base of the pump. The microprocessor controller takes the vacuum pressure reading from the pressure sensor 64 and divides it by the ambient pressure reading from the second pressure sensor to calculate the vacuum pressure in the canister as a percent of ambient pressure.

[0036] Referring now to Figs. 4-6, the collection canister 44 has a main body 78 which is typically formed from a polished, clear plastic material which is molded into the illustrated shape. The main body 78 has an open upper end 76 which can be covered by a removable clear plastic lid 80. The clear plastic lid 80 is typically attached by a bayonet connector 82, and a form or other gasket 84 will seal the lid to the open end of the main body 78.

[0037] A groove 94 is formed in one side of the main body 78 and is shaped so that it can be placed over the post 50 in the recess 48 of the enclosure 46 of the vacuum console 42. As best seen in Fig. 5, the pressure sensing port 104 and the vacuum port 102 are located at the upper end of the groove 94 so that they align and connect with the vacuum connector 52 and pressure sensing connector 54 on the post 50 when the canister 44 is in place in the recess 48.

[0038] The pressure sensing port 104 is connected to a tube or lumen which extends upwardly in the main body 48 of the canister 44 and terminates in an upper opening or aperture 106. Similarly, the vacuum port 102 extends upwardly through a much larger lumen or tube and terminates in an open aperture 108 at its upper end. The apertures 106 and 108 are located near the top of the interior of the main body 78 but will be below the bottom of the lid 80 when the lid is in place on the canister 44. Thus, both of the apertures 106 and 108 will be exposed to the interior of the canister 44 but will be maintained well above the mid-section and bottom where the clot and blood are collecting. In this way, the risk of contamination from blood and clot is minimized.

[0039] A filter plate 86, shown as a perforated screen but which could also be a woven screen or other separating member, is held in the mid-section of the interior of the main body 78 of the canister 44. The clot is drawn into the interior of the canister through a connector 110 which is attached to a proximal end of the catheter or other tubing. The clot and blood are drawn into the interior of the main body 78 by the vacuum which is drawn through the vacuum port 102 by the vacuum console 42, as previously described. As the clot and blood fall downwardly from connector 110 into the canister 44, the clot collects on the upper surface of the filter plate 86 while

the blood flows through the perforations in the plate and collects in the bottom of the canister. As the plate is inclined downwardly from a sleeve 88 which is mounted on a post 90 in the interior of the canister, excess blood may flow over an open bypass region 100 (Fig. 4) which is formed on a backside of the plate and allows the blood to flow directly down to the bottom of the canister. Filter body 92 occupies the interior of post 90 and aperture 108, and prevents extracted material from contaminating the interior of enclosure 42. Filter body 92 occupies the interior of post 90 and extends to aperture 108. The filter body can thus prevent extracted material from contaminating the interior of enclosure 42. A groove 94 is formed on a side of the main body 78 of the canister 44 and is received over the post 50 in the recess 48 of the enclosure 46 in order to align the vacuum and pressure sensing connectors and vacuum ports. A gasket 96 is further provided at the seal between the vacuum ports and the vacuum connectors.

[0040] The foregoing examples are not intended to limit the scope of the invention. All modifications, equivalents and alternatives are within the scope of the invention.

WHAT IS CLAIMED IS:

1. A canister assembly for removably mounting on a mounting region of a vacuum console which has a vacuum connector connected to a vacuum pump and a pressure sensing connector connected to a pressure sensor, said canister assembly comprising:
a clear canister with an interior and an open top; and
a lid removably attachable over the open top of the clear canister;
said clear canister having a vacuum port and a pressure sensing port each formed in a wall of the canister, wherein the vacuum port aligns with the vacuum connector and the pressure sensing port aligns with the pressure sensing connector when the canister assembly is mounted on the mounting region of the vacuum console.
2. A canister assembly as in claim 1, wherein the lid has an aspiration port configured to removably connect to a catheter or aspiration tube.
3. A canister assembly as in claim 1, further comprising a filter plate configured to be suspended in the interior of the clear canister at a location mid-way between the open top and a bottom.
4. A canister assembly as in claim 1, wherein the vacuum port and the pressure sensing port are each formed in the wall at a location mid-way between the open top and a bottom and are each connected to riser tubes within the interior of the clear canister, wherein the riser tubes are open at their upper ends so that the vacuum is drawn and the pressure sensed near the top of the canister.
5. A canister assembly as in claim 4, wherein the riser tube connected to the vacuum port has a filter in a lumen thereof.
6. A canister assembly as in claim 2, wherein the aspiration port includes both a threaded connector and a tubular connector so that it can connect to a catheter or aspiration tube having a threaded connector or to a catheter or aspiration tube having a tubular connector.

7. A canister assembly as in claim 6, wherein the threaded connector of the aspiration port has detents configured to mate with detents on a threaded connector of the catheter or aspiration tube.

8. A canister assembly for removable mounting on a mounting region of a vacuum console which has a vacuum connector connected to a vacuum pump and a pressure sensing connector connected to a pressure sensor, said canister assembly comprising:
a clear canister with an interior and an open top; and
a lid removably attachable over the open top of the clear canister;
said clear canister having a filter plate configured to be suspended in the interior of the clear canister at a location mid-way between the open top and a bottom.

9. A canister assembly as in claim 8, wherein the lid has an aspiration port configured to removably connect to a catheter or aspiration tube.

10. A canister assembly as in claim 8, further comprising a vacuum port and a pressure sensing port each formed in a wall of the canister, wherein the vacuum port aligns with the vacuum connector and the pressure sensing port aligns with the pressure sensing connector when the canister assembly is mounted on the mounting region of the vacuum console.

11. A canister assembly as in claim 10, wherein the vacuum port and the pressure sensing port are each formed in the wall at a location mid-way between the open top and a bottom and are each connected to riser tubes within the interior of the clear canister, wherein the riser tubes are open at their upper ends so that the vacuum is drawn and the pressure sensed near the top of the canister.

12. A canister assembly as in claim 11, wherein the riser tube connected to the vacuum port has a filter in a lumen thereof.

13. A canister assembly as in claim 9, wherein the aspiration port includes both a threaded connector and a tubular connector so that it can connect to a catheter or aspiration tube having a threaded connector or to a catheter or aspiration tube having a tubular connector.

14. A canister assembly as in claim 13, wherein the threaded connector of the aspiration port has detents configured to mate with detents on a threaded connector of the catheter or aspiration tube.

15. A vacuum console for removably receiving a canister assembly including a clear canister with an interior and an open top and a lid removably attachable over the open top of the clear canister, said vacuum console comprising:

an enclosure having a mounting region for removably receiving the canister assembly;

a vacuum pump and a pressure sensor within the enclosure; and

a vacuum connector connected to the vacuum pump and a pressure sensing connector connected to the pressure sensor, said connectors both located on the enclosure within the mounting region;

wherein the vacuum connector aligns with a vacuum port formed in a wall of the canister and the pressure sensing connector aligns with a pressure sensing port formed in the wall of the canister when the clear canister assembly is received in the mounting region of the vacuum console.

16. A vacuum console as in claim 15, wherein the vacuum connector and the pressure sensing connector are located within the mounting region of the enclosure so the connectors are covered by the clear canister assembly is received in the mounting region of the vacuum console.

17. A vacuum console as in claim 15, further comprising at least one light in the mounting region, where the light is oriented to direct light across the clear canister when the clear canister is received in the mounting region so that the light illuminates the contents of the clear canister.

18. A vacuum console as in claim 15, further comprising a light bar display on a top of the enclosure indication the percentage of pressure detected by the pressure sensor.

19. A vacuum console as in claim 15, wherein the light bar is circular and segmented into quadrants.

20. A system for connection to a catheter or aspiration tube to aspirate clot from the vasculature of a patient, said system comprising:

a vacuum console as in claim 15; and

a canister assembly configured for removably mounting in the mounting region of the vacuum console said canister assembly comprising:

a clear canister with an interior and an open top; and

a lid removably attachable over the open top of the clear canister;

said clear canister having a vacuum port and a pressure sensing port each formed in a wall of the canister, wherein the vacuum port aligns with the vacuum connector and the pressure sensing port aligns with the pressure sensing connector when the canister assembly is mounted on the mounting region of the vacuum console.

21. A system for connection to a catheter or aspiration tube to aspirate clot from the vasculature of a patient, said system comprising:

a vacuum console as in claim 15; and

a canister assembly configured for removably mounting in the mounting region of the vacuum console said canister assembly comprising:

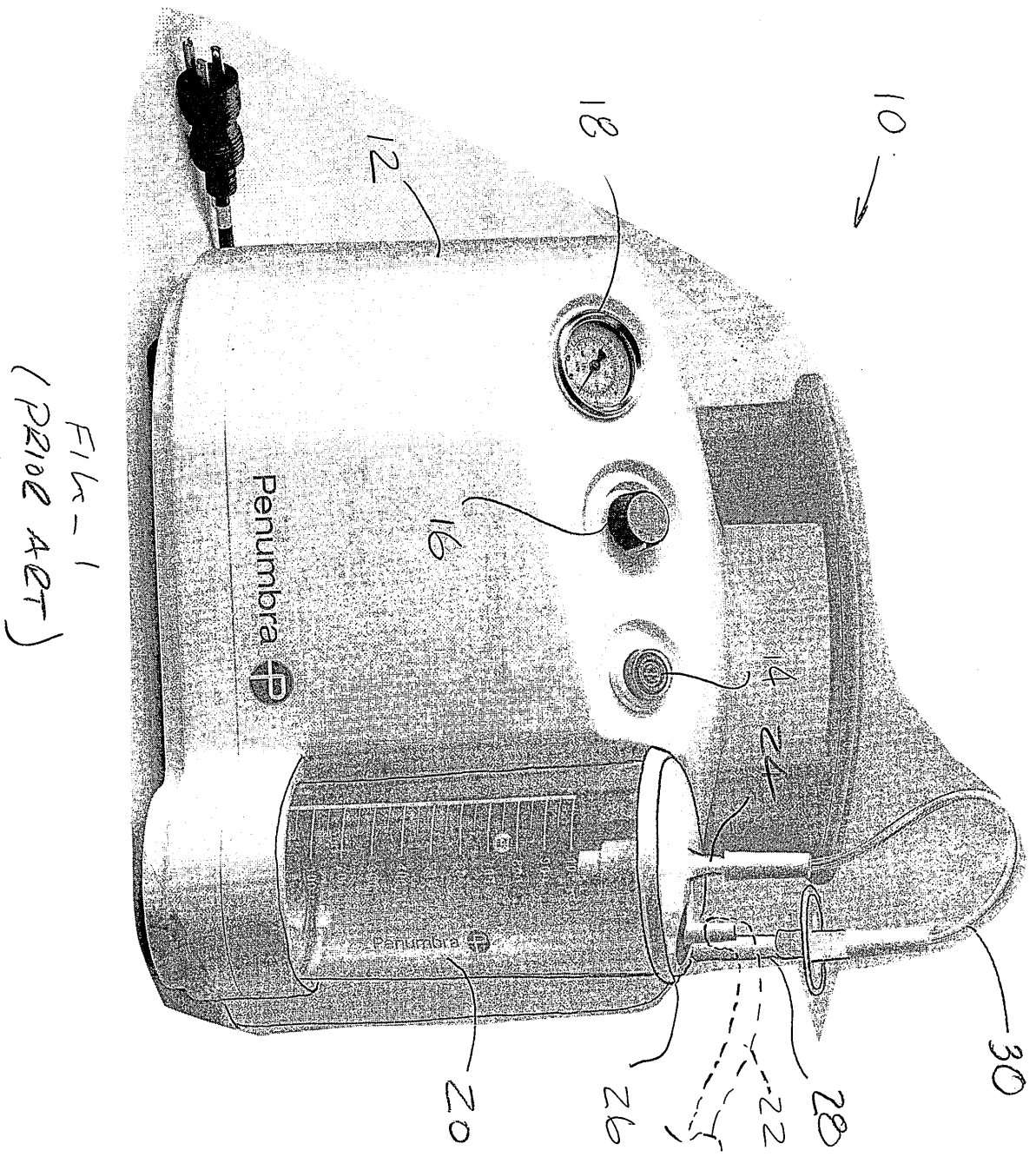
a clear canister with an interior and an open top; and

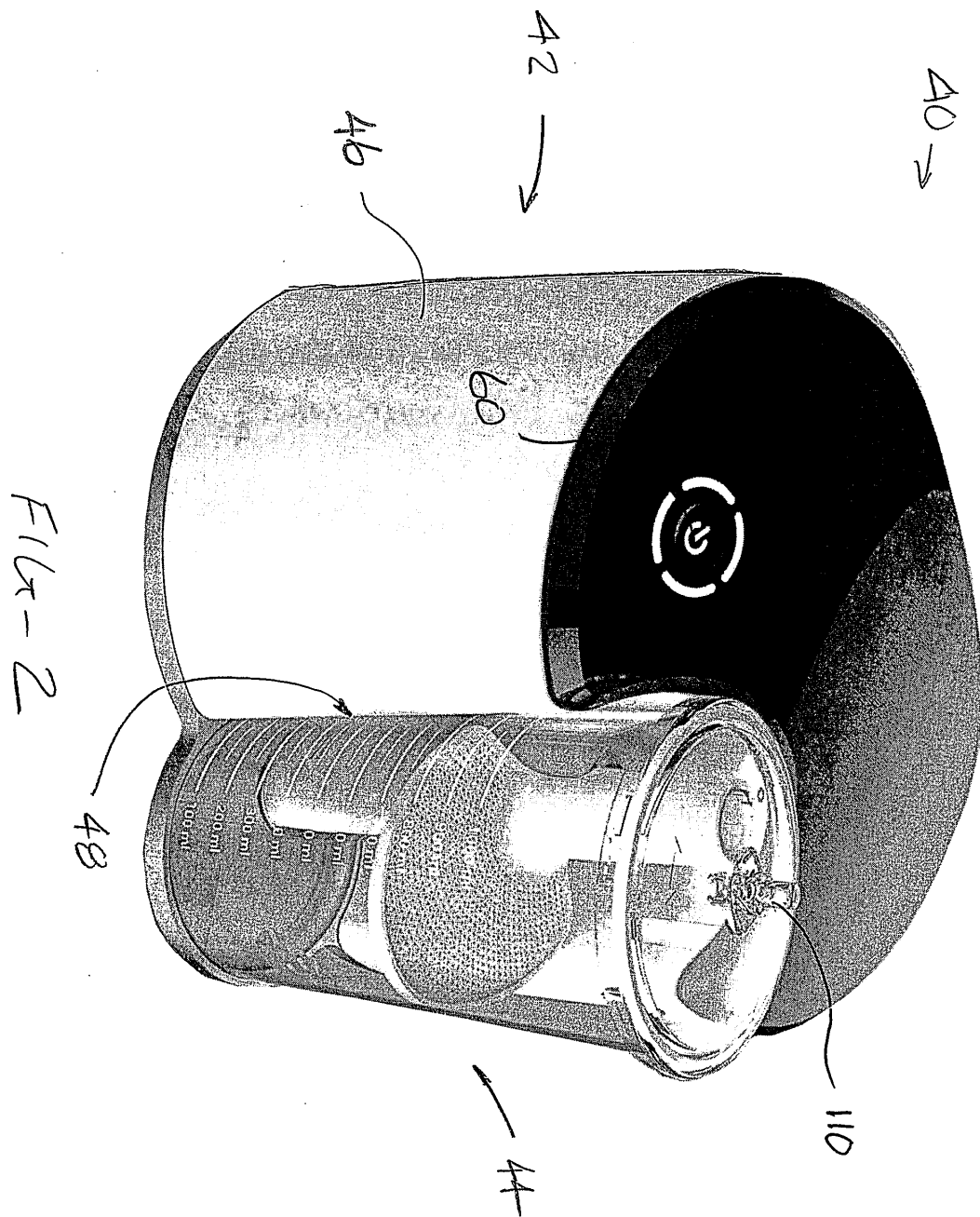
a lid removably attachable over the open top of the clear canister;

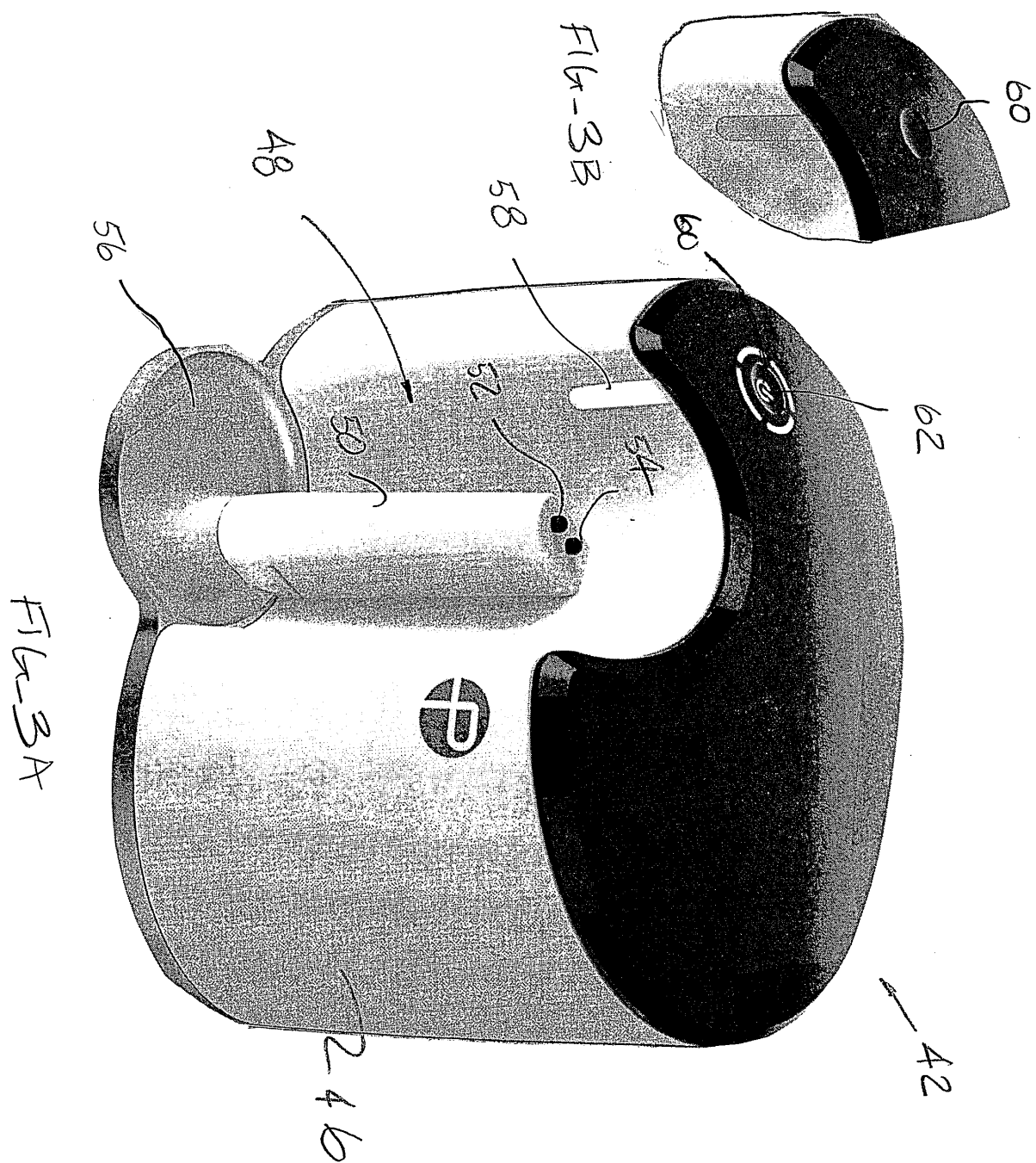
said clear canister having a filter plate configured to be suspended in the interior of the clear canister at a location mid-way between the open top and a bottom.

ABSTRACT

A system for connection to a catheter to aspirate clot from the vasculature of a patient includes a vacuum console and a canister assembly which can be removably mounted in a mounting region of the vacuum console. The canister assembly includes a clear canister with an interior and an open top. A lid is removably attachable over the open top of the clear canister, and the clear canister has a vacuum port and a pressure sensing port each formed in a wall of the canister. The vacuum port aligns with a vacuum connector on the enclosure and the pressure sensing port aligns with a pressure sensing connector on the enclosure when the canister assembly is mounted on the mounting region of the vacuum console. The clear canister has a filter plate configured to be suspended in the interior of the clear canister at a location mid-way between the open top and a bottom to separate clot from blood as they are aspirated from the catheter.







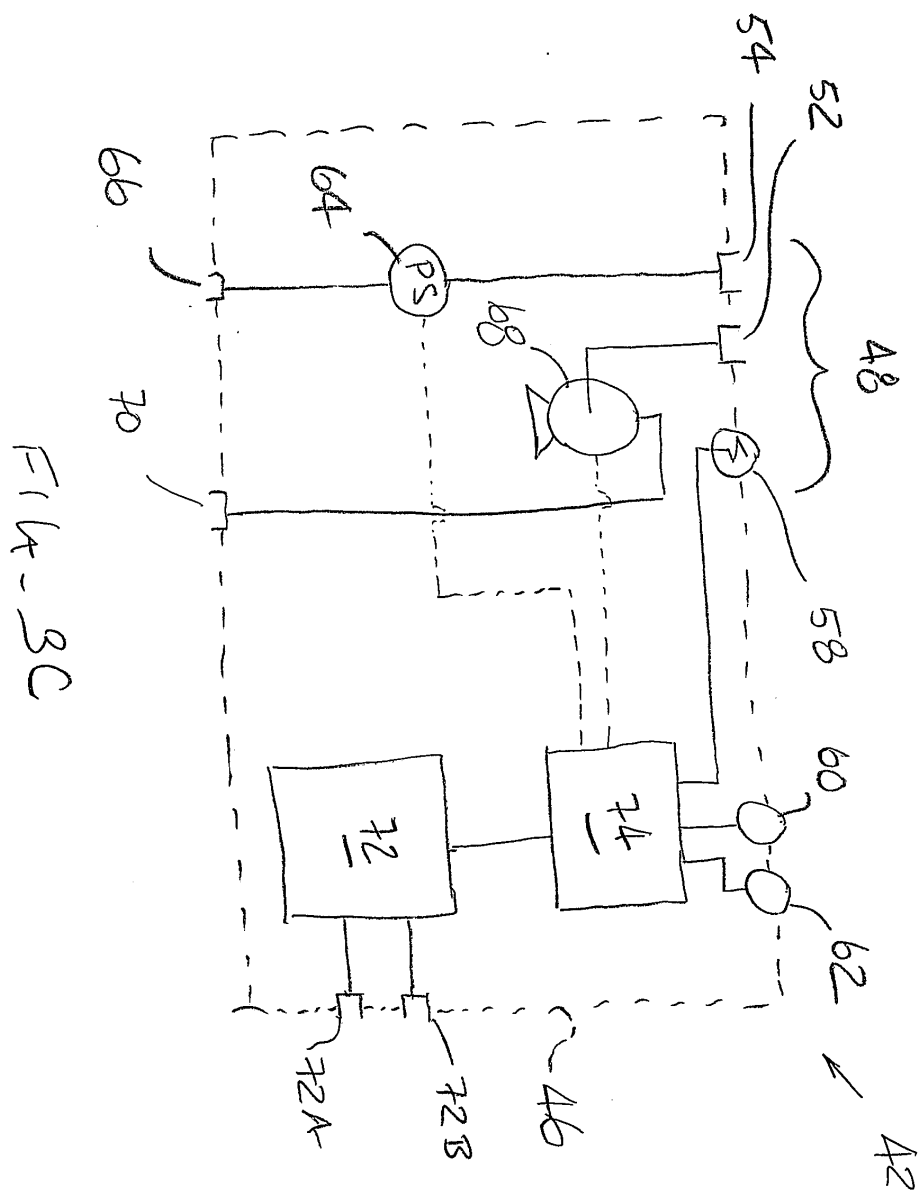


FIG. 3C

