Japan Patent Office

Patent Laying-Open Gazette

Patent Laying-Open No.	S61-143069
Date of Laying-Open:	June 30, 1986
International Class(es):	A61M 1/14
ID Code Agency Ref.No.	6675-4C

Examination requested. No. of Claims: 1

(6 pages in all)

Title of the Invention: Pressure Measuring Method for Blood Circuit

Patent Appln. No. S59-266907

Filing Date: December 18, 1984

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Specification

1. Title of the Invention

Pressure Measuring Method for Blood Circuit

2. Scope of Claims for Patent

[Claim 1]

A pressure measuring method for a blood circuit, comprising:

dividing an inside of a sealed container into a blood chamber and an air chamber with a diaphragm interposed therebetween;

connecting a blood circuit in a manner that allows blood to circulate in said blood chamber; and

measuring a pressure of air in said air chamber.

[Claim 2]

The pressure measuring method for the blood circuit according to claim 1, wherein an air content in said air chamber is adjustable.

3. Detailed Description of the Invention

(Industrial Applicable Field)

[0001]

The invention relates to a pressure measuring method for a blood circuit applicable for detecting pressure in a device such as a hemodialysis machine or cardiopulmonary bypass device, and for automatically controlling such a device.

(Prior Art)

[0002]

Conventionally, there are devices universally used, such as an artificial kidney device (dialysis machine), and cardiopulmonary bypass device. The dialysis machine is a device to be used in a human body with renal failure to purify blood in place of the kidneys, by removing waste product in the body. The cardiopulmonary bypass device is a device used in the event of a cardiac surgery to provide blood with oxygen in place of the heart. To use either of these devices, a blood circuit to be extracorporeally circulated is fabricated and operated as required for blood within the blood circuit.

Therefore, measuring a blood pressure at certain points in the blood circuit is necessary to automatically perform the operation or observe whether the operation is normally carried out.

[0003]

Fig. 9 is a drawing of an example of a conventional dialysis machine for positive-pressure dialysis. Referring to Fig. 9, a blood vessel in extremity of a body A is punctured with cannulae 1a and 1b and used as an inlet and an outlet for blood to be extracorporeally circulated. A certain flow volume of blood suctioned by a blood pump 2 and flowing out through the cannula 1a is supplied to a dialyzer 3, and tube 5 is partly narrowed by restrictor 4 to generate a positive pressure in blood in the dialyzer 3. In the blood inlet and outlet of the dialyzer 3 are installed air chambers 6a and 6b and pressure gauges 7a and 7b to check on an ultrafiltration pressure. A feed-in path 8a and a discharge path 8b are connected to the dialyzer 3 to feed a dialyzing fluid separately prepared. To dialyze blood through this dialysis machine, the blood pump 2 is rotated with the dialyzing fluid being continuously supplied through the feed-in path 8a. Then, the positive pressure is generated by tightening the restrictor 4 and regulated to an appropriate ultrafiltration pressure with the pressure gauges 7a and 7b being checked.

[0004]

The inventors of this invention previously proposed the dialysis machines described in, for example, Japanese Patent Application Nos. 1983-57147 and 1983-212895. The inventions are directed to improving the dialyzing efficiency of these dialysis machines to shorten required dialyzing time, and achieving better safety by automatically observing any abnormal events during the dialysis.

[0005]

These dialysis machines are both equipped with an air chamber to measure a blood pressure. Fig. 10 is an enlarged view of the air chamber. As illustrated in this drawing, blood c and air d are constantly in contact with each other in an air chamber 6. This air-blood contact accelerates coagulation of blood in a reaction system, resulting

in advanced coagulation. Clots formed in coagulation may be a factor of clogging in the dialyzer, leading to a poor dialyzing efficiency, as well as other unacceptably unfavorable events for hemodialysis, which necessarily demands that fluidity of blood be kept. An option often employed to prevent any of these unfavorable events is injection of an anticoagulant such as heparin. This is, however, possibly associated with failure to arrest hemorrhage in some patients. It is a very complicated and difficult procedure to determine and administer a minimum effective dosage of heparin for each case. To adjust the liquid level of blood c in the air chamber 6 and the pressure of air d, an air-d content is moderately adjusted by use of an injector 10 with a clamp 9 for blocking a tube 9a being loosened. If this adjustment is inadequate, however, the liquid level of blood c may be elevated to an abnormally high level, and the pressure gauges 7a and 7b may become no longer usable or blood may be contaminated with bacteria. On the other hand, an abnormally low liquid level may invite air into the tube 5, possibly placing a patient in life-risking danger. Further, there are some drawbacks with the air chamber 6 in handleability; this air chamber in use needs to be retained in a certain posture, and the tube 5 used for a pipe may be lengthened and bentkinked, or may narrow an installation area of the pressure gauges 7a and 7b and injector 10.

(Problems to be Solved by the Invention)

[0006]

The invention was accomplished to solve the various problems associated with the use of such an air chamber by enabling pressure measurement without any contact between air and blood in an extracorporeal circuit.

(Technical Means for Solving the Problems)

[0007]

A pressure measuring method according to the invention includes: dividing inside of a sealed container 11, 33, 37, 40 into a blood chamber a, and an air chamber b with a diaphragm 12 interposed therebetween; connecting a blood circuit in a manner that allows blood to circulate in the blood chamber a; and measuring a pressure of air in

the air chamber b.

(Embodiments)

[0008]

Referring to the accompanying drawings, the invention is hereinafter described based on an example.

[0009]

Referring to Fig. 1, an inside of a sealed container 11 is divided by a diaphragm 12 into two chambers; blood chamber a, and air chamber b. Container 11 has an inlet 14 and an outlet 15 communicating with blood chamber a, and a first connection port 16 and a second connection port 17 communicating with air chamber b. Inlet 14 and outlet 15 are connected in series to a blood circuit by way of tubes 18 and 19 to allow blood to flow into blood chamber a from inlet 14 and flow out from outlet 15. First connection port 16 and second connection port 17 are respectively connected to a pressure gauge 22 and an injector 23 for pumping purpose through tubes 20 and 21. Tube 21 is clamped by a clamp 24 and thereby blocked.

[0010]

A pressure converter 25 refers to a device including container 11 and diaphragm 12. Pressure converter 25 is more specifically structured as described below. Referring to Fig. 2, container 11 is composed of two container members 11a and 11a divided in halves in an identical shape and facing each other. Between flanges 11b and 11b of container members 11a and 11a is interposed diaphragm 12 having an identically shaped outer periphery. These members are welded to one another to be tightly sealed. Container member 11a is formed from a polymer material such as vinyl chloride, rigid vinyl chloride, polycarbonate, or silicon rubber. Container member 11a is integral with inlet 14 and outlet 15 or first connection port 16 and second connection port 17. Diaphragm 12 has an appropriate elasticity and is formed from the same material as that of container member 11a to facilitate welding. Container member 11a or diaphragm 12 is preferably a transparent member so that a current status inside can be observed.

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