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PARENTERAL FLUID EQUIPMENT

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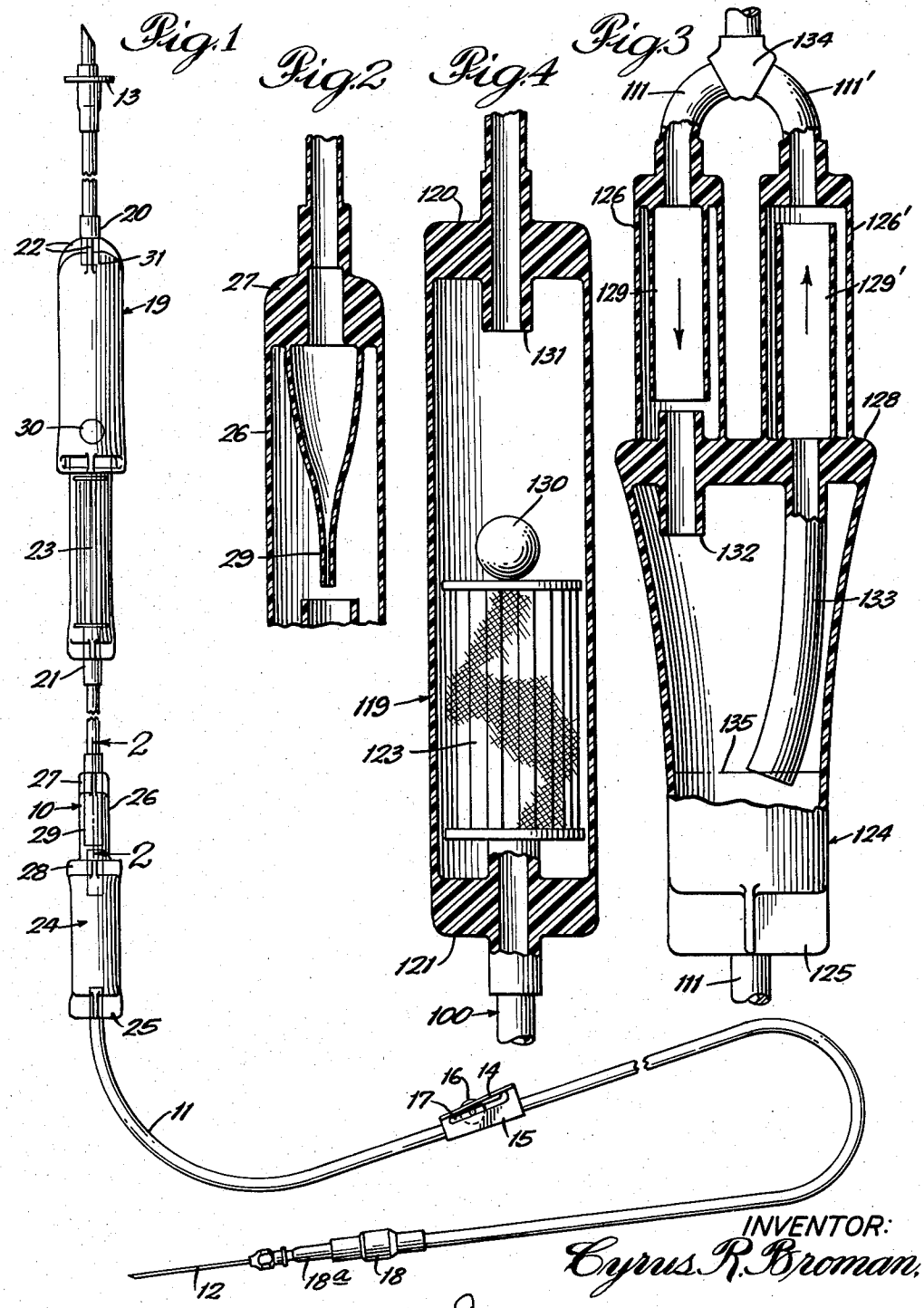

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PARENTERAL FLUID EQUIPMENT

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This invention relates to parenteral fluid equipment and, more particularly, to equipment especially suited for the pressure administration of human blood.

This application is related to my copending application, Serial No. 428,739, filed May 10, 1954.

The above-mentioned related applicaton shows a widely-employed, manually operable blood pump which includes a resilient pumping chamber having an inlet check valve provided by a floating ball. The pumping chamber is disposed in combination with a drip chamber provided below the pumping chamber.

A problem has arisen during the employment of the above-described equipment for pressure transfusions. During the manual flexing of the pumping chamber, the drip level in the drip chamber is destroyed by virtue of the drip chamber becoming completely filled with blood. When this occurs, it is necessary to complete the transfusion by pressure or spend the time to reestablish the drip level.

Also during a pressure transfusion, the flexing of the pumping chamber induces upward flow of blood into the tubing of the administration set with which the pumping chamber is associated. This not only temporarily deprives the patient of blood, but also makes the transfusion non-uniform because of the reversal of flow of the blood.

Attempts to overcome this problem have included placing the pumping chamber below the drip chamber. Although this reduces the possibility of losing the drip level, it introduces a much more serious problem—that of pumping air. Pumping of air in a manually-operable blood administration set is the one bugaboo present in every pressure transfusion. Before the advent of manually-operable blood pumps, pressure transfusions were performed by subjecting the blood bottle source to compressed air or oxygen, sometimes with fatal results. This problem was overcome by the floating ball structure found in my above-mentioned application, since pressure on the pumping chamber when no blood was present would only send the air back into the empty bottle. Where, however, a pumping chamber is positioned below the drip housing and equipped with a check valve adequate to prevent loss of drip level, the pumping chamber also permits pumping of air into a patient, with the chance of causing an embolism.

It is, therefore, an object of this invention to overcome the problems and difficulties described above. Another object is to provide a novel type of manually-operable blood pump. Still another object is to provide a novel manually-operable blood pump including separate pumping and drop viewing chambers where the inlet of the drop viewing chamber is equipped with valve means permitting only inward flow of fluid into the drop viewing chamber. Yet another object is to provide novel parenteral fluid equipment where a dripmeter is equipped with an inlet check valve. Other objects and advantages of this invention can be seen as this specification proceeds.

This invention will be explained, in an illustrative embodment, in conjunction with the accompanying drawing, in which—

FIG. 1 is an elevational view of a blood administration set embodying teachings of this invention; FIG. 2 is an enlarged, fragmentary, sectional view of a portion of the set of FIG. 1; FIG. 3 is an elevational view partly in

section of a modified form of the drip chamber portion of a blood administration set, and FIG. 4 is an elevational view partly in section of the pumping chamber portion of a set and adapted to be inter-connected with the structure of FIG. 3.

In the illustration given, the numeral **10** designates generally a blood administration set as seen in FIG. 1. Set **10** includes a length of flexible tubing **11**, preferably constructed of a heat-sealable thermoplastic material such as polyvinyl chloride. Tubing **11** is of rather small diameter but greater than the bore of hypodermic needle **12** with which it communicates at one end. Hypodermic needle **12** is adapted to be inserted into the vein of a patient intended to receive a transfusion of blood.

Flexible tubing **11**, at its other end, communicates with a plug-in connector **13** which is adapted to be inserted into a passageway of the resilient closure of a blood bottle (not shown). As is well known, parenteral fluid transfusions are usually achieved through disposing a bottle source of fluid in a mouth-downward condition and securing a length of flexible tubing between the mouth of the bottle and the vein of the intended recipient.

Mounted on flexible tubing **11** is a clamp **14** adapted to compress tubing **11** and thereby regulate the rate of fluid flow therethrough. In the illustration given, clamp **14** includes a trough-shaped body portion **15** which slidably carries a knurled roller **16**. Movement of roller **16** along slot **17** produces varying amounts of compression of tubing **14**, and thereby regulates the flow of fluid in tubing **11**.

Mounted on tubing **11**, at the end thereof adjacent hypodermic needle **12**, is a flashback indicating device **18** which can be flexed after needle **12** is inserted into the patient's body to ascertain whether the needle has satisfactorily penetrated a vein. Flashback device **18** also permits the introduction of supplemental medication inasmuch as it is constructed of a self-sealing material such as rubber.

Positioned in tubing **11** between the ends thereof is a resilient collapsible pumping chamber generally designated **19** and which is set forth in detail in my copending application mentioned above. Chamber **19** includes a tube of resilient, heat-sealable thermoplastic material such as polyvinyl chloride, of considerably greater diameter than tubing **11** and united at the ends thereof with tubing **11** as at **20** and **21**. Preferably, the union at points **20** and **21** is achieved through heat-sealing of the thermoplastic tubes together. This can be conveniently performed by fusing sector portions **22** together through dielectric heating, whereby the smaller tube **11** is axially disposed within the larger tube providing chamber **19**. Mounted about the outlet of chamber **19** (adjacent point **21**) is a blood filter **23**.

Also positioned in tubing **11** intermediate the ends thereof is a drip chamber or drop viewing chamber generally designated **24**. The outlet of chamber **24**, designated **25**, is heat-sealed to tubing **11** by the same type of heat-seal described above as at **20** and **21** in conjunction with pumping chamber **19**.

Disposed in tubing **11** and positioned immediately above drip chamber **24** is a smaller auxiliary chamber **26**, united at one end to tubing **11** by a heat-seal as at **27** and at the lower end thereof with chamber **24** by a heat-seal as at **28**. Supported within auxiliary chamber **26** from the inlet portion is a collapsible tube or sleeve **29**, seen in cross-section in FIG. 2. Sleeve **29** is unsupported at its lower end and acts as a check valve, permitting fluid flow only into drip chamber **24**.

It is believed that a brief description of the operation of the device just described will further aid in its understanding. Therefore, such a description follows herewith.

Operation

Before the actual transfusion of blood through set **10** is begun, the set is first communicated with a source of colorless parenteral fluid such as saline solution. Through flexing of chamber **19** and/or chamber **24**, depending on whether both are constructed of resilient flexible materials, the entire set can be filled with fluid except that chamber **24** is only partially filled to establish a drip level. Care is always exerted so that the set below the drip level in chamber **24** is absolutely purged of air. For this, the set is disposed with needle **12** positioned above the outlet of chamber **24** and small amount of solution is permitted to issue from needle **12** to insure that there are no entrapped air bubbles. For this purpose, it is additionally attractive to employ saline, since it is far less valuable than blood. Once the set is properly filled with saline solution, vein puncture of a patient (not shown) is made by means of hypodermic needle **12**. Thereafter, flashback device **18** is manually flexed and if the vein puncture is proper, a red coloration can be noted between device **18** and needle **12** which are communicated by a length **18***a* of transparent rigid plastic material serving as an adapter for the hub of needle **12**. Thereafter, connector **13** is communicated with a source of whole blood and a blood transfusion is commenced, the rate of transfusion being regulated by means of clamp **14**.

Where a faster rate of transfusion is required than is possible by means of gravity flow, even with clamp **14** wide open, the attending physician manually flexes chamber **19**. Chamber **19**, being previously partially filled with blood, upon first collapse will first force air upward through connector **13** and into the blood bottle source until the floating ball **30** abuts the inlet **31** of chamber **19** so as to close the same against fluid flow. Subsequent collapse of chamber **19** forces blood downwardly and into the patient's vein. Upon release of pressure on chamber **19**, blood flows therein through connector **13** from the source (not shown). However, no air from drop counting chamber **24** is able to enter chamber **19** because of the closure of the check valve structure provided by sleeve **29**, as shown most clearly in FIG. 2. Thus, it is possible, through the use of the embodiment illustrated in FIG. 1, to intermittently employ pressure when needed in a transfusion and thereafter revert to regulated gravity flow. At the same time, there is never a danger of pumping air, since the inlet to the pumping chamber, whenever the pumping chamber **19** is not completely filled with blood, is completely open by virtue of the position of floating ball **30**.

It is also important to note that another advantage accrues from the disposition of elements found in the embodiment shown in FIG. 1 wherein the filter **23** is positioned below the pumping chamber. During the course of a blood transfusion, it is not uncommon for the filter to become clogged and therefore resistant to the passage of blood therethrough. With the provision of a pumping chamber above the filter, it is possible to apply additional pressure so as to force a sufficient amount of blood through the filter notwithstanding its condition of additional resistance. This is not possible where the pumping chamber is positioned below the filter.

Another embodiment of this invention is seen in FIGS. 3 and 4, which again depict a blood administration set, here generally designated by the numeral **100**. Positioned in the length of flexible tubing **111** is a pumping chamber **119** equipped with an inlet **131**, a floating ball **130**, a filter **123**, and heat-sealed to tubing **111** as at **120** and **121** substantially as is described hereabove with respect to the structure shown in FIG. 1. Positioned in tubing **111** and above pumping chamber **119** is a drop counting chamber generally designated **124**. Drop counting chamber **124** is equipped with an outlet **125** suitably heat-sealed to tubing **111**. The top portion of drip chamber **124** is closed by a flat heat-seal **128** and has extending therethrough a pair of conduits **132** and **133**. Each conduit in turn is connected to an auxiliary chamber integral with heat-seal **128** and designated **126** and **126'**, respectively. Supported within auxiliary chamber **126** is a one-way valve **129**, substantially as seen in FIG. 1 at **29**. Auxiliary chamber **126'** is also provided with a one-way check vale **129'** which is reversely oriented from valve **129**. Valve **129'** is mounted on chamber **124** at the lower portion of the sleeve or tube forming valve **129'** and permits fluid flow only out of drip chamber **124**. The upper ends of each auxiliary chamber **126** and **126'** communicate with flexible tubing **111** and **111'**, respectively, which are united through a Y-connector **134**. Connector **134** in turn communicates with a plug-in connector (not shown). similar to that designated **13** in FIG. **1**.

Through the cooperation of check valves **126** and **126'**, the drip level in chamber **124** is always maintained at the level indicated by the numeral **135** whenever a fluid source is communicated with Y-connector **134**. Whenever the level falls below that designated by **135**, air is permitted to leave chamber **124** through conduit **133** and valve **129'** until the level reaches the lower end of conduit **133**.

While, in the foregoing specification, I have set forth specific structures in considerable detail as a means for illustrating the invention, it will be understood that such details may be varied widely by those skilled in the art without departing from the spirit of my invention.

I claim:

1. In a manually-operable blood pump for pressure pumping chamber, and means associated with the inlet check valve and a drip chamber positioned below said pumping chamber, and means associated with the inlet of said drip chamber permitting only inward flow of fluid into said drip chamber.

2. The structure of claim 1, in which said means is a check valve.

3. The structure of claim 1, in which said means includes a length of flexible tubing supported at one end in spaced relation to the inlet of said drip chamber.

4. Parenteral fluid equipment, comprising a drip chamber having a pair of inlets, check valve means associated with each of said inlets, said check valve means being oppositely oriented, each of said inlets being provided with depending conduit means extending into said drip chamber, the conduit means from one of said inlets extending further into said drip chamber than the conduit means from the other of said inlets, the check valve means associated with the inlet equipped with the longer extending conduit means permitting fluid flow only out of said chamber, and the check valve means associated with the other of said inlets permitting only fluid flow into said chamber.

5. Parenteral fluid equipment, comprising a length of flexible tubing equipped with vein puncture means at one end and connector means at the other end, said connector means being adapted to communicate said tubing with a source of parenteral fluid, pumping chamber means in said tubing and drip chamber means in said tubing, and check valve means in said tubing associated with the inlet of said drip chamber means permitting only inward flow of fluid into said drip chamber means, said drip chamber means being equipped with a pair of inlets, one of said inlets being associated with said check valve means, and the other of said inlets being associated with second check valve means, said second check valve means being oppositely oriented to said first-mentioned check valve means.

6. The structure of claim 5, in which each of said inlets is provided with depending conduit means extending into said drip chamber means, the conduit means from the other of said inlets extending further into said drip chamber means than the conduit means from the first of said inlets.

7. In parenteral fluid equipment, a length of flexible tubing equipped with vein puncture means at one end and

connector means at the other end, said connector means being adapted to communicate said tubing with a source of parenteral fluid, pumping chamber means equipped with an inlet check valve in said tubing, and drip chamber means in said tubing spaced below said pumping chamber means, said drip chamber means having inlet and outlet ends, and check valve means in said tubing associated with the inlet end of the said drip chamber means permitting only inward flow of liquid into said inlet end and positively preventing outflow of air through said inlet end.

8. The structure of claim 7 in which the tubing between said chamber means is provided with an enlarged portion, the check valve means of the inlet end of said drip chamber means being mounted in said enlarged portion and comprising a flexible, collapsible tube.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,989,052 June 20, 1961

Cyrus R. Broman

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 30, for "pumping chamber, and means associated with the inlet" read -- transfusions, a pumping chamber equipped with an inlet --.

Signed and sealed this 5th day of December 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

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USCOMM-DC