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 application 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 an undesirable practice 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 embodiment, 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 insuch 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 14 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-sealable 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 set, 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 18a 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 force first force air upward through connector 13 and into the blood 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 clamp 14, 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 apply 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. Positoned in the length of flexible tubing 111 is a pumping chamber 119 equipped with an inlet 121, a floating ball 120, a filter 123, and a heat-seal 124 to tubeting 111 as at 120 and 121 substantially as is described heretofore 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 there-through 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 valve 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, various 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 speed 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 adaptably 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...
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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.

References Cited in the file of this patent

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,989,052

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

DAVID L. LADD
Commissioner of Patents
USCOMM-DC