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PARENTERAL EQUIPMENT VALVE AND PUMP

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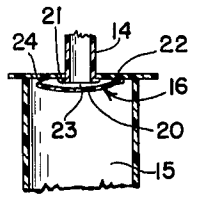


FIG. 2

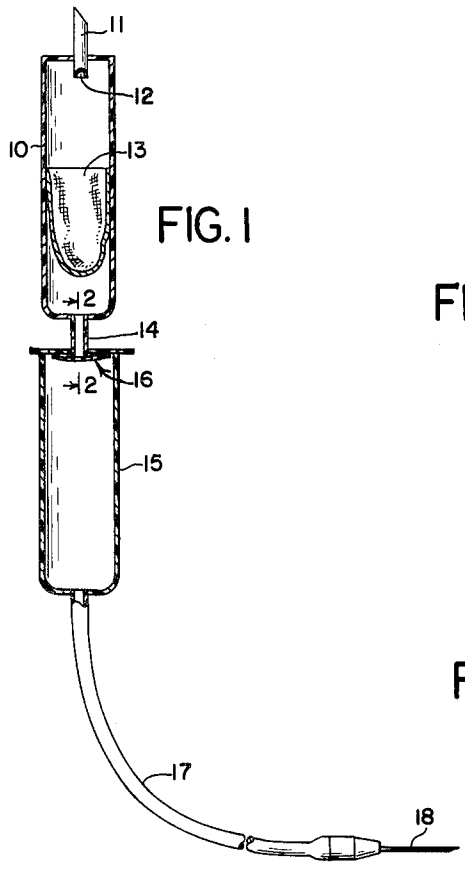


FIG. 1

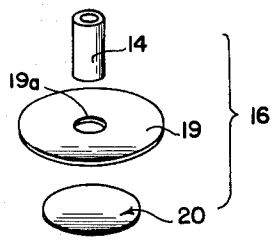


FIG. 3

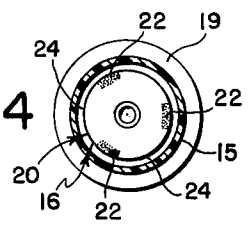


FIG. 4

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PARENTERAL EQUIPMENT VALVE AND PUMP

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The present invention relates to surgical apparatus for the intravenous administration of parenteral fluids such as blood, blood plasma, and the like. More particularly, it relates to an improved valve structure adapted for use in apparatus for the pressure administration of parenteral fluids and the like.

Parenteral fluids such as blood, blood plasma, and the like, are normally administered by suspending the receptacle containing them above the recipient and allowing the parenteral fluid to flow into the vein of the recipient under the influence of gravity. However, in cases of emergency it is often necessary to force large amounts of parenteral fluid into the recipient, as for example, when the recipient has lost a great deal of blood.

Most of the devices used for the pressure administration of parenteral fluids include a one-way valve system as an essential ingredient. Such a system, of course, is necessary for the device to function as a pressure pump and further to eliminate the possibility of air embolism.

Equipment which comes in contact with parenteral fluid during the course of administration must either be thoroughly cleansed and resterilized or discarded after a single use to avoid dangerous contamination. The development of suitable plastics has made it desirable to make such equipment, if possible, from plastic which is relatively inexpensive and expendable. One example of a pressure pumping device for blood which is made of plastic is disclosed in U.S. 2,538,662.

In the past, the valve structures of such devices have employed systems having free-moving parts, which in addition to being expensive to manufacture, may become inoperative if their movement is hampered.

It is an object of the present invention to disclose a novel apparatus for the pressure administration of parenteral fluids which has no free-moving parts and is made primarily of plastic.

It is a further object to disclose a novel inexpensive valve made entirely of plastic material.

These and still further objects will become more apparent from the specification and drawings in which:

FIG. 1 is a front elevation of one embodiment of the invention.

FIG. 2 is a sectional view taken along line 2—2 of FIGURE 1 showing the valve structure in an open position.

FIG. 3 is an exploded perspective view of the valve and its components.

FIG. 4 is a top view of the valve 16 showing the arrangement of the peripheral heat seals.

Referring now to the drawing, in FIGURE 1 is shown an administration set for the pressure infusion of blood comprising a combination drip and filter chamber 10. The chamber 10 is provided at one end with connecting means such as the pointed connector 11. The chamber 10 is further provided at a point below the drop forming tube 12 with a suitable filter 13. This filter may be constructed of nylon mesh, stainless steel, and the like, in a wide variety of forms. The combination drip and filter chamber is provided with an outlet communicating with a length of tubing which in turn communicates with the inlet 14 of the pump 15 which is equipped with a one-way valve 16. The outlet of the pump communicates with a length of flexible tubing 17 equipped at its unattached end with a recipient needle 18. The combination of 10, 14, 15, 17 and 18 provides for a conduit for the flow of parenteral fluid from a source to a recipient (neither shown).

The pump 15 is a length of tubing of a cross-sectional area greater than that of the tubing 17, and usually at least twice as great. It is constructed of a material having a wall thickness and resiliency that permits it to be manually compressible to bring the opposite sides of the tubing together and, through cooperation with the latter to be described one-way valve, to force the incompressible liquid from it. Preferably the pump 15 is a polyvinyl chloride tube 5 inches long and 0.8 inch in cross section. A full compression of this pump delivers 25 cc. of the fluid. Upon release of the compressing force the pump regains its original tubular form.

The pump 15 is equipped adjacent its inlet with a valve generally referred to as 16. As can best be seen in the exploded view of FIGURE 3, the valve comprises the inlet tube 14, the relatively rigid flat plate-like top section of the pump 19 and a highly flexible diaphragm 20. These components are sealed one to the other by the use of heat or adhesive. The inlet tube 14 is centered above and sealed within opening 19*a* of the flat top section 19 to form a smooth conduit and a leak proof junction the underside of which is an annular raised section which serves as a valve seat 21 (seen only in section in FIGURE 2). The diaphragm 20 is then centered below the plate-like section 19 and sealed to it at spaced intervals along its outer edges. This is done in such a manner that the central portion of the diaphragm is directly below the opening 19*a* and the valve seat. The components when thus positioned are sealed together at spaced intervals 22 along their common periphery to form flow passage 24 (seen in FIGURE 4.) This is done in such a manner that it results in a slight degree of spacing 23 between the plate 19 and the diaphragm 20 which permits fluid to flow from the inlet tube into the spacing 23 and out through the unsealed portions of the periphery or flow channels 24 into the pump chamber proper. Because of the presence of its imperforate central portion and by virtue of its extreme resiliency, the diaphragm 20 will upon the least degree of gaseous or liquid pressure upon the under side of the diaphragm such as results from compressing the pump chamber, move upward to seal against the valve seat about the inlet tube thereby preventing any departure of fluid from the pump through said inlet.

The valve is preferably comprised of an inlet tube of polyvinyl chloride 0.04 inch think, 5/8 inch in length and having an inner diameter of 0.140 inch. The top plate-like portion 19 preferably comprises a disc of polyvinyl chloride which is 1 inch in diameter and .040 inch thick. It is further provided with the aperture 19*a* which has an inner diameter of about 0.140 inch. The flexible diaphragm 20 has a diameter of 5/8 inch and a thickness of 0.004 inch. The plate-like portion 19 and the diaphragm 20 are heat sealed together at spaced intervals 22 about their common periphery to form the flow channels 24. Preferably three flow channels of equal size are formed by heat sealing the common periphery at three spaced apart points. The heat seals 22 are preferably 0.250 inch long. The space 23 between the diaphragm 20 and the top portion 19 exists only during conditions of flow and is about 0.06 to 0.07 inch. When assembled in final form the diameter of the diaphragm 20 located within the peripheral seals 22 is about $1\frac{7}{32}$ inch.

When it is desired to utilize the apparatus in the administration of blood, the connector 11 is used to connect the set to a source of blood. A clamp (not shown) is opened and air purged from the set. The clamp is closed and a drip level is then established in conventional manner, as for example, by compressing the drip and

filter chamber. The needle is then inserted in the vein of a recipient and the administration allowed to proceed. If pressure administration is required it is accomplished by simply compressing the pump chamber manually thus forcing the contents out of the outlet, through the needle into the patient. This may be accomplished simply and easily due to the presence of the one-way valve system. The valve, as it prevents the back-flow of air or parenteral fluid into the drip chamber also preserves the previously established drip level.

While the novel valve system has been described in conjunction with a specific pressure administration apparatus it will be readily apparent that the invention is not so restricted. For example, other types of filters and flow regulatory devices than those shown may be used if desired.

The valve may be used in a wide variety of situations in which a simple, inexpensive one-way valve structure is needed, as, for example, for inflatable traction devices and similar inflatable objects and for simple pumping devices of all descriptions.

What I claim is:

A disposable plastic blood pump comprising a hollow cylindrical chamber of resilient synthetic plastic material, said chamber being closed at one end with an end wall provided with an outlet tube and at the other end with a combination inlet means and one-way valve, said combination inlet means and one-way valve comprising a plate-like member formed of a synthetic plastic material which closes the open end of said chamber and which is provided with a central aperture; an inlet tube formed

of a synthetic plastic material positioned above said plate-like member and sealed about said aperture to form a fluid tight path through said member and a valve seat upon the lower side of said member; and an imperforate resilient diaphragm formed of a synthetic plastic material and of slightly lesser diameter of said plate-like member said diaphragm being formed of a synthetic plastic material and being positioned below said plate-like member and sealed to it at three equidistantly spaced points along the periphery of the diaphragm; said combination inlet means and one-way valve being integrally sealed together and to said chamber member to form a unitary disposable blood pump into which blood can be introduced via the inlet tube and removed therefrom only via the exit tube, said one-way valve being effective to prevent the exit of blood from said chamber through said inlet tube.

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