May 30, 1961 R. G. TROUT ET AL 2,986,098

EXPANSIBLE CHAMBER LIQUID PUMP

Filed Oct. 23, 1959

FIG. 1

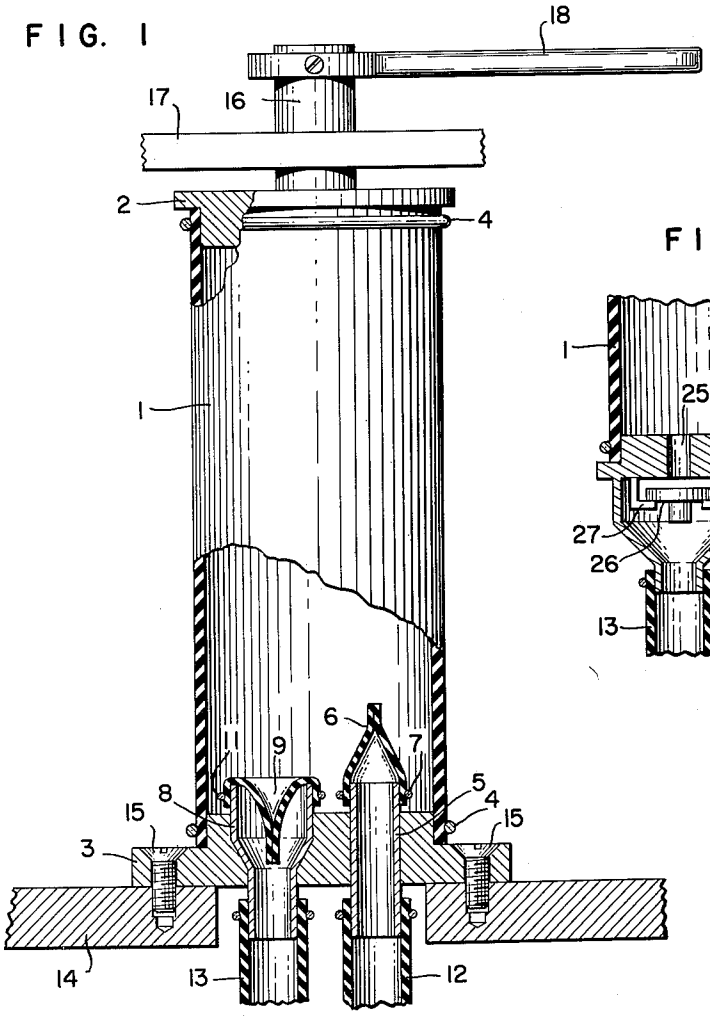


FIG. 3

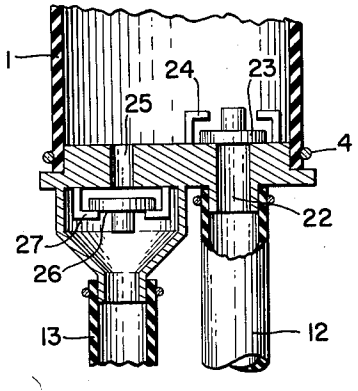
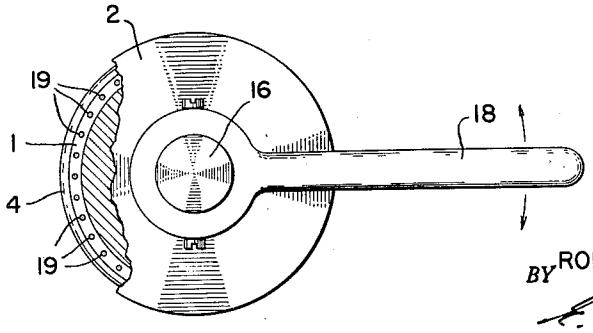


FIG. 2



INVENTORS.
ROBERT G. TROUT
BY ROBERT P. DOBBIE JR.

ATTORNEY.

United States Patent Office 2,986,098
Patented May 30, 1961

2,986,098

EXPANSIBLE CHAMBER LIQUID PUMP

Robert G. Trout and Robert P. Dobbie, Jr., Philadelphia, Pa., assignors to Cardiovascular Research Foundation, Philadelphia, Pa., a corporation of Pennsylvania

Filed Oct. 23, 1959, Ser. No. 848,265

3 Claims. (Cl. 103—148)

The present invention relates to pumps and more particularly to an expansible chamber type of pump.

In many applications it is desirable to have a pump in which delicate or corrosive liquids can be moved through a pipe without harm to the liquid or to the pump. An example of such an application is in the pumping of blood for extracorporeal circulation systems. The volume of liquid flow must be substantially constant and the liquid must not be bruised. Another example is the pumping of acids, in which case all parts of the pump must be made of non-corrosive materials. In either case the pump must be easily disassembled for cleaning and sterilization.

It is an object of the invention to provide a pump for liquids which is simple in operation and easy to clean. It is a further object of the invention to provide a liquid pump which will not harm the material being pumped either mechanically or chemically.

The various features of novelty which characterize our invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which we have illustrated and described a preferred embodiment of the invention.

In the drawings:

Fig. 1 is a view, partly in section, of the pump,

Fig. 2 is a top view, partly in section, and

Fig. 3 is a view of a modified form of valve used with the pump.

Referring to the drawing the pump is shown as including a fiexible and resilient tube 1 that can be made of rubber or some suitable plastic material that has the property of returning normally to its cylindrical shape. The upper end of the tube is closed by a rigid plug or end wall 2 while the lower end is closed by a rigid plug or end wall 3 to form a cylindrical chamber. The ends of the tube are held on the projections of the end walls by means of a suitable clamp 4 which may be the type of clamp used for radiator hoses. Fluid is introduced into the chamber formed by the tube 1 through a liner 5 that is fastened in wall 3. Placed over the upper end of this liner is a flapper valve 6 which can consist of a piece of tubing that is inserted over the upper end of the liner 5 with the tubing being so formed that its upper end is normally pinched or closed as shown in the drawing. The valve is retained in position on the liner by means of a suitable clamp 7. The outlet from the pump chamber is formed by a liner 8 that is also inserted in end wall 3. An outlet valve 9 also formed of a resilient material, the end of which is normally closed as shown in the drawing, is fastened by a clamp 11 on the inner end of liner 8. Inlet tube 12 is fastened to the lower end of liner 5 while an outlet tube 13 is fastened to the lower end of liner 8. All of the above

described parts are to be made of materials that are inert with respect to the material being pumped.

The entire pump can be supported in any suitable fashion on a rigid surface. As shown herein a suitable support is indicated at 14. The support is provided with an opening to receive the inlet and outlet tubes, and the pump is held in position on the support by screws 15. The upper end wall 2 is provided with a vertically extending shaft 16 that is received for sliding and oscillating movement in a fixed support 17. An operating handle 18 is rigidly attached to the upper end of shaft 16.

In the operation of the pump, handle 18 is rotated in first one direction and then the other. As this rotation takes place tube 1 will be twisted in one direction thus moving wall 2 toward wall 3 to decrease the volume of the chamber formed thereby and then in the opposite direction to return the end walls to the relative positions shown and thus return the volume of the chamber to normal. As the handle 18 is moved to decrease the volume of the chamber, liquid therein will be forced through valve 9 and tube 13. During this operation flapper valve 6 will remain closed. When handle 18 is moved in the other direction in order to return the volume of the chamber to its maximum, the reduced pressure caused thereby will draw liquid into the chamber through valve 6, whereas valve 9 will remain closed at this time. It will be seen that continued oscillation of the handle 18 will cause liquid first to be drawn into the chamber and then discharged therefrom. It will be obvious that the handle 18 can be moved either manually or mechanically by some suitable mechanism. In order to strengthen the walls of tube 1 and increase its tendency to return to its normal undistorted shape shown in Fig. 1, the walls of the tube may have embedded therein a series of piano wires 19, as shown in Fig. 2 of the drawing.

Another form of valve that may be used in connection with the pump is disclosed in Fig. 3. In this figure the bottom end wall of the chamber is indicated at 21 and is shown as being provided with an inlet opening 22. This opening is closed by a gravity operated disc valve 23 that is held in position over opening 22 by a cage 24. The end wall is also provided with an outlet opening 25 which may be closed by a valve 26 that is held in position to cover the opening by a cage 27.

In the operation of this embodiment, when the chamber is expanded to draw liquid into it, the suction effect will cause the liquid to lift valve 23 away from opening 22, and will draw valve 26 against opening 25. As the chamber is decreased in size to force liquid therefrom, valve 23 will move to the position shown to close opening 22, and valve 26 will drop to the position shown to permit liquid to flow from the chamber. It will be obvious that other situable valves such as a ball valve could also be used.

From the above description it will be seen that we have provided an expansible type of pump in which the flow of liquid into and out of the chamber is accomplished by means of pressure changes, thus there is no mechanical force exerted against the liquid to harm it or its constituent parts in any manner. The volume of flow can be varied by varying the arc through which handle 18 is moved. Furthermore the various elements of the pump can be manufactured of suitable materials that are chemically inert with respect to the liquid that is being pumped. The construction and arrangement of the parts is such that they can be assembled and disassembled with ease for cleaning and sterilization if it is necessary.

While in accordance with the provisions of the statutes, we have illutsrated and described the best form of em-

bodiment of our invention not known to us, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention set forth in the appended claims, and that in some cases certain features of our invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. In a pump, the combination of a rigid base provided with a pair of passages therein, a cylindrical sleeve of flexible and resilient material detachably fastened at one of its ends to said base with said sleeve surrounding said passages, an end member detachably fastened to the other end of said sleeve whereby said sleeve, base and end form a cylindrical chamber, an inlet valve detachably fixed across one of the passages in said base, an outlet valve detachably fixed across the other of said passages in said base, said valves serving to control the flow of fluid to and from said chamber, and means to oscillate said end member around the axis of said chamber relative to said base to distort said sleeve and thereby vary the size of said chamber from a maximum volume to a smaller volume.

2. The combination of claim 1 including a projection extending outwardly from said end member axially away from said chamber, and a guide surrounding said projection.

3. The combination of claim 1 including a series of resilient reinforcing members extending axially through the material forming said cylindrical sleeve.

References Cited in the file of this patent

UNITED STATES PATENTS

2,144,997	Thaheld	Jan. 24, 1939
2,189,554	Schweiss	Feb. 6, 1940
2,810,351	Bower	Oct. 22, 1957

FOREIGN PATENTS

3,152	Great Britain	of 1904