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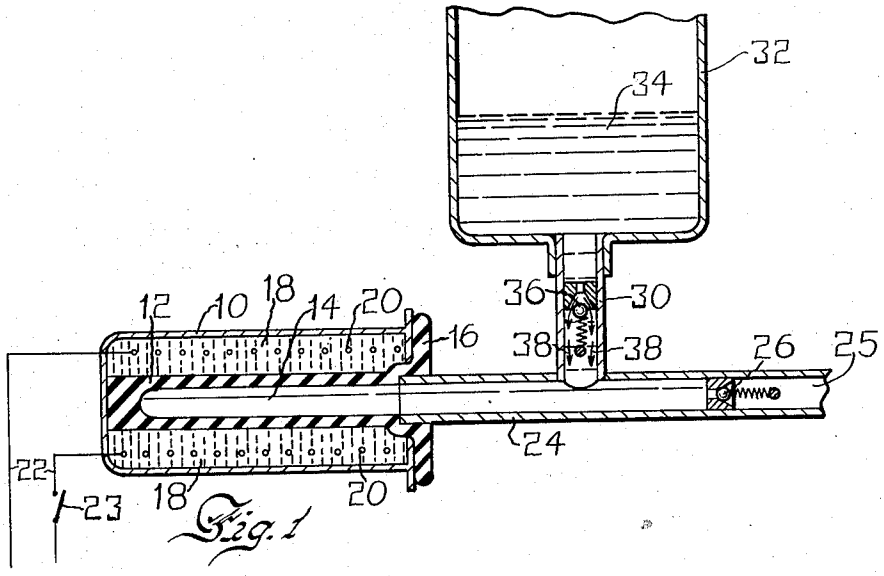

Fig. 1

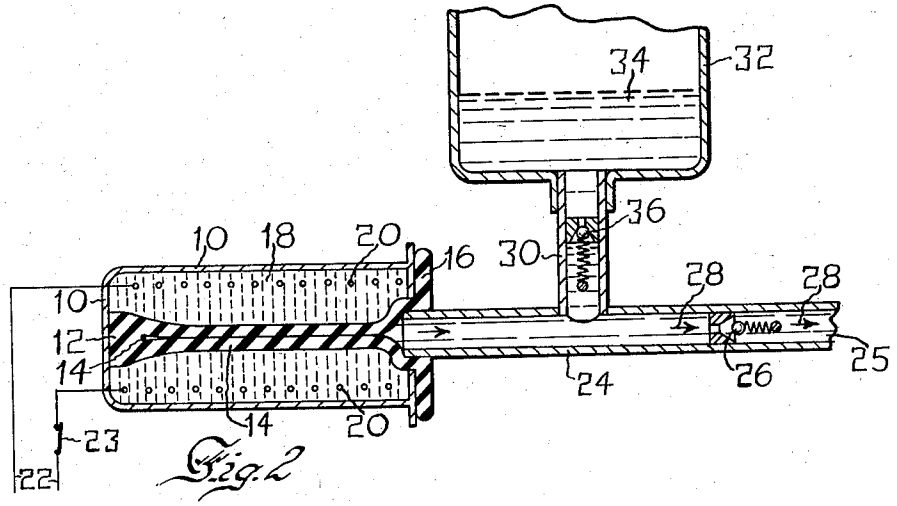

Fig. 2

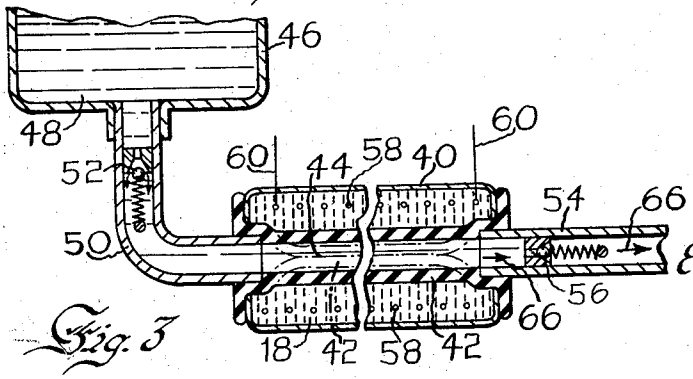

Fig. 3

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5 Claims. (Cl. 103—152)

This invention relates to a pump. The invention relates more particularly to a positive displacement pump.

An object of this invention is to provide a pump which is capable of discharging metered quantities of fluid.

Another object of this invention is to provide a pump which has silent operation.

Another object of this invention is to provide a pump which has a minimum number of moving parts.

Another object of this invention is to provide a pump which has no rotating elements and which may be electrically operated.

Another object of this invention is to provide a pump which has long life.

Other objects and advantages reside in the construction of parts, the combination thereof, the method of manufacture, and the mode of operation, as will become more apparent from the following description.

In the drawing:

Figure 1 is a side sectional view showing a pump assembly of this invention.

Figure 2 is a side sectional view similar to Figure 1 but showing the moving parts of the pump assembly in other positions of operation.

Figure 3 is a side sectional view of a preferred modification of a pump assembly of this invention.

Referring to the drawings in detail, a pump assembly of this invention comprises a container member **10**, as shown in Figures 1 and 2. Within the container member **10** is an elastic body **12** provided with a bore or cavity **14** therein. The elastic body **12** is provided with a sealing flange **16** at one end thereof which extends through one end wall of the container member **10**.

Within the container member **10** and engaging the elastic body **12** is a quantity of thermal responsive expansible-contractible material **18**. This thermal responsive expansible-contractible material **18** may be any element or any combination of elements giving the material the physical property characteristics of a high co-efficient of expansion over a given temperature range.

Also within the container member **10** and disposed within the thermal responsive expansible-contractible material **18** is an electric heater element **20** which is provided with extending external conductor leads **22** which are adapted to connect to any suitable source of electrical energy. One of the conductor leads **22** is provided with a switch **23** for controlling flow of electrical energy to the heater element **20**.

Attached to the container member **10** and joining the cavity **14** of the elastic body **12** is a fluid conduit member **24**. The end of the conduit **24** opposite the container **10** has a discharge passage **25**. The fluid conduit member **24** is provided with a uni-directional valve mechanism **26** within the discharge passage **25**. The valve mechanism **26** permits flow of fluid only outwardly through the discharge passage **25** in the direction shown by arrows **28** in Figure 2.

Joined to the fluid conduit member **24** intermediate the container member **10** and the valve mechanism **26** is a fluid conduit member **30** which connects to a tank **32** which is provided with a supply of fluid **34**. Within the fluid conduit member **30** is a uni-directional valve mechanism **36** which permits flow of fluid only from the tank **32**, as shown by arrows **38** in Figure 1.

The uni-directional valve mechanisms **26** and **36** may be of any suitable type.

When the switch member **23** is open the electric heater element **20** is deenergized. Thus, the expansible-contractible material **18** is not heated and contracts so that the elastic body **12** is substantially in the shape shown in Figure 1. The cavity **14** within the elastic body is thus fully open as shown in Figure 1. Thus, fluid **34** from the supply thereof within the tank **32** flows through the valve mechanism **36**, through the fluid conduit **30** as shown by arrows **38**. Thence, the fluid flows into the fluid conduit **24** and into the cavity **14** until the cavity **14**, the fluid conduits **24**, and **30** are completely filled.

When it is desired to discharge fluid by means of the pump assembly, the switch **23** is closed so that the heater element **20** within the container member **10** is energized. Thus, the heater element **20** heats the expansible-contractible material **18** so that the expansible-contractible material **18** expands. Expansion of the expansible-contractible material **18** causes the material **18** to fill completely all portions of the container member **10** which are not occupied by the elastic body **12**. Further expansion of the expansible-contractible material **18** causes the side walls of the elastic body **12** which form the cavity **14** to be forced inwardly as shown in Figure 2. Thus, fluid from within the cavity **14** is forced outwardly from the cavity **14**. The fluid is thus forced through the valve mechanism **26** and through the discharge passage **25**, as shown by arrows **28** in Figure 2. The valve members **26** and **36** prevent fluid from flowing in a reverse manner into the tank **32** rather than outwardly through the discharge passage **25**.

The amount of fluid discharged through the valve mechanism **26** is dependent upon the volumetric capacity of the cavity **14** of the elastic body **12**. Thus, when the bore or cavity **14** is completely closed by expansion of the material **18**, the amount of fluid which flows outwardly through the valve mechanism **26** and through the discharge passage **25** is equal to the volumetric capacity of the cavity **14**.

After the discharge through the valve mechanism **26** occurs, as shown in Figure 2, the switch **23** is opened in order to permit the expansible-contractible material **18** to contract, permitting the elastic body **12** to resume the shape thereof shown in Figure 1 so that the maximum volumetric capacity of the cavity **14** is again obtained, as shown in Figure 1. Thus, the bore or cavity **14** is again filled with fluid from the supply thereof within the tank **32**, as shown by arrows **38** in Figure 1.

In Figure 3 is shown a preferred modification of the pump assembly of this invention. A container member **40** has an opening at each end thereof. Within the container member **40** is an elongate elastic body **42** which is provided with a cavity or bore **44** extending the length thereof. The ends of the cavity or bore **44** are open and in alignment with the opening at each end of the container member **40**.

A tank member **46**, adjacent the container member **40**, contains a supply of fluid **48**. A fluid conduit **50** joins the tank member **46** to one end of the container member **40**. The fluid **48** may flow from the tank **46** through a unidirectional valve mechanism **52** within the fluid conduit **50** and into the bore **44** of the elastic body **42**. Connected to the container member **40** at the end thereof

opposite the fluid conduit **50** and joining the cavity **44** is a discharge conduit **54** which is provided with a unidirectional valve mechanism **56**. Thus, the cavity **44** and all of the space between the valve mechanism **52** and **56** are completely filled with fluid from the tank **46**.

Surrounding the elastic body **42** within the container member **40** is a quantity of expansible-contractible material **18** of the character discussed above with respect to Figures 1 and 2. An electric heater element **58** is disposed within the expansible-contractible material **18** and is provided with electric conductor leads **60** which are adapted to be connected to a source of electrical energy.

Thus, when it is desired to discharge a quantity of fluid through the discharge conduit **54** the electric heater element **58** is heated by means of the conductor leads **60** so that the walls of the elastic body **42** which form the cavity **44** are forced one toward the other as shown by broken lines in Figure 3. Thus, the fluid from within the cavity **44** is discharged outwardly therefrom and through the valve mechanism **56** and outwardly through the discharge conduit **54** as shown by arrows **66** in Figure 3.

The uni-directional valve mechanisms **52** and **56** prevent reverse flow of the fluid as the fluid is forced from the bore **44**. In a manner similar to that discussed in regard to the preferred embodiment of Figures 1 and 2, the amount of fluid discharged upon each actuation of the pump of Figure 3 is dependent upon the volumetric capacity of the cavity **44** within the elastic body **42**.

If desired, the electric heater element of the pump of this invention may be energized with lesser current or for a shorter period of time so as to only partially close the cavity of the elastic body. If the cavity is only partially closed by expansion of the expansible-contractible material **18**, only a portion of the fluid within the cavity is forced therefrom. Thus, a metered quantity of fluid less than the total volume of the cavity or bore is obtained.

It is also to be understood that any suitable means other than an electric heater element for heating the expansible-contractible material **18** within a container of this invention may be used.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

Having thus described my invention, I claim:

1. A pump assembly for discharging metered quantities of fluid including a container having rigid enclosing walls, the container having an aperture through one of the enclosing walls thereof, an elastic body within the container, the elastic body having a cavity therein which is open at one end thereof, the elastic body being in engagement with the said enclosing wall of the container which has the aperture therethrough, the open end of the cavity being in direct communication with the aperture, thermal responsive expansible-contractible material enclosed within the container exterior of the elastic body, an electric heater element within the thermal responsive expansible-contractible material, means joining the electric heater element to a source of electrical energy, a fluid conduit member joined to the container, the conduit member having an open end thereof in alignment with the aperture through said end wall so that the conduit member communicates directly with the cavity of the elastic body, the conduit member having an outlet passage spaced from the container and provided with a unidirectional valve therein permitting flow of fluid therefrom, the conduit member also having an inlet passage spaced from the container and provided with a unidirectional valve joining the conduit member to a source of fluid supply.

2. A pump assembly comprising a container provided with rigid enclosing walls, the container having an aperture extending through one of said enclosing walls, an elastic body within the container, the elastic body having a cavity therein open at one end thereof, the elastic body being in engagement with said enclosing wall of the container having the aperture therethrough, the open end of the cavity being in alignment and in direct communication with said aperture, thermal responsive expansible-contractible material enclosed within the container exterior of the elastic body, an electric heater member connected to the container for heating the expansible-contractible material, means connecting the heater member to a source of electrical energy, a fluid conduit member attached to the container and having an open end thereof in direct communication with the aperture through said enclosing wall, the conduit member having an inlet passage and an outlet passage, each of said passages being exterior of the container.

3. A pump for discharging metered quantities of fluid comprising a container member, an elastic body within the container member, the elastic body having wall members forming a bore therein, the container member having fluid port means communicating with the bore of the elastic body so that fluid may flow through the port means into and out of the bore of the elastic body, thermal responsive expansible-contractible material enclosed within the container member engaging the elastic body and arranged to move said wall members one toward the other upon sufficient expansion of the expansible-contractible material, electric heater means within the expansible-contractible material, fluid within the bore thus being forced therefrom by expansion of the expansible-contractible material, the amount of fluid forced from the bore being dependent upon the amount of expansion of the expansible-contractible material.

4. A pump for dispensing fluids comprising a container, an elastic body within the container, the elastic body having wall members forming a bore therein, the container having a fluid port communicating with the bore of the elastic body, thermal responsive expansible-contractible material enclosed within the container exterior of the elastic body, heater means within the expansible-contractible material, means for conducting fluid to and from the container so that fluid may enter the bore and flow out of the bore, fluid within the bore of the elastic body being discharged therefrom by expansion of the expansible-contractible material which expansion causes inward movement of the wall members forming the bore of the elastic body.

5. A fluid pump comprising a container member having a fluid port through an enclosing wall thereof, fluid conduit means joining the fluid port of the container member to a source of fluid, unidirectional valve means permitting flow of fluid into said conduit means, the conduit means having an outlet port, unidirectional valve means in said outlet port permitting flow of fluid from said fluid conduit means, an elastic body within the container member, the elastic body having a bore therein communicating with said fluid port of the container member, a thermal responsive expansible-contractible material enclosed within the container member exterior of the elastic body and in engagement therewith, heater means connected to the container member for heating the expansible-contractible material.

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