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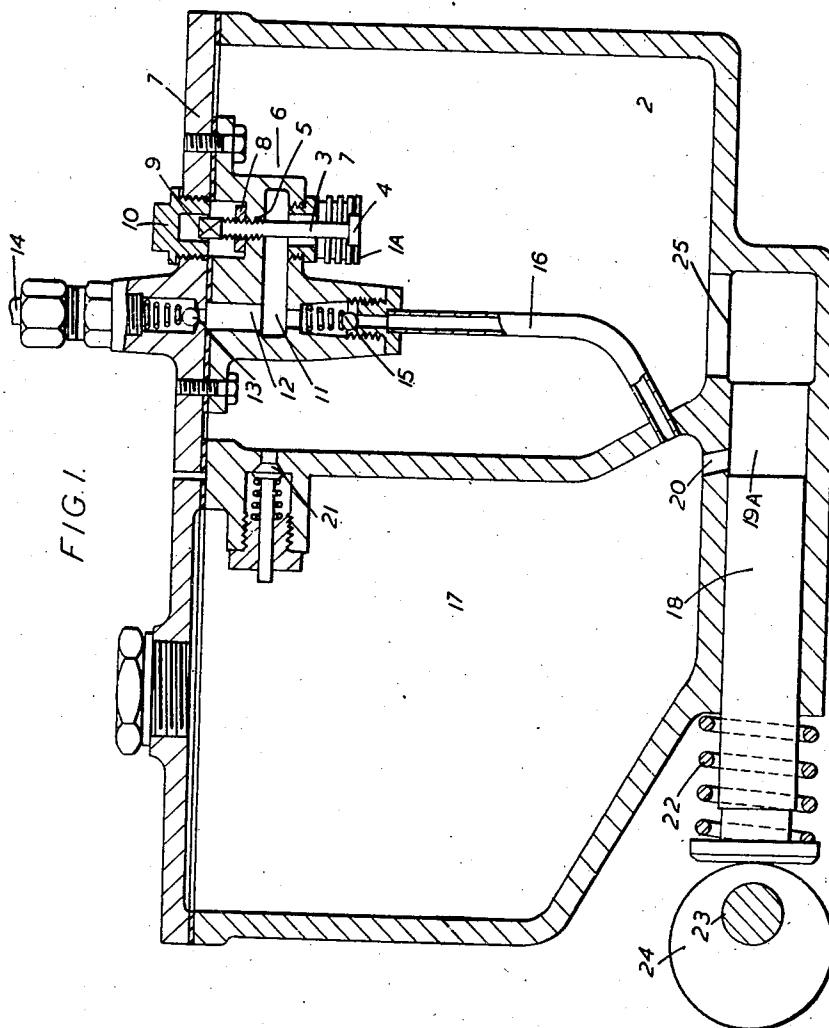
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PUMP

Filed May 22, 1944

2 Sheets-Sheet 1



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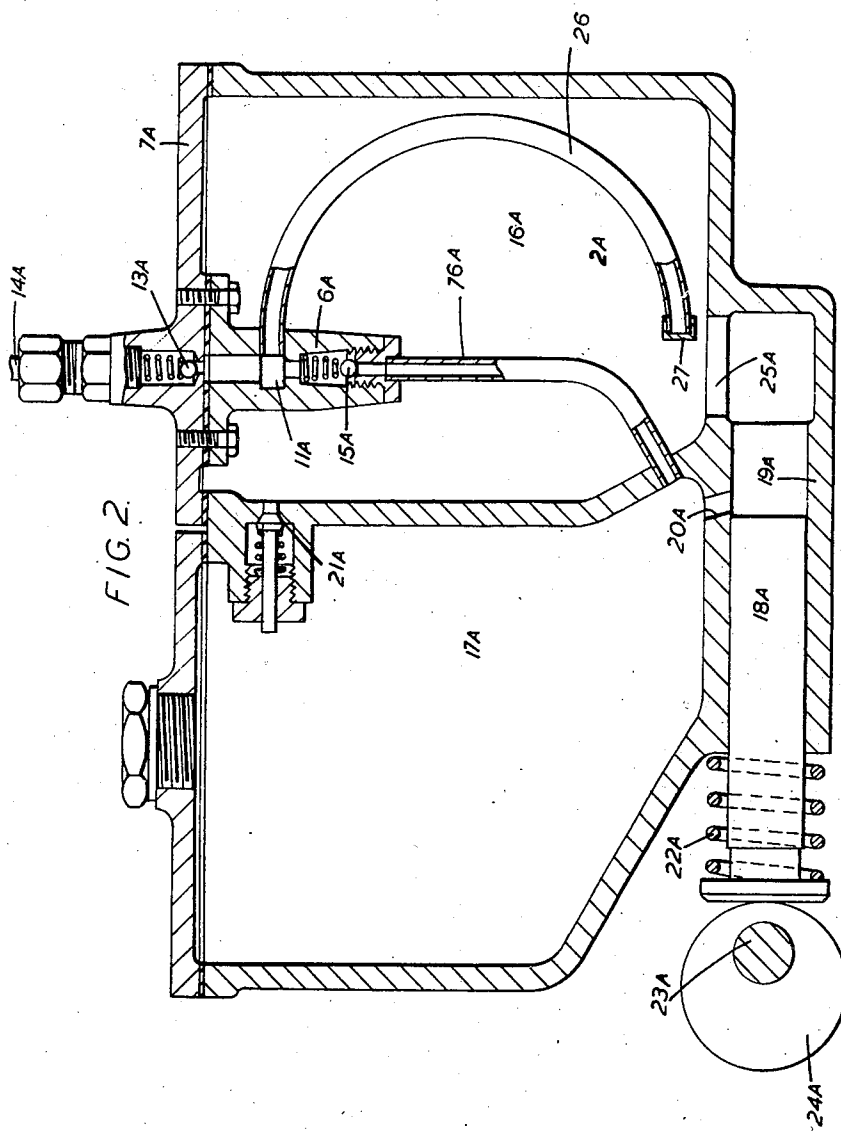
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Camille Clare Spfrankling Le Clair,
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8 Claims. (Cl. 103—44)

This invention relates to pumps and more particularly to pumps for delivering positively very small quantities of fluids.

One object of the invention is to provide a pump which will be adapted to deliver small positively-measured quantities of liquids without resorting to mechanisms having parts too small to be made by ordinary engineering manufacturing methods. One of the main difficulties which arises in providing such a pump is the leakage of the liquid and, obviously, the fewer leakage paths there are the better. One of the main leakage paths in a plunger type of pump is between the plunger and its cylinder or past its stuffing box if such is fitted.

According to the present invention, a pump is characterized by the feature that the pumping operations are carried out by at least one hollow collapsible and expansible pumping member arranged within a container for fluids, means for causing the pressure of the fluid within the container to fluctuate so to cause the collapsing and (or) expanding of the member in order to change the container volume of the member, an inlet valve for permitting fluid from a supply source to enter the member when the latter is expanded, and an outlet valve for permitting fluid, drawn into the member when the member is expanded, to be discharged from the member to the place of use of the fluid when the member is collapsed.

The said collapsible and expansible hollow member may take various forms. For example, it may consist of a bellows-like device, a tube of elliptical section, which may either be straight or curved in the manner of a Bourdon tube.

By the use of such a pumping member, not only is the principal leakage path eliminated, but stop means may be provided for limiting its travel or pulsation so that its discharge per pulsation may be reduced to some predetermined and exceedingly small quantity. In this way, a pump having an extremely small delivery can be constructed without resort to parts too small for satisfactory manufacture.

As mentioned above, according to the present invention, the said hollow pumping member is expanded and collapsed by fluctuating fluid pressure, such as hydraulic, acting upon the member, and in order to accomplish this, the member is arranged within a pressure tight container wherein the pressure may be fluctuated through a predetermined range.

Such an arrangement has several advantages. For example, it permits a multiplicity of collapsible and expansible pumping elements, each ca-

pable of extremely small discharge, to be housed within one container, the pressure within which can be fluctuated by a single pump of manufacturable size. Further, by limiting the range of fluctuating pressure, the maximum pressure against which each individual pumping element will deliver, may be limited to some safe figure so that, should a delivery pipe become clogged up, for example, the pressure will not build up until fracture takes place.

In addition to the stop means referred to above, the fluid discharge per pulsation may be controlled by varying the design of the pumping member. Thus, in the case of a tube of elliptical section, the amount of discharge per pulsation is affected by the length of the tube, the size and shape of its cross section and also the thickness of its walls. In the case of a bellows device, the discharge is affected by the diameter, the number of convolutions and the thickness of the material.

Two constructional forms of the present invention, both applied to apparatus suitable for a multi-point forced lubrication system, are shown, by way of example, with reference to the accompanying drawings, whereon—

Fig. 1 is a sectional view of a multiple pump unit wherein the collapsible and expansible pumping members consist of bellows devices; and

Fig. 2 is a sectional view of a modification in which the pumping members consist of curved elliptical tubes.

Referring to Fig. 1—

A number of hollow, metallic collapsible members 1 are mounted inside a pressure-tight container 2. These collapsible members are in the form of bellows, as previously mentioned.

Each bellows is fitted with an adjustable stop means, comprising a screwed plunger 3 having a head 4 adapted to bear on the bottom 1A of the bellows to limit the collapsing movement. The plunger is screwed into a hole 5 in a hollow housing 6 projecting downwards from, and fixed to, the cover 7 of the container, and the plunger may be adjusted axially and fixed in its adjusted position by a locknut 8. The plunger is formed with a square end 9 which is arranged in a hollow cap 10 screwed into a hole in the cover. The container volume of each bellows is arranged to communicate through a cross passage 11 and a vertical passage 12 in the housing with a spring-urged outlet valve 13, past which oil may be discharged through a pipe 14 to a place of use when the bellows collapses. The said container volume also communicates with an inlet valve 15

through which a fresh charge of oil is admitted when the bellows expands, the oil being taken through a pipe 16 from an oil supply source 17 external to the pressure tight container 2 but adjacent thereto and integral therewith.

The fluctuating pressure is provided by a single pump, hereinafter called the "main pump," comprising a plunger 18 operating in a cylinder 19 integral with the container 2 and oil supply source 17.

This pump cylinder 19 is provided with an inlet port 20 adapted to be uncovered by the plunger 18 at the end of its outward or suction stroke. There is no discharge valve in the ordinary sense of the term, but a relief valve 21 is fitted between the pressure-tight container and the oil supply source 17 such that should the pressure in the former rise beyond a predetermined figure, the valve allows any excess oil to return to the supply source. The pump plunger is pressed outwards by a spring 22 and operated by a rotating shaft 23 and eccentric or cam 24.

At the outward end of the inlet stroke of the plunger 18, the inlet port 20 is uncovered and oil from the supply source flows into and charges the cylinder 19. On its inward or discharge stroke the plunger first closes the inlet port 20 and then forces the entrapped oil forward through a port 25 into the pressure-tight container 2, raising the pressure in the container and at the same time collapsing all the collapsible bellows 1 and discharging a predetermined quantity of oil from each. If, as will generally occur, this takes place before the main pump has finished its stroke, any excess oil delivered by the latter will pass through the said relief valve 21 back to the supply source 17. On the next suction stroke of the main pump this amount plus the amount discharged by the bellows will pass once again through the inlet passage 20 into the pump cylinder and the cycle will be repeated.

The construction shown in Fig. 2 is similar to that shown in Fig. 1 in that it comprises a pressure-tight container 2A which is closed by a cover 7A and is integral with an oil supply source 17A. A hollow housing 6A is attached to the cover 7A and spring-urged inlet and outlet valves 15A and 13A are also fitted. The outlet valves provide communication with outlet pipes 14A leading to the place of use of the oil and the inlet valves connect with the inlet pipes 16A leading from the supply source 17A. A relief valve 21A is also fitted. Instead of bellows devices, however, use is made of curved metal tubes 26 of elliptical section resembling Bourdon tubes. The upper end of each tube communicates with the passage 11A in the housing 6A while its lower end is closed by a cap 27. As in the preceding construction, the apparatus is provided with a main pump comprising a plunger 18A slidable in a cylinder 19A, an inlet port 20A providing communication between the interior of the cylinder and the oil supply source 17A when the plunger is at the end of its suction stroke, and an outlet port 25A providing constant communication between the cylinder and the pressure-tight container 2A. The plunger is operated by a cam or eccentric 24A mounted on a rotating shaft 23A. On the discharge stroke of the plunger 18A, oil under pressure is forced from the cylinder 19A through the port 25A into the container 2A. The pressure of the oil in the container alters the section and shape of, and collapses, the tubes 26 thereby forcing oil from the tubes into the hollow interior of the housing 6A, and thence past the outlet valves

13A through the discharge pipes 14A to the place of use. Towards the end of the discharge stroke of the plunger 18A after the tubes 26 have collapsed any excess oil delivered is discharged back to source via the relief valve 21A. When the plunger 18A is moved in the opposite direction, however, the pressure immediately drops, the tubes 26 again expand and oil is drawn from the oil supply source 17A through the pipes 16A and past the inlet valves 15A into the interior of the housing 6A and into the tubes 26 to replace that previously expelled from the latter. At the end of the suction stroke, the inlet port 20A is once more uncovered and the pump chamber is replenished as previously explained.

The tubes 26 could be straight instead of being curved. Whatever form of pumping member is used, however, it is desirable that the whole of the internal container volume of the member with its associated passages from the inlet valve to the discharge valve should have an upward trend towards the latter so that any air which may gain admission can find its way past the discharge valve by levitation.

Stop means (not shown) may be provided for limiting the collapsing of the elliptical tube and such means may be adjustable.

In the construction shown in Fig. 1, the stop means 4 may be external to the collapsible members, limiting their free shape, instead of limiting their collapsed shape internally as shown.

The main pump may draw fluid from, and discharge fluid past the relief valve 21 or 21A back to, a supply source separate from that from which the collapsible members draw their supply, and the main pump may itself be separate from either the supply source or the pressure container and connected thereto by pipe connections.

It will be understood that the pump may be constructed in the form of a multiple pump unit as described above, which comprises two or more collapsible and expansible or flexible pumping members, or it may comprise a single pumping member. A multiple pump unit may comprise one or more main pumps and the pumping members may be arranged in the same or in individual pressure-tight containers.

I claim:

1. A pump comprising a pressure type container for fluids, at least one hollow collapsible and expansible pumping member within said container, a source of fluid to be pumped, at least one main pump which receives fluid from said supply source and forces it into said container so as to cause the pressure of the fluid in said container to fluctuate thereby causing said member to collapse and expand to change its container volume, at least one hollow housing associated with said container having an inlet port and an outlet port, check valves controlling the flow of fluid through said ports, said member being mounted to communicate with the interior of said housing, and means connecting the inlet port with said fluid source.

2. The combination set forth in claim 1 wherein said hollow collapsible and expansible pumping member consists of a bellows device.

3. The combination set forth in claim 1 wherein said hollow collapsible and expansible pumping member consists of a tube of elliptical section.

4. The combination set forth in claim 1 including stop means positioned to limit the extent of movement of said pumping member, so that its discharge per pulsation may be reduced to some predetermined and small quantity.

5. The combination set forth in claim 1 wherein said hollow collapsible and expansible pumping member consists of a bellows device, and including stop means to limit the extent of movement of said bellows device.

6. The combination set forth in claim 1 wherein said hollow collapsible and expansible pumping member consists of a bellows device, and including adjustable stop means to limit the extent of movement of said bellows device to any desired and predetermined amount.

7. The combination set forth in claim 1 wherein said source of fluid is in communication with the main pump cylinder through an inlet port con-

trolled by the pump plunger, and wherein the main pump cylinder is in constant communication with said container through an outlet port.

8. The combination set forth in claim 1 wherein said source of fluid is in communication with the main pump cylinder through an inlet port controlled by the pump plunger, and wherein the main pump cylinder is in constant communication with said container through an outlet port, and including pressure-relief means in said container to allow any excess fluid to be returned to said source whenever the pressure in said container rises above a predetermined value.

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