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(54) Circulation system circulating drop

(57) A one pipe circulation system for paints or other similar materials is provided which allows for circulation through the paint drops (20) without the requirement for an extra return line. This circulation through the drops (20) is provided by a shuttle valve (30) which acts as a small seal-less pump to provide adequate circulation through the drop (20) at relatively low cost.

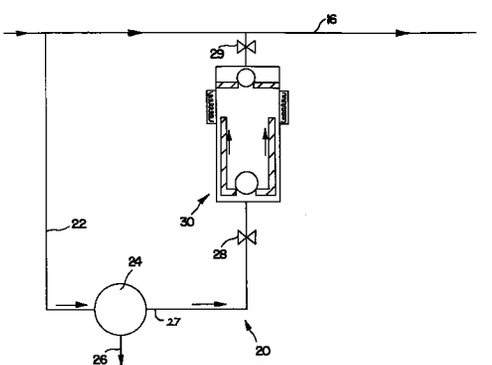

FIG. 2

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Description

Circulation systems for paints and other materials have been used for many years. Various one, two and three pipe systems have been utilised with each having its own benefits and problems. The simplest system is traditionally a one pipe system. However, such system generally has suffered from the fact that the so-called drops where spray guns or other dispensing stations are located do not have circulation down to the dispensing device with the result that the fluid within the drop tends to settle out and separate with the resultant quality problems when that fluid is later attempted to be dispensed.

One way of providing circulation in such a system is to provide a return line from the gun or other device. However such a system provides a substantial increase in plumbing (and cost) depending upon the size of the facility and the number of drops.

It is therefore an object of this invention to provide a one pipe circulation system which is capable of circulating down to the gun or other dispensing device without the necessity for a separate return line.

In the preferred embodiment, this function is accomplished by providing a small electromagnetically driven two-ball reciprocating pump. This pump is sealless and totally enclosed and thus is not capable of leaking upon seal failure. Such a pump is essentially a booster pump, that is, if the pressure in the circulation line is 200 psi, this pump boosts the pressure at the outlet of the drop loop by 30 psi or so and thus is capable of injecting paint back into the main circulating loop.

The device maintains flow in the station drop and has a timed electrical controller which actuates an electromagnetic coil which moves the magnetic shuttle valve and forces paint to circulate through the paint station piping. The ball checks ensure that paint is pumped only in the correct direction.

The shuttle pump in the preferred embodiment pumps in one direction and is electromagnetically returned in the other direction although gravity or springs may also be utilised for the return function. The flow rate may be controlled by a timed electrical controller. The advantages of such a system are reduced system installation costs, simplified system design and operation, reduced system flow rates and reduced paint degradation. Also provided are the advantages of reduced paint settling and paint dirt and simplified pipe cleaning.

In other variations, an air operated double diaphragm pump may be used as a station pump. A colour change valve such as that manufactured by Graco Inc., applicant of this application, may be used to control flow from the drop loop to the application device. Also, a single diaphragm pump forming two chambers may be operated by an external reciprocator such as an air motor manufactured by Graco Inc. Lastly, an embodiment may use a rotary air motor magnetically coupled (to remove the need for seals) to a gear pump.

These and other objects and advantages of the invention will appear more fully from the following description made in conjunction with the accompanying drawings wherein like reference characters refer to the same or similar parts throughout the several views.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying diagrammatic figures, in which:

Figure 1 is a schematic view of the device of the instant invention as fitted into a system.

Figure 2 is a schematic view of a more detailed showing of an individual drop.

Figure 3 is a cross-sectional view of the shuttle valve itself.

Figure 4 shows a colour change valve in the drop loop.

Figure 5 shows an alternate embodiment using an air operated double diaphragm pump.

Figure 6 shows a system schematic of the alternate embodiment of Figure 5 using an air operated double diaphragm pump.

Figure 7 shows an alternate embodiment using an air operated two chamber single diaphragm pump.

Figure 8 shows an alternate embodiment using an air operated rotary motor magnetically coupled to a gear pump.

The system of the instant invention, shown in Figure 1, is generally designated 10 and is comprised of a material tank 12 having connected thereto a pump 14 which circulates paint or other fluid through a main circulation pipe 16 which leads to a back pressure regulator 18 which is in turn connected back to tank 12. A plurality of drops 20 are provided along the main circulation loop.

Turning to Figure 2, each drop 20 has an inlet line 22 leading to a regulator 24 which is connected to a application device 26 such as a spray gun. The downstream side 27 of regulator 24 leads to a bail valve 28 and thence to shuttle valve 30 which is also connected on its downstream side via a bail valve 29 to the main circulation loop 16.

As shown in Figure 3, the shuttle valve or station pump 30 is provided with an inlet 32 thereof and an outlet 34 in a main housing 36. Shuttle 38 is formed of stainless steel (as are all wetted parts) and slides in a stainless steel inner sleeve 40. It has located at the outlet 34 thereof an outlet check 42 while adjacent inlet 32 is inlet check 44. Shuttle 38 has a pair of annular magnets 46 which are confined by an inner ring of carbon steel 48.

A plurality of electromagnets 50 are located in housing 36 and separated by carbon steel rings 52. As electromagnets 50 are successively energised, shuttle 38 reciprocates from one end to the other of housing 36. Electromagnets 50 are connected to control electronics 60 which are conventional in nature.

When the shuttle 30 in Figure 3 is to be operated,

the electromagnets 50 are energised and shuttle 38 moves downwardly thereby closing outlet check 42 and forcing the paint in outlet chamber 54 out of outlet 34 while at the same time pulling open inlet check 44 and allowing inlet chamber 56 to be filled. As the electromagnets 50 are energised in the other direction, shuttle 38 moves upwardly thereby closing inlet check 44 and allowing outlet check 42 to open thereby allowing the paint or other fluid to flow from inlet chamber 56 to outlet chamber 54 through interior passage 58.

Figure 4 shows a colour change valve 60 in the drop loop. Several of these may be added to provide colour change capability.

Figures 5 and 6 show an alternate embodiment using an air operated double diaphragm pump 102. This uses a conventional air operated double diaphragm pump which has the bail checks 104 removed from the side leading to the application device as shown. The air operated double diaphragm pump has first and second fluid chambers, said first chamber receiving flow from said circulation loop and outputting flow to said application device and said second chamber receiving flow from said application device and outputting flow to said circulation loop.

Figure 7 shows an alternate embodiment using an air operated two chamber single diaphragm pump 202. This is plumbed in the same way as the Figure 5 and 6 embodiment but uses a single diaphragm with an external air motor. This embodiment allows the pump to be pressure balanced as there is little pressure differential across the diaphragm.

Figure 8 shows an alternate embodiment using an air operated rotary motor magnetically coupled to a gear pump.

It is contemplated that various changes and modifications may be made to the circulation system without departing from the spirit and scope of the invention as defined by the following claims.

The aforegoing description has been given by way of example only and it will be appreciated by a person skilled in the art that modifications can be made without departing from the scope of the present invention.

Claims

1. A circulating system comprising a main circulation loop (16) and a plurality of drops (20) to application devices from said loop, and characterised by further comprising a station pump (30; 102; 202) attached to at least one of said drops adjacent one of said application devices, the outlet of said pump being connected to said main circulation loop.

2. The circulation system of claim 1, wherein the distance between said application device and said station pump is small compared to the distance between said application device and said main loop.

3. The circulation system of claim 1 or claim 2, wherein said station pump is operated on a periodic basis.

4. The circulation system of claim 1 or claim 2, wherein said station pump is operated on a non-continuous basis.

5. The circulation system of any preceding claim, wherein said station pump is an air operated double diaphragm pump (102).

6. The circulation system of claim 5, wherein said double diaphragm pump comprises first and second fluid chambers, said first chamber receiving flow from said circulation loop and outputting flow to said application device and said second chamber receiving flow from said application device and outputting flow to said circulation loop.

7. The circulation system of any one of claims 1 to 4, wherein said station pump is an electromagnetic shuttle pump (30).

8. The circulation system of any one of claims 1 to 4, wherein said station pump comprises a diaphragm forming first and second fluid chambers, said first chamber receiving flow from said circulation loop and outputting flow to said application device and said second chamber receiving flow from said application device and outputting flow to said circulation loop.

9. The circulation system of any preceding claim, wherein said station pump is operated on a non-continuous basis when said application device does not require fluid flow.

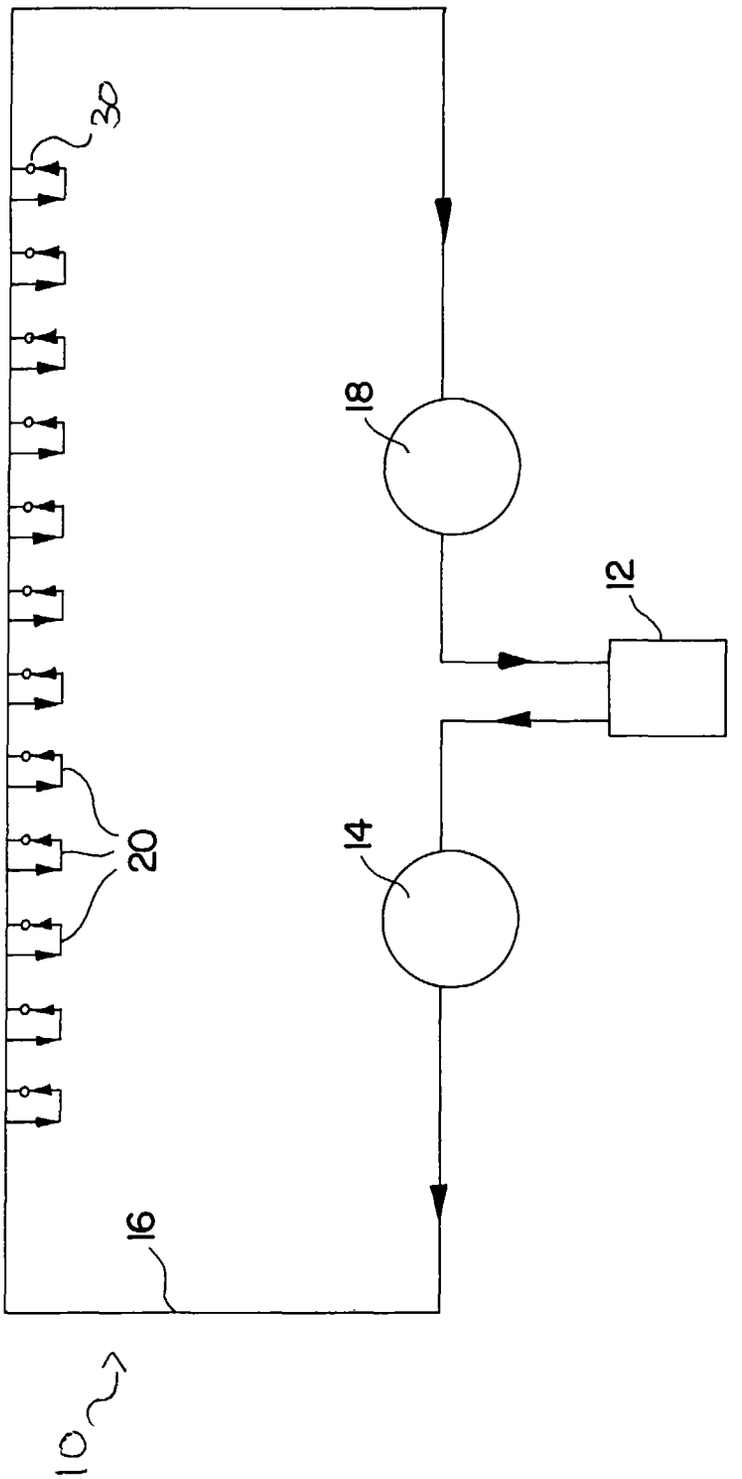

FIG. 1

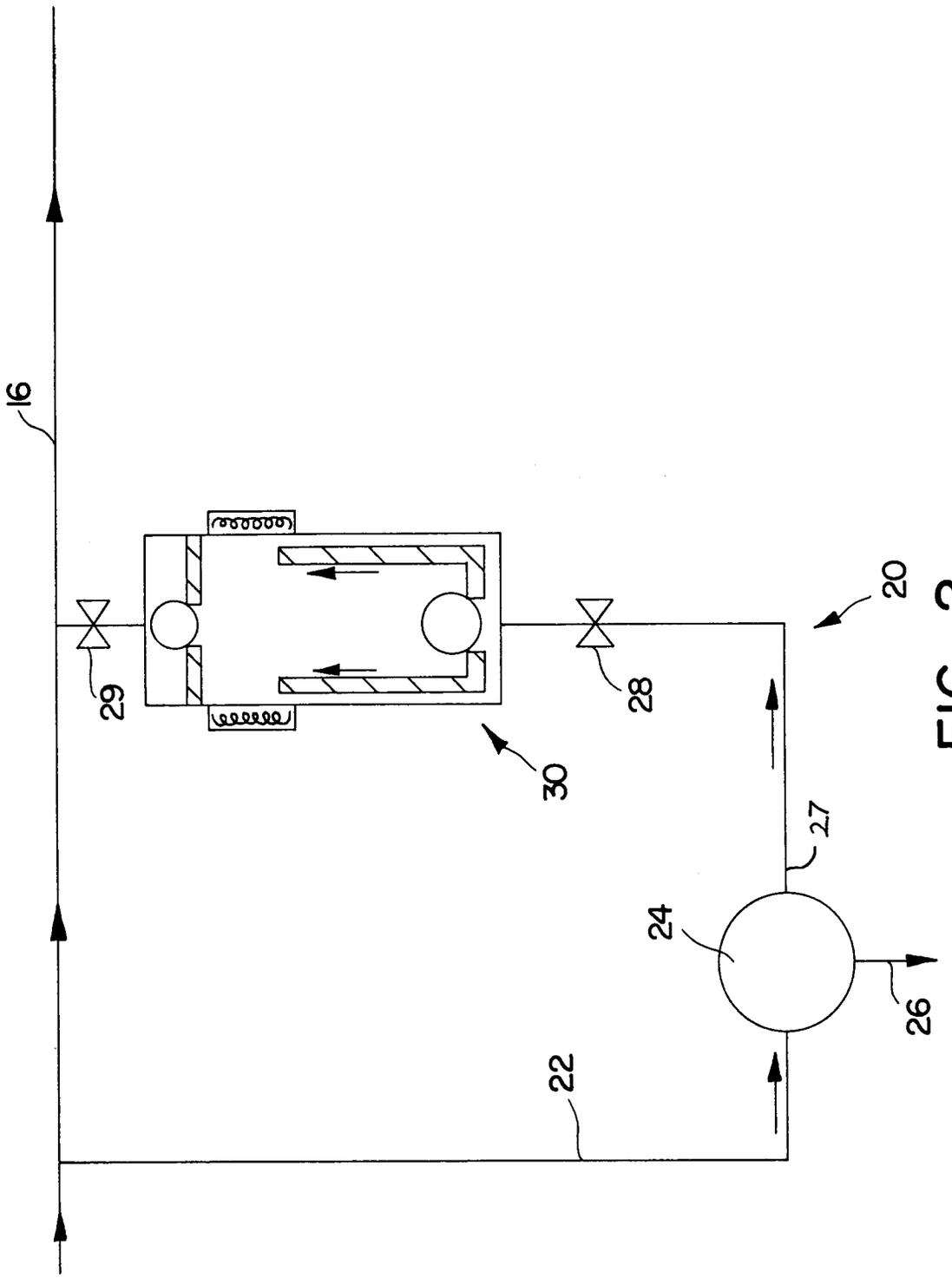

FIG. 2

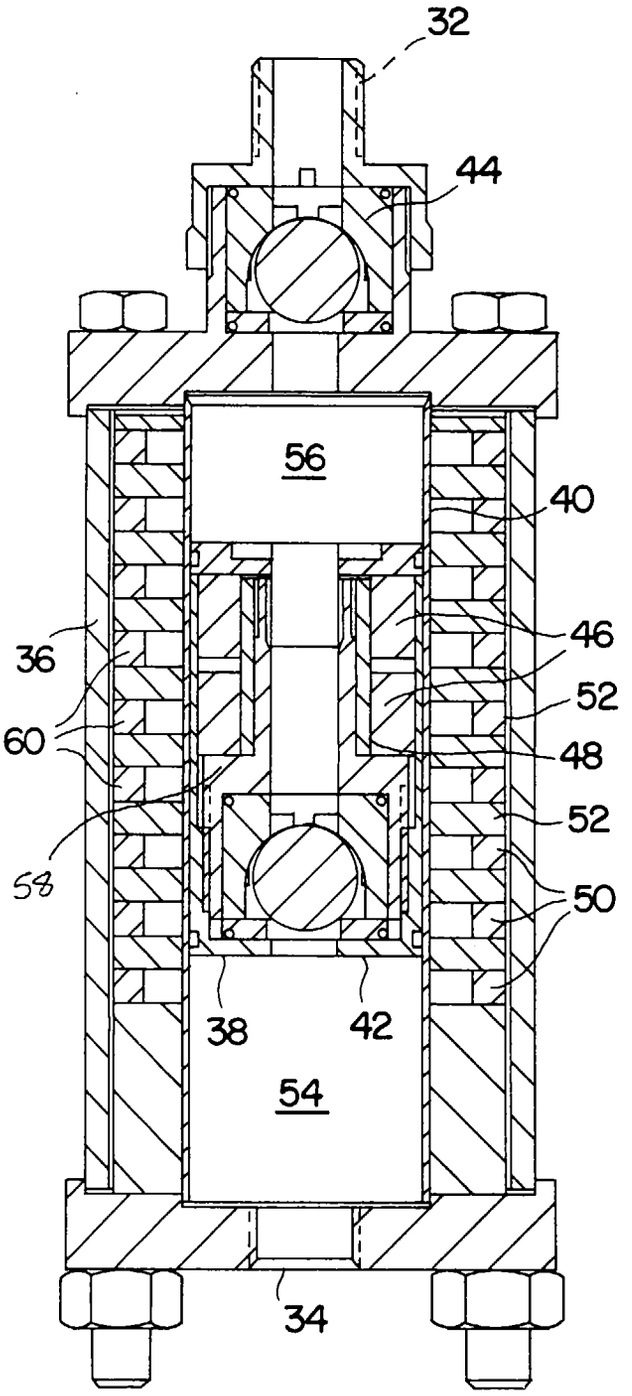

FIG. 3

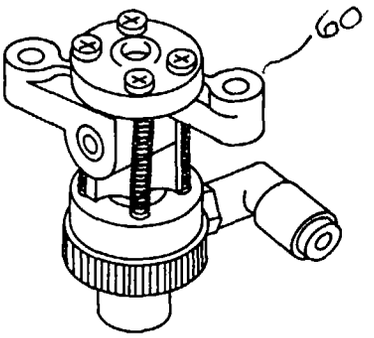

FIG. 4

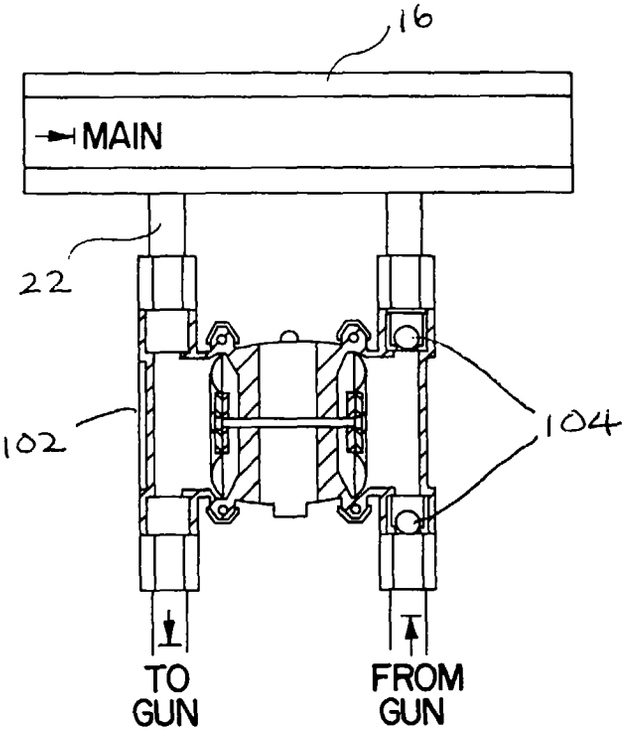

FIG. 5

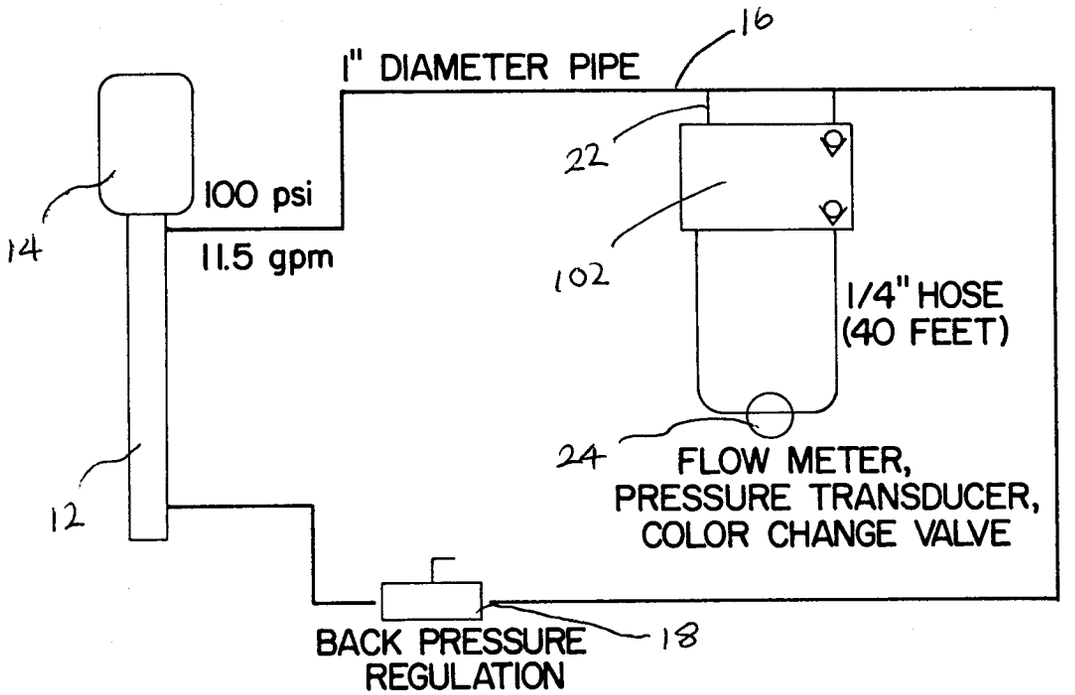
1" DIAMETER PIPE
16
22
100 psi
11.5 gpm
14
102
1/4" HOSE
(40 FEET)
24
FLOW METER,
PRESSURE TRANSDUCER,
COLOR CHANGE VALVE
12
BACK PRESSURE
REGULATION
18

FIG. 6

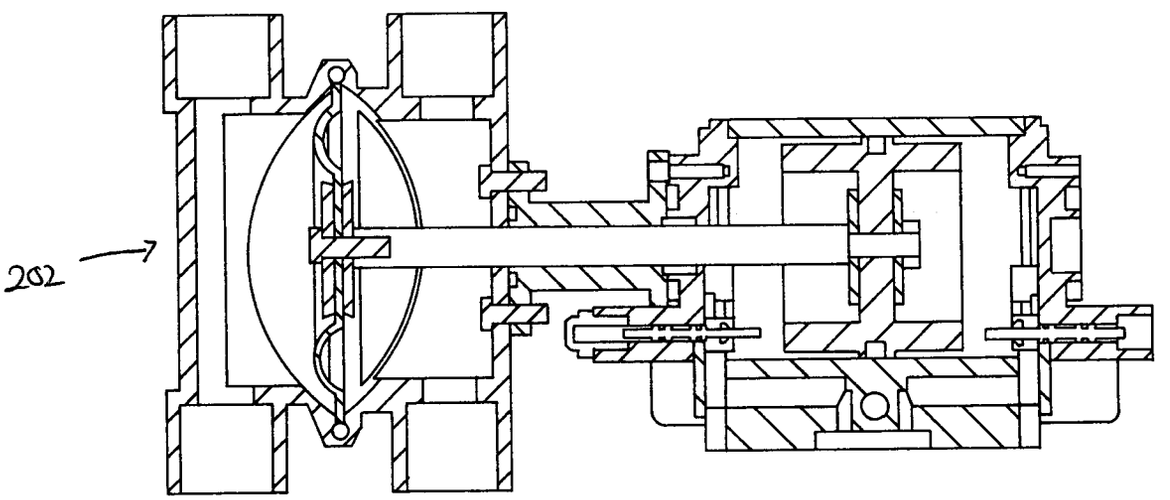
202

FIG. 7

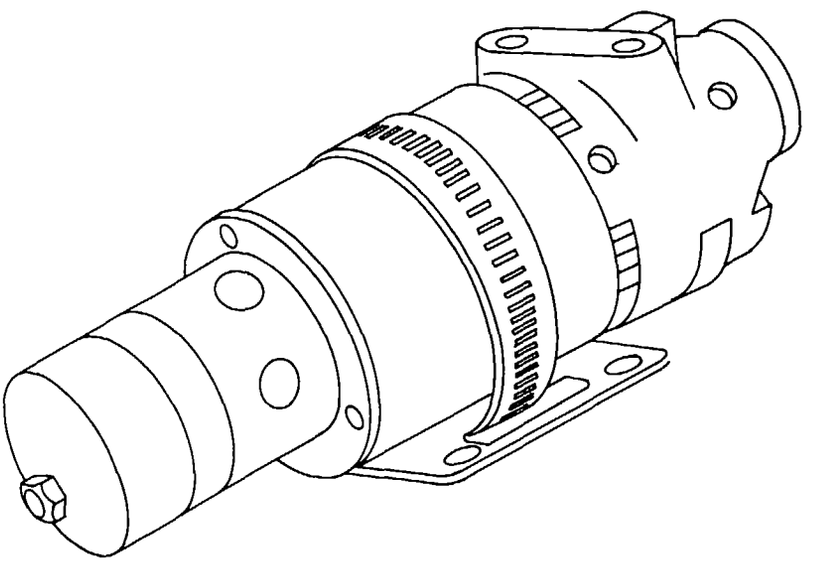

FIG. 8