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[54] GEAR PUMP CONSTRUCTION

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[52] **U.S. Cl.** **417/44,** 417/425, 417/420

[51] **Int. Cl.**.....**F04b 49/02**

[58] **Field of Search**.....417/2, 44, 425

[56] **References Cited**

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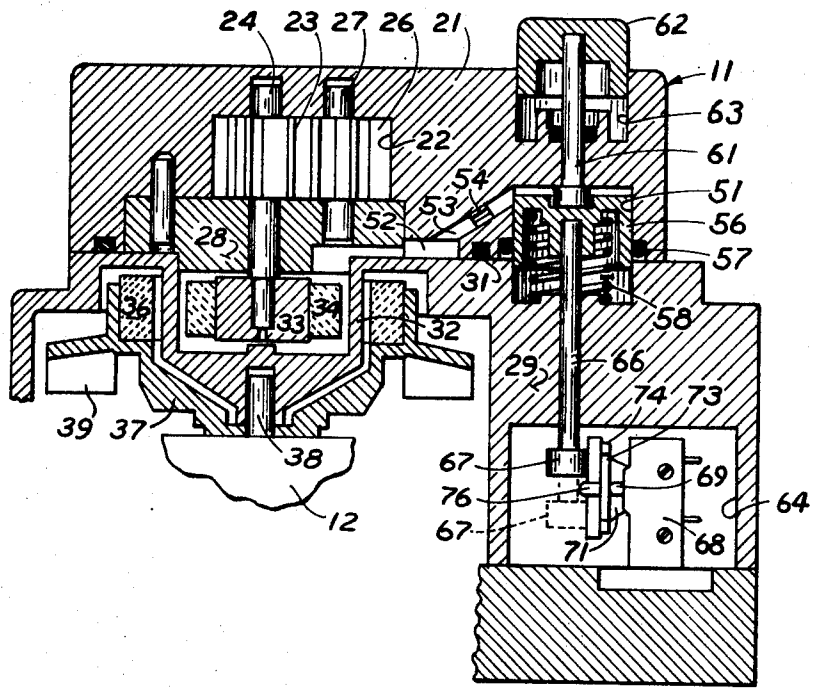
[57] **ABSTRACT**

A motor-driven gear pump used to pump fluid from a reservoir to a dispensing spigot has a cylinder connected to the pump discharge having a spring biased piston. The piston rod has a knob engaging a normally open microswitch controlling the motor. When the motor is running and the pump delivering through the spigot, the piston is in intermediate position and the knob maintains the switch closed. When the spigot is closed, back pressure builds up in the cylinder, forcing the piston to overcome the spring and the knob to move out of contact with the switch, stopping the motor. If the reservoir is empty, the cylinder empties and the spring moves the piston so that the knob moves out of contact with the switch, again stopping the motor as a safety precaution. Check valves are installed in the inlet line and discharge line of the pump. A manually actuated button moves the piston against the force of the spring and thus primes the pump and also closes the switch to start the motor.

5 Claims, 6 Drawing Figures



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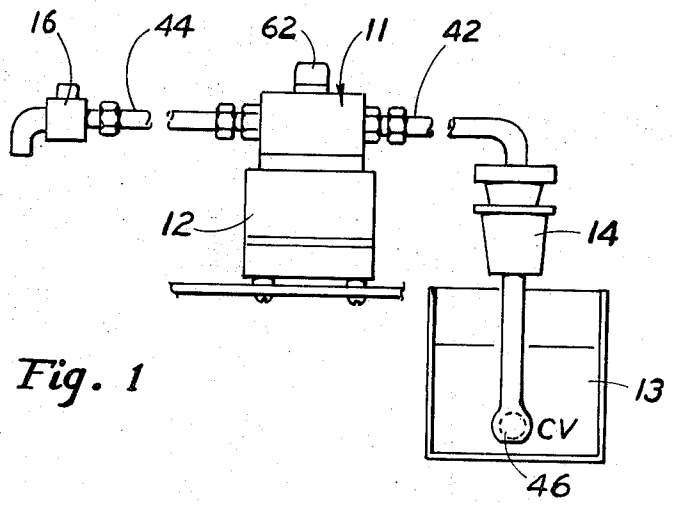

Fig. 1

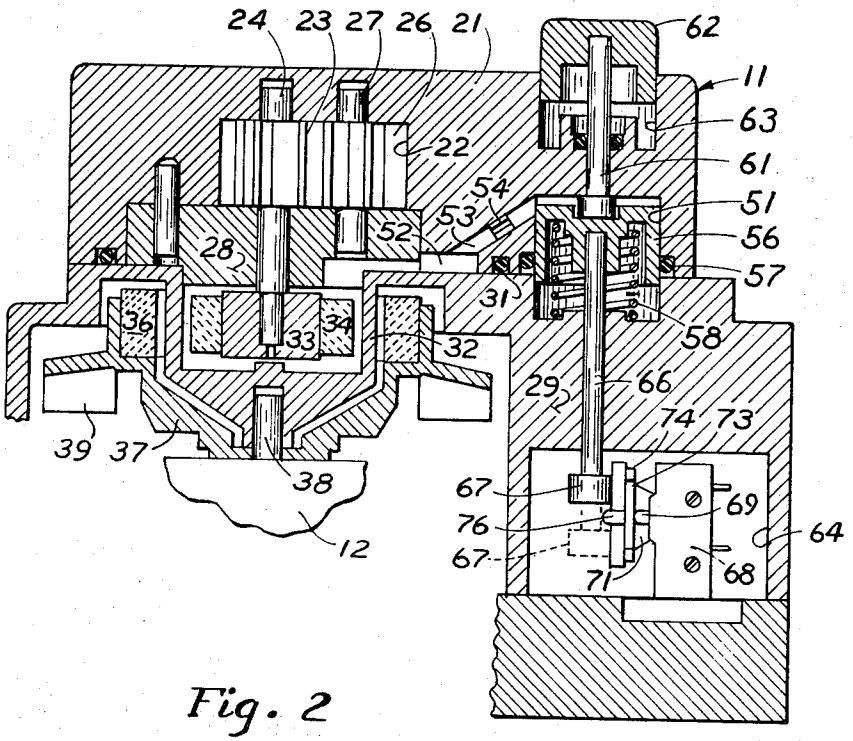

Fig. 2

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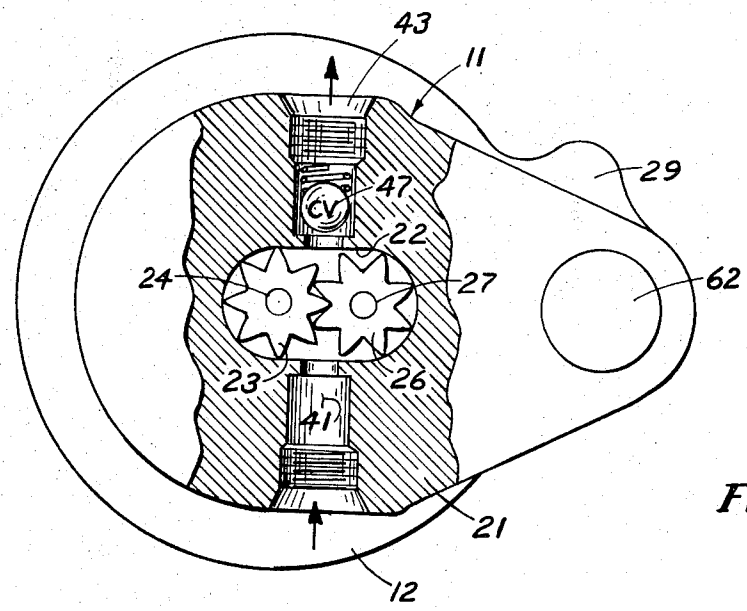
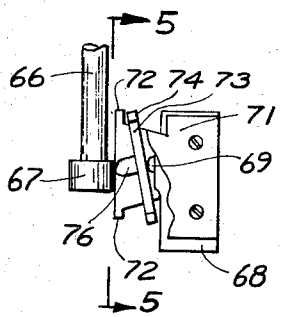


Fig. 3



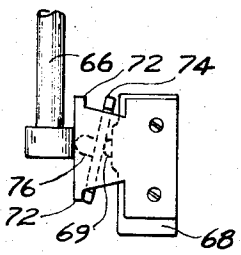


Fig. 4A

Fig. 4

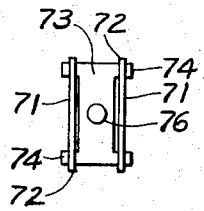


Fig. 5

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GEAR PUMP CONSTRUCTION

This invention relates to a new and improved gear pump construction having a motor switch which is dependent upon discharge pressure of the pump and which automatically shuts down the pump when such pressure exceeds a preselected maximum pressure or falls below a preselected minimum pressure.

In accordance with the present invention, the action of pressing the switch restart button when the pressure has fallen and the motor has stopped also functions to prime the pump. Accordingly, a principal feature of the invention is the fact that a single manual control is used both for the motor restarting and pump priming functions; and by repeated depressing of the control, fluid is drawn into the pump chamber to prime the pump; and once the pump is primed, the control is capable of remaining at an intermediate position which insures that the switch is closed to maintain the motor driving the pump.

It is a feature of the construction that there is a manually actuated control button so constructed that it moves a spring-biased piston from its up position (which it assumes when the pump has run dry) to an intermediate position where the spring is balanced by the discharge pressure of the pump and in such position moves a knob which controls the switch to closed position to maintain the motor operating so long as the piston is in the intermediate position. The same piston also is moved against the force of the spring by excessive discharge pressure in the pump to a third or full-down position which also stops the motor. Thus the same piston, working against the discharge pressure of the pump and biased by a spring of preselected strength, is used either to turn off the motor when the pressure falls below a preselected minimum (as when the pump runs dry) or exceeds a predetermined maximum (as when the valve in the discharge line is shut off).

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

FIG. 1 is a schematic view showing a typical installation for the present invention.

FIG. 2 is an enlarged, vertical sectional view to the pump and control mechanism.

FIG. 3 is a top plan of the structure of FIG. 2 partly broken away to reveal internal construction.

FIGS. 4 and 4*a* are enlarged, fragmentary details of the switch actuator in different positions.

FIG. 5 is a view taken substantially along the lines 5—5 of FIG. 4.

A typical installation of the present invention is shown in FIG. 1 wherein a pump 11 is driven by an electric motor 12 to draw liquid from a reservoir 13 through a filter 14 and to dispense the liquid through a valve 16 which may be a spigot. The discharge from the spigot 16 is variable, and when the spigot is closed, it is desirable to stop the motor 12. Further, it sometimes occurs that the reservoir 13 is exhausted and it is desired to stop the motor 12 until the condition has been rectified. The present invention incorporates automatic controls for stopping the motor 12 when the spigot 16 has been closed for a period of time more than instantaneous or when the reservoir 13 has been emptied. When the spigot 16 is opened, the control restarts the motor 12. When the reservoir 13 has been refilled, a single control button is used not only to restart the motor 12 manually but also to pump liquid from the reservoir to prime the pump, all as hereinafter appears.

Pump 11 may be constructed in various ways. In a preferred form, it is provided with an irregularly shaped housing 21 formed with a pump chamber 22 in which is a driver gear 23 here shown rotatable on a vertical shaft 24. Mating with gear 23 is driven gear 26 which is rotatable on a parallel shaft 27. A plate 28 is inserted in a bore in housing 21 and furnishes a bearing for shafts 24 and 27 and closes the pump chamber 22.

A secondary housing 29 encloses the plate 28 and the opening in the bottom of housing 21 and is sealed to the housing by means of a seal 31, such as an O-ring. Secondary housing 29 is formed with a cup-shaped portion 32 which is in line with shaft 24. The lower end of shaft 24 is fixed to a hub 33 on which is mounted annular ceramic magnet 34. Surrounding magnet 34 on the outside of cup 32 is ceramic annular driver magnet 36. The poles of magnets 34, 36 are inter-laced so that rotation of magnet 36, as hereinafter described, drives magnet 34 to turn gears 23 and 26 to actuate the pump.

Magnet 36 is mounted in annular flange 37, which is fixed for rotation with shaft 38 of electric motor 12. Shaft 38 is centered in cup member 32 but does not rotate therewith. To assist in cooling motor 12, fan blades 39 may be formed on a periphery of flange 37.

Directing attention to FIG. 3, housing 21 is formed with a horizontally directed, pipe-threaded inlet port 41 which is connected by conduit 42 through filter 14 to reservoir 13. Similarly, on the opposite side of chamber 22 and in line with port 41 is an outlet port 43 which is connected by conduit 44 to spigot 16 or other valve means. For the purpose of priming the pump, as hereinafter appears, an inlet check valve 46 is installed in the lower end of conduit 42 permitting flow only from the reservoir 13 to the pump 11 and a second check valve 47 is installed at port 43 permitting flow only out of the pump 11. The structure of the check valves 46 and 47 is subject to considerable variation but a preferred form is the "duckbill" type, although a spring biased ball check valve will suffice.

Formed in the abutting ends of housing 21 and secondary housing 29 is a cylinder 51 which has a vertical axis. Duct 53 extends from the upper end of cylinder 51 to a cavity 52 which is in fluid communication with the discharge port 43 through the pump mechanism. Preferably a restricted orifice 54 is installed in duct 53.

Reciprocating in cylinder 51 is a piston 56 which is sealed within the cylinder 51 by means of a sealing ring 57. Spring 58 biases piston 56 to the up position of FIG. 2; and as shown in FIG. 2, the piston is in full-up position.

In line with the axis of cylinder 51 and extending out through the top of housing 21 is a vertically reciprocating rod 61 which has an actuating button 62 at the top, said button 62 preferably extending above the top surface of the housing 21. Button 62 slides in a counterbore 63 in the top of housing 21. The depth of counterbore 63 is such as to limit the downward movement of

button 62 and rod 61 so that the lower end of the rod 61 pushes the piston 56 downward against the force of spring 58 to mid-position in cylinder 51 rather than to full-down position. Rod 61 is not fixed to piston 56 but pushes down upon it when it is in fullup position.

Also in line with the axis of cylinder 51 and extending down through secondary housing 29 into a switch cavity 64, is a bottom rod 66 which is fixed to piston 56. On the lower end of rod 66 is a knob 67 which controls a micro-switch 68 located in cavity 64. Switch 68 has a switch button 69 which, when depressed, closes the normally open switch 68. To facilitate actuation of the device and as is best shown in FIGS. 4, 4A and 5 the micro-switch is modified. For this purpose, side brackets 71 are screwed to the switch body, extending inwardly toward rod 66 adjacent the path of travel of knob 67. The bracket 71 have vertically outward extending ears 72 at top and bottom. Captured in the space between ears 72 and button 69 is a switch actuator plate 73 which has laterally-outwardly extending ears 74 at each of its four corners which are behind ears 72. Thus the actuator plate 73 may rock from the downward-rightward tilted position of FIG. 4A or to an intermediate position. The plate 73 has a button 76 projecting to the left as viewed in FIG. 4 which supplements button 69. When the rod 66 is in mid-position, as shown in FIG. 4, the knob 67 contacts the button 76 pushing the plate 73 inwardly in a slanted direction to push the button 69 inwardly and to close switch 68. On the other hand, when the knob 67 is in the position of FIG. 4A and the plate 73 is oppositely tilted, the button 69 is also pushed inward to close switch 68. However, when the rod 66 is either in up or down position as controlled by piston 56, then the knob 67 is out of contact with button 76 and the spring (not shown) which is installed as initial equipment in the switch 68 pushes the button 69 and the actuator plate 73 to the left and opens the switch and stops motor 12.

In the operation of the device, assuming that the pump 11 is operating in normal fashion and that reservoir 13 is full, when the spigot 16 is opened, the drop in pressure at outlet port 43 is communicated through duct 53 to the top of cylinder 51, causing the piston 56 (which, as hereinafter explained, would have been in full-down position before the spigot 16 was opened) to rise to intermediate position under the influence of spring 58. Thus the knob 67 rises from its full down position shown in dotted lines in FIG. 2 to an intermediate position intermediate the dotted line position and the full-line position of FIG. 2. Such position is illustrated either in FIG. 4 or FIG. 4A. In such position the button 69 is depressed, closing switch 68, actuating motor 12 and turning gears 23, 26 to draw liquid from the reservoir 13 out through the spigot 16.

When the spigot 16 is closed, the parts return to initial position. Thus as the pump 11 continues to turn for a short time pressure is built up at discharge port 43 and communicated through duct 53 to the top of cylinder 51. This build-up of pressure depresses spring 58 and drive piston 56 and accordingly knob 67 to the down position shown in dotted lines in FIG. 2. When this position is achieved, the spring in switch 68 forces the knob 69 and plate 73 to the left and opens the switch and stops motor 12. The motor remains stopped until there is a change in the demand at the spigot 16, whereupon the operation of the preceding paragraph is repeated.

Assuming, however, that an abnormal condition prevails, namely, that the reservoir 13 has been emptied or line 42 ruptured, then it is desirable to shut down the system until the condition has been rectified. Although in normal operation, the piston 56 does not rise above its mid-position (i.e. the pressure in duct 53 always at least balances the force of spring 58), when there is no liquid being drawn through the pump, the pressure in outlet port 43 and accordingly in duct 53 drop and the spring 58 pushes the piston 56 to full-up position shown in FIG. 2. This raises the knob 66 above the level of the button 76 and this again opens the switch 68 and stops the motor 12. The motor remains stopped until the condition has been rectified.

Assuming that after the reservoir 13 has been emptied a new supply of liquid has been installed or other condition has been repaired, it is then necessary to start the pump and also to prime it. Depressing button 62 performs both these functions. In the priming function, depressing button 62 pushes rod 61 downward and this in turn contacts piston 56 and moves it down against the force of spring 58. The downward movement of piston 56 draws air into cylinder 51 through duct 53. Such air can only be drawn from conduit 42 because of the directions of check valves 46 and 47. Upon release of button 62, spring 58 restores piston 56 to full-up position and expels air from the cylinder 51 through ducts 53. Such dispelled air can only be discharged through conduit 44 (assuming that the spigot 16 is held open) because of the said check valves 46, 47. Repeated depressing of the button 62 continues to reciprocate the piston 56 and eventually draws liquid up from reservoir 13 and out the spigot 16. If the spigot 16 is then closed and the button 62 released, there will be pressure in conduit 44 and thus in cylinder 51 which will balance the force of spring 58 and maintain the piston 56 in its intermediate position. In other words, the knob 67 closes switch 68. Thus the motor will continue to run and pressure will build up in the system. If the spigot 16 is then opened, the motor 12 will continue to drive the pump. On the other hand, if the spigot 16 is closed for an appreciable period of time, the build-up of pressure at the outlet port 43 will cause the piston 56 to be depressed so that the knob 67 is in dotted line position when the switch 68 will open and stop the motor 12. However, the pump remains primed and is ready for use as soon as the spigot 16 is opened.

As hereinabove appears, the button 62 performs two functions. By depressing the button and then releasing it repeatedly, the piston 56 draws liquid up from the reservoir 13 to prime pump 11. By depressing the button, the switch 68 is closed and the motor 12 is restarted.

What is claimed is:

1. A pump comprising a housing having a pump chamber, an inlet and an outlet port for said pump chamber, an impeller in said pump chamber for pumping fluid from said inlet port through said pump chamber and out said outlet port at a higher pressure than at said inlet port, an inlet conduit connected to said inlet port, a first check valve in said inlet conduit, means establishing a source of supply of fluid for said pump connected to said inlet conduit, an outlet valve,

an outlet conduit from said outlet port to said outlet valve, a second check valve in said outlet conduit, said housing also formed with a second chamber having at least one duct in one end of said second chamber, in fluid communication with said discharge port, a piston reciprocable in said second chamber, resilient means biasing said piston toward said one end against the pressure in said discharge port, manually operable means for moving said piston toward a second end opposite said one end to pump fluid from said source into said pump chamber to prime said pump chamber, a motor and drive means between said motor and said impeller, said piston having a rod extending externally of said housing and having a cam, a switch controlled by said cam controlling said motor, said cam operable to actuate said switch to stop said motor when the pressure in said discharge port overcomes the force of said resilient means and moves said piston to said second end.

2. A pump according to claim 1 in which pressure in said discharge port balances said resilient means to hold said piston in an intermediate position between said one and said second ends, said piston being moved by said resilient means to said one end when said source is dry, said cam operable to actuate said switch to stop said motor when said source is dry.

3. A pump according to claim 2 in which said manually operable means simultaneously moves said piston from said one end to said intermediate position to prime said pump and moves said cam to actuate said switch to start said motor.

4. A pump according to claim 3 in which said first-mentioned rod is fixed to said piston and extends out through said second end of said second cylinder and in which said manually operable means comprises a second rod extending from the exterior of said housing through said one end of said cylinder to contact said piston, reciprocation of said second rod moving said piston from said one end to said intermediate position.

5. A pump according to claim 1 in which said drive means includes a pair of magnets.

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