Sept. 30, 1969 R. D. EAST 3,469,528

SELF-PRIMING IMPELLER PUMP WITH FLOW DEMAND CONTROL AND SELECTIVE PRIMER AND RUNNING CIRCUITS

Filed May 20, 1968 3 Sheets-Sheet 1

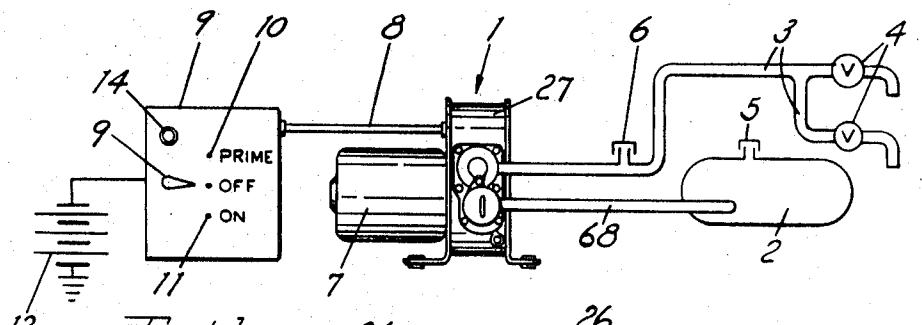


Fig. 1

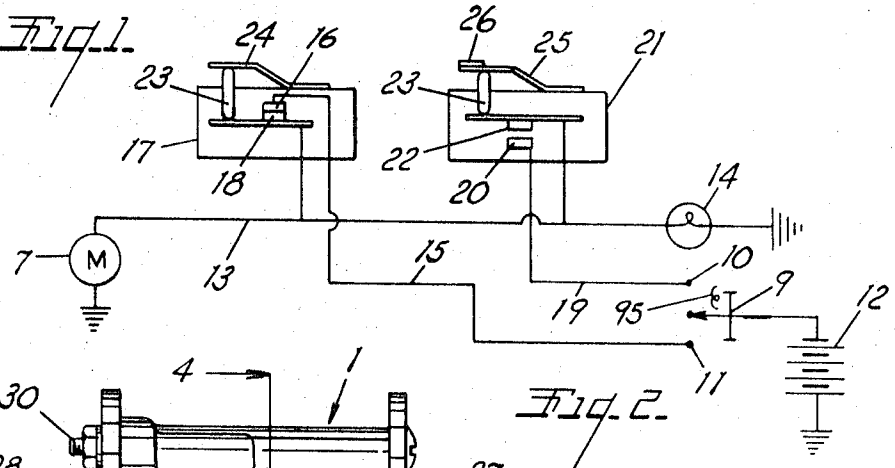


Fig. 2

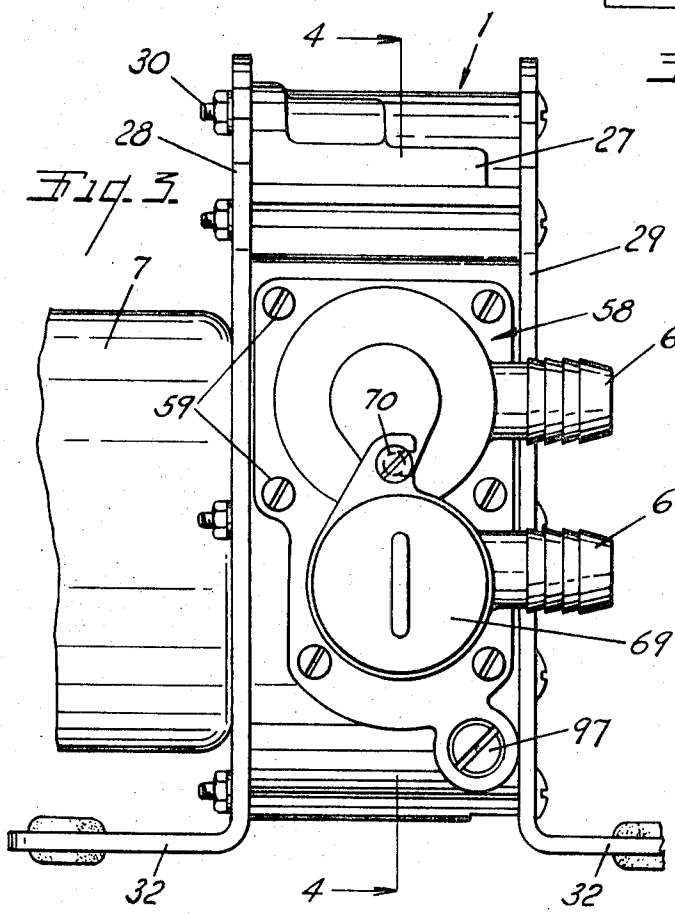


Fig. 3

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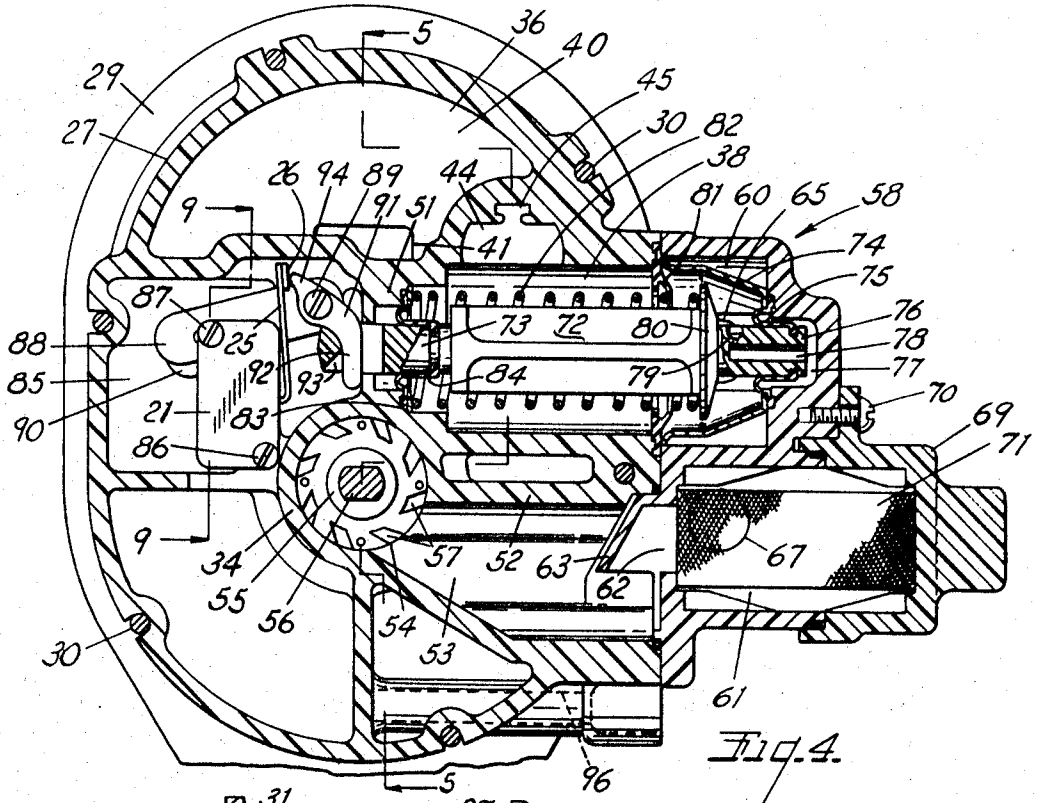


Fig. 4.

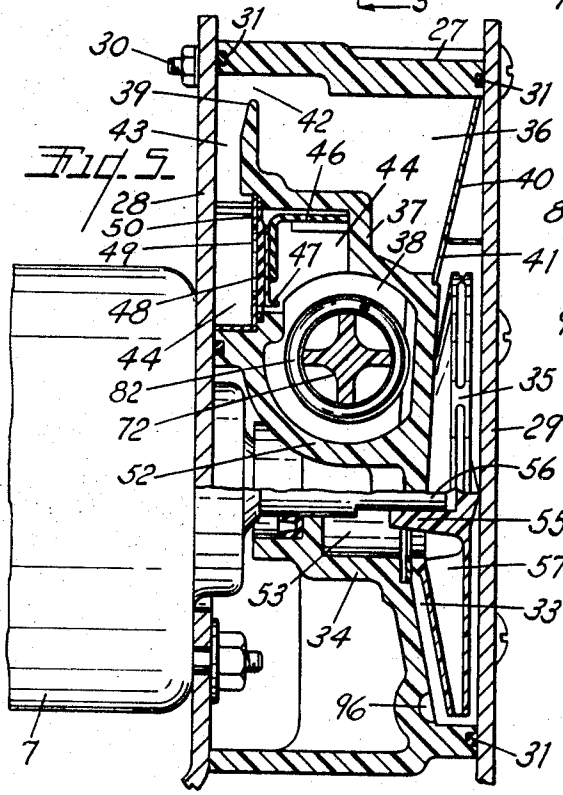


Fig. 5.

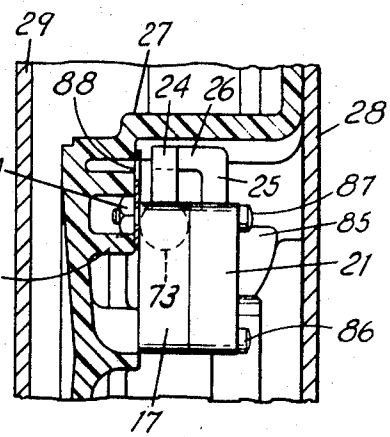


Fig. 3.

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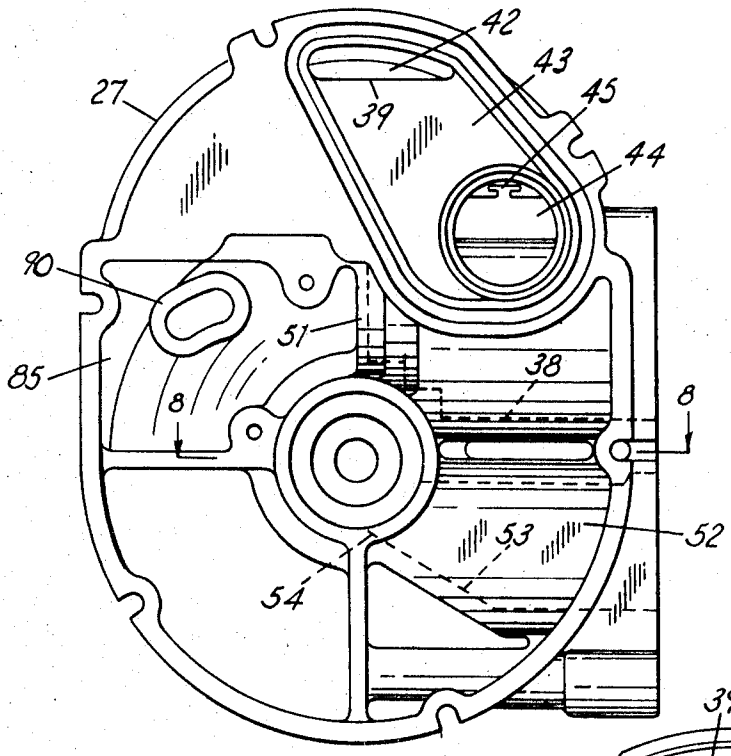


Fig. 6.

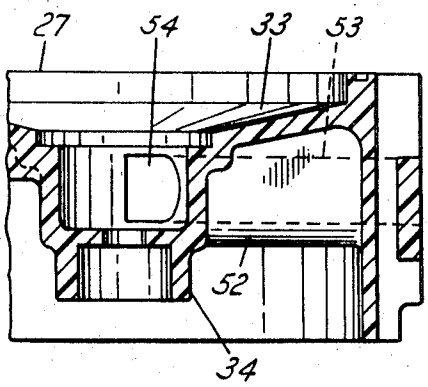


Fig. 8.

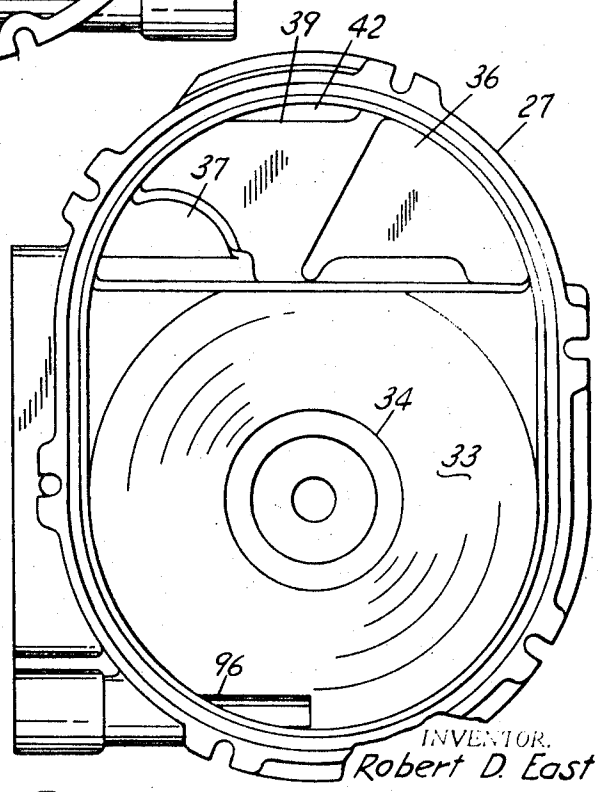


Fig. 7.

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United States Patent Office 3,469,528
Patented Sept. 30, 1969

3,469,528

SELF-PRIMING IMPELLER PUMP WITH FLOW DEMAND CONTROL AND SELECTIVE PRIMER AND RUNNING CIRCUITS

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Filed May 20, 1968, Ser. No. 730,262
Int. Cl. F04b 49/06; F04d 9/02; H01h 35/40
U.S. Cl. 103—25
13 Claims

ABSTRACT OF THE DISCLOSURE

Impeller delivers through raised chamber to check valve so chamber provides priming liquid when valve closes. Flow chamber on downstream side of check valve has control member subject to force differential between pump delivery and back pressure of system. Control member is connected to stop pump in two opposite extreme positions, and start pump in intermediate position when back pressure in system falls. Spring biases control member to one extreme off position on failure of liquid supply to create force differential. Control member actuates two switches connected through two selective circuits to automatically stop pump after priming.

Related patents

This invention is an improvement over the pump and control shown in Patent No. 3,376,821 to applicant Robert D. East.

Outline of invention

With the pump and control of the above patent, it was possible to wastefully empty the liquid supply tank and leave the pump running if the manual control switch was accidentally left in prime position. The present system automatically shuts off the system when the pump is primed and delivery flow is established in the system.

The pump of this invention provides an integral internal housing for the flow control switches, provides a motion dampening cushion for the flow actuated control member, and provides a one piece molded pump body with metal end plates that act as mounts for the pump and the pump motor.

FIGURE 1 is a schematic view conventionally illustrating the water distribution and pump control system of the invention.

FIGURE 2 is a schematic wiring diagram of the pump control.

FIGURE 3 is an edge or front elevational view of the pump with a portion of the driving motor attached thereto.

FIGURE 4 is a fragmentary vertical cross sectional view taken along the plane of the line 4—4 in FIGURE 3.

FIGURE 5 is a cross sectional view taken axially through the pump along the plane of the broken line 5—5 in FIGURE 4.

FIGURE 6 is a rear side elevational view of the body taken from the motor side of the pump.

FIGURE 7 is a fragmentary front side elevational view of the body of the pump taken from the impeller side thereof.

FIGURE 8 is a fragmentary cross sectional view taken horizontally through the pump axis along the plane of the line 8—8 in FIGURE 6.

FIGURE 9 is a fragmentary cross sectional view taken along the plane of broken line 9—9 in FIGURE 4 and appearing on the same sheet as FIGURE 4.

The pump and control of the invention is designed for use in the water system of mobile vehicles such as trailers and pleasure boats.

FIGURE 1 conventionally illustrates the system in which a pump generally indicated at 1 is connected to draw water from a supply tank 2 and deliver it through the distribution pipes 3 to outlet faucets or valves 4. The supply tank 2 is provided with a filler opening 5. A closable connection 6 through the supply pipe is provided for connecting an external source of water pressure to the distribution system. A check valve to be described presently is incorporated in the pump to prevent external water pressure from backing up through the pump. The pump is driven by a motor 7 and is energized through the electrical cable 8 from a manually operable switch 9. The switch 9 has an "off" position illustrated and selectively opposite positions 10 used to prime the pump and an "on" or operating position 11 in which the motor 7 is energized from a battery 12 through the cable and automatically actuated switches positioned in the pump to activate the motor upon demand for liquid as will be described.

As is more particularly illustrated in FIGURE 2 the electrical system of the pump and motor includes an energizing conductor 13 which connects the motor 7 and a pilot or indicator light 14. The motor and the light have ground returns to the battery which is also grounded on one side. The "on" terminal 11 connects through a conductor 15 to one terminal 16 of a normally closed switch 17. The other terminal 18 of the switch is connected to the energizing conductor 13. The pump priming terminal 10 is connected by the conductor 19 to one terminal 20 of a normally open switch 21 and the other terminal 22 of the switch is also connected to the energizing conductor 13. Both switches 17 and 21 have actuating plungers or pins 23 arranged to shift the switches from their normal positions illustrated. Switch 17 is provided with a flexible spring 24 overlapping its pin 23 and arranged to open the terminals 16 and 18 when the spring is depressed. Switch 21 has a leaf spring 25 overlying its plunger 23 and similarly arranged to close the terminals 20 and 22 when the spring is depressed. Spring 25 carries a laterally projecting arm 26 which overlies the spring 24 in the installation of the switches in the pump housing.

The pump 1 has an integrally molded main body 27 with recesses and cavities on each side. Mounting end plates 28 and 29 are clamped to the opposite sides of the body by tie bolts 30. Seal rings 31 seal the periphery of the body to the end plates. Mounting flanges 32 on the bottoms of the end plates serve to secure both the motor and the pump in place.

The outer or front side of the body shown in FIGURE 7, and at the right side of FIGURE 5 defines a concave impeller recess 33 centered about an inlet housing 34 that surrounds the motor shaft. The recess 33 is located below the center of the oval shaped body so that the centrifugal impeller 35 positioned in the recess discharges upwardly into a discharge chamber 36 in the top of the body. The lower wall 37 of the discharge chamber 36 is stepped upwardly, as appears most clearly in FIGURE 5 over an outlet or flow control passage 38 to a raised lip or dam 39. A segmental arcuate insert 40 clamped between the face of the body and the end plate 29 completes the periphery of the impeller chamber 33 to an outlet throat 41. The lip 39 is spaced downwardly from the top of the body to form an outlet 42, and is further spaced inwardly from the rear end plate 28 to define a downwardly directed passage 43 opening to the rear of a check valve chamber 44 that extends forwardly, or to the right in FIGURE 5, under the stepped wall 37.

The top of the check valve passage defines a key shaped slot 45 which supports one end of a flexible strap 46. The other end of the strap hangs down and bears against the right or down stream side of a flat check valve backing

plate 47. The plate 47 is connected to and backs a flexible flapper 48 of a check valve. The valve closes over an opening 49 in the plate 50. The plate 50 has rearwardly turned flanges on the bottom and sides that are engaged by the rear face plate 28 to hold the plate 50 against an annular seal formed integrally with the check valve and seated in the recessed rear face of the body at the bottom of the passage 43. The discharge chamber 36, up to the level of the lip 39 forms a priming chamber from which water trapped by the check valve, drains back down into the impeller chamber 33.

Offset axially inwardly or to the left in FIGURE 5 from the impeller chamber 33, the central portion of the body defines the generally cylindrical transverse control chamber 38. The chamber 38 opens to the lower side of the inner end of the check valve passage 44, and is closed at its inner end by a vertical wall 51 extending axially of the body above the inlet housing 34. A radially extending and axially curved wall 52 separates the control passage or chamber 38 from a pump inlet chamber 53 that opens radially through the inlet housing 34 to the center of the impeller at 54. The impeller has a hub 55 mounted on the motor shaft 56 in the housing 34. Radial vanes 57 on the impeller pick up liquid from the inlet housing 34 at the back side and center of the impeller. Both the control chamber 38 and the inlet chamber 53 open to the front edge of the main body.

A removable end cap indicated generally at 58 is secured to the front edge of the body as by screws 59. The upper end of the cap defines an inwardly opening recess 60 that registers with and closes the end of control chamber 38. The lower portion of the end cap defines a cylindrical filter chamber 61 with an inwardly opening passage 62 at its inner end. A deflecting shield 63 positioned over the opening 62 directs liquid down into the inlet chamber 53. The shield projects into the inlet chamber to keep air from the tank from entering the pump when it is idle. The cap 58 closes the remainder of the outer end of the inlet chamber. A delivery tube 64 projects axially forwardly from the upper portion of the cap 58 and opens through the wall thereof to recess 60 at 65 (see FIGURE 4). The tube 64 is adapted to be connected to the delivery pipe 3. An intake tube 66 projects forwardly from the side of the cap 58 and communicates through the wall thereof with the side of the filter chamber 61 at 67. The tube 66 is adapted to be connected to a supply pipe 68 which draws water from the tank 2. A chambered cover 69 is removably secured over the outer end of the filter chamber 61 by a twist lock flange and screw 70 to permit a suitable cylindrical filter screen 71 to be clamped in the chamber 61 with its ends closed against coacting seats at the inner end of the chamber and on the inside of the cover.

Positioned within the control chamber 38 is a spool like control member 72 having a stem 73 on its inner end projecting slidably through a supporting bearing opening in the wall 51. An outer support in the form of a cup shaped spider 74 is secured over the outer end of chamber 38 by the end cap 58. The spider supports one end of a U-fold annular bellows 75 of flexible material and seals the bellows to the inside of cap 58, while the other end of the bellows is secured in an O-ring groove in an outer stem 76 on the control member. The cap 58 defines a small cushion chamber 77 that surrounds the end of the stem 76. The outer stem 76 is axially bored as at 78 to open into the cushion chamber, while a small radial bleed port 79 opens from the bore to within the bellows 75 and the outlet or delivery chamber.

Toward its outer end, the control member 72 has a circular valve-like head 80. The head coacts with an annular seat 81 of flexible material that is clamped around the outer end of the control chamber 38 by the end cap 58. A coil spring 82 surrounding the control spool bears between the inside of the head 80 and a stepped shoulder 83 at the inner end of the control chamber. The spring 82 biases the control member 72 outwardly of the control chamber. The inner end of the spring also seals the periphery of a second reverse fold sealing bellows 84 to the body. The inner edge of bellows 84 is received in an O-ring groove in the inner stem 73 to prevent water from leaking out around the stem.

The inner end of the stem 73 projects into a switch chamber 85 formed in the rear end and rear side of the main body. The wall which separates the impeller chamber from the switch chamber receives a pivot screw 86 which clamps both switches 17 and 21 in the switch chamber. Another screw 87 is engageable in adjusted positions in a slot in a plate 88. The plate is anchored by a screw 89 and is backed by an arcuate boss 90 and permits adjustment of the positions of the switches. The boss 90 holds the nut 87A while the switches are adjusted. The leaf spring actuator 25 of switch 21 has the transversely extending arm 26 secured to its outer end which extends in lapped relation across the spring arm 24 of switch 17. Pivotally supported on the screw 89 is a lever 91. One arm 92 of the lever extends through a slot 93 in the arm 73. The other arm 94 is positioned to engage the cross arm 26 between the switches and actuate both switches when the control member is moved outwardly of the control chamber or to the right in FIGURE 4. When the control member moves inwardly to the left, the end of stem 73 actuates the leaf spring 24 of switch 17, without actuating switch 21.

The action of the system is as follows: With tank 2 full and the connection 6 to exterior water pressure closed, and assuming a back pressure equal to the output pressure of the pump in delivery pipe 3, and switch 9 closed on the "On" terminal 11; the back pressure acting on the outer face of head 80, plus the same pressure built up in cushion chamber 77, will move the control member 72 inwardly until the head closes on the lip of the flexible seat or gasket 81, and inner stem 73 actuates the spring lever 24 of switch 17. In this condition of the system, back pressure will have closed the check valve 48. The force differential on the control member partially overcomes spring 82. The electrical circuit to the motor will be open at the terminals 16–18 of actuated switch 17, so the pump will not operate. A small supply of water for priming the pump will be trapped in chamber 36, as well as in the lower part of impeller chamber 33.

If now one of the valves or faucets 4 is opened indicating a demand, the back pressure on the outer side of head 80 drops sharply, and the force of spring 82 on the head moves the control member to the right. The water collected in the cushion chamber 77 acts to slow or limit the outward movement of the control member because the back pressure built up in the cushion chamber does not escape immediately through the bleed port 79. Also, outward movement of the stem tends to maintain the pressure in the cushion chamber, so that the control member does not move to its opposite extreme. As soon as the inner stem 73 of the control member moves away from spring leaf 24, switch 17 is deactuated and moves to its normally closed condition. This starts the motor 7, and the impeller of the pump immediately starts to deliver water in response to the demand.

While the pump is operating and water is being delivered, the flow is through the control chamber 38 and the annular opening between the lip 81 and the head 80. The full delivery pressure of the system exists in the chamber 60, and also builds up through the bleed passage 79 into the cushion chamber 77. In this condition, the forces on the outer or right end of the control member 72 are greater than the force acting on the inner side of the head. The force differential slightly compresses the spring 82 and holds the control member in an intermediate position in which neither switch 17 nor 21 is actuated.

When the facuet or valve 4 is closed, a back pressure slightly greater than delivery pressure immediately builds

up in chamber 60 and the force differential moves the control member inwardly to open switch 17 and stop the pump. The back pressure also acts through the flow control chamber 38 and check valve chamber 44 to close the check valve 48. The system is thus in condition to again start the pump in response to a second demand. The cushion chamber 77 also acts to slow or cushion the shut-off action of the pump, as the increased back pressure is not communicated immediately through the bleed port 79, and inward motion of the stem tends to reduce pressure in chamber 77.

Should the pump fail to deliver, as will happen when the tank 2 runs dry, or if there is some malfunction of the impeller, there will be no delivery pressure or back pressure in the delivery pipe 3 or outlet chamber 60. As a result, there is no force differential on the head 80 of the control member, so the spring 82 forces the control member to its extreme outer position. This causes the inner edge of the slot 93 to engage the arm 92 of lever 91. The lever pivots on screw 89 so that the nose or end 94 depresses the cross arm 26 which in turn depresses both leaf springs 24 and 25. Contacts 16 and 18 open so the motor does not continue to run, with a dry tank, or a faulty impeller. Actuating of switch 21 closes the contacts 20 and 22, but before the pump may be restarted, the manual switch 9 must be moved intentionally to "prime" position 10. Desirably a spring 95 opposes this motion, so the system cannot be left accidentally in the prime position.

In repriming or manually restarting the pump, after correcting the fault such as by refilling the tank, it is desirable to open one of the valves or faucets 4, to permit trapped air to escape. At this time, manual closing of switch 9 on the "prime" terminal 10 completes an energizing circuit through contacts 20–22 to the motor and pilot lamp 14. The pump commenses to operate, and primes itself with the water which drained back into the impeller chamber 33 from the chamber 36 above the impeller. Once the output of the pump has refilled the pipes, the delivery pressure acting in chamber 60 reestablishes the normal force differential on the control member which causes it to move inwardly against spring 82 to its intermediate position. This permits contacts 20–22 to open, so the motor will stop and lamp 14 will go out. As long as the valve is open and prime switch 10 is closed, the pump and lamp will cycle off and on as a signal that the valve may be closed and the switch 10 released from "prime" position. Switch 10 may then be left in either "off" or "on" positions.

When an external source of pressure is connected to the system at 6, the pressure acts backwardly through pipe 3, chambers 60, 38 and 44, to close the check valve 48. Thus it is impossible for an external water supply to flow back through the pump and overflow the supply tank 2. The seal around the shaft between the motor and the impeller is also protected from external pressure, which is frequently higher than the normal pressure for which the shaft seal is designed. By being located on the suction side of the impeller, the shaft seal may be designed with very light sealing pressure. This reduces drag on the shaft, and power requirements of the pump. The seal functions as much to prevent air from being sucked into the system as it functions to prevent water from leaking out. A drain passage 96, closed by the plug 97 is provided for draining the impeller chamber.

What is claimed as new is:

1. In a water distribution system having a centrifugal impeller pump connected to deliver from a tank to a control valve, a flow control chamber and an outlet chamber connected in fluid series on the output side of said pump with means forming a flow opening between said chambers, a flow control member reciprocable through said opening and having a head closable in said opening and a stem projecting exteriorly of the flow control chamber and arranged to actuate switch means connected to control a motor connected to drive the pump, the improvement which comprises

a normally open switch and a normally closed switch each having a terminal connected to energize said motor,

actuating means coacting between said stem and said switches to actuate said normally closed switch to open position upon extreme movement of said control member in one direction, and to actuate both said switches in the opposite extreme positions of said control member,

and a manually operable switch connected to selectively and alternatively energize said switches.

2. A distribution system as defined in claim 1 in which there is an outer stem on said control member reciprocable in a cushion chamber in the body of the pump,

sealing means coacting with said outer stem to close said cushion chamber,

and means forming a restricted bleed opening between said cushion chamber and the delivery side of said system.

3. A distribution system as defined in claim 2 in which said seal means is a flexible bellows having inner and outer edges sealed respectively to said outer stem and a surrounding wall defining said cushion chamber.

4. A distribution system as defined in claim 3 in which said restricted bleed opening is formed through said outer stem and opens on opposite sides of said bellows.

5. A distribution system as defined in claim 1 in which said normally open and said normally closed switches are mounted side by side in a recess in the body of said pump,

a first actuating member associated with said normally closed switch and positioned to be engaged and actuated by inward movement of said inner stem,

a second actuating member associated with said normally open switch and having a part overlying said first actuating member,

and a lever pivoted in the body of said pump and having one end engageable with said inner stem and another engageable with said second actuating member to actuate both switches upon outward movement of said control member.

6. A distribution system as defined in claim 5 in which said pump comprises an integrally molded body with an impeller chamber molded in one side thereof,

said flow control chamber and said outlet chamber being molded in said body and opening to one edge thereof,

and a switch recess molded in the opposite side of said body and opposite the end of said flow control recess and having said switches mounted therein.

7. A pump and motor assembly comprising a unitary molded body having an impeller recess in one side,

a flow control recess formed in said body in transversely extending relation to said impeller recess and opening to one edge of said body,

a pair of end plates clamped to opposite sides of said body with one plate closing said impeller recess,

a motor mounted on the other of said plates and having a shaft extending into said impeller recess,

an impeller connected to said shaft,

means forming an inlet to said impeller recess at the center of the impeller,

an upright recess formed in the other face of said body and closed by said other plate, and opening at its inner end to said flow control recess,

said upright recess communicating at its upper end with a passage extending through said body to the top of said impeller recess,

a check valve positioned in the communicating opening between said upright recess and said flow control recess,

a switch recess formed in the other side of said body

in alignment with said flow control recess and closed by said other end plate,

a wall in said body between the adjacent inner ends of said switch recess and said flow control recess and defining an opening therethrough,

a cover secured to the edge of said body and having a chambered side registering with the outer end of said flow control recess with a cushion chamber formed in the end of the chambered side,

an outlet formed in said cover and opening from the chamber therein,

an annular orifice member clamped between the edge of said body and said cover,

an elongated flow control member reciprocably mounted in said flow control recess with an inner stem extending in sealing relation through said opening in said wall between said switch recess and said flow control recess, and an outer stem projecting into said cushion chamber,

a head on said control member positioned in said chambered cover and movable inwardly to closing relation with said orifice member,

a spring biasing said flow control member outwardly away from said orifice member,

a flexible diaphragm sealed between the peripheries of the outer stem on said flow control member and the edge of said cushion chamber,

means forming a restricted bleed passage between said cushion chamber and the chambered side of said cover,

and switch means mounted in said switch recess in position to be actuated by said inner stem on said flow control member, and connected to control said motor,

said flow control member being arranged to close said switch means at an intermediate position with said head spaced from said orifice member, and to open said switch means at each opposite extreme position of the control member,

said spring biasing said control member outwardly being of insufficient strength to overcome the force differential of liquid delivered by said impeller through said flow control opening and said chamber in said cover.

8. A pump and motor assembly as defined in claim **7** in which said means forming said inlet to said impeller chamber is an inlet recess formed in said body in transversely extending relation to said motor shaft, and opening radially to the center of said impeller recess.

9. A pump and motor assembly as defined in claim **8** in which said inlet recess is formed in said body in generally parallel relation to said flow control recess and therebelow,

and a part of said cover closing the outer end of said inlet recess and having a connection to a supply conduit formed thereon.

10. A pump and motor assembly as defined in claim **9** in which said cover defines a filter recess communicating with said inlet recess.

11. A pump and motor assembly as defined in claim **10** in which said cover has a downwardly inclined baffle over the inner end of said filter recess projecting into said inlet recess,

a cylindrical filter screen in said filter recess,

and a second cover secured to said first cover over the outer end of said filter recess and holding said screen in place.

12. A pump and motor assembly comprising a molded body of generally oval and upright contour with flat and parallel inner and outer faces and front and back edges,

a conically recessed impeller chamber formed in said outer face with a cylindrical hub recess opening

from its inner end axially of said impeller chamber and body in centered relation to the lower part of the body,

a pair of inner and outer end plates clamped to the corresponding faces of said body,

a motor mounted on said inner end plate with a shaft extending therethrough and in sealing relation through a shaft opening formed in a wall in said body at the inner end of said hub recess,

axially extending walls in said body forming a flow passage in the upper front quadrant of said body communicating at its front end with the periphery of said impeller recess and closed by said end plates,

an upwardly and inwardly stepped bottom wall between said axially extending walls, terminating in a raised upper lip spaced outwardly from said inner plate and below the top of said body,

transversely extending walls forming a generally cylindrical flow control recess positioned above said hub recess and opening to the front edge of said body, and having an axially extending wall at its inner end with an opening therethrough,

a check valve recess formed under said stepped bottom wall and opening axially to the inner face of said body below said upper lip, and opening tangentially to the rear or inner end of said flow control recess,

a check valve in said check valve recess arranged to close against return flow to said impeller chamber,

other transversely extending walls forming an inlet passage opening radially through a lower quadrant of said hub recess and extending to an edge of said body,

cover means secured to said body and closing the outer ends of said flow control recess and said inlet recess and having inlet and outlet connections to said recesses formed thereon,

a switch recess formed in said body and opening to said inner plate behind said wall at the inner end of said flow control recess,

switch means connected to control said motor and mounted in said switch recess,

a flow control member reciprocably mounted in said flow control recess and responsive to liquid flow therethrough,

said flow control member having a stem on its inner end extending in sealed relation through said opening at the inner end of the flow control chamber,

and means actuated by said stem arranged to deactuate said switch means at the inner and outer extreme positions of said flow control member and to actuate the switch means at an intermediate position of the control member corresponding to the position assumed by the member under the influence of liquid flow from the pump.

13. A pump and motor assembly as defined in claim **12** in which said inlet passage extends below said flow control passage and opens to the same front edge of said body,

said cover means being a single member secured over the outer ends of both passages.

References Cited

UNITED STATES PATENTS

1,952,265	3/1934	Leland.
2,897,764	4/1959	Tracy.
3,283,094	11/1966	Lung.
3,376,821	4/1968	East.

WILLIAM L. FREEH, Primary Examiner

U.S. Cl. X.R.

103—113; 200—81.9