July 13, 1954 R. A. HILL ET AL 2,683,420

PRIMER PUMP

Filed Aug. 28, 1950 2 Sheets-Sheet 1

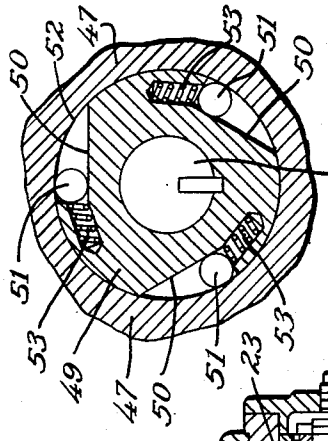


Fig. 3

Fig. 1

Fig. 4

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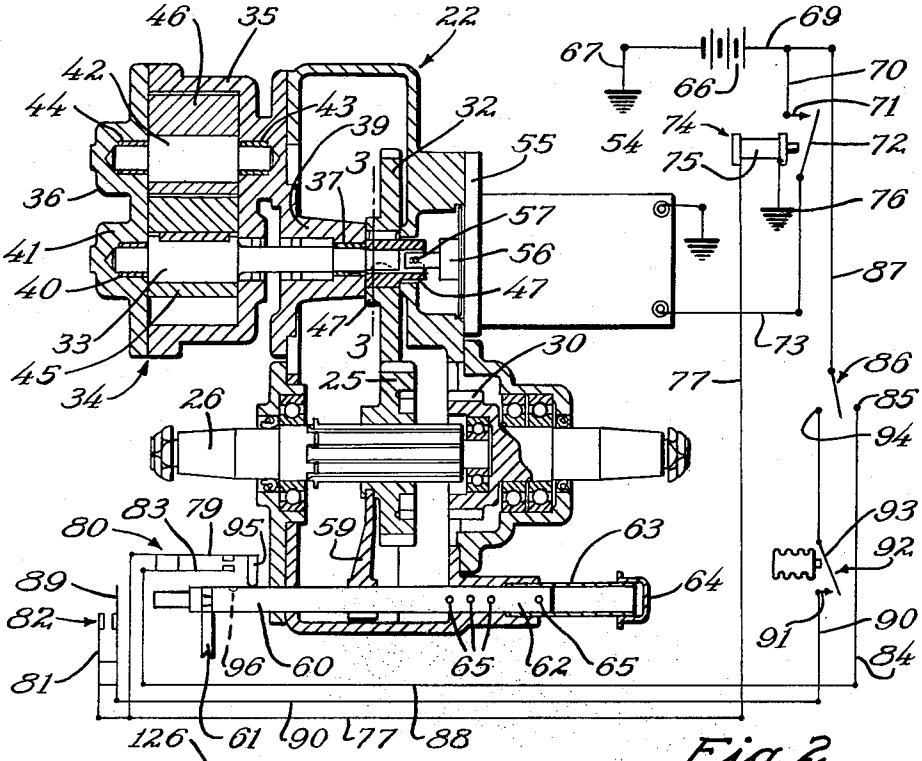


Fig. 2

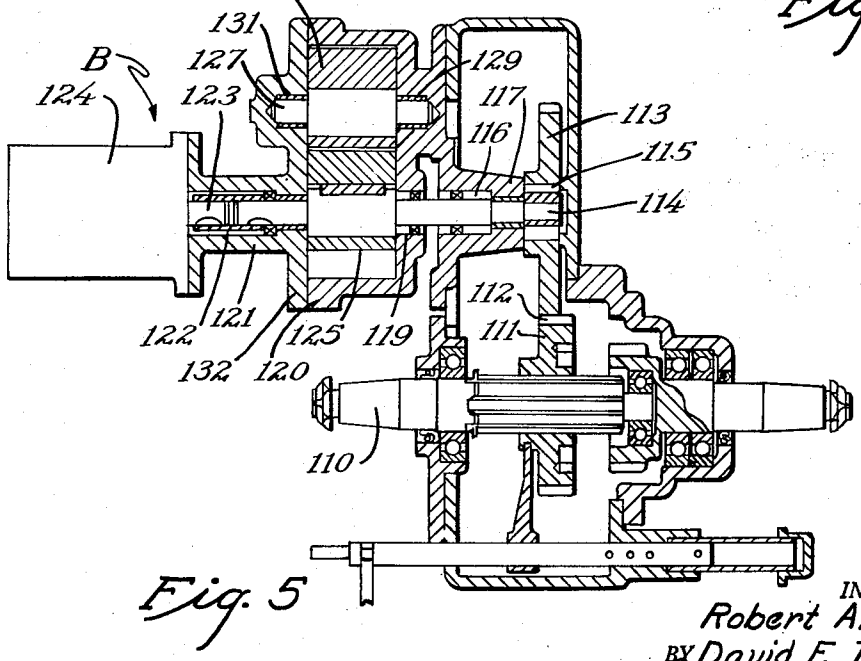


Fig. 5

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Patented July 13, 1954 2,683,420

UNITED STATES PATENT OFFICE

2,683,420

PRIMER PUMP

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Application August 28, 1950, Serial No. 181,818

6 Claims. (Cl. 103—113)

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This invention relates to an improvement in primer pumps and deals particularly with a means for and method of priming a centrifugal pump.

Centrifugal pumps are commonly used in fire engines and other fire fighting equipment. Pumps of this type must be primed before they will function, if used to draught water from a pond, river or lake. Various means have been employed for priming these pumps, one common method being to provide a priming pump of a gear type connected to the engine for actuation thereby. Such pumps tend to draw the air from the interior of the centrifugal pump, thereby drawing water through the intake of the pump. As soon as the centrifugal pump has been properly primed, the priming pump is disconnected.

Priming systems of this type usually require time to operate and if the pump is not properly handled, the prime will be lost. Oftentimes the drive mechanism is so arranged that either the priming pump or the centrifugal pump may be selectively connected to the driving engine. When the priming pump has drawn the liquid into the centrifugal pump the drive arrangement must be shifted to stop the priming pump and to start the centrifugal pump into operation. If the prime is lost during this process, or if a temporary interruption of the water flow into the pump intake takes place, considerable time is lost. The time required to place the equipment in operation is of particular importance in the type of equipment involved.

It is an object of the present invention to provide a centrifugal pump with a priming motor which is electrically operated and which is preferably connected to the electrical system of the vehicle. As a result the priming pump may be operated simultaneously with the centrifugal pump if desired and the operation of the priming pump is discontinued when the pump is completely primed.

A feature of the present invention lies in the fact that through the use of an electric motor driven priming pump, an automatic priming system may readily be provided. By providing a pressure actuated switch connected to the discharge of the centrifugal pump, the priming motor may be automatically disconnected when the centrifugal pump develops pumping pressure. At the same time, this pressure actuated switch may serve to restart the priming pump motor in the event the pressure at the pump outlet drops below a predetermined minimum.

A feature of the present invention lies in the

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fact that my priming pump may be selectively connected either to the electric motor or to the vehicle engine so that it may be actuated by either source of power. In the event the electrical system shall fail for any cause, the pump may be mechanically connected to the engine driving the centrifugal pump.

These and other objects and novel features of my invention will be more clearly and fully set forth in the following specification and claims.

In the drawings forming a part of the specification:

Figure 1 is a vertical sectional view through a pump of the type in question showing the general arrangement of the parts therein.

Figure 2 is a sectional view horizontally through the drive shaft of the pump, the position of the section being indicated by the line 2—2 of Figure 1.

Figure 3 is a sectional view through a detail portion of the structure, the position of the section being indicated by the line 3—3 of Figure 2.

Figure 4 is a wiring diagram of a modified form of control system.

Figure 5 shows a modified form of construction.

The centrifugal pump is indicated in general by the letter A. The pump includes a pump housing 10 having a horizontally extending impeller shaft 11 extending therethrough. The pump includes a pair of spaced impellers 12 and 13 supported upon the shaft 11 in spaced relation. These impellers 12 and 13 have a central intake indicated at 14 and 15 respectively. The intake 14 of the impeller 12 is connected to the intake manifold 16 within the pump housing. The intake 15 of the impeller 13 is connected to the intake manifold 17 within the housing 10. Both intake manifolds 16 and 17 are usually connected together to a source of water supply through a suitable flexible connection such as a hose or the like.

The impeller 12 rotates within a volute 19, while the impeller 13 forces water into a volute 20. The pump housing 10 is provided with suitable passages therethrough controlled by valves, not illustrated in the drawings, to connect the output from the impellers, either in series or in parallel to the discharge manifold 21.

One end of the impeller shaft 11 projects from the pump casing into the gear casing indicated in general by the numeral 22. A pinion 23 is supported upon the impeller shaft 11, this pinion being in mesh with an idler gear 24. The idler gear 24 is driven by a drive gear 25 slidably supported upon the drive shaft 26. The drive shaft 26 is

preferably connected to the vehicle engine or to a similar source of power supply. External teeth 27 on the gear 25 mesh with the teeth of the idler gear 24 when the gear 25 is in proper driving position. The gear 25 is also provided with internal teeth 29 which may mesh with external teeth 30 of the driven shaft 31, usually aligned with the drive shaft 26. When the gear 25 engages the gear 30 the engine is connected to the wheels of the vehicle.

With reference now to Figure 2 of the drawings, it will be noted that the gear 25 on the drive shaft 26 is also engageable in one position with a drive gear 32 on the drive shaft 33 of a rotary pump 34. The rotary pump 34 includes a pump casing 35 fastened to the gear casing 22 and includes a removable closure plate 36. The drive shaft 33 is supported by a suitable bearing 37 within a hollow boss 39 forming a part of the housing 35 and by a bearing 40 supported within the hollow boss 41 of the closure plate 36. A parallel shaft 42 is supported by suitable bearings 43 and 44 within the housing 35 and the closure plate 36 respectively. The shafts 33 and 44 support interengaging rotors 45 and 46 or interlocking gears, providing a positive pumping action.

The drive gear 32 is provided with a hub 47 which encircles the drive shaft 33 and is rotatable relative thereto. A hub or sleeve 49 is keyed to the drive shaft 33 and is provided with angularly spaced inclined notches 50 in which are positioned rollers 51. The rollers 51 are urged into engagement with the inner surface 52 of the gear hub 47 by springs 53. These rollers 51 provide an overrunning clutch which permits the drive shaft 33 to rotate freely in one direction. The purpose of this overrunning clutch is to permit rotation of the drive shaft 33 by external means, while the gear 32 is in engagement with the gear 25, without tending to drive the engine of the vehicle.

An electric motor 54 is provided with a mounting flange 55 at one end which is bolted or otherwise secured to the gear housing 22. The motor shaft extends from the motor 54 and is pin connected or otherwise connected at 57 to the drive shaft 33 through the hub 49. Rotation of the motor 54 may thus rotate the hub 49 and the drive shaft 33 and consequently may drive the rotors 45 and 46.

The gear 25 is moved longitudinally of the drive shaft 26 by a shifting fork 59 mounted upon a shaft 60 slidable in a direction parallel to the axis of the shaft 26. This shift shaft 60 may be moved longitudinally by manual means such as the shifting member 61, partially shown in the drawings. One end 62 of the shaft 60 is preferably enclosed within a sleeve 63 which is capped as indicated at 64. Means are provided for tending to hold the shaft 60 in any of four positions, this means including recesses 65 in the shaft 60 in longitudinally spaced relation and suitable spring urged means not shown in the drawings engageable in these recesses. The gear 25 is movable from pumping position shown in Figure 1 of the drawings to priming position shown in Figure 2 of the drawings. If the gear 25 is moved to the right from its position shown in Figure 2 out of engagement with the gear 32 and not yet in engagement with the gear 30, the gear 25 is in a neutral position which is the third of the four gear positions. The fourth position is when the gear 25 is engaged with the gear 30 to drive the vehicle wheels.

A control system for controlling the priming operation of the pump is diagrammatically illustrated in Figure 2. The system includes the battery or power supply source 66, one terminal of which is grounded at 67. The other battery terminal is connected by conductors 69 and 70 to a relay terminal 71. The relay arm 72 is connected by a conductor 73 to one terminal of the motor 54, the other terminal of which is grounded. Thus when the relay 74 is energized a circuit is closed to the motor 54 to drive the priming pump.

The relay 74 includes the coil 75, one terminal of which is grounded at 76. The other coil terminal is connected by a conductor 77 to one blade 79 of a switch 80, and one blade 81 of a switch 82. The cooperable blade 83 of switch 80 is connected by conductor 84 to one terminal 85 of a single pole double throw switch 86. The arm of the switch 86 is connected by conductors 87 and 69 to the live terminal of the battery 66.

The second blade 89 of the switch 82 is connected by a conductor 90 to a terminal 91 of a single pole, single throw pressure actuated switch 92. The pressure chamber of switch 92 is connected to the discharge manifold 21 of the centrifugal pump A and is so arranged to open the switch when a predetermined pressure is reached in this manifold. For example, the switch 92 can open the circuit when a pressure of twenty-five pounds per square inch is built up within the pump discharge 21. The arm 93 of the switch 92 is connected to the second terminal 94 of the double throw single pole switch 86, completing this circuit.

The switch 80 is provided with an operating lug 95 which rides upon the surface of the shaft 60. A notch or indentation 96 is provided in the shaft 60 which is engageable with the lug 95 only when the shaft 60 is in position to hold the drive gear 25 in neutral position. Thus the circuit through the switch 80 may be closed only when the pump is in neutral position. The switch 82 is mounted in the path of movement of the shaft 60 and is closed by engagement with this shaft when the pump is in pumping position. Thus the switch 82 is closed only when the pump is in pumping condition.

The two circuits described are alternative, one circuit comprising a fully automatic system, while the other comprises a semi-automatic system. When the arm of the switch 86 is against the switch terminal 85, a circuit is closed from the battery 66 through conductors 69 and 87, the switch 86, conductor 84, switch 80, and conductor 77 to the relay coil 75, the other terminal of which is grounded. Thus if the pump is in neutral position, a circuit may be closed to the relay coil 75, thus closing the motor circuit to the motor 54 and starting the priming pump. When the pump has acted to prime the centrifugal pump A, the shifting shaft 60 is moved into pumping position, thereby opening the switch 80 so that the circuit is opened to the solenoid coil 75 and subsequently to the priming motor 54 as the pump starts to function. If preferred the switch 86 can be manually broken. If it is desired to reprime the pump and if the switch 86 remains in position to close a circuit to terminal 85, the priming motor can again be started by merely shifting the shaft 60 to place the gear 25 in neutral position.

If the switch 86 is in its other extreme position in connection with terminal 94, a circuit is closed from the battery 66 through conductors 69 and

87 through the switch 86 through the normally closed pressure switch 92 and the conductor 90 to the switch 82. This switch 82 is connected by the conductor 77 to the relay coil 75, the other terminal of which is grounded. Thus if the shaft 60 is in pumping position with the gear 25 engaged with the pump gear, as shown in Figure 1, the priming motor 54 is started as soon as the switch 86 is closed. The switch 86 is then detained in closed position during the pump operation. When the pressure in the discharge manifold of the centrifugal pump reaches the necessary pressure to open normally closed pressure switch 92, this circuit is opened and the circuit to the priming motor 54 is opened. However, if the pressure shall fail in the discharge of the pump A, the switch 92 will again close and the priming motor will be restarted to again prime the pump. Thus any time the pump shall lose its prime with the switch 86 in this position, it will be reprimed.

The system illustrated is advantageous because of the speed with which the pump may be primed and because of the automatic repriming operation at any time when the pump loses its prime. Even in the semi-automatic operation of the system, the priming motor 54 will be turned off when the pump is connected to the drive shaft, thus permitting the repriming of the pump automatically as the shifting member is shifted into neutral position.

In Figure 4 of the drawings is disclosed a manually operable control system for controlling the circuit to the priming motor 54. In this instance, the vehicle battery 66 or other source of current supply, has one terminal grounded as indicated at 97. The other battery terminal is connected by conductor 99 to a normally open manually closed switch 100. The other terminal of the switch 100 is connected by conductor 101 to a relay coil 102, which in turn is grounded at 103. Thus when the switch 100 is manually closed, the relay coil 102 is energized. The relay arm 104 is connected by conductor 105 to the priming motor 54, the other terminal of which is grounded at 106. The arm 104 when energized is engageable with a terminal 107 connected by conductors 109 and 99 to the battery 66. Thus when the relay coil 102 is energized the motor 54 is set into operation. The motor remains in operation until the manual switch 100 is manually released to open the circuit.

In Figure 5 of the drawings we disclose a modified form of construction which differs slightly from the construction shown in Figures 1 and 2 of the drawings. The main point of difference of this form of construction lies in the fact that the electric priming motor is mounted on the opposite side of the gear case from the form of construction previously described. This arrangement is somewhat more awkward in appearance and somewhat less compact in design, but has the advantage that the motor may be added to a conventional pump with fewer mechanical changes.

The pump B illustrated in Figure 5 is virtually identical with the pump A, except for the shape of the gear casing and the motor mounting. The drive shaft 110 acts to rotate a drive gear 111 which is spline connected thereto and which is provided with external teeth 112 engageable in one position with a drive gear 113 on a parallel shaft 114. An over-running clutch 115 is interposed between the gear 113 and the shaft 114 for a purpose which will be understood.

The shaft 114 is supported by suitable bearings 116 in an internally extending boss 117 and is also supported by bearings 119 supported within the pump casing 120. The shaft 114 extends into a hollow boss 121 on the pump housing 120 opposite the bearing 119. A suitable flexible connection 122 connects the shaft 114 with the shaft 123 of the priming motor 124.

A gear 125 is provided on the shaft 114 which meshes with a similar gear 126 on a counter-shaft 127. The counter-shaft 127 is supported by a bearing 129 in the pump housing and by an aligned bearing 130 in the pump housing cover plate 132 of which the hollow boss 121 is a part.

In other respects the pump similates the pump A and the drive gear 111 is connected by suitable gear means to the impeller shaft to drive the impellers precisely in the manner illustrated in Figure 1. Thus the structure of Figure 5 differs from the structure of Figure 2 mainly in the manner in which the electric motor is connected thereto.

The motor 124 is controlled similarly to the motor 54 and accordingly the wiring diagram shown in Figure 2 is not repeated in Figure 5. The structure of Figure 2 illustrates the motor 54 attached directly to the gear housing 22. As a result some modification of the gear housing is necessary to accommodate the electric motor 54. However, this arrangement is compact and the motor 54 is attached to the shaft 33 at the end thereof opposite the end extending into the plmp housing 35. On the other hand, the construction illustrated in Figure 5 may be produced by merely changing the design of the pump closure plate, such as 132, and by changing the construction of the shaft 114. Thus it is somewhat less costly to modify conventional pumps to produce the construction shown in Figure 5 than to produce the construction shown in Figure 2.

In accordance with the patent statutes, the principles of construction and operation of the primer pump have been described, and while it has been endeavored to set forth the best embodiment thereof, it is desired to have it understood that obvious changes may be made within the scope of the following claims without departing from the spirit of the invention.

We claim:

1. A priming system for priming a centrifugal pump, the pump including an impeller shaft and gear means for driving said shaft and connected thereto, a drive shaft, a drive gear slidably supported on said drive shaft and movable into or out of engagement with said gear means, a priming pump, a gear connected to said priming pump for actuating the same, said gear being engageable with said drive gear in one position thereof, an electric motor connected to said priming pump for selectively actuating the same, an over-running clutch interposed between said gear connected to said priming pump and said priming pump, said clutch acting to disengage said last named gear from said priming pump when the rotative speed of said motor is greater than the rotative speed of said gear.

2. A priming system for priming a centrifugal pump, the pump including an impeller shaft and gear means for driving said shaft and connected thereto, a drive shaft, a drive gear slidably supported on said drive shaft and movable into or out of engagement with said gear means, a priming pump, a gear connected to said priming pump for actuating the same, said gear being engageable with said drive gear in one position thereof,

an electric motor connected to said priming pump for selectively actuating the same, means for sliding said drive gear on said drive shaft from a neutral position into selective enmeshment with either said gear means or said priming pump gear, and means engageable with said drive gear sliding means for energizing said electric motor only when said drive gear is in said neutral position.

3. A priming system for priming a centrifugal pump, the pump including an impeller shaft and gear means for driving said shaft and connected thereto, a drive shaft, a drive gear slidably supported on said drive shaft and movable into or out of engagement with said gear means, a priming pump, a gear connected to said priming pump for actuating the same, said gear being engageable with said drive gear in one position thereof, an electric motor connected to said priming pump for selectively actuating the same, means for sliding said drive gear on said drive shaft from a neutral position into selective enmeshment with either said gear means or said priming pump gear, and means engageable with said drive gear sliding means for energizing said electric motor only when said drive gear is in mesh with said gear means.

4. A priming system for priming a centrifugal pump, the pump including an impeller shaft and gear means for driving said shaft and connected thereto, a drive shaft, a drive gear slidably supported on said drive shaft and movable into or out of engagement with said gear means, a priming pump, a gear connected to said priming pump for actuating the same, said gear being engageable with said drive gear in one position thereof, an electric motor connected to said priming pump for selectively actuating the same, and a control system for controlling the operation of said electric motor, said control system including a manually operable switch, a normally closed pressure switch operable by an increase in pressure at the centrifugal pump discharge to open the circuit to said electric motor, and an interlocking switch in series with said pressure control switch and closed only when said drive pinion is in mesh with said gear means.

5. A priming system for priming a centrifugal pump, the pump including an impeller shaft and gear means for driving said shaft and connected thereto, a drive shaft, a drive gear slidably supported on said drive shaft and movable into or out of engagement with said gear means, a priming pump, a gear connected to said priming pump for actuating the same, said gear being engageable with said drive gear in one position thereof, an electric motor connected to said priming pump for selectively actuating the same, a double control circuit for controlling the electric motor, said double control system including a two position switch movable into position to control either of two circuits of said double circuit, one of said two circuits including a switch closed only when said drive gear is in neutral position and operable when the drive gear is in said neutral position to close a circuit to said electric motor, and the other circuit of said double circuit including a switch closed only when said drive pinion is in engagement with said gear means and a pressure switch connected to the discharge of the centrifugal pump to open the circuit upon an increase in pressure of the centrifugal pump discharge, said second circuit portion also closing the circuit to said electric motor.

6. A pump priming system comprising a centrifugal pump including a casing, an impeller shaft supported by said casing, a gear on said impeller shaft, a priming pump mounted on said casing, and in fluid communication with said centrifugal pump, said priming pump having an operating shaft supported by said casing, a gear on said operating shaft, a drive shaft supported by said casing and adapted to cooperate with said impeller shaft, a source of power connected to the drive shaft, gear means on said impeller shaft and the gear on said operating shaft, an electric motor connected to said operating shaft, said motor being operable to drive said priming pump while said impeller shaft is connected to said source of power through said drive shaft.

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