May 12, 1959 W. A. RAY 2,885,860

OPERATOR UTILIZING A HYDRAULIC MOTOR

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Fig. 1

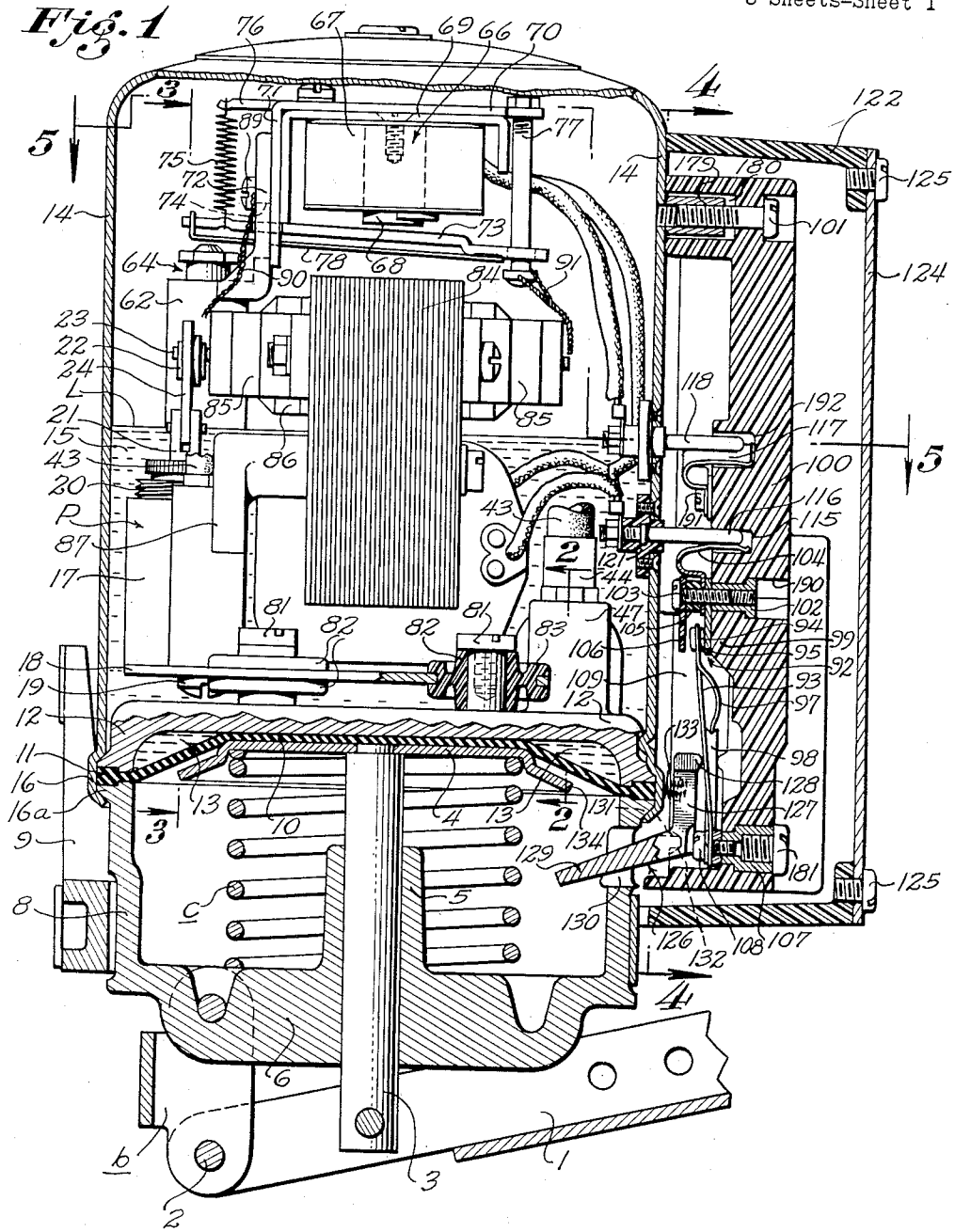

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Fig. 3

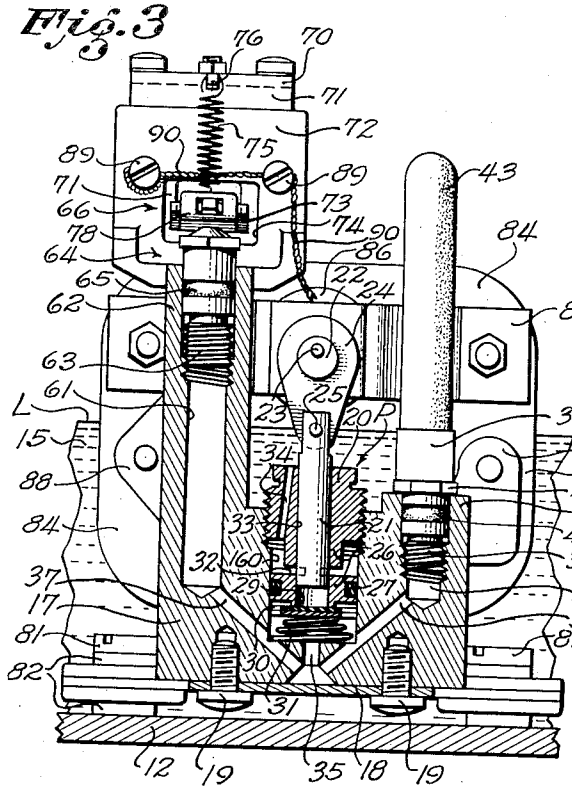

Fig. 4

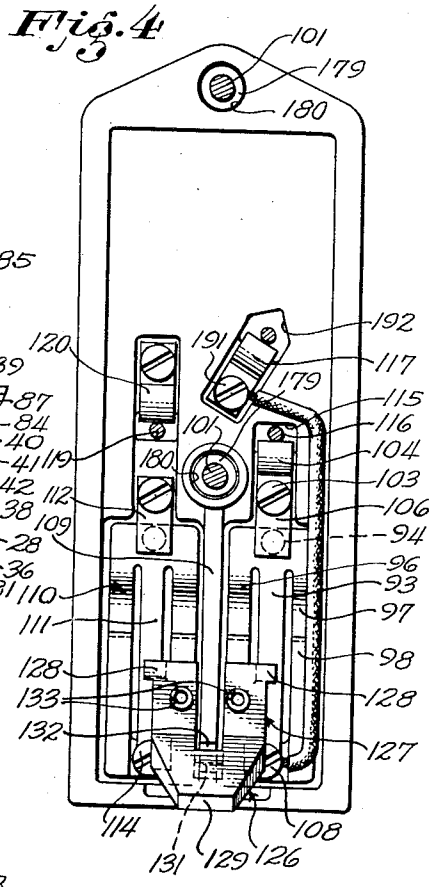

Fig. 2

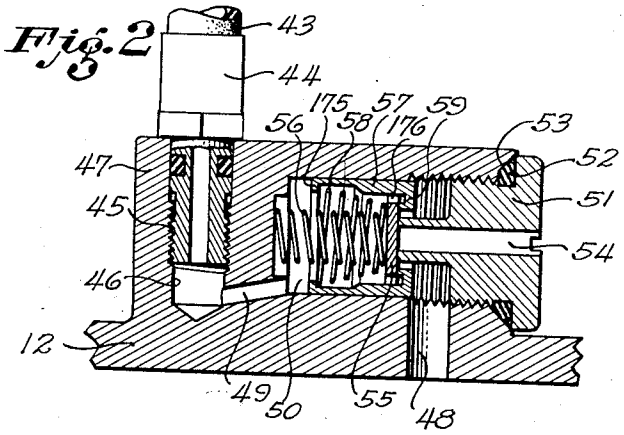

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Fig. 5

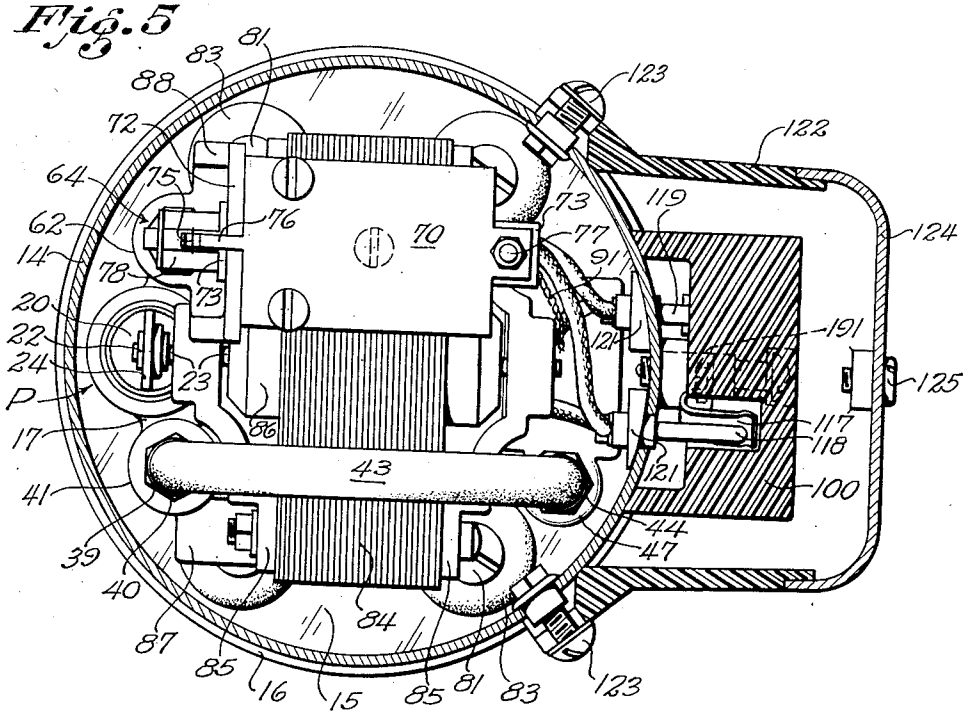
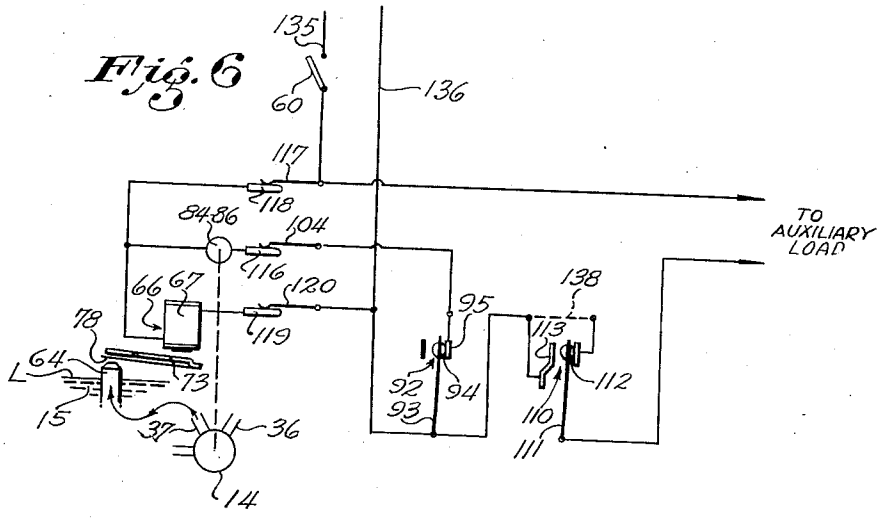


Fig. 6



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United States Patent Office 2,885,860 Patented May 12, 1959

2,885,860

OPERATOR UTILIZING A HYDRAULIC MOTOR

William A. Ray, North Hollywood, Calif., assignor to General Controls Co., a corporation of California

Application June 6, 1955, Serial No. 513,423

8 Claims. (Cl. 60—52)

This invention relates to hydraulic mechanism in which an electrically operated motor serves to pump a liquid, such as oil or the like to move a piston. The piston in turn is used to perform work, such as to open or close a switch, or to open or close a damper associated with a fuel burning system or furnace.

Such mechanisms are usually conveniently disposed in a housing in which the liquid is also accommodated. The electric motor and the pump are usually so placed as to be substantially completely immersed in the oil.

It is one of the objects of this invention to improve, in general, mechanisms of this character.

It is another object of this invention to improve the efficiency of the motor-pump combination.

Systems of this general character are often installed in homes for the control of heating furnaces, or the like. The resultant noise, due to the mechanical vibrations set up by the motor and pump is highly objectionable. It is another object of this invention to reduce the noise level to a tolerable value.

Ordinarily, the electric motor is energizable at a remote point by the aid of a circuit controller, and is automatically de-energized by the aid of a limit switch operated by the work piston when it reaches a desired position. It is another object of this invention to provide a simple limit switch operator.

It is still another object of this invention to provide a simple and effective means for connecting the electric motor and other electrical equipment in the housing to an appropriate source of electrical energy without requiring access to the interior of the housing.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a vertical sectional view of a hydraulic mechanism incorporating the invention;

Fig. 2 is a fragmentary sectional view, taken along a plane corresponding to line 2—2 of Fig. 1;

Fig. 3 is a fragmentary sectional view, taken along a plane corresponding to line 3—3 of Fig. 1;

Fig. 4 is a sectional view, taken along a plane corresponding to line 4—4 of Fig. 1;

Fig. 5 is a sectional view, taken along a plane corresponding to line 5—5 of Fig. 1; and

Fig. 6 is a wiring diagram of a system in which the hydraulic device may be utilized.

In the present instance, the load to be operated is represented by a damper lever 1 (Fig. 1). This damper lever is merely one example of the load to be operated.

Such a damper may be arranged, for example, to control the flues of a gas furnace for home heating. The lever is mounted on a pivot pin 2 supported by a bracket *b* forming a portion of the mounting for the apparatus.

In order to move this lever 1 in a clockwise direction above its pivot pin 2, a movable stem 3 is utilized, pivotally joined to the lever 1. This stem is shown as attached to its upper end to a disc 4 which is preferably made of thin metal. The stem 3 is furthermore guided for its longitudinal movement by a long boss 5 formed integrally with the lower wall 6 of a body 8. This body is substantially cylindrical, and is provided with a bracket 9 for attachment on a supporting surface.

The upper open end of the body 8 is covered by a flexible diaphragm 10. The edge 11 of this diaphragm 10 is thickened so that it may be well adapted to be clamped between the upper edge of body 8 and a cover member 12. A compression spring *c*, surrounding boss 5, is located within the body 8. It engages disc 4 and serves to urge the disc into contact with the lower surface of the diaphragm 10, thereby moving the stem 3 upwardly when it is desired to return the damper lever 1 to a position illustrated in Fig. 1.

Downward movement of the stem 3 for performing its work is effected by a liquid under pressure in the space 13 between the diaphragm 10 and the cover 12. Cover 12 is also shown in Figs. 2 and 3. A body of liquid, such as oil, located in chamber 13, is caused to exert fluid pressure on the upper side of the diaphragm 10, causing the stem 3 to be moved downwardly against the force of spring *c*.

A generally cylindrical housing 14 (Figs. 1 and 5) is utilized as a reservoir or tank for accommodation of a body of oil 15. This housing has a lower flange 16 in close fitting relationship with an enlarged annulus 16*a*, formed by the body 8 and cover 12, and provides a fluid-tight connection therewith.

In order to supply oil under pressure to the space 13 use is made of an electric motor-driven pump P located in the housing 14 (Figs. 3 and 5). The structure of this pump may be of any usual form and may be best described in connection with Figs. 1, 3 and 5. The frame of the pump is formed by a casting 17 attached to a metal base 18, as by a plurality of screws 19. The base 18 is supported in a manner to be hereinafter described upon the cover member 12. As shown most clearly in Figs. 1 and 3, the oil level L extends above the pump structure, whereby the pump is completely submerged. This pump structure includes a bore 160 having a vertical axis, and formed in the frame 17. This bore 160 is provided with a threaded upper end for the accommodation of a piston guide 20. A piston 21 is arranged to reciprocate within the member 20. It is driven, for example, by the aid of an eccentric 22 mounted upon a shaft 23, appropriately driven by an electric motor. The eccentric 22 moves within an appropriate bore formed in a link 24. The lower end of this link is pivotally joined to the piston 21 as by a pin 25 passing through a clevis formed at the upper end of the piston 21.

As the shaft 23 is rotated, the eccentric moves the link 24 in a reciprocating path, and the piston 21 is correspondingly reciprocated.

In the present instance, a driving electric motor has a rotor 86 directly coupled to the shaft 23. This motor structure will be hereinafter described in detail.

The guide member 20 carries a lower extension 26, defining a space between this extension and the upper portion of the guide member 20. An O-ring 27 is disposed in a groove in the extension 26 to provide a seal for the cylinder space or bore 33. At the lower end of the extension 26 there is an annular seat 29 for a closure 30. This closure 30 may be made of appropriate flexible

material, such as rubber. It is urged upwardly against the seat 29 by a compression spring 31 resting upon the bottom of the bore 160.

Upon upward movement of the piston 21, oil can pass into the space beneath the piston 21 through slots 32 that intersect the cylinder bore 33.

Oil is supplied from housing 14 to the space above the extension 26 by the aid of a port 34 extending through the guide member 20.

Communicating with the bore 160 is a port 35, in turn communicating with two diagonal ports 36 and 37. The port 36 corresponds to the outlet of the pump structure. It communicates with the lower end of a recess 28. This recess 28 in turn accommodates the threaded end 38 of a nipple member 39. This nipple is made of metal and is firmly fitted by the aid of hexagonal flange 40 on top of a boss 41. This boss 41 is formed integrally with the frame 17. A packing, such as an O-ring 42, is carried by the shank of the coupling nipple 39, between flanges formed above the threaded portion 38.

A conduit 43 has one end firmly attached to nipple member 39. The conduit extends upwardly and above apparatus located in housing 14.

The opposite end of conduit 43, as shown most clearly in Figs. 1 and 2, extends downwardly, and terminates in a nipple member 44 of identical construction as nipple member 39. This nipple has a threaded portion 45 threaded into a recess 46 in a boss 47 integrally formed on the cover member 12.

In order to reduce noise occasioned by the rapidly moving and vibrating pump parts, the conduit 43 is made of yielding or flexible material, preferably rubber, or a rubber substitute.

From the recess 46 the liquid under pressure is urged downwardly through a port 48 into the space above the operating diaphragm 10.

The path of liquid to the port 48 includes the port 49 which leads into a cylinder bore 50. This cylinder bore is partially defined by a plug 51 threaded into the threaded right-hand end of the bore 50. An O-ring 52 is interposed between the flange of the plug and a sloping shoulder 53 surrounding the threaded opening into which the plug 51 is threaded.

The plug 51 has a central port 54 communicating with the body of liquid 15 within housing 14.

Normally when the apparatus is at rest, a spring-pressed closure disc 55 closes the port 54. This closure disc is urged to closed position by a light compression spring 56. This spring extends between the inner end of bore 50 and the disc 55. The reduced portion of plug 51 forms a seat for the closure disc 55.

Located in the cylinder bore 50 is a hollow piston member 57. This piston member is urged as by compression spring 58 toward the left, since the left-hand end of this spring engages the inner surface of the inwardly turned flange 175 formed on member 57, and its right-handed end engages the left-hand face of disc 55. The right-hand end of member 57 has an inwardly directed flange 59 contacting the right-hand surface of the closure disc 55; and this flange 59 limits the movement of the piston 57 with respect to the closure 55.

However, when the pump structure is operating, oil under pressure flows through port 49, and urges the piston 57 toward the right. Under such circumstances, flange 59 leaves disc 55, and oil can flow freely through slots 176 formed in the periphery of disc 55 and around the reduced end of the plug 51, downwardly to the port 48.

The damper lever 1 is thus moved downwardly by the stem 3, due to the force exerted upon this stem by the pressure of the oil in space 13.

As hereinafter described, when the stem 3 is moved downwardly through a predetermined distance, the motor operating pump shaft 23 is stopped. Nevertheless oil pressure is maintained through port 48, by preventing

return of oil from space 13 through the port 49 and nipple 45. When, however, the pressure is relieved, the compression spring c forces the diaphragm 10 upwardly, exerting a pressure upon the oil sufficiently to unseat the closure disc 55 against the force of the spring 56. The oil then quickly spills through the port 54 into the housing 14. This quick spill-over device is described and claimed in a copending application in the name of William A. Ray, Serial No. 223,702, filed April 30, 1951, now Patent No. 2,735,445, issued February 21, 1956.

The control of the hydraulic apparatus is effected by a remote switch 60 shown in Fig. 6. This switch may be manually operated, and may be closed when it is desired to move the damper lever 1 downwardly. The switch may be opened when it is desired to cause the damper lever 1 to assume the position of Fig. 1.

The manner in which this control is effected will be described hereinafter.

Closing of the switch 60 also insures that the oil pressure in space 13 will be maintained even after the pump is stopped. For this purpose the port 37 (Fig. 3) is used as a relief port. This port leads to a port 61 located in a boss 62 formed integrally with the frame 17. The upper portion of the port 61 is threaded to accommodate the threaded shank 63 of a relief jet structure 64. This jet structure extends above the boss 62 and is sealed with respect to port 61, as by the aid of an O-ring 65.

When the relief jet opening is closed, the pressure in the space 13 is maintained. When it is opened, the pressure is relieved, and oil may flow upwardly through the jet member 64 back into the housing 14.

Control of the jet structure is effected by an electromagnet structure 66 (Figs. 1 and 3). This electromagnet structure includes a coil 67 mounted on a core 68. Coil 67 is attached to a frame 69. This frame is made of magnetic material and carries the core 68. In turn the frame 69 is attached to a support 70 having a downwardly extending leg 71. This leg 71 is attached as by screws 89 to an integral portion 72 of the frame 17.

The core 68, when coil 67 is energized, is adapted to attract an armature 73 which extends through opening 74 of the bracket 72, as well as through a registering opening in leg 71. This armature is pivoted on the lower edge of this opening in the support 71. In the position shown in the drawings, the armature 73 is in the unattracted position. It is urged to this unattracted position by the aid of a tension spring 75 anchored to the arm 76 carried by the support 70. Furthermore, the right-hand end of the armature has a slot accommodating a guiding screw 77 attached to support 70.

The lower side of the armature 73 carries a jet control member 78, made of spring material and overlying the jet structure 64. This spring member 78 is attached to the armature 73 adjacent its right-hand end. Accordingly, when the armature 73 is tilted in a counterclockwise direction by energization of the coil 67, the relief valve formed by the jet structure 64 is closed, and the pump structure as hereinbefore described is capable of performing its function of passing liquid under pressure through the conduit 43 to the space 13. In the unenergized position illustrated in the drawings, the relief valve is open, permitting discharge of the liquid from the space 13 upwardly through the port 61 (Fig. 3).

The base member 18 is mounted on the cover 12 by the aid of four cap screws 81. These cap screws pass through rubber bushings 82, each having a large external flange 83 (Fig. 1). This flange is grooved so that this rubber bushing may appropriately engage the edges of apertures formed in the base 18.

By the aid of such rubber mounting for the base 13, the vibrations due to the operation of the pump and of the electric motor are rendered substantially noiseless.

The motor structure includes, as hereinbefore stated, the shaft 23; it also includes the stator laminations 84 mounted between and compressed by the end frames 85.

These end frames 85 serve to support the rotor 86 by providing bearings for shaft 23 upon which the rotor is mounted. Furthermore, the stack of laminations 84 is supported upon ears such as 87, 88 formed on frame 17.

As seen most clearly in Fig. 3, the stack of laminations is so arranged that the motor shaft 23 is considerably above the level L of the oil in housing 14. Thus the rotor 86 is not retarded by the fluid friction of oil 15, although the stator laminations 84 are partially submerged in the oil.

The screws 89 which support the electromagnet structure for controlling the relief jet 64 are prevented from accidental removal or loosening by the aid of a twisted safety wire 90. In order to lubricate the shaft 23, the safety wire 90 (Fig. 3) is arranged to end above the shaft 23.

A similar wire wick 91 (Fig. 1) attached to screw 77 serves to lubricate the other end of the shaft 23. Oil vapor necessarily condenses on these wire elements 90 and 91. Droplets are formed which are conducted downwardly by these elements 90 and 91 to drop onto the shaft 23.

The energization of the motor 84—86 for operating the pump P can continue only until a limiting circuit controller 92 is opened (Fig. 6). This circuit controller is shown to best advantage in Figs. 1 and 4. It includes an arm 93 carrying a contact point 94 cooperating with a stationary contact member 95. In the position shown in Fig. 1, the arm 93 is urged toward the right, to bring contact members 94 and 95 into engagement. However, the arrangement is such that when the contact arm is permitted to move toward the left as viewed in Fig. 1, the upper end of the arm 93 snaps over to an open position. This effect is secured by a well-known "microswitch" action. Thus the spring arm 93 is formed integrally with a pair of depending looped arms 96 and 97, respectively, on opposite sides of arm 93. They are normally positioned as illustrated in Fig. 1. The free lower ends of these arms engage in notches formed at the upper ends of the stationary members 98. Both these members are integrally joined at their lower ends for conveniently supporting them (Fig. 4), as hereinafter described.

Stationary contact member 95 is mounted upon the inner surface of a boss 99 formed upon a base 100 made from insulation material. This insulation base 100 is in turn mounted on the exterior surface of the housing 14 as by the aid of a pair of screws 101. These screws (Fig. 1) are threaded into threaded bosses 179 attached to housing 14 and extending into recesses 180 in base 100.

The stationary contact member 95 is held by the aid of a screw 103 (Fig. 1). This screw 103 engages the threaded bushing 102 that is supported in base 100. The bushing 102 has a non-circular head accommodated in a conforming recess 190 in base 100 so as to restrain the bushing against rotation. Screw 103 also passes through an aperture in a spring contact member 104, an insulation sleeve 105, as well as a stop member 106 of insulation material for the arm 93. The contact member 104, as hereinafter described, forms one element of a pair of detachable contact members for making it possible to remove base 100 as a unit from housing 14.

The spirng arm 93 is similarly attached to a conducting bushing 107 by the aid of a screw 108. This bushing is similar to bushing 102, and includes a binding post 181, by the aid of which a connection may be made to the arm 93. The screw 108 also serves to attach members 98 to the base 100.

The base 100 is provided with an integral barrier 109 separating the microswitch structure just described from an identical microswitch structure 110. This microswitch structure includes a contact arm 111 (Fig. 4) operating in this instance between front contact 112 and back contact 113 (see Figs. 4 and 6). The spring arm 111 is supported on the base 100 by the aid of a screw 114.

The base 100 is purposely removable to facilitate connections to these microswitch structures located on opposite sides of the barrier 109. For this purpose three conducting prongs are permanently supported on the housing 14 and adapted to cooperate with spring fingers, such as spring finger 104 already referred to. For example, the spring finger 104 extends into a recess 115 in the base 100. It is adapted to form a detachable electrical connection with the prong 116 connected to one side of the motor 84—86 (see also Fig. 6).

Another spring finger 117 is mounted on the base 100 in a similar manner, as by aid of a screw 191. This finger extends into recess 192. It is adapted to form an electrical connection with the prong 118 supported upon the housing 15. The electromagnet coil 67 similarly is connected to a prong 119 for operating with a spring finger 120.

Each of the prongs may be supported upon the housing 14 in the manner illustrated in Fig. 1 in connection with prong 116. Thus an insulation support 121 is mounted on the interior surface of the housing 14. The prong 116 extends through the insulation support and is mounted therein. The support has a flange screwed to the inner wall of the housing 14.

By removing the screws 101 (see Figs. 1 and 4), the detachable connections formed by the spring arms 104, 117 and 120 with prongs 116, 118 and 119 may be broken, and the base 100 may be removed for repairing or replacing the electrical connection.

A protecting cover 122 is provided around the base 100. This may be made of insulation and supported by the aid of screws 123 on the exterior of the housing 14 (Fig. 5). A metal cover plate 124 may also be detachably mounted upon the protecting cover 122 as by the aid of screws 125.

For operating the switches 92 and 110, use is made of a lever 126 (Figs. 1 and 4). This lever has a bifurcated operating arm 127, provided with the spring arm engaging points 128. The lever arm 129 extends into the casing 8 through an aperture 130 (Fig. 1).

This lever 126 is pivoted in the bottom of a groove 132 formed in the edge of the barrier 109, as by the aid of a projection 131 formed between the bifurcations of lever 126. A pair of compression springs 133 normally urge the lever 126 in a clockwise direction for maintaining contact points 94, 95, and 111, 112 in engagement.

The circuit controller 92 is adapted to be opened with a snap action when the lever 126 is moved in a counterclockwise direction away from spring arm 93. This is effected by the aid of the downwardly directed edge 134 of the disc 4. This occurs upon sufficient movement of the diaphragm 10 downwardly, as viewed in Fig. 1.

When the contact members 94 and 95 separate, the circuit to motor 84—86 is opened as is apparent from Fig. 6. The motor 84—86 is normally energized through the circuit from a main 135, through the remote control switch 60, motor 84—86, prong 116, spring arm 104, contact members 95, 94, arm 93 and the other main 136. Although circuit controller 60 may remain closed, the opening of the motor circuit 84—86 occurs upon the limiting downward movement of the diaphragm 10.

When the remote control switch 60 is closed, the circuit through the coil 67 is also closed, making it possible for the pump to be effective. This circuit includes prong 119 and spring contact member 120. This circuit remains closed even after the motor 84—86 is deenergized, whereby the diaphragm 10 is maintained in its lower limiting position. It is only when the circuit controller 60 is purposely opened that the electromagnet coil 67 is deenergized. When this occurs, relief jet 64 is uncovered. The flow from space 13 can flow back through the quick spill port 54 into the reservoir 14.

The damper arm **1** is thus returned to the position of Fig. 1.

The circuit controller **110** may be used to operate an auxiliary load, such as a valve or the like. This auxiliary load may be connected either to be normally energized or deenergized by proper choice of connections to one or the other of the contacts **112, 113**. This is indicated by the aid of a dotted line **138.**

The inventor claims:

1. In a hydraulic device: a pump having an inlet and an outlet; an electric motor for driving the pump and having a stator and rotor; a common housing for the pump and motor; liquid in the housing and in communication with the pump inlet; the rotor of said motor being entirely above the level of the liquid, the stator being partially immersed therein, and the pump being entirely immersed in the liquid; and means forming a relief passage from the pump outlet and having an opening discharging into the housing.

2. In a hydraulic device: a pump having an inlet and an outlet; an electric motor for driving the pump and having a rotor; a common housing for the pump and motor; liquid in the housing and in communication with the pump inlet; the rotor of said motor being above the level of the liquid, and the pump being immersed in the liquid; said motor having a shaft; and means for collecting finely divided liquid from above said level and transmitting said collected liquid to the shaft.

3. In a hydraulic device: a pump having an inlet and an outlet; an electric motor for driving the pump; a common housing for the pump and motor; liquid in the housing and in communication with the pump inlet; a member supported on the housing to be available exteriorly of the housing for conducting electrical energy to the motor; a circuit controller for the motor; a support for the circuit controller; means attaching the support to the housing; and a second conducting member carried by the support and separably detachable from the first conducting member when said support is removed from the housing.

4. In a hydraulic device: a pump having an inlet and an outlet; an electric motor for driving the pump; a common housing for the pump and motor; liquid in the housing and in communication with the pump inlet; one or more posts extending from the housing and supported on the housing, for conducting electrical energy to the motor; a circuit controller for the motor; a support detachably mounted on the housing for said circuit controller; and one or more conducting fingers mounted on the support for cooperation with said posts.

5. In a hydraulic device: a motor; an energizing circuit for the motor; a pump; a common housing for the pump and motor; liquid in the housing and adapted to be pumped by the pump; said pump having an outlet; conduit means for by-passing the outlet; and electrically energizable means in the housing for controlling said conduit means, said energizable means being independent of the motor energizing circuit.

6. In a hydraulic device: a motor; an energizing circuit for the motor; a pump; a common housing for the pump and motor; liquid in the housing and adapted to be pumped by the pump; said pump having an outlet; conduit means for by-passing the outlet; said conduit means having an opening above the liquid in the housing; an electromagnet structure having an armature for covering and uncovering said opening; and electrically energizable means in the housing for controlling said conduit means, said energizable means being independent of the motor energizing circuit.

7. The combination as set forth in claim 1 in which said relief passage opening is located above the level of liquid in the housing; and means in the housing above the liquid level for controlling said opening.

8. In a hydraulic device: a pump having an inlet and an outlet; an electric motor for driving the pump; a hydraulic motor connected to the pump outlet and having a wall movable in a path; a common housing for the pump and the motor; the housing providing exterior access to one side of said wall; one or more posts extending from the housing and supported thereby for conducting electrical energy to the electric motor; a circuit controller for the electric motor; a support for said circuit controller detachably mounted on the housing; one or more conducting fingers mounted on the support for cooperation with said posts; and a movable actuator member for said circuit controller and mounted upon said support, said member having a portion projecting into the path of movement of said wall.

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