June 1, 1937. G. W. BOWER 2,082,613

HYDRAULIC OPERATING MECHANISM

Filed Aug. 3, 1934

Fig. 1.

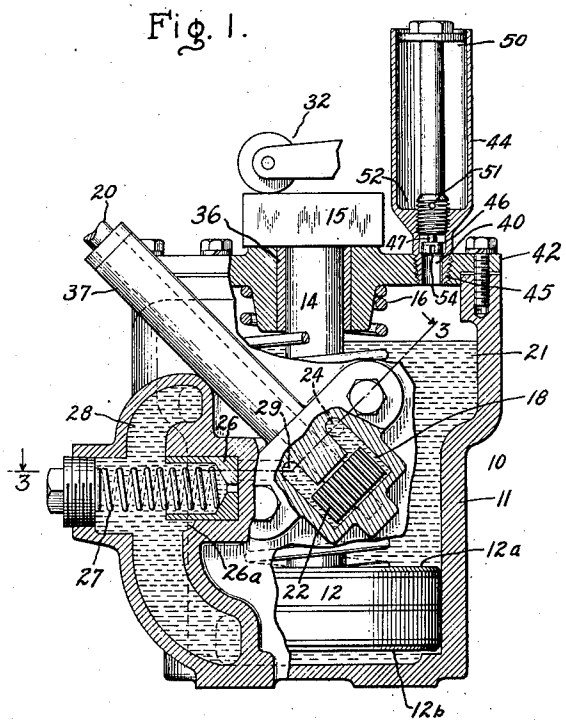


Fig. 2.

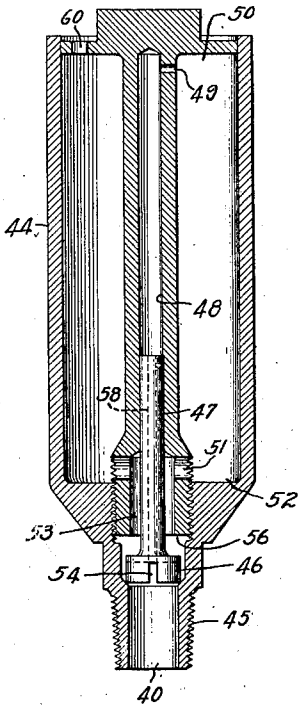


Fig. 4.

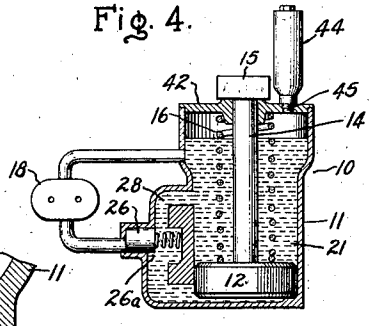
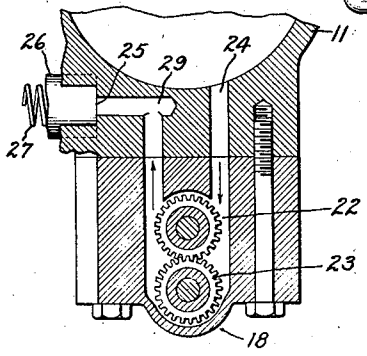


Fig. 3.



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HYDRAULIC OPERATING MECHANISM

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Application August 3, 1934, Serial No. 738,249

6 Claims. (Cl. 60—52)

My invention relates to hydraulic operating mechanisms of the type provided with a piston and has for an object the provision of pressure equalizing means arranged to prevent leakage of the operating fluid from the mechanism.

Heretofore hydraulic operators of the type shown in patent application Serial No. 708,637, McNairy, filed January 27, 1934, now Patent No. 2,072,481, issued March 2, 1937, entitled "Hydraulic operating mechanism for circuit breakers and the like", and assigned to the same assignee as the present invention, have been used to reset circuit breakers. After the hydraulic operator has closed or reset the circuit breaker, a large valve opens permitting the quick return of the operating piston. A pressure greater than atmospheric pressure is thereby generated in the cylinder causing leakage of a mixture of entrapped air and oil around the piston and the pump shaft.

In carrying out my invention in one form thereof, I provide an attachment for equalizing the pressure within the cylinder with the atmospheric pressure outside of the cylinder. More specifically, I provide an auxiliary oil chamber and an automatically operated valve for venting the cylinder through the chamber to the outside atmosphere while separating the leakage oil from the mixture of oil and air and returning the oil to the cylinder.

For a more complete understanding of my invention, reference should now be had to the drawing wherein I have shown in Fig. 1 a sectional elevation of my invention applied to a hydraulic operator; Fig. 2 is an enlarged sectional elevation of an attachment embodying my invention; Fig. 3 is a fractional sectional elevation taken on the lines 3—3 of Fig. 1, while Fig. 4 illustrates diagrammatically the hydraulic operator with my attachment applied to it.

Referring to the drawing, I have shown my invention in one form as applied to a hydraulic operator 10 provided with a cylinder 11 within which is slidably mounted a piston 12 connected by piston rod 14 to an actuating plate 15 located on the outside of the cylinder. A coil spring 16 strongly biases the piston to one position, the piston being operable upwardly against the bias of the spring 16 by means of a pressure producing device shown as a gear pump 18. The gear pump is driven by an electric motor (not shown) connected to a driving shaft 20. The cylinder is substantially filled with a liquid 21, such as oil, so that when the shaft 20 is rotated by the motor the gears 22 and 23 of the gear pump are rotated in a direction to move the oil through an inlet conduit 24 from that portion of the cylinder located above the upper face 12a of the piston 12 against the face 25 of a bypass valve 26. As the pressure builds up against the bypass valve 26 it is operated against the bias of a spring 27 to close a bypass channel 28 extending on opposite sides of the piston 12 and to connect through an opening 26a (Fig. 1) the output end 29 of the gear pump directly to that part of the cylinder located below the face 12b of the piston 12. As the hydraulic pressure is increased by the gear pump the piston 12 is operated against the bias of its spring 16 upwardly, the actuating plate 15 being moved thereby into engagement with a switch actuating member 32, which member can be used to reclose a circuit breaker or for any other purpose. As soon as the piston reaches a predetermined second position, the rotation of the shaft 20 is interrupted by the deenergization of its driving motor. The motor can be deenergized either by a limit switch or by a manually operable switch, neither being shown in the drawing. As soon as the gears 22 and 23 are brought to a standstill the pressure against the lower face 12b of the piston immediately drops to zero. The spring 27 thereupon quickly accelerates the valve 26 to the position shown in Fig. 1, opening the bypass channel 28. At the same time, the spring 16 acting against the upper face 12a of the piston immediately accelerates the piston towards its original position.

As the piston moves downwardly, the displaced oil from below the piston 12 rushes through the bypass channel 28 to the upper side of the piston. The resulting turbulence and the stirring causes the oil to foam and to fill the space adjacent the upper end of the cylinder with a fluid mixture of oil and air. Since the piston rod moving into the cylinder occupies a substantial proportion of the volume within the upper portion of the cylinder, the foam or fluid mixture of oil and air is subjected to a pressure. This pressure is produced because for a given transfer of oil from the lower to the upper side of the piston due to movement of the piston, the increase of volume above the piston is less than the decrease in the volume below the piston. The difference between the two volumes—the volume of the additional portion of the piston rod introduced into the cylinder—being taken up by the compression of the fluid mixture.

Heretofore the pressure was released by the flow of the fluid mixture around the piston rod 14 through its guide bearing 36 to the atmosphere. This flow has not only been undesirable but has made necessary periodic replenishment of the

liquid oil supply within the cylinder. There was also some leakage oil which escaped through the housing 37 provided around the pump actuating shaft 20.

In accordance with my invention pressure in the upper portion of the cylinder is immediately relieved through an inlet opening 40 located on the upper end 42 of the cylinder 11 and permitting a flow of the fluid mixture of air and oil from the cylinder into a container 44 mounted on the cylinder by screw-threaded engagement of its lower end 45 with the cylinder. A valve 46 mounted adjacent the inlet opening 40 is guided for movement between predetermined positions by a valve stem 47 which slidably engages the walls of the passageway 48 extending between opposite ends of the container 44. An opening 49 connects the passageway 48 to the upper end 50 of the container while a plurality of apertures 51 connect the lower end 52 of the container to a passageway 53 of larger diameter than the valve stem 47 so that oil can flow through this passageway 53 from the container to the cylinder, openings 54 being provided in the valve 46 to permit the return of the oil around the valve.

When pressure exists within the upper portion of the cylinder, however, the valve 46 is actuated upwardly from the position shown to a second position in which the valve 46 seats against the surface 56 and thereby closes the passageway 53. A duct or passageway 58 provided through the central portion of the valve 46 and its stem 47 permits the free flow of fluid in the form of oil foam from the cylinder through the passageway 48 and the opening 49 to the container 44. The sharp right-angle turn provided by the opening 49 between the passageway 48 and the upper end 50 of the chamber abruptly changes the direction of travel of the fluid so that the liquid oil collects on the bottom of the container while the air is exhausted to atmosphere through an outlet 60 forming a vent at atmospheric pressure. I have found that by the time the fluid mixture reaches the lower portion of the container the liquid and gaseous portions have so far separated that no perceptible quantity of liquid is carried to the atmosphere.

As soon as the pressure within the cylinder is relieved, the valve 46 operates by gravity to its first position, permitting the return flow of the oil which has been trapped in the container 44 to flow through the apertures 51, the passageway 53, and around the openings 54 through the inlet 40 to the cylinder 11. Since the duct 58 is relatively large as compared with the opening around the piston rod 14 and the opening around the driving shaft 20, I have found that the pressure in the upper portion of the cylinder is diminished so rapidly that no leakage occurs around either the piston or the driving shaft. Consequently, the annoyance of leakage is entirely eliminated by my pressure equalizer and no liquid losses occur since all of the liquid is returned to the cylinder.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Pressure equalizing means for a hydraulic operator having a piston immersed in liquid and means for producing a pressure on one side of said piston, comprising a container provided with inlet and outlet pasageways, said inlet passageway connecting the container to the opposite side of said piston and said outlet passageway forming a vent at atmospheric pressure for said container, a connecting passageway, formed so as to change abruptly the direction of flow between said inlet and outlet passageways and thereby permit the escape of gas but preventing escape of said fluid from said container, and a pressure operated valve in said inlet passageway normally permitting a return flow of liquid from said container and operable in response to pressures above atmospheric pressure for preventing the return flow of liquid from said container, said valve including means for connecting at all times said inlet passageway and said connecting passageway.

2. Pressure equalizing means comprising a casing provided with an inlet and a vent to the atmosphere, normally open valve means connecting said inlet with said casing, said valve means having a passageway at all times connecting said inlet with a remote portion of said casing, and means within said casing forming a restricted flow path from said passageway for changing abruptly the direction of said flow path, said normally open valve means being movable to a closed position in response to the pressure at said inlet to restrict to said passageway the flow path from said inlet to said casing.

3. Pressure equalizing means for hydraulic operators provided with a cylinder and piston mounted therein, comprising a container, walls forming a passageway extending substantially between the ends of said container and open at opposite ends of said container, an inlet between one end of said container and said cylinder, a valve slidably mounted in said passageway operable between predetermined positions for opening and closing said inlet, said valve having a duct providing at all times a flow path from said cylinder to said passageway, said container being provided with an outlet remotely located from said inlet and opening to the atmosphere.

4. Pressure equalizing means for hydraulic operators provided with a cylinder and a piston comprising an oil-receiving container, an inlet from said cylinder to one end of said container, walls forming a passageway from said inlet to the opposite end of said container, said opposite end of said container being provided with an outlet opening to the atmosphere, a valve guided by said passageway for operation between predetermined positions, said valve being provided with a conduit for connecting at all times said container to said passageway, said valve being operable by pressure within said cylinder for closing said inlet to restrict flow of fluid from said cylinder to said container through said passageway.

5. Pressure equalizing means for preventing the flow of leakage liquid from a hydraulic operator provided with a cylinder, a piston, and a piston rod extending through the walls of said cylinder comprising, a container provided with a passageway open at opposite ends of said container, an inlet connecting both said container and its passageway to said cylinder, a valve operable by pressure in said cylinder from one position to a second position for connecting said inlet to said passageway only, and when in said first position connecting said inlet to both said passageway and said container, whereby pressure within said cylinder is quickly exhausted to

the atmosphere, the liquid entrapped in said container and thereafter returned to said cylinder.

6. Pressure equalizing means comprising a casing provided with an inlet and a vent to the atmosphere, valve means mounted within said inlet and provided with a passageway at all times connecting said inlet to the interior of said casing, means within said casing forming a restricted flow path from said passageway for changing abruptly the direction of said flow path, and an additional passageway normally connecting said casing to said inlet, said valve being operable to close said additional passageway and restrict thereby said flow path to said passageway provided in said valve means.

GEORGE W. BOWER.