March 2, 1937. J. W. McNAIRY 2,072,481

HYDRAULIC OPERATING MECHANISM FOR CIRCUIT BREAKERS AND THE LIKE

Filed Jan. 27, 1934

Fig. 1.

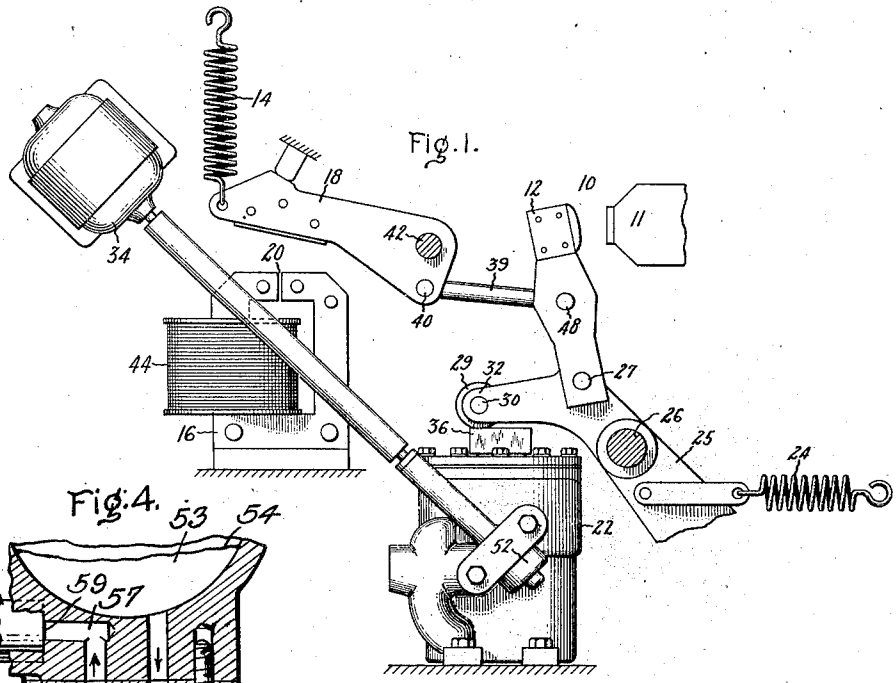


Fig. 4.

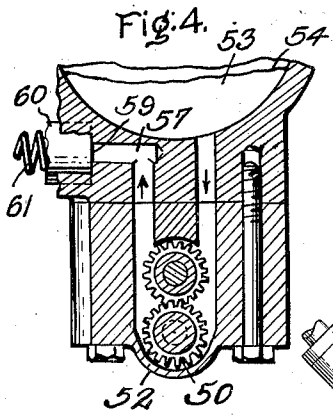


Fig. 5.

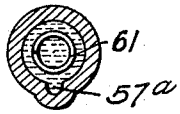


Fig. 2.

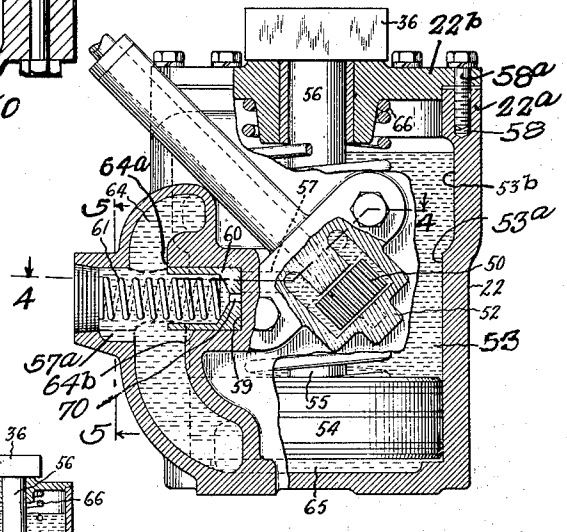
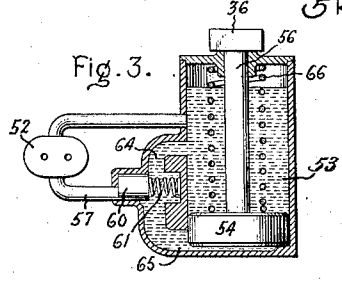


Fig. 3.



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HYDRAULIC OPERATING MECHANISM FOR CIRCUIT BREAKERS AND THE LIKE

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Application January 27, 1934, Serial No. 708,637

6 Claims. (Cl. 60—52)

My invention relates to hydraulic operating mechanisms for circuit breakers and the like and has for an object the provision of a simple, positive-acting hydraulic mechanism for resetting a circuit breaker after it has been tripped.

In applying an hydraulic operator to circuit breakers of the trip-free type it is desirable to provide means permitting a quick return of the hydraulic operator after the circuit closing operation has been initiated so that the circuit breaker will be free to open its contacts immediately in case of overload. Furthermore, the ordinary by-pass valves heretofore used on hydraulic operators do not permit a quick retraction of the hydraulic operating mechanism and furthermore are not sufficiently positive in operation to be reliable under all conditions of operation.

In carrying out my invention in one form thereof I provide a gear pump arranged to apply pressure to a switch-operating piston, the operation of a controlling by-pass valve being accomplished in response to pressure developed by the pump. The by-pass valve is of relatively large diameter and is normally biased to its open position by means of a compression spring. In closing the circuit breaker the gear pump motor is energized to drive liquid against the face of the by-pass valve to move it to a closed position to transfer the flow of fluid to the operating piston. A further feature of the invention is the provision of a relatively small opening in the face of the by-pass valve so that a minimum resistance is encountered in the movement of the valve from the closed position to the open position with respect to the by-pass passageway.

For a more complete understanding of my invention, reference should be had to the accompanying drawing wherein I have shown diagrammatically in Fig. 1 my invention applied to a circuit breaker; Fig. 2 is an elevation, partly in section, of the gear pump; Fig. 3 diagrammatically illustrates the hydraulic system of the gear pump of Fig. 2; Fig. 4 is a sectional elevation taken on the lines 4—4 of Fig. 2, and Fig. 5 is a sectional elevation taken on the lines 5—5 of Fig. 2.

Referring to the drawing, I have shown my invention in one form as applied to a circuit breaker 10 provided with a stationary contact 11 and a movable contact 12. The movable contact 12 is normally biased to the open circuit position by means of a strong opening spring 14, a holding magnet 16 being arranged to cooperate with an armature 18 to hold the circuit breaker in the closed circuit position. It will be observed that the electromagnet 16 is provided with an air gap 20 in which is mounted a tripping coil or bucking bar (not shown) arranged to shift the magnetic flux from the armature 18 to permit the opening of the circuit breaker.

Circuit breakers of this general character are designed to carry currents of large magnitude, the parts being relatively heavy to provide adequate current carrying capacity. Consequently in order to insure the high speed opening of the circuit breaker, a large amount of energy is stored in the opening spring 14 during the circuit closing operation. The spring 14 of course presents a substantial amount of resistance to the closing operation. I have found it desirable to provide a gear pump hydraulic closing device 22 to close the circuit breaker against the strong bias of the opening spring. The circuit breaker 10 is trip-free, that is to say it cannot be held in the closed circuit position by means of the operating member or hydraulic closing means 22, the trip-free feature being provided by a closing spring 24 connected to a switch member 25 pivoted at 26 and to which is pivoted at 27 the movable contact member 12.

In order to close the circuit breaker with the parts in the positions shown an electric motor 34 is energized and operates the gear pump closing means 22 to move a plunger 36 against the roller 29, mounted by means of a pin 30 in the divided end 32 of the switch member 25. As the plunger 36 rises it moves the end 32 of the switch member 25 in a clockwise direction around its pivot 26, thereby moving the movable contact 12 a predetermined distance towards the circuit closing position. A link 39 connected to the movable contact member 12 and to one end 40 of the armature 18 causes the armature pivoted at 42 to be rotated in a counter-clockwise direction into engagement with the holding magnet 16. At this time the operating coil 44 of the holding magnet 16 is energized and maintains the armature 18 against the magnet. The opening spring 14 and the closing spring 24 are under a maximum amount of tension. As soon as the armature 18 is operated into engagement with the electromagnet the motor 34 is deenergized and the closing means 22 automatically retracts the plunger 36 in a very short interval of time. As the plunger 36 moves downwardly the closing spring 24 rotates the switch member 25 in a counter-clockwise direction, one end 48 of the connecting link 39 thereupon providing a pivot point for the movable contact member 12 so that the movable contact member 12 is rotated in a clockwise direction into engagement with the stationary contact 11.

Referring to Figs. 2 and 3, the operation of the closing means 22 will now be described in detail and it will be apparent how I accomplish the positive operation of the hydraulic operator and provide for a quick retraction of the plunger 36 after the circuit closing operation has been completed.

As soon as the motor 34 is energized the gears 50 of a gear pump 52 are rotated in a direction to transfer oil or a similar liquid from a reservoir which comprises the upper side 53 of a piston 54 secured to one end 55 of a rod 56 connected to the plunger 36. The movement of the piston 54 is not greater than the cylinder guide wall 53a, the upper end of which surface terminates adjacent an enlarged portion 53b of the cylinder. The enlarged portion 53b permits the insertion of a cylinder boring tool for the machining of the cylinder guide wall without the necessity of machining the entire inner surface of the device 22. Furthermore, a slightly larger oil storage space is provided by this enlarged portion 53b. The upper end 22a of the cylinder is provided with threaded holes 58 to receive threaded bolts 58a which serve to secure the cylinder head 22b to the cylinder.

Continuing with the operation of my invention, the flow of oil from the gear pump is conducted through the conduit 57 to the face 59 of a by-pass valve 60 which is biased to its open position by a compression spring 61. As the pressure builds up on the face 59 of the by-pass valve 60 it is operated against the bias of the spring 61 until it closes the upper half of a conduit 64 extending between the upper side 53 of the piston 54 and a chamber having a movable wall comprising the lower side 65 of the piston 54. The lower half 64b of the conduit 64 is offset with respect to the upper half 64a so that the valve when in its closed position connects the lower half of the conduit 64 to the conduit 57. A groove 57a is provided to insure adequate room for the flow of oil.

By operating the valve directly with the output from the gear pump any tendency for the valve 60 to stick is overcome, since in that event the pressure would be gradually built up by the gear pump 52 on the value until it is operated. It will be understood by those skilled in the art that the pressure built up by the gear pump may be of the order of several hundred pounds per square inch which, of course, would be more than ample to free the valve 60 from the worst possible case of sticking that might be encountered.

Continuing with the operation of my invention, as soon as the by-pass valve 60 is operated to close the conduit 64 the output of the gear pump 52 will be applied to the lower side 65 of the piston 54. The flow of oil from the gear pump is by way of conduit 57, groove 57a, and the lower half of conduit 64. The groove 57a insures an unrestricted flow of oil to the lower side 65 of the piston. The pressure built up by the flow of oil moves the piston 54 gradually and positively upward against the bias of a retracting spring 66, the plunger 36 engaging the roller 29 to initiate the closing of the circuit breaker 10.

As soon as the piston 54 has been operated to its uppermost position corresponding to the time the armature 18 has been moved against the electromagnet 16, the motor 34 is deenergized and quickly comes to a standstill. As soon as the gears 50 and 51 of the gear pump stop, the pressure exerted against the face 59 of the by-pass valve 60 drops to zero and the spring 61 operates the valve to the position shown in Fig. 2. In order to minimize the resistance of the valve face 59 against the head of oil, an aperture 70 is provided in the valve face 59. The size of the aperture is not sufficient, however, to prevent the building up of the pressure against its face 59.

With the valve open, the conduit 64 which is of relatively large diameter, permits a relatively large volume of oil to flow immediately from the lower side 65 of the piston 54 to the upper side 53, thereby permitting the retracting spring 66 to operate quickly the piston to the position shown in Fig. 2. In actual operation I have found that in a typical installation the hydraulic pump operated the plunger 36 to its outermost position in approximately two seconds and permitted the retraction of the plunger 36 in substantially one-half second, this time for the sequence of operations being entirely satisfactory for the closing of the circuit breaker 10.

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 in the United States is:

1. An hydraulic operating mechanism comprising a housing containing a liquid, a gear pump mounted in said housing, an operating piston, a passageway extending between the upper and lower sides of said piston, a by-pass valve in said passageway normally biased to its open position for the flow of liquid through said passageway, means for directing the liquid from said pump against said valve so that the fluid pressure developed by said gear pump acts directly on said valve to operate it to its closed position to close said passageway, an opening being provided around said valve for the flow of said liquid against one face of said piston, and means for decreasing the fluid resistance of said valve for insuring a rapid movement of said valve when operated from said closed position to said open position.

2. An hydraulic operating mechanism, comprising a housing containing a liquid, a piston mounted in said housing, a gear pump, a passageway connecting the upper and lower sides of said piston, a by-pass valve operable from an open position to a closed position to prevent the flow of liquid from one side of the piston to the other, a conduit connecting one side of said gear pump to the upper side of said piston, and a second conduit connecting said gear pump to said by-pass valve, the flow of liquid from said gear pump being applied directly to said by-pass valve to operate it from its open position to its closed position, said valve when in said closed position connecting said second conduit to said passageway for the flow of liquid to the lower side of said piston.

3. An hydraulic mechanism comprising a housing containing a liquid, a piston mounted in said housing for movement between predetermined positions, a conduit of relatively large cross sectional area extending between the upper and lower portions of said housing above and below the said predetermined positions of said piston, a by-pass valve normally biased to an open position and arranged to be operated to a closed position to prevent the flow of fluid between the upper and lower sides of said piston, a gear pump, con-

duits connecting the output side of said gear pump to one face of said valve and the input side of said gear pump to said upper portion of said housing, the operation of said gear pump thereby forcing liquid against said by-pass valve to operate positively said valve to said closed position, said valve when in said closed position permitting the flow of liquid from said pump to the lower side of said piston, and means biasing said piston to its lowermost position whereby said piston is returned to said lower position as soon as said pressure on said by-pass valve decreases sufficiently to permit its biasing means to operate said valve from said closed position to said open position.

4. An hydraulic operating mechanism comprising a housing containing a liquid, a piston slidably mounted in said housing, a passageway connecting the upper and lower sides of said piston, a gear pump, a conduit connecting one side of said pump to said upper side of said piston to receive oil therefrom, a second conduit connecting the other side of said gear pump to said passageway intermediate the ends thereof for the delivery of liquid thereto, a by-pass valve slidably mounted for movement between open and closed positions, biasing means for biasing said valve to said open position, said valve when in said open position being operable to said closed position by the flow of liquid from said second conduit, said valve when in said closed position connecting said second conduit to that part of said passageway connected to said lower side of said piston and closing that portion of said passageway connected to said upper side of said piston.

5. An hydraulic operator comprising a liquid filled chamber having a movable wall, a reservoir, a passageway extending between said chamber and said reservoir, a by-pass valve in said passageway normally biased to its open position to permit the flow of liquid through said passageway, pumping means connected to said reservoir, means for directing the liquid from said pumping means against said valve so that the pressure developed by said pump acts directly on said valve to operate it to its closed position and thereby close said passageway, said valve when in said closed position providing for the flow of said liquid into said chamber to move said wall, and means for decreasing the fluid resistance of said valve for insuring a rapid return movement of said valve from said closed position to said open position upon a predetermined decrease in the pressure supplied by said pumping means.

6. An hydraulic operator comprising a liquid filled chamber having a movable wall, a reservoir, a passageway extending between said chamber and said reservoir, a by-pass valve in said passageway normally biased to its open position to permit the flow of liquid through said passageway, pumping means connected to said reservoir, means for directing the liquid from said pumping means against a face of said valve so that the pressure developed by said pumping means acts directly on said valve to operate it to its closed position and thereby close said passageway, said valve when in said closed position providing for the flow of liquid into said chamber to move said wall, and means including an aperture in said valve face for minimizing the liquid resistance to movement of said valve from said closed to said open position to insure a rapid return movement of said valve upon a predetermined decrease in the pressure supplied by said pumping means, the size of said aperture being insufficient to prevent the building up of pressure on said valve face by said pumping means.

JACOB W. McNAIRY.