

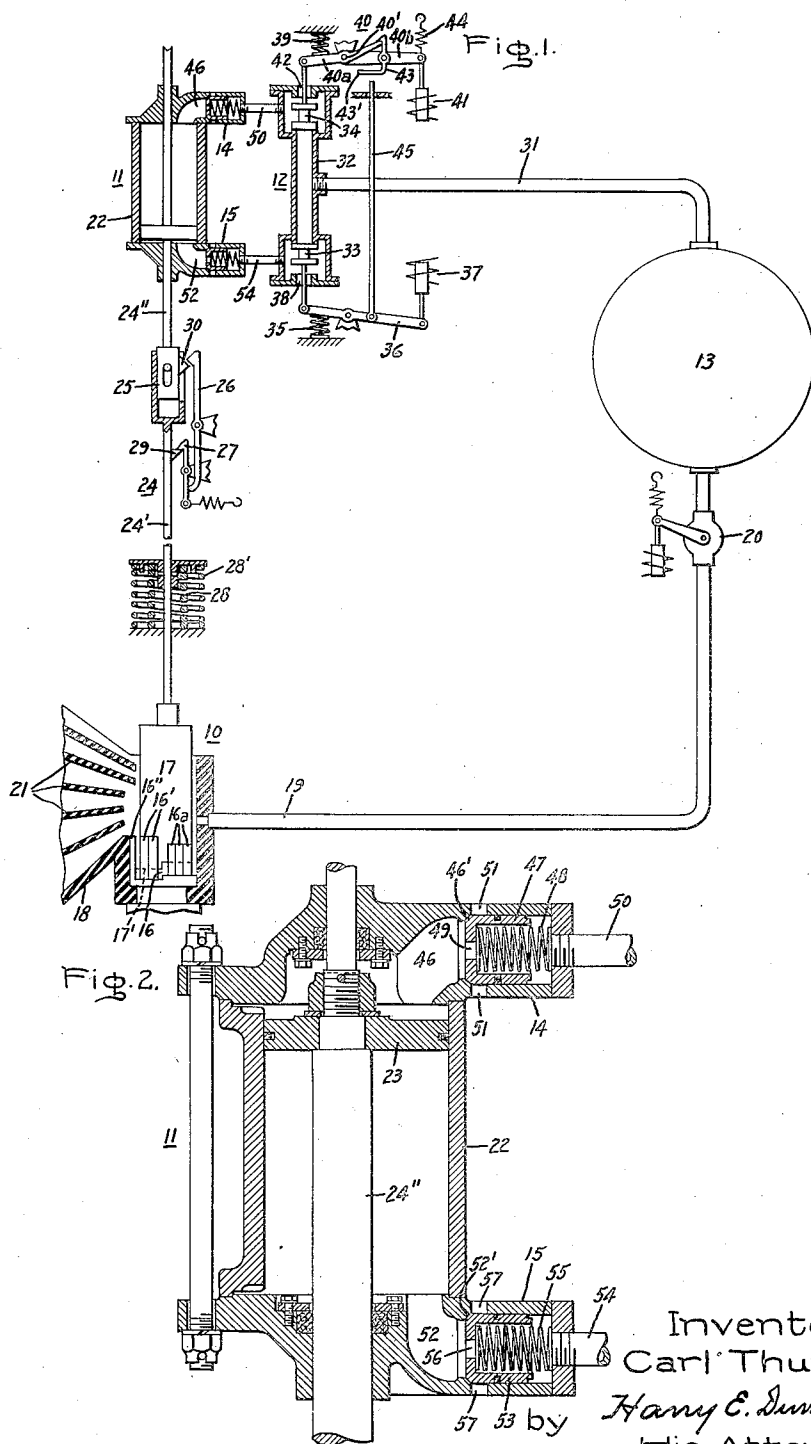
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ELECTRIC CIRCUIT BREAKER

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ELECTRIC CIRCUIT BREAKER

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5 Claims. (Cl. 200—82)

My invention relates to an electric circuit breaker and more particularly to a trip-free fluid-actuated operating mechanism therefor constructed so that the means to be actuated, such as the circuit breaker, can be released with respect to the fluid-actuated operating mechanism during the course of the closing stroke and prior to completion thereof.

Heretofore, circuit breaker operating mechanisms of the trip-free type have generally included a collapsible linkage arrangement or the like involving a more or less complicated design of toggles, levers, and latches. Since the trip-free type mechanism is required to be very rapid in action due to the fact that immediate trip-free operation of the circuit breaker is essential when the circuit breaker is closed on a fault current, mechanical arrangements have been preferred heretofore due to the unsatisfactory operation of the known fluid-actuated operating mechanisms. A trip-free fluid-actuated operating mechanism serving as satisfactorily as the comparable mechanical arrangements known heretofore would be very desirable in order to avoid the complicated design of toggles, levers, and latches ordinarily required. The demand for a satisfactory trip-free fluid-actuated operating mechanism has increased greatly due to the recent demand for gas-blast circuit breakers wherein fluid-actuated means, such as pneumatic-operating means, are most feasible.

Because of the importance of continuity of service, high-speed reclosing circuit breakers of all types have been developed. Fluid-operated circuit breakers have heretofore presented problems with regard to high speed reclosing analogous to those encountered in trip-free operation, and it would be desirable to provide a fluid-actuated operating mechanism which is not only trip-free in operation but which is readily adaptable to high-speed reclosing of the associated circuit breaker.

It is an object of my invention, therefore, to provide a new and improved trip-free fluid-actuated operating mechanism that is efficient, positive, and rapid in operation, rugged and compact in design, and composed of a comparatively few essential operating elements.

It is another object of my invention to provide a fluid-actuated operating mechanism for electric circuit breakers which is not only trip free in operation but which readily lends itself to high-speed reclosing of the circuit breaker.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention, 60

reference may be had to the accompanying drawing in which Fig. 1 is a partly diagrammatic layout of a trip-free operating mechanism for an electric circuit breaker embodying my invention, while Fig. 2 is an enlarged cross-sectional view of a portion of the apparatus illustrated in Fig. 1.

Referring now to Fig. 1 of the drawing, I have illustrated an electric circuit breaker 10 arranged to be operated by a fluid motor 11 which is controlled by a valve arrangement, generally indicated at 12, connected to a suitable source 13 of fluid under pressure. As will be described in greater detail hereinafter, means including a pair of independent dumping valves 14 and 15 are interposed between the fluid motor 11 and the valve arrangement 12 so that trip-free operation and high-speed reclosing, if desired, of circuit breaker 10 may be obtained.

Although my invention is applicable to any fluid-operated circuit breaker, for the purpose of simplifying the drawing and the description, I have merely illustrated my invention as applied to a single-phase fluid-operated circuit breaker 10 of the cross gas-blast type comprising a stationary contact 16 and a movable contact 17 arranged to be operated so as to draw an arc in arc chute 18. Contacts 16 and 17 are arranged to be connected to suitable line terminals, not shown, by means well understood by those skilled in the art. The fixed contact 16 is provided with spring-pressed contact fingers 16a and longer arcing contact fingers 16', while movable contact 17 is provided with an arcing tip 17' so that, when the contacts separate, an arc is drawn between arcing tips 16' and 17'. Immediately after separation of the contacts, one terminal of the arc is transferred by a blast of fluid, such as air, issuing from conduit 19 which is preferably connected to source 13 through a solenoid-operated valve 20 from contact fingers 16' to the arcing plate 18'', which is preferably provided with a tip of arc-resistant metal. The fluid blast issuing from conduit 19 upon opening of the circuit breaker 10 drives the arc drawn into arc chute 18 against the edges of the plurality of partitions 21 mounted in the arc chute 18 transverse to the arc gap and the ends of which extend close to the path of movement of the arcing tip 17' of movable contact 17. The circuit breaker 10, illustrated by way of example in order better to describe my trip-free fluid-actuated operating mechanism, is not my invention but is described and claimed in United States Letters Patent 2,284,842, granted June 2, 1942, upon the joint application of David C. Prince, William K. Rankin, and Wilfred F. Skeats and assigned to the same assignee as the present application.

In order to produce relative movement between contacts 16 and 17 through the utilization of fluid under pressure, I provide a fluid-operated

motor 11, which comprises a cylinder 22 in which is reciprocatingly mounted a piston 23 operatively connected to movable contact 17 by means of connecting rod 24. This connecting rod 24 comprises two parts, 24' and 24'', joined with one another by a lost-motion connection 25 which, in turn, is arranged to operate a tripping means 26 for releasing latch 27 which holds the circuit breaker 10 in the closed position. For high-speed opening of circuit breaker 10, it is desirable to release some form of energy-storage means to aid the fluid-operated means during the opening operation. Accordingly, I have illustrated an energy-storage means which comprises a spring 28 illustrated in the charged condition when circuit breaker 10 is closed. As illustrated in the drawing, balancing spring 28' just strong enough to balance the weight of the parts of the movable structure is supplied to hold the circuit breaker 10 in the open position. Latch 27 is provided in order to hold springs 28 and 28' in the charged condition so as to be ready for high-speed opening of circuit breaker 10. As shown, springs 28 and 28' are arranged to be charged or compressed by the fluid motor 11 during the closing movement of circuit breaker 10, and latch 27 cooperating with member 29 attached to the portion 24' of operating rod 24 restrains the circuit breaker and the springs 28 and 28' in the closed and charged positions, respectively, until upward movement of the piston 23 causes member 30 of the lost-motion connection 25 to engage with tripping means 26, whereby latch 27 is released.

In order to operate piston 23 and, consequently, also movable contact 17 in response to fluid pressure, source 13 of fluid under pressure, which may for example, be air under pressure, is connected by means of a conduit 31 to a manifold 32 of valve arrangement 12 from which the fluid under pressure may be led to either end of cylinder 22 in accordance with the operation of either a circuit breaker opening valve 33 or a circuit breaker closing valve 34. Opening valve 33 is normally held in the position indicated in Fig. 1, closing the lower end of manifold 32 against the fluid pressure from conduit 31, by means of a relatively heavy spring 35 acting on a lever 36 associated with opening valve 33. Valve 33 is arranged to be operated by opening solenoid 37 which is connected to one end of lever 36. In its opened position, opening valve 33 is adapted to close an escape port 38 in manifold 32 through which fluid may escape under certain conditions as will be described hereinafter.

Similarly, closing valve 34 is normally held in the position indicated in Fig. 1, closing the upper end of manifold 32 against the fluid pressure from conduit 31 by means of a relatively heavy spring 39 acting on lever 40 associated with closing valve 34. Lever 40, however, comprises two parts, namely, 40a and 40b, both mounted on a fixed pivot 40' and, hence, differs from lever 36 associated with opening valve 33 in a manner which will be described in greater detail hereinafter. Closing valve 34 is arranged to be operated by closing solenoid 41. In its open position, closing valve 34 is adapted to close an escape port 42 through which fluid may escape to atmosphere under certain conditions.

Trip-free operation of circuit breaker 10 is obtained by virtue of dumping valve 14, which will be described in detail hereinafter, and the particular construction of lever 40 and its cooperation with lever 36. Accordingly, lever 40 associated with closing valve 34 and closing solenoid

41 is constructed of two parts, 40a and 40b as mentioned above, which are held together as a single lever by means of a latch 43 pivotally mounted on member 40b and adapted to engage with an extension of member 40a. A relatively light spring 44 is provided to bias the member 40b in such a direction that latch 43 may engage the extension on member 40a. It will be understood, of course, that suitable spring means will be provided for latch 43 so as normally to tend to rotate it in a counterclockwise direction to engage with the extension of member 40a.

In view of the arrangement just described, lever 40 acts as a unitary member when closing solenoid 41 is energized to open closing valve 34 and, hence, to cause closing of circuit breaker 10. If, however, during the closing operation of the circuit breaker 10, opening solenoid 37 should be energized through any cause, such, for example, as an abnormal current condition on the power circuit associated with circuit breaker 10, opening valve 33 would be operated. In order to obtain rapid closing of closing valve 34 under such conditions and trip-free operation of circuit breaker 10, I provide a rod 45 associated with opening lever 36 which is arranged to engage a projection 43' on latch 43, thereby releasing lever 40a and allowing heavy spring 39 to close valve 34 rapidly even though closing solenoid 41 is still energized and holding lever 40b downwardly against the tension of relatively light spring 44. The operating mechanism thus far described is disclosed and claimed in my co-pending application filed jointly with Edward J. Frank and Alexander C. Boisseau, Serial No. 317,564, on February 6, 1940, and assigned to the same assignee as the present application.

Without dumping valve 14, however, trip-free operation of circuit breaker 10 would not be obtained to a very satisfactory degree since it is evident that the reversal of piston 23 during the closing stroke will be delayed by the back pressure acting thereon. In accordance with my invention, therefore, dumping valve 14 is provided, immediately to reduce this back pressure to a very low value, upon the initiation of a trip-free operation. Dumping valve 14 is interposed between closing valve 34 and the large inlet 46 at the upper end of cylinder 22 of fluid motor 11. As best shown in Fig. 2, dumping valve 14 comprises a reciprocating pistonlike valve member 47 movably mounted in a suitable housing. A light spring 48 normally biases dumping valve member 47 against valve seat 46' adjacent the relatively large inlet 46 to cylinder 22. Dumping valve member 47 is provided with a suitable opening 49, which is somewhat smaller than inlet 46, at the upper end of cylinder 22, through which fluid under pressure passing through valve 34 and conduit 50 may enter cylinder 22 so as to cause closure of circuit breaker 10. The relative size of openings 46 and 49 is of no consequence as far as my invention is concerned, it being merely necessary that opening 46 is somewhat and preferably considerably larger than opening 49.

Whenever closing valve 34 is opened, fluid under pressure will tightly hold pistonlike dumping valve member 47 against seat 46' causing the dumping valve to remain closed so that the full fluid pressure is urged against piston 23. If during the closing operation of circuit breaker 10, however, opening solenoid 37 were energized by virtue of a fault condition existing on the power lines associated with circuit breaker 10, rod 45 would cause release of lever 40a and im-

mediate closing of closing valve 34 would result as well as opening of escape port 42. The fluid pressure therefore, tending to hold dumping valve 47 against seat 46' having been released through escape port 42, the back pressure in cylinder 22 upon reversal of piston 23 will cause dumping valve member 47 to move away from seat 46', thereby opening very large escape ports 51 and almost instantaneously reducing the pressure in cylinder 22 so that very high-speed opening and true trip-free operation of circuit breaker 10 may be obtained without the requirement of complicated toggles, links, and latches used in prior-art arrangements.

If it were desired to obtain high-speed reclosing of circuit breaker 10 after a tripping operation, means would be required to reduce the back pressure below piston 23 for, otherwise, it would be impossible to reclose with any speed. Accordingly, large inlet 52 at the lower end of cylinder 22 of fluid motor 11 is provided with a valve seat 52' cooperating with dumping valve member 53 of dumping valve 15 which may be identical in all respects with dumping valve 14 described above. Dumping valve 15 is interposed between large inlet 52 and conduit 54 leading to opening valve 33. A relatively light spring 55 is provided to hold dumping valve member 53 against valve seat 52' and, as in dumping valve 14, dumping valve member 53 is provided with a suitable opening 56 through which fluid under pressure may be conveyed from opening valve 33 to cylinder 22. When reclosing circuit breaker 10 under high speed, opening valve 33 is closed and escape port 38 is opened so that a relatively small pressure below piston 23 will cause dumping valve member 53 to move away from dumping valve seat 52' and allow the fluid to escape through very large ports 57, thereby rapidly reducing the back pressure against piston 23 so that high-speed reclosure of circuit breaker 10 may be obtained. It will be understood by those skilled in the art that, by properly positioning dumping valves 14 and 15, light springs 48 and 55 may be dispensed with and valve members 47 and 53 may be held against their respective seats 46' and 52' by gravity.

In view of the detailed description included above, the operation of my trip-free fluid-actuated operating mechanism will be obvious to those skilled in the art. The operation of the high-speed reclosing feature will also be obvious. It will be observed that dumping valves 14 and 15 are entirely independent and, if high-speed reclosing is not desired, dumping valve 15 might be dispensed with under certain conditions. In any event, dumping valves 14 and 15 are of simple, rugged construction and adapted instantly to reduce the back pressure resulting from the rapid reversal of fluid motor 11 so that trip-free operation or high-speed reclosing, as the case may be, are obtained.

It will be apparent to those skilled in the art that my invention is not limited to the particular construction shown but that changes and modifications may be made without departing from the spirit and scope of my invention, and I aim in the appended claims to cover all such changes and modifications.

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

1. In a fluid-actuated operating mechanism for an electric circuit breaker, a source of fluid

under pressure, a fluid motor arranged to be connected to said source, means operatively relating said motor to said circuit breaker for operating said breaker, and means interposed between said source and said fluid motor for substantially instantaneously relieving the fluid pressure acting in one direction on said motor so that high-speed reversal thereof may be obtained comprising a valve member operable in response to a relatively small force produced by virtue of the back pressure resulting upon the reversal of said fluid motor.

2. In an operating system for an electric circuit breaker comprising a plurality of relatively movable contacts, a fluid motor for producing relative movement between said contacts, a source of fluid under pressure for operating said motor, means for connecting said source of fluid with said fluid motor for operating said circuit breaker, and means interposed between said fluid motor and said first-mentioned means for substantially instantaneously relieving the fluid pressure tending to retard the reversal of said fluid motor either from closing to opening or from opening to closing movements of said circuit breaker.

3. In a fluid-actuated operating mechanism for an electric circuit breaker comprising a plurality of relatively movable contacts, a fluid motor comprising a cylinder and piston for producing relative movement between said contacts, a source of fluid under pressure for operating said motor, means for connecting said source of fluid with said motor for closing said circuit breaker, and means interposed between said fluid motor and said first-mentioned means for rapidly relieving the fluid pressure tending to retard the reversal of said fluid motor to open said circuit breaker including a valve member operable in response to a relatively small force produced by virtue of the back pressure resulting upon the reversal of said fluid motor for opening a large escape port between said cylinder and atmosphere.

4. In a fluid-actuated operating mechanism for an electric circuit breaker, a source of fluid under pressure, a fluid motor arranged to be connected to said source, means operatively relating said motor to said circuit breaker for closing said circuit breaker, a pair of dumping valves interposed between said source and said fluid motor for rapidly relieving the fluid pressure tending to retard the reversal of said fluid motor whereby trip-free operation and high-speed reclosing of said circuit breaker may be obtained.

5. In an operating system for an electric circuit breaker comprising a plurality of relatively movable contacts, a source of fluid under pressure, a fluid motor for producing relative movement between said contacts arranged to be connected to said source, said fluid motor comprising a cylinder and a piston reciprocally mounted therein, means defining a relatively large opening in either end of said cylinder arranged to be selectively connected to said source of fluid pressure or to atmosphere, and means including a dumping valve associated with the opening at one end of said cylinder and operable in response to the back pressure acting on said piston upon reversal thereof for substantially instantaneously relieving said back pressure to permit high-speed reversal of said fluid motor.

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