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T. R. COGGESHALL

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ELECTRIC CIRCUIT BREAKER

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Fig. 1.

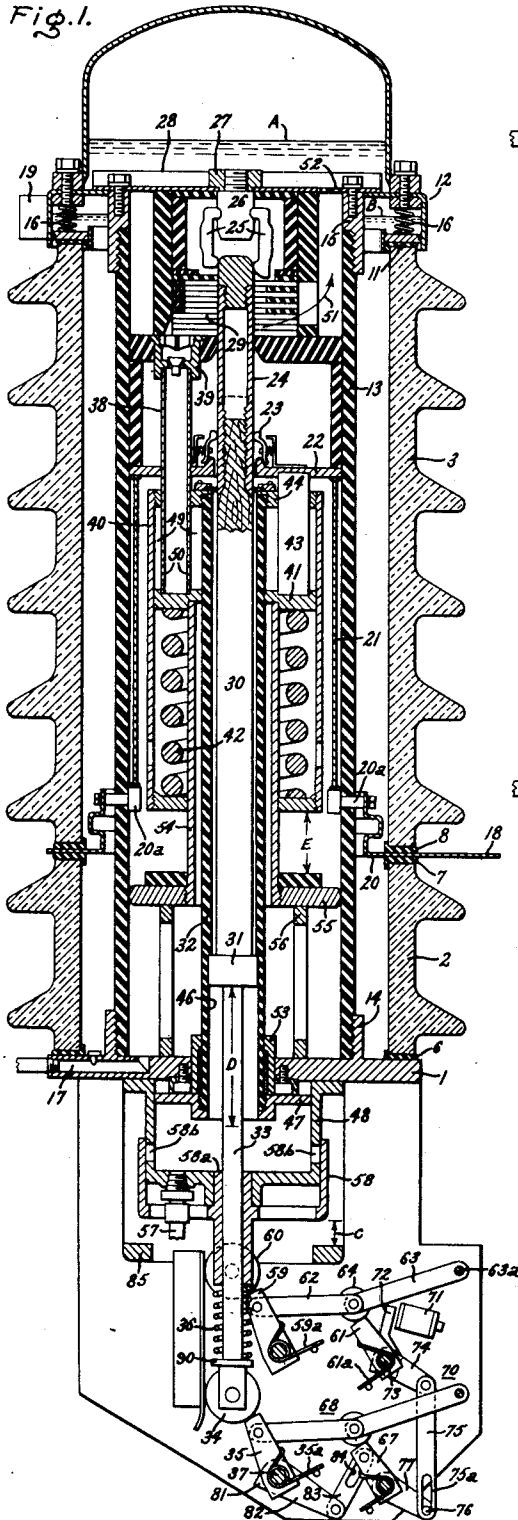


Fig. 2.

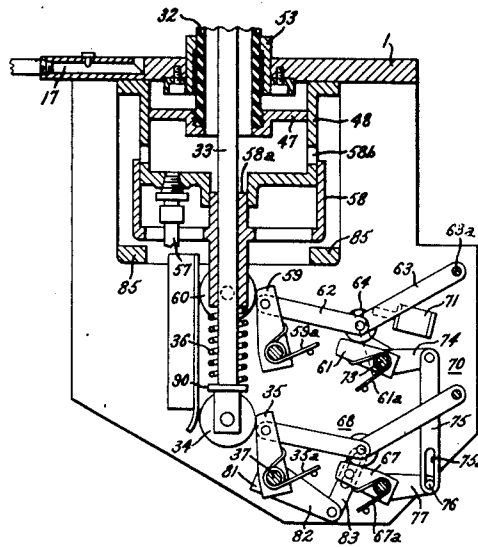
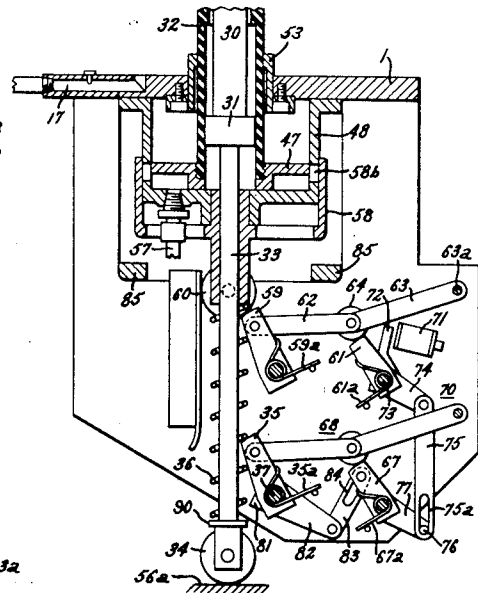


Fig. 3.



Inventor:
Thellwell R. Coggeshall,
by *J. Wesley Humber*
His Attorney.

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2,789,186

ELECTRIC CIRCUIT BREAKER

Thellwell R. Coggeshall, Cynwyd, Pa., assignor to General Electric Company, a corporation of New York

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13 Claims. (Cl. 200—150)

This invention relates to electric circuit breakers and more particularly to high voltage circuit interrupters of the so-called impulse type wherein a flow of liquid dielectric is forced by piston means between the contacts of a circuit breaker after separation thereof in order to aid in extinguishing the arc drawn therebetween.

The trend toward higher system voltages and breaker voltage ratings inherently tends to increase the physical size of circuit breaker structures since higher voltage ratings must of necessity require longer creepage distances and greater gap separation distance of the contacts. Furthermore, the physical size and weight of the breaker operating mechanism is generally proportional to the size of the breaker. Since the size of a breaker and its operating mechanism determines the cost, it is desirable to keep the breaker dimensions at a minimum consistent with proper performance.

A principal object of this invention is to provide a compact arrangement of the various elements of an impulse-type circuit breaker and its operating mechanism.

Another object of this invention is the provision of an improved circuit interrupter of the impulse type wherein the operating mechanism, the impulse means, and the contacts are disposed coaxially in a vertical disposition so as to minimize the amount of floor or ground space required for the breaker.

Still another object is to provide for an electric circuit breaker an improved compact fluid-actuated operating mechanism which is capable of providing rapid and effective trip-free opening operation.

According to one form of the invention, an electric circuit interrupter is provided with a reciprocally movable rod-like contact, impulse piston and cylinder means, together with fluid actuating means, all of which elements are coaxially disposed and contained within a continuous enclosing structure. According to another feature of the invention a quick-release latched-closed dump valve of large pressure-release area is characterized by having but a relatively small actuating surface area which is exposed to the fluid pressure supplied to the operating mechanism for the circuit breaker. Because of this small actuating surface a sensitive high-speed latch, or prop, can be, and is, used for holding the dump valve closed against the force of said fluid pressure. Thus, when the latch receives an operating impulse, say during the performance of a circuit breaker closing operation with a fault present on the line, it causes the valve quickly to open suitable dumping ports. This produces an immediate collapse in the fluid pressure within the operating mechanism and thereby enables appropriate energy-storing means to impart an advantageous quick reversal to the circuit breaker operating parts.

The invention will be better understood from the following description taken in conjunction with the drawing in which Fig. 1 is a cross-sectional view of an interrupter and its operating mechanism embodying the invention with the parts shown in the closed position of

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the breaker; Fig. 2 is a cross-sectional view of the lower portion of Fig. 1 with the moving parts shown transiently with the breaker almost open and with the dump valve about to reset; while Fig. 3 shows these parts in their positions of rest which they will occupy with the breaker in its fully open circuit position.

Referring now to Fig. 1, I provide a metallic base-plate 1 on which is mounted porcelain shell sections 2 and 3 which together form an enclosing structure for the circuit breaker. A gasket 6 of resilient insulating material such as rubber is interposed between the base-plate 1 and the ceramic shell 2. Similar insulating gaskets 7 and 8 are interposed between the ceramic shells 2 and 3, while still another insulating gasket 11 is mounted between the upper end of shell section 3 and metallic closure structure generally designated by the numeral 12.

The structure described thus far is maintained sealingly in compression by means of a mechanically strong insulating tubular casing 13 which is shown sealingly secured to the base member 1 at its lower extremity by an internally threaded collar 14. Likewise, the upper end of the casing 13 is shown secured to the upper closure structure 12 by the bolted collar structure 15. The tensional tubular casing 13 and the compressional porcelain shell elements 2 and 3 are maintained in constant resilient relationship through the interaction of an annular series of yieldable compression springs 16 which bear against an annular plate which telescopes sealingly within the cylindrical flange of the closure structure 12 as shown.

It is preferable to avoid free communication between the contaminable interrupter oil filling the interior of casing 13 and the purely insulating oil for the ceramic shell surrounding the casing 13. To this end, the flange portion of the structure 12 serves as a division barrier which permits two oil levels to be maintained, that of the interrupter (which is indicated as oil level A) lying above the flange structure, and that of the shell (indicated as oil level B) lying within the flange structure. However, oil from both sides of the casing 13 may be drained out through the drain passage indicated by the numeral 17 which is shown in communication with the inside of the casing 13 and with the annular space between the casing and the weatherproof insulating shell sections 2 and 3.

The circuit breaker has an upper and a lower terminal, the lower terminal being indicated at 18, while the upper terminal is indicated by the numeral 19 and, preferably, is electrically connected by brazing or welding so as to be integral with the closure member 12. Terminal 18 is an extension of an annular bellows-like structure 20, a flange of which is clamped between the insulating gaskets 7 and 8, and having the upstanding portion thereof electrically connected to the interrupter structure by a plurality of conducting studs 20a which extend sealingly through openings formed within the casing 13 and which, at their inner ends, connect to the internal metallic conducting sleeve 21. Sleeve 21 at its upper end is welded or otherwise secured to a conducting plate 22 which forms an electrical connection through the agency of spring pressed contact fingers 23 with the reciprocally movable metallic rod contact 24. This movable rod contact in turn cooperates, for drawing the arc to be extinguished, with an upper set of fixed finger contacts 25 disposed tulip-fashion about the conducting stud 26 which is secured within the hub portion 27 of the closure member 12. Hub portion 27 is supported by a spider-like structure 28 which, attached to the member 12, thus is in electrical contact with the upper terminal 19.

When the rod-like contact 24 is drawn downwardly and separates from the contact fingers 25, an arc is

drawn therebetween and within the interrupter structure generally designated by the numeral 29. Since the details of this interrupter structure form no part of the present invention, it is believed sufficient merely to say that the interrupter unit 29 comprises a plurality of baffle plates constructed of insulating material suitably apertured to define an interrupting chamber through which the rod contact 24 is reciprocable. The interrupting chamber is also provided with lateral openings permitting arc-extinguishing fluid to flow there across and extinguish the arc, as will soon appear more clearly.

The lower extremity of the rod-like contact 24 is threadedly secured to an insulating operating rod 30 at the lower extremity of which is mounted piston member 31. Piston 31 is reciprocable within the enlarged lower end of an insulating sleeve 32. A metallic extension of the wooden operating rod 30 is indicated at 33 and the lower extremity thereof is provided with a roller 34 which engages a prop-type latch member 35 to maintain the rod contact 24 in the closed circuit position. Contact 24 is biased toward the open position by gravity and by means of a compression spring 36 which encircles the rod 33. Thus, upon clockwise movement of the prop or latch 35 about the axis of its pivot shaft 37, the rod contact 24 separates from the finger contacts 25 due to gravity and to the downward force of biasing spring 36.

For the purpose of ensuring the extinguishment of the arc produced when the contact 24 is withdrawn downwardly through the interrupting unit 29, a blast of liquid dielectric is forced transversely across the interrupter unit comprising the baffle stack 29. The structure for directing and supplying this impulse or blast of fluid across the lower portion of the baffle stack 29 comprises a tubular conduit 38 which is threadedly connected at its upper end under the baffle stack by an adapter element 39 (which preferably houses a schematically-shown non-return valve), the conduit 38 telescoping into a reciprocally movable cylinder 40 operative about a fixedly mounted annular piston member 41. When in the charged position as shown, the movable cylinder 40 is biased downwardly by means of the compression spring 42 which at its upper end engages the fixed piston 41 which is supported on one side by one or more of the above-described blast conduits 38 and on the other by a corresponding number of counter-poise cylinders 43 of the same diameter, which elements are maintained immovably between the fixed piston and the conducting plate 22. The upper end of the movable cylinder 40 is substantially sealed by means of a cover plate 44 which is provided with suitable packing for preventing unnecessary wastage of the impulse blast of arc-extinguishing liquid which must usefully flow through the conduits 38. The strong insulating thrust tube 32 for the cylinder 40 is provided with a lower bored portion 46 which constitutes an operating cylinder for the contact-actuating piston 31 of the contact operating rod 30. The lower extremity of the impulse thrust tube 32 is threadedly secured in the large reciprocally movable piston member 47 which is slidable within a main operating cylinder 48.

For the purpose of preventing the leakage of fluid through the base-plate 1 in the opening through which the rod 33 is reciprocable, an appropriate oil seal 53 is provided.

For cooperating with the blast tubes 38 and counter-poise spacers 43 in the support of the fixed piston 41, a metallic cylinder 54 abuts at its upper end the piston 41 while its lower end is screwed into a fixed plate 55 which in turn stands upon the supporting members 56 which are mounted on the base-plate 1.

From the above, it will be understood that with the breaker in the contact-closed impulse-charged position shown in Fig. 1, the hold-closed latch or prop 35 supports the rods 33 and 30 whose piston 31 in turn supports (at

the upper end of the bore 46) the thrust tube 32 which, through the upper end cover of the impulse cylinder 40, transmits this holding action or effect in opposition to the downward bias of the heavy impulse spring 42. In addition, the hold-closed prop 35 acting through rods 33 and 38 maintains the contact 24 in closed position against the bias of the contact opening spring 36.

Thus, when the latch 35 is tripped, the rod 33, the rod 30 and contact 24 descend under the action of the biasing spring 36 at high speed to draw the interrupting arc while, in addition, the movable cylinder 40 is forced downwardly but independently and at a slower rate due to the oil-compressing action of spring 42. Accordingly, the faster-moving piston 31 will have moved out of engagement with the shoulder of the bore 46 of the insulating thrust tube 32. Downward movement of cylinder 40 forces oil contained in the space 49 above the fixed piston 41 to be forced from the space 49 through the ports 50, upwardly through the conduit or conduits 38, across the arc in the baffle structure 29, after which it vents upwardly as indicated by the arrow 51 and through the ample perforations 52 formed in the closure plate 28. Such a cross-blast of liquid dielectric effectively aids in extinguishing an arc drawn between the upper end of the rod contact 24 and the finger contacts 25, as is well known in the art.

During the above-described opening movement, it will be observed that the downward contact opening stroke D is substantially longer than the impulse stroke E, as indicated in Fig. 1; for at the end of the stroke the large impulse movable cylinder 40 and its operative piston 47 has been arrested by the buffer resting on the supporting member 55, while the contact piston 31 has continued downward to the point where its roller 34 finally rests against a suitable stop such as shown at 56a in Fig. 3.

In order to close the interrupter, and to charge the opening and impulse piston springs, fluid pressure is supplied through a conduit 57 to the space within the cylinder 48 to exert an upward force simultaneously on both the small piston 31 to close the rod contact 24 and on the large piston 47 to raise the movable cylinder 40 to its upper spring-charged position through the impulse thrust tube 32. As is well known, a suitable pressure reservoir and control valve means would be utilized to supply fluid pressure through the conduit means 57 to the cylinder 48. Preferably, the fluid for operating pistons 31 and 47 would be air under pressure.

Should an arc of fault proportions strike between the finger contacts 25 and the rod contact 24 at an instant just before the parts reach the closed position, it is desirable to have the breaker trip itself free in which event the rod contact should rapidly reverse toward open position with the impulse means comprising cylinder 40 and the fixed piston 41 available for immediate use. In order for these elements to reverse motion quickly, it is necessary to relieve the fluid pressure within cylinder 48 promptly. To this end, the cylinder is provided with large dump ports 58b which are normally closed off by means of a dump valve 58 comprising a sleeve portion fitting about the cylinder 48. The dump valve 58 has a piston-like portion which surrounds the operating rod 33 and has an actuating surface 58a which is exposed to fluid pressure within the cylinder 48. The actuating surface 58a has a relatively small area in comparison to the large cross-sectional area of the cylinder and of the dumping ports 58b, and, as a result, the pressure forces tending to drive the valve 58 downwardly into an open position are comparatively light. This is advantageous, in that it permits me to use a sensitive high-speed latch, or prop, for holding the high-capacity dump valve 58 in closed position. Such a prop is shown at 59 cooperating with a suitable latch roller 60. When this prop 59 receives an operating impulse, say in response to the breaker being closed on a fault, it is ca-

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pable of responding at high speed, i. e., unlatching, to permit the dump valve 58 quickly to open under the force of pressurized fluid in said cylinder. This permits fluid pressure within the cylinder 48 rapidly to collapse so that the pistons 47 and 31 are free to move downwardly rapidly against negligible back pressure under the released force of their opening springs.

After the dump valve 58 has opened to permit collapse of the fluid pressure in the cylinder 48, it will be restored to its normal or closed position by means of the spring 36, which serves not only as a contact opening spring but also as a dump valve resetting spring. The dump valve 58 will then be held in its closed position by the valve-controlling prop 59, as will soon be more apparent.

Referring to Fig. 1, the valve prop 59 is provided with a latch face so inclined that the downwardly-acting fluid pressure forces urge the prop toward its released position against the bias of a suitable resetting spring 59a mounted about the pivot of the prop. This valve prop 59 is normally prevented from moving into its released position by means of a secondary latch 61 which cooperates with an undercenter toggle coupled to the prop. This toggle comprises a pair of pivotally interconnected links 62 and 63 carrying at their knee a latch roller 64 which is normally supported on the secondary latch 61. The toggle link 63 is pivotally supported on a fixed pivot pin 63a and the toggle link 62 is pivotally joined to the prop 59.

The contact prop 35 likewise is provided with a latch face so inclined that the opening spring 36 urges the prop 35 toward its released position against the bias of a suitable resetting spring 35a. The prop is normally prevented from moving into its released position by means of another secondary latch 67 which cooperates with an undercenter toggle 63 corresponding to the previously-described toggle 62, 63, 64.

The two secondary latches 61 and 67 are coupled together for simultaneous tripping by a linkage 70 which, together with the secondary latches, constitutes a master latch assembly which is operable by a single tripping solenoid 71. This tripping solenoid 71 is suitably connected by means (not shown) to be responsive to abnormal current conditions in the breaker power circuit. The linkage 70 comprises a tripping crank 72 pinned to the rotatable shaft 73 of latch 61. Another crank 74 pinned to this shaft 73 is pivotally joined to a connecting link 75 having a lost motion slot 75a at its lower end. This lost motion slot 75a receives a pin 76 carried by another crank 77 which is pinned to the shaft of the secondary latch 67.

Thus, when the tripping solenoid 71 is energized, as from abnormal line conditions, it drives the tripping crank 72 counterclockwise tripping the valve-controlling latch 61. Such movement of trip crank 72 also turns crank 74 and lifts the connecting link 75 thereby tripping the contact controlling latch 67. When the valve-controlling secondary latch 61 is tripped, the toggle 62, 63 is free to collapse and the valve prop 59 to release under the influence of downwardly-acting fluid pressure forces transmitted through the roller 64. Thus, if pressurized fluid is then present in the cylinder 48 it will force the dump valve open and quickly exhaust through ports 53b thereby permitting the then-unlatched pistons 31 and 47 to move rapidly downwardly against negligible back pressure within cylinder 48, whereby to produce rapid breaker-opening movement.

In the event that this circuit breaker opening movement was a normal switching-open operation, the dump valve prop 59 would not have responded because, although the secondary trip latch 61 had moved out from under the toggle-knee roller 64, no downward force would have been applied to the dump valve to overcome the upward force thereupon exerted by the upper end of the spring 36, and because the latch's reset spring

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59a would have kept the toggle links 62 and 63 extended (in the Fig. 1 position). The reason that no downward force would have been applied to the dump valve is that pressurized fluid within cylinder 48 would previously have been exhausted to atmosphere by the usual control valve (not shown) which normally vents the cylinder to atmosphere except when operated to supply fluid to the cylinder 48.

Thus, for a normal opening operation, it will be understood that only the main prop 35 would respond to the tripping of secondary latches 61 and 67 and that the breaker would open while the dump valve would remain undisturbed during this spring-operated breaker opening operation.

As soon as the tripping solenoid 71 is deenergized, the valve-controlling secondary trip latch 61 can reset immediately through the agency of its reset spring 61a. The lost-motion slot 75a in the link 75 permits the latch 61 to reset independently of the other secondary latch 67 which may reset independently at any time because of its own reset spring 67a. With the breaker now in its open position, i. e., with the roller 34 now occupying its lowermost position, which is shown in Fig. 3, the main prop 35 will have resumed its reset position under the influence of its own return spring 35a.

Consequently, in response to a subsequent closing operation when pressure air is admitted to cylinder 48 through conduit 57, the breaker contacts will be reclosed through stroke D, and the impulse spring 42 will be recharged through its shorter stroke E, as the small and large pistons respectively move upwardly. It will be observed that the shoulder formed at the upper end of bore 46 interconnects the contact-controlling piston 31 and the impulse-charging piston 47 for movement in unison near the end of the closing stroke. This effectively insures that the impulse means 40, 42 will be fully charged at the time the contact closing stroke is completed, thereby insuring that the impulse means will then be prepared for a fully rated operation in case immediate reopening is necessary.

In this upward closing stroke, the roller 34 will have to move past the now reset main prop 35. In so doing, it will have once more to break its toggle 63. To enable this to take place, I provide a cam-like extension 81 for a latch crank 82, which, like prop 35, is free to rotate about shaft 37. At its other end, the crank 82 is pivotally connected to an actuating link 83 which has a lost-motion connection 84 with the contact-controlling secondary latch 67. The extension 81 is located so as to be in interfering position with respect to the roller 34. As a result, when the roller 34 moves upwardly during a closing operation, it encounters extension 81, rotates crank 82 clockwise, pulls link 83 downward, thereby pulling the secondary latch 67 out from under its toggle roller so that the toggle 63 now may collapse as the contact roller 34 brushes past the main prop 35 and temporarily displaces it to the right. The prop 35 instantly resets under the roller 34 (as the latter assumes its fully closed position of Fig. 1) under the influence of its return spring 35a. Secondary latch 67 also resets at the same time under the bias of its return spring 67a. Independence between these resetting movements is provided by means of the lost-motion connection 84 between link 83 and the secondary latch 67. Thus, inertia or rebound forces on the prop 35 and the latch 67 do not communicate one with another to impede the fast resetting speed of the prop and latch.

Assuming that no line fault was present during this closing stroke, pressure has been exerted downwardly upon the surface 53a of the dump valve 58, but, because the tripping solenoid 71 has remained un-energized, the dump valve is held closed by the prop-latch 59. At the end of the closing stroke, the cylinder 48 exhausts in the usual manner through its conventional control valve (not shown) which had passed pressure air to the cylinder through the

conduit 57 when opened but had exhausted to atmosphere when closed.

If now, on the other hand, the breaker should close on a faulted line, the tripping solenoid 71 would become energized, possibly before the end of the upward stroke of the contact piston 31. Consequently, both props 35 and 39 would be released in such a case; for now the downward pressure on the face 58a of the dump valve 58 would cause roller 60 to sweep latch 59 from out of its path, for the reason that the downward pneumatic force on valve face 58a is greater than the upward force of spring 36. Accordingly, the dump valve will move down through its travel distance C where it will be arrested by, say, an abutment 85 as is clearly shown in Fig. 2. With the dump valve in this open position, it is apparent that the residual pressure below the almost closed piston 47 is instantly evacuated through the ports 58b so that the moving contact structure can open unimpededly downward, even through the control valve (not shown) may still be feeding pressure air through the conduit 57. Thus, the dumping valve arrangement of my invention, having a large escape port area and a small integral piston area provides a very effective way of permitting instant reversal of the closing members of the circuit breaker in the event of a trip-free operation resulting from closing on a faulted line.

Fig. 3 shows the tripped-open condition to which the breaker and mechanism return after experiencing either a tripping operation from the closed position of Fig. 1 or a trip-free operation shown commencing as in Fig. 2. In the position of Fig. 3, it will be observed that both pistons 31 and 47 are down and the dump valve 58 has been returned to its closed upper position by the upward bias of spring 36. Also the contact roller 34 is in its lowermost position due to the downward bias of the spring 36.

It will be understood that although my disclosed mechanism permits the use of a single compression spring 36 for controlling dump valve-resetting and contact-opening, the single spring 36 could be replaced by two separate springs, one spring for biasing the rod 33 and associated parts downwardly and another spring for maintaining the dump valve 59 in its normally closed position. For example, a fixed structure could be arranged so as to surround the rod 33 and one spring could have its upper end engage the dump valve 59 and its lower end bear on the fixed plate, while another spring could engage the shoulder 90 on the rod 33 and its upper end could engage the lower surface of the fixed plate.

While I have shown and described particular embodiments of the invention, I do not wish to be limited thereto and intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. A fluid actuated operating mechanism for an electric circuit breaker having a biased-open latched-closed movable contact and having impulse means normally occupying a position corresponding to the closed position of said movable contact and movable to an operated position upon opening of said movable contact for supplying liquid dielectric to the arc drawn thereby, said mechanism comprising a cylinder, means for supplying pressure fluid to said cylinder, a first piston operatively coupled to said movable contact and movable in response to pressure fluid in said cylinder for imparting closing movement to said contact, and a second piston operatively coupled to said impulse means and movable in response to pressure fluid in said cylinder for moving said impulse means to its normal position.

2. The mechanism of claim 1 in combination with means interconnecting said pistons for movement in unison near the end of a closing stroke for insuring that

said impulse means is returned to its normal position when said contact is in closed position.

3. An electric circuit interrupter comprising a reciprocally movable contact, impulse means including a piston and cylinder and operable to supply liquid dielectric to the arc drawn by said contact upon opening movement thereof, said contact and said impulse means being substantially coaxially disposed, latch means for holding said contact in its closed position and for holding said impulse means in a normal position corresponding to the closed position of said contact, biasing means for producing opening movement of said contact upon release of said latch means, means for operating said impulse means upon release of said latch means, a fluid motor including two coaxially disposed pistons operable from pressure fluid supplied to a common cylinder, means for operatively connecting one of said pistons with said contact and the other of said pistons with said impulse means, and means for supplying pressure fluid to said motor to operate said pistons thereby to cause closing movement of said contact and movement of said impulse means to its normal position.

4. An electric circuit breaker comprising a biased-open latched-closed reciprocally movable rod contact, reciprocable impulse means normally occupying a position corresponding to the closed position of said movable contact and movable to an operated position upon opening of said movable contact for supplying liquid dielectric to the arc drawn thereby, said contact and said impulse means being coaxially disposed with said contact being reciprocable in an opening through said impulse means, an operating cylinder, said cylinder and said contact being coaxially disposed, means for supplying pressure fluid to said cylinder, a first piston movable with said movable contact and operable in response to pressure fluid in said cylinder for imparting closing movement to said contact, and a second piston movable with said impulse means and operable in response to pressure fluid in said cylinder for moving said impulse means to its normal position.

5. An electric circuit breaker comprising a biased-open latched-closed reciprocally movable rod contact, reciprocable impulse means normally occupying a position corresponding to the closed position of said movable contact and movable to an operated position upon opening of said movable contact for supplying liquid dielectric to the arc drawn thereby, said contact and said impulse means being coaxially disposed with said contact being reciprocable in an opening through said impulse means, an operating cylinder, said cylinder and said contact being coaxially disposed, means for supplying pressure fluid to said cylinder, a first piston movable with said movable contact and operable in response to pressure fluid in said cylinder for imparting closing movement to said contact, and a second piston movable with said impulse means and operable in response to pressure fluid in said cylinder for moving said impulse means to its normal position, said pistons being substantially coaxially disposed.

6. A fluid actuated operating mechanism for an electric circuit breaker having a biased-open latched-closed movable contact and having impulse means normally occupying a position corresponding to the closed position of said movable contact and movable to an operated position upon opening of said movable contact for supplying liquid dielectric to the arc drawn thereby, said mechanism comprising a cylinder having a dumping port in a wall thereof, means for supplying pressure fluid to said cylinder, a dump valve normally closing said port and having a surface exposed to pressure fluid in said chamber, latch means for holding said valve in its normal position, the force exerted by the pressure fluid in said cylinder on said surface being effective to move said valve to an operated position thereby to open said port in response to release of said latch means, a first piston operatively related with said movable contact and movable in response

to pressure fluid in said cylinder for imparting closing movement to said contact, and a second piston operatively related with said impulse means and movable in response to pressure fluid in said cylinder for moving said impulse means to its normal position.

7. In an electric circuit breaker comprising a movable contact and means biasing said contact toward open position, an operating cylinder having a dumping port, piston means operable by pressurized fluid supplied to said cylinder for imparting closing movement to said contact, a dump valve normally closing said port and having an actuating surface exposed to pressurized fluid in said cylinder, first prop means operable when latched to hold said dump valve in closed position and operable when unlatched to permit said dump valve to open under the force of pressurized fluid in said cylinder, second prop means operable when latched to hold said contact in closed position and when unlatched to permit opening of said contact, master latch means normally maintaining both of said prop means in latched position and releasable to cause unlatching of both of said prop means, a single tripping solenoid operable to cause release of said master latch means whereby to cause opening of said dump valve and said contact, means operable while said contact is in open position for returning said dump valve to closed position, and means operable thereafter for restoring said first prop means to its latched position thereby holding said dump valve closed so that pressurized fluid can then be applied to said cylinder to impart closing movement to said contact.

8. The mechanism of claim 7 in which said contact biasing means and said dump valve restoring means comprises a single spring acting between said dump valve and said movable contact.

9. The mechanism of claim 7 in which said master latch means comprises a pair of trip latches for respectively holding said prop means in latched position, and a linkage interconnecting said trip latches and operable by said solenoid to cause substantially simultaneous tripping of said latches.

10. The mechanism of claim 7 in which said master latch means comprises a pair of trip latches for respectively holding said prop means in latched position, and a linkage interconnecting said trip latches and operable by said solenoid to cause substantially simultaneous tripping of said latches, said linkage comprising a lost-motion connection for permitting independent resetting of said trip latches into their respective holding positions after tripping thereof.

11. In an electric circuit breaker comprising a movable contact and means biasing said contact toward open position, an operating cylinder having a dumping port, piston means operable by pressurized fluid supplied to said cylinder for imparting closing movement to said contact, a dump valve normally closing said port and having an actuating surface exposed to pressurized fluid in said cylinder, first prop means operable when latched to hold said dump valve in closed position and operable when unlatched to permit said dump valve to open under the force of pressurized fluid in said cylinder, second prop

means operable when latched to hold said contact in closed position and when unlatched to permit opening of said contact, master latch means normally maintaining both of said prop means in latched position and releasable to cause unlatching of both of said prop means, a single tripping solenoid operable to cause release of said master latch means whereby to cause opening of said dump valve and said contact, means for returning said dump valve to closed position after opening thereof, means operable while said contact is in open position for restoring both of said prop means to latched position whereby to hold said dump valve closed, means responsive to contact-closing movement for temporarily displacing said second prop means without disturbing said first prop means, and means for thereafter restoring said second prop means to its latched position in response to completion of said closing movement whereby to hold said contact closed.

12. Operating mechanism for an electric circuit breaker comprising an operating cylinder having a peripheral wall containing a radially extending dump port, means for supplying pressurized fluid to said cylinder, piston means operable by said pressurized fluid for actuating said breaker, an axially movable dump valve fitting about said wall and normally closing said port, said dump valve having an actuating portion exposed to pressurized fluid within said cylinder, the effective working area of said actuating portion being only a minor fraction of the cross section area of said cylinder, and latch means normally holding said dump valve closed and operable when released to permit said valve to open under the force of pressurized fluid in said cylinder.

13. In a fluid-actuated operating mechanism for an electric circuit breaker having a movable contact biased toward open position, an operating cylinder, rod means extending through an end wall of said cylinder and operatively connected to said contact, a piston coupled to said rod means and movable in response to pressure fluid supplied to said cylinder for imparting closing movement to said contact, said cylinder having a radial dump port in a peripheral wall thereof, an axially-movable sleeve-type dump valve fitting about said cylinder and normally closing said port, said valve having an actuating portion surrounding said rod means and including an actuating surface exposed to pressure fluid in said cylinder, and releasable latch means for holding said valve in its normal position, the force exerted by the pressure fluid in said cylinder on said actuating surface being effective to move said valve to an operated position in which said dump port is open in response to release of said latch means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,728,829	Hilliard	Sept. 17, 1929
2,286,023	Strang	June 9, 1942
2,420,872	Easley	May 20, 1947
2,566,095	Scarpa	Aug. 28, 1951
2,578,204	Peek	Dec. 11, 1951
2,578,349	Goodwin	Dec. 11, 1951