July 28, 1942. H. E. STRANG 2,291,357

ELECTRIC CIRCUIT BREAKER

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Fig. 2.

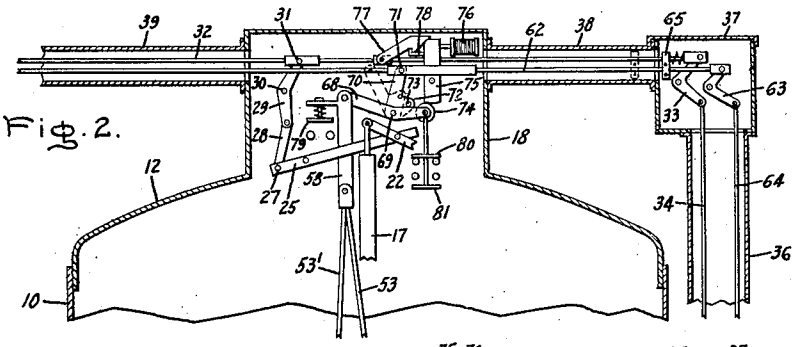


Fig. 3.

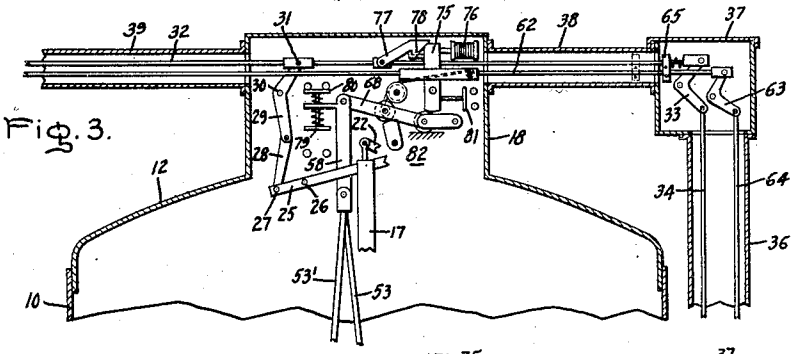


Fig. 4.

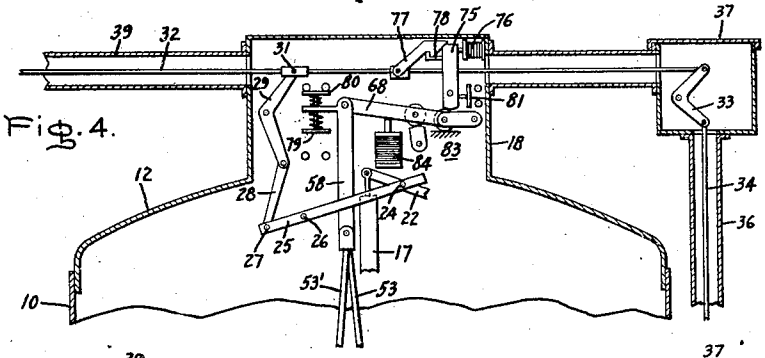
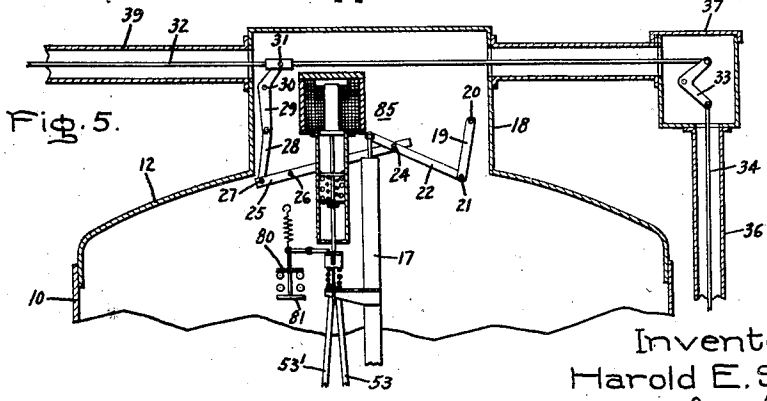


Fig. 5.



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UNITED STATES PATENT OFFICE

2,291,357

ELECTRIC CIRCUIT BREAKER

Harold E. Strang, Ardmore, Pa., assignor to General Electric Company, a corporation of New York

Application June 8, 1940, Serial No. 339,533

7 Claims. (Cl. 200—50)

My invention relates to electric circuit breakers and more particularly to operating mechanisms for high-speed circuit breakers.

In the operation of modern high-tension transmission systems comprising a network of high-tension lines interconnecting a number of generating stations, it is often necessary to clear a circuit upon the occurrence of a short circuit or other fault within a few cycles in order to maintain system stability. The conventional oil circuit breakers generally used for this purpose receive a tripping impulse through a trip coil, the trip coil in turn actuating a latch or release causing switch-opening movement. Since the moving parts of the circuit breaker including the usual linkage mechanism, operating rod, and bridging member are of considerable mass, acceleration of the movable structure involves a certain time lag after release. This together with the time required for the coil to release the mechanism comprises the time between the tripping impulse and the separation of the switch contacts and may take up quite a number of cycles, endangering system stability unless the circuit is interrupted within a cycle or so of arcing. It would be desirable to provide a high-speed circuit breaker wherein the circuit is interrupted within a minimum of time without endangering the system stability.

It is an object of my invention to provide an improved high-speed circuit breaker wherein the mass of the operating mechanism for the circuit-interrupting contacts is reduced to a minimum so that high-speed circuit interruption may be obtained.

It is another object of my invention to provide a circuit breaker having separate arcing and isolating contacts including separate operating mechanisms therefor so that high-speed circuit interruption may be obtained.

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, reference may be had to the accompanying drawings in which Fig. 1 is a cross-sectional view of the circuit breaker embodying my invention, and Figs. 2, 3, 4 and 5 are cross-sectional views through the upper portions of circuit breakers embodying my invention to illustrate various modifications of the arrangement of Fig. 1.

It will be understood by those skilled in the art that my invention is of general application but, for purposes of illustration, I have shown my invention as applied to oil circuit breakers having a separate breaker for each phase of the circuit to be interrupted.

Referring now to Fig. 1, the housing or pressure confining casing enclosing the switch contacts and the insulating liquid in which they are immersed comprises essentially the metal cylinder 10, the bottom end head 11, and the top cover 12, the entire casing being constructed to withstand relatively high pressures. The bottom end head 11 and the cover 12 comprise dome-shaped members, preferably pressed out from sheet-metal stock. The bottom end head 11 has its flanged edge fitted within and welded to the cylinder 10, thereby forming the tank.

A pair of insulator bushings 13 and 13', only portions of which are shown, are supported by the cover 12 through which they extend in the well known manner so as to be connected with an external electric circuit. Insulator bushings 13 and 13' are provided at the lower end thereof with fixed isolating contacts 15 and 15' respectively each comprising a plurality of resilient fingers and are adapted to be bridged by a movable bridging contact member 16 which is actuated by the operating or lift rod 17 extending up to the operating mechanism above. The arrangement thus far described is substantially the same as that of the electric circuit breaker described and claimed in United States Letters Patent No. 1,816,799 to J. W. Upp and William K. Rankin, granted July 28, 1931, and assigned to the same assignee as the present application.

The operating mechanism for producing relative movement between isolating contacts 15 and 15' and bridging member 16 by imparting vertical movement to operating rod 17 connected to the latter is housed for the most part in an upward extension 18 of cover 12, a rectangular opening being cut away in the central portion of the head comprising the cover 12. The operating mechanism for imparting straight-line vertical motion to operating rod 17 is substantially the arrangement disclosed and claimed in United States Letters Patent 1,754,179 to William K. Rankin, granted April 8, 1930, and assigned to the same assignee as the present invention. This operating mechanism comprises a link 19 pivotally mounted at 20 to the upward extension 18 of cover 12. The other end of link 19 is pivotally connected at 21 to link 22, which, in turn, is pivotally connected to operating rod 17 at 23. The intermediate portion of link 22 is pivotally con-

40 and 40'. To eliminate any reversal of this order, I provide an interlock 65 connected to arcing contact actuating rod 62 which will prevent arcing contact actuating rod 62 from closing the contacts of arcing contact structures 40 and 40' prior to the engagement of contacts 15 and 15' with bridging member 16 and which will not allow bridging member 16 to be disengaged from isolating contacts 15 and 15' prior to the interruption of the circuit by the arcing contacts associated with arcing contact structures 40 and 40'. A spring 66 is provided with interlock 65 to eliminate impact between the two operating systems.

The arrangement just described permits very efficient high-speed circuit interruption wherein the operation of the long stroke and relatively low-pressure isolating contacts is taken care of by one operating mechanism while a second operating mechanism handles the short stroke and relatively heavy pressure arcing contacts. It will be understood by those skilled in the art that this arrangement is readily adaptable for high-speed reclosing circuit breakers and a control system may be provided, causing operation of the arcing contacts to interrupt the circuit without relative movement of the isolating contacts having taken place. The arcing contacts are immediately reclosed and, if the fault has cleared, the isolating contacts are not operated. If the fault cannot be cleared, as may be indicated by several successive opening and reclosing operations of the arcing contacts, then the isolating contacts may also be operated.

The operation of my high-speed circuit breaker illustrated in Fig. 1 will be understood by those skilled in the art. Upon the occurrence of an abnormal current condition on the circuit with which my invention is associated, a tripping impulse will be transmitted to the operating mechanism contained within housing 35, causing movement of rod 64 thereby producing relative movement of the arcing contacts to interrupt the circuit. This circuit interruption may take place at very high speeds since a relatively small movement of the operating mechanism is required and it is unnecessary to wait for the operation of bridging member 16 associated with the relatively heavy operating mechanism which must produce considerable movement thereof as in prior art devices in order to interrupt the circuit. Interlock 65 will prevent bridging member 16 from disengaging with contacts 15 and 15' until the arcing contacts within chambers 41 and 41' have interrupted the circuit. When reclosing the contacts, interlock 65 will require that isolating contacts 15 and 15' are bridged prior to the closure of the arcing contacts, and, if an abnormal current condition should occur during the closing operation of the circuit breaker, the trip-free mechanisms, not shown, contained within housing 35 will allow immediate reopening of the circuit.

In order to increase the opening speed of the circuit breaker, I have shown an arrangement in Fig. 2 wherein the mass of the operating parts associated with the arcing contacts is decreased and, furthermore, wherein a single phase of the polyphase system may be interrupted without affecting the other phases. The parts of Fig. 2 similar to Fig. 1 are designated by the same reference numerals. The operating mechanism for the isolating contacts is identical with that of Fig. 1. However, while the linkage connected to rod 34 causes both the opening and closing of the isolating contacts, the operating mechanism associated with rod 64 does only the closing of the arcing contacts and takes care of trip-free protection in a conventional manner while the normal tripping of the arcing contacts takes place within each tank 10. The operating mechanism associated with rod 64 is shown solid in the position at the end of the closing stroke of the circuit breaker after which the operating mechanism associated with rod 64 is deenergized and is returned to the dotted position of certain parts shown in Fig. 2. In order to close the arcing contacts associated with lift rods 53 and 53', link 58 is connected to a lever 69 pivotally mounted at 69 and arranged to be rotated in a clockwise direction by lever 70 having one end thereof pivoted at 69 while the other end is connected to arcing contact actuating rod 62 at 71. Lever 70 is provided with an extension 72 including a pin 73 which engages with the end of lever 68 remote from link 58 to cause clockwise rotation thereof and closure of the arcing contacts when operating rod 64 is moved downwardly to the solid position shown in Fig. 2. The end of lever 68 is provided with a roller 74 arranged to be engaged by pivotally mounted latch 75, which normally tends to assume the vertical position, but which may be provided with spring means, not shown, so as to be biased toward the latching position to hold the arcing contacts in the closed-circuit position even when interlock 65 and lever 70 assume the dotted positions shown in Fig. 2. In case of an abnormal current condition, trip coil 76 is energized to cause counterclockwise rotation of latch 75, thereby releasing lever 68 and allowing downward movement of lift rods 53 and 53' under the influence of springs 56 and 56' of Fig. 1 to cause interruption of the circuit at the arcing contacts. In case operating rod 34 is moved either manually or by accident, I provide a hook 77 associated with isolating contact actuating rod 32 which engages with cooperating member 78 associated with latch 75 to cause tripping of the arcing contacts. Since interlock 65 has been moved away from its interference position (see dotted position of Fig. 2) as soon as the operating mechanism for rod 64 is deenergized hook 77 is now necessary to insure circuit interruption at the arcing contacts.

In order to operate the circuit breaker of Fig. 2 as a reclosing circuit breaker, a suitable switch 79 associated with link 58 may be provided to initiate reclosing of the arcing contacts as soon as they are opened. Suitable switches 80 and 81 may also be provided to act as cut-off switches or to control signalling means as will be well understood by those skilled in the art. It will be observed that, by virtue of hook 77 associated with isolating contact actuating rod 32, opening movement of rod 34 will cause tripping of the arcing contacts of all the breakers associated with actuating rod 32. It will also be observed that, with the arrangement of Fig. 2, any phase may be interrupted and the circuit reclosed without disturbing the other phases. As will be understood, any conventional control circuit may be provided.

In order to increase the speed of operation when trip-free operation is desired, I have shown an arrangement in Fig. 3 wherein rod 64 is moved only to close the arcing contacts and the mass of this rod and associated mechanism need not be moved during trip-free operation. To accomplish this, I provide a trip-free linkage, with both the trip-free latch and prop, in the upper

part of each circuit breaker generally indicated at 82 in Fig. 3. The corresponding parts of Fig. 3 are designated by the same reference numerals as in Figs. 1 and 2. No description of the trip-free linkage will be included here since it will be well understood by those skilled in the art and is generally similar to that disclosed and claimed in United States Letters Patent 2,112,054, Thumim, granted March 22, 1938, and assigned to the assignee of the present invention. Trip-free operating mechanisms of this type generally employ flexible chains in connection with the collapsible force-transmitting structure. The operation of the arrangement disclosed in Fig. 3 will be obvious to those skilled in the art.

In the arrangement disclosed in Fig. 4, I have entirely eliminated the mechanical operating means for lift rods 53 and 53', whereby each phase of the polyphase circuit breakers may be individually controlled for circuit closing as well as for circuit interruption. In this arrangement, separate trip-free opening and closing units generally indicated at 83 are provided for each phase. The corresponding parts of Fig. 4 are designated by the same reference numerals as in the prior disclosures and the trip-free linkage 83 is very similar to that of Fig. 3 except that a closing solenoid 84 has been provided to close the arcing contacts instead of the flexible member included in mechanism 82 of Fig 3 attached to arcing contact actuating rod 62. It will be understood that, with the arrangement of Fig. 4, the masses of the closing as well as of the tripping parts have been reduced to a minimum with consequent increase in the speed of operation particularly when used as a reclosing circuit breaker.

In Fig. 5, I have disclosed an operating mechanism substantially the same as that of Fig. 4 except that a self-latching solenoid mechanism generally indicated at 85 of the type disclosed and broadly claimed in copending application Serial No. 248,783, filed December 30, 1938, on behalf of Eugene W. Boehne, and assigned to the same assignee as the present application, now Patent No. 2,278,971, dated April 7, 1942, is employed. This arrangement simplifies the construction to a considerable extent and, due to the magnetic latch, will give considerably faster tripping. It will be understood that, in the arrangement of Fig. 5, electrical interlocking will be provided to obtain the proper sequence of operation between the isolating and arcing contacts.

While I have shown and described several particular embodiments of my invention as applied to electric circuit breakers, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention and I, therefore, aim in the appended claims to cover all such changes and 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. In an electric circuit breaker, a housing, a plurality of relatively movable arc-extinguishing contacts and an isolating contact connected in series with one another and mounted in said housing, an arc-confining chamber within which said arcing contacts are mounted, an arc-quenching liquid within said casing, said casing having exhaust ports adjacent and opposite a break formed by separation of said arcing contacts so that arc pressure created within said casing upon opening of the circuit is effective to drive liquid through the arc at said ports, said isolating contact being located exteriorly of said casing, an operating mechanism for said arcing contacts, and a separate operating mechanism for said isolating contact so that high-speed interruption of said circuit may be obtained.

2. In an electric circuit breaker comprising a plurality of relatively movable arc-extinguishing contacts and an isolating contact connected in series with one another, an arc-confining chamber within which said arcing contacts are mounted, an arc-quenching liquid within said casing, said casing having exhaust posts adjacent and opposite a break formed by separation of said arcing contacts so that arc pressure created within said casing upon opening of the circuit is effective to drive liquid through the arc at said ports, said isolating contact being located exteriorly of said casing, an operating mechanism for said arcing contacts, a separate operating mechanism for said isolating contact so that high-speed interruption of said circuit may be obtained, and interlocking means for requiring operation of said isolating contact prior to the closure of said arcing contacts while permitting said isolating contact to perform its function only after the opening of said arcing contacts.

3. In a multiphase electric circuit interrupter, a plurality of relatively movable arcing contacts for each phase to be interrupted, a plurality of relatively movable isolating contacts connected in series with said arcing contacts, operating means for producing simultaneous relative movement between the isolating contacts associated with all of said phases, and a plurality of separate operating means one associated with the arcing contacts of each phase so that high-speed circuit interruption may be obtained.

4. In a multiphase electric circuit interrupter, a plurality of relatively movable arcing contacts for each phase to be interrupted, a plurality of relatively movable isolating contacts connected in series with said arcing contacts, operating means for producing simultaneous relative movement between the isolating contacts associated with all of said phases, a plurality of separate operating means one associated with the arcing contacts of each phase so that high-speed circuit interruption may be obtained, and interlocking means for causing operation of all of said separate operating means associated with said arcing contacts in the event that relative separation between said isolating contacts occurs.

5. In an electric circuit interrupter, a housing, a pressure-confining chamber mounted in said housing, a plurality of relatively movable arcing contacts mounted in said chamber, a plurality of relatively movable isolating contacts connected in series with said arcing contacts and mounted in said housing, operating means for producing relative movement of said isolating contacts, and separate operating means having a much lower inertia than said first-mentioned operating means for producing relative movement of said arcing contacts to insure high-speed circuit interruption.

6. In an electric circuit interrupter, a housing, a pressure-confining chamber mounted in said housing, a plurality of relatively movable arcing contacts mounted in said chamber, a plurality of relatively movable isolating contacts connected in series with said arcing contacts, operating means for producing relative movement of said isolating contacts, separate operating means having a much lower inertia than said first-men-

tioned operating means for producing relative movement of said arcing contacts to insure high-speed circuit interruption, and interlocking means for requiring closure of said isolating contacts prior to the closure of said arcing contacts while permitting said isolating contacts to open only after the opening of said arcing contacts.

7. In an electric circuit breaker, a housing, a pressure-confining chamber mounted in said housing, a pair of relatively movable arcing contacts mounted in said chamber, a pair of relatively movable isolating contacts connected in series with said arcing contacts and mounted in said housing, said arcing contacts being arranged to interrupt the circuit with a relatively small separation of said arcing contacts while said isolating contacts are arranged for a relatively large separation thereof, operating means for producing relative movement of said isolating contacts, and separate operating means having a much lower inertia than said first-mentioned operating means and, consequently, adapted to move at much higher speed than said first-mentioned operating means for producing relative movement of said arcing contacts to insure high-speed circuit interruption.

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July 28, 1942. H. W. UHLRIG ET AL 2,291,359

COOKING DEVICE

Original Filed Jan. 26, 1939 2 Sheets-Sheet 1

Fig. 1.

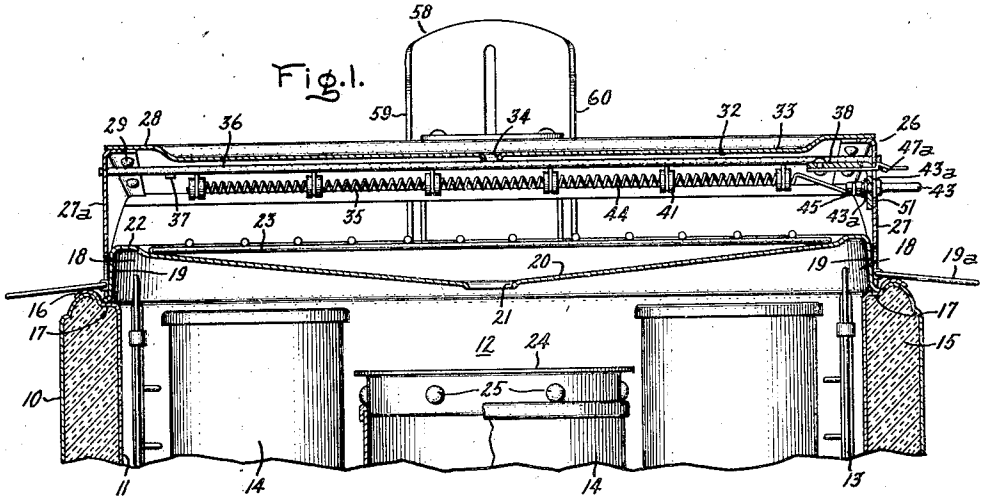
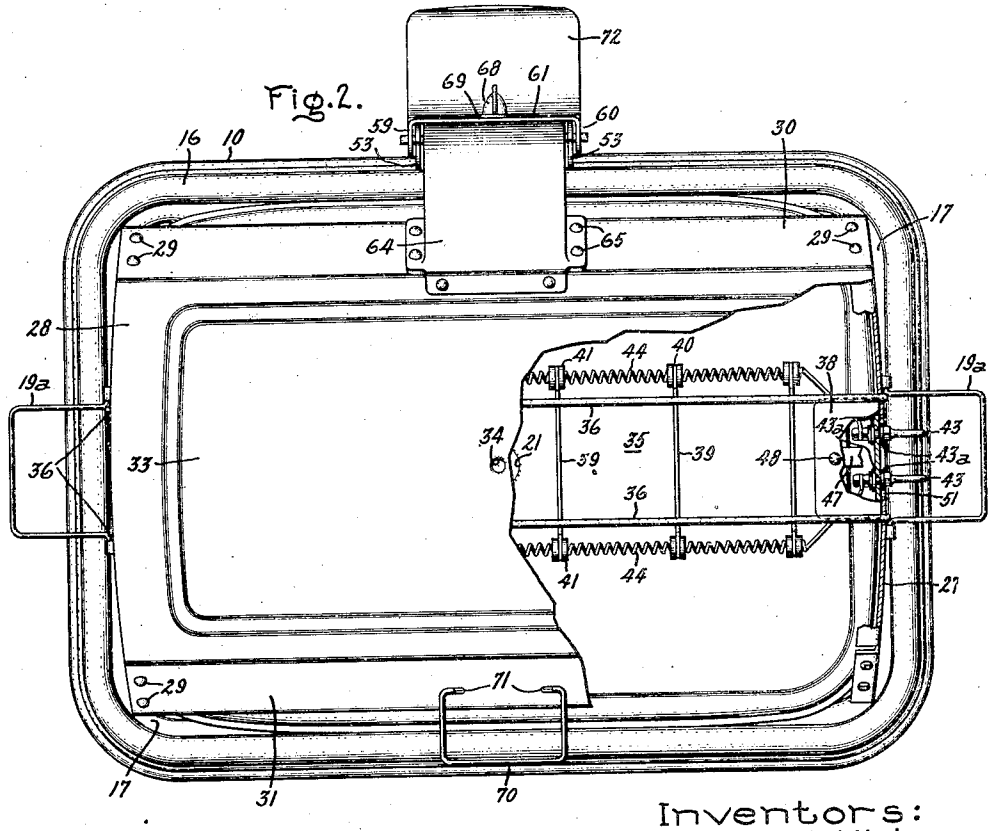


Fig. 2.



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