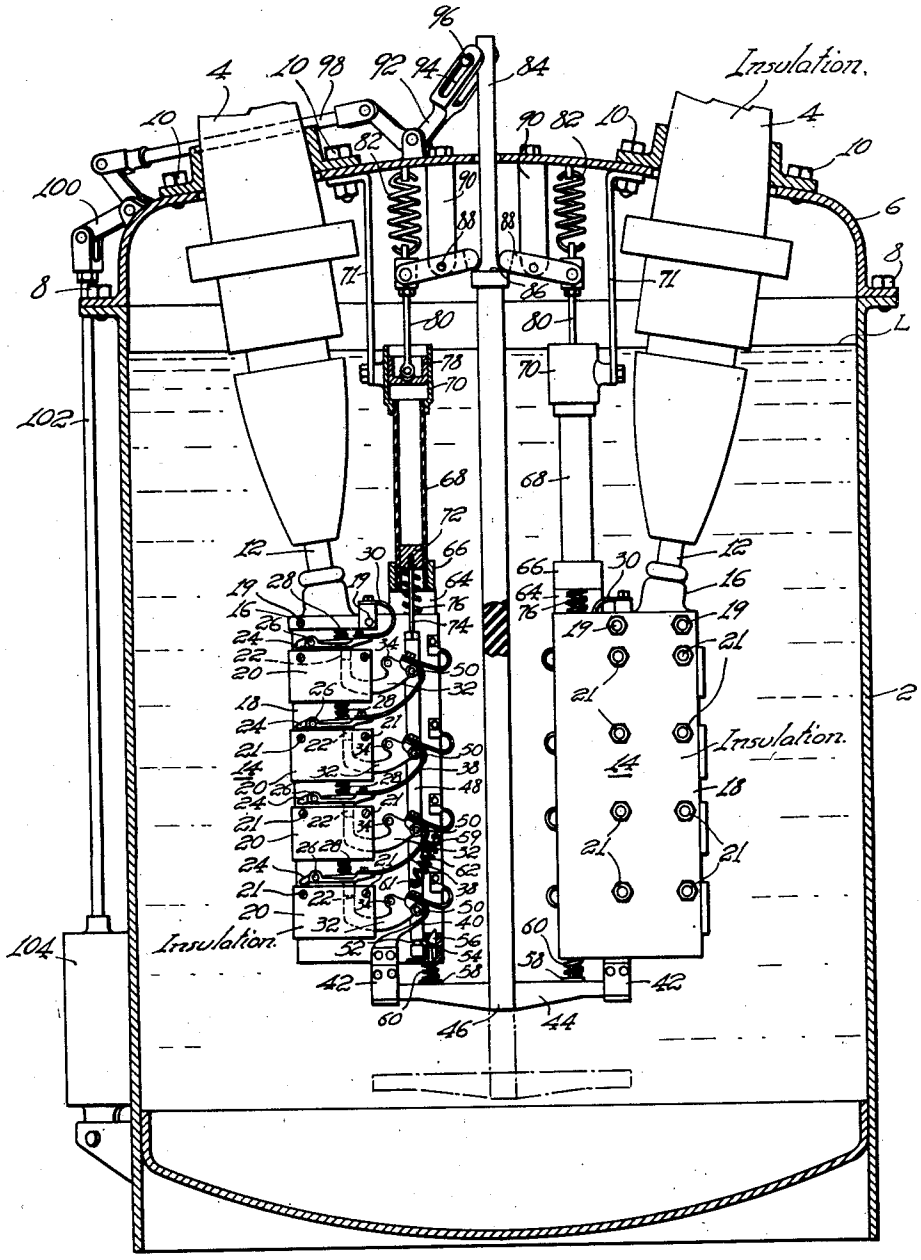
May 17, 1949. J. M. CUMMING 2,470,604

CIRCUIT BREAKER

Filed Nov. 21, 1944



WITNESSES:

E. C. Keiding.

A. T. Stratton

INVENTOR

James M. Cumming.

BY

Ralph L. Swingle

ATTORNEY

Patented May 17, 1949 2,470,604

UNITED STATES PATENT OFFICE

2,470,604

CIRCUIT BREAKER

James M. Cumming, Turtle Creek, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application November 21, 1944, Serial No. 564,447

15 Claims. (Cl. 200—150)

1

This invention relates generally to electric circuit interrupters, and more particularly to circuit breakers.

In relatively large circuit breakers, such as those having one or more sets of contacts suspended in an insulating medium within a tank or similar enclosure, a common mode of actuating such contacts is by means of a lift rod extending downwardly from the top of the enclosure. Where the breaker contacts are biased open, the lift rod is required to withstand the load imposed by this bias, and the contact pressure load as well. With modern operating practice requiring high speed breaker operation, the impact load on closing the breaker is extremely high, thus requiring a relatively heavy lift rod structure to withstand the forces encountered. Of course, any increase in mass of the operating mechanism requires a greater operating force in order to rapidly accelerate the mechanism to the desired high speed operation.

One object of this invention, therefore, is to provide means for closing circuit breaker contacts at high speed independently of the breaker lift rod.

Another object of this invention is to provide a novel arrangement of hydraulic motion transmitting mechainsm for actuating circuit breaker contacts.

Another object of this invention is to provide in a circuit breaker of the type having its contacts suspended from the top of an enclosure, novel means of a compression type for transmitting motion from a point adjacent the top of the enclosure to the breaker contacts.

Another object of this invention is to provide in a circuit breaker of the type described having contacts biased to an open circuit position, a lift rod for controlling latching of the contacts in the closed circuit position, and motion transmitting means independent of the lift rod for closing said contacts at a high speed.

A further object of this invention is to reduce the mass of the parts required to be moved in actuating circuit breaker contacts so that high speed operation is possible by the use of a minimum actuating force.

These and other objects of this invention will become more apparent upon consideration of the following detailed description of a preferred embodiment thereof, when taken in consideration with the attached drawing, in which the single figure illustrates a circuit breaker with the breaker tank shown in substantially central longitudinal section, and with the mechanism in the

2

tank being shown partially in section and partially in elevation.

The circuit breaker illustrated is adapted to be suspended in a tank 2 from the tank cover 6. For this purpose, a pair of insulating bushings 4 are provided with supporting collars intermediate their ends, and the bushings are adapted to extend through openings in tank cover 6 with the supporting collars secured to the cover, for example, as by bolts 10. The cover 6 is adapted to be removably secured to the tank in any desired manner, such, for example, as by bolts 8. Bushings 4 are each provided with a longitudinally extending bore for receiving a conductor rod 12 adapted to support a contact assembly 14 inside casing 2.

Each contact assembly 14 includes a supporting bracket 16 at the upper end thereof, having a threaded socket for threaded engagement with the lower end of bushing conductor rod 12. Each supporting bracket 16 is of a good electrical conducting material, and is adapted to have supporting plates 18 secured to opposite sides thereof, for example, as by bolts 19. Supporting plates 18 should be of insulating material, and are adapted to support therebetween a plurality of hollow arc-extinguishing casings 20 in spaced relation. The arc-extinguishing casings 20 may be of solid construction, but preferably are composed of a plurality of superposed plates of insulating material, as shown more particularly in the patent to J. B. MacNeill No. 2,192,772, on a Circuit interrupter, issued March 5, 1940, to the same assignee as this invention. The arc-extinguishing casings 20 are adapted to be secured between supporting plates 18 by through bolts 21, and each casing is provided with an opening at the top for receiving a contact projection 22 formed integral with a contact support 24. Each contact support 24 is mounted for limited pivotal movement at one end by a pivot pin 26 extending between supporting plates 18, and each contact support is biased for movement of its contact projection 22 in a direction to move into its associated arc-extinguishing casing 20, by a coil compression spring 28 reacting between the contact support 24 and a stationary support such as the arc-extinguishing casing immediately thereabove, or in the case of the uppermost arc-extinguishing casing, its spring 28 reacts against supporting bracket 16. Movement of each contact projection 22 into its associated arc-extinguishing casing 20 is limited by engagement of contact support 24 with the upper side of the arc-extinguishing casing. The contact support 24

associated with the uppermost arc-extinguishing housing 20 is adapted to be electrically connected with supporting bracket 16 by a flexible shunt 30.

Each arc-extinguishing casing 20 has a movable contact 32 associated therewith, which is mounted for pivotal movement about a pivot pin 34 extending between supporting plates 18, so as to be movable toward and away from its associated contact projection 22 through a suitable opening provided in the hollow arc-extinguishing casing 20. The arc-extinguishing casing 20 may also be provided with side vent openings to provide for the relief of fluid pressure built up within the casing when the contacts separate, and to provide for a flow of fluid laterally through the arc upon separation of the contacts, in the manner shown in the aforesaid MacNeill patent. Each movable contact 32 is electrically connected with the contact support 24 immediately below it by a flexible shunt 38, and the lowermost movable contact 32 is electrically connected with a pair of stationary contact jaws 42, by means of a flexible shunt 40. The contact jaws 42 of the pair of contact assemblies 14 are adapted to be bridged by a bridging contact bar 44 mounted on a movable lift rod 46 of an insulating material, preferably a molded insulating material.

The movable contacts 32 of each contact assembly 14 are connected for movement together by a connecting link 48 pivotally connected with each movable contact by means of pivot pins 50. Connecting link 48 is provided at its lower end with a latch groove 52 for cooperation with a ball latch 54, to releasably latch the movable contacts in engagement with relatively stationary contact projections 22, with pressure springs 28 stressed a predetermined amount. A movable latch retainer 56 stressed a predetermined amount. A movable latch retainer 56 is adapted to be held in a position to retain ball latches 54 in engagement with latch grooves 52 in the closed circuit position of the breaker, by engagement of a head 58 provided on the lower end of retainer 56, with the bridging contact bar 44. A release spring 60 reacts between head 58 of latch retainer 56 and the lower end of each contact assembly 14, so that when bridging contact bar 44 is moved downwardly to disengage contact jaws 42, latch retainer 56 will be moved downwardly by release spring 60 to permit ball latch 54 to escape from latch groove 52, and permit movable contacts 32 to rapidly disengage contact projections 22, under the influence of contact opening spring 62, which reacts between a stationary pin 59 anchored in supporting plates 18, and a pin 61 provided on connecting link 48.

In order to reclose movable contacts 32 against opening spring 62, there is provided hydraulic motion transmitting means supported on each contact assembly by means of a bracket 64 having a supporting sleeve 66, adapted to be supported above and substantially in alignment with connecting link 48. Supporting sleeve 66 is adapted to threadedly receive the lower end of a cylindrical conduit 68 of insulating material, such for example as a molded insulating material. A cylindrical pump sleeve 70 is adapted to be threaded on the upper end of conduit 68, and a bracket 71 connects pump sleeve 70 to cover 6, to rigidly support the pump sleeve and upper end of conduit 68. A piston 72 is provided in the lower end of conduit 68, and this piston has a piston rod 74 secured to the upper end of connecting links 48. Piston 72 may have its own biasing spring 76 which reacts between the piston and the upper end of its associated contact assembly 14, to bias the piston 72 in a direction to cause opening of contacts 32. A pump piston 78 is provided in pump cylinder 70, and it has a piston rod 80 connected to a retrieving spring 82 reacting between piston rod 80 and cover 6, for a purpose to be described.

Pump piston 78 is adapted to be actuated by an operating rod 84 secured to the upper end of lift rod 46, and having a shoulder 86 adapted to engage one end of an actuating lever 88, which is pivotally mounted intermediate its ends on a bracket 90 supported from cover 6, and lever 88 is connected with piston rod 80 at its other end.

The operation of the circuit breaker described above will now be apparent. If it is assumed that the breaker is in its closed-circuit position illustrated in the drawing, the circuit may be opened by moving operating rod 84 downwardly. This releases ball latches 54 in the manner previously described to permit opening springs 62 to rapidly separate movable contacts 32 from contact projection 22. This downward movement of operating rod 84 and lift rod 46 may be very small, for example about one-half inch, and as a matter of fact the contacts may be opened so rapidly by opening spring 62 that they will be fully opened before bridging contact bar 44 is disengaged from contact jaws 42. Pump piston 78, being larger than piston 72, needs to be retrieved only a short distance by its retrieving spring 82, to permit sufficient flow of liquid through conduit 68 that piston 72 is not checked in the circuit opening movement of connecting link 48, but this movement is actually assisted by piston spring 76. Opening movement of operating rod 84 will continue of course, until bridging contact bar 44 reaches substantially the position shown in dotted lines on the drawing, to assure a safe gap in the circuit, and thus prevent restriking of the arc after circuit interruption. The rapid opening movement of movable contacts 32 and the action of arc-extinguishing casings 20 contribute to obtain rapid extinguishment of the series arcs drawn during circuit opening in the several arc-extinguishing casings 20. Since tank 2 is adapted to be filled substantially to the level L by an arc-extiguishing liquid, this liquid will fill the arc-extinguishing casings 20 so that when the contacts separate therein, and an arc is drawn, gases will be formed to create pressure within each arc-extinguishing casing 20 and cause a blast of gas substantially transversely through the arc and out the vent openings. This flow of fluid through the arc, together with the rapid opening movement of the contacts and confinement of the arc within the arc-extinguishing casings, contributes to rapid and efficient arc extinction, as pointed out in the above-mentioned MacNeill patent.

In closing the circuit breaker, operating rod 84 is moved upwardly from the dotted line position shown on the drawings, and this results in bridging bar 44 moving into engagement with contact jaws 42, and thereafter shoulder 86 on the operating rod engages actuating levers 88 to move pump pistons 78 downwardly, thereby exerting pressure on the liquid entrapped between pump piston 78 and piston 72 in conduit 68, to cause downward movement of piston 72 and consequent closing movement of movable contacts 32. This reclosing movement of contacts 32 must overcome opening spring 62 and stress the same sufficiently to cause rapid opening of the contacts, and, in addition, sufficient

force must be employed to stress each contact pressure spring 28. Also, it is highly desirable that the closing movement of the breaker be as rapid as possible, which means that relatively large forces are required to accomplish closing of the breaker contacts because of the high force required to prevent rebounding and consequent momentary separation of the contacts, at the moment of initial contact or impact of the contacts.

It will be observed that in the breaker construction described above, the operating force is transmitted from operating rod 84 which may be of steel or similar material having a relatively high strength, and that the lift rod 46 may be relatively light because it is relieved of the force required to actually close the breaker contacts, and the only force it is required to withstand is that necessary to engage and disengage bridging bar 44 with contact jaws 42, and to compress relatively light latch release springs 60. This is of considerable importance because lift rod 46 must be of an insulating material, and if it were required to carry the contact closing load, it would have to be excessively large and massive in construction. Accordingly, it is not only possible to obtain faster contact movement with the operating mechanism disclosed herein due to the lighter construction of the parts, but faster opening movement of the contacts is possible due to the small movement of lift rod 46 needed to open the contacts. In other words, it is possible with this construction to obtain opening of the contacts in a shorter time after initiation of movement of the contact operating mechanism.

Operating rod 84 may be operated in any desired manner, and there is illustrated for this purpose a bell crank 92 pivotally mounted on casing cover 6 and having a slot 94 in one arm for receiving a pin 96 on the operating rod, with the other arm of the bell crank pivoted to a connecting rod 98, which in turn is operably connected to a push rod 102 mounted alongside casing 2 by a second bell crank 100. Push rod 102 may be actuated in any desired manner, such for example as by actuating means 104 mounted on the breaker casing adjacent the lower end thereof. Operating means 104 may comprise any well known operating means, such as a solenoid or the like.

Having described preferred embodiments of the invention in accordance with the Patent Statutes, it is desired that this invention be not limited to the particular structure disclosed herein inasmuch as it will be obvious particularly to persons skilled in this art, that many changes and modifications may be made in this particular structure without departing from the broad spirit and scope of this invention, as defined in the following claims.

I claim as my invention:

1. In a circuit breaker, a liquid container having side, bottom and top walls, separable contacts supported from said top wall so as to be positioned in said container below the liquid level thereof, said contacts being biased apart to an open circuit position, means located adjacent said contacts for latching said contacts closed, actuating mechanism supported on said top wall, liquid motion transmitting means also supported from said top wall and connected between said mechanism and contacts for closing said contacts against said bias when said mechanism is operated in one direction, and said mechanism having a relatively light movable rod which is separate from said motion transmitting means and contacts and extends downwardly in said container into proximity with said latching means for releasing said latching means by movement independent of said contacts in response to operation of said mechanism in the opposite direction.

2. In a circuit breaker, a container, a pair of spaced bushings of insulating material extending into said container, a conductor in each of said bushings, an interrupting structure mounted on each of said bushings, each of said structures having at least one set of separable contacts which are biased apart and are adapted to control the circuit through said conductors, a contact on the outer end of each interrupting structure, a movable bridging contact for bridging the outer contacts of said interrupting structures, actuating mechanism for operating said contacts, said mechanism including a movable rod carrying said bridging contact at its outer end, means to releasably latch said separable contacts closed, and means controlled by initial opening movement of said rod prior to separation of said bridging contact from said outer contacts for releasing said latch means and permitting said separable contacts to separate under the influence of their bias to open the circuit, after which said bridging contact is moved by said lift rod to insert a relatively large gap in the circuit.

3. In a circuit breaker, a container, a pair of spaced bushings of insulating material extending into said container, a conductor in each of said bushings, an interrupting structure mounted on each of said bushings, each of said structures having at least one set of separable contacts which are biased apart and are adapted to control the circuit through said conductors, a contact on the outer end of each interrupting structure, a movable bridging contact for bridging the outer contacts of said interrupting structures, actuating mechanism for operating said contacts, said mechanism including a movable rod carrying said bridging contact at its outer end, means to releasably latch said separable contacts closed, means controlled by initial opening movement of said rod prior to separation of said bridging contact from said outer contacts for releasing said latch means and permit said separable contacts to separate under the influence of their bias to open the circuit, after which said bridging contact is moved by said rod to insert a relatively large gap in the circuit, and means cooperative with said rod at a point adjacent the other end thereof for reclosing said separable contacts in response to reverse movement of said rod.

4. In a circuit breaker, a container, a pair of spaced bushings of insulating material extending into said container, a conductor in each of said bushings, an interrupting structure mounted on each of said bushings, each of said structures having at least one set of separable contacts which are biased apart and are adapted to control the circuit through said conductors, a contact on the outer end of each interrupting structure, a movable bridging contact for bridging the outer contacts of said interrupting structures, actuating mechanism for operating said contacts, said mechanism including a movable rod carrying said bridging contact at its outer end, means to releasably latch said separable contacts closed, means controlled by initial opening movement of said rod prior to separation of said bridging contact from said outer contacts

for releasing said latch means and permitting said separable contacts to separate under the influence of their bias to open the circuit, after which said bridging contact is moved by said rod to insert a relatively large gap in the circuit, and means cooperative with a portion of said mechanism for reclosing said separable contacts in response to reverse movement of said rod.

5. In a circuit breaker, a container, a pair of spaced bushings of insulating material extending into said container, a conductor in each of said bushings, an interrupting structure mounted on each of said bushings, each of said structures having at least one set of separable contacts which are biased apart and are adapted to control the circuit through said conductors, a contact on the outer end of each interrupting structure, a movable bridging contact for bridging the outer contacts of said interrupting structures, actuating mechanism for operating said contacts, said mechanism including a movable rod carrying said bridging contact at its outer end, means to releasably latch said separable contacts closed, means controlled by initial opening movement of said rod prior to separation of said bridging contact from said outer contacts for releasing said latch means and permitting said separable contacts to separate under the influence of their bias to open the circuit, after which said bridging contact is moved by said rod to insert a relatively large gap in the circuit, means cooperative with said rod at a point adjacent the other end thereof for reclosing said separable contacts in response to reverse movement of said rod, including liquid motion transmitting means located adjacent said bushings.

6. In a circuit breaker, a container, a pair of spaced bushings of insulating material extending into said container, a conductor in each of said bushings, an interrupting structure mounted on each of said bushings, each of said structures having at least one set of separable contacts which are biased apart and are adapted to control the circuit through said conductors, a contact on the outer end of each interrupting structure, a movable bridging contact for bridging the outer contacts of said interrupting structures, actuating mechanism for operating said contacts, said mechanism including a movable rod carrying said bridging contact at its outer end, means to releasable latch said separable contacts closed, means controlled by initial opening movement of said rod prior to separation of said bridging contact from said outer contacts for releasing said ltch means and permitting said separable contacts to separate under the influence of their bias to open the circuit, after which said bridging contact is moved by said rod to insert a relatively large gap in the circuit, and means for transmitting motion from a portion of said mechanism located adjacent the other end of said rod to said separable contacts when said mechanism is operated to move said rod to close the circuit, said motion transmitting means being ineffective to transmit motion when said mechanism is operated to open the circuit.

7. In a circuit breaker, a container, a pair of spaced bushings of insulating material extending into said container, a conductor in each of said bushings, an interrupting structure mounted on each of said bushings, each of said structures having a plurality of sets of separable contacts which are biased apart and are adapted to control the circuit through said conductors, said sets of contacts being arranged in longitudinally spaced relation, a contact on the outer end of each interrupting structure, a movable bridging contact for bridging the outer contacts of said interrupting structures, actuating mechanism for operating said contacts, said mechanism including a movable rod carrying said bridging contact at its outer end, means to releasably latch said separable contacts closed, and means controlled by initial opening movement of said rod prior to separation of said bridging contact from said outer contacts for releasing said latch means and permitting said separable contacts to separate under the influence of their bias to open the circuit, after which said bridging contact is moved by said rod to insert a relatively large gap in the circuit.

8. In a circuit breaker, a container, a bushing of insulating material extending into said container and having an electrical conductor therein, an interrupting structure mounted on the inner end of said bushing and including at least one set of separable contacts which are biased apart and are adapted to control the circuit through said conductor, a contact on the outer end of said interrupting structure, actuating mechanism including a movable rod extending down into said container, a contact carried by said rod at its outer end for movement with said rod into and out of engagement with said outer end contact, means for releasably latching said separable contacts closed, and means controlled by initial movement of said rod in a direction to open the circuit to release said latching means prior to separation of said rod contact from said lower end contact.

9. In a circuit breaker, a container, a bushing of insulating material extending into said container and having an electrical conductor therein, an interrupting structure mounted on the inner end of said bushing and including at least one set of separable contacts which are biased apart and are adapted to control the circuit through said conductor, a contact on the outer end of said interrupting structure, actuating mechanism including a movable rod extending down into said container, a contact carried by said rod at its outer end for movement with said rod into and out of engagement with said outer end contact, means for releasably latching said separable contacts closed, means controlled by initial movement of said rod in a direction to open the circuit to release said latching means prior to separation of said rod contact from said lower end contact, and means cooperative with said rod at a point adjacent the other end thereof for reclosing said separable contacts in response to reverse movement of said rod.

10. In a circuit breaker, a container, a bushing of insulating material extending into said container and having an electrical conductor therein, an interrupting structure mounted on the inner end of said bushing and including at least one set of separable contacts which are biased apart and are adapted to control the circuit through said conductor, a contact on the outer end of said interrupting structure, actuating mechanism including a movable rod extending into said container, a contact carried by said rod at its outer end for movement with said rod into and out of engagement with said outer end contact, means for releasably latching said separable contacts closed, means controlled by initial movement of said rod in a direction to open the circuit to release said latching means prior to separation of said rod contact from said lower end contact,

and means for transmitting motion from a portion of said mechanism located adjacent the other end of said rod to said separable contacts when said mechanism in operated to move said rod to close the circuit, said motion transmitting means being ineffective to transmit motion when said mechanism is operated to open the circuit.

11. In a circuit breaker, a container, a bushing of insulating material extending into said container and having an electrical conductor therein, an interrupting structure mounted on the inner end of said bushing and including a plurality of longitudinally spaced sets of separable contacts which are biased apart and are adapted to control the circuit through said conductor, a contact on the outer end of said interrupting structure, actuating mechanism including a movable rod extending into said container, a contact carried by said rod at its outer end for movement with said rod into and out of engagement with said outer end contact, means for releasably latching said separable contacts closed, and means controlled by initial movement of said rod in a direction to open the circuit to release said latching means prior to separation of said rod contact from said lower end contact.

12. In a circuit breaker, a container, a bushing of insulating material extending into said container and having an electrical conductor therein, an interrupting structure mounted on the inner end of said bushing and including at least one set of separable contacts which are adapted to control the circuit through said conductor, actuating mechanism mounted on said container, means for actuating said contacts including tubular means of insulating material extending between said mechanism and said contacts, said tubular means adapted to be filled with liquid, and displaceable means at each end of said tubular means associated with said contacts and mechanism, respectively, to at least actuate said contacts to closed circuit position in response to actuating of said mechanism in one direction.

13. In a circuit breaker, a container, a bushing of insulating material extending into said casing and having an electrical conductor therein, an interrupting structure mounted on the inner end of said bushing and including at least one set of separable contacts which are adapted to control the circuit through said conductor, actuating mechanism mounted on said container, means for actuating said contacts including tubular means of insulating material extending between said mechanism and said contacts, said tubular means adapted to be filled with liquid, displaceable means at each end of said tubular means associated with said contacts and mechanism, respectively, to at least actuate said contacts to closed circuit position in response to actuation of said mechanism in one direction, said contacts being biased apart, releasable latch means for maintaining said contacts in engagement, means responsive to actuation of said mechanism in the opposite direction to release said latch means, and said mechanism being movable in said opposite direction independently of the displaceable means associated therewith.

14. In a circuit breaker, a liquid container having side, bottom and top walls, separable interrupting contacts positioned in said container below the liquid level thereof, said contacts being biased apart to an open circuit position, means located adjacent said contacts latching said contacts closed, actuating mechanism suported on said top wall, liquid motion transmitting means connected between said mechanism and contacts for closing said contacts against said bias when said mechanism is operated in one direction, separable disconnect contacts in said container and connected in series circuit relation with said interrupting contacts, said mechanism including a relatively light movable rod which is separate from said motion transmitting means and said interrupting contacts and carries one of said disconnect contacts adjacent its lower end, and means controlled by initial movement of said rod by said mechanism in opening the circuit to release said latching means by movement independent of said interrupting contacts to permit separation of said interrupting contacts under the influence of their bias to open the circuit, after which said one disconnect contact is separated from the other of said disconnect contacts.

15. In a circuit breaker, a liquid container having side, bottom and top walls, separable interrupting contacts positioned in said container below the liquid level thereof, said contacts being biased apart to an open circuit position, means located adjacent said contacts latching said contacts closed, actuating mechanism supported on said top wall, liquid motion transmitting means connected between said mechanism and contacts for closing said contacts against said bias when said mechanism is operated in one direction, separable disconnect contacts in said container and connected in series circuit relation with said interrupting contacts, said mechanism including a relatively light movable lift rod which is separate from said motion transmitting means and said interrupting contacts for carrying one of said disconnect contacts adjacent its lower end, means controlled by initial movement of said rod by said mechanism in opening the circuit to release said latching means by movement independent of said interrupting contacts and permit separation of said interrupting contacts under the influence of their bias to open the circuit, after which said one disconnect contact is separated from the other of said disconnect contacts, and an operative connection between said motion transmitting means and the upper end of said lift rod for closing said interrupting contacts upon movement of said rod in the opposite direction.

JAMES M. CUMMING.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,086,752	Thornburg	July 13, 1937
2,192,772	MacNeill	Mar. 5, 1940
2,249,006	Kesselring et al.	July 15, 1941