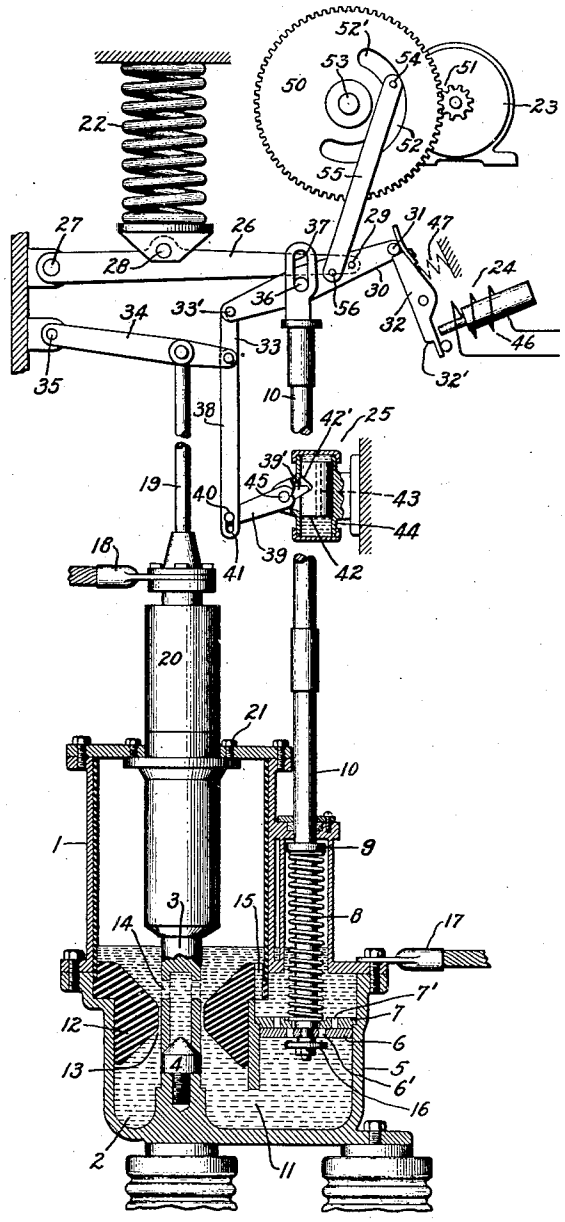
Dec. 24, 1935. D. C. PRINCE 2,025,549

OPERATING MECHANISM FOR ELECTRIC CIRCUIT BREAKERS

Filed Aug. 28, 1934 2 Sheets-Sheet 1

Fig. 1.



Inventor:
David C. Prince,
by Harry E. Dunham
His Attorney.

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Fig. 2.

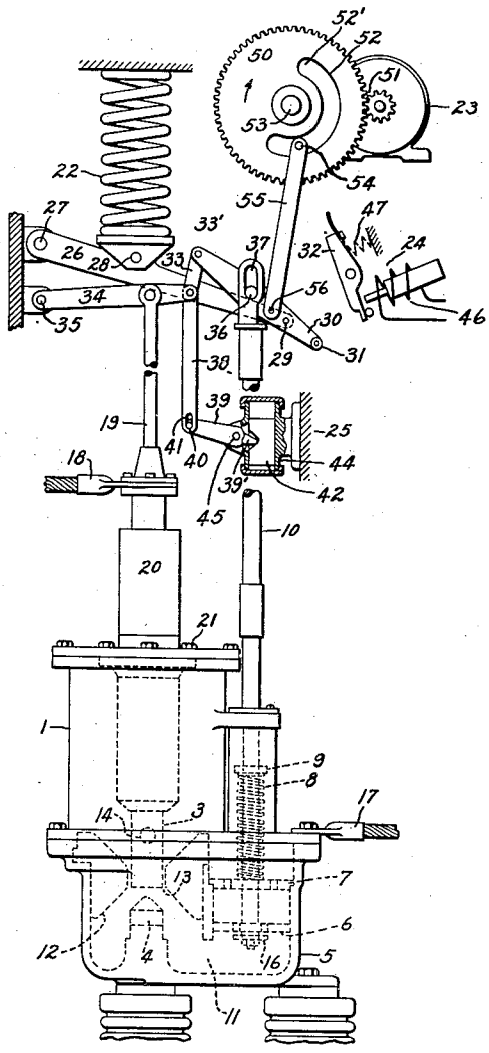
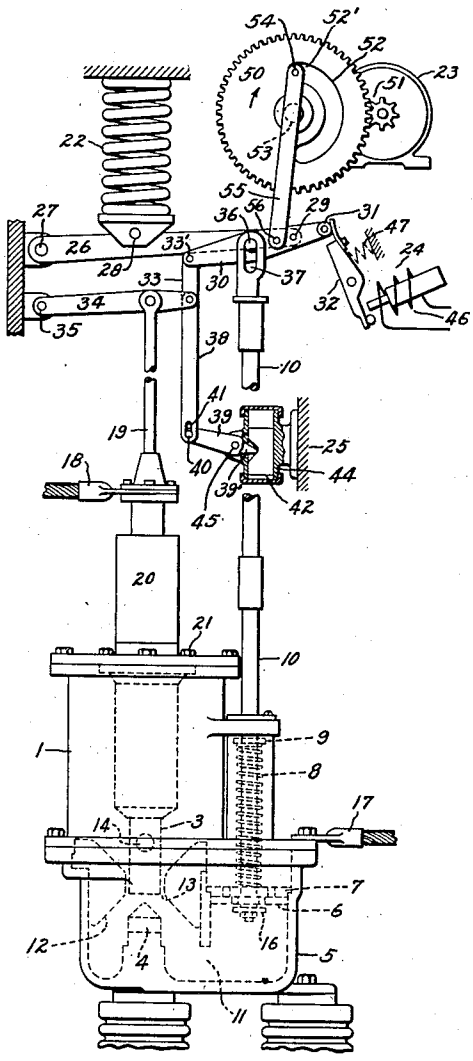


Fig. 3.



Inventor:
David C. Prince,
by Harry E. Dunham
His Attorney.

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UNITED STATES PATENT OFFICE

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OPERATING MECHANISM FOR ELECTRIC CIRCUIT BREAKERS

David C. Prince, Swarthmore, Pa., assignor to General Electric Company, a corporation of New York

Application August 28, 1934, Serial No. 741,789

9 Claims. (Cl. 200—150)

My invention relates to operating mechanisms for electric circuit breakers, particularly to circuit breakers of the type wherein a mechanically controlled flow of arc extinguishing liquid, as oil, is directed across the breaker contacts upon separation thereof.

In the operation of electric circuit breakers of the aforesaid type difficulties may be encountered, particularly in the interruption of short circuit currents, where the breaker contacts are separated an appreciable distance. As is well known, the gas pressure produced by the action of an arc in an insulating liquid, as oil, is increased as the arc is lengthened. This increase in length is accompanied by increased deterioration in the dielectric strength of the oil, and an increased formation of gas and carbon. It is accordingly desirable to limit the length of the arc and the resulting arc pressure to an extent consistent with efficient interruption by the oil jet. Any increase in arc length over this value will produce unnecessary arc pressure and oil deterioration. In the event of severe short circuits, this unnecessary arc pressure may reach such values as to cause damage to the breaker.

Further, a serious problem is encountered where the actuating means for the arc-extinguishing oil jet comprises a spring biased piston or the like. If high arc pressure exists during short circuit interruption, the piston may be either retarded or even forced backwards so as to greatly decrease the effect of or eliminate the oil jet, resulting in probable failure of the breaker. After the circuit has been interrupted it is desirable, especially in case of high voltage installations, to increase the distance between the contacts after interruption of the circuit in order that the contacts may be adequately insulated by the intervening oil.

A principal object of my invention is the provision of improved operating mechanism for electric circuit breakers of the aforesaid type which shall be efficient and positive in operation at all values of current within the rated capacity of the breaker.

In accordance with my invention, the circuit opening operation comprises quick separation of the contacts a predetermined distance which is consistent with limitation of pressure and interruption of arcing between the contacts, and decelerating the contacts by dashpot action or the like while an oil jet is directed across the contacts by a spring biased piston or its equivalent.

My invention will be more fully set forth in the following description referring to the accompanying drawings, 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.

Referring more particularly to the drawings, Fig. 1 is an elevational view, partly in section, of an oil circuit breaker and operating mechanism in the closed circuit position embodying my invention; Fig. 2 is a view of the breaker and mechanism in the open circuit position prior to resetting of the actuating means, and Fig. 3 is a similar view of the breaker and mechanism in the open circuit reset position in readiness for the subsequent closing and opening cycle.

The circuit breaker illustrated comprises a casing 1 containing an arc-extinguishing liquid 2, as oil, in which is immersed relatively movable contact structure, as a movable tubular contact 3, and a coacting stationary contact 4. The casing 1 is provided with a cylindrical portion 5 within which a piston 6 is movable for directing oil across the contacts upon separation thereof. The piston 6 is normally biased upwardly against a stop plate 7 by a spring 8, said spring being seated at its lower end on the stop plate 7 and at its upper end on flange 9 carried by the piston rod 10. The lower end of the piston cylinder 5 is in communication, as at 11, with the main casing so that downward movement of the piston is effective to force oil into the main part of the casing.

The flow of oil across the contacts is controlled by an insulating baffle or partition 12 having a central aperture 13 for receiving the movable contact. The contact 3 which is tubular in form and open at its lower end is provided with ports 14 positioned above the insulating partition 12. Accordingly, when the contact 3 is moved upwardly away from contact 4 to interrupt the circuit, oil under pressure beneath the insulating partition may escape into the upper part of the chamber only through the contact 3 and ports 14 which results in effective interruption of arcing.

The oil level in the casing is normally above the insulating partition 12 as illustrated, the piston cylinder 5 being in communication at 15 with the oil above the partition. Within the cylinder 5 the stop plate 7 is provided with oil ports 7' and the piston with similar ports 6' adapted to be closed when the piston is depressed by a simple disk valve 16 slidably mounted at the lower end of the piston rod.

The casing of the circuit breaker may be constructed of metal so as to be in direct electrical

contact with the stationary contact 4 and one breaker terminal 17. The other breaker terminal may be suitably connected at 18 to the movable contact which is connected to an operating rod 19 and guided for vertical reciprocal movement within an insulating bushing 20 mounted, as at 21, in the upper wall of the breaker casing.

The circuit breaker so far described is of the well known "impulse" type and is described and claimed in my Patent No. 1,922,862, granted August 15, 1933, for Electrical switching apparatus.

The operating means for the circuit breaker comprises a common actuating means as compression spring 22, a motor 23 for charging said spring, tripping means 24 for releasing the energy of said spring, and retarding means 25 for decelerating the movable contact.

With the mechanism in the closed circuit position shown, the spring 22 is under compression and is maintained in such position by the tripping means 24. The linkage structure operatively interconnecting the aforesaid elements comprises a main lever 26 pivotally supported as at 27 and connected as at 28 to the compression spring 22.

At the end of the lever 26, at 29, a floating lever 30 is pivotally carried, one end of the floating lever having a pin or roller 31 adapted to be engaged by the pivoted latch 32 of the tripping means and the other end pivotally connected through a link 33 to the contact actuating lever 34 which is pivotally mounted at 35. The floating lever 30 is likewise provided with a pin 36 operable within a slot 37 formed in an extension of the piston rod 10.

It will, therefore, be apparent that the bias of spring 22 tends to rotate the floating lever 30 in a counter-clockwise direction about the pin 31 which serves as the fulcrum, with the result that the contact rod 19 is forced downwardly to make firm contact engagement between contacts 3 and 4.

The contact retarding means 25 is connected to the contact operating lever 34 through a link 38 which is connected through a lost motion connection to the dashpot lever 39. The aforesaid lost motion connection comprises a pin 40 at the end of the lever 39 operable in a slot 41 at the lower end of link 38. The retarding means per se forms no part of the present invention and may comprise a simple dashpot or shock-absorbing device as a piston 42 having a through-bore 43 operable within a cylinder 44 containing oil or liquid of suitable viscosity. The actuating lever 39 which is pivotally mounted on the cylinder casing, as at 45, is provided with an extension 39' operating in a notch 42' formed in the piston so as to effect reciprocal movement thereof.

The foregoing description is sufficient for a complete understanding of the circuit opening operation which will be presently described since the motor and its associated mechanism take no part in this operation.

The circuit opening operation may be controlled in any suitable manner as by the usual over-current device. Such means, as a tripping solenoid, is indicated at 46 for coacting with the tripping latch 32. When the tripping solenoid 46 is actuated by excess current, the plunger thereof strikes the extension 32' of the latch and rotates the same clockwise against the bias of latch spring 47 so that the latch no longer restrains pin 31 of the floating lever 30. This pin, therefore, no longer functions as a fulcrum, with the result that the fulcrum is instantly shifted from the pin 36 to the pin 37. A momentary fulcrum is established at this point by reason of the inertia of the piston and oil body causing clockwise rotation of the floating lever 30 about said fulcrum until the lost motion connection with the retarding device at 40, 41 is taken up.

This preliminary rotation of the floating lever 30 lifts the contact operating lever 34 and operating rod 19 to cause opening of contact 3. At this point it will be noted that the retarding device 25 comes into action opposing further rapid separation of the contacts.

At the point where the lost motion connection with the retarding device is taken up the fulcrum of the floating lever 30 may be considered as having shifted to the pin 33'. That is, the pin 33' may be considered a yielding fulcrum due to the dashpot resistance so that the spring 22 now acts through the floating lever 30 and pin 36 to drive the piston rod 10 downwardly. The piston 6 accordingly drives oil across the separating contacts at a high rate and the movable contact is decelerated in moving to its final open circuit position which is illustrated by Fig. 2.

It will be noted that although the main force of the spring 22 is not applied to the piston until after initial separation of the contacts, the pin 36 functions as a fulcrum during this initial separation so that a downward force is exerted on the piston rod 10 from the instant of tripping.

The circuit breaker and mechanism in Fig. 2 are in the open circuit position, the contacts 3 and 4 being insulated with respect to each other by the oil 2 and the piston 6 being at the lower end of its stroke. The resetting of the mechanism, including recharging of the compression spring 22, is effected in the following manner.

The motor 23 is energized through suitable control circuits (not shown) so as to rotate the main cam gear 50 in clockwise direction as indicated. The cam gear 50 which is suitably connected to the motor through a reduction gearing, indicated at 51, is provided with an arcuate slot 52 concentric with respect to the cam shaft 53. A roller connected at 54 to a pitman 55 is positioned in the slot 52. The opposite end of the pitman 55 is pivotally connected, as at 56, to the floating lever 30. The pitman connection 56 is so located with respect to the main lever connection 29 that elevation of the pitman tends to rotate the floating lever clockwise about 29 as a center.

Elevation of the pitman is accomplished by energization of motor 23. It will be noted that rotation of the cam gear 50 causes the cam to pick up the roller 54 at the end of the slot at 52' within nearly a half revolution. Continued rotation of the cam carries the pitman to the high dead-center position of the cam illustrated by Fig. 3 at which point the motor 23 is suitably deenergized as by a limit switch for example.

During rotation of the cam 50 in elevating the pitman, the floating lever 30 is restrained at its end 33' with respect to clockwise rotation since the circuit breaker is open, the movable contact being at its upper limiting position. Accordingly, the cam force is applied directly at the end of the main lever 29 to cause counter-clockwise rotation thereof and compression of spring 22. During this operation the pin and slot connection 36—37 between the floating lever and piston rod permits the floating lever to move independently of the piston rod.

Referring to Fig. 3, at the end of the spring

charging operation the roller 31 of the floating lever is opposite and somewhat beyond the coacting end of latch 32, the mechanism being held in such position by the cam 50. The piston 6 is separately returned to its upper position by its spring 8, the floating lever pin 36 in this position being at the upper end of the slot 37. The mechanism is now in its open circuit reset position.

The circuit closing operation is accomplished by releasing part of the stored energy in spring 22. This is effected simply by energizing the motor 23 so as to move the pitman 55 beyond the dead-center position. Upon release, the spring 22 acting on the floating lever 30 at 29 causes roller 31 to engage latch 32. The floating lever 30 is thereupon rotated in a counterclockwise direction about the roller 31 to cause downward circuit closing movement of the movable contact rod 19, thus returning the circuit breaker and mechanism to the position illustrated by Fig. 1. It will be noted that the contacts are protected against excessive closing force by the dashpot action of the retarding means 25, the retarding means therefore functioning usefully during both the circuit opening and closing operations.

The mechanism is, therefore, effective to limit the arc pressure within the circuit breaker and to establish an oil jet for effectively interrupting the arc at the upper limit of the breaker capacity. The mechanism is likewise trip-free in action since opening of latch 32 during the circuit closing operation would cause the breaker to assume the open circuit position illustrated by Fig. 2.

It should be understood that my invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit 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 including separable contacts and a piston for directing an arc-extinguishing liquid between said contacts upon separation thereof, operating means for effecting separation of said contacts and a working stroke of said piston common thereto, and a retarding device for decelerating said contacts after predetermined separation thereof independently of the working stroke of said piston.

2. In an electric circuit breaker including separable contacts and a piston for directing an arc-extinguishing liquid between said contacts upon separation thereof, an operating spring for effecting separation of said contacts and a working stroke of said piston, and a retarding device for decelerating said contacts after predetermined separation thereof, said spring completing the working stroke of said piston independently of said retarding device.

3. Operating mechanism for electric circuit breakers having separable contacts and a piston for directing an arc-extinguishing liquid between said contacts upon separation thereof comprising an actuating spring, linkage structure operatively interconnecting said spring, the movable contact and said piston, and a retarding device operatively connected to said linkage structure arranged so that said movable contact is decelerated after predetermined opening movement concurrent with a working stroke of said piston.

4. Operating mechanism for electric circuit breakers of the type including separable contacts and means for directing a jet of arc-extinguishing liquid between said contacts upon separation thereof, comprising actuating means common to said liquid directing means and contacts, retarding means, and means operatively interconnecting said actuating means, contacts and retarding means so that quick separation and subsequent deceleration of said contacts are accompanied by a high velocity jet of arc-extinguishing liquid.

5. Operating mechanism for electric circuit breakers of the type including separable contacts and a piston for directing an arc-extinguishing liquid between said contacts upon separation thereof, comprising energy storing means common to said piston and contacts, retarding means, means including a lost motion connection interconnecting one of said contacts and said retarding means, means operatively interconnecting said energy storing means, piston and contact, and tripping means associated with said last-named means, actuation of said tripping means causing quick separation of said contacts in accordance with said lost motion connection and subsequent deceleration of said contact concurrent with actuation of said piston by said energy storing means.

6. Operating mechanism for electric circuit breakers of the type including separable contacts and a piston for directing arc-extinguishing liquid between said contacts upon separation thereof, comprising a main actuating spring, retarding means connected through a lost motion connection to one of said contacts, means interconnecting said spring, contact and piston, and tripping means for said interconnecting means, said interconnecting means arranged so that upon actuation of said tripping means said spring is effective to separate said contacts a predetermined distance independently of said retarding means and to effect a working stroke of said piston during deceleration of said contact by said retarding means.

7. Operating mechanism for electric circuit breakers of the type including separable contacts and a piston for directing an arc-extinguishing liquid between said contacts upon separation thereof, comprising a main actuating spring common to said piston and the movable contact, linkage structure operatively interconnecting said spring, movable contact and piston, said linkage structure having a lost motion connection with said piston, retarding means operatively connected through a lost motion connection to said linkage structure, and tripping means coacting with said linkage structure maintaining said spring in charged position, actuation of said tripping means causing initial opening movement of said movable contact independently of said retarding means, said movable contact being subsequently decelerated by said retarding means, said spring acting simultaneously upon said piston and movable contact to effect an arc-extinguishing flow of said liquid.

8. Operating mechanism for electric circuit breakers of the type including separable contacts and a piston for directing an arc-extinguishing liquid between said contacts upon separation thereof, comprising a main actuating spring, a lever operatively connected to said spring, a floating lever pivotally connected to said first-named lever, tripping means coacting with said floating lever, means operatively connecting said floating lever to the movable contact, retarding means operatively connected through a lost motion con-

nection to said movable contact, and means including a second lost motion connection operatively connecting said floating lever and piston, actuation of said tripping means causing said spring initially to actuate said floating lever to cause quick opening movement of said movable contact for a predetermined distance followed by deceleration thereof, said spring acting on said piston to cause an arc-extinguishing flow of liquid.

9. Operating mechanism for electric circuit breakers of the type including separable contacts and a piston for directing an arc-extinguishing liquid between said contacts upon separation thereof, comprising a main actuating spring, a lever operatively connected to said spring, a floating lever pivotally carried by said first lever, tripping means for coacting with said floating lever, said floating lever being likewise operatively connected to the movable contact and to said piston, retarding means operatively connected through a lost motion connection to said movable contact, and motor actuating means operatively connected to said floating lever for storing energy in said spring, actuation of said tripping means effecting release of said energy for actuating said movable contact and piston, said retarding means decelerating said movable contact after predetermined travel opening movement thereof concurrent with a working stroke of said piston.

DAVID C. PRINCE.