Feb. 16, 1937. C. THUMIM 2,071,185

ELECTRIC CIRCUIT BREAKER

Filed June 6, 1935

Fig. 1.

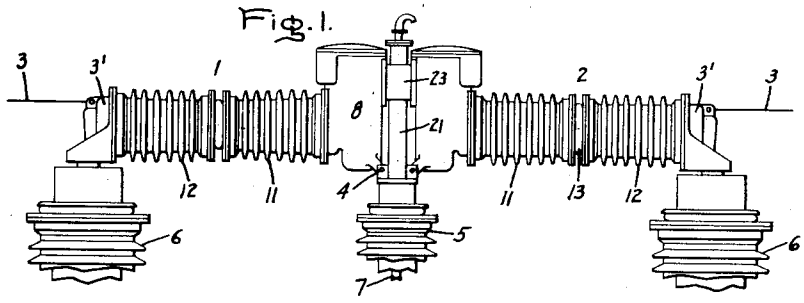


Fig. 2.

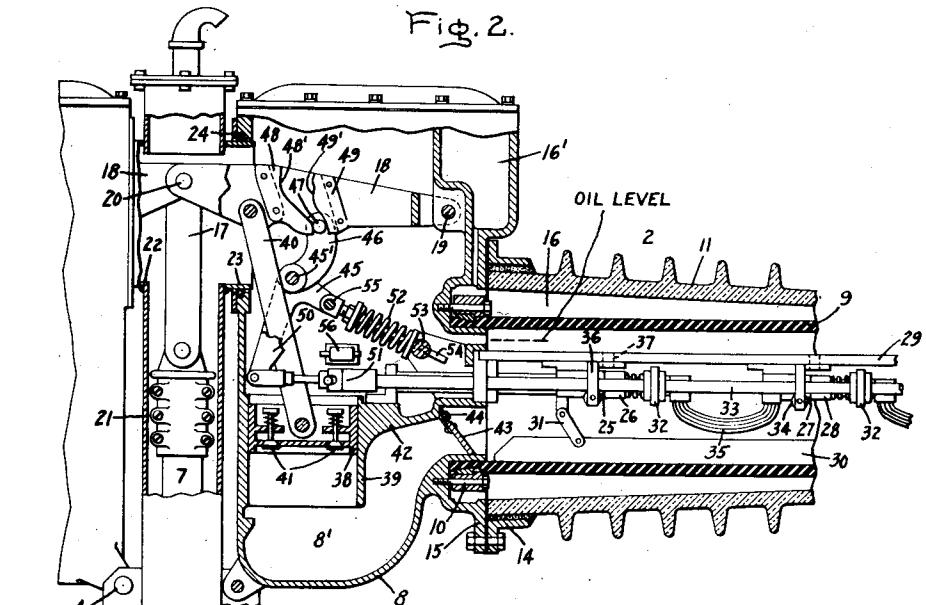
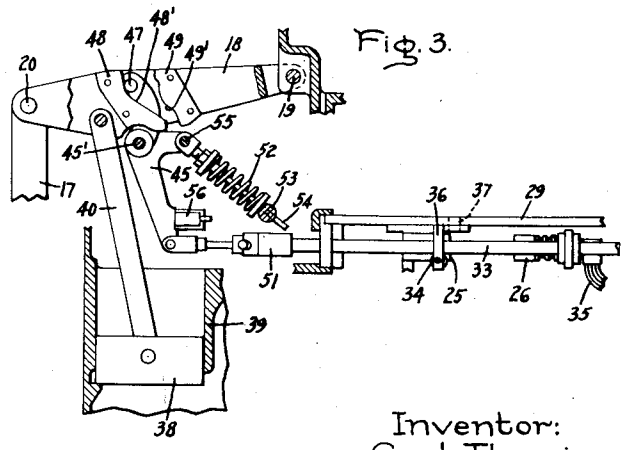


Fig. 3.



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Carl Thumim,
by Harry E. Dunham
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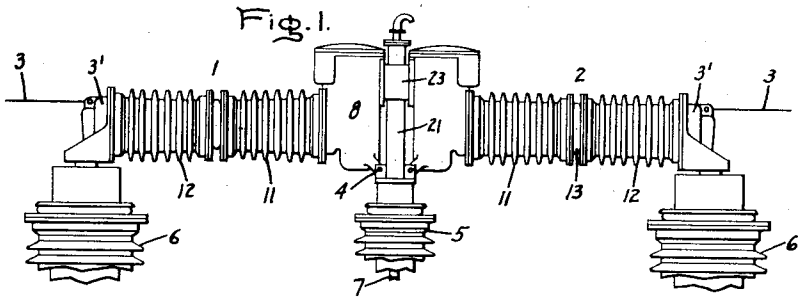


Fig. 2.

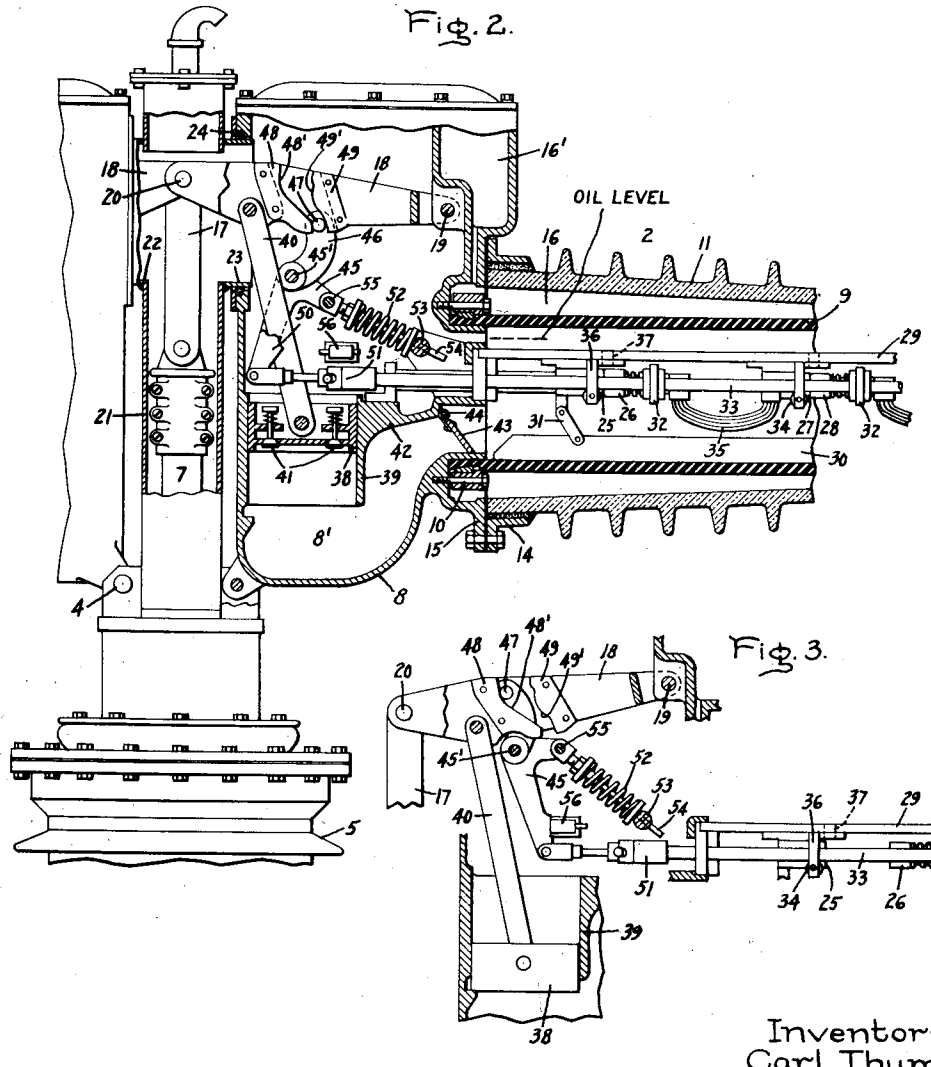


Fig. 3.

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Patented Feb. 16, 1937 2,071,185

UNITED STATES PATENT OFFICE

2,071,185

ELECTRIC CIRCUIT BREAKER

Carl Thumim, Yeadon, Pa., assignor to General Electric Company, a corporation of New York

Application June 6, 1935, Serial No. 25,222

4 Claims. (Cl. 200—150)

My invention relates to electric circuit breakers, more particularly to operating and controlling means for high tension multiple-break electric circuit breakers of the liquid blast or impulse type, and has for its principal object the provision of an improved and simplified electric circuit breaker of the aforesaid type.

My invention will be more fully set forth in the following description referring to the accompanying drawing, 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 to the drawing, Fig. 1 is an elevational view of the main portion of an electric circuit breaker of the impulse type to which my invention may be applied; Fig. 2 is an elevational view, partly in section, of a portion of the circuit breaker shown by Fig. 1, and Fig. 3 is a similar view wherein the mechanism shown by Fig. 2 is in another position.

Fig. 1 illustrates a high tension multiple-break electric circuit breaker of the impulse type comprising a pair of similar interrupting units 1 and 2 for interrupting a high tension power circuit indicated at 3. Each interrupting unit is pivotally mounted at 4 on a stationary insulating support 5, the free terminal ends of the interrupting units each having a non-rigid connection with an insulating support 6.

The operating means for the interrupting units includes an operating rod 7 which extends upwards from suitable operating mechanism (not shown) through the hollow insulating support 5 and terminates in linkage coacting with the interrupting units. The insulating supports 5 and 6 together with the operating mechanism above referred to are suitably mounted on structural steel framework or other rigid foundation.

Referring more particularly to Fig. 2, the interrupting unit 2, which is generally similar in all respects to the interrupting unit 1, comprises a metallic housing or casing 8 to which is united an elongated insulating casing 9 comprising a cylindrical tube of mechanically strong insulating material. The tube 9 is secured at 10 to an annular flange of the casing 8 and is in communication with the interior of said casing. The opposite end of the tube is closed to form with the casing 8 a reservoir for suitable arc-extinguishing liquid, such as oil for example.

For the purpose of insulating and for protecting the interrupting unit from the effects of weather and climate, an outer insulating casing is provided comprising a pair of insulating shells 11 and 12 of ceramic material suitably united at adjacent ends by a fluid-tight flexible connection, such as a metallic bellows 13 for example. The insulating shell 11 is suitably connected at one end at 14 to an annular flange 15 of the casing 8, the other shell 12 being closed at its outer end by terminal structure 3'.

The annular space 16 between the tube 9 and shells 11 and 12 is sealed with respect to the interior of the tube 9 and is filled with insulating oil. The oil space 16 is in communication with an oil reservoir and expansion chamber 16' formed by the casing 8. Accordingly, accidental breakage of one of the insulating shells would permit escape only of the oil in the space 16, thereby permitting continued normal operation of the interrupting unit.

The mounting for the interrupting unit comprises a pivotal support 4 to which the casing 8 is directly connected, and the unit at its other end is provided with a non-rigid sliding connection with the support 6. This arrangement permits a limited amount of relative movement between the interrupting unit and the stationary support 5 insulating the operating unit.

The operating rod 7 extending through the central insulating support 5 is connected through a link 17 to an operating lever 18 which is pivotally mounted at 19 within the casing 8 and extends through a wall of the casing 8, as illustrated, to the link connection at 20. The operating rod 7 operates within a tubular casing 21 which is provided with a T-connection at 22 for enclosing the connection between the operating rod and the operating levers 18 of both interrupting units. The T-connection includes a sleeve member 23 extending through a wall of the casing 8 and having a sliding liquid-tight seal therewith at 24. Accordingly, a limited movement of the interrupting unit about the pivotal support 4 is permitted without loss of oil from the interrupting unit during operation thereof.

The circuit interrupting means comprises a plurality of pairs of contacts 25—26, 27—28, etc. connected in series and arranged generally along the longitudinal axis of the insulating tube 9. The contacts are mounted on and supported by an insulating partition 29 extending longitudinally of the tube and arranged to form upper and lower chambers therein. The partition 42 is braced within the tube by a positioning member 30 which is connected by means of a plurality of links 31 to the partition structure. Longitudinal movement of the member 30 towards the left, as viewed in Fig. 2, tends to straighten the links 31

and force the partition 29 into firm engagement with the tube 9.

The relatively movable contact structure at each break comprises a pair of butt contacts 25 and 26, each movable contact being connected by means of a crosspiece or yoke 32 to a pair of spaced rods 33. The rods are guided and supported by rollers 34 carried by depending insulating members 36 for reciprocal longitudinal movement with respect to the coacting stationary contacts. The movable and stationary contacts of adjacent pairs of contacts are electrically connected by flexible conductors 35, thereby connecting the respective pairs of contacts in series. Each stationary contact is rigidly mounted on an insulating member 36 depending from the partition 29.

The partition 29 is provided with an exhaust opening 37 adjacent the point of separation of each pair of contacts. The arrangement is such that arc-extinguishing liquid filling the lower chamber and placed under pressure during the circuit opening operation forces a jet of oil across the arc path, through the exhaust passage into the chamber above the partition.

The source of pressure for driving the oil from the lower chamber through the arcs into the upper chamber in accordance with a circuit opening operation comprises in the present instance a piston which is operatively associated with the contact operating means so that a high velocity jet of oil is directed across the arc gap immediately upon separation of the contacts and after said contacts are separated.

Referring more particularly to Fig. 2, the source of pressure comprises a piston 38 operable in an open end cylinder 39 formed in the casing 8. The piston 38 is operatively connected through a link 40 to the operating lever 18 and is provided with valves 41 disposed in the operating face of the piston so as to be firmly seated and closed by fluid pressure during the downward or working stroke of the piston, and to open on the return stroke of the piston for passing oil above the piston into the lower reservoir 8' in the casing 8. The space above the partition 29 is in free communication with the space in the casing above the piston and defined by the separating wall structure 42 so that oil in the upper chamber after each interruption may circulate back through the piston to the reservoir 8'.

A flap valve 43, pivoted at 44, is arranged to close the passage between the piston and the main lower chamber during the return or suction stroke of the piston. The valve 43 opens freely under fluid pressure on the working stroke of the piston. By this arrangement, oil, instead of being sucked back into the lower chamber after an arc-interrupting operation, is drawn into the casing 8 where it is directed through the piston to the reservoir 8'. Since the quantity of oil for a single interrupting operation is comparatively small, the valves 41 and 43 insure substantially complete circulation of the oil for successive circuit interrupting operations before re-use. Consequently, the rate of oil deterioration due to carbonization and other cases is uniform and reduced to a minimum.

Another function of the valve 43 is to prevent sucking of air or gas, the dielectric strength of which is considerably less than that of oil or other suitable insulating and arc-extinguishing liquids, into the lower chamber during the return stroke of the piston. The valve 43 in closing on the suction stroke of the piston prevents the formation of air or gas bubbles adjacent the contact structure which might result were air or gas sucked from the upper chamber through the exhaust port into the lower chamber. Furthermore, the presence of air or gas beneath the partition 29 would tend to defer the building up of pressure in the otherwise substantially incompressible arc-extinguishing liquid and so delay the blast effect.

The contact opening and closing mechanism associated with the lever 18 comprises a bellcrank 45, one arm 46 of which is provided with a roller 47 for coacting with oppositely disposed cam members 48 and 49 carried by the member 10. Another arm 50 of the bellcrank is connected by means of a yoke, or the like, at 51 to the pair of contact supporting rods 33, the arrangement being such that rotation of the bellcrank 45 in opposite directions causes opening or closing movement of the contacts. Another arm of the crank 45 is connected to a compression spring 52 having a pivotal support at 53 with respect to the casing 8. The guide pin 54 of the compression spring 52 is pivotally connected to the crank 45 at 55. As illustrated in Fig. 2, the contacts are closed and the spring 52 is slightly over-center with respect to the crank pivot 45' and pivot 53. Accordingly, the crank 45 is biased by the spring in clockwise direction, thereby holding the contacts by means of the rods 33 in closed position.

For the purpose of correlating the contact opening movement and the fluid pressure created by the piston 38, the operating lever 18 is provided with a lost motion connection with the contacts comprising the pair of spaced cam plates 48 and 49 having cam surfaces 48' and 49' arranged to coact with the crank roller 47. The cam face 49' coacts with the roller 47 in the circuit opening operation and the cam face 48' in the closing operation. When the operating rod 7 is lowered, as viewed in Fig. 2, for effecting the contact opening operation, the consequent counter-clockwise movement of the lever 18 effects not only the working stroke of the piston 38 for placing the oil in the lower chamber under pressure but also counter-clockwise rotation of crank 45 by reason of the camming action between the face 49' and roller 47 for opening the contacts. The cam face 49' is designed so that a comparatively quick contact separation is obtained at the initiation of the circuit opening movement, after which the rate of separation is decreased or is independent of the cam operator coincident with the oil blast across the arcs. The compression spring 52 furthermore, after it has passed its over-center position, biases the contacts towards the completely open position as clearly illustrated by Fig. 3. This spring may if desired constitute the sole opening means after initial separation of the contacts by reason of suitable spacing between the cams 48 and 49. For the purpose of minimizing shock during the circuit opening operation, a suitable dashpot device indicated at 56 is positioned in the path of the lower arm of the crank 45 so as to take up the force of the spring 52.

It will be noted that in the circuit opening operation the oil in the lower chamber is placed under pressure by the piston immediately after movement of the operating rod 7. In fact, the flow of oil into the upper chamber through the port 37 is under way at the instant of contact separation so that the short arc path is at once subjected to a transverse oil jet. The flow of oil across the arc path continues at high velocity when the contacts have separated a predeter-

mined distance, the circuit generally being interrupted within several half cycles of arcing. The continued separation of the contacts under the influence of the spring **52**, and if desired the cam face **49'** is accompanied by continued oil flow through the ports **37** so as to clear all gases and products of arcing from the vicinity of the contacts.

The circuit closing operation is effected by raising the operating rod **7** and lever **18** so as to force, by means of the cam face **48'**, the crank **45** in clockwise direction to the position shown in Fig. 2. The contact rods **33** are moved towards the left and the contacts closed. During the circuit closing operation the spring **52** is again compressed and moved to its overset contact restraining position.

Accordingly, my invention is particularly adapted to circuit breakers of the liquid blast type wherein a quick initial separation of the contacts coincident with the arc interrupting blast is desirable. More particularly, the contact operating mechanism is considerably simplified by utilizing an auxiliary force, such as a double function spring, for completing the opening after the initial separation and for holding the contacts in engagement. This eliminates the necessity for comparatively complicated variable speed controlling means.

The mounting for the interrupting units **1** and **2** and certain other features, such as the contact unit and valve structures, form no part of the present invention and are described and claimed in a copending application entitled "Electric circuit breakers", Serial No. 25,267, filed concurrently herewith by David C. Prince and assigned to the same assignee as the present invention.

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. An electric circuit breaker of the liquid blast type comprising relatively movable contacts, operating means having a lost motion connection with said contacts for effecting to a predetermined extent positive initial separation of said contacts, resilient means for independently biasing said contacts at a lower rate toward open circuit position after said initial separation, and pressure producing means operatively connected to said operating means for causing an arc-extinguishing blast of liquid across said contacts at a continuously high rate during both the initial and final separation thereof.

2. An electric circuit breaker comprising relatively movable contacts, operating means for effecting separation of said contacts including a cam arranged to cause initial separation of said contacts at a comparatively high rate and a spring arranged to bias said contacts toward completely open circuit position after said initial separation, and means operatively connected to said cam for causing an arc-extinguishing blast of liquid across said contacts at a continuously high rate during both the initial and final separation thereof.

3. An electric circuit breaker comprising relatively movable contacts, operating means for said contacts comprising a crank operatively connected to said contacts, a lever having oppositely disposed cam members for coacting with a portion of said crank and an over-center spring connected to said crank, circuit opening movement of said lever effecting through one of said cam members initial separation of said contacts, said over-center spring thereupon biasing said contacts towards completely open circuit position, and a piston operatively connected to said lever for directing an arc-extinguishing liquid across said contacts upon separation thereof, the other of said cam members causing during opposite movement of said lever closing movement of said contacts and compression of said spring to an over-center position for biasing said contacts into engagement.

4. An electric circuit breaker comprising relatively movable contacts, operating means including a lever having a lost motion connection with said contacts for effecting initial separation of said contacts and an auxiliary spring independent of said lever for completing the opening movement of said contacts, means including said lever for placing said spring under compression in the closed contact position thereby biasing said contacts into engagement, and a piston connected to said operating means and independent of said spring for causing during both the initial and final separation an arc-extinguishing blast of liquid across said contacts in accordance with the circuit opening movement.

CARL THUMIM.