Nov. 28, 1933. G. N. LEMMON ET AL 1,937,409

CIRCUIT INTERRUPTER

Filed Dec. 7, 1929 3 Sheets-Sheet 1

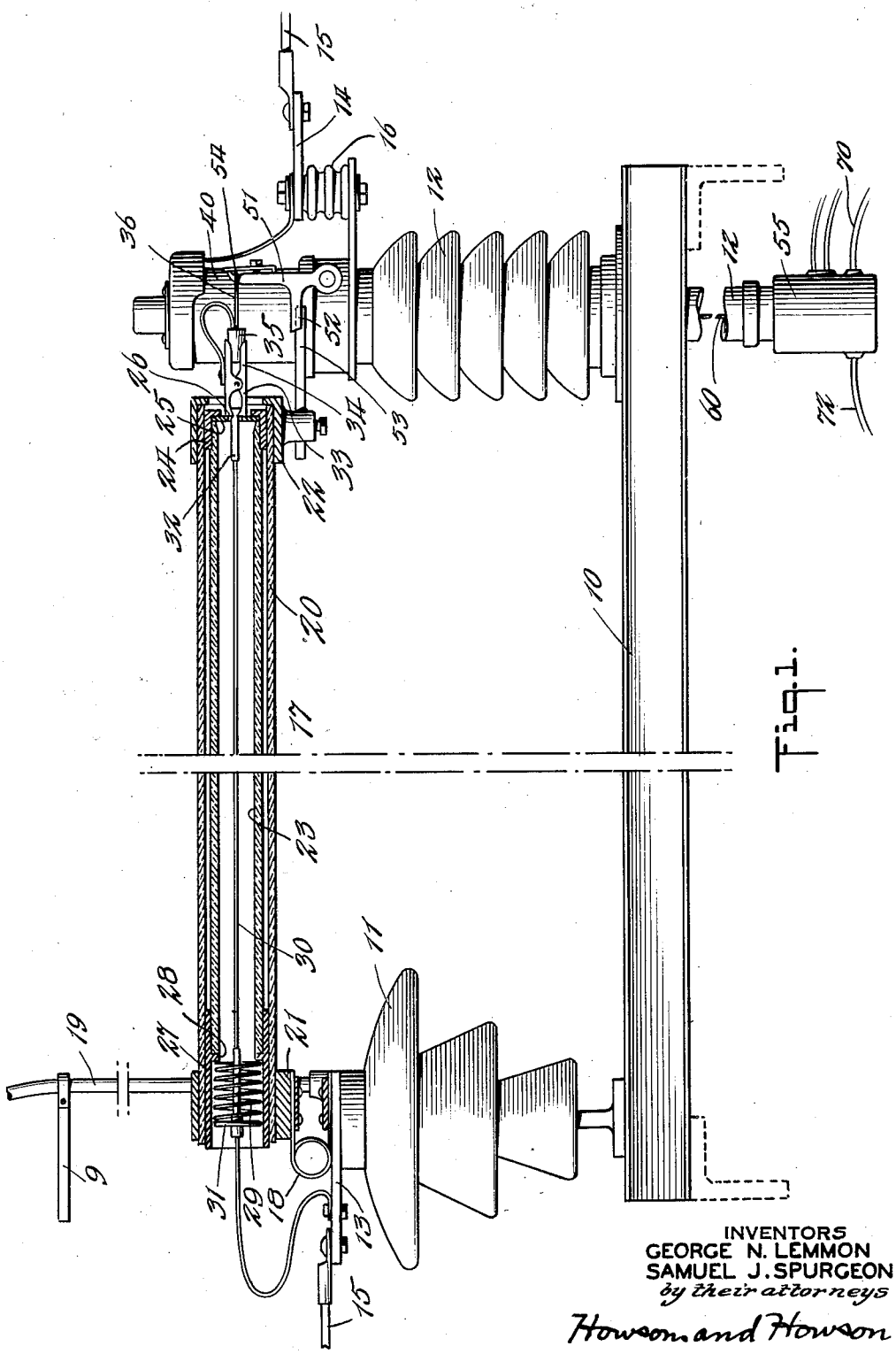


Fig. 1.

INVENTORS
GEORGE N. LEMMON
SAMUEL J. SPURGEON
by their attorneys
Howson and Howson

Nov. 28, 1933. G. N. LEMMON ET AL 1,937,409

CIRCUIT INTERRUPTER

Filed Dec. 7, 1929 3 Sheets-Sheet 2

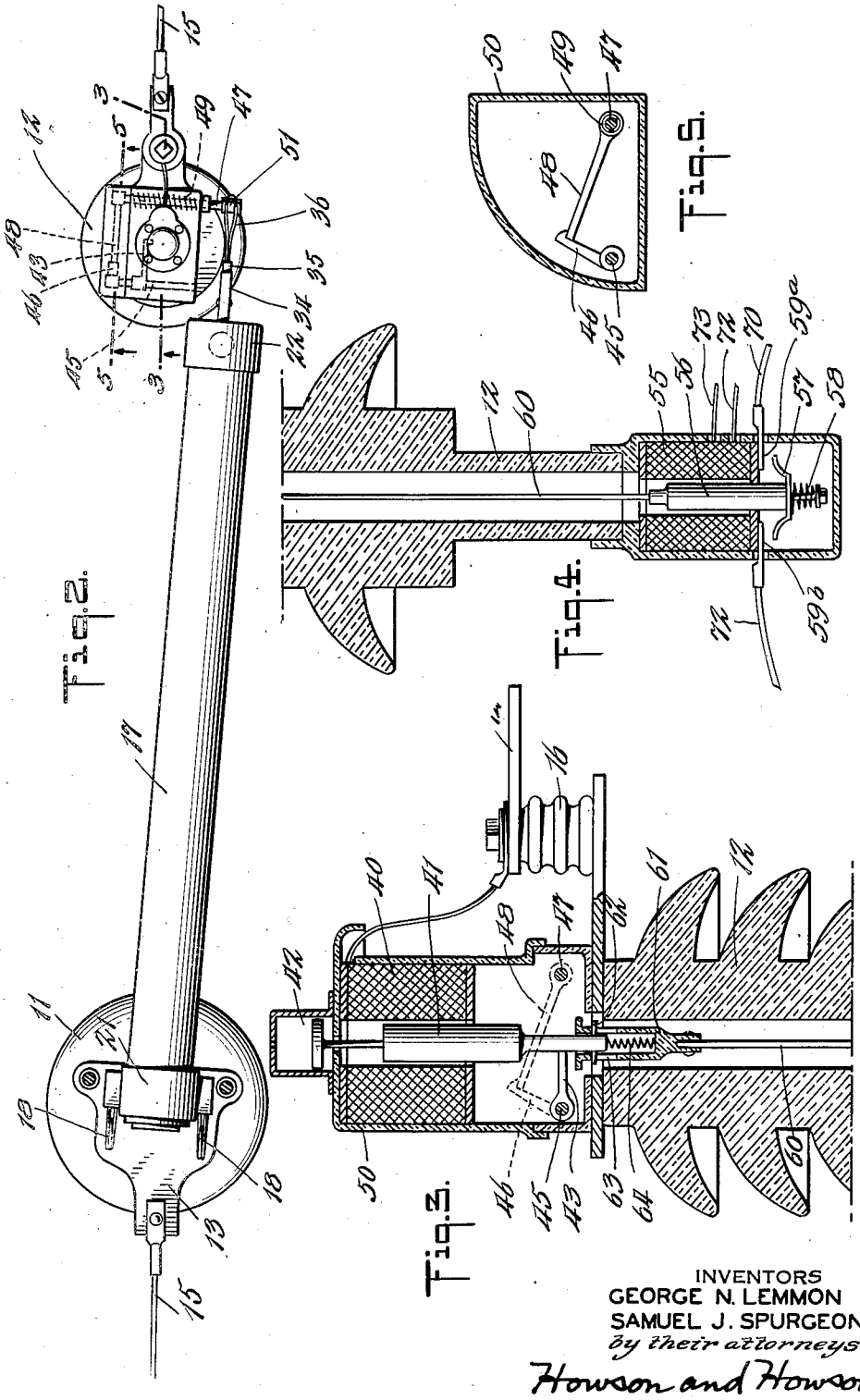


Fig. 2.

Fig. 5.

Fig. 4.

Fig. 3.

INVENTORS
GEORGE N. LEMMON
SAMUEL J. SPURGEON
by their attorneys
Howson and Howson

Nov. 28, 1933. G. N. LEMMON ET AL 1,937,409

CIRCUIT INTERRUPTER

Filed Dec. 7, 1929 3 Sheets-Sheet 3

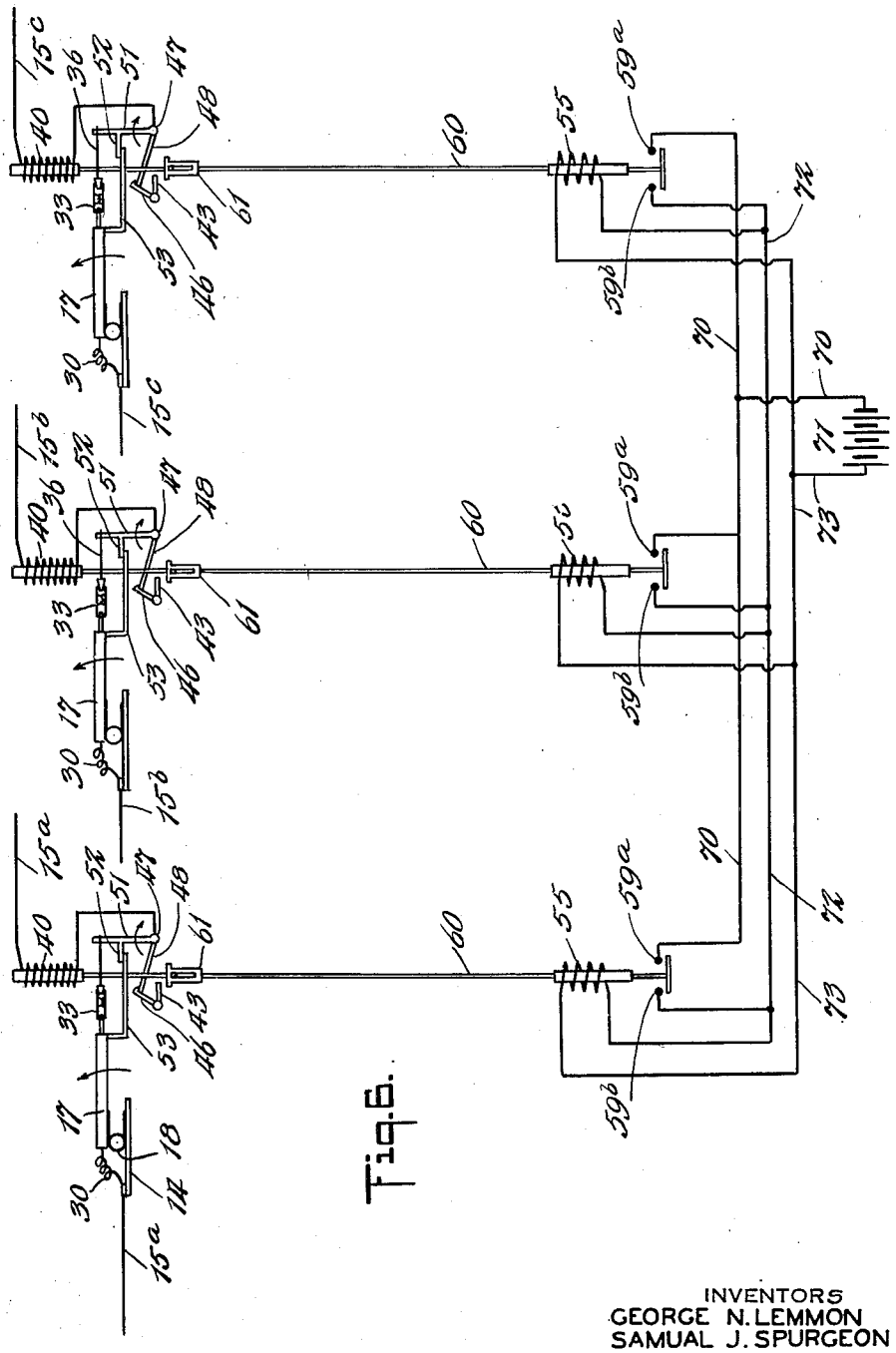


Fig. 6.

INVENTORS
GEORGE N. LEMMON
SAMUAL J. SPURGEON
by their attorneys
Howson and Howson

Patented Nov. 28, 1933 1,937,409

UNITED STATES PATENT OFFICE

1,937,409

CIRCUIT INTERRUPTER

George N. Lemmon and Samuel J. Spurgeon, Birmingham, Ala., assignors to Southern States Equipment Company, Birmingham, Ala., a corporation of Alabama

Application December 7, 1929. Serial No. 412,430

13 Claims. (Cl. 200—106)

This invention has to do with circuit breakers operated upon overload in an electrical power transmission line. It provides a separable connection, between the spaced terminals of a break in a line, with a spring device or the equivalent tending to separate the parts and a relay mechanism including a clamp which normally holds the parts of the connection together overcoming the separating tendency but which acts upon overload in the line to release the clamp, thereby permitting the separation to be effected. There is also an expulsion tube for holding a flexible conductor that is part of the separable connection and for moving one part of the connection bodily away from the other and expelling it after the break in order to quicken and make more certain the extinction of the arc formed upon breaking the connection. The mechanism operates without dependence upon fusible parts and therefore is akin to and has many of the advantages of the construction shown in the application Serial No. 279,757 filed by the present applicants jointly with Harry H. Knowles.

The present invention, in addition to its new form of separable connection, affords a way of associating breakers in the several lines of a polyphase circuit or in any two or more related lines so that upon the operation of a breaker in one line the corresponding breaker or breakers in the related line or lines will be operated as well, with the result that the flow of current in all of the lines will be interrupted when there is an overload in any one of them.

In the accompanying drawings:

Figure 1 is a side view of a breaker unit, the expulsion tube being shown in section.

Figure 2 is a plan view of the same unit.

Figure 3 is a view in vertical section through the upper part of the right hand end of the unit shown in Figures 1 and 2, the section being on the line 3—3 in Figure 2.

Figure 4 is a similar view of the parts directly below those shown in Figure 3 and therefore the complement of Figure 3.

Figure 5 is a sectional view on the line 5—5 of Figure 2.

Figure 6 is a diagram of the connections between units of the sort shown in Figures 1 to 5 when arranged in a three phase line.

The breaker unit is supported on a frame 10 and has a pin insulator 11 at one end of the frame and a tubular insulator 12 at the other, both supporting conductive terminal plates 13, 14 to which are secured the ends of the line conductor 15, bridged by the breaker unit. The terminal plate 14 is mounted directly on a small insulator 16 which is attached however to the larger insulator 12. The pin insulator 11 also supports the hinged end of an expulsion tube 17. The hinge is a piece of coil spring 18 secured to a fixed part of the insulator and to the tube so that its tendency is to swing the tube upwardly to a vertical plane or preferably beyond. An arcing horn 19 is provided and with it a piece of spring metal 9 arranged to intercept the tube and retard its final movement by being bent sidewise by the tube.

The expulsion tube here shown corresponds, in the main, to a known sort illustrated in the McGee Patent 1,635,049 and characterized by the presence of a spring for withdrawing a flexible conductor from the tube. It has an outer tube 20 of insulating material with a metal collar 21 at the hinged end for attachment to the spring 18 and a collar 22 at its other end which holds a part of the clamping mechanism yet to be described. An inner insulating tube 23 has a collar 24 at the free end (the right in Figure 1) with an inturned flange which serves to hold a diaphragm 25, having a hole 26 in it, against the end of the inner tube 23. There is a sleeve 27 at the other end of the inner tube providing, by virtue of an internal circular rib 28, a socket for a coil spring 29. The inner tube is held within the outer one in any suitable way, preferably affording a clearance between them.

The conductor extending through the expulsion tube is a flexible element 30 connected at one end (the left in Figure 1) to the terminal plate 13 and provided with a disc 31 which rests against the coil spring 29 within the sleeve 27. The other end of the flexible element has a terminal piece 32 with a portion of reduced area near its outer end adapted to extend through the hole 26 in the diaphragm 25. The purpose of this is to permit the terminal piece to be grasped between the inner jaws 33 of a pincer-like device. The outer jaws 34 receive between them a plug 35 that has a flexible, looped element 36 arranged to rest over the vertical arm of a latch mechanism when the plug 35 is supported between the jaws 34. It is desirable to attach the plug 35 to the pincer device or clamp by a thong or wire so that the plug will not be lost when removed. All of these parts are of conductive material so that current may flow from the terminal plate to the arm when the forward jaws 33 engage the terminal piece 32. The coil spring 29 exerts a tension on the flexible conductor 30 by reason of its bearing against the

disc 31 and the flexible conductor is held against this tension by the engagement of the terminal jaws 33 against the diaphragm 25. This is the normal position of the parts.

To remove the plug 35 and thus release the grip of the jaws 33 on the terminal piece 32 so that the spring 29 may draw the flexible element into the expulsion tube, thus breaking the electrical connection, there is a mechanism actuated by an overload relay. The relay or solenoid itself, 40, is mounted on the top of the tubular insulator 12 (see Figure 3). The armature 41 of the relay works vertically and upon overload moves upwardly, being retarded by a dash pot 42. In so moving it lifts a lever 43 which is arranged to rock a horizontal rod 45 carrying a latch 46. Any suitable projection on the armature would serve to strike and lift the lever 43 but here the actual engagement is between the lever and the upper edge of a member 61, described hereinafter, which moves upwardly with the armature.

A parallel horizontal rod 47 carries a lever 48 that swings into engagement with and is held by the latch 46 against the effort of a spring 49 which surrounds and at one end is attached to the rod 47, thus tending to turn it in a direction to swing the lever 48 upwardly from the position shown in Figures 3 and 5. The rod 47 extends outwise of the relay casing 50 and there has fixed to it the vertical arm 51 mentioned above as receiving the loop 36. This arm has a horizontal extension 52 arranged to rest over a rod 53 extending from the collar at the free end of the expulsion tube. The upper end of the arm 51 is recessed to receive the looped element 36 and there is a binding piece 54 secured to the arm to hold the loop in good conducting contact with the arm. The circuit from the looped element 36 to the terminal plate 14 is completed, by way of the arm 51 and the rod 47, to a wire leading to the relay coil, the other end of the coil being connected to the plate 14.

When the armature 41 is in its lower position, which it assumes due to its weight in the absence of any action of the solenoid, the latch 46 rests over the lever 48 and thereby holds the rod 47 from turning. In this position the arm 51 is vertical and the extension 52 rests on the rod 53 restraining the expulsion tube from being swung upwardly by the hinge springs 18.

It is evident that upon overload in the line 11 sufficient to actuate the relay and lift the armature, the latch 46 is tripped whereupon the coil spring 49 turns the rod 47 and with it the arm 51 whereby to draw the plug 35 from between the jaws 34. In this way the grip of the inner jaws 33 is relaxed and the spring 29 immediately withdraws the conductor from the expulsion tube in the known way. At the same time, the rod 53 is released by the movement of the extension 52 on the arm 51 and the expulsion tube swings upwardly under the influence of the spring 18.

An arc is drawn out between the jaws 33 of the pincer-like part and the terminal piece 32 but it does not exist for any length of time, being subjected to several extinguishing forces. The inward movement of the terminal piece 32 together with the dropping of the jaws 33 attenuates the arc and at the same time the up-swing of the expulsion tube further separates the ends of the arc, also putting its insulation in the straight line path between these ends. The well known expulsion effect, caused by the generation of pressure in the confined space within the tube, blows the arc and forces the flexible conductor 30 out of the hinged end of the tube, thus adding to the effect of the spring 29 and not only effectually breaking the connection and the arc but putting the connecting parts far apart where there is no chance of a resumption of the arcing. The diaphragm 25, through which the terminal piece 32 operates, substantially closes the free end of the tube and provides substantial impediment to the expulsion of gases through that end of the tube. On the other hand, when a circuit-breaking due to overload occurs, the disc 31 and spring 29 will be quickly thrown out their end of the tube allowing substantially free expulsion of the gases from said end of the tube.

The mechanism now to be described is provided in order to cause the actuation of similar units on one or more related lines, as, for instance in a three phase system 15^a, 15^b, 15^c when one breaker acts upon overload in the line which it governs. Below the tubular insulator of each unit is a low-voltage relay 55 (see Figure 4) with a vertically movable armature 56 which has a switch contact 57 yieldably held against its lower end by a spring 58. When energized the solenoid lifts the armature and presses the switch contact 58 against two terminals 59^a, 59^b arranged in a circuit yet to be described. The spacing between the switch contact 57 and the terminals is such that the latter are not engaged until the lever 43 has been lifted to trip the latch 46.

The armature of this lower relay has an insulating rod 60 extending up from it through the tubular insulator to the member 61 (see Figure 3) which provides a lost motion connection to the armature of the upper relay. This member is hollow and receives the lower end of the upper armature 41. This end has a pin 62 extending through vertical slots 63 in the wall of the connection member 61. A spring 64 within the said member tends to hold the pin 62 against the upper ends of the slots 63 but offers less resistance to the upward movement of the rod 60 than is afforded by the weight of the upper armature and the impedance of the dash pot 42. Thus the arrangement is such that the upper armature 41 can not rise without lifting the rod 60 and with it the lower armature and the switch contact 58. The lower armature 56 can rise however and lift the rod 60 and the hollow member 61 without moving the upper armature 41.

The several units are interconnected in the manner shown in Figure 6, assuming a three phase system as illustrative and a breaker unit in each phase line. One terminal 59^a of each switch is connected to a wire 70 leading to one side of a low-voltage potential source 71 and the other terminal 59^b of each switch is connected to a common neutral wire or bus 72 to which is connected also one end of the coil of each lower relay 55. The other end of each coil is connected to a wire 73 leading to the other side of the source of potential 71.

When any one of the upper relays acts upon overload in the phase with which it is associated, the switch contact 57 of that unit is brought up against its terminals 59^a, 59^b thereby completing a circuit from the wire 70 to the neutral wire 72 and thence through the coils of the lower relays in the other units to the wire 73 of opposite potential because the coils are always connected across the neutral wire 72 and the live wire 73. The result is that the other lower relays 55 are energized and their armatures 56 are

lifted, thus raising the rods 60 to such extent that the lever 43 are engaged and tilted by the upper ends of the respective connection members 61. In this way all of the latches 46 in the other units are tripped and the arms 51 and 52 are swung to pull the plugs 35 for releasing the conductors 30 and to free the expulsion tubes for their upward swings.

The purpose of the lost motion connection between the armatures of the two relays of each unit is to avoid the use of a large lower or switch-actuating relay and to permit the lower relay to be effective quickly in tripping the latch mechanism of its unit without retardation by the dash pot. It is desirable to use the dash pot to delay the tripping of the latch in the unit first affected by the overload but once one unit has operated to open its line, the others preferably should be opened promptly thereafter, hence the lower relays are independent of the dash pots. If there were no dash pot or equivalent retarding device, as for instance where it was deemed desirable to open immediately the line first affected by the overload, it would be possible to connect the armatures of the two relays directly without "lost-motion".

The breaker unit of course may be used without inter-connection with other units and in such case the lower relay would be omitted and the insulator 12 could be of the pin type, there being no need for a hollow interior. The advantage of the tubular insulator when the lower relay is used is that it provides a compact construction with a minimum of external working parts.

Due to the facts that the upper relay 40 is directly on top of the insulator 12 and that the arm 51 is at one side of the relay, the expulsion tube 17 is so mounted that when in its lower position it is not parallel with the line connecting the centers of the insulators 11, 12, but is at an angle to the center line, thus making it possible for the center line to lie in the direction of the line conductor 15. This imposes the least stress on the insulators. The casing of the relay 40 also is set at an angle on the insulator 12 so that the rod 47 lies at right angles to the expulsion tube, causing the arm 51 to draw on the plug in a straight line through the tube.

It is to be noted that the device, exemplified here by the dash pot, which retards the opening of the line first affected by the overload also determines the delay for all of the related lines. What is provided therefore is a breaker system, for opening two or more lines upon overload in any one, in which all the units are subject to a predetermined delay in operation regardless of which line is first affected.

We claim—

1. In a circuit breaker, spaced line terminals, a flexible conductor connected to one terminal, an insulating tube for said conductor with means tending to move the latter lengthwise in said tube and out at one end, and mechanical holding means for retaining one end of said conductor in conductive relation to the other terminal and serving also normally to hold the conductor against the withdrawal tendency, together with means to release the mechanical holding means upon overload in the line.

2. In a circuit breaker, spaced line terminals, an insulating tube with a conductor therein between said terminals and means tending to withdraw the conductor from the tube, in combination with conductive parts arranged to act with the said conductor in completing the circuit between said terminals and including a mechanical clamp for holding said conductor in a circuit closing position against the withdrawal tendency, in combination with means for releasing said clamp upon overload in the line.

3. In a circuit breaker, spaced line terminals, an insulating tube with a flexible conductor therein between said terminals, and means tending to withdraw the conductor from one end of the tube, in combination with a device for holding said conductor in a circuit closing position against the withdrawal tendency, and a solenoid in circuit with the conductor and the line for causing said device to release the conductor upon overload in the line.

4. In a circuit breaker, spaced line terminals, an expulsion tube hinged at one terminal and biased away from the other and a conductor within said tube connected with said one terminal, in combination with mechanical means for holding the other end of the conductor and putting it in circuit with the other terminal, a device for holding said tube in a position bridging said terminals, and means acting on overload in the line to release said mechanical means and said tube.

5. In a circuit breaker, spaced line terminals, an expulsion tube hinged only at one terminal and biased away from the other, a conductor within said tube connected with said one terminal and a means tending to withdraw the conductor from the hinged end of the tube, in combination with means for clamping the other end of the conductor in a circuit closing position against the withdrawal tendency and for holding said tube in a position bridging said terminals, said clamping means being adapted to be released upon overload in the line.

6. In a circuit breaker, spaced line terminals, a movable expulsion tube adapted to bridge said terminals in one position but biased toward an open position, a flexible conductor within said tube having means tending to move the conductor bodily toward one end of the tube, in combination with a mechanism normally holding said tube in said one position and holding said conductor against the tendency of said means while completing the circuit through said conductor between said terminals, and a solenoid controlling said mechanism and acting upon overload in the line to release said tube and conductor.

7. In a circuit breaker, spaced line terminals, an expulsion tube bridging the terminals, a flexible conductor within the tube and completing the circuit therethrough, spring means tending constantly to expel the conductor out one end of the tube, mechanical means at the other end of the tube to retain the conductor in circuit-closing position and electro-mechanical means to release the said mechanical means upon overload conditions in the circuit.

8. In a circuit breaker, a tubular insulating container hinged at one end and movable from closed-circuit to open-circuit position, means in one end of said container presenting a substantial impediment to the expulsion of gases, from said end, the other end of said container allowing substantially free expulsion of gases upon circuit interruption due to overload, means operable upon overload in the circuit to move the flexible conductor outwardly through said other end of the container and, means rendered operative on overload to move the container from closed-circuit to open-circuit position, together with means operable through the impeded end of the

tube to initiate concomitantly the outward movement of said conductor and the open circuit movement of the tube.

9. In a circuit breaker, a tubular insulating container hinged at one end and movable from closed-circuit to open-circuit position, means in one end of said container presenting a substantial impediment to the expulsion of gases from said end, the other end of said container allowing substantially free expulsion of gases upon circuit interruption due to overload, means operable upon overload in the circuit to move the flexible conductor outwardly through said other end of the container and to move the container from closed-circuit to open-circuit position, together with a movable member operable through the impeded end of the tube to initiate concomitantly the outward movement of said conductor and the open circuit movement of the tube.

10. In a circuit breaker, in combination, a tubular insulating container, means in one end of said container presenting a substantial impediment to the expulsion of gases from said end, the other end of said container allowing substantially free expulsion of gases upon circuit interruption due to overload, said container being pivotally mounted at said other end and movable from closed-circuit to open-circuit position, external latch means at the impeded end of the container to hold it in closed-circuit position, a flexible conductor within the container and completing a circuit therethrough, means operable upon overload in the circuit to move the flexible conductor out of said container through the unimpeded end thereof, means to release the latch means upon overload in the circuit, and means operable through the impeded end of the container to initiate concomitantly the movement of the flexible conductor and the release of the latch.

11. In a circuit breaker, in combination, a tubular insulating container, means in one end of said container presenting a substantial impediment to the expulsion of gases from said end, the other end of said container allowing substantially free expulsion of gases upon circuit interruption due to overload, said container being pivotally mounted at said other end and movable from closed-circuit to open-circuit position, external latch means at the impeded end of the container to hold it in closed-circuit position, a flexible conductor within the container and completing a circuit therethrough, means operable upon overload in the circuit to move the flexible conductor outwardly through the unimpeded end of the container, means to release the latch means upon overload in the circuit, and a movable member at the impeded end of the container and operable therethrough to initiate concomitantly the movement of the flexible conductor and the release of the latch.

12. In a circuit breaker, two spaced insulated supports, an insulating tube movable between open and closed circuit positions and hingedly mounted upon one support, holding means on the other support holding the swinging end of the tube normally in closed circuit position, a flexible conductor within the tube normally completing a circuit therethrough, together with means operable upon overload in the circuit to release the swinging end of the tube, to start opening the metallic circuit at the swinging end of the tube, and to move the flexible conductor outwardly at the hinged end of the tube.

13. In a circuit breaker, a terminal at each end of an insulating tubular container, a flexible conductor within the container and connected by a friction contact with one of said terminals, spring means to withdraw the flexible conductor from the friction contact, and automatic means operable upon overload in the circuit to initiate the action of the said spring means.

GEORGE N. LEMMON.
SAMUEL J. SPURGEON.