Nov. 10, 1942. G. S. PARKER 2,301,746

CIRCUIT INTERRUPTER

Filed Jan. 24, 1940 4 Sheets-Sheet 1

Fig. 1.

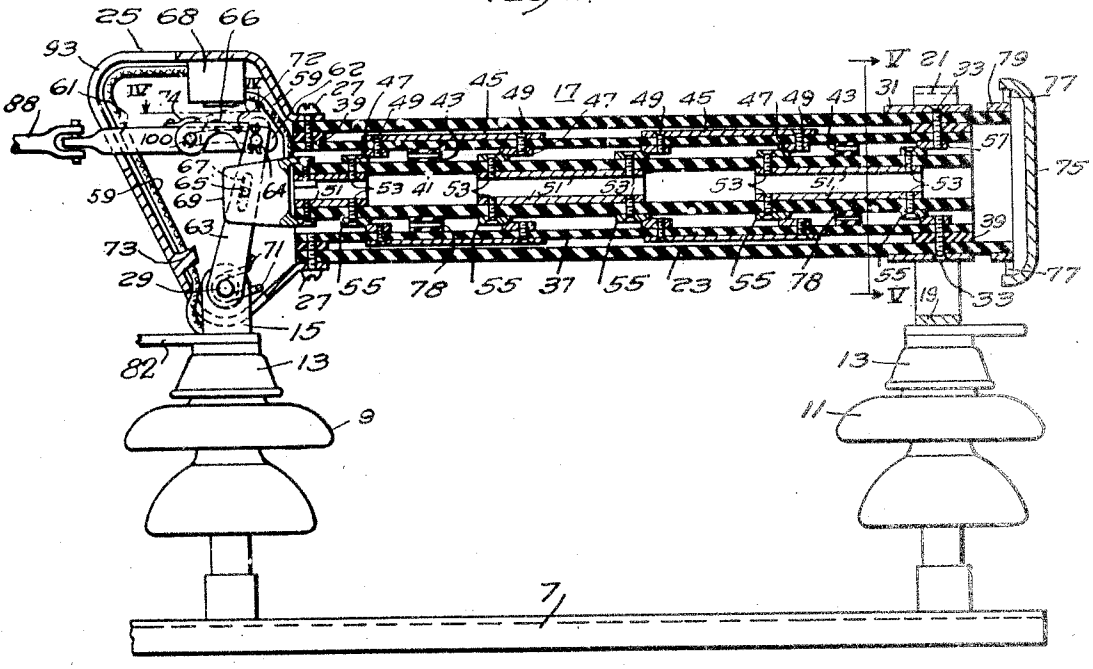
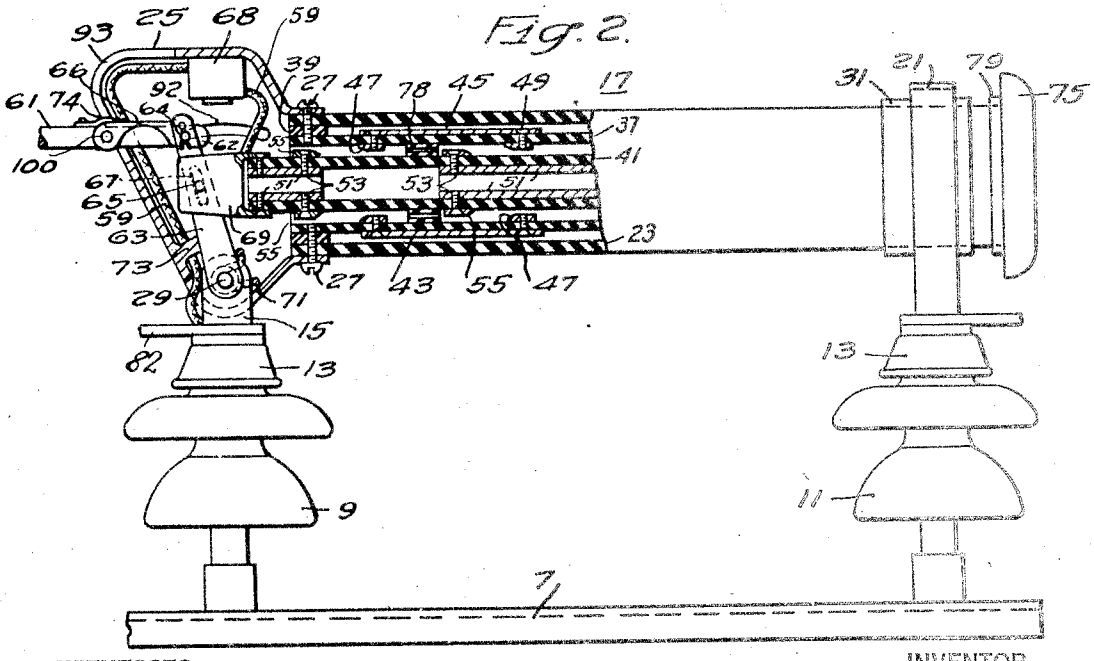


Fig. 2.



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CIRCUIT INTERRUPTER

Filed Jan. 24, 1940 4 Sheets-Sheet 2

Fig. 3.

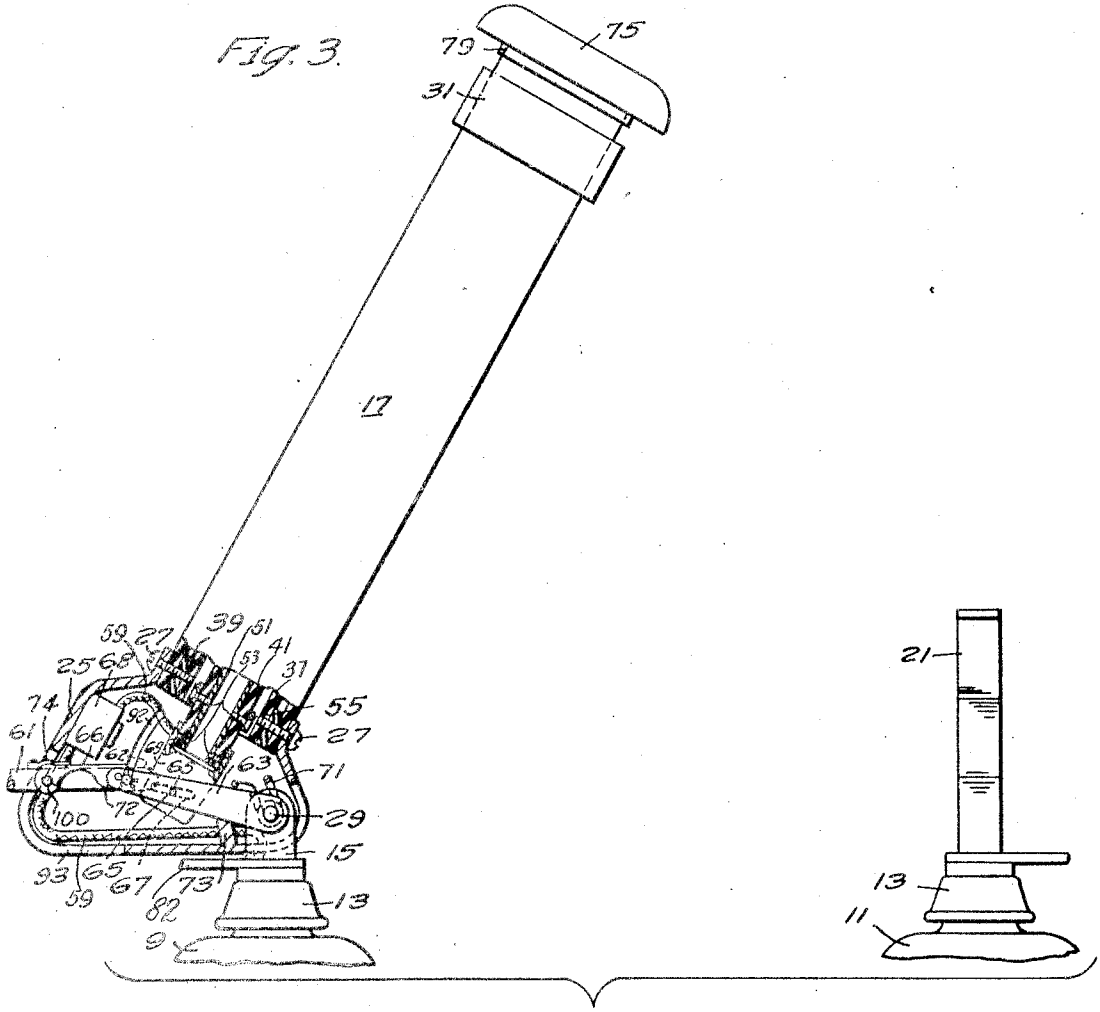


Fig. 3.

Fig. 4.

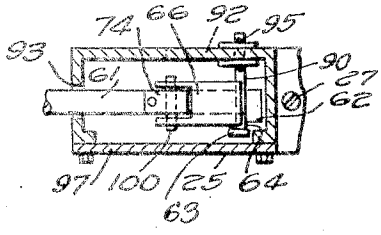
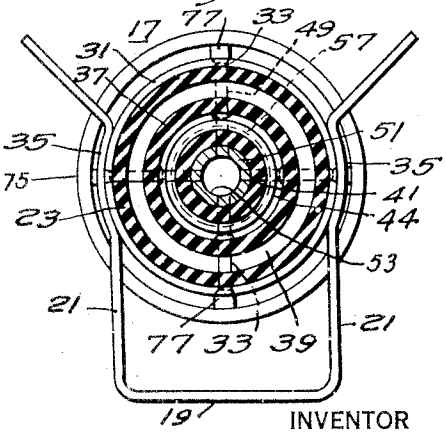


Fig. 5.



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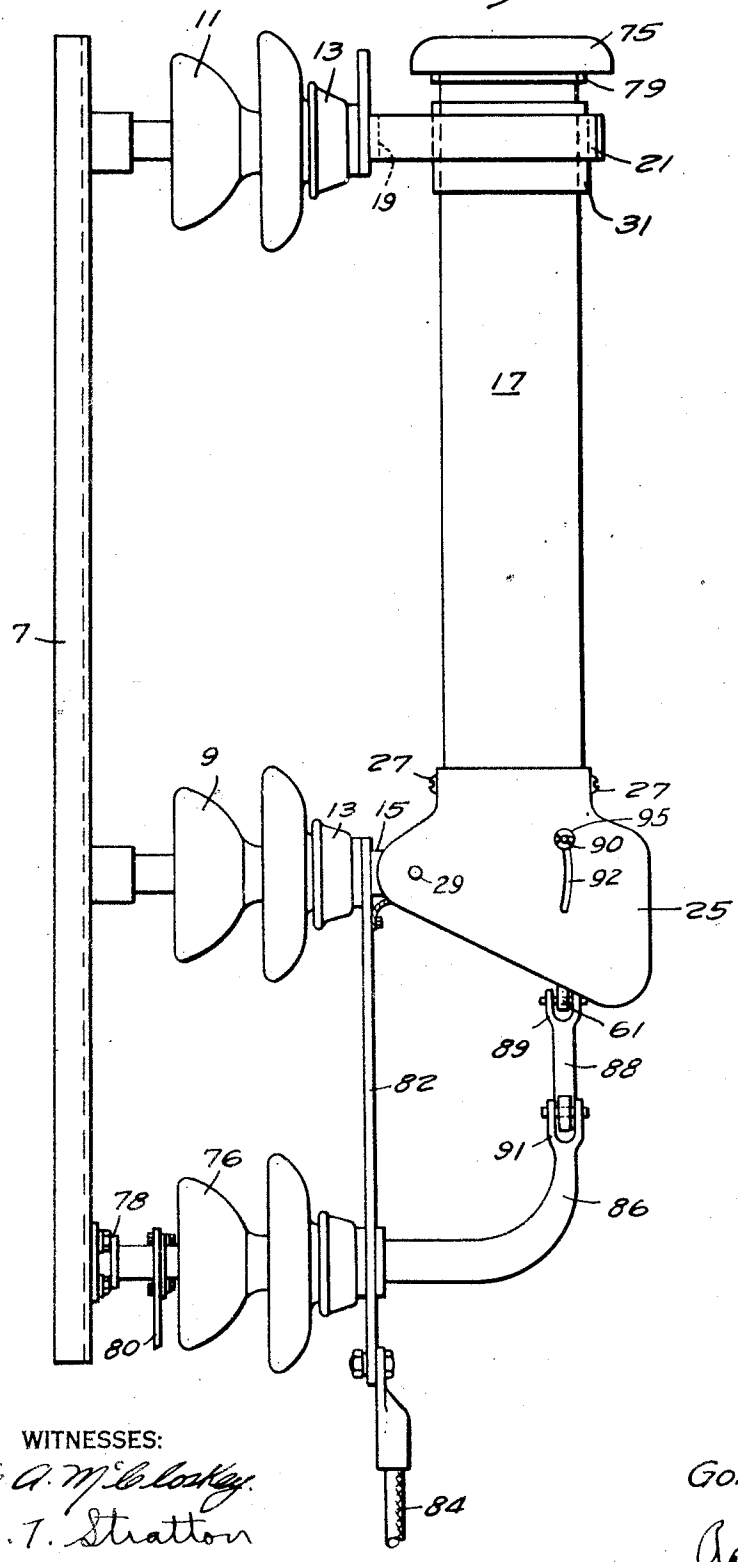
CIRCUIT INTERRUPTER

Filed Jan. 24, 1940 4 Sheets-Sheet 3

Fig. 6.



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CIRCUIT INTERRUPTER

Filed Jan. 24, 1940 4 Sheets-Sheet 4

Fig. 7.

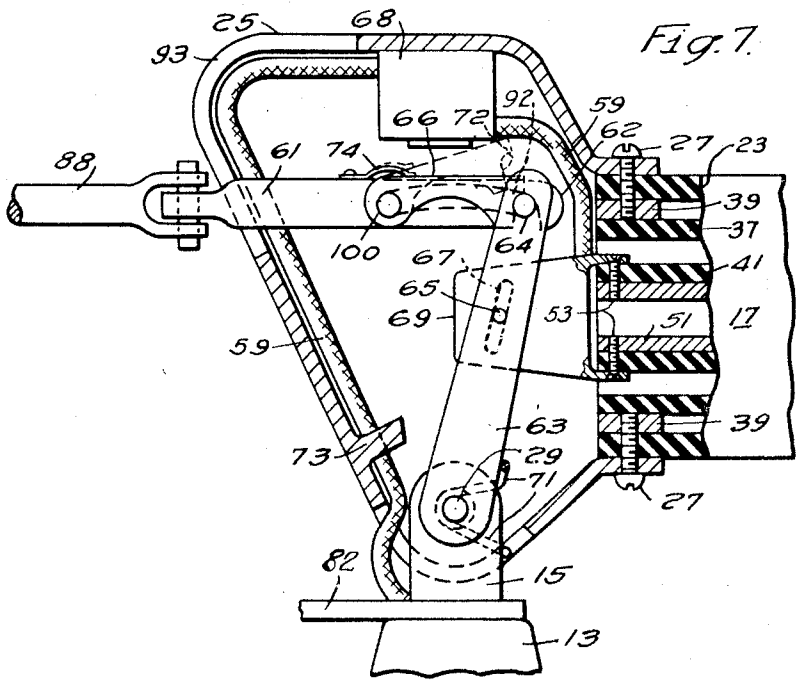
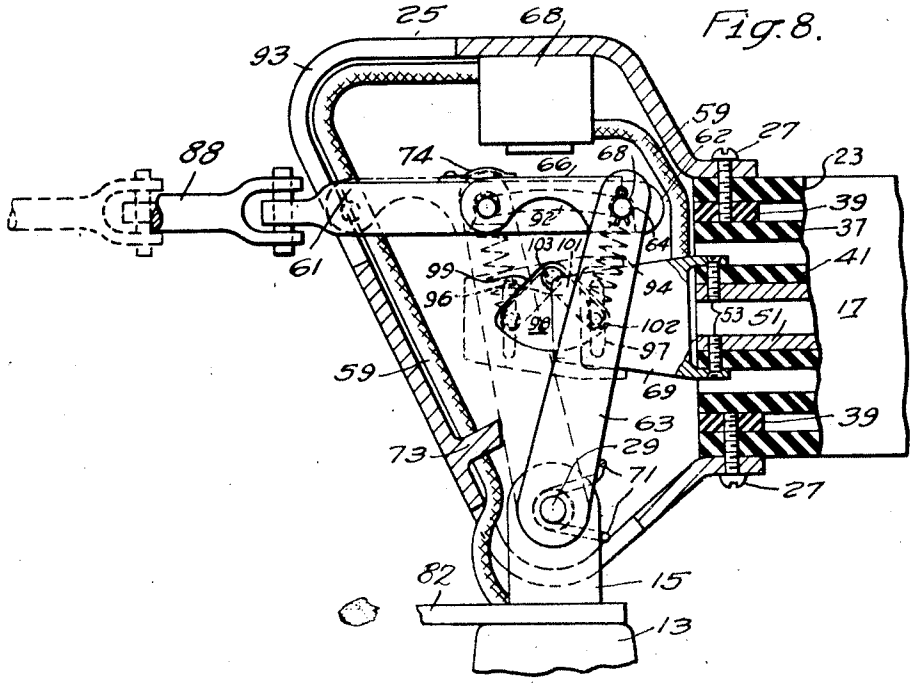


Fig. 8.



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Patented Nov. 10, 1942

2,301,746

UNITED STATES PATENT OFFICE

2,301,746

CIRCUIT INTERRUPTER

Gordon S. Parker, Edgewood, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application January 24, 1940, Serial No. 315,338

20 Claims. (Cl. 200—89)

My invention relates generally to circuit interrupting devices, and more particularly to circuit interrupters which are capable of interrupting moderate amounts of electric power, and also of introducing a safe air gap in the circuit.

The copending application of H. J. Lingal, Serial No. 203,310, filed April 21, 1938, now matured into Patent No. 2,223,731, issued December 3, 1940, and assigned to the assignee of this invention, discloses one form of manually operable interrupting device embodying two sets of contacts, with one set of contacts being especially constructed and arranged within a movable enclosure for establishing and interrupting the circuit, and one contact of the other set being carried by the enclosure and movable therewith for inserting a relatively large air gap in the circuit. The operating means is arranged to sequentially operate said sets of contacts so that the circuit is always first interrupted and finally made by the current interrupting set of contacts, and so that no arcing will occur at the other set of contacts.

Air break interrupters of this type combine the features of a disconnecting switch and some features of a circuit breaker, and may be employed with a fuse for controlling circuits such as rural service lines, where the cost of a circuit breaker for interrupting the circuit would be unwarranted.

One object of my invention is to provide an improved interrupting device of the above type with means for automatically opening the circuit in response to the passage therethrough of currents greater than a predetermined value.

A device of this type combines all the features of a circuit breaker and disconnecting switch into a single unit, thus materially reducing the expense, and greatly simplifying the protection of certain types of circuits.

Another object of my invention is to provide a disconnect type interrupting device embodying serially connected current interrupting contacts and disconnecting contacts manually operable sequentially, with automatic means operable in response to overload currents of a predetermined magnitude for opening at least the current interrupting contacts to interrupt the circuit.

Another object of my invention is to provide a novel association of automatic operating means with manual operating means for a circuit interrupter of the type described.

Another object of the invention is the provision of an air break circuit interrupter comprising current interrupter contacts connected in series with a pair of disconnecting contacts, and an operating mechanism which is manually operable to first open the current interrupting contacts and then open the disconnecting contacts, and which is automatically operable in response to predetermined overload condition to open the current interrupting contacts alone.

A further object of my invention is to provide a circuit interrupter as previously described in which the current interrupting contacts are opened and closed with a snap action.

Still another object of my invention is to provide in an interrupting device as previously described, snap action means for controlling the current interrupting contacts, which means are manually or automatically actuable.

These and other objects of my invention will become more apparent upon consideration of the following detailed description of preferred embodiments of my invention, taken in connection with the attached drawings, in which:

Figure 1 is a side elevational view, partly in section of a switch constructed in accordance with my invention, the switch being shown in the fully closed position;

Fig. 2 is a side view, partially in section, of the switch shown in Fig. 1 showing the position of the various parts during an opening operation of the switch immediately after the interrupting means has interrupted the circuit and prior to the swinging of the blade to open position;

Fig. 3 is a side view, partly in section, of the switch shown in Figs. 1 and 2 and showing the switch in the fully open position;

Fig. 4 is a sectional view taken substantially on the line IV—IV of Fig. 1;

Fig. 5 is an enlarged, transverse, sectional view of the switch blade taken substantially at the line V—V of Fig. 1;

Fig. 6 is a side elevational view of the complete switch showing the rotatable operating insulator therefor;

Fig. 7 is an enlarged partial sectional view illustrating the operating mechanism for the interrupter shown in Figs. 1 to 6; and

Fig. 8 is a view similar to Fig. 7 but showing a slightly modified form of operating means.

Referring to the drawings, the reference character 7 designates a channel-shaped metal base on which is rigidly mounted a pair of spaced supporting columns 9 and 11, formed of vitreous insulating material, each of which has a metal cap 13 rigidly secured to its upper end. The cap 13 of the insulating column 9 has a hinge terminal member 15 of conducting material rigidly

secured thereto which forms a pivot support for a hollow switch member or blade indicated generally at 17. A break terminal member 19 of conducting material is rigidly secured to the cap 13 of the other insulator 11. The break terminal member 19 is of the clip type, being provided with a pair of spaced resilient arms 21 which are adapted to receive and resiliently grip a contact member carried on the free end of the switch member 17.

The switch member 17 comprises an outer protective tube 23 of strong insulating material which is secured at one end to the neck of a hollow cast housing 25 by means of a plurality of screws 27. The housing 25 is pivotally mounted on the hinge terminal 15 by means of a pivot shaft 29 carried by the hinge terminal member. The insulating tube 23 is thus mounted on the hinge terminal 15 for swinging movement into and out of engagement with the break terminal member 19, and the tube has a contact member 31 in the form of a ring of conducting material secured on the outer end thereof by means of a plurality of screws 33. The contact member 31 is engageable with the arms 21 of the break terminal member 19, the ends of the arms 21 being bent outwardly to guide the switch member as it is moved to closed position. The arms 21 are also provided with curved portions 35 for resiliently gripping the contact member 31 and releasably holding the hollow switch member in closed position.

A circuit interrupting device is mounted within the protective tube 23 for establishing or interrupting a circuit between the hinge terminal member 15 and the break terminal member 19 when the switch member is in closed position. The interrupting means in the embodiment of the invention illustrated comprises a stationary tube 37 of insulating material at least the inner wall of which is of a material which is capable of evolving an arc extinguishing gas when in proximity to an electric arc, such as fiber, boric acid or a synthetic resin. The tube 37 is concentrically mounted within the outer protective tube 23 and rigidly secured thereto by means of the screws 27 and 33 at each end of the tube, with tube 37 being spaced from the protective tube 23 by a pair of insulating spacer sleeves 39. An inner tube 41, at least the outer wall thereof being of a material similar to that comprising the inner wall of tube 37, is mounted concentrically within the fixed tube 37 for sliding movement therein by means of a plurality of annular spacer sleeves 43 of insulating material. A plurality of sleeves 45 of conducting material are mounted in spaced relation along the outer surface of the fixed insulating tube 37, and each of the conducting sleeves has its ends mechanically and electrically connected to a pair of annular ring contacting members 47 on the inner surface of the tube by means of the screws 43. The screws 43 serve to clamp the conducting sleeves 45 and the annular ring contact members 47 to the opposite surfaces of the tube 37 and also to electrically connect the ring contact members 47 with their corresponding conducting sleeves 45.

The inner insulating tube 41 also has a plurality of sleeves 51 of conducting material mounted in spaced relation along the inner surface thereof, and each of the conducting sleeves 51 has its ends mechanically and electrically connected by means of a plurality of screws 53 to a pair of annular ring contact members 55, with the screws 53 serving to clamp the conducting sleeves 51 and the ring contact members 55 to the opposite surfaces of the tube 41, and to electrically connect the ring contact members 55 to their corresponding conducting sleeves 51.

The fixed insulating tube 37 has an annular ring contact member 57 secured to the inner surface thereof adjacent the outer end of the tube by means of the screws 33 which serve to electrically connect the ring contact member 57 with the outer contact member 31 mounted on the outer surface of the protective tube 23. The conducting sleeve 51 of the inner insulating tube 41 adjacent the left-hand end of the tube is electrically connected to the hinge terminal member 15 by means of a flexible shunt conductor 59.

The inner insulating tube 41 is axially movable within the fixed tube 37 towards the right to a closed circuit position in which the ring contact members 55 carried by the inner tube engage the cooperating stationary ring contact members 47 and 57 carried by the fixed insulating tube 37 as shown in Fig. 1, to establish an electrical circuit extending from the hinge terminal 15 through the interrupting device within the hollow switch blade 17 to the outer ring contact member 31 which engages the break terminal member 19. When the switch is in closed circuit position, the circuit extends from the hinge terminal member 15 through the flexible shunt conductor 59, the conducting sleeves 51, the ring contact members 55 and 47, and the conducting sleeves 45 to the ring contact member 57 at the outer end of the tube 23, through the screws 33 and the outer contact ring 31 to the break terminal member 19. The inner insulating tube 41 is also movable axially within the fixed tube 37 towards the left to an open circuit position in which the ring contact members 55 carried by the inner tube 41 are separated from the cooperating ring contact members 47 and 57 carried by the fixed tube 37 as shown in Fig. 2. The inner insulating tube 41 when in the open circuit position thus provides a plurality of gaps in the circuit between the hinge terminal member 15 and the contact member 31 carried by the free end of the hollow switch member 17. The arcs bridging these serially arranged gaps are positioned in intimate contact with the walls of tubes 37 and 41, resulting in the evolution of quantities of arc extinguishing gases from the tube walls which gas blows through the arcs to extinguish them. Most of the gases evolved will pass out the open end of the circuit interrupting device. It should be noted that in passing from one arc to a succeeding arc, the hot gases are exposed to intervening walls of tubes 37 and 41 which evolve additional quantities of unionized gases to cool and deionize these gases before passing through the next succeeding arc.

Each of the ring contact members 47 and 57 carried by the fixed insulating tube 37 has its contact surface bevelled or inclined towards the hinge end of the switch, and the ring contact members 55, carried by the longitudinally movable inner insulating tube 41, have their contact faces bevelled or inclined toward the free end of the switch. Thus, the oppositely bevelled or inclined surfaces of the ring contact members 55 and 47 serve to limit outward movement of the inner insulating tube 41 and also allow the ring contact members to be engaged with a predetermined contact pressure when the switch is closed.

The operating means for the switch comprises an operating rod 61 adapted to engage the free end of an actuating lever 63. As shown more particularly in Fig. 4, the operating rod 61 has a

laterally projecting abutment portion 62 at one end for engaging one side of an integral pin 64 projecting from the back side of the actuating lever 63. A pivoted coupling member 66, which preferably is made of any desirable magnetic material such, for example, as soft iron, includes a U-shaped portion at the outer end thereof, seated over the operating rod 61 and pivotally connected thereto as by the pivot pin 100. As shown, the pivoted coupling member 66 over-lies the operating rod 61 and is positioned beneath a trip solenoid 68, which is connected in series in the flexible lead 59. One leg of the U-shaped pivoted coupling member 66 has the inner end thereof terminating in an abutment 72 for engagement with the other side of the pin 64 on the actuating lever 63. A resilient bowed spring 74 has one end thereof secured to the operating rod 61 and the other end thereof bearing upon the pivoted coupling member 66 to normally maintain the same in the full line position shown. Actuating lever 63 is rotatably mounted on pivot pin 29, and carries an integral pin 65 engaging a slot 67 in a plate 69 secured to insulating tube 41, to be coupled thereto.

Rotation of the actuating lever 63 in a clockwise direction when the switch member 17 is in closed position moves the inner insulating tube 41 axially toward the right to closed circuit position, and counter-clockwise movement of the actuating lever 63 moves the insulating tube 41 axially toward the left to open circuit position, the pin and slot connection between the actuating lever 63 and the inner end of the tube 41 providing for straight line motion of the tube 41. The actuating lever 63 is biased in a counter-clockwise direction about the pivot shaft 29 by means of a helical spring 71 which encircles the shaft 29, one end of the spring engaging the lever 63 and the other end engaging the hinge terminal member 15. The counter-clockwise movement of the actuating lever 63 is limited by a stop projection 73 formed integral with the housing 25.

As shown in Fig. 6, the operating rod 61 is operated by a rotatable insulator 76 which is journalled in a bearing member 78 secured to the channel support 7, and which includes an operating crank 80 which may embody an aperture for the reception of a hook-stick operating member or which may be coupled to an operating linkage for rotating the insulator 76. The outer end of the rotatable insulator 76 is journalled in a coupling member 82 of conducting material which is secured to the hinge tongue 15 on the insulator 9, and the coupling member includes an outwardly extending terminal portion to which a circuit conductor 84 may be attached. The rotatable insulator 76 further includes an outer crank portion 86 which is coupled to the operating rod 61 of the switch by means of a pivoted link member 88. The link 88 is connected to the rod 61 and to the crank 86 by universal connections 89 and 91.

The inner end of the operating rod 61 is guided in its movement by a pin 90 integral with the rod 61 which projects from the rear side thereof and rides in an arcuate slot 92 formed in the back side of the housing 25. The slot 92 has an arc parallel to the arc described by the pin 64 on the lever 63 so that the abutments 62 and 72 carried by the rod 61 are maintained in contact with the pin 64 during normal opening and closing operations of the device. The arcuate slot 92 also insures resetting of the abutments 62 and 72 in engagement with the pin 64 upon resetting movement of the mechanism.

The operating rod 61 is guided for movement in a single plane between the side walls of the housing 25 in spite of angular movement of the crank 86 and the link 88, by means of the side edges of the narrow slot 93 in the end of the housing 25 and by the pin 90 engaging in slot 92, the pin 90 being held against lateral displacement by washers and cotter key 95 carried by the pin 90 on opposite sides of the slotted back wall of the housing (see Fig. 4).

The housing 25 is preferably open on one side, and the open side is closed by a cover plate 97 bolted to the housing so as to permit assembly of the mechanism in the housing.

The operation of the device is briefly as follows. To open the circuit the rotatable insulator 76 is rotated in a direction to move the operating rod 61 toward the left, as viewed in Figs. 1 and 7. During the first portion of the movement of the operating rod 61, the actuating lever 63 is rotated in a counter-clockwise direction about the pivot shaft 29 to effect movement of the inner insulating tube 41 towards the left to open circuit position. During this movement, the hollow switch member 17 remains in closed position due to the fact that its free end is resiliently gripped by the arms 21 of the break terminal 19. The movement of the inner insulating tube 41 to open circuit position causes the ring contact members 55 carried thereby to separate from the cooperating ring contact members 47 and 57 carried by the fixed insulating tube 37. The separation of the ring contact members introduces a plurality of air gaps in the circuit between the hinge terminal 15 and the contact member 31 at the free end of the switch member which engages the break terminal member 19. The plurality of arcs drawn between the ring contact members during their separation are restricted in the narrow annular space between the fixed insulating tube 37 and the movable insulating tube 41 where they are quickly extinguished in the manner referred to above. The circuit between the terminals of the switch is thus completely interrupted by the interrupting means within the hollow switch member 17 while the switch member remains in closed position. This position of the parts is illustrated in Fig. 2. At this point, the actuating lever 63 engages the stop projection 73 carried by the housing 25 so that continued movement of the operating rod 61 towards the left swings the switch member 17 in a counter-clockwise direction about the pivot shaft 29 to a substantially vertical open position as shown in Fig. 3. The switch member 17 in the open position provides a large air gap between the terminals 15 and 19 of the switch which is capable of withstanding high voltages.

To close the circuit, the operating rod 61 is moved towards the right by rotation of the insulator 76, and since the actuating lever 63 is maintained in engagement with the stop projection 73 by means of the biasing spring 71, this movement of the operating rod 61 swings the switch member 17 in a clockwise direction about the pivot shaft 29 to closed position, in which the contact member 31 on the free end of the switch member engages the resilient arms 21 on the break terminal member 19. During this swinging movement of the switch member 17 to closed position, the spring 71 maintains the actuating lever 63 in engagement with the stop projection 73 to maintain the circuit interrupting means

within the switch member in open circuit position. Continued movement of the operating rod 61 towards the right after the switch member has been rotated to closed position as far as it will go, rotates the actuating lever 63 in a clockwise direction about the pivot shaft 29 to effect axial movement of the inner insulating tube 41 towards the right, to closed circuit position, causing the ring contact members 55 carried by the tube 41 to move into engagement with the cooperating ring contact members 47 and 57 carried by the fixed insulating tube 37. This movement of the ring contact members into engagement establishes the circuit between the terminals of the switch. The throw of the operating rod 61 is sufficient to provide the required contact pressure between the ring contact members when the switch is in the fully closed position.

Upon the occurrence of predetermined overload currents through the circuit in which the switch is connected, the solenoid 68 will become sufficiently energized to attract the pivoted coupling member 66 and move it upwardly to the dotted line portion shown in Figs. 1 and 7 to thus remove its abutment portion 72 from the left side of the actuating lever pin 64 and permit the spring 71 to move the actuating lever 63 to the left, as viewed in Figs. 1 and 7, to thereby release the actuating lever 63. The spring 71 then quickly moves the lever 63 in a counterclockwise direction causing automatic opening of the contacts within the switch member 17 to interrupt the circuit, the switch member 17 remaining in engagement with the break terminal 19.

To reset or reclose the interrupter following an automatic opening operation, it is necessary to rotate the insulator 76 in a manner to move the operating rod 61 to the left as viewed in Fig. 1 to bring it substantially to the position shown in Fig. 2 where the operating rod abutment 62 and the pivoted coupling member abutment 72 are again brought into engagement with the actuating lever pin 64, whereupon the actuating rod 61 may be then moved to the right to close the contacts within the switch member 17.

During the resetting movement of the operating rod 61, the inner end of the rod is guided to the proper position shown in Fig. 2 to reengage the pin 64 by reason of the guide pin 80 sliding in the arcuate guide slot 82. In the meantime, the pivoted coupling member 66 has been returned to normal latching position shown in Fig. 2 by its bracing spring 74.

A shroud 75 carried by a ring 78 is mounted on the outer end of the insulating tube 23 for preventing the entrance of rain, sleet or snow in the outer end of the tube, the inwardly directed edge of the shroud being attached to the ring 78 by means of a plurality of struts 77 to provide an opening for the escape of gases through the outer end of the tube.

Referring now to the embodiment of my invention shown in Fig. 8, the switch itself is identical with that described in connection with the previous embodiment, and like reference characters will be used to designate like parts. This embodiment of my invention differs from that previously described in the provision of snap-acting mechanism for opening and closing the contacts within the switch member 17. As shown in Fig. 8, the pin 64 on the switch operating lever 63 is connected to one end of a tension coil spring 94, the other end of which is connected to a movable actuating lever 96 pivotally supported as at 100 on a side wall of the housing 25 for limited pivotal movement within an arcuate or segmental groove or recess 98 provided in the housing wall so that opposite walls 99 and 101 of the recess 98 act to limit pivotal movement of lever 96. The end of the movable actuating lever 96 to which the spring 94 is connected is provided with an integral pin 102 received in the slot 97 provided in the plate 69 secured to the left-hand inner end of the insulating tube 41.

The operation of this embodiment of my invention is much the same as that described in connection with the embodiment shown in Figs. 1 to 7, differing therefrom only in the opening and closing movements of the contacts within the switch member 17. For example, in the opening movement of these contacts, as the operating rod 61 is moved to the left, as viewed in Fig. 8, the movable switch member 41 temporarily remains stationary, held in position by the spring 94 for a substantial length of movement of the operating rod, and until the line of action of the overcenter spring 94 crosses over the pivot of the actuating lever 96, whereupon the spring 94 acts to instantaneously move the inner insulating tube 41 and its associated contacts to the left to an open position. The reverse of this operation takes place when the switch operating rod 61 is moved to the right. In other words, the contacts within the switch member 17 remain open until the line of action of the overcenter spring 94 crosses to the right of the pivot axis of the lever 96, whereupon the contacts within the switch member 17 are closed with a snap action. This snap action movement of the switch contacts also occurs when the switch is opened automatically upon the passage through the device of overload currents of a sufficient magnitude to energize the solenoid 68 sufficiently to attract the pivoted release member 66. In this event, when the release member 66 is moved upwardly by the solenoid 68, the spring 71 then operates to move the operating lever 63 to the left to thereby again open the contacts within the switch blade 17 with a snap action. The spring 71, of course, is of sufficient strength to operate the snap-acting parts comprising the overcenter spring 94 and the movable spring supporting lever 96.

It should further be noted that the switch contacts within the switch member 17 in both embodiments of my invention, are maintained in a closed position against the bias of coil spring 71 by means of the toggle formed by the connections to the rotating insulator 86.

Having described preferred embodiments of my invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made in the particular embodiments disclosed without departing from the broad spirit and scope of my invention. I, therefore, desire that my invention be interpreted as broadly as possible, and that it be limited only as required by the prior art.

I claim as my invention:

1. In a circuit interrupting device, a pair of disconnecting contacts, one of which is mounted on a movable contact support for movement therewith into and out of engagement with its cooperating contact, current interrupting contacts carried by said movable support and connected in series with said disconnecting contacts, an operating mechanism for sequentially operating said contacts in a circuit opening operation to first open said interrupting contacts and to thereafter open said disconnecting contacts, and

means operable to automatically open said current interrupting contacts in response to currents above a predetermined value.

2. In a circuit interrupting device, a pair of disconnecting contacts, one of which is mounted on a movable contact support for movement therewith into and out of engagement with its cooperating contact, current interrupting contacts carried by said movable support and connected in series with said disconnecting contacts, means for sequentially operating said contacts in both a circuit closing and a circuit opening operation, and additional means for automatically opening said current interrupting contacts in response to the passage through the device of currents greater than a predetermined magnitude.

3. In a circuit interrupting device, a pair of disconnecting contacts, one of which is mounted on a movable contact support for movement therewith into and out of engagement with its cooperating contact, current interrupting contacts carried by said movable support and connected in series with said disconnecting contacts, snap-acting means for operating said current interrupting contacts, means for sequentially operating said snap-acting means and said movable support to sequentially operate said current interrupting contacts and said disconnecting contact, and means for causing automatic operation of said snap-acting means to open said current interrupting contacts in response to the passage through the device of currents above a predetermined value.

4. In a circuit interrupter, an arc extinguishing device mounted for bodily movement, a pair of disconnecting contacts, one of said disconnecting contacts being movable with said arc extinguishing device into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having a pair of arc establishing contacts connected in series with said disconnecting contacts, operating means for both of said pairs of contacts, operable to open said arc establishing contacts while said disconnecting contacts remain engaged, and thereafter to move said arc extinguishing device to open the circuit at said disconnecting contacts, and means operable to cause said operating means to automatically open said arc establishing contacts in response to passage through the interrupter of currents above a predetermined magnitude.

5. In a circuit interrupter, an arc extinguishing device mounted for bodily movement, a pair of disconnecting contacts, one of said disconnecting contacts being movable with said arc extinguishing device into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having a pair of arc establishing contacts connected in series with said disconnecting contacts, operating means for both of said pairs of contacts, operable to open said arc establishing contacts while said disconnecting contacts remain engaged, and thereafter to move said arc extinguishing device to open the circuit at said disconnecting contacts, and operable to move said arc extinguishing means to close said disconnecting contacts while said arc establishing contacts remain open and to thereafter close said arc establishing contacts to close the circuit, and means operable to cause said operating means to automatically open said arc establishing contacts in response to passage through the interrupter of currents above a predetermined magnitude.

6. In a circuit interrupter, an arc extinguishing device mounted for bodily movement, a pair of disconnecting contacts, one of said disconnecting contacts being movable with said arc extinguishing device into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having a pair of arc establishing contacts connected in series with said disconnecting contacts, operating means for both of said pairs of contacts, and operable in its opening movement to sequentially open said arc establishing contacts and said disconnecting contacts, and operable in its closing movement to sequentially close said disconnecting contacts and said arc establishing contacts, and means for independently opening said arc establishing contacts.

7. In an interrupter, a pair of spaced terminals, a hollow switch member for bridging said terminals, said bridging member having a contact thereon engageable with one of said terminals, circuit interrupter means in said hollow switch member connected to the other terminal and said contact and operable to establish and interrupt a circuit between said terminals when said switch member is in bridging position, operating means operable in one continuous movement to first open said interrupting contacts and then swing said switch member to open position, and means operable in response to predetermined conditions to cause said mechanism to automatically open said interrupting contacts.

8. In a circuit interrupting device, a movably mounted enclosure for an arc extinguishing device, a pair of disconnecting contacts, one of which is movable with said enclosure into and out of engagement with the other of said disconnecting contacts, arc establishing contacts within said enclosure and connected in series with said disconnecting contacts, operating means for sequentially operating said contacts and including means within said enclosure operable in response to the passage therethrough of currents above a predetermined magnitude to open at least said arc establishing contacts.

9. In a circuit interrupter, contact means biased to an open position with respect to cooperating contact means, an operating member movable in opposite directions for opening and closing said contact means, and including a movable abutment normally engageable with a part associated with said contact means in the closing movement of said operating member to close said contact means, said abutment being movable in response to the passage through the interrupter of currents above a predetermined magnitude, out of engagement with said contact means to permit the same to move to open position, and said operating member further including a fixed abutment engageable with said part in the opening movement thereof to open said contact means.

10. In a circuit interrupter, disconnecting contacts one of which is mounted on a movable contact support for movement into and out of engagement with another of said disconnecting contacts, separable contact means on said support in series relation with said disconnecting contacts and normally biased to an open circuit position, operating means including an operating member movable in opposite directions relative to said support for opening and closing said contact means, and including a movable abutment resiliently biased to a position in which it is normally engageable with a part associated

with said contact means in the closing movement of said operating member to close said contact means, and being movable in response to the passage through the interrupter of currents above a predetermined magnitude, out of engagement with said part to permit said contact means to move to open position, and said support including means positioned to be engaged by a portion of said operating means after said contact means have been opened, whereby said support may be actuated thereafter to open said disconnecting contacts.

11. In a circuit interrupter, an arc extinguishing device mounted for bodily movement, a pair of disconnecting contacts, one of said disconnecting contacts being movable with said arc extinguishing device into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having a pair of arc establishing contacts connected in series with said disconnecting contacts, and operating means for both of said pairs of contacts, operable in its opening movement to sequentially open said arc establishing contacts and said disconnecting contacts and in its closing movement to sequentially close said disconnecting contacts and arc establishing contacts, means to independently open said arc establishing contacts, means normally biasing said operating means toward opening movement, and said operating means in- including locking means for maintaining said contacts closed.

12. In a circuit interrupting device, a movably mounted tubular arc extinguishing device, a pair of disconnecting contacts one of which is movable with said arc extinguishing device into and out of engagement with the other of said disconnecting contacts, arc establishing contacts within said arc extinguishing device and connected in series with said disconnecting contacts, operating means for sequentially operating said contacts and including means operable in response to the passage therethrough of currents above a predetermined magnitude to open at least said arc establishing contacts.

13. In a circuit interrupter, an arc extinguishing device mounted for bodily movement, a pair of disconnecting contacts, one of said disconnecting contacts being movable with said arc extinguishing device into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having a pair of arc establishing contacts connected in series with said disconnecting contacts, operating means for both of said pairs of contacts, and operable in its opening movement to sequentially open said arc establishing contacts and said disconnecting contacts, and operable in its closing movement to sequentially close said disconnecting contacts and said arc establishing contacts, and current responsive means for opening said arc establishing contacts independently of said disconnecting contacts, whereby said arc establishing contacts may be opened by said current responsive means while said disconnecting contacts are closed.

14. In a circuit interrupter, an arc extinguishing device mounted for bodily movement, a pair of disconnecting contacts, one of said disconnecting contacts being movable with said arc extinguishing device into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having a pair of arc establishing contacts connected in series with said disconnecting contacts, operating means for both of said pairs of contacts, and operable in its opening movement to sequentially open said arc establishing contacts and said disconnecting contacts, and operable in its closing movement to sequentially close said disconnecting contacts and said arc establishing contacts, said operating means including a releasable connection to said arc establishing contacts, current responsive means operable to release said connection and permit said arc establishing contacts to open without opening said disconnecting contacts, and said connection being capable of being re-established by movement of said operating means without opening said disconnecting contacts.

15. In a circuit interrupter, a pair of disconnecting contacts, one of which is mounted on a movable support for movement therewith into and out of engagement with the other of said disconnecting contacts, circuit interrupting contacts carried by said movable support and connected in series with said disconnecting contacts, operating mechanism comprising means operable to open said interrupting contacts at high speed and to close said interrupting contacts, said means being biased at all times to open said interrupter contacts, means for opening and closing said disconnecting contacts, said last-mentioned means being operable during an opening operation to first cause said interrupting contact means to open said interrupting contacts while said disconnecting contacts remain engaged and to then open said disconnecting contacts, and effective when in closed position to maintain both of said contacts closed, a releasable connection between said interrupting contact operating means and said disconnecting contact operating means, and current responsive means operable upon overload to release said interrupting contact operating means from said disconnecting contact operating means to cause opening of said interrupting contacts while said disconnecting contacts remain closed, and said disconnecting contact operating means being operable to reset said releasable connection without opening said disconnecting contacts.

16. In a circuit interrupting device, insulating support means, a pair of disconnecting contacts mounted on said support means, one of said contacts being mounted for movement into and out of engagement with the other to insert a large visible air gap in the circuit when in open position, current interrupting contacts also mounted on said support means and arranged in series circuit relation with said disconnecting contacts, an operating mechanism for sequentially operating said contacts in a circuit opening operation to first open said interrupting contacts and to thereafter open said disconnecting contacts, and means operable to automatically open said current interrupting contacts in response to currents above a predetermined value.

17. In a circuit interrupting device, insulating support means, a pair of disconnecting contacts mounted on said support means, one of said contacts being mounted for movement into and out of engagement with the other to insert a large visible air gap in the circuit when in open position, current interrupting contacts also mounted on said support means and arranged in series circuit relation with said disconnecting contacts, means for sequentialy operating said contacts in both a circuit closing and a circuit opening operation, and additional means for automatically opening said current interrupting contacts in response to the passage through the device of currents greater than a predetermined magnitude.

18. In a circuit interrupting device, insulating support means, a pair of disconnecting contacts mounted on said support means, one of said contacts being mounted for movement into and out of engagement with the other to insert a large visible air gap in the circuit when in open position, current interrupting contacts also mounted on said support means and arranged in series circuit relation with said disconnecting contacts, snap-acting means for operating said current interrupting contacts, means for sequentially operating said snap-acting means and said movable support to sequentially operate said current interrupting contacts and said disconnecting contact, and means for causing automatic operation of said snap-acting means to open said current interrupting contacts in response to the passage through the device of currents above a predetermined value.

19. In a circuit interrupting device, insulating support means, a pair of disconnecting contacts mounted on said support means, one of said contacts being mounted for movement into and out of engagement with the other to insert a large visible air gap in the circuit when in open position, current interrupting contacts also mounted on said support means and arranged in series circuit relation with said disconnecting contacts, common operating means for said disconnecting and interrupting contacts, and operable in its opening movement to sequentially open said arc establishing contacts and said disconnecting contacts, and operable in its closing movement to sequentially close said disconnecting contacts and said arc establishing contacts, and means for independently opening said arc establishing contacts.

20. In a circuit interrupting device, insulating support means, a pair of disconnecting contacts mounted on said support means, one of said contacts being mounted for movement into and out of engagement with the other to insert a large visible air gap in the circuit when in open position, current interrupting contacts also mounted on said support means and arranged in series circuit relation with said disconnecting contacts, common operating means for said disconnecting and interrupting contacts, and operable in its opening movement to sequentially open said arc establishing contacts and said disconnecting contacts, and operable in its closing movement to sequentially close said disconnecting contacts and said arc establishing contacts, and current responsive means for opening said arc establishing contacts independently of said disconnecting contacts, whereby said arc establishing contacts may be opened by said current responsive means while said disconnecting contacts are closed.

GORDON S. PARKER.

DISCLAIMER

2,301,746.—*Gordon S. Parker*, Edgewood, Pa. CIRCUIT INTERRUPTER. Patent dated November 10, 1942. Disclaimer filed February 12, 1945, by the assignee, *Westinghouse Electric & Manufacturing Company*.

Hereby enters this disclaimer to claims 1, 2, 3, 4, 12, 16, 17, and 18 in said specification.

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