

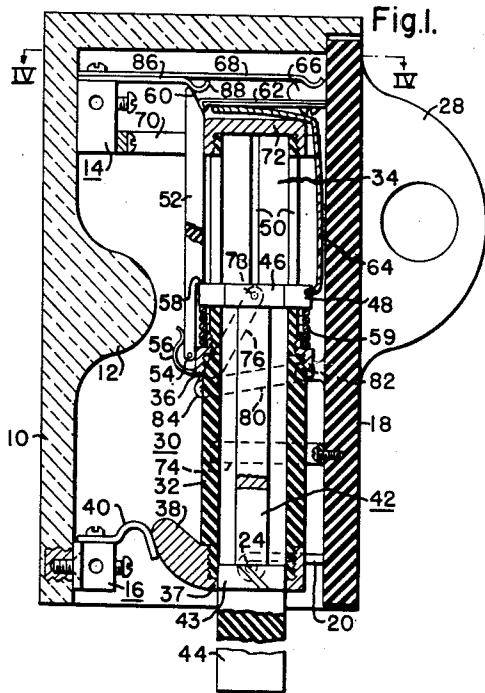
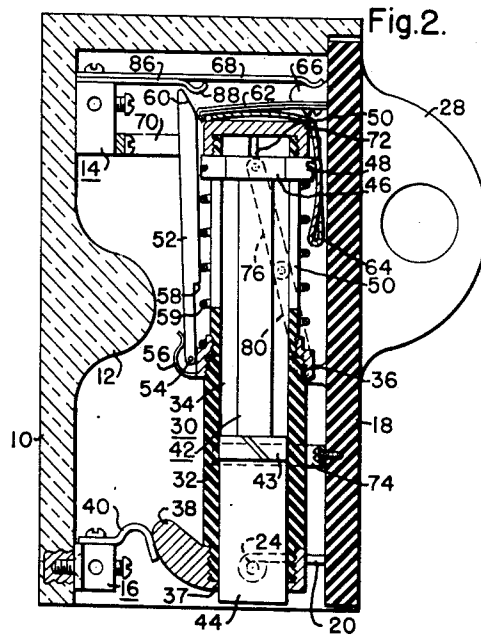
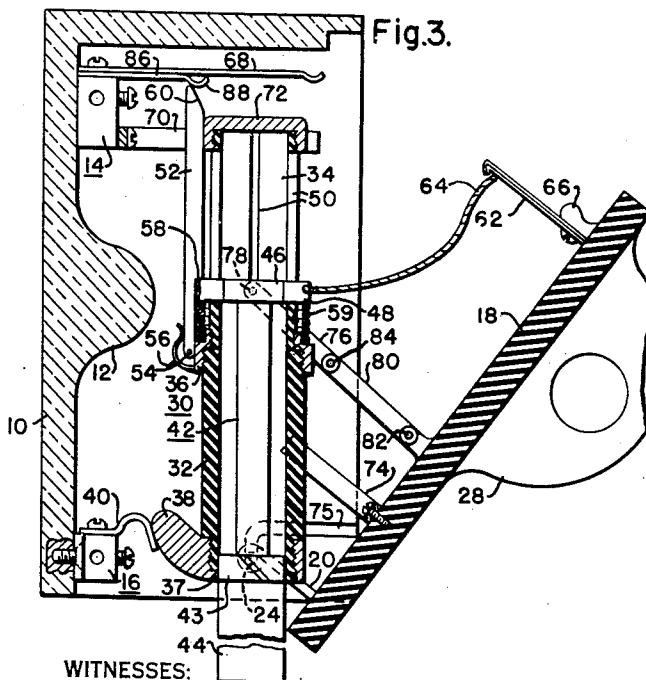
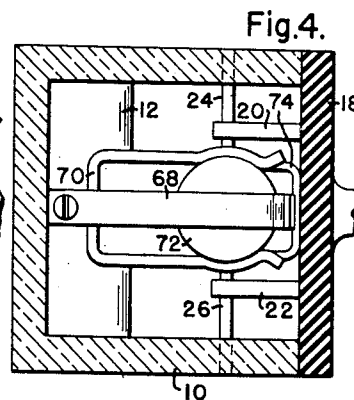
Dec. 22, 1953

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2,663,776

PROTECTIVE DEVICE

Filed Aug. 18, 1949



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2,663,776

PROTECTIVE DEVICE

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Application August 18, 1949, Serial No. 110,964

17 Claims. (Cl. 200—116)

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This invention relates to protective devices for electric circuits and more particularly to an electric circuit breaker of the fuseless cutout type.

Fuseless cutout devices have heretofore been proposed for use in the protection of high tension electric circuits, and it has been determined that their use avoids many of the disadvantages and difficulties inherent in cutouts of the type employing replaceable fuses. The main advantage of course is the elimination of the necessity of fuse replacement when the fuseless cutout operates to automatically interrupt the circuit upon the occurrence of any overload condition. In all of the prior fuseless cutouts however, a rather complicated arrangement of parts is utilized which renders the devices expensive to manufacture, install and maintain in a proper condition of adjustment and repair.

It is accordingly an object of the present invention to provide a protective device of the fuseless cutout type which comprises relatively few parts and which is so constituted as to overcome the objections and disadvantages of the prior cutouts.

Another object is to provide a novel fuseless cutout for the protection of electric circuits, which is of relatively simple construction and which is compact, rugged and thoroughly reliable in operation.

A further object is to provide in a protective device of the above character a novel construction which materially simplifies the resetting of the contacts following a separation thereof due to an overload condition.

A still further object resides in the provision of a novel arrangement of parts for a protective device of the above character, which includes a housing provided with a pivoted closure member, the construction being such that a manual opening and reclosing of the circuit may be accomplished solely by pivotal opening movement of the closure member.

Other objects and novel features of the invention will appear more fully hereinafter from a consideration of the following detailed description when taken in connection with the accompanying drawing. It is to be expressly understood however, that the drawing is utilized for purposes of illustration only and is not to be taken as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawing, wherein similar reference characters refer to similar parts throughout the several views:

Fig. 1 is a vertical sectional view of a protective

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device constructed in accordance with the present invention, the same illustrating the parts in normal circuit-closing position;

Fig. 2 is a view similar to Fig. 1 but showing the position of the parts following the automatic separation of the contacts in accordance with an abnormal load condition;

Fig. 3 is a view similar to Fig. 1 and showing the manner in which the contacts are reclosed and latched, and

Fig. 4 is a sectional view taken substantially along line IV—IV of Fig. 1, the linkage between the door and interrupter tube having been omitted in order to more clearly illustrate the pivotal mountings for the interrupter tube and door.

Referring more particularly to Fig. 1 of the drawing, a protective device of the fuseless cutout type embodying the principles of the present invention is illustrated therein as comprising a housing 10 of porcelain or similar insulating material, provided with an integrally formed gas barrier 12 disposed between stationary line terminals 14 and 16. As shown, the housing 10 is provided with an open side which is normally closed by a door 18 of insulation material, the latter being pivotally mounted in the housing as by means of a pair of arms 20 and 22 which are connected to hinge pins 24 and 26 supported by the sides of the housing adjacent the bottom thereof, see Figs. 3 and 4. The door 18 is preferably provided with an integral eyelet handle 28 which may be manually grasped or which may receive the hooked end of a switch stick in order to open the door and actuate the interrupter contacts within the housing in a manner which will appear more fully hereinafter.

A novel interrupter mechanism is positioned within the housing 10 and includes an interrupter 30 comprising a lower tube 32 and an upper guide member 34, both of these parts being constructed of insulating material and being connected together by a threaded collar 35. At its lower end, the tube 32 threadedly receives a terminal ferrule 37 provided with an extension 38 for engagement with a stationary contact 40 of the terminal 16. As illustrated, the ferrule 37 and hence the interrupter 30, is pivotally mounted on the same axis as the door 18, this arrangement being achieved in any suitable manner as by pivot pins 24 and 26 being secured to ferrule 37. Due to this construction and in accordance with certain phases of the operation of the device, the door 18 and the interrupter 30 may be both pivotally moved about the pins 24 and 26.

Separable contact means are provided within the interrupter for interrupting a load circuit

associated with the protective device, and in the form of the invention illustrated, such means includes a rod 42 which is provided at its lower end with a split contact ring 43 for engagement with the ferrule 37 in the closed circuit position illustrated in Fig. 1. Also secured to the lower end of the rod 42 is a follower 44 of insulating material which normally projects downwardly and serves as a reliable indicator of the condition of the device. At its upper end, the rod 42 is guided for reciprocable movement by the guide member 34, the construction including a head 46 provided with a plurality of extensions 48 which in turn are received in and guided by vertically arranged slots 50 provided in the wall of the guide member 34.

Novel means are provided for normally maintaining the separable contacts, constituted by the ring 43 and the ferrule 37, in engagement while allowing prompt disengagement thereof in response to a normal operation or an overload condition. In the form shown such means includes a latch lever 52 which is pivoted to the collar 36 at 54 and is normally urged to the latching position illustrated in Fig. 1 by means of a spring 56. In this position, a notch 58 on the latch lever 52 engages one of the extensions 48 of the head 46 and serves to maintain a spring 59 in a compressed condition. Such spring 59 is interposed between the extensions 48 and the collar 36 and constantly tends to move the head 46 and rod 42 upwardly with respect to the tube 32 to separate the contacts 43, 37 in the manner illustrated in Fig. 2. When the head 46 is latched, as shown in Fig. 1, the latch lever extends substantially vertically upward and is provided with an inclined end surface 60 in engagement with the free end of a bimetal strip 62. Such free end is electrically connected with the head 46 through a flexible conductor 64, with the other end of the bimetal being secured to a contact block 66 carried by the door 18. Bimetal strip 62 is formed in a well known manner of a pair of laminations of materials having different coefficients of expansion internally secured together with the lamination having the greater coefficient of expansion being located uppermost. The circuit from the bimetal to the line terminal contact 14 is completed by way of a contact spring latch 68, the free end of which is received within a notch on top of the block 66. It will thus be perceived that the latch 68 serves to releasably latch the door 18 in its closed position, while the said latch together with the block 66 constitute disconnecting contacts which separate when the door 18 is opened.

The interrupter 30 is maintained in the position shown in Fig. 1 by a U-shaped spring clip 70 which is secured to the casing in any suitable manner, such as to terminal 14 and is provided with spring arms for embracing opposite sides of a top cap 72, threadedly received by the upper end of guide member 34. A similar retaining spring clip 74 is secured to the door 18 and is adapted to releasably hold the door and interrupter in assembled relation when these parts are removed from the housing 10.

In addition to the foregoing features of construction, the present invention provides a novel arrangement for normally separating the contacts 37, 43, and for reclosing the said contacts in the event they have been manually or automatically separated. More particularly and referring to Fig. 1, such construction includes two pairs of pivotally connected links disposed on

each side of the interrupter 30, each pair including a link 76 pivoted to the head 46 at 78, and a link 80 pivoted to the door 18 at 82, the two links being pivoted together at 84 as illustrated. In addition to the link arrangement, a resilient retaining finger 86, secured to the line terminal 14 and provided with a bent end portion 88 is provided for releasing latch lever 52 to allow separation of the contacts 37, 43, all in a manner which will appear more fully hereinafter.

With the parts in the closed circuit position shown in Fig. 1, the circuit through the novel protective device may be traced from the upper line terminal 14, through the contact latch 68 to block 66 on door 18, through bimetal strip 62, and thence to the lower line terminal 16 by way of the flexible conductor 64, head 46, rod 42 and the closed contacts 37, 43. Under these conditions the follower 44 will project below the housing 10 and thus indicate the closed circuit condition of the device. When an overload occurs in the circuit with which the protective device is associated, the bimetal 62 will be heated thereby and the free end will deflect downwardly in engagement with the inclined surface 60 of the upper end of the latch lever 52, to move the latter to the unlatched position shown in Fig. 2 where the notch 58 is moved out of engagement with the head 46. The expansible spring 59 will then rapidly move the rod 42 upwardly and quickly separate the contacts 37 and 43. Such separation of the contacts will draw an arc which will be restricted by the follower 44 in the relatively small annular space between the follower and the interrupter tube 32. Preferably, tube 32 and follower 44 are of an insulating material such as fiber which is capable of evolving an arc-extinguishing gas when in proximity to an electric arc in order to more quickly quench the arc which accompanies the separation of the contacts 37 and 43. When the circuit opens, as thus described, the follower 44 is drawn up into the housing 10, thereby clearly indicating at the exterior that the circuit of the device is open.

To effect reclosure of the contacts 37, 43, it is only necessary to pivotally move the door 18 to the open position illustrated in Fig. 3. Such opening of the door may be effected by inserting the end of a switch stick within the eyelet of the handle 28. As the door is opened, the interrupter 30 is maintained in the position shown by the relatively strong retaining clip 70, while the friction clip 74 between the door and the tube 32 which is relatively weak readily releases frictional engagement with the interrupter tube 32. Separation of the contacts 66 and 68 will not then draw any arc in view of the fact that the circuit is then open through the interrupter 30. It will be readily understood that as the door is pivotally moved from the closed position shown in Fig. 2 to the open position shown in Fig. 3, the link connection between the head 46 and the door 18, comprising pivotally connected links 76 and 80, will move the rod 42 and the contact 43 downwardly in order to compress the spring 59 and reclose the contacts 37 and 43. During this operation, the latch lever 52 will be reset by spring 56 urging the latch bar to reengage its notch 58 with the head 46 as soon as the latter moves downwardly past the notch. It will thus be seen that due to the novel features provided, a simple, pivotal opening movement of the door 18 a predetermined amount, will reclose the interrupter contacts 43, 37, compress the spring 59, and reset the latch 52.

Following the reclosure of the separable contacts 43, 37, as above described, the circuit may be restored by merely pivotally moving the door to the closed position shown in Fig. 1. When the door is closed, the circuit is completed through the contacts 66 and 68, the bimetal 62 in the meantime having cooled down to be deflected back to its original position.

If it is desired to inspect or service the device, the door may be pivotally opened to an extent greater than that illustrated in Fig. 3. Under these conditions, the links 76 and 80 will move the interrupter 30 about its pivotal mounting 24, 26 and release the same from frictional engagement with the spring clip 70. The door and interrupter may then be pivotally moved to a depending position with respect to the housing 10 and removed entirely from the housing, if desired. This may be accomplished by slots 75 provided in opposite side walls of housing 10 through which pivot pins 24 and 26 may be removed. In reassembling the interrupter and door with the housing, the interrupter is so placed with respect to the door as to be engaged by the spring clip 74. The assembly of the interrupter and door is then pivotally attached to housing 10 and pivotally moved to the closed circuit position in the manner heretofore described.

In addition to the foregoing features, the invention provides a novel arrangement whereby the circuit may be manually opened by merely pivotally opening the door a slight amount. Thus it will be observed from Fig. 1 that with the latch lever 52 set in latched position, and the links 76 and 80 folded as shown, the interrupter is releasably held to the door 18 by these links and friction clip 74. Hence as the door is initially opened, the interrupter 30 will be pivotally moved with the door an amount sufficient to cause the end portion 88 of the retaining finger 86 to hold the latch lever 52 until the head 46 has cleared the notch 58, even though friction clip 74 is not strong enough to pull the interrupter completely out of retaining clip 70. The contacts 37, 43 will thereupon be immediately separated as heretofore described, and this action takes place before the contacts 66 and 68 are separated. Hence the arc will occur within the interrupter tube 32 and will be drawn out and extinguished in the manner previously pointed out. It is understood that further opening movement of the door to the position shown in Fig. 3 will first separate disconnecting contacts 66 and 68, and then reclose the contacts 37, 43, compress the spring 59 and reset the latch lever 52, it being pointed out that the spring clip 70 holds the interrupter within the housing during such further opening movement of the door.

There has thus been provided by the present invention, a novel protective device of the fuseless cutout type which embodies a relatively simple construction but which is highly efficient in its operation. The number of constituent parts of the device has been reduced to a minimum and hence the same may be manufactured and maintained in proper working condition at a relatively low cost. Manual opening and reclosing of the separable contacts may be accomplished by a single pivotal opening movement of the door, thus avoiding the complicated constructions and the accompanying difficulties of the devices previously proposed. In addition to the foregoing and other advantages, the use of the follower 44 provides in addition to its arc extinguishing function, a readily visible indica-

tion of the condition of the circuit of the protective device.

While the invention has been illustrated and described herein with considerable particularity, it will be readily understood by those skilled in the art that various modifications may be resorted to without departing from the spirit of the invention. Reference will therefore be had to the appended claims for a definition of the limits of the invention.

I claim as my invention:

1. In an electric protective device, a housing provided with an open side, a door of suitable rigid material for closing said open side, a circuit interrupter mounted in the housing and including a pair of separable contacts, means pivotally mounting said door for movement relative to said housing and said circuit interrupter, means in said housing responsive to a predetermined condition of the circuit for effecting separation of said contacts to interrupt the circuit associated with said interrupter when said door is closed, and a lost motion connection between said door and said contacts permitting separation of said contacts without movement of said door but responsive to pivotal opening movement of the door with respect to the housing and interrupter for reclosing said contacts.

2. In an electric protective device, a housing provided with an open side, a door of suitable rigid material for closing said open side, a circuit interrupter mounted in the housing and including a pair of relatively movable parts which are biased apart, a contact connected with each of said parts, means pivotally mounting said door for movement relative to said housing and said circuit interrupter, latch means for normally maintaining said parts and contacts in a circuit closing position, means including electro-responsive means for releasing said latch means to separate the contacts and interrupt a load circuit associated with said interrupter in response to an overload condition, and a lost motion connection between one of said parts and said door permitting separation of said contacts without movement of said door but operable upon pivotal opening movement of the door with respect to the housing and interrupter for moving said one part to reclose said contacts.

3. In an electric protective device, a housing provided with an open side, a door of suitable rigid material for closing said open side, a circuit interrupter mounted in the housing and including a pair of separable contacts, means pivotally mounting said door for movement relative to said housing and said circuit interrupter, means for effecting separation of said contacts to interrupt a load circuit associated with said interrupter, and pivoted links interconnecting one of said contacts and the door and occupying a folded position when said door and contacts are closed to be straightened out upon separation movement of said contacts relative to said door to form a drive connection between the door and said one contact effective in response to pivotal opening movement of the door with respect to the housing and interrupter for reclosing the contacts.

4. In an electric protective device, a housing provided with an open side and bottom, a door of suitable rigid material for closing said open side, means for movably connecting said door to the housing, a circuit interrupter mounted in the housing and including an interrupter tube provided with a fixed contact, said interrupter

tube extending generally vertically in said housing with its lower end being open and located near the open bottom part of said housing and its fixed contact located adjacent the lower end of the tube, said interrupter including also a movable element in said tube carrying a movable contact and a follower element below the movable contact which normally extends out through the lower end of the tube and housing when the contacts are in engagement to be visible from the exterior, said movable element being biased upwardly, to separate said contacts, a latch normally operative to maintain said movable element in a position to close the contacts, means responsive to an overload condition for releasing said latch to allow movement of said element under the influence of the resilient means to separate the contacts and interrupt a load circuit associated with the interrupter and to withdraw said follower element into said tube and housing.

5. In an electric protective device, a housing provided with an open side, a door of suitable rigid material for closing said open side, means for pivotally connecting said door to the housing, a circuit interrupter within the housing and including an interrupter tube provided with a fixed contact and including also a movable element carrying a movable contact, expansive resilient means constantly tending to separate said contacts, a latch normally operative to maintain said movable element in a position to close the contacts and compress said resilient means, means responsive to an overload condition for releasing said latch to allow movement of said element under the influence of the resilient means to separate the contacts and interrupt a load circuit associated with the interrupter, and a pair of pivotally connected links interconnecting the door and said movable element for moving the latter to a position to reclose the contacts, compress said resilient means and reset the latch, upon opening movement of the door.

6. In an electric protective device, a housing provided with an open side, a door of suitable rigid material for closing said open side, means for pivotally connecting said door to the housing, a circuit interrupter within the housing and including an interrupter tube provided with a fixed contact and including also a movable element carrying a movable contact, expansive resilient means interposed between the tube and the movable element constantly tending to move the latter in a direction to separate said contacts, a latch engageable with the movable element to normally maintain the latter in a position to compress said resilient means and close the contacts, bimetallic means responsive to an overload condition to release the latch to allow movement of said element under the influence of the resilient means to separate the contacts and interrupt a load circuit associated with the interrupter, and a pair of pivotally connected links interconnecting the door and said movable element for moving the latter to a position to reclose the contacts, compress said resilient means and reset the latch, upon opening movement of the door.

7. In an electric protective device, a housing provided with an open side, a door of insulation material for closing said open side, a circuit interrupter mounted in the housing and including a pair of separable contacts, means pivotally mounting said door for movement relative to said housing and said circuit interrupter, a pair of

disconnecting contacts arranged in series with said separable contacts, one of said disconnecting contacts being carried by said door and the other carried by the housing, means responsive to pivotal opening movement of the door a predetermined amount for sequentially effecting separation of said separable contacts and said disconnecting contacts, and lost motion connection between said door and the movable one of said separable contacts permitting separation of said contacts without movement of said door but responsive to pivotal opening movement of the door beyond said predetermined amount for reclosing said separable contacts.

8. In an electric protective device, a housing provided with an open side, a door of suitable rigid material for closing said open side, a circuit interrupter within the housing and including a pair of separable contacts, means pivotally mounting said door for movement relative to said housing and said circuit interrupter, means responsive to initial pivotal opening movement of the door with respect to the housing for effecting separation of said contacts, and lost motion connection between said door and the movable one of said separable contacts permitting separation of said contacts without movement of said door but responsive to continued pivotal opening movement of the door with respect to the housing for reclosing said contacts.

9. In an electric protective device, a housing provided with an open side, a door of suitable rigid material for closing said open side, means for pivotally connecting said door to the housing, a circuit interrupter within the housing and including a pair of separable contacts, means for pivotally mounting said interrupter in said housing, means operated by initial pivotal opening movement of the door with respect to the housing for moving said interrupter about its pivotal mounting, means operable in response to such initial pivotal opening movement of the interrupter to effect separation of said contacts, means permitting further pivotal movement of the door without further pivotal movement of the interrupter after separation of said contacts, and means dependent upon continued pivotal opening movement of said door with respect to the housing for reclosing said contacts.

10. In an electric protective device, a housing provided with an open side, a door of suitable rigid material for closing said open side, means for pivotally connecting said door to the housing, a circuit interrupter within the housing and including a pair of separable contacts, an expansive spring constantly tending to separate said contacts, latch means for normally maintaining said spring in a compressed condition with said contacts closed, means for pivotally mounting said interrupter in said housing, means operated by initial pivotal opening movement of the door with respect to the housing for moving said interrupter about its pivotal mounting, means operable in response to such initial pivotal opening movement of the interrupter to trip the latch means to allow the spring to expand and separate the contacts to interrupt a load circuit associated with said interrupter, means permitting further pivotal movement of the door without further pivotal movement of the interrupter after separation of said contacts, and means dependent upon continued pivotal opening movement of said door with respect to the housing for reclosing the contacts, compressing said spring and resetting the latch means.

11. In an electric protective device, a housing provided with an open side and having spaced line contacts therein, a door of suitable rigid material for closing said open side, means for pivotally connecting said door to the housing, a circuit interrupter within the housing and having spaced terminals and a pair of separable contacts connected in series therewith, means for pivotally mounting said interrupter within the housing for movement of one terminal thereof into and out of engagement with a line contact, means responsive to initial pivotal opening movement of the door with respect to the housing for effecting separation of said contacts, means responsive to further pivotal opening movement of the door for reclosing said contacts, releasable means in said housing engaging said interrupter for holding said one interrupter terminal and its contact in engagement during the aforesaid opening and reclosing of said contacts and means responsive to a still further pivotal opening movement of the door for releasing said holding means and moving said interrupter about its pivotal mounting to expose the same for inspection or repair.

12. In an electric protective device, a housing provided with an open side, a door of suitable rigid material for closing said open side, means for pivotally connecting said door to the housing, a circuit interrupter within the housing and including a pair of separable contacts, means for pivotally mounting said interrupter in the housing, and means responsive to continued pivotal opening movement of the door with respect to the housing for sequentially first effecting separation of said contacts, thereafter effecting reclosure of said contacts, and finally moving the interrupter with the door to at least partially remove the interrupter from the housing for inspection and repair.

13. A circuit interrupter comprising, an open-sided housing, a door of suitable rigid material mounted on said housing for movement between open and closed positions relative to the open side of the housing, a circuit interrupter mounted on said housing for movement into and out of said housing, spaced line contacts in said housing, terminals on said interrupter adapted to engage said line contacts when said interrupter is within said housing, and at least one of said terminals moving out of engagement with its line contact when said interrupter is moved out of said housing, means for normally holding said interrupter in said housing, said interrupter having separable contacts in series circuit relation with the interrupter terminals, means responsive to a predetermined condition of the circuit for causing separation of said interrupter contacts, a lost motion connection between said door and a movable interrupter contact permitting separation of said interrupter contacts without movement of said door from its closed position while said lost motion is taken up, whereby opening movement of said door following separation of said interrupter contacts closes said interrupter contacts, and said door can be then closed without causing movement of said interrupter or operation of the interrupter contacts.

14. A circuit interrupter comprising, an open-sided housing, a door of suitable rigid material mounted on said housing for movement between open and closed positions relative to the open side of the housing, a circuit interrupter mounted on said housing for movement into and out of said housing, spaced line contacts in said

housing, terminals on said interrupter adapted to engage said line contacts when said interrupter is within said housing, and at least one of said terminals moving out of engagement with its line contact when said interrupter is moved out of said housing, means for normally holding said interrupter in said housing, said interrupter having separable contacts in series circuit relation with the interrupter terminals, means responsive to a predetermined condition of the circuit for causing separation of said interrupter contacts, a lost motion connection between said door and a movable interrupter contact permitting separation of said interrupter contacts without movement of said door from its closed position while said lost motion is taken up, whereby opening movement of said door following separation of said interrupter contacts closes said interrupter contacts, and said door can be then closed without causing movement of said interrupter or operation of the interrupter contacts, and means on said door for causing separation of said interrupter contacts in response to initial opening movement of said door.

15. A circuit interrupter comprising, an open-sided housing, a door of suitable rigid material mounted on said housing for movement between open and closed positions relative to the open side of the housing, a circuit interrupter mounted on said housing for movement into and out of said housing, spaced line contacts in said housing, terminals on said interrupter adapted to engage said line contacts when said interrupter is within said housing, and at least one of said terminals moving out of engagement with its line contact when said interrupter is moved out of said housing, releasable means for normally holding said interrupter in said housing, said interrupter having separable contacts in series circuit relation with the interrupter terminals, means responsive to a predetermined condition of the circuit for causing separation of said interrupter contacts, a lost motion connection between said door and a movable interrupter contact permitting separation of said interrupter contacts without movement of said door from its closed position while said lost motion is taken up, whereby opening movement of said door following separation of said interrupter contacts closes said interrupter contacts and said door can be thus closed without causing movement of said interrupter or operation of the interrupter contacts, and a stop for said interrupter contacts when closed so that additional force may then be exerted on said door in the opening direction to release said releasable means and move said interrupter out of said housing.

16. A circuit interrupter comprising, an open-sided housing, a door of suitable rigid material pivotally mounted on said housing for movement between open and closed positions relative to the open side of the housing, a circuit interrupter in said housing, said interrupter having separable contacts, means responsive to a predetermined condition of the circuit for causing separation of said interrupter contacts, a lost motion connection between said door and a movable interrupter contact permitting separation of said interrupter contacts without movement of said door from its closed position while said lost motion is taken up, whereby opening movement of said door following separation of said interrupter contacts closes said interrupter contacts and said door can be then closed without causing

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movement of said interrupter or operation of the interrupter contacts.

17. A circuit interrupter comprising, an open-sided housing, a door of suitable rigid material pivotally mounted on said housing for movement between open and closed positions relative to the open side of the housing, a circuit interrupter in said housing, said interrupter having separable contacts, means for normally holding said interrupter in said housing, said interrupter having separable contacts in series circuit relation with the interrupter terminals, means responsive to a predetermined condition of the circuit for causing separation of said interrupter contacts, a lost motion connection between said door and a movable interrupter contact permitting separation of said interrupter contacts without movement of said door from its closed position while said lost motion is taken up, whereby opening movement of said door following separation of

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said interrupter contacts closes said interrupter contacts and said door can be then closed without causing movement of said interrupter or other operation of the interrupter contacts, and means on said door for causing separation of said interrupter contacts in response to initial opening movement of said door.

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