May 22, 1956 H. E. SCHLEICHER 2,747,047

INTERLOCKED SWITCH AND CIRCUIT BREAKER UNIT

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Fig. 1.

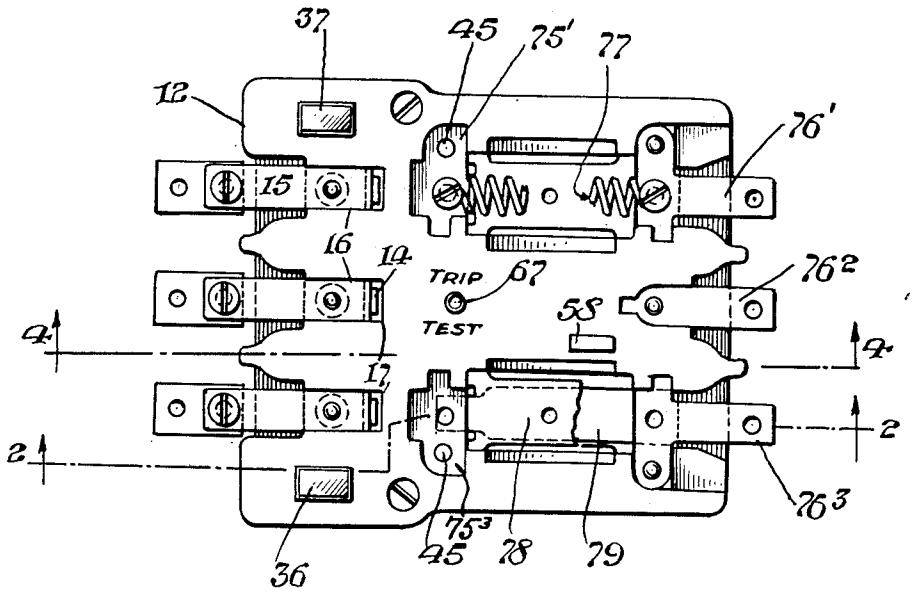
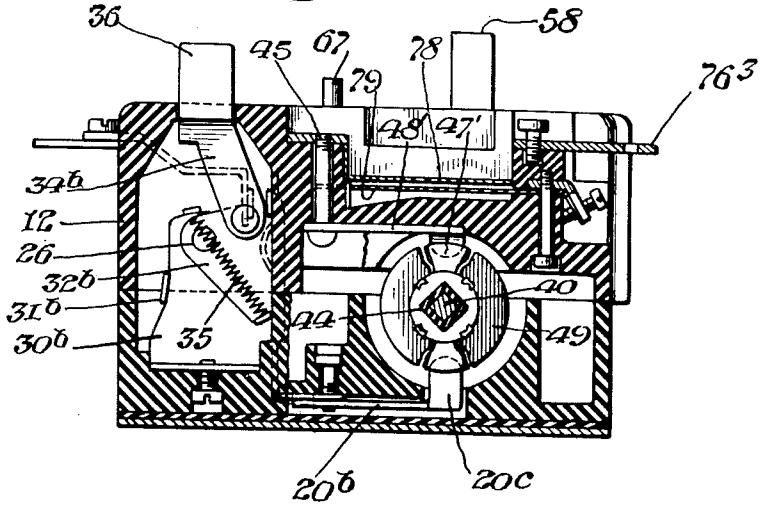


Fig. 2.



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Fig. 3.

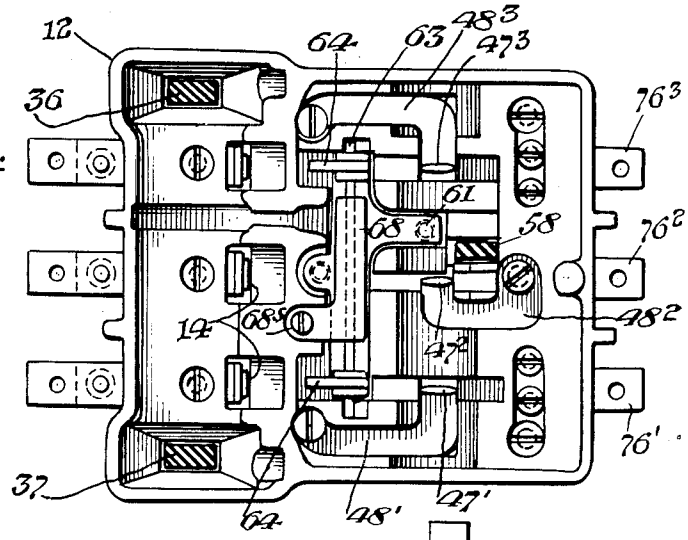


Fig. 4.

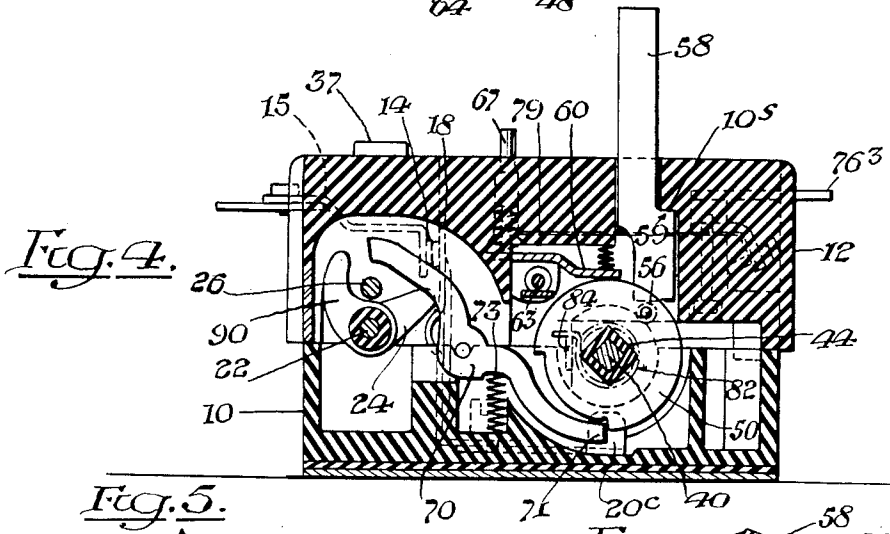


Fig. 5.

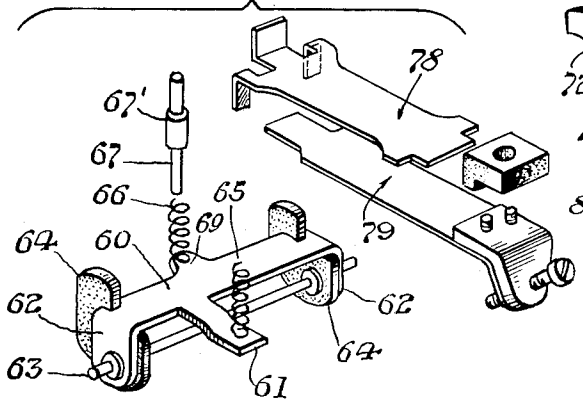
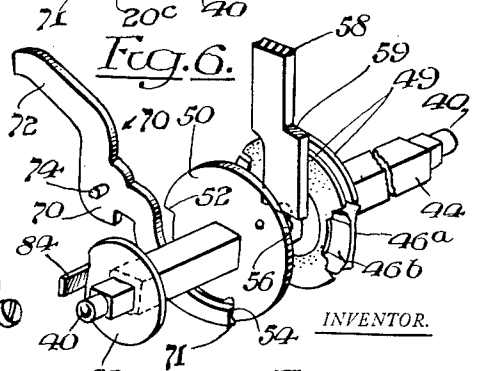


Fig. 6.



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Fig. 7.

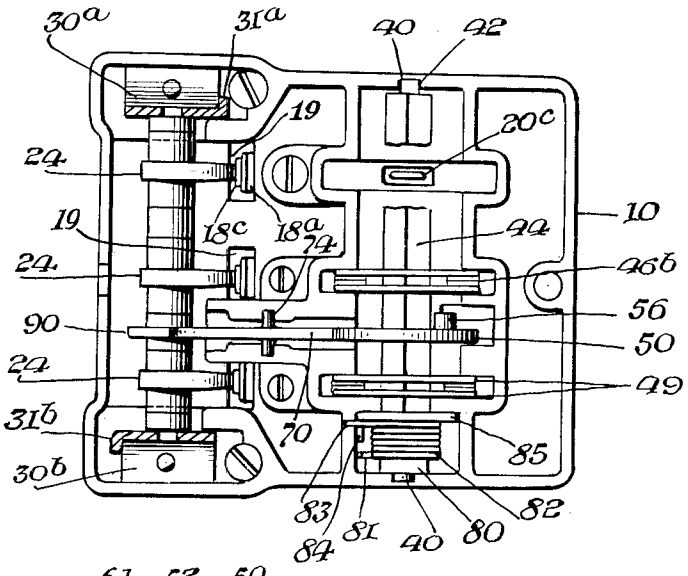
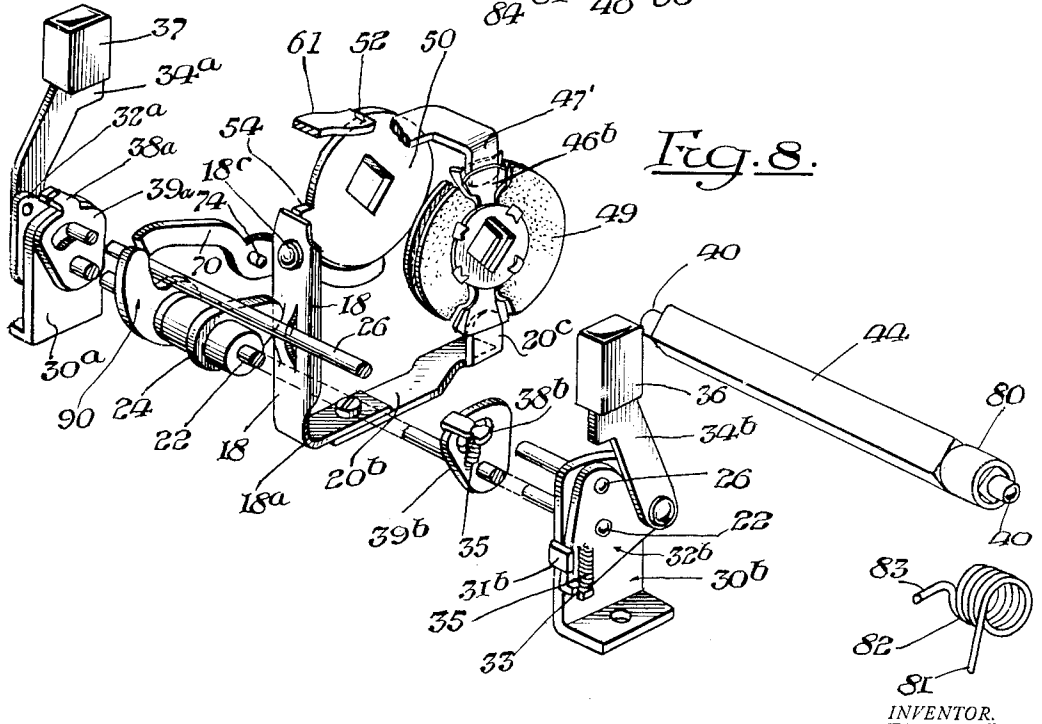


Fig. 8.



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United States Patent Office

2,747,047

Patented May 22, 1956

2,747,047

INTERLOCKED SWITCH AND CIRCUIT BREAKER UNIT

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Application March 23, 1954, Serial No. 418,035

20 Claims. (Cl. 200—50)

In many prior electric circuit making and breaking devices, the same set of contacts is required to serve for normal opening and closing of the circuit and also to serve for overload circuit breaking duty. Since the circumstances and conditions of these two services are different, the ideal for one is not the ideal for the other. Overload actions may shorten the life of the contacts for normal switching and normal wear in switching may impede action where urgently needed on overload.

This invention relates to an interlocked switch and circuit breaker unit wherein the switch is used for normal opening and closing of the circuit by hand while the circuit breaker is provided for opening the circuit under overload conditions. More particularly, the invention relates to an interlocked switch and circuit breaker unit wherein the circuit-breaker contacts cannot be reengaged while the switch is in closed position, but wherein it is necessary first to operate the switch to open circuit position in order to allow the circuit breaker to be reclosed.

It is sometimes desirable to have normal opening and closing of the circuit with a snap action of the switch contacts. Since the reclosing of the circuit-breaker contacts is normally a slow action, it is therefore necessary to provide for interlocking the circuit breaker and switch mechanisms to require the final closing of the circuit to be by the switch contacts rather than by the circuit-breaker contacts.

It is also desirable to have the switch contacts of rugged construction, such as butt contacts, which stand up under hard usage as when it is necessary repeatedly to open and close a circuit carrying currents necessary to the running of heavy machinery.

It is also desirable to have provision to test the operability of the circuit breaker mechanism since the circuit-breaker contacts might be stuck or welded closed without that condition becoming known. That could occur because the normal operation of the opening and closing of the circuit is by manual operation of the switch contacts which are in series with the circuit-breaker contacts. Thus, a permanent sealing of circuit-breaker contacts, which are not visible, would not be otherwise indicated by any irregularity of function of the circuit breaker.

Therefore, it is an object of the invention to provide an improved unit including two separate interlocked mechanisms which act respectively for normal circuit opening and closing and for overload opening of the circuit.

Another object is to provide, in a unit of the above type, switching means wherein the contacts which control the normal opening and closing will snap closed and open.

Another object is to provide in such a combination, provision to prevent reclosing of the circuit breaker when the switch is closed.

Another object is to provide means in such a combination for testing the operability of the circuit breaker mechanism, as a safety feature, to give assurance of normal functioning.

A further object is to provide in a device possessing the foregoing characteristics, an arrangement of elements which will permit straight-through wiring.

A further object is to provide in a combination of the foregoing type, an arrangement which will not interfere with the commercial needs for interchangeability of the overload-responsive heater elements for the various lines of the circuit.

A further object is to provide a unit having the foregoing characteristics which is fully enclosed to keep out lint and dirt and whose parts are formed for minimum effect by vibration and shock, so that the unit will be particularly useful on machines and in places where both or one of those conditions exist.

Another object of the invention is to provide a device having the foregoing characteristics which constitutes a single unit permitting interchangeability of one unit for another without disturbing the wiring of the whole installation.

Other objects and advantages of the invention will become apparent as it is described in connection with the accompanying drawings.

In the drawings:

Fig. 1 is a plan view of a device embodying the invention with certain parts removed or broken away adjacent the thermal elements.

Fig. 2 is a longitudinal section view taken along line 2—2 of Fig. 1.

Fig. 3 is a bottom view of the inside of the cover when removed from the device.

Fig. 4 is a longitudinal elevation view taken along line 4—4 of Fig. 1.

Figs. 5 and 6 are exploded perspective views of parts of the thermal release mechanism and interlocking mechanism respectively employed in the invention.

Fig. 7 is a plan view of the base and parts contained therein with the cover removed.

Fig. 8 is an exploded perspective view of the operating mechanism of the switch in association with certain parts of the circuit breaker mechanism.

The invention is conveniently mounted in a generally rectangular two part molded insulating housing. The base portion 10 of the housing is hollowed out in its top surface for part of the elements which make up the invention. The cover portion 12 is hollowed out to receive part of the elements and also to fit over the base and to cooperate therewith so that the operating mechanism and the switch and circuit breaker contacts are entirely enclosed. The invention is shown as applied to a three-wire circuit in which thermally-responsive means for causing the opening of the circuit on overload conditions are located in two of the outside lines.

The invention comprises in general a switching mechanism and a circuit breaking mechanism, each of which is operable separately, but between which there is an interlocking arrangement to prevent the reclosing of the circuit breaking contacts and mechanism while the switching contacts and mechanism remain in closed-circuit position.

The switching mechanism is located at one end of the housing and comprises a plurality of pairs of butt contacts. The number of pairs, is not significant, three being shown only as an example of the invention when used to control a three-wire circuit. The fixed contact buttons 14 of each pair are mounted on stamped sheet metal terminal bars 15 affixed on the top of the cover and seated in deep recesses 16 in one end thereof. The terminals are bent at right angles so that the ends on which the contact buttons are mounted extend through apertures 17 in he cover at the inner ends of the terminal-receiving recesses 16.

The movable contact buttons 18c are each mounted on a flexible L-shaped stamped sheet metal strip 18 which extends through an aperture 19 in the floor of the base and has its foot 18a secured to the underside of the base. Each foot is also engaged with the bar portion 20b of a combined connector bar and fixed contact of the switching mechanism. These bar portions are flat and run along the bottom of the base to apertures therein, through which the contact portion 20c is bent to extend up into the housing.

For operating the movable switch contacts, a cam shaft 22 is journaled in a pair of stamped sheet metal end brackets 30a, 30b fixedly mounted at opposite sides of one end of the base. Insulating wedge-shaped cam members 24 are fixedly mounted at spaced points along the cam shaft in position to engage and flex the movable contact-carrying members 18 against their normal bias into engagement with the fixed contacts.

Also journaled in the end brackets, parallel to and above the cam shaft, is an operating shaft 26. Affixed to each end of the operating shaft outside the end brackets is an upper corner of a triangularly shaped stamped sheet metal actuating plate 32a, 32b. Pivotally connected to another upper corner of each of the actuating plates is one end of an operating sheet metal bar 34a, 34b, on the other end of which is mounted an insulating button 36, 37.

Attached to an out-turned lug 33 at the lower corner of the actuating plate is the lower end of a coiled tension over-center spring 35 whose upper end is attached to an out-turned lug 38a, 38b overlying the top of the bracket and extending from a cam shaft actuating member 39a, 39b. The cam shaft actuators 39a, 39b are stamped sheet metal parts affixed to the cam shaft near its ends inside and adjacent the brackets 32a, 32b. Arcuate slots are provided in the cam shaft actuators through which the operating shaft 26 passes so that the actuators 39a, 39b can move relative to the shaft.

It is necessary that the depression of the two buttons shall move the cam shaft in different directions to cause engagement and disengagement of the contacts. To that end the cam shaft actuators 39a 39b and actuating plates 32a, 32b which are respectively identical, are mounted facing in opposite directions, with the result that the pivotal connections of the operating or button bars 34a, 34b are on opposite sides of the plane of the operating and cam shafts 22, 26. Hence, when one button is depressed, it tends to move the actuating member and operating shaft in one direction and to snap the parts to open-circuit position while when the other button is depressed, it does the opposite. Since the brackets are faced oppositely, the stop lug 31b on one serves to stop the motion of the mechanism in one direction when the shaft operating plate 32b abuts it, while the lug on the other bracket stops the motion of the mechanism in the other direction in the same way.

A mechanism and separate set of contacts are provided for breaking the circuit on occurrence of an overload. This set of circuit breaking contacts separate independently from the contacts 14, 18c of the switching mechanism just described. However, the resetting of the circuit breaking mechanism is conditioned by interlocking means upon the switching mechanism being in open-circuit position.

The circuit breaking mechanism is located near the opposite end of the base from the switching mechanism. It comprises a square circuit-breaker shaft 40 located transversely in the base in parallel relation to the shafts of the switching mechanism. The ends of the circuit-breaker shaft which are round are seated in journal or bearing recesses 42 in the top edge of the walls of the base. Mounted upon the circuit-breaker shaft is a square insulating sleeve 44. Mounted upon the sleeve at spaced points are fabricated bridging-contact wafers, each comprising pairs of identical conductive flexible arms, designated generally by 46, extending diametrically and facing one another so as to be able to engage on opposite sides of flat fixed contacts, e. g. 20c and 47'. Fiber insulating discs 49 are affixed against the outside of the bridging contact arms to snuff out the arc. Since the structure of the bridging contacts and the fiber discs is conventional, it need not be further described.

At a convenient position intermediate the ends of the circuit breaker-shaft, a latch disc 50 is mounted on the square sleeve 44. This disc may conveniently be made from sheet metal with a segmental cut formed in its periphery extending about 90° around the circumference providing at its opposite ends shoulders 52, 54. One shoulder 52 is adapted to be engaged by a finger 61 extending from a latch member 60 as hereinafter described while the other shoulder 54 is adapted to be engaged by the lower end or foot 71 of an interlocking member 70 as hereinafter described. Extending laterally from the latch disc, is a short pin 56 in position to be engaged by the lower end of a reset bar or button 58. The reset bar may be of insulating material and extend perpendicularly upward through the cover with an offset or shoulder 59 provided in one side thereof to engage with a similar shoulder 19s inside the cover, thus to prevent the button from moving entirely outwardly through the cover after the device has been assembled.

In order to bias the circuit-breaker shaft into open circuit position, a round sleeve 80 is provided on one end of the shaft, around which is coiled a tension spring 82. One end 81 of the spring extends downwardly into and engages with the side wall 12s of a recess in the base wherein the spring is located. The other end 83 of the spring is adapted to engage with one side of a laterally bent lug 84 from the periphery of a spring tension disc 85. This spring tension disc 85 may be stamped conveniently from sheet metal with a square aperture in its center so as to fit slidably on the square shank of the circuit-breaker shaft near its end. With the end 83 of the spring pressing on lug 84, the spring constantly urges the disc 85 and shaft 40 in a counterclockwise direction (as viewed in Figs. 2, 4, 6 and 8 of the drawings).

The bridging circuit breaker contacts 46, of which there will be three in the embodiment illustrated, normally connect bottom fixed circuit breaker contacts 20c (of which there are also three, mounted in the floor of the base as hereinbefore described) to top fixed circuit breaker contacts 47', 47^2 or 47^3. These top contacts are each bolted to the inside surface of the cover in position to lie directly over one of the bottom circuit breaker contacts. The top contacts comprise flat fingers bent down at right angles from stamped metal bars 48', 48^2, 48^3 which extend longitudinally of the cover, the outside ones 48' and 48^3 extending toward the switch mechanism while the middle one 48^2 extends in the opposite direction. The fixed and movable circuit breaker contacts of each set are located in one plane, the planes of the three sets being parallel.

Bolts 45', 45^2, 45^3 pass through the cover and serve to secure the bars and contacts 47, 48 (designated generally) to the cover and also serve to electrically connect those parts to the stamped metal terminal plate 75 mounted in recesses in the top of the cover. Connecting these terminal plates 75 to stamped metallic wire-terminal plates 76', 76^3, secured in recesses at the end of the cover, are coiled resistance heater elements 77 which are each attached at their ends by screwbolts to the terminal plates 75', 76' and 75^3, 76^3 respectively.

On overload the heat from these heaters, passing through a metal shield plate 78, affects one or another of similar bimetallic cantilever strips 79, each attached at one end to the cover under the terminals 76', 76^3. On heating, the affected bimetal flexes, its unattached or inner end engaging and causing pivoting of the latch member 60.

The thermally-responsive member 60 is a fabricated

unit comprising a sheet metal part stamped in U-shape through the parallel legs **62** of which pass a long pivot pin **63** paralleling the transverse midportion of the member. Mounted on the pivot pin and connected to the member **60** flat against each of the inside surfaces of the legs **62** is a flat insulating cam **64**, the bottom or inner surface of which is positioned to be pressed upon by the flexing bimetal strip **79**. The cam pieces are slotted to embrace the transverse portion of the member **60**, so as to be caused to turn therewith about pivot pin **63**. The ends of the pivot pin **63** seat in bearing recesses or seats formed in the underside of the cover. In order to hold the ends of the pivot pin **63** in their seats, a flat stamped sheet metal L-shaped securing bar **68** has its long leg overlying the midportion of the pin and secured in that position by a screw **68***s* passing through the short leg into the cover.

The latch finger **61** extends laterally from the midportion of the member **60** in a direction to overlie the periphery of the latch disc **50**. The finger is biased into engagement with the periphery of the latch disc **50** by a small coiled compression spring **65** seated in a small bore or recess in the underside of the cover and pressing upon the top surface of the finger **61**.

As the bimetallic members or one or the other of them flexes, the tip or tips of the affected bimetal will press on an insulating cam **64**, causing the member **60** to pivot counterclockwise (referring to Fig. 4) about the pin **63**. The finger **61** is thus lifted from the latch disc **32** interrupting its latch action. Thereupon the bias of the circuit breaker spring **82** causes the circuit breaker mechanism to rotate counterclockwise (Fig. 4) disengaging the bridging contact **46** from the fixed contacts **20***c* and **47** (all designated generally). As this occurs, the trip lever biasing spring **73** moves the foot **71** of the trip lever into the cut in the latch disc **50** behind the shoulder **54**. That prevents resetting by the return of the disc and circuit breaker mechanism to their former position, until the interlocking lever foot **71** is moved from the shoulder **34**.

To unlatch the circuit breaker mechanism and permit its resetting, a flat releasing finger **90** of generally arcuate form is fixedly mounted upon the cam shaft **22** of the switch mechanism in the same plane as the interlocking lever and is so positioned about the axis of the shaft that when the shaft is in switch-open position, the releasing finger will press against the head end **72** of the interlocking lever and cause it to pivot clockwise, thus disengaging its foot **71** from the latch disc. Thus when the switch is open, the reset button **58** of the circuit breaker can be depressed, causing the circuit breaker to rotate clockwise and causing reclosing of the circuit breaker contacts. On return to closed-circuit position, the latch finger **61** of the thermally responsive member drops behind the shoulder **52** holding the circuit breaker in that position. Now the switch can be closed by pressing the "start" button. That moves the cam shaft **22** counterclockwise in Fig. 4, thus rotating the releasing finger **90** away from the head **72** of the interlocking lever and freeing that lever for operation to latch the circuit breaker open upon the next tripping of the circuit breaker mechanism.

It will thus be seen that so long as the switch mechanism remains closed, the circuit breaker mechanism cannot be reset, i. e. moved from open to closed-circuit position. Only after the switch contacts and mechanism have been moved to open-circuit position is the interlocking means moved to permit the circuit breaker mechanism to be reset.

In order that it shall be possible to test the operation of the circuit breaker mechanism and the latch member, a test pin **67** extends through the cover over a lug **69** laterally extending from the opposite side of the midportion of the member **60** from the finger **61**. A coiled tension spring **66** presses upon this lug and is coiled around the inwardly extending end of the test pin, engaging against a shoulder formed by an enlargement **67'** thereon. This enlargement also prevents the pin from being pressed up through the cover by the spring **66**.

The path of the outside-lines current through the device is typically as follows: From terminal **15** through butt contacts **14**, **18***c*, movable contact strip **18**, bus bar and circuit breaker contacts **20***c*, **46**, **47'**, bolt **45'** heater coil **77** to wire terminal **76'** The path through the neutral line is the same except that from circuit breaker contact 47^2 and bar 48^2, the connection is through a bolt directly to wire terminal 76^2.

From the foregoing, it will be observed that the switching mechanism may be operated manually to normally open and close the circuit; but that after the circuit has been opened upon overload as a result of the action of the thermally responsive latching means, the circuit may not be reclosed by the closing of the circuit breaker contacts. The closing of the circuit breaker contacts cannot be accomplished so long as the switch contacts remain closed. The switch mechanism must first be moved into open-circuit position before the circuit breaker mechanism can be reset. This ensures that the closing of the circuit shall always take place by action of the switch contacts which operate both between open and closed positions with a snap action. The life of the device is thus prolonged by reason of the ordinary circuit opening and closing always taking place between the butt type contacts of the switch mechanism.

It will also be observed, particularly by reference to Figs. 1, 2 and 4, that the parts of the unit are fully enclosed, thus preventing dust and lint from entering as is particularly likely in textile mills. Moreover, the use of the particular form of circuit breaker contacts *46a*, *46b* and associated disc **49** and circular latching disc **50** together with switching contact that are biased closed, enables usage of the device on machines and under conditions where there is apt to be considerable vibration without danger of accidental contact separation.

Many modifications within the scope of the invention will occur to those skilled in the art. Therefore, I do not limit the invention to the specific form and detail of the embodiment in connection with which it is illustrated and described.

What is claimed is:

1. Switching mechanism comprising contacts, manually operable means to cause closing and opening of said contacts, in combination with circuit breaker mechanism comprising contacts adapted to be opened and closed, current responsive means to cause operation of said circuit breaker contacts automatically on occurrence of predetermined conditions in the circuit, manually operable means to restore said circuit breaker contacts to the position occupied before automatic operation, and mechanical interlocking means between said switch and circuit breaker mechanisms preventing said restoration of said circuit breaker contacts while the position of said switch contacts remains unchanged.

2. Switching mechanism comprising contacts, manually operable means to cause closing and opening of said contacts, in combination with circuit breaker mechanism comprising contacts adapted to be opened and closed, current responsive means to cause opening of said circuit breaker contacts automatically on occurrence of predetermined conditions in the circuit, manually operable means to reclose said circuit breaker contacts, means automatically locking said circuit breaker contacts open on occurrence of automatic operation of said circuit breaker, and means interconnecting said locking means with said switch mechanism to disable said locking means on movement of the switching mechanism to open said switch contacts.

3. Switching mechanism comprising contacts, manually operable means to cause closing and opening of said contacts, in combination with circuit breaker mechanism

comprising contacts adapted to be opened and closed, current responsive means to cause operation of said circuit breaker contacts automatically on occurrence of predetermined conditions in the circuit, manually operable means independent of said manually operable switch-contact-operated means, to reset said circuit breaker mechanism, and mechanical interlocking means between said switch and circuit breaker mechanisms preventing resetting of said circuit breaker mechanism until said switching mechanism has been operated from the position it occupied when the circuit breaker mechanism operated automatically.

4. Switching mechanism comprising contacts, manually operable means to cause closing and opening of said contacts, in combination with circuit breaker mechanism comprising contacts adapted to be opened and closed, current responsive means to cause operation of said circuit breaker contacts automatically on occurrence of predetermined conditions in the circuit, manually operable means to reset said circuit breaker mechanism, and mechanical means between said switch and circuit breaker mechanisms operable automatically on automatic operation of the circuit breaker mechanism to lock said circuit breaker mechanism in automatically-operated position, and means operable on subsequent operation of the switch mechanism to disable said locking means.

5. The combination claimed in claim 1 in which the switch mechanism includes butt type contacts, and snap acting means to cause opening and closing of said butt contacts.

6. The combination claimed in claim 3 in which the switch mechanism includes butt type contacts, and snap acting means to cause opening and closing of said butt contacts.

7. The combination claimed in claim 1 in which the circuit breaker mechanism is normally biased, and latching means holding said circuit breaker mechanism against said bias, said latching means being operable by said current responsive means.

8. Switching mechanism comprising contacts, manually operable means to cause closing and opening of said contacts, in combination with circuit breaker mechanism comprising contacts adapted to be opened and closed, current responsive means to cause operation of said circuit breaker contacts automatically on occurrence of predetermined conditions in the circuit, manually operable means to reset said circuit breaker mechanism, mechanical interlocking means between said switch and circuit breaker mechanisms, means movable concomitantly with said circuit breaker contacts engaging said interlocking means to latch said circuit breaker mechanism in auto-operated position, and means movable concomitantly with said switch operating means to de-activate said interlocking means in one position of said switching means.

9. The combination claimed in claim 8 in which the interlocking means comprises a pivoted lever one end of which is engageable with the means movable with the circuit breaker, the other end being engageable with the means movable with the switch operating means.

10. The combination claimed in claim 9 in which the switch operating means includes a rockable shaft, and the means movable with the switch operating means is mounted on said rockable shaft.

11. The combination claimed in claim 10 in which the latching means movable with the circuit breaker comprises a notched disc.

12. The combination claimed in claim 8 in which the interlocking means comprises a pivoted lever one end of which is engageable with the means movable with the circuit breaker, thte other end being engageable with the means movable with the switch operating means and in which the latching means movable with the circuit breaker comprises a notched disc.

13. The combination claimed in claim 4 in which the circuit breaker mechanism includes a notched disc cooperating with said means to lock the circuit breaker.

14. The combination claimed in claim 13 in which the current responsive means includes a latching element engaged with said notched disc and disengaging therefrom on response to said predetermined current conditions.

15. The combination claimed in claim 4 in which the automatic circuit breaker operating means includes a latch disc, and a latching element engaged with said disc and disengaging therefrom on response to said predetermined current conditions.

16. The combination claimed in claim 3 having manually operable means to actuate said current responsive means irrespective of current passage therethrough to test the operation of the latter.

17. The combination claimed in claim 13 in which the current responsive means includes a latching element engaged with said notched disc and disengaging therefrom on response to said predetermined current conditions and manually operable means engageable with said latching element to disengage it from said disc for testing the operation of said automatic operating means.

18. The combination claimed in claim 3 and a two part housing enclosing the same, said automatic operating means of the circuit breaker mechanism including a latching element and thermally responsive means to move said latching element both mounted in one portion of the housing, said circuit breaker and switch mechanisms both being mounted in the base portion of the housing.

19. The combination claimed in claim 3 and a two part housing enclosing the same, said switch mechanism being mounted entirely in the base portion of the housing.

20. The combination claimed in claim 3 in which the switching contacts and the circuit breaking contacts each include a movable contact and a fixed contact, a two part housing enclosing said combination, a fixed contact of the switch and of the circuit breaker being mounted in one housing part and a movable contact of the switch and of the circuit breaker being mounted in the other housing part.

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