March 13, 1951 J. D. WOOD 2,545,402

CIRCUIT BREAKER

Filed Sept. 7, 1944 2 Sheets-Sheet 1

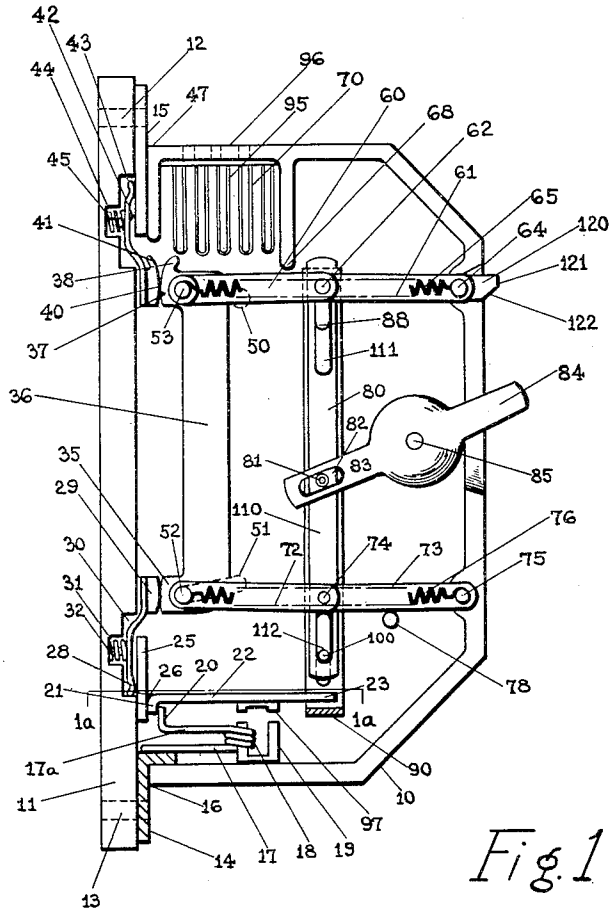


Fig. 1

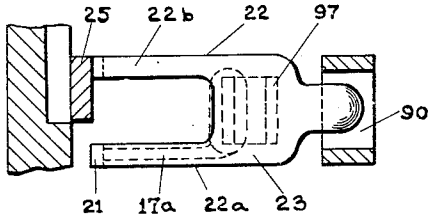


Fig. 1a

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Filed Sept. 7, 1944 2 Sheets-Sheet 2

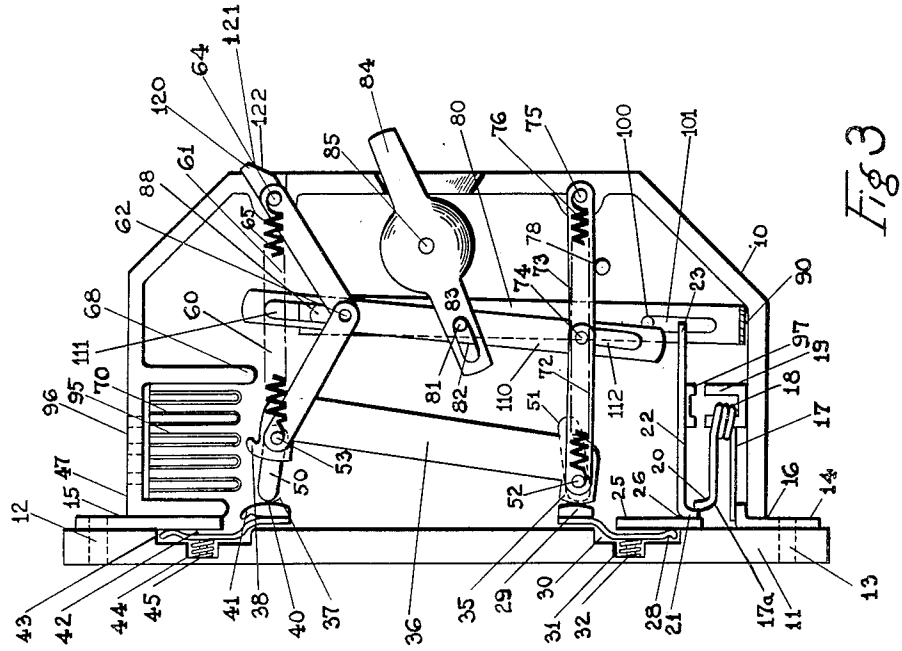


Fig 3

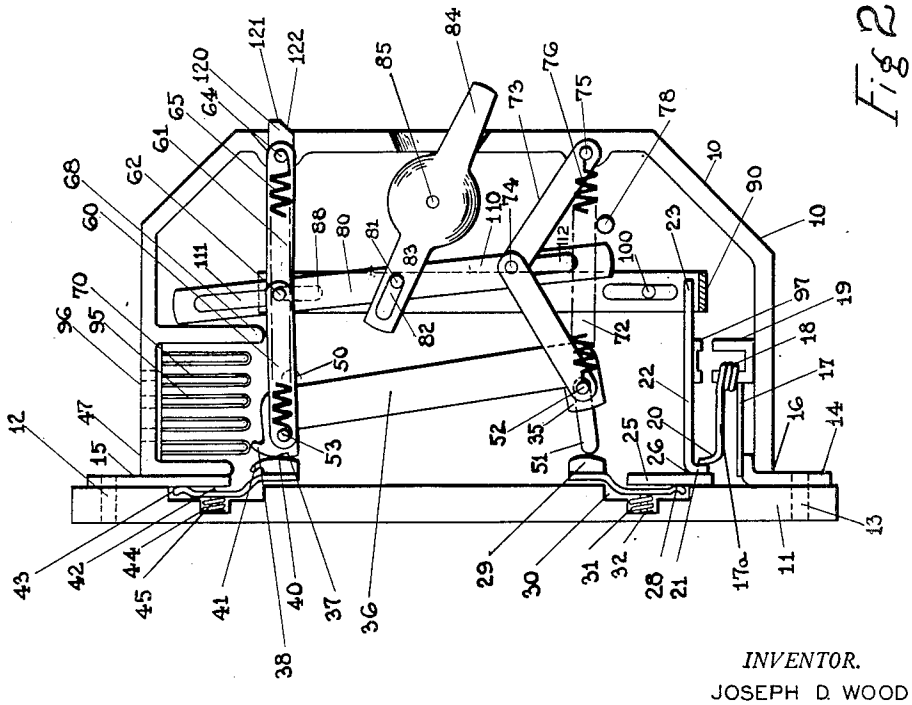


Fig 2

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UNITED STATES PATENT OFFICE

2,545,402

CIRCUIT BREAKER

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Application September 7, 1944, Serial No. 552,997

3 Claims. (Cl. 200—88)

1

My present invention relates to circuit breakers, and more particularly to combined thermal magnetic circuit breakers which are adapted to be tripped with a time delay which varies inversely with the excess load placed thereon, but which are also arranged to trip instantaneously on short circuits or loads beyond a predetermined excess load.

Combined thermal magnetic circuit breakers are generally well known and frequently include some form of mechanism for operating the contacts between open and closed position, a spring which biases a toggle mechanism toward a collapsed position to trip the contacts apart, and a latch which temporarily overcomes the action of the spring.

The bi-metallic thermal element or the magnetic trip are arranged to operate this latch so that the action of the opening spring will no longer be defeated and so that the contacts may be separated.

Such thermal magnetic circuit breakers sometimes include simplified arc extinguishing means but rarely include arcing contacts since the current values at which they operate are relatively small.

The interrupters themselves are relatively inexpensive and the contacts, or for that matter, the whole circuit breaker may be changed without excessive cost.

Such terminal magnetic circuit breakers have tended, however, constantly toward greater and greater complexity as the commercial development of the art has proceeded, until the usual present day small thermal magnetic circuit breaker, while nevertheless remaining within an approximate over-all size no larger than previous circuit breakers, has compacted the many additional elements thereof within the same size casing. These breakers have thus become delicate in operation; they fall readily out of adjustment; and maintenance or replacement is an important factor to be considered.

My present invention contemplates a novel thermal magnetic circuit breaker for the protection of relatively small loads which maintains the compactness and simplicity of external operation which has previously been achieved, but which nevertheless is simplified and sturdy in construction and economical in manufacture and assembly.

My invention further contemplates a novel arrangement wherein the number of moving parts in the housing is substantially decreased and where the over-all number of parts within the housing is also substantially decreased, delicate

2

latches are obviated, and delicate adjustments are made unnecessary. Indeed for the most part, a circuit breaker housing for any particular capacity which is of the same size as the housings of prior circuit breakers having the same capacity, is characterized in my invention by the amount of empty space within the housing itself.

This space may be filled with additional insulating elements or where the installation of a new switchboard makes this possible, the housing may be substantially reduced in size for the same capacity circuit breaker.

Accordingly, a primary object of my invention is the construction and formation of a novel thermal magnetic circuit breaker.

Another object of my invention is the formation of a circuit breaker having inverse time delay characteristics for excess loads below a predetermined value and instantaneous tripping characteristics for any excess load above the predetermined value.

Still another object of my invention is the formation of a thermal magnetic circuit breaker which is simple and sturdy in construction and in which delicate latches and moving parts are obviated.

These and many other objects of my invention will become apparent from the following description and drawings in which:

Figure 1 is a side view with the cover removed of my novel thermal magnetic circuit breaker showing the parts thereof in closed circuit position.

Figure 1*a* is a plan view of the thermal unit of the circuit breaker of Figure 1, taken from line 1*a*—1*a* of Figure 1.

Figure 2 is a view corresponding to those of Figures 1 and 3, showing the parts of the circuit breaker re-set preparatory to the circuit closing operation; and

Figure 3 is a side view of my novel thermal magnetic circuit breaker showing the parts thereof in tripped condition.

Referring now to Figure 1, my novel thermal magnetic circuit breaker is enclosed in the insulating housing 10, the base 11 of which is adapted to be secured to a switchboard in any suitable manner, as for instance by connecting screws, through the openings 12 and 13 in the said base 11, and in the terminals 14 and 15. Current enters through the lower terminal 14 which preferably is an L-shaped piece of suitable conductive material, the end of which passes through the slot 16 in the lower end of the housing.

Current then passes to the connector 17 which is secured to the terminal 14 in any suitable manner, as for instance by brazing; current then passes through the energizing coil 18 for the magnet 19. The magnet is secured to the interior of the wall of the housing 10 in any suitable manner. Current flows from the magnet coil 18 to the conductor 17*a*, the end 20 of which is secured to the lower leg 21 of the bi-metallic thermal element 22. Bi-metallic thermal element 22 is a U-shaped member having the customary construction. Current passes up one leg 22*a* of the bi-metallic thermal element 22, across the top of the U at 23, and down the other leg 22*b* to the terminal block 25 to which the opposite leg of the bi-metallic thermal member 22 is conductively secured at 26.

Current then passes from the terminal block 25 to the lower flexible contact support 28, through the contact support 28, to the main stationary contact 29 which is secured to the end of the flexible contact support 28 in any suitable manner. The contact support 28 is mounted in a recess 30 of the base 11 of the housing, and recess 30 is provided with a bore 31 in which is mounted the compression spring 32. Compression spring 32 drives the flexible contact support 28 toward the terminal block 25 which prevents the flexible contact support 28 from being pushed out of position; and spring 32 also drives the main stationary contact 29 toward the main movable contact 35 to maintain adequate current carrying pressure.

Current then passes from the main stationary contact 29 to the main movable contact 35 on the contact bridge 36, through the contact bridge 36, to the movable arcing contact 37 and movable arcing horn 38, which are mounted on the opposite end of the contact bridge 36. Current then passes from the movable arcing contact 37 to the stationary arcing contact 40 and stationary arcing horn 41, which members are mounted on the end of the upper flexible contact carrying member 42. This member is exactly similar in construction to the lower flexible contact carrying member 28 and is mounted in the recess 43, the said recess having the bore 44 in which the compressing spring 45 is positioned to drive the flexible contact carrying member 42 toward the moving arcing contact to establish proper current carrying pressure between the arcing contacts.

The spring 45 also drives the flexible current carrying member 42 against the upper terminal member 15, which upper terminal member 15 prevents the contact carrying member 42 from being pushed out by the spring. The upper terminal member 15 passes out through the slot 47 in the top of the housing 10 adjacent the base in order that an appropriate connection may be made thereto.

The movement of the contact bridge 36 with respect to the housing and with respect to the stationary contact members is limited by the converging curved slots 50 and 51.

A pin 52 carried by the bridge 36 at its lower end bears in the slot 51 and thus guides that end of the bridge when the same is brought into movement as hereinafter described. The pin 53 carried by the contact bridge at its upper end rides in the slot 50 of the housing and also guides that end of the bridge when the same is brought into movement.

An upper toggle consisting of the links 60 and 61 connected by the knee-pin 62 maintains the arcing contacts 36 and 37 in engagement with

each other. The toggle link 61 is pivoted on the housing at the pin 64, while the toggle link 60 is pivoted on the contact bridge 36 by the pin 53.

The knee-pin 62 moves over center when the circuit breaker is closed. That is, a tension spring 65 connects the opposite pins 64 and 53 of the toggle tending to collapse the toggle, as shown in Figure 2. When the circuit breaker is brought to the fully closed circuit position, the toggle is straightened against the tension of spring 65 and then the knee-pin 62 moves upwardly over center to a position where the spring 65 tends to collapse the toggle upwardly. This upward collapse of the toggle, however, is prevented by the fact that the link 60 of the toggle 60—62—61 bears against the end wall 66 of the arc chute 70. Consequently, the toggle 60—62—61 by its movement over center positively maintains the arcing contacts 36 and 37 in engagement while the spring 45 on the upper contact carrying member 42 ensures adequate contact pressure.

The lower end of the contact bridge 36 is also provided with a toggle consisting of the links 72 and 73 connected by the knee-pin 74. The left-hand end of the left-hand link 72 is connected to the pin 52 at the lower end of the contact bridge 36, while the right-hand end of the right-hand link 73 is connected to the stationary pin 75 carried by the wall of the housing. A tension spring 76 between pins 75 and 52 tends to collapse the toggle. Ordinarily in the open condition of the circuit breaker, where the lower contacts 35 and 29 are open, the toggle collapses upwardly as shown in Figure 3. When the circuit breaker is fully closed, the knee-pin 74 of the toggle is moved downwardly to straighten the toggle against the tension of the spring 76 and the said knee-pin 74 moves over center so that the collapsing force of the spring 76 on the toggle is a downward force. This downward collapsing force is resisted by the pin 78 carried by the housing which acts as a stop therefor.

Here again the contact 35 is maintained in current carrying relation with the stationary contact 29 in a positive manner by the over center position of the toggle 72—74—73 while appropriate current carrying engagement between contacts 39 and 25 is obtained by the compression spring 32 which urges the flexible contact carrying member 28 toward the movable contact 35.

A yoke 80, preferably of insulating material, is connected to the knee-pin 62 of the upper toggles. The yoke 80 is provided with a slot 88 at its upper end through which pin 62 passes. The normal position of the yoke 80 in the closed circuit position of the circuit breaker as shown in Figure 1 is one wherein the uppermost end of the slot 88 bears against the upper side of the knee-pin 62 of toggle 60—62—61. The lowest end of the yoke 80 is provided with a re-entrant flange 90 which extends just below the end 23 of the bi-metallic element 22.

On the occurrence of excessive current conditions sufficient to heat the bi-metallic element 22 to deflect the same downwardly, the end 23 of the bi-metallic element bears against the flange 90 and pulls the yoke 80 downwardly. The upper end of slot 88 of the yoke then pulls the knee-pin 62 of the toggle 60—62—61 downwardly through center, and when the toggle passes through center so that the knee-pin is below the line of the spring 65, the tension spring collapses the toggle in the manner shown in Figure 2 and the arcing contacts 36 and 37 separate and inter-

rupt the current flow through the circuit breaker (see Figure 3).

The yoke 80 is slidably positioned in the housing 90 in any suitable manner, as for instance by being mounted in a slot in the wall of the housing or by the pin 100 extending from the wall of the housing into the long slot 101 of the yoke 80 (Figure 3). The yoke 80 is free to move downwardly once the toggle 60—62—61 collapses so that the slot 86 therein offers no impediment to the opening of the arcing contacts.

When the arcing contacts 36 and 37 separate, an arc is drawn between them and moves up on to the arcing horns 38 and 41 and moves into the arc chute 70. The arc chute 70 is of the type described in Patent No. 2,353,729 for Air Blast Arc Chute, issued July 18, 1944, to O. Jensen, and consists of successive U-shaped plates 95 of relatively high electrical resistance. As the arc moves upwardly and is broken in series between these plates, the movement of the arc along these plates not only cools the arc but progressively introduces greater resistance in series with the arc, thus further hastening the interruption thereof.

The arc gases are then vented through the top opening 96 of the arc chute 70. On the occurrence of excess current conditions above a predetermined value, as for instance in the case of short circuits, the magnet 19 is sufficiently energized by the coil 18 to attract the armature 97 mounted on the bi-metallic element 22 and thus causes the end 23 of the bi-metallic element to be deflected downwardly to engage the flange 90 of the yoke 80 to cause collapse of the toggle 60—62—61 and thus to cause the arcing contacts 36 and 37 to separate.

During the separation of the arcing contacts 36 and 37, the main contacts 35 and 29 remain connected not only because of the over center position of their toggle 72—74—73 but also because the curves of the two slots 50 and 51 are such that the only position which main contacts 35 and 29 may assume when the arcing contacts open is the closed position. Consequently the main contacts 29 and 35 never carry interrupting current.

A connecting link 110 is provided between knee-pins 62 and 74 of the upper and lower toggles. The connecting link 110 has an upper slot 111 and a lower slot 112 engaging respectively the upper knee-pin 62 and the lower knee-pin 74. The connecting link 110 is also provided with a pin 81 which is engaged by the slot 82 of the end 83 of the handle 84, which handle is rotatable about the pin 85.

In order now to re-set the arcing contacts in closed position from the position of Figure 3 to the position of Figure 2, the end 84 of the handle is rotated downwardly in a clockwise direction. Through the slot 82 in the opposite end 83 of the handle the pin 81 of the connecting link 110 is forced upwardly. The lower end of slot 111 now forces the knee-pin 62 of the toggle 60—62—61 upwardly against the tension of the spring 65 to straighten the toggle and finally to force the same through center so that the tendency of the spring 65 is to collapse it upwardly, this collapsing force being resisted by the wall 68 of the arc chute 70 which wall bears against the link 60.

Thus, as shown in Figure 2, by the downward rotation of handle 84, the arcing contacts are closed. During this upward movement of the connecting link 110, the lower end of the slot 112 in the connecting link 110 engages the knee-pin 74 of the toggle 72—74—73 and breaks the same upwardly through center so that it collapses and opens the main contacts 29 and 35.

During this upward movement of the toggle pin 62, the yoke 80 is carried upwardly also by the pin 62 in the slot 86 to re-position the yoke 80 for a subsequent tripping operation, also as shown in Figure 2.

When the members have reached the position of Figure 2, the handle 84 may now be rotated upwardly to close the main contacts 29 and 35. This upward rotation of the handle 84 in a counterclockwise direction moves the opposite end 83 downwardly and hence the slot 82 moves the pin 81 of the connecting link 110 downwardly. The lower slot 112 in the connecting link 110 now engages the pin 74 of the toggle 72—74—73 to straighten the toggle against the tension of spring 76 and moves the knee-pin 74 through center so that the collapsing force of the spring 76 is one which would now tend to collapse the toggle downwardly; this downward collapsing force is however resisted by reason of the fact that the link 73 of the toggle bears against the stop 78.

When this operation is completed, the circuit breaker parts are back once more in the position shown in Figure 1 where the circuit breaker is in closed circuit position.

The operation is entirely trip free since on closing of the main contacts 29 and 35, the yoke 80 is free to move to collapse the toggle 60—62—61 even though the handle 84 is held upwardly. This is obvious from an inspection of Figure 3 where even though the handle 84 is in upward or closed position, the toggle 60—62—61 has collapsed.

Should it be desired to open the circuit breaker manually, a downward rotation of the handle 84 from the position shown in Figure 1 to the position shown in Figure 2 will move the connecting link 110 upwardly until the lower end of slot 112 moves the knee-pin 74 through center to collapse the toggle 72—74—73 and open the contacts 29 and 35. Since this manual opening operation will occur under normal current conditions, no arc extinguishing means need be provided for contacts 29 and 35. Arc extinguishing means are required only for the contacts 36 and 37 which will interrupt excess loads.

A simple indication is provided for the condition of the circuit breaker. The toggle 61 has a small extension 120 beyond the pin 64 which extends slightly outside the front end of the housing 10. When the circuit breaker is in the fully closed circuit position of Figure 1, the handle 84 is up and the extension 120 extends straight out from the circuit breaker. The end 121 of the extension 120 may be marked with the word "On." When the circuit breaker trips to the position shown in Figure 2, although the handle 84 remains up, the extension 120 will have been rotated upwardly so that the surface 122 will become visible. This surface 122 may be marked with the word "Tripped." Even though the extension 120 may be in the "On" position, shown in Figure 2, the position of the handle 84 in the down position of Figure 2 will show that the circuit breaker is off. Consequently the upper position of the handle should be marked "On" and the down position of the handle should be marked "Off."

In the foregoing I have illustrated my invention only in connection with preferred simple

embodiments thereof. The essence of the invention includes simplified, latchless and sturdy operating members for the circuit breaker, which members are readily accessible for replacement and repair. This simplicity and sturdiness, as contrasted with the many delicate moving parts and latching means of prior thermal magnetic circuit breakers, is a definite benefit with respect to economical manufacture, assembly and maintenance.

All flexible pigtails which have often been a source of trouble in prior thermal magnetic circuit breakers have been eliminated by the use of the two flexible contact carrying members 28 and 42, which are biased into appropriate position by the small compression springs 41 and 32, which springs themselves are fully protected since they are completely covered by the flexible contact carrying members.

While these contact carrying members have been described as flexible contact carrying members, it is obvious from the foregoing that they may preferably be rigid members, the mounting of which however, is flexible, in that they are not positively held at either end but are biased into appropriate position by their respective springs. This elimination of pigtails eliminates one of the primary reasons for wear and maintenance in prior thermal magnetic circuit breakers. This circuit breaker structure has been found to be practical in operation and unique in its freedom from necessity from maintenance and repair.

Since many variations and modifications of my invention will now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosures herein, but only by the appended claims.

I claim:

1. In a circuit breaker, a first stationary contact and a first movable contact engageable therewith, a first toggle connected to said first movable contact, said first toggle being over-set when said first movable contact engages said first stationary contact; a second stationary contact and a second movable contact; said first and second movable contacts being in series with and rigidly connected to each other; said circuit breaker having a first and a second terminal; said first and second stationary contacts being connected respectively to said first and second terminals; a second toggle connected to said second movable contact, said second toggle being over-set when said second movable contact engages said second stationary contact; means automatically responsive to selected current conditions for drawing said first toggle through center and collapsing the same to move said first movable contact away from said first stationary contact; a link connecting said toggles; and a manually operated member connected to said link for drawing said second toggle through center and collapsing the same to move said second movable contact away from said second stationary contact, and for thereafter operating said first toggle to effect engagement of said first mentioned cooperating contacts.

2. In a circuit breaker, a first stationary contact and a first movable contact engageable therewith, a first toggle connected to said first movable contact, said first toggle being over-set when said first movable contact engages said first stationary contact; a second stationary contact and a second movable contact connected in series with said first mentioned contacts; said circuit breaker having a first and a second terminal; said first and second stationary contacts being connected respectively to said first and second terminals; a second toggle connected to said second movable contact, said second toggle being over-set when said second movable contact engages said second stationary contact; means automatically responsive to selected current conditions for drawing said first toggle through center and collapsing the same to move said first movable contact away from said first stationary contact; a link connecting said toggles; and a manually operated member connected to said link for drawing said second toggle through center and collapsing the same to move said second movable contact away from said second stationary contact; and for thereafter operating said first toggle to effect engagement of said first mentioned cooperating contacts; said manual and automatic means being independently operable to open their respective contacts, and providing trip free action to said circuit breaker.

3. In a circuit breaker, a first stationary contact and a first movable contact engageable therewith, a first toggle connected to said first movable contact, said first toggle being over-set when said first movable contact engages said first stationary contact; a second stationary contact and a second movable contact connected in series with said first mentioned contacts; said circuit breaker having a first and a second terminal; said first and second stationary contacts being connected respectively to said first and second terminals; a second toggle connected to said second movable contact, said second toggle being over-set when said second movable contact engages said second stationary contact; means automatically responsive to selected current conditions for drawing said first toggle through center and collapsing the same to move said first movable contact away from said first stationary contact; a link connecting said toggles, slots in said link, pins on said toggles movable in said slots, and manually operative means connected to said link for drawing said second toggle through center and collapsing the same to move said second movable contact away from said second stationary contact; and for thereafter operating said first toggle overcenter to effect engagement of said first mentioned contacts; said manual and automatic means being independently operable to open their respective contacts; and said toggles being connected to said link through said movable pins in said slots in said link whereby said automatic means are operable to trip said circuit breaker open while said manual means is held against opening to effect trip free operation thereof.

JOSEPH D. WOOD.

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