Feb. 4, 1941. W. L. BUTLER 2,230,713

CIRCUIT BREAKER

Filed Oct. 25, 1939 3 Sheets-Sheet 1

Fig. 1.

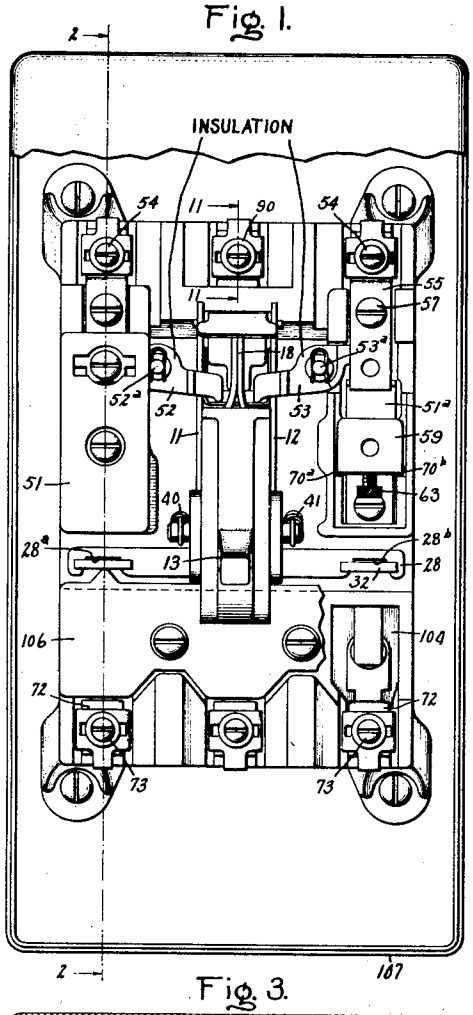


Fig. 2.

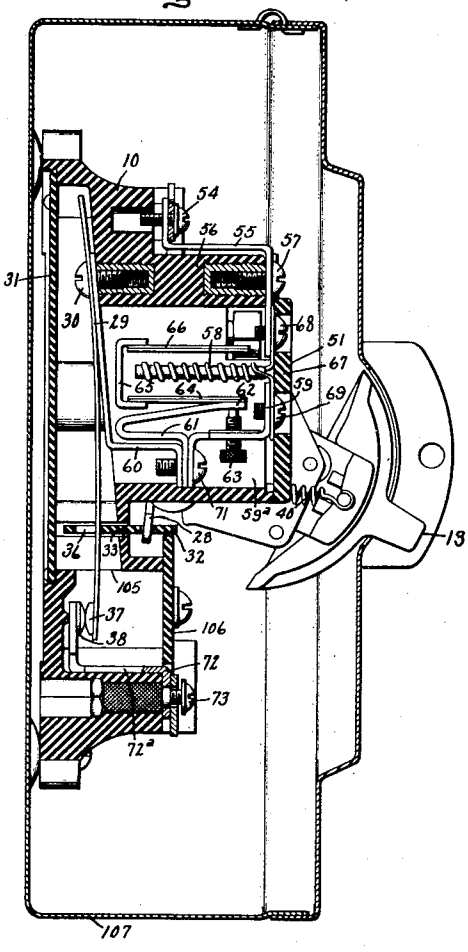
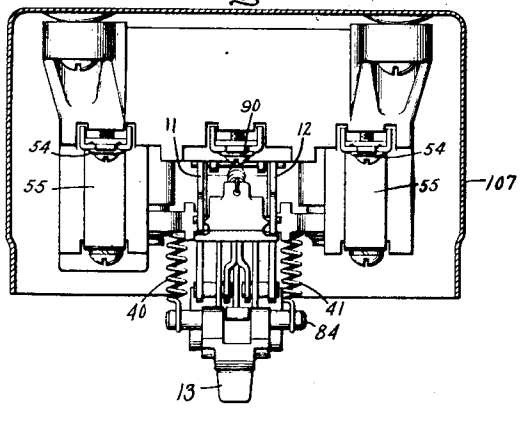


Fig. 3.



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Fig. 4.

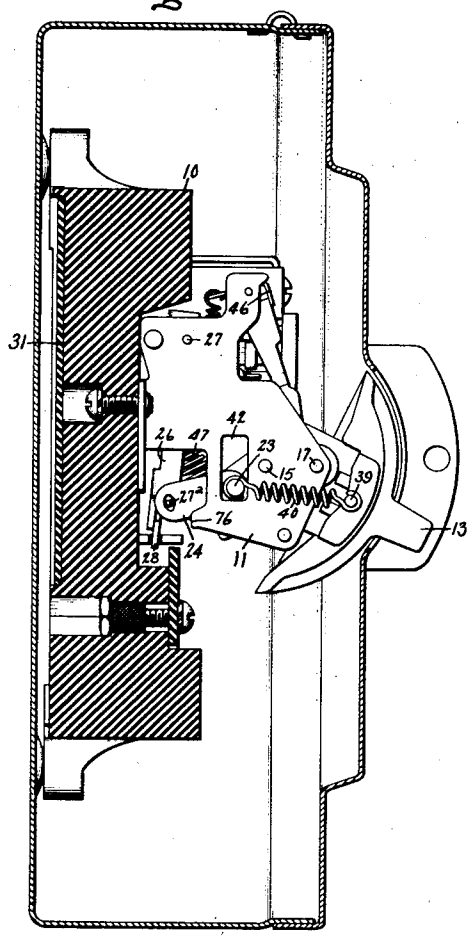


Fig. 6.

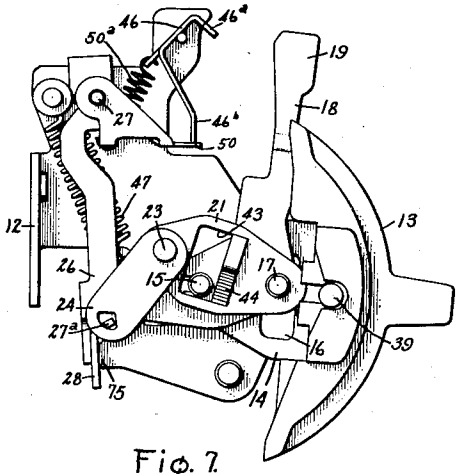


Fig. 7.

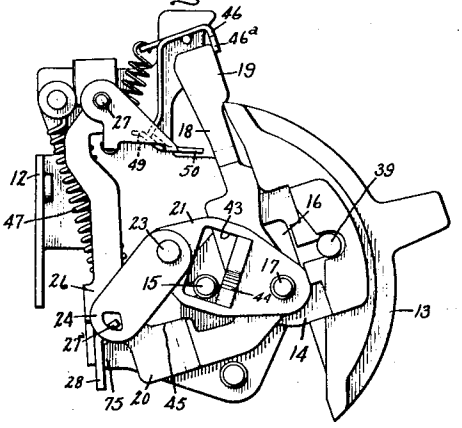
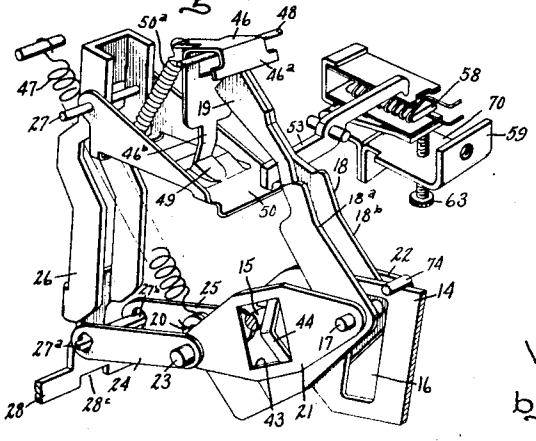


Fig. 5.



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CIRCUIT BREAKER

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Fig. 8.

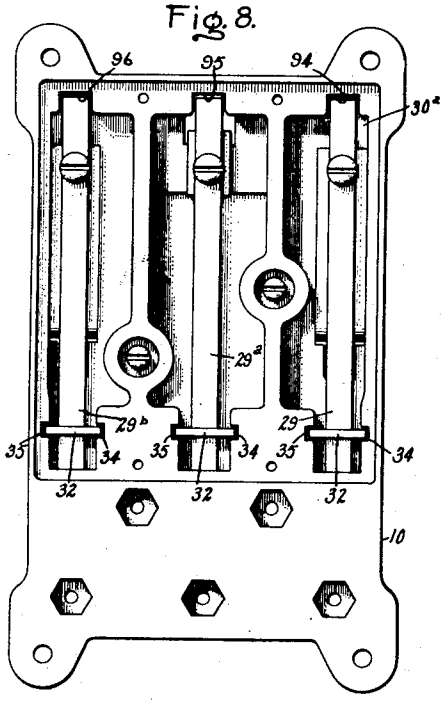


Fig. 9.

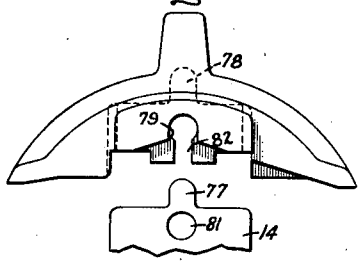


Fig. 10.

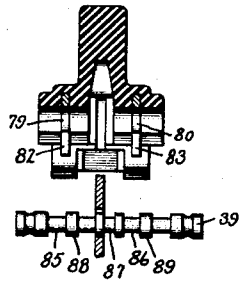


Fig. 11.

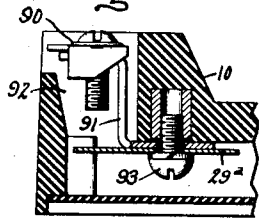
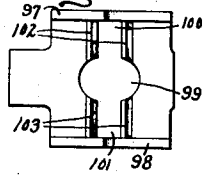


Fig. 13.



Fig. 12.



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Patented Feb. 4, 1941

2,230,713

UNITED STATES PATENT OFFICE

2,230,713

CIRCUIT BREAKER

William Lawrence Butler, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application October 25, 1939, Serial No. 301,255

21 Claims. (Cl. 200—116)

My invention relates to circuit breakers, more particularly to manually-operated circuit breakers provided with current responsive means for opening them in response to predetermined maximum current conditions, and has for its object a simple and reliable construction which may be manufactured at low cost and which is adapted to withstand shocks and jars.

My invention is especially useful in manually-operated current responsively tripped circuit breakers used in the connection of small motors directly across the supply source without starting resistance. These devices are of small physical dimensions and at the present time are used with motors up to 5 H. P. at 440 volts.

For a more complete understanding of my invention, reference should be had to the accompanying drawings, Fig. 1 of which is a plan view of an automatic motor starter switch embodying my invention; Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1 looking in the direction of the arrows; Fig. 3 is an elevation view of the operating mechanism looking in a downward direction on Fig. 1; Fig. 4 is a side elevation view of Fig. 1 looking toward the right hand; Fig. 5 is an enlarged perspective view of the manual operating means and the current responsive tripping means with said supporting parts removed for purposes of clarity; Fig. 6 is a view similar to Fig. 4 but enlarged and showing the manual operating and tripping means only and said supporting parts removed and showing the parts in the automatic tripped open position; Fig. 7 is a view similar to Fig. 6 but showing the parts in the manual open position; Fig. 8 is a bottom view; Figs. 9 and 10 are fragmentary views showing the detachable connection for the handle; Fig. 11 is a fragmentary sectional view along the lines 11—11 of Fig. 1 looking in the direction of the arrows; while Figs. 12 and 13 are views showing the construction of the terminal clip.

Referring to the drawings, my invention in the form shown comprises a base 10 made of electrically insulating material such as a molded compound and of irregular shape for convenience in supporting the various parts of the device. The switch actuating mechanism is supported on two plates 11 and 12 which are secured rigidly to the base and project therefrom in parallel spaced relation with each other, the operating mechanism being mounted between the plates on suitable pivots supported by them. An operating handle 13 made of a suitable molded insulating material is secured on the end of a metallic plate 14 forming an arm the opposite end of which is pivotally mounted on a fixed pivot 15 (Fig. 5) carried by the two supporting plates 11 and 12. This arm 14 is provided with an elongated slot 16 providing for freedom of movement of the arm with respect to a fixed pivot pin 17 carried by the supporting plates.

Pivotally mounted on this pin 17 is a trip or operating arm 18 formed of two identical metallic members 18a and 18b (Fig. 5) substantially in the shape of a bell crank and secured in parallel spaced relation with each other on the pivot pin 17, the operating arm 14 being mounted between them. The two ends 19 and 20 of the bell crank members 18a and 18b are bent together and secured rigidly to each other as by spot welding, the space between the two arms at their central portions loosely embracing the arm 14.

Also mounted on the fixed pivot pin 17 are two links 21 and 22 on opposite sides of the bell crank arm 18. These two links 21 and 22 have their opposite ends connected to a movable or operating pivot pin 23 which forms a connection with a second pair of spaced links 24 and 25 having their other ends connected to a switch operating arm 26. The switch operating arm 26 is mounted at one end on a fixed pivot 27 carried by the supporting plates 11 and 12. It is shaped as by punching to provide two pivot projections 27a and 27b on which the links 24 and 25 are pivoted.

Adjacent the projections 27a and 27b the operating arm 26 is provided with a cross extension 28 provided with three laterally spaced notches 28a, 28b (Fig. 1), and 28c, Fig. 5. These notches receive short connecting links for operating the switch contacts. It will be understood that I have shown my invention as applied to a three-pole or three circuit motor starter such as might be used with a three-phase motor. Each of the three electrical contacts consists of a spring arm 29 (Fig. 2) which is secured as by a screw 30 to the base 10 in an elongated recess 30a provided for it in the bottom of the base 10, i. e., on the side of the base opposite the supporting plates 11 and 12 and the operating mechanism carried thereby. In other words, each of the three spring switch arms 29 is physically separated from the other two switch arms by walls molded into the bottom of the base 10. Furthermore, a plate of molded electrically insulated material 31 is provided to fit over the bottom of the base 10 and completely enclose the three recesses containing the switch arms 29.

Although only one switch arm 29 is described, it will be understood that the construction of the other two, 29a and 29b (Fig. 3) is identical with this one together with their operating connections with the operating arm 26. As shown in Fig. 2, the arm 29 is connected to the cross extension 28 by means of a short rigid strip 32 of insulating material. This strip extends through an aperture 33 provided for it in the base and at each side it fits in grooves 34 and 35 (Fig. 3) in the base so that it is freely slidable in a direction transverse to the switch arm 29. The switch arm 29 extends through a rectangular aperture 36 in the link 32, this aperture being enlarged in the direction of movement of the strip 32 to provide for insertion of the movable contact and therethrough in the assembly of the switch and to provide for movement of the contact 37 by the resiliency of the contact arm when the switch is opening. In the event that the contacts should weld together, however, the strip 32 engages and forcibly moves the contact arm during the last portion of its opening movement. At its other end the link 32 is provided with oppositely disposed notches which receive the side walls of the notch 28a to form a loose connection between the cross bar 28 and the link 32. The switch arm 29 is formed of electrically conducting spring material such as an alloy of copper. It is secured to the base 10 so that it biases by its own resiliency the movable contact 37 carried on its free end to an open circuit position in disengagement with the stationary contact 38.

A detachable connection is provided between the insulating handle 13 and the outer end of the arm 14, to be described hereinafter more in detail, which includes a transversely extending pin 39 having its ends projecting at each side of the handle. These projecting ends form supports for the two ends of the overcenter snapping springs 40 and 41 the other ends of which are secured to the projecting ends of the movable pivot pin 23. This pin 23 has its ends projecting through elongated apertures in the supporting plates 11 and 12, only one aperture 42 (Fig. 4) being shown, the springs 40 and 41 being on the outer sides of the supporting plates 11 and 12. Also each of the links 21 and 22 is provided with a rectangular aperture 43 through which extends the fixed pivot pin 15. For spacing and positioning purposes a V-shaped portion 44 is struck outward on each of the links 21 and 22, these two portions, only one of which is shown, frictionally engaging the inner surfaces of the supporting plates 11 and 12.

Thus the handle 13 may be moved from the closed circuit position, shown in Fig. 2, upward to the position shown in Fig. 7 to thereby move the overcenter springs 40 and 41 from the lower side to the upper side of the fixed pivot 17 and thereby snap the movable pivot pin 23 upward to the position shown in Fig. 7. This breaks the toggle formed by the pairs of links 21, 22, and 24, 25 and moves the operating arm 26 toward the right-hand as seen in Fig. 7 to open the switch. The opposite movement of the handle snaps the toggle to its closed position to close the switch, the pin 23 then being slightly past the toggle straightened position whereby the toggle is locked, i. e., on the opposite side of a line connecting the projection 27a with the fixed pivot pin 17, as seen in Figs. 4 and 5.

In this closed position, the pin 23 comes to rest against the trip arm 18 at the point 45, Fig. 7. Therefore, when the end 19 of the trip arm is released by the current responsive latch 46 normally holding it and is moved in a clockwise direction, as seen in Fig. 5 by a strong tripping spring 47 connected to its lower end, the pivot pin 23 is forceably moved against the force applied by the springs 40 and 41 to the open circuit position, the toggle being broken as indicated in Fig. 6. As seen most clearly in Fig. 5, the latch 46 is mounted on a pivot 48 secured to the supporting plates 11 and 12. One end 46a is bent laterally to overlap and secure the end of the trip arm 18 while the other end 46b extends laterally to a position near the trip arm and engages a latching notch or projection 49 on a second pivoted trip arm 50 which is mounted on the fixed pivot 27. A helical tension spring 50a extends between the arm 50 and the latch arm 46 so as to bias each of them in a counterclockwise direction about their pivots as seen in Fig. 5 and thereby normally hold the end 46b into engagement with the projection 49.

Two current responsive devices 51 and 51a of identical construction are provided in the two outside circuits of the three electrical circuits through the switch for independently moving the latch arm 50 to trip the switch. These two devices include respectively small lever arms 52 and 53 (Fig. 1) made of electrically insulating material, having their inner ends in position to engage the trip lever 50. The trip levers 52 and 53 are mounted on pivots 52a and 53a secured to the base.

Since the current responsive devices are identical in construction, one only will be described in detail. As shown in Fig. 2, the terminal 54 corresponding to the circuit of the trip device 51 is connected through an electrically conducting strap 55 extending over a projection 56 on the base and to which projection the strap 55 is secured by a screw 57. The opposite end of this strap 55 forms a support as well as an electrical connection for one end of a heating resistor 58 whose opposite end is connected to a second electrically conducting strap 59. This strap 59 extends into a recess or chamber 59a provided for it in the base, as does also the heater 58, and has its opposite end connected to and supported by a third conducting strap 60 which extends in substantially parallel relation with the switch arm 29 and is clamped securely by the screw 30 to the bottom of the base between the switch arm and the base and in electrically conducting relation with the switch arm. It will be observed that the chamber 59a extends through the base from the top to the bottom thereof and communicates with the recess 30a.

Also secured to this inner end of the strap 59 is a substantially U-shaped member 61 having its end 62 engaging an adjustment screw 63 carried by the strap 59. Secured to the end 62 is a link or bar of bimetallic thermostatic material 64 which is mechanically and electrically connected through a non-bimetallic connecting strap 65 to a second link or bar 66 of bimetallic material. The free end of the link 66 is in position to engage and move the operating lever 52 when the bimetallic links 64 and 66 are distorted by an increasing temperature, see Figs. 2 and 5. These two bimetallic members, it will be observed, are in parallel relation with each other on opposite sides of the heater 58 and are closely adjacent the heater so as to be heated quickly thereby. These parts 59, 61, 64, 65 and 66 have their ends

secured rigidly to each other in the relation shown, preferably by spot welding.

The bimetallic thermostats 64 and 66 are arranged with their high expansion metals adjacent the heater. Consequently, upon an increase in temperature, the free end of the thermostat 64, i. e., the end secured to the non-bimetallic part 65 moves downward as viewed in Fig. 2, thus tilting upward the right-hand or free end of the thermostat 66. Also the thermostat 66 itself is distorted so as to still further move its free end upward. This arrangement thus takes advantage of the combined distortions of the two thermostats.

The non-bimetallic connecting length 65 is provided because of the fact that this portion of the thermostat in the event of very heavy overloads is not heated as fast as the portions 64 and 66 by reason of the closer proximity of the latter to the heater. On the other hand, during relatively light overloads, this portion 65 by convection and also by conduction from the other two portions is heated at substantially the same rate as the other two portions. As a result, if the thermostat were made of a continuous U-shaped portion of bimetallic material, the distortion of the thermostat during heavy overloads would be decreased in relative magnitude by the lower temperature of the portion 65 as compared with its distortion in response to light overloads. In other words, by making this length 65 of non-bimetallic material, the thermostat is made more closely responsive to changes in temperature of the heater, i. e., changes in the current through the switch.

The heater 58 is secured to a plate 67 made of electrically insulating material, there being apertures in the insulating support 67 to provide access to screws 68 and 69 whereby the ends of the heater are secured to the ends of the straps 55 and 59 and the heater thereby secured in place. Any suitable form of heater may be used. Preferably the heater is a wire of suitable resistance material which is wound on a supporting strap of electrically conducting material suitably insulated as by a layer of mica. An additional support is provided for the strap 59 by providing grooves 70*a* and 70*b* (Fig. 1) in the base in opposite walls extending perpendicular to the bottom of the base to receive the sides of the central portion 70 of the strap, this portion being somewhat wider, as shown in Fig. 5.

Thus it will be observed that the heater 58 is secured in place and also electrically connected in the circuit by means of the screws 68 and 69. After the heater and base 51 for it are removed, the screw 71 securing the strap 59 to the strap 60 may be removed and the screw 57 taken out to release the strap 55. Then the strap 59 and the other parts assembled to it can be removed. By removing the screw 30, the switch arm 29 and the strap 60 are loosened and can be removed from the bottom of the base. Moreover, the stationary contact 38 is mounted on a strap 72 having its end bent laterally and clamped in place by a terminal screw 73, this screw thus performing the double function of holding the strap 72 and stationary contact 38 in place and also of effecting the electrical connection with the conductor connecting the switch in the controlled circuit. The strap 72 is further secured by the side wall of the base which loosely embrace the central portion 72*a* of the strap.

The adjusting screw 63 is provided to adjust the position of the thermostats and thereby vary the current setting of the thermostats.

When the switch is opened automatically by release of the trip lever 18, the overcenter springs are carried to the other side of the stationary pivot 17, thereby returning the handle to an intermediate position, as shown in Fig. 6. In this position, a cross pin 74, Fig. 5, secured to the arm 14, rests against the upper edge of the trip lever. In reclosing the switch, the handle is first moved toward the open position whereby the cross pin 74 moves the trip lever 18 to its latched position, the end of the trip lever engaging the latch lever 46 and moving it clockwise, as viewed in Fig. 6 back to the latched position whereby the latching end 46*a* assumes a position to secure the trip lever. It will be understood of course that before the latch arm 46 can be secured, the thermostats must have cooled sufficiently to allow the latch lever 50 to return to its latching position. The switch can now be closed in the normal manner by returning the handle to the closed position. It should be noted that in the open position, the cross bar 28 rests against projections 75 (Fig. 6), and 76 (Fig. 4).

Referring to Figs. 9 and 10, a quickly detachable connection is provided between the handle and the arm 14. The arm 14 has on its outer end a projection 77 which fits in a slot and recess 78 in the handle, and the handle is provided with metallic inserts having apertures 79 and 80 registering with an aperture 81 in the arm 14 when the end of the arm is slipped in place between the two metallic inserts. The inserts are, furthermore, provided with slots 82 and 83 of materially less width than the diameters of the holes 79 and 80 and connecting with the holes. The handle is secured in place by a pin 39 which extends through the apertures 79, 80 and 81. For the purpose of locking the pin in place, it is provided with sections 85, 86 and 87 of reduced diameter such that they are free to pass through the slots 82 and 83. The handle is assembled by placing the pin in the aperture 81 in the position shown in Fig. 9, then placing the handle in place, the reduced portions 85 and 86 slipping through the slots 82 and 83. The pin is then pushed toward the left-hand whereby the sections 88 and 89 are moved into the holes 79 and 80 and the smaller section 87 is moved into the hole 81. As thus assembled, the force applied by the overcenter springs 40 and 41 holds the pin in place with the arm 14 in the notch formed by the reduced section 87, while the handle is secured against lateral movement by the projection 77 and the end of the arm 14 fitting into the recess in the handle provided for it.

The middle terminal 90 of the switch which does not lead through a resistance heater is connected directly to the middle contact arm 29*a* by a supporting strap 91 (Fig. 11). As shown, this strap 91 is mounted in a recess or aperture 92 in the base 10 provided for it and has its lower end bent laterally and secured to the base 10 by a screw 93 which also clamps the contact arm 29*a* against the strap thus forming a good electrical connection between the two.

As shown in Fig. 8, the ends of the contact arms 29, 29*a* and 29*b* opposite the movable contact fit in recesses 94, 95 and 96 in the base which secure them against displacement by turning on their screw supports.

Figs. 12 and 13 show details of the terminal clips each of which is provided with downwardly turned sides 97 and 98 embracing the conducting strap and with a central aperture 99 for the clamping screw holding the clip in place. More-

over from the hole 99, slots 100 and 101 extend toward the sides 97 and 98. These slots are punched or formed with projecting sharp edges 102 and 103 projecting from the surface between the sides 97 and 98. These edges engage the looped conducting wire by means of which the switch is connected in an electric circuit so as to firmly secure the wire and form a good electrical connection therewith.

As shown in Figs. 1 and 2, each stationary contact is mounted in a separate compartment or chamber 104 formed in the moulded base, each compartment having a side opening 105 through which the corresponding flexible contact arm extends. These three compartments for the stationary contacts are closed at the top by a cover plate 106 made of electrically insulating material. Preferably as shown, the base and the operating mechanism connected thereto is mounted in an enclosing metal casing 107.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto, since many modifications may be made and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A circuit breaker comprising cooperating switch contacts, a switch member for moving one of said contacts, a manually-operated member for moving said switch member between open and closed circuit positions, a trip member biased to move said switch member to its open circuit position, a latch member securing said trip member, a second latch member securing said first latch member, a spring connecting said latch members biasing said second member to secure said first member and biasing said first member to release said trip member, and means responsive to the current through said switch contacts for actuating said second latch member in opposition to said spring thereby to release said trip member.

2. A circuit breaker comprising cooperating switch contacts, a switch member for moving one of said contacts, manually-operated means for moving said switch member between open and closed circuit positions, a trip member, means biasing said trip member to move said switch member to its open circuit position, a latch lever securing said trip member and provided with a portion adjacent said trip member, a second latch lever securing said first latch lever, a spring connecting said latch levers biasing said second lever to secure said first lever and biasing said first lever to release said trip member, means responsive to the current through said switch contacts for actuating said second latch lever in opposition to said spring thereby to release said trip member, said portion of said first latch lever moving toward said trip member, and means operated by said manually-operated means for engaging said trip member to return it to its latched position, said trip member then engaging said first latch lever to move it to a position to be held by said second lever.

3. A circuit breaker comprising cooperating switch contacts, a switch arm for moving one of said contacts, overcenter spring operating means including a manually-operated member for moving said switch arm between open and closed circuit positions with a snap action, a trip arm for actuating said operating means, means biasing said trip arm to move said switch arm to its open circuit position, a latch lever having one end overlapping and securing one end of said trip arm and its other end extending adjacent said trip arm, a second latch lever having one end overlapping and securing said other end of said first latch lever, a spring connecting said latch levers and biasing said second lever to secure said first lever and said first lever to release said trip arm, means responsive to the current through said switch contacts for actuating said second latch lever against said spring thereby to release said trip arm, said other end of said first latch lever moving toward said trip arm, and means actuated by said manually-operated means for engaging and returning said trip arm to its latched position, said trip arm engaging said first latch lever to move it to a position to be held by said second latch lever.

4. A circuit breaker comprising a base made of electrically insulating material provided with a chamber extending through said base from the top to the bottom thereof, a switch member secured to said base, electrically conducting members secured to said base forming supports at least one of which extends into said chamber and at least one of which is electrically connected to said switch member, electric heating means in said chamber having its terminals secured to said supports in electrically conducting relation therewith whereby said heater is supported in said chamber, a temperature responsive operating means in said chamber secured to one of said supports in heat transfer relation with said electric heating means, and means operated by said temperature responsive means for moving said switch member to its open circuit position.

5. A circuit breaker comprising a base made of electrically insulating material provided with a chamber extending through said base from the top to the bottom thereof, a switch member secured to said base, electrically conducting members secured to said base forming supports, electric heating means in said chamber having its terminals secured to said supports in electrically conducting relation therewith whereby said heater is supported in said chamber, thermostatic operating means in said chamber in heat transfer relation with said electric heating means, said thermostatic operating means comprising two substantially parallel bimetallic bars on opposite sides of said heating means, a member securing together two adjacent ends of said thermostatic bars, a second non-thermostatic member secured to the other end of one of said thermostatic bars and connected to one of said supporting members, the other end of the other of said bars forming the free end of said operating means, said thermostatic bars being arranged so that their free ends tend to move in opposite directions in response to a change in temperature whereby the flexure of said thermostats is cumulative in the movement of the free end of said operating means, and means actuated by said free end for moving said switch member to its open circuit position.

6. A circuit breaker comprising a base made of electrically insulating material provided with a recess in the bottom and a chamber extending through said base from the top to the bottom thereof and communicating with said recess, an electrically conducting support secured to the top of said base having one inner end adjacent said chamber, switching means in said recess,

a second electrically conducting support extending through said chamber having one end in said recess secured to said base and electrically connected to said switching means and having its other inner end in spaced relation with the inner end of said first support, electric heating means in said chamber detachably connected to the ends of said supports so as to be removable from the top of said base, temperature responsive operating means in said chamber detachably secured to said second support in heat transfer relation with said electric heating means and removable from the top of said base, operating means biased to move said switching means to its open circuit position, and means normally securing said operating means but actuated by said temperature responsive means to release said operating means in response to a predetermined current through said heating means.

7. A circuit breaker comprising a base made of electrically insulating material provided with a recess in the bottom and a chamber extending through said base from the top to the bottom thereof and communicating with said recess, an electrically conducting support secured to the top of said base having one inner end adjacent said chamber, switching means in said recess, a second electrically conducting support extending through said chamber having one end in said recess secured to said base and electrically connected to said switching means and having its other inner end extending into said chamber, a third electrically conducting support in said chamber having one end secured to the inner end of said second support and its other end in spaced relation with the inner end of said first support, electric heating means in said chamber detachably connected to the ends of said first and third supports so as to be removable from the top of said base, temperature responsive operating means in said chamber detachably secured between said second and third supports in heat transfer relation with said electric heating means and removable from the top of said base, operating means biased to move said switching means to its open circuit position, and means normally securing said operating means but actuated by said temperature responsive means to release said operating means in response to a predetermined current through said heating means.

8. A circuit breaker comprising a base made of electrically insulating material provided with a recess in the bottom and a chamber extending through said base from the top to the bottom thereof and communicating with said recess, an electric conductor, means cooperating with said conductor for securing said conductor to the top of said base with an outer end adjacent one end of said base and an inner end adjacent said chamber, a spring switch arm in said recess having one end secured to said base, a second electric conductor having one end secured to said base in electrically conducting relation to said switch arm, said second conductor extending into said chamber with its other inner end in spaced relation with the inner end of said first conductor, a heating resistance having its ends connected to the inner ends of said conductors, temperature responsive operating means in close proximity with said heating resistance, operating means biased to move said switch arm to its open circuit position, and means normally securing said operating means but actuated by said temperature responsive means to release said operating means in response to a predetermined current through said resistance.

9. A circuit breaker comprising a base made of electrically insulating material provided with a recess in the bottom and a chamber extending through said base from the top to the bottom thereof and communicating with said recess, an electric conductor, means cooperating with said conductor at an intermediate point thereof for securing said conductor to the top of said base with an outer end adjacent one end of said base and its other inner end projecting over said chamber, terminal connecting means on said outer end of said conductor, a spring switch arm in said recess having one end secured to said base, a second electrical conductor having one end clamped between said switch arm and said base whereby said conductor is secured to said base and electrically connected to said switch arm, said second conductor extending into said chamber with its other inner end in closely spaced relation with the inner end of said first conductor, a heating resistance in said chamber having its ends detachably connected to the inner ends of said conductors, so as to be supported by said conductors and removable from the top of said base, temperature responsive operating means in said chamber in close proximity with said heating resistance, said temperature responsive means being detachably secured to said second conductor and removable from the top of said base, operating means on the exterior of said chamber biased to move said switch arm to its open circuit position, and means normally securing said operating means but actuated by said temperature responsive means to release said operating means in response to a predetermined current through said resistance.

10. A circuit breaker comprising a base made of electrically insulating material, an electric conductor, means cooperating with said conductor for securing said conductor to said base with an outer end adjacent one end of said base, terminal connecting means on said outer end of said conductor, a switch arm having one end secured to said base, a second electric conductor having one end secured to said base and electrically connected to said switch arm with its other inner end extending in spaced relation with the inner end of said first conductor, electric heating means connected to the inner ends of said conductors, temperature responsive operating means in heat transfer relation with said heating means, operating means biased to move said switch arm to its open circuit position, and means normally securing said operating means but actuated by said temperature responsive means to release said operating means in response to a predetermined current through said heating means.

11. A circuit breaker comprising a base made of electrically insulating material, an electric conductor, means cooperating with said conductor at an intermediate point thereof for securing said conductor to said base with an outer end adjacent one end of said base, terminal connecting means on said outer end of said conductor, a spring switch arm having one end secured to said base, a second electric conductor having one end clamped between said switch arm and said base whereby said conductor is secured to said base with its other inner end extending in spaced relation with the inner end of said first conductor, a heating resistance connected to the inner

ends of said conductors, temperature responsive operating means in heat transfer relation with said heating resistance, operating means biased to move said switch arm to it open circuit position, and trip mechanism normally securing said operating means but actuated by said temperature responsive means to release said operating means in response to a predetermined current through said resistance.

12. A circuit breaker comprising a base made of electrically insulating material, an electrically conducting strap, means cooperating with said strap at an intermediate point thereof for securing said strap to said base with an outer end adjacent one end of said base, terminal connecting means on said outer end of said strap, a spring switch arm having one end secured to said base, a second electrically conducting strap having one end clamped between said switch arm and said base whereby said strap is secured to said base and electrically connected to said switch arm, said base being provided with a chamber into which said second strap extends with its other inner end in closely spaced relation with the inner end of said first strap, a heating resistance having its ends connected to the inner ends of said straps, a bimetallic thermostat secured to said second strap in close proximity with said heating resistance, manually operated means for moving said switch arm between open and closed circuit positions, a second operating means biased to move said switch arm to its open circuit position, and an electrically insulating trip mechanism normally securing said second operating means but engaged and moved by said thermostat to release said second operating means in response to a predetermined current through said resistance.

13. A circuit breaker comprising a base made of electrically insulating material, an electrically conducting strap, means cooperating with said strap at an intermediate point thereof for securing said strap to said base with an outer end adjacent one end of said base, terminal connecting means on said outer end of said strap, a spring switch arm having one end secured to said base, a second electrically conducting strap having one end clamped between said switch arm and said base whereby said strap is secured to said base and electrically connected to said switch arm, said base being provided with a chamber into which said second strap extends, a third electrically conducting strap having one end secured to said second strap and supported thereby in said chamber with its other inner end extending in closely spaced relation with the inner end of said first strap, a heating resistance having its ends connected to the inner ends of said first and third straps, a bimetallic thermostat secured to said third strap in close proximity with said heating resistance, manually operated means for moving said switch arm between open and closed circuit positions, a second operating means biased to move said switch arm to its open circuit position, and an electrically insulating trip lever mechanism normally securing said second operating means but engaged and moved by said thermostat to release said second operating means in response to a predetermined current through said resistance.

14. A circuit breaker comprising a base made of electrically insulating material provided with a recess in the bottom and a chamber extending through said base from the top to the bottom thereof and communicating with said recess, an electric conductor, means cooperating with said conductor for securing said conductor to the top of said base with an inner end adjacent said chamber, a switch member in said recess secured to said base, a second electric conductor having one end secured to said base in said recess electrically connected to said switch member, said second conductor extending into said chamber with its other inner end in spaced relation with the inner end of said first conductor, a manually operated member for moving said switch member between open and closed circuit positions, a trip member biased to move said switch member to its open circuit position, a latch member securing said trip member, electric heating means in said chamber connected to the inner ends of said conductors, and temperture responsive operating means in said chamber in heat transfer relation with said heating resistance for actuating said second latch member against said spring thereby to release said trip member.

15. A circuit breaker comprising a base made of electrically insulating material provided with a recess in the bottom and a chamber extending through said base from the top to the bottom thereof and communicating with said recess, an electric conductor, means cooperating with said conductor for securing said conductor to the top of said base with an outer end adjacent one end of said base, terminal connecting means on said outer end of said conductor, a spring switch arm in said recess having one end secured to said base, a second electric conductor having one end clamped between said switch arm and said base whereby said conductor is secured to said base and electrically connected to said switch arm, said second conductor extending into said chamber with its inner end extending in closely spaced relation with the inner end of said first conductor, a manually operated member for moving said switch arm between open and closed circuit positions, a trip member biased to move said switch member to its open circuit position, a latch member securing said trip member, a heating resistance connected to the inner ends of said conductors, and temperature responsive operating means in heat transfer relation with said heating resistance for actuating said latch member to release said trip member.

16. A circuit breaker comprising a base made of electrically insulating material provided with a recess in the bottom and a chamber extending through said base from the top to the bottom thereof and communicating with said recess, an electric conductor, means cooperating with said conductor at an intermediate point thereof for securing said conductor to the top of said base with an outer end adjacent one end of said base, terminal connecting means on said outer end of said conductor, a spring switch arm in said recess having one end secured to said base, a second electric conductor having one end clamped between said switch arm and said base whereby said conductor is secured to said base and electrically connecetd to said switch arm, said second conductor extending into said chamber with its inner end extending in closely spaced relation with the inner end of said first conductor, a manually operated member for moving said switch arm between open and closed circuit positions, a trip member biased to move

said switch arm to its open circuit position, a latch member securing said trip member, a second latch member securing said first latch member, a spring connecting said latch members and biasing said second member to secure said first member and biasing said first member to release said trip member, a heating resistance connected to the inner ends of said conductors, and temperature responsive operating means in heat transfer relation with said heating resistance for actuating said second latch member against said spring thereby to release said trip member.

17. In combination, a movable member, an arm, a handle member provided with a recess for a movable end of said arm, a pair of projections on said handle on opposite sides of said arm, said projections being provided with apertures and said arm being provided with an aperture registering with the apertures in said projections, said projections being provided with slots communicating with said apertures in said projections, a pin extending through said apertures for securing said handle to said arm, said pin being provided with a plurality of sections of reduced cross section to pass through said slots whereby said pin may be moved longitudinally to provide for removal of said handle, and spring operating means for said movable member connected to said pin.

18. A circuit breaker mechanism comprising a switch member, an arm, a handle member made of insulating material provided with a recess for a movable end of said arm, a pair of projections on said handle on opposite sides of said arm, said projections being provided with apertures and said arm being provided with an aperture registering with the apertures in said projections, said projections being provided with slots extending lengthwise of said arm and communicating with said apertures in said projections, a pin extending through said apertures for securing said handle to said arm, said pin being provided with sections of reduced cross section to pass through said slots whereby said pin may be moved longitudinally to provide for removal of said handle, and spring operating means for said switch member connected to said pin.

19. In combination, a movable member, an operating member, a handle member provided with a recess for an end of said operating member, a pair of projections on said handle on opposite sides of said operating member, said projections being provided with apertures and said operating member being provided with an aperture registering with the apertures in said projections, said projections being provided with slots communicating with said apertures in said projections, a pin extending through said apertures in said operating member and said projections for securing said handle to said operating member, said pin being provided with at least three sections of reduced cross section, two of said sections registering with said slots when said pin is in one longitudinal position to provide for the removal of said handle from said operating member, and the third of said sections registering with said aperture in said operating member when said pin is in another longitudinal position so as to secure said pin against longitudinal movement, and spring operating means for said movable member connected to said pin.

20. In combination, a movable member, an arm, a handle member provided with a recess for a movable end of said arm, a pair of projections on said handle on opposite sides of said arm, said projections being provided with apertures and said arm being provided with an aperture registering with the apertures in said projections, said projections being provided with slots extending lengthwise of said arm and communicating with said apertures in said projections, a pin extending through said apertures in said arm and projections for securing said handle to said arm, said pin being provided with at least three sections of reduced cross section, two of said sections registering with said slots when said pin is in one longitudinal position to provide for the removal of said handle, and the third of said sections registering with said aperture in said arm when said pin is in another longitudinal position so as to secure said pin against longitudinal movement, and spring operating means for said movable member connected to said pin.

21. A circuit breaker comprising a switch member, means for operating said switch member between closed and open circuit positions including an operating member, spring means biasing said operating member to move said switch member to its open circuit position, a first latch member normally securing said operating member against the bias of said spring means, a second latch member normally securing said first latch member, a spring having its ends connected to said first and second latch members so as to bias said second latch member to a position to secure said first latch member and bias said first latch member to a position to release said operating member, and means for actuating said second latch member in opposition to said spring thereby to release said first latch member.

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