May 19, 1942. J. G. JACKSON 2,283,736

CIRCUIT BREAKER

Filed Nov. 3, 1938 3 Sheets-Sheet 1

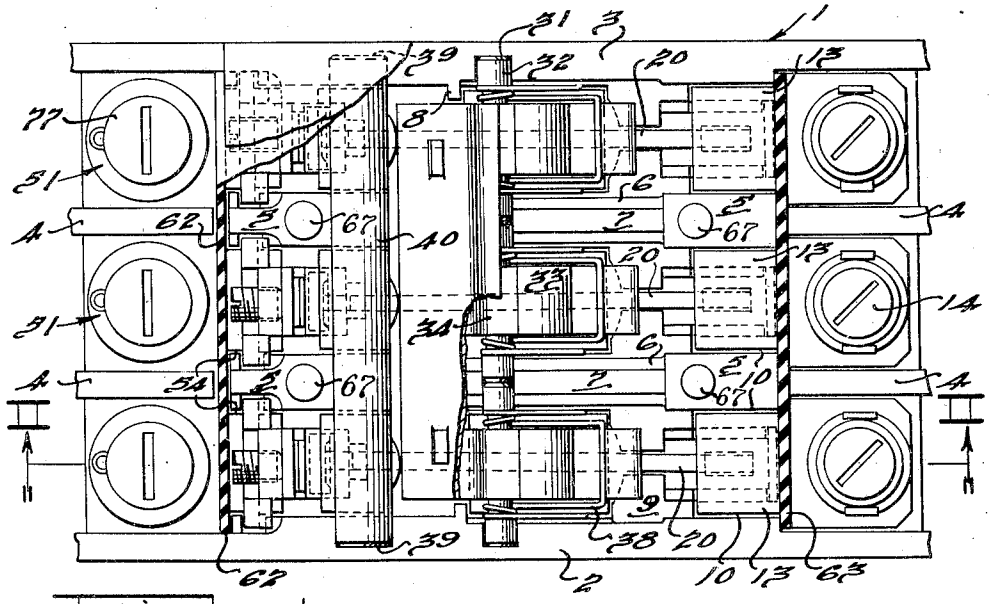


Fig. 1.

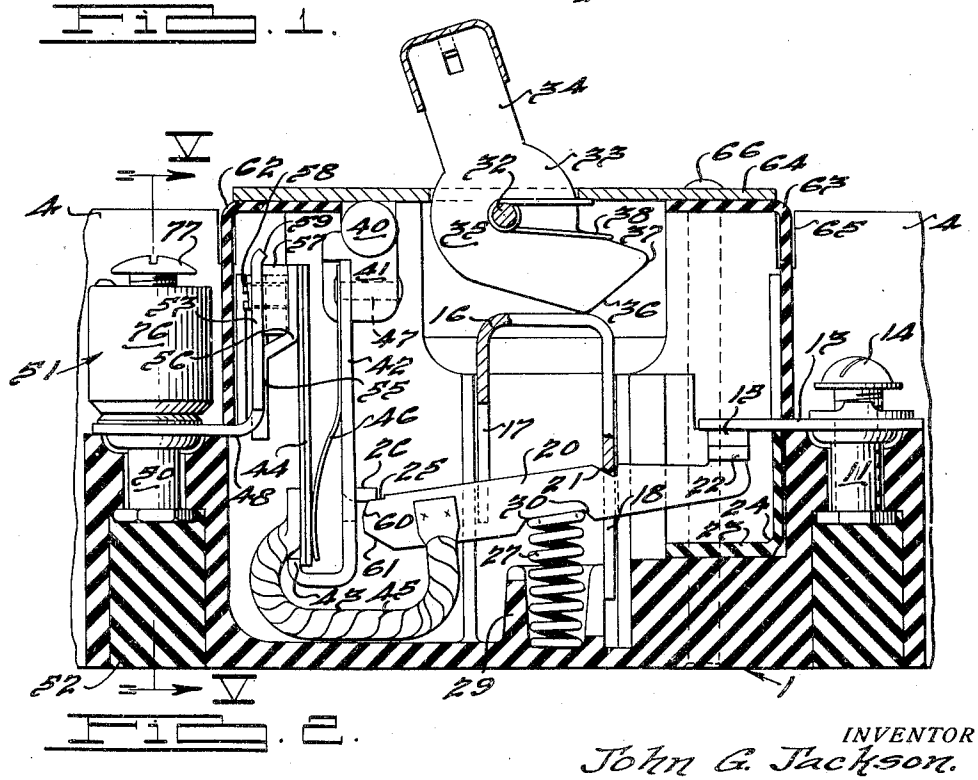


Fig. 2.

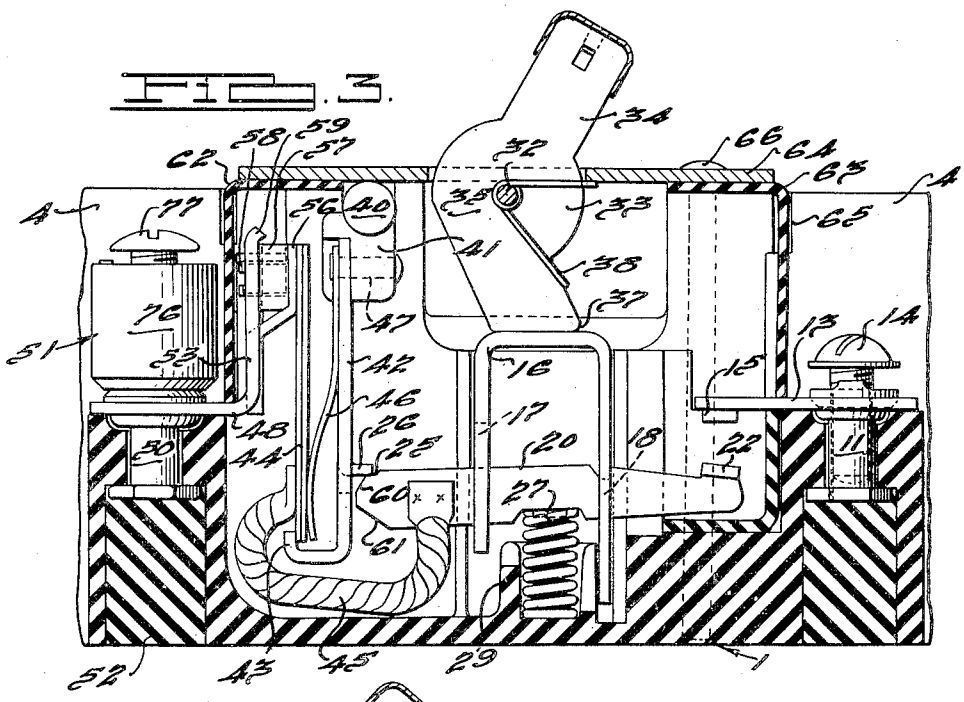
INVENTOR
John G. Jackson.
BY Myron J. Seibold
ATTORNEY

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CIRCUIT BREAKER

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FIG. 3.



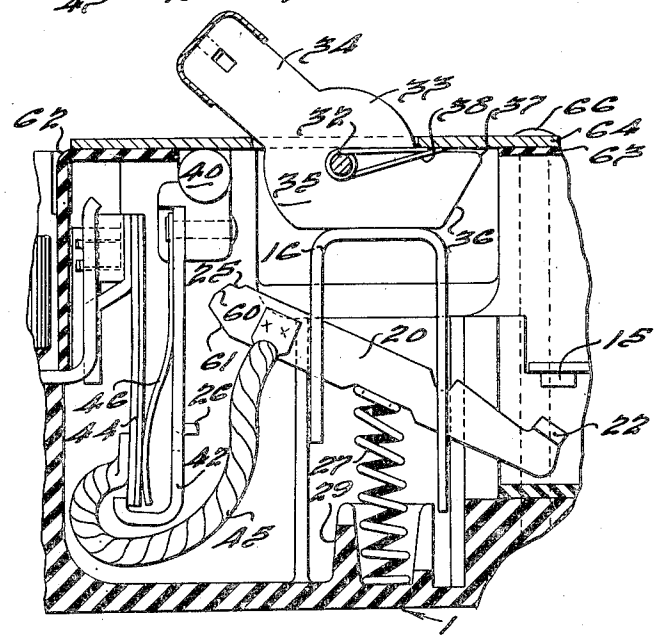


FIG. 4.

INVENTOR
John G. Jackson.
BY Myron J. Seibold
ATTORNEY

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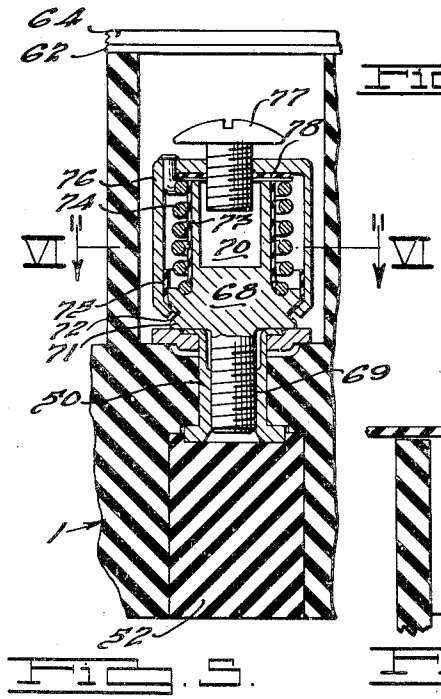


Fig. 5.

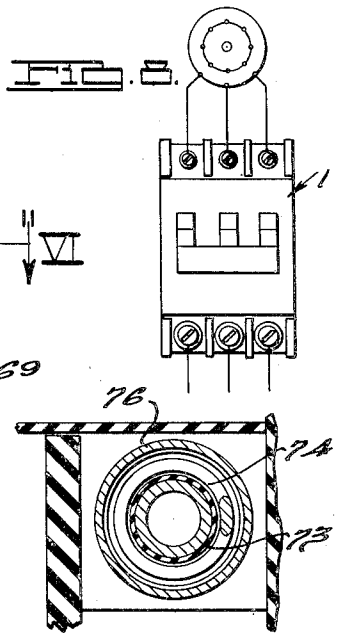


Fig. 6.

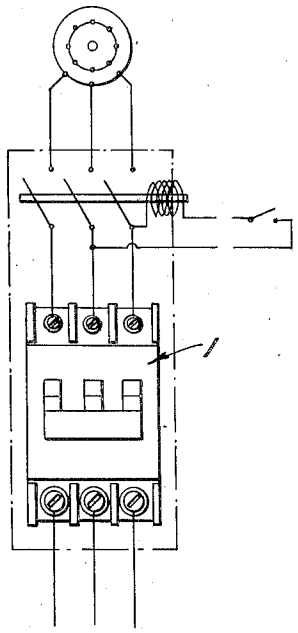


Fig. 9.

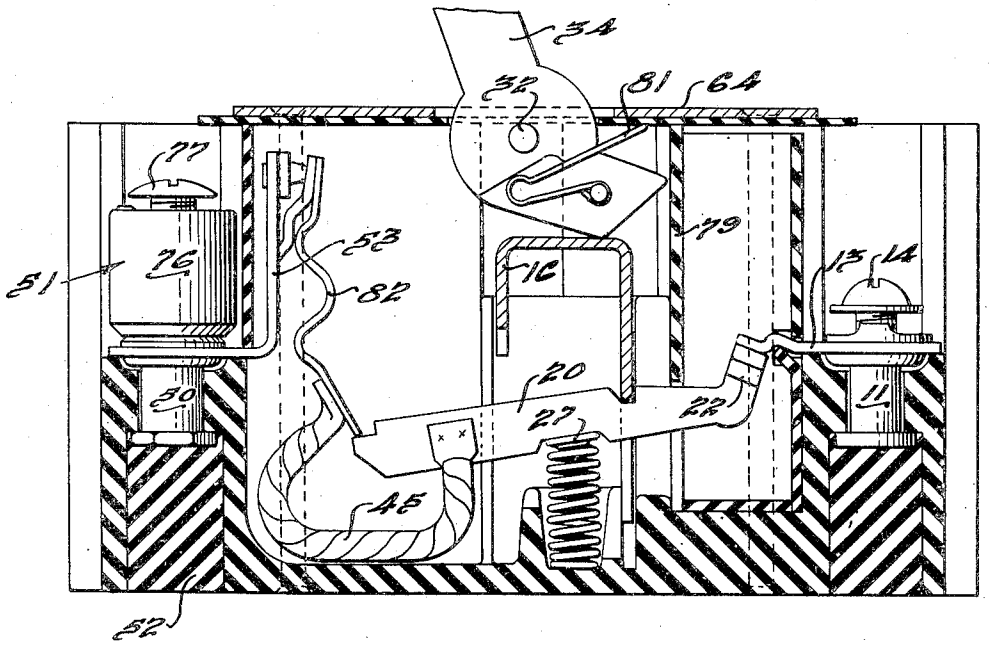


Fig. 7.

INVENTOR
John G. Jackson.
BY Myron J. Seibold
ATTORNEY

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UNITED STATES PATENT OFFICE

2,283,736

CIRCUIT BREAKER

John G. Jackson, Detroit, Mich., assignor to Square D Company, Detroit, Mich., a corporation of Michigan

Application November 3, 1938, Serial No. 238,604

17 Claims. (Cl. 200—122)

This invention relates to electric circuit controlling instrumentalities and more particularly to automatic electric circuit breakers adapted for the protection of motors from overloads.

One object of the invention is to provide a device for changing the trip time characteristic of an automatic circuit breaker.

Another object of the invention is to provide a device for tripping an automatic circuit breaker at a predetermined motor overload.

Another object of the invention is to provide an automatic electric circuit breaker having a cover sealably secured thereto and having interchangeable means at the exterior of its sealed enclosure for changing the current rating at which the breaker will automatically trip.

Another object of the invention is to provide an automatic electric circuit breaker bearing a certain current and/or time rating characteristic with means interchangeably mounted at an exterior terminal of the circuit breaker to decrease the tripping current rating thereof.

Another object of the invention is to provide readily interchangeable means for effecting tripping of an automatic electric circuit breaker at predetermined motor overloads, said means being adapted to engage a terminal means at the exterior of the circuit breaker.

Another object of the invention is to provide a unitary element including a series resistor for adjusting the trip rating characteristic of an automatic electric circuit breaker and adapted to be secured to an exterior terminal thereof.

Another object of the invention is to provide a series resistance element for varying the current and/or time rating characteristic of an automatic electric circuit breaker and adapted to be supported by an exterior terminal thereof and having a means thereon for the attachment of circuit wiring.

Further objects and features of the invention will be readily apparent to those skilled in the art from the following specifications and the drawings illustrating certain embodiments of the invention in which:

Figure 1 is a top plan view of the circuit breaker according to the present invention with a major portion of the top cover broken away to show internal parts.

Figure 2 is a vertical sectional view of the circuit breaker according to the present invention taken along the line II—II of Figure 1.

Figure 3 is a view similar to Figure 2 showing the parts in manual "off" position.

Figure 4 is a view similar to Figure 2 showing the parts in automatic trip position.

Figure 5 is a sectional view taken along the line V—V of Figure 2.

Figure 6 is a sectional view taken along the line VI—VI of Figure 5.

Figure 7 is a vertical sectional view of a modified form of the invention.

Figure 8 is a schematic diagram of the connection of the device according to the present invention to directly control the circuit of the motor.

Figure 9 is a schematic diagram of an additional feature of applicant's invention wherein the circuit breaker motor overload protection device is combined with a remotely controlled magnetic switch to control the motor circuit.

The circuit breaker comprises an insulating base 1 of "Bakelite" or other material having side walls 2 and 3 and end flanges 4 serving as barriers between the separate terminals and extending to the full height of the circuit breaker. Within the breakers are portions 5 in line with the barriers 4, serving as barriers between the poles and for support of the cover portion and which also extend to the full height of the breaker. In line with the barriers 5 and integral therewith but extending for only a portion of the height of the breaker to provide an opening for an operating member to be hereinafter described are further barrier portions 6 having ribs 7 to increase the leakage paths between the parts of opposite polarity within the breaker. By the barrier portions 5 and 6 the interior of the breaker is divided into three portions having common openings above the rib 7.

The side walls and barriers 6 are provided with pairs of guiding projections 8 and 9 and with reduced ledge portions 10 adjacent one end. At this end, the exterior of the breaker between the barriers 4 may be provided with ledges for the support of terminal connectors which may comprise interior metallic sleeves 11 having their tops spun over depressed portions in connectors 13 which extend within the interior of the breaker and are there supported upon the ledges 10. Terminal studs 14 may be threaded into the sleeves 11 for attachment of circuit conductors. To the interior lower surfaces of the connectors 13 are brazed or otherwise attached the stationary contacts 15.

Between the guiding projections 8 and 9 are disposed elements 16 which are generally U-shaped in cross section and having a flat top surface. The legs of the U are of varying lengths

as shown and are provided with central slots 17 and 18 aligned with their respective stationary contacts 15 and have a substantially equal depth so that their ends rest at different levels in view of the variation of the length of the legs. Within the slots 17 and 18 are disposed rigid conducting contact bars 20 provided with notches 21 in their top edges which receive the ends of slots 18 and are maintained thereby in proper relation to the other working parts. The ends of the bars 20 adjacent to the stationary contacts 15 are provided with contact tips 22 adapted to cooperate therewith to close the circuit through the breaker. The arc chambers surrounding the contacts 15 and 22 are preferably provided with liners 23 of fibre or other material which may be formed from a sheet notched as at 24 and then bent to the rectangular shape shown fitting within the chambers. The ends of the bars 20 remote from the contact tips 22 are provided with latching surfaces 25 adapted to cooperate with latching portions 26 supported on a movable structure to be hereinafter described in detail.

Heavy compression springs 27 are guided within small cup portions 29 integral with the bottom of the base 1 and are received within notches 30 in the bottom edges of the bars 20 and bias the bars upwardly against the stationary contacts 15 and the latching portions 26.

The side walls 2 and 3 at their top are provided with grooves 31 receiving a shaft 32 carrying manual operating members 33 each having an exterior handle 34 projecting through the top of the breaker and each with an interior portion comprising a cam surface 35 disposed above the top face of the element 16. The cam surface 35 includes a flat portion 36 forming a stable support for the manual "off" position of the breaker and a resetting tip 37 to be hereinafter explained.

A spring 38 biases the handle for rotation in a clockwise direction as shown and hence maintains cam surface 35 in contact with the top face of the member 16; spring 38 likewise biasing the member 16 firmly within the notches 21 in the bars 20. The purpose of maintaining the cam surface against the member 16 is to provide an "on" position for the operating handle which shall be different from the overload trip position as will be hereinafter explained. Above the latching end of the bars 20, the side walls 2 and 3, and the barriers 5, are provided with grooves 39 serving as bearings for a shaft 40 having integrally depending portions 41 disposed between the side walls 2 and 3 and the barrier portions 5. To the depending portions 41 are rigidly secured generally L-shaped elements 42 from the surface of which the latching portions 26 are pressed. The bases of the L-shaped members 42 are provided with upstanding flanges 43 engageable by bimetallic members 44 as they become heated to move the members 42 to an unlatching position where the latching portions 26 are disengaged from the latching surfaces 25 on the bars 20. A flexible lead 45 interconnects the free end of each of the bimetals 44 and its corresponding bar 20 and may be rigidly conductingly secured thereto by brazing or in any other manner. Leaf springs 46 attached to the members 42, as for instance, by means of a rivet 47 which secures the member 42 to the depending portions 41 on the shaft 40 are disposed against the faces of the bimetallic members 44 and bias the members 42 in a counterclockwise direction with respect to the bimetallic members 44.

The support and adjusting means for the bimetallic members 44 will now be described. Between the barriers 4 on the exterior of the breaker, at the left hand end as shown, are supported connectors 48 which are rigidly secured in place by having depressed portions into which are spun the tops of metallic inserts 50. Above the connectors 48 are disposed resistor buttons 51 to be hereinafter described in detail. The openings in the bottom of the base 1 through which the inserts 11 and 50 are inserted are preferably closed as by insulating wax as at 52. The connectors 48 extend into the interior of the breaker and are there bent at right angles to provide vertical portions 53. The connectors 48 are notched as at 54 to clear the projecting portions on the barriers between the breaker poles and the vertical portions 53 are slidably disposed in vertical notches 55 in the barriers and side walls of the breaker. The central portions of the vertical portions 53 of the connector are pressed out as at 56 and to these portions are rigidly welded or brazed the fixed ends of the bimetallic members 44. Between the vertical portions 53 and the pressed out portions 56 are disposed bridging blocks 57 into which may be threaded adjusting screws 58. The tops of the vertical portions 53 are preferably bent over as at 59 to maintain the blocks in place. These blocks may be loosely disposed between the portions 53 and 56 and are prevented from vertical removal by the bent over portions 59 and from sidewise removal by engagement with the barrier walls. Due to the notches 54 and the slots 55 each connector and bimetal assembly may be readily slid into place and securely held by the spinning of the inserts 50 within the depressed portions of the connectors.

The ends of the bars 20 adjacent the latching surfaces 25 are provided with inclined surfaces 60 and 61. The surfaces 60 are provided to cause further opening movement of the latching members 42 upon release of any one of the bars 20. Due to the inclined portion 60, when one bar is released the action of this surface upon the corresponding latching portion 26 will cause a further movement of all the latching members 42 and insure that all the bars will be released upon the release of any one of them and will, therefore, insure that all the poles of the breaker will be opened if there is an overload upon any one of them. The inclined surfaces 61 provide ease in resetting of the bars as they will easily slide over the latching portions 26. In enclosing the breaker parts within the interior, the ends are closed by means of two fibre sheets 62 and 63 which are bent at right angles and have one leg disposed beneath the metallic cover 64 and the other leg disposed vertically at the ends of the breaker. Between the barriers 4 and 5 are provided notches 65 into which the vertical legs of the sheet 63 extend and which serve to securely hold them in vertical position. These sheets may in turn be provided with slots receiving the barriers 4 below the notches 65 therein. The sheets are maintained in place by the cover 64 which is in turn sealably secured to the base 1 by means of rivets 66 extending through openings 67 in the insulating barriers 5. The sheets 62 and 63 are thick enough to be rigid and when in place serve to seal the mechanism of the breaker from access from the exterior.

The resistor button 51 disposed at the left hand end of the breaker between the barriers 4 and above the connectors 50 is formed of a

supporting element 68 having one extremity 69 threaded and having the other extremity provided with an opening 70. A collar 71 is disposed generally midway upon the element 68 and is notched as at 72. A mica tubing 73 is disposed about the upper extremity of element 68 and a coil 74 is wound thereupon. Another mica tubing 75 encircles the lower extremity of the coil 74 and extends to the notch 72. Enclosing the whole of the upper extremity of element 68 is a cap 76 having a threaded opening in the top thereof to receive the stud 77 and provided with a smaller opening within which the upper extremity of the coil 74 is secured. The cap 76 extends to the notch 72 of the collar 71 and both the cap and the mica tubing 75 are crimped at their lower extremities to provide a sealed rigid attachment to the element 68. A mica cover 78 is disposed above the resistor wire 74 and beneath the under surface of the top of the cap 76, said mica cover having openings therein to permit the passage therethrough of the wire 74 and the stud 77, the stud 77 forming a terminal for the reception of circuit wiring. For the better retention of heat by the resistor button 51, heat insulating material is disposed in the space between the coil 74 and the inner surface of the cap 76. The resistor button is rigidly secured to the breaker by its threaded extremity and the metallic insert 58.

The operation of the circuit breaker will now be described. In the position shown in Figure 2, the parts are in their normal or circuit closed position. In this position the current path through each pole of the breaker is from the connector 48 through the portion 53 thereof to the bimetal 44, from the free end of the bimetal through the flexible lead 45 to the contact bar 20 and thence through the contacts 15 and 22 to the opposite connector 13. If it is desired to manually open the contacts to open the circuit through the breaker, the operating handle 34 is rotated clockwise, as shown, into the position shown in Figure 3, with the flat part 36 of the cam surface 35 in engagement with the top flat surface of the member 16. As the center of rotation of the operating member is now within the engagement of the flat portion 36 with the member 16, this is a stable position which will be maintained by the parts. In this position, the members 16 have been moved toward the bottom of the circuit breaker compressing the spring 27 and moving the contact tip 22 away from the stationary contact 15 into the position shown. In this movement the bars 20 have rotated about their engagement with the latching portions 26 on the member 42. To place the parts again in closed circuit position, the handle is rotated counter-clockwise from its position in Figure 3 to the position in Figure 2 and the contacts are moved into engagement by the force exerted by the springs 27.

If, while in the closed circuit position of Figure 2, an overload should occur through any pole of the breaker, the corresponding bimetal will become heated and will warp in a clockwise direction as shown in Figure 4, whereupon the free end thereof by its engagement with its cooperating portion 43 will rotate the members 42 clockwise, thus moving the latching portions 26 away from the latching surfaces 25 on the bars 20. When a latching portion 26 reaches the edge of a latching surface 25 on any of the bars 20, that bar will be snapped to the position shown in Figure 4 and by the engagement of its surface 60 with the latching portion 26 will further move the member 42 clockwise and insure that the other bars will also be released and moved to the same position. In moving to this position, the bars, under the bias of the compression springs 27, rotate about the engagement of the notches 21 with the top of the slots 18 and their latching ends move upwardly until the top edges of the bars engage the tops of the slots 17 in the left hand legs of the member 16 as shown in Figure 4. The parts are so related that in the closed circuit position of Figure 2 the handle 34 will be in the position shown due to the bias of the spring 38 pressing against members 16. As the springs 27 are very much stronger than the spring 38, when the bars are released on overload, the members 16 will move upwardly under their bias until the interior portion of the manual operator engages the underside of the cover as shown in Figure 4, thus rotating the handle in a counter-clockwise direction and indicating the tripped condition of the breaker. In the automatic tripping, it is noted that the members 42 are rigidly connected to the depending portions 41 on the shaft 40 and move together as a unit. When only a single one of the bimetals 44 is carrying an overload, it will move as shown in Figure 4. If the other bimetals are not warped the members 42 corresponding thereto will move toward these bimetals compressing their leaf springs 46.

To reset the breaker, after an automatic opening, the handle is rotated clockwise from the position shown in Figure 4. The blades 20 then move in straight lines toward the base until the back edges adjacent to the contact tips 22 engage the bottoms of the arc chambers whereupon further movement of the handle causes the blades 20 to rotate about the pivot formed by the engagement of the notches 21 with the ends of slots 18. As the movement of the handle continues, the inclined surfaces 61 will engage the tops of the latching portions 26 and will move the latches clockwise to permit the latching ends of the bars to pass beyond the latching surfaces. If the bimetal has cooled sufficiently to permit the members 42 to resume their normal position, release of the handle will then cause the latching tips 25 to be engaged with the latching portions 26 to latch the ends of the bars in position.

In the movement to resetting position, it is necessary to move the handle beyond the position shown in Figure 3 so that the tips 37 of the cam surfaces of the members 16 cause a further movement of the members 16 toward the base beyond that shown in Figure 3. When the handle is released after reset, it will rotate in a counter-clockwise direction due to the moving of the members 16 upwardly under the action of the springs 27 until the position of Figure 3 or the manual "off" position is reached. To thereafter move the breaker to closed circuit position, the handle is moved counter-clockwise as from manual "off" position and the parts are moved into engagement by the bias of springs 27.

In the calibrating of the poles of the breaker, adjustment is secured through the adjusting screws 58. By moving these screws inwardly, they press against the portions 56 serving to bend them and change the positions of the free ends of the bimetals, thus regulating the amount of movement that is necessary for each bimetal to release the latching portions 26 from the latching surfaces 25 on the bars 20. When the

breaker poles have been properly calibrated, the screws 58 may be locked by means of a drop of solder or other sealing material and with the fibre sheet 62 in place and the cover 64 sealably attached to the base, access to the interior of the breaker will be prevented so that calibration cannot be tampered with.

The resistor button 51 provides a means for readily lowering the rating of the breaker, and the buttons 51 may be very readily interchanged with others having different values of resistance to secure, if desired, lower rating of the tripping point for the breaker, while it is impossible to raise the original calibration of the breaker by any such means external to it.

In the normal connection of the circuit breaker, as heretofore known, in the art, there is a good conducting path from the bimetal 44 through the connector 48 to the exterior circuit wiring. As the bimetal 44 will, when at or near its tripping temperature, be operating at a much higher temperature than the room temperature, there will ordinarily be a very considerable flow of heat from the bimetal out through the circuit wiring. The cooling effect which this flow of heat has on the bimetal is furthermore most effective at the portion thereof which is mounted on the connector 48, and it is this portion of the bimetal which is most effective in producing movement of the latching end thereof, since any movement at this point will be greatly multiplied in terms of actual transverse movement due to the length of the bimetal between its attached point and its latch releasing portion. Whether the resistor within button 51 will be operating at a higher or lower temperature than the bimetal 44 will depend upon the change in current rating desired in the circuit breaker, and from this upon the value of the resistance within the button and the current flowing therethrough. It can readily be seen that the results obtainable by the present invention in lowering the rating of the bimetal will be attained even though the resistor at the exterior circuit breaker terminal should not be at a higher temperature than the bimetal 44, since any rise in temperature at the terminal will act to inhibit the flow of heat from the bimetal to the circuit wiring by creating a hot spot at the terminal which will lessen the flow of heat from the bimetal. This is obviously true, since the flow of heat from the bimetal to the terminal will be a direct function of the difference of temperature between them. For certain rating change values, it may be that the resistor within the button 51 will be operating at a greater temperature than the bimetal 44, so that there will be an actual flow of heat from the resistor to the bimetal, so that the temperature of the bimetal will not only be increased by the stoppage of flow of heat therefrom, but that there will be an actual input from the bimetal to the resistor. Either of these cases results in the bimetal operating at a higher temperature than previously for a given flow of current and, hence, means that there will be a greater unlatching movement of the bimetal at a given current than heretofore, so that the current at which the bimetal will move sufficiently to unlatch the breaker will be greatly reduced.

With applicant's invention, a standard automatic electric circuit breaker having a rating sufficient to protect the circuit wiring with which it is connected may be readily modified by a resistor element such as at 51 to give to the circuit breaker a lower effective rating suitable for the protection of a motor supplied through the circuit breaker and results in the provision of both short circuit and motor protection in a single device.

It has furthermore been found that with a construction according to applicant's invention that the effective rating of the standard circuit breaker may be so modified by means of the external terminal resistors as to produce a trip time characteristic within the normal requirements for motor protection. That is, with the circuit breaker time current rating characteristic being such as to produce tripping within a time element upon a sustained overload for a given size of motor, that the circuit breaker time lag will be sufficient using the button to carry the starting current load of the motor without tripping out. As an example of this, on a single pole circuit breaker rated at 15 amperes in accordance with the circuit breaker standard of the Underwriters' Laboratories, and having a short circuit capacity sufficient to interrupt the short circuit current of a circuit having a capacity of 5,000 amperes was modified by means of a button 51 so that it would trip ultimately at a current of about 6 amperes which would be suitable for the protection of a ¼ H. P. motor in accordance with the standards of the National Electrical Code. It was further found that this arrangement corresponded to the requirements for motor overload protection in tripping within the limiting times at both 200% and 600% of normal rating and that on actual test it would hold in in ample length of time to permit the motor to start with its heavy inrush current. By using resistances of different values, at the external terminal, it is possible with the same circuit breaker protection to secure any desired motor overload protection up to the rating of the circuit breaker.

Applicant's invention, therefore, provides a very economical means for providing a tamperproof circuit breaker protection with readily interchangeable values of motor overload protection and permits the ready varying of a standard circuit breaker to produce a combination circuit-breaker motor starter having all the necessary characteristics of such a device.

In Figure 7 there has been illustrated a single pole circuit breaker provided with the external resistance for providing the desired motor overload protection and while there are detailed changes in the design of the circuit breaker parts having no bearing on the present invention, as, for example, the change in the mounting of the stationary contact connector 13, the addition of the fibre arc chamber sheet 79, and the change in the handle spring 81, as well as the different manner of connecting the end barrier sheets and the interposition of a further insulating fibre sheet beneath the metal cover, the main difference lies in the bimetallic latch 82 which is shown as corrugated in accordance with the invention described in the claims in the patent to Olav Masing No. 2,122,693, and which directly latches the movable contact bar since, in a single pole, there is no necessity for the use of the latching members 42 in the multipole construction which may be moved in unison by any one of the bimetals.

Figure 8 shows schematically the connection of a circuit breaker and motor overload device according to the present invention to control a motor where direct manual operation of the circuit to start and stop the motor is desired.

Figure 9 is a schematic representation of a

motor starter circuit breaker combination for remote control of the motor circuit in which a remote push button is used to control the operating coil of a magnetic switch to effect opening and closing of the motor circuit. The combination of applicant's improved circuit breaker and motor overload protection device with the magnetic switch is a further inventive conception of the concept of this invention in view of the fact that with the device according to the present invention the magnetic switch is not equipped with overload protection, but the overload protection for the motor is embodied in the combination circuit breaker and overload protective device. In previous arrangements, an overload in the motor had been used to interrupt the energizing current of the magnetic switch to effect opening of the circuit at the contacts of the magnetic switch. In applicant's arrangement, the motor overload current is interrupted by the circuit breaker contacts and the magnetic switch is not equipped with overload means as heretofore provided, so that the magnetic switch is called upon to interrupt only the normal current of the motor while overload currents, as well as short circuit currents, are interrupted by the circuit breaker mechanism.

While the construction of the particular circuit breaker illustrated in the drawings has been specifically described in accordance with the patent statutes, it is understood that applicant's invention is equally applicable to any thermal circuit breaker wherein it will have the effect of modifying the normal current-temperature characteristic of the thermal current responsive element. While applicant's invention is entirely independent of any particular circuit breaker mechanism, it will, however, have its greatest effect in a thermal breaker where the thermal element is closely associated with the exterior terminal so that the exterior resistance will have its greatest effect upon the thermal element within the circuit breaker interior.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What is claimed is:

1. In an automatic electric circuit breaker, relatively movable contacts, current responsive means for effecting separation of said contacts, when the current exceeds a predetermined value for a predetermined period of time, and means for lowering the value of current at which said current responsive means will operate to effect said separation, including a readily interchangeable resistance unit connected in series circuit with the current responsive means, said resistance unit being insulated from relative heat transfer with respect to said current responsive means except by conduction through said series connection.

2. In combination, relatively movable contacts, serially connected, current responsive, thermal means for effecting separation of said contacts when the current exceeds a predetermined value for a predetermined period of time, and readily interchangeable auxiliary resistance means connected in series circuit with said thermal means and adapted to be heated by the current flowing through the contacts and current responsive means, to supply an additional increment of heat to the current responsive means, said resistance means being connected with said thermal means in electrical and heat conducting relation and being so disposed with respect to said thermal means as to transmit heat thereto by conduction alone.

3. In combination, relatively movable contacts, serially connected, current responsive means for effecting separation of said contacts when the current exceeds a predetermined value for a predetermined period of time, and resistance means interposed between said current responsive means and circuit wiring electrically connected thereto and adapted to be heated by the flow of current through the contacts and current responsive means, said contacts and current responsive means being mounted within a sealable enclosure preventing access thereto and said resistance means being readily interchangeably mounted at the exterior of said enclosure.

4. In an automatic electric circuit breaker, a sealable enclosure having relatively movable contacts and current responsive means for effecting separation of said contacts sealed within said enclosure from outside access, said means effecting said separation when the current exceeds a predetermined value for a predetermined period of time, and a resistance element readily interchangeably mounted at the exterior of said enclosure in series circuit with said current responsive means for lowering the value of current at which said current responsive means effects said separation.

5. In an automatic electric circuit breaker, a sealable enclosure, stationary and movable contacts and current responsive means for effecting separation of said contacts mounted within said enclosure, manually operable means for effecting separation of said contacts and for resetting said circuit breaker mechanism after an automatic contact separation, including an operating handle extending to the exterior of the enclosure, and a resistance unit readily interchangeably mounted at the exterior of the enclosure and connected in series circuit with the current responsive means to lower the value of current at which said current responsive means becomes effective to effect such separation.

6. In an automatic electric circuit breaker, a sealable enclosure, relatively movable contacts and current responsive means for effecting separation of said contacts mounted within said enclosure and sealed from outside access, a terminal for said circuit breaker mounted at the exterior of said enclosure and connected to said current responsive means in electrical and heat conducting relation therewith, and a readily interchangeable resistance unit mounted on said terminal at the exterior of the enclosure and heated by the passage of current therethrough to lower the value of current at which said current responsive means effects such separation.

7. In an automatic electric circuit breaker, a sealable enclosure, relatively movable contacts and current responsive means for effecting separation of said contacts mounted within said enclosure and sealed from outside access, a terminal for said circuit breaker mounted at the exterior of said enclosure and connected to said current responsive means in electrical and heat conducting relation therewith, and a readily interchangeable resistance means directly mounted upon said terminal and having a further terminal thereon for the reception of circuit wires to be connected to the circuit breaker, said resist-

ance being heated by the passage of current therethrough to lower the value of current at which said current responsive means will effect such separation.

8. In an automatic electric circuit breaker, separable contacts, serially connected, current responsive, thermal means for effecting separation of said contacts when the current therethrough exceeds a predetermined value for a predetermined period of time, a terminal for said circuit breaker in electrical and heat conducting relation with said current responsive means, and a resistance unit mounted directly on said terminal by a threaded screw connection therebetween, and having disposed on said unit auxiliary terminal means adapted for the connection of exterior circuit wiring.

9. In an automatic electric circuit breaker, separable contacts, serially connected, current responsive, thermal means for effecting separation of said contacts when the current therethrough exceeds a predetermined value for a predetermined period of time, a terminal for said circuit breaker in electrical and heat conducting relation with said current responsive means, an opening through said terminal, a resistance unit mounted on said terminal by an element threaded into said opening, and auxiliary terminal means on said resistance unit adapted for the connection of exterior circuit wiring.

10. In a multipole electric circuit breaker, a plurality of sets of relatively movable contacts, a plurality of current responsive thermal means connected in series with said sets of contacts, means cooperating with said current responsive thermal means for effecting separation of all of said sets of contacts when the current through any one or more of said current responsive means exceeds a predetermined value for a predetermined period of time, and a plurality of readily interchangeable resistance means mounted in series circuit with said current responsive means to lower the value of current at which said separation will be effected.

11. In a multipole electric circuit breaker, the plurality of sets of relatively movable contacts, a plurality of current responsive thermal means connected in series with said sets of contacts, means cooperating with said current responsive thermal means for effecting separation of all of said sets of contacts when the current through any one or more of said current responsive means exceeds a predetermined value for a predetermined period of time, and readily interchangeable resistance means connected in series circuit with each of said current responsive means and adapted to modify the current-temperature characteristics of the current responsive means to lower the value of current at which said separation will be effected.

12. In a multipole electric circuit breaker, the plurality of sets of relatively movable contacts, a plurality of current responsive thermal means connected in series with said sets of contacts, means cooperating with said current responsive means for effecting separation of all of said sets of contacts when the current through any one or more of said current responsive means exceeds a predetermined value for a predetermined period of time, connectors from said current responsive means leading to the exterior of the circuit breaker, and readily interchangeable resistance units mounted upon said connectors at the exterior of the circuit breaker to modify the value of current at which said separation will be effected.

13. In an automatic electric circuit breaker, relatively movable contacts serially connected, current responsive thermal means for effecting separation of said contacts when the current therethrough exceeds a predetermined value for a predetermined period of time, and resistance means serially connected with said thermal means between the thermal means and the external circuit wiring electrically connected thereto, said resistance means being heated by the current flow through said contacts and thermal means, and establishing a point of higher temperature than that of the exterior circuit wiring to inhibit the flow of heat from said thermal means normally dissipated to the exterior circuit wiring, said resistance means being insulated from radiation of heat to said thermal means.

14. In a multipole automatic electric circuit breaker, a plurality of sets of relatively movable contacts, a plurality of current responsive thermal means connected in series with said sets of contacts so as to be traversed by the current flowing therethrough, means cooperating with said current responsive thermal means for effecting separation of all of said sets of contacts when the current through any one or more of said current responsive means exceeds a predetermined value for a predetermined period of time, a sealable enclosure for said circuit breaker preventing access to said thermal means, and a plurality of readily interchangeable resistor means mounted at the exterior of said enclosure in series circuit with said thermal means so as to be traversed by the current flowing therethrough and through the contacts, and operating to lower the value of current at which said thermal means function to effect separation of contacts.

15. In a multipole electric circuit breaker, a plurality of sets of relatively movable contacts, a plurality of current responsive thermal means connected in series with said sets of contacts, means cooperating with said current responsive thermal means for effecting separation of all of the sets of said contacts when the current exceeds a predetermined value for a predetermined period of time, a sealed enclosure for said circuit breaker preventing access to said thermal means, connectors from said current responsive means leading to the exterior of the circuit breaker to form terminal means for the breaker, and readily interchangeable resistance units mounted upon said terminals at the exterior of the circuit breaker and functioning to modify the value of current at which the contact separation will be effected, said resistance units carrying additional terminal means for the connection of circuit wiring.

16. In an automatic electric circuit breaker adapted for both circuit and motor overload protection, a sealable enclosure, separable contacts and current responsive thermal means for effecting separation of said contacts sealed within said enclosure from exterior access, said thermal means operating to effect separation of the contacts when the current therethrough exceeds a predetermined value for a predetermined period of time, these predetermined values being fixed against variation and corresponding to the desired protection for the circuit wiring, and readily interchangeable resistance units mounted in series relation with said thermal means at the exterior of the sealed enclosure and being inter-

changeable to provide for the desired motor overload protection whereby different values of motor overload protection may be secured without exceeding a predetermined maximum rating corresponding to the inaccessible circuit protective setting of the thermal means.

17. In an automatic electric circuit breaker, a sealable enclosure, separable contacts and current responsive thermal means for effecting separation of said contacts sealed against access within said enclosure, said thermal means being serially connected with the contacts and operating to effect separation thereof when the current therethrough exceeds a predetermined value for a predetermined period of time, said predetermined values being relatively fixed by the inaccessibility of the thermal means within the sealed enclosure, and means for lowering the current-time rating for the tripping of the circuit breaker comprising readily interchangeable resistance means mounted at the exterior of the sealed enclosure in series circuit relation with the thermal means, whereby a circuit breaker having a fixed maximum current-time rating may have its rating readily lowered to desired values without permitting the exceeding of the predetermined maximum setting.

JOHN G. JACKSON.