May 13, 1924.

1,494,320

O. P. CRAMER

CIRCUIT CONTROLLER

Filed July 11, 1922

2 Sheets-Sheet 1

FIG. 1.

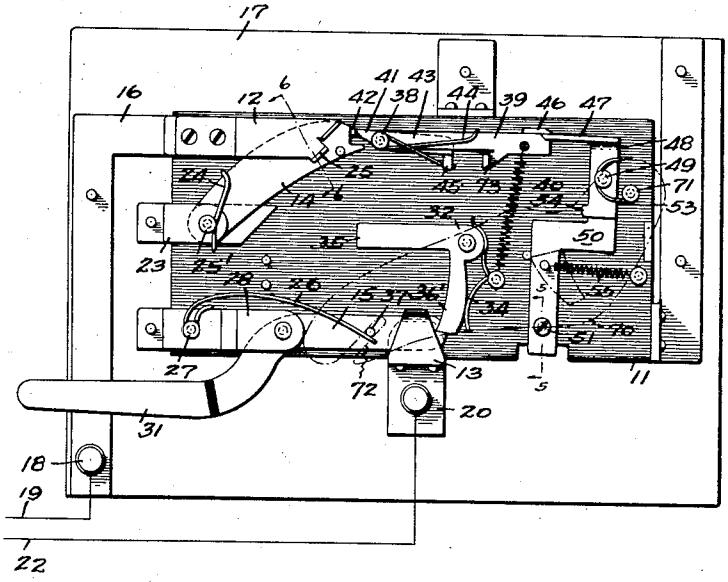
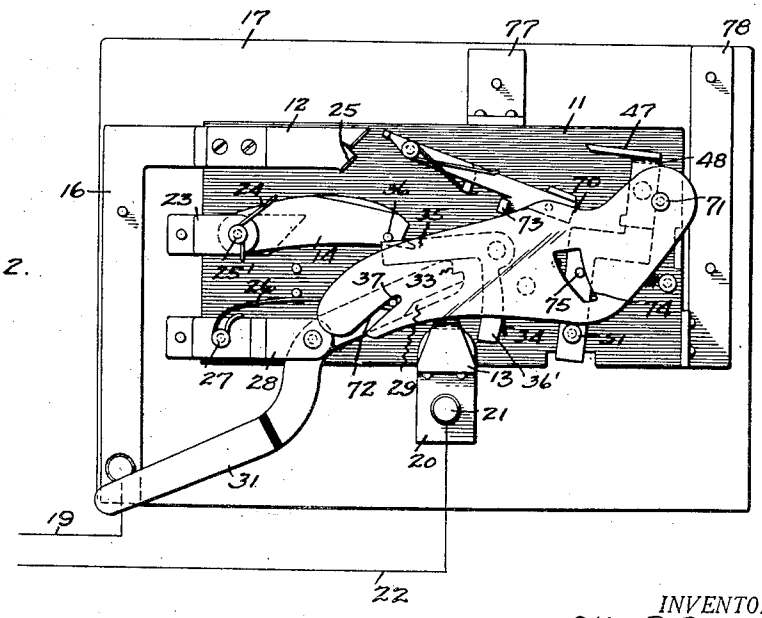


FIG. 2.



Witness:
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FIG. 3.

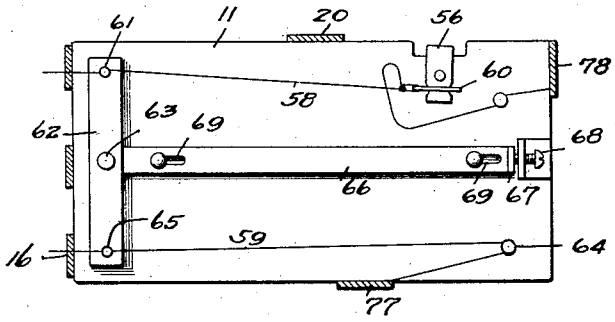


FIG. 5.

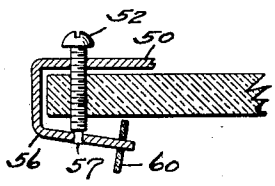


FIG. 4.

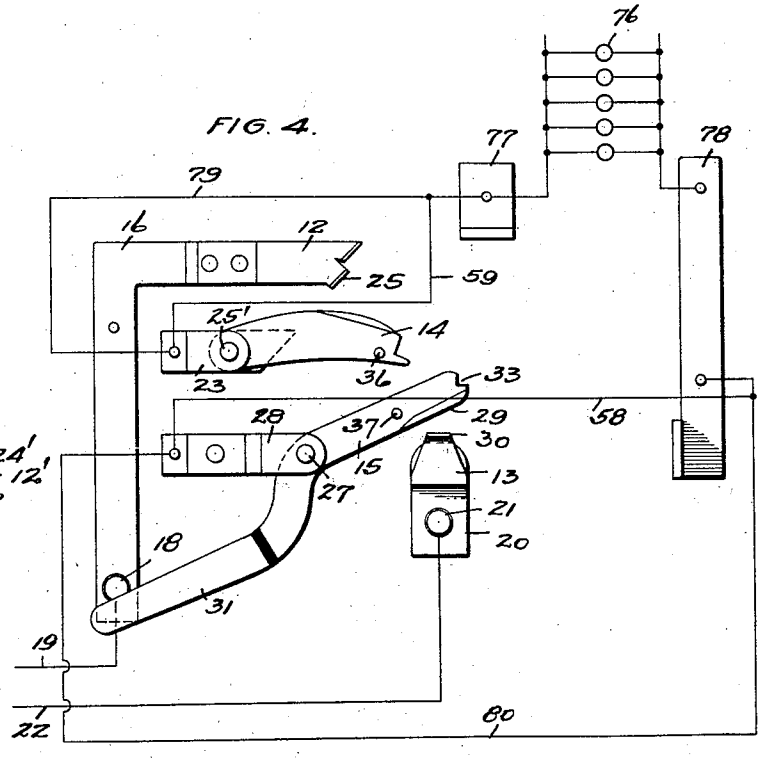
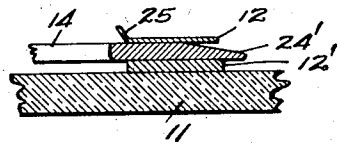


FIG. 6.



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Patented May 13, 1924. 1,494,320

UNITED STATES PATENT OFFICE.

OTTO P. CRAMER, OF SAN MATEO, CALIFORNIA.

CIRCUIT CONTROLLER.

Application filed July 11, 1922. Serial No. 574,254.

To all whom it may concern:

Be it known that I, OTTO P. CRAMER, a citizen of the German Republic, and a resident of the city of San Mateo, in the county of San Mateo and State of California, have invented a new and useful Circuit Controller, of which the following is a specification.

This invention relates to a circuit interrupting device, and more particularly to a thermal responsive circuit breaker. Such a device finds great utility in ordinary dwellings where it is essential to maintain the load at a safe value to prevent fires. For such purposes it has been common to use fusible metallic conductors, usually termed fuses, that melt and interrupt the circuit when the load becomes sufficiently great. The use of such fuses is attended with many disadvantages. The blowing of a fuse requires replacement. In a great many instances the consumer finds it impracticable to renew the fuse himself, or else he feels that the safest course is to obtain the services of an electrician. In either case there is a delay as well as an expense involved. Furthermore, fuses in general are not the best form of safeguard, since there is no certainty that they will blow at any predetermined amperage; in fact they are designated universally by their safe carrying capacity, and by how much it is possible to overload a fuse no one is capable of foretelling. This condition arises from the inherently variable factors entering into the manufacture of the fuses and also into the conditions of operation. A small variation, for example in physical dimensions, or in chemical composition, may cause a large variation in the amount of current necessary to blow the fuse. For this reason there is thus little assurance that a fuse will protect a dwelling from fire. Still another disadvantage resides in the use of unauthorized heavy copper jumpers to replace the fusible wire; this is quite often resorted to by careless or ignorant persons who desire to rid themselves of the annoyance of frequent fuse renewals.

It would of course be possible to overcome all these disadvantages by installing a circuit breaker. In substantially all cases, however, such an installation is prohibitive from the standpoint of cost. It is thus one of the objects of my invention to provide an extremely inexpensive circuit controller made to serve the same purpose as an ordinary circuit breaker.

Another object of my invention is to provide a circuit controller extremely simple to operate, so that in case it is desired to reclose it, there would be no necessity for delaying it until a skilled person arrives.

Another object of my invention is to reduce as far as possible the manufacture cost of such a controller, so that it may compare favorably as regards first cost and maintenance expense with the ordinary fuse which must be replaced after each operation.

Another object of my invention is to provide an inexpensive thermally operated circuit controller, in which the effect of the temperature of the surrounding air is compensated, whereby it is possible to set the apparatus accurately to cause it to open the circuit upon a predetermined current load.

My invention possesses other advantageous features, some of which, with the foregoing, will be set forth at length in the following description where I shall outline in full that form of the invention which I have selected for illustration in the drawings accompanying and forming part of the present specification. In the drawings I have shown but one embodiment of my invention, but it is to be understood that I do not desire to be limited thereto, since the invention as expressed in the claims may be embodied in other forms as well.

Referring to the drawings:

Figure 1 is a top plan view of a simple embodiment of my invention, with the cover removed and the contacts closed;

Fig. 2 is a view similar to Fig. 1, but with the contacts open;

Fig. 3 is a view from below showing the mounting of the operating wires and of the compensating device;

Fig. 4 is a wiring diagram;

Fig. 5 is a sectional view along line 5—5 of Fig. 1; and

Fig. 6 is a sectional view along line 6—6 of Fig. 1.

A base 11 of insulating material is shown carrying substantially all of the working parts of the device. Upon this base are mounted the main switch contacts, comprising the stationary spring clips 12, 12′ and 13, and the cooperating movable blades 14 and 15. These form in effect a double pole switch. In order to provide for appropriate

connections for one of the incoming lines, a conducting strip 16 is fastened to the stationary clips 12 and 12′ and extends along a base 17 of insulating material. This strip 16 is fastened in any appropriate manner to base 17, and carries a convenient binding post or terminal 18 to which the incoming lead 19 may be connected. To the other pair of stationary clips 13 is attached in any appropriate manner the conducting strip 20 carrying the other terimnal 21 to which the other incoming line 22 is connected. The strips 16 and 20 also serve in a measure to support the base or panel 11 above the base 17, and they are shown in section in Fig. 3, in close proximity to the edge of base 11.

The blade 14, adapted to enter between the clips 12 and 12′ is pivoted in a pair of spring supports 23, and is urged to open position by any appropriate device, such as the spring 24, coiled about the pivot pin 25′. The edge of blade 14 where it first approaches clip 12 is beveled off at 24′ as shown in the sectional view of Fig. 6, so as to confine the sparking to this beveled surface when the contact is broken. This beveled surface 24′ coacts with the upturned lip 25 on the clip 12, which lip extends beyond the lower clip 12′. In this way when the blade moves away from the clip 12, the sparking extends only between the beveled surface 24′ and the lip 25; no pitting or other bad effects destroy the smoothness of the main contact surfaces. The life of the contacts by the provision of this expedient is indefinitely prolonged.

The blade 15 is urged also toward open position by an appropriate device, such as spring 26, acting against pin 37 on blade 15, which spring is coiled about the pin 27 acting as a pivot for the blade 15. This blade is pivoted between spring clips 28, and is provided with a beveled surface 29 similar to that on blade 14, for coacting with the upturned lip 30 of clip 13.

A handle 31, fastened to the blade 15 and preferably insulated therefrom may be used for manually closing both contacts. To accomplish this result, handle 31 is first rotated in a counter-clockwise direction from the position shown in Fig. 2; this causes the upper edge of blade 15 to contact with the free end of blade 14, and to push this blade between clips 12, on continued rotation of handle 31. An appropriate latch to be hereinafter described retains blade 14 in closed position against the pressure of spring 24. After the blade 14 is latched, the handle 31 is rotated in a clockwise direction until blade 15 enters between clips 13. This blade is adapted to be latched by a pivoted lever 32, the lower arm 36′ of which is adapted to engage the shoulder 33 on the blade 15. This lever 32 is urged normally to engaging position by the spring 34. However, the upper arm 35 is in the path of movement of a projection or pin 36 on blade 14, so that while this blade 14 is open, the lower arm 36′ is moved out so that it cannot engage with the shoulder 33 of blade 15. The result is that blade 14 must be first latched before blade 15 can be retained in closed position.

The arrangement of the contacts, so that they are opened and closed in succession, and not simultaneously, has a great advantage when it is attempted to close the contacts before the load is reduced to a safe value. Assume that there is a short circuit across the terminals of clips 23 and 28, or that translating devices, too many for safety, are connected across these clips. If the handle 31 is rotated in a counterclockwise direction, blade 14 will be retained between clips 12, but as soon as the clockwise rotation of the handle causes blade 15 to contact with clips 13, the latch holding blade 14 is tripped due to the unsafe condition of the circuit. The opening of blade 14 of course prevents the arm 36′ from engaging shoulder 33 of blade 15, so that it springs open also. It is thus seen that the circuit can be completed only for an extremely short interval of time. This is due in a measure to the fact that the circuit is completed only when the blade 15 is closed. At that time this blade has moved far enough away from blade 14 so that this latter blade is not prevented from opening, and is thus responsive even before completion of the circuit to the releasing of the latch holding it. In this respect my device differs materially from an ordinary circuit breaker, which is so arranged that the movement of the contacts to closed position prevents their immediate response to the tripping of the latch.

The latch which holds blade 14 in closed position and which acts in response to an unsafe load is represented in closed and open position respectively in Figs. 1 and 2. Pivoted at 38 is an arm 39 which is urged in a clockwise direction by a coiled spring 40. Pivoted also at 38 is a shorter latch arm 41 which has a projection 42 coacting with the end of blade 14. The pivot 25′ of blade 14, and pivot 38 of arm 41 are so disposed relatively to each other that the pressure of blade 14 against projection 42 is substantially in line with the pivot 38. In this way spring 24 merely causes a compressive stress to be applied upon the arm 41, and the blade 14 is prevented from opening. The arm 41 has a member 43 extending below arm 39, and a spring 44 is so arranged that there is a tendency to rotate arm 41 in a counter clockwise direction with respect to arm 39, but is prevented from doing so by the projection 45 on member 43, which projection engages the side of arm 39. The spring con-

nection between arms 39 and 41 is necessary in order that during the closing operation of blade 14, projection 42 may ride over the edge of this blade without the necessity of moving arm 39.

The friction between the projection 42 and the blade 14 is more than overcome by the spring 40, which if it were allowed to act, would cause rotation of arm 39 to the position of Fig. 2, and the blade 14 would be released. It is however, prevented during normal conditions on the circuit, by the engagement of a projection 46 on arm 39 with a projection 47 carried on an arm 48 pivoted at 49 to a lever 50, which is in turn pivoted at 51 by means of a screw 52 threaded through lever 50, as clearly shown in Fig. 5. A spring 53 is so arranged that it urges arm 48 in a counterclockwise direction with respect to lever 50, but is prevented from doing so by the projection 54. The provision of the screw 52 in place of a conventional pivot pin has the advantage that the lever 50 does not bear against any flat shoulder; instead its tapped aperture rests upon the helical surface of screw 52, and there is much less friction than with the ordinary arrangement. It is of prime importance to reduce this friction, since it is this lever 50 which is moved directly by the thermally responsive element of my device.

A spring 55 tends to rotate lever 50 so as to release arm 39. This action is opposed by the force acting on the arm 56 of lever 50, which arm extends below the base 11 as shown in Figs. 3 and 5, and is journaled on the tip 57 of screw 52. How this force is applied may be readily explained with the aid of Fig. 3, which shows the bottom of base 11. A thermally responsive element consisting of a pair of fine wires 58 and 59 of conducting material is provided. These wires are preferably copper although other suitable material may be used. They are so arranged in the electric circuit that a definite portion of the current passes through them and causes them to heat. If the temperature is sufficiently great, they expand and permit spring 55 to withdraw the projection 47 from below projection 46 on arm 39. The use of a plurality of looped wires to effect this result is described and claimed in a co-pending application in my name, entitled "Electric safety devices with time adjustment", having Serial No. 492,438, and filed August 15, 1921.

To perform the desired functions, one end of wire 58 is connected to an eye 60 made of insulating material and looped over the arm 56 of lever 50. The other end of wire 58 is fastened as by screw 61 to a lever 62 pivoted to a brass strip 66 at 63. This lever is made of insulating material such as fibre. The wire 59 is connected to a stationary post 64 at one end, and at the other end to the lever 62, by means of screw 65. With this arrangement it is possible so to adjust the tensions of wires 58 and 59 that they overcome the pull of spring 55. However, as soon as they expand sufficiently under the influence of the current so as to reduce the tension by a predetermined amount, the lever 50 is rotated by the spring 55 to perform the latch tripping function. The expansions of wires 58 and 59 are added up by the aid of lever 50, and in this regard this disclosure is somewhat similar to that of my prior application heretofore identified. In the present instance the wires 58 and 59 are located in opposite sides of the circuit although such an arrangement is by no means essential.

The mounting of the lever 62 on the brass bar 66 affords a convenient means for compensating for the temperature of the circumambient atmosphere. The bar has a projection 67 abutting against an adjustable screw 68, and is free to slide or expand longitudinally due to the provision of slots 69 in the bar. The screw 68 affords an extremely convenient means for manually adjusting the tension of the wires 58 and 59. When the temperature of the atmosphere is high there is a tendency for the tension of wires 58 and 59 to decrease, but in the present arrangement this is overcome by the expansion of bar 66 which automatically takes up the slack. When the temperature is low the tendency to increase the tension is overcome by the contraction of bar 66. In this way it is possible to set the point at which the switch releases with great accuracy, by properly determining the initial or no load tension.

The mechanism whereby the latch is restored when the blades are closed is made directly responsive to the movement of handle 31. This mechanism comprises a control plate 70 shown in dot-dash lines in Fig. 1 and overlying many of the operating parts. This plate is preferably made of insulating material or is otherwise insulated from the live parts of the mechanism. It is pivoted to the base 11 by means of the pivot 71, and is provided at its free end with a slot 72 in which is engaged the pin 37 fixed to blade 15. This slot and pin connection serves as a convenient means for rotating the control plate 70 in response to the movement of handle 31. Thus when the handle is first moved in a counter-clockwise direction to close blade 14, the plate 70 is likewise moved in a clockwise direction around its pivot 71. In so doing the upper edge of plate 70 abuts against a projection 73 on arm 39, and rotates this arm in opposition to the pull of spring 40. At the time blade 14 reaches its final position, the arm 39 is returned by this control to a position slightly higher than

that of Fig. 1. An aperture 74 is provided in the plate 70 which has a cam shaped edge to engage with the post 75 fixed to lever 50. This cam is so shaped that the lever 50 is rotated against the tension of spring 55 in a counterclockwise direction, far enough so as to position the projection 47 under the projection 46. In this way there is a positive locking movement of lever 50, entirely independent of the condition of wires 58 and 59. As soon as the handle 31 is rotated in a clockwise direction to move blade 15 into closing position, the plate 70 is correspondingly moved in a counterclockwise direction. This permits spring 40 to act and pull projection 46 against projection 47, and thus the latching of blade 14 is completed. The control plate finally takes the position shown in Fig. 1, upon completion of the movement of blade 15. The controller is thus in position to respond to an overload or to a short circuit. In order that the resetting operation be properly performed, it is essential that the various elements of the control plate 70 be so proportioned that the various movements caused by it take place in the order set forth. This however is a comparatively easy matter to accomplish. The member 48 is for ease of operation made separate from lever 50 so as to permit projection 46 to pass beyond projection 47 while the mechanism is being reset. It is for this purpose also that the edges of projections 46 and 47 are beveled off.

The arrangement of the circuits connecting the load to the apparatus is illustrated diagrammatically in Fig. 4. The load is in this instance shown as a plurality of lamps 76. One terminal of the load is connected to a conducting member 77 which is fastened to the bottom base 17 and also serves to support the top base 11. The other terminal of the load 76 is connected to a similar conducting strip 78. Between conducting strip 77 and the spring plates 23 of blade 14 extend the wire 59 as well as a shunt 79 of conducting material. In a somewhat similar manner the wire 58 extends between strip 78 and the clips 28, while another shunt 80 parallels this wire. These two shunts are for convenience disposed between the bases 11 and 17, and are therefore hidden from view in Figs. 1 and 2. However, it is thought that the diagram of Fig. 4 is sufficiently clear in this regard. It is to be understood also that both shunts are of substantially identical length and cross section, as is true of the active portions of wires 58 and 59. Furthermore in order to calibrate the apparatus it is possible to multiply the shunts, so that instead of a single conductor forming a shunt between parts 77 and 23 for example, a plurality of substantially identical conductors may be used. Each conductor is preferably so proportioned that it has a larger resistance than the corresponding wire 58 or 59. This may be accomplished by making the shunts out of the proper conducting material, or by making them of the same material but longer than the wires 58 and 59. When this is done, the heating of the shunts is much less than of the wires and there is no danger that there will be any increase in the temperature of the wires due to the proximity of the shunts.

The complete circuit for the apparatus and the load, when the contacts are closed, may now be traced. Entering at lead 19, the circuit continues to bar 16, clips 12 and 12′, blade 14 and clips 23, where it divides, part of the current going through wire 59 to member 77, and the rest through shunt 79 to member 77; from this member the current flows through the load 76, to strip 78, where it again divides, a part flowing through wire 58 to clips 28, and the remainder through shunt 80 to clips 28; from clips 28 the current then flows through blade 15, and clips 13 to line 22. When the blades are open the lines 19 and 22 extend merely to clips 12 and 13, and the circuit is there interrupted.

The embodiments of the various mechanical expedients disclosed may, and very likely would, be varied to suit varying conditions of operation. The features which I consider essential for the practice of my invention are set forth in the claims appended to the specification.

At this point it is advisable to review in a condensed manner the operation of the device as embodied in the apparatus illustrated. Assume that the contacts are closed as in Fig. 1. Upon the occurrence of a short circuit or an overload, the wires 58 and 59 expand, and permit spring 55 to rotate lever 50 so as to free the projection 46 of arm 39. Thereupon spring 40 rotates this arm, and frees projection 42 from the path of blade 14. The spring 24 is now permitted to act, and blade 14 opens. In so doing, the pin 36 rotates the lever 32 to the position shown in Fig. 2, and the arm 36′ releases blade 15, which opens due to the pressure of spring 26. This completes the opening of the circuit. When it is desired to reclose the circuit, handle 31 is pulled down, blade 15 pushing blade 14 into closed position. At the same time the control plate 70 lifts arm 39 and causes lever 50 to move toward this arm. The projection 42 is returned and retained in the position shown in Fig. 1. The handle 31 is now pulled up until blade 15 enters clips 13, and the circuit is again completed. Due to the plurality of triggers placed one after another between the movement of lever 50 and the unlatching of blade 14, it is possible to ensure against failure of operation, since in this way a comparatively light force acting on lever 50 is sufficient to unlatch the blade.

I claim:

1. In a circuit controller, a pair of switch blades, a pair of contacts cooperating with said blades, means urging said blades to open position, means for holding one of said blades in closed position, and means active only while that blade is in closed position for holding the other blade in closed position.

2. In a circuit controller, a pair of switch blades, a pair of contacts cooperating with said blades, a handle for moving one of said blades, means whereby movement of this handle to move the blade with which it is associated toward open position, serves to move the other blade to closed position, a catch for holding the blade with which the handle is associated, in closed position, and means whereby the other blade releases said catch when that other blade is in open position.

3. In a circuit controller, a conductor adapted to expand under the influence of heat generated in it by the passage of an electric current, means whereby the expansion operates the controller, a member to which one end of the conductor is attached, and a metallic bar carrying the member at one end and fastened at the other, whereby variations in the air temperature result in varying the position of the member.

4. In combination, a pair of conductors adapted to expand under the influence of heat generated in them by the passage of an electric current, a lever pivoted intermediate its ends, and fastened on opposite sides of the pivot point to the conductors, a metallic bar to which the lever is pivoted, and means for holding one end of the bar stationary which is remote from the lever comprising an adjustable abutment against which the bar rests.

5. In a circuit controller, a pair of conductors adapted to expand under the influence of heat generated in them by the passage of an electric current, a metallic bar, an adjustable abutment for one end of the bar, a lever pivoted near the other end of the bar, between the extremities of the lever, the conductors being fastened to opposite sides of the lever, and means whereby the expansion of the conductors causes operation of the controller.

6. In a circuit controller, a pair of relatively movable contacts for controlling one side of a circuit, another pair of relatively movable contacts for controlling the other side, means tending to urge said sets of contacts to open position, latches for holding them in closed position, means for unlatching one of said sets of contacts in response to load conditions in a circuit, and means whereby the other set is unlatched in response to the unlatching of the first set.

7. A circuit controller having two pairs of contacts for controlling both sides of the circuit, means tending to operate said pairs of contacts to open the circuit, latches for the contacts to hold them closed, and a conductor adapted by its expansion due to the flow of current therethrough to release one of said latches, characterized by the fact that the release of the other latch is dependent upon the opening of the contacts controlled by the first latch.

8. In a circuit controller, a pair of contacts, means urging said contacts apart, a latch for holding the contacts closed, and means for closing the contacts from the open position comprising means for moving the contacts together, and a movable member operated by the operation of said latter means to move the latch to hold the contacts closed.

9. In a circuit controller, a pair of contacts, means urging said contacts apart, a latch for holding the contacts closed, means urging the latch to open position, a member responsive to circuit conditions for permitting said latter means to act, and means for closing the contacts from open position and maintaining them closed comprising means for moving the contacts together, and a movable member operated by the operation of said latter means to move the latch to closed position and the member which is responsive to circuit conditions so as to retain the latch.

10. In a circuit controller, a pair of switch blades, contacts cooperating with said blades, means for moving one of said blades so that it urges the other to closed position, means tending to open the blades, a latch for holding that blade closed which is moved by the other, means tending to open the latch, a member responsive to circuit conditions for preventing said latch from opening, and a pivoted control plate rotated by the movement of the blade to closed position for setting the latch and moving the circuit condition responsive member to its holding position.

In testimony whereof, I have hereunto set my hand.

OTTO P. CRAMER.