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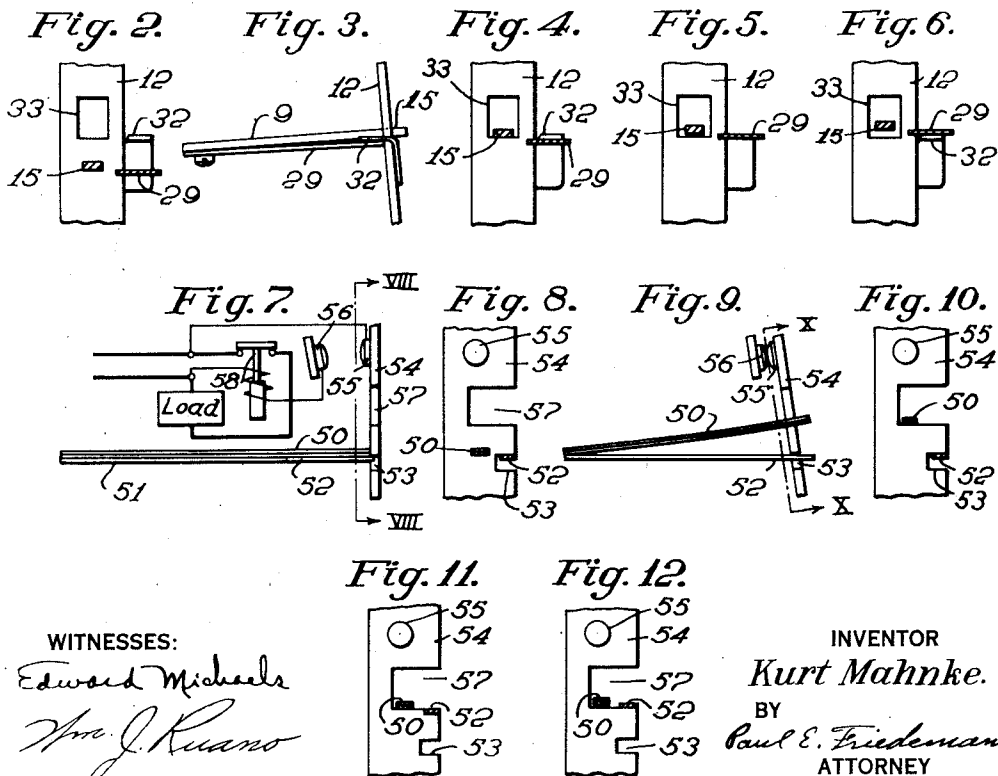
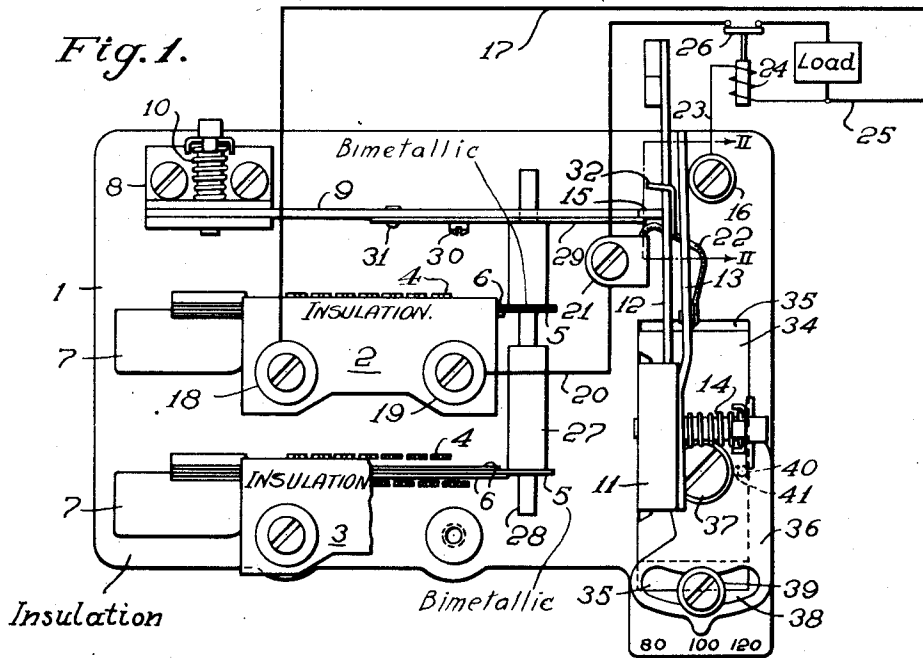
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2,217,488

THERMAL OVERLOAD RELAY

Filed March 31, 1939

2 Sheets-Sheet 1



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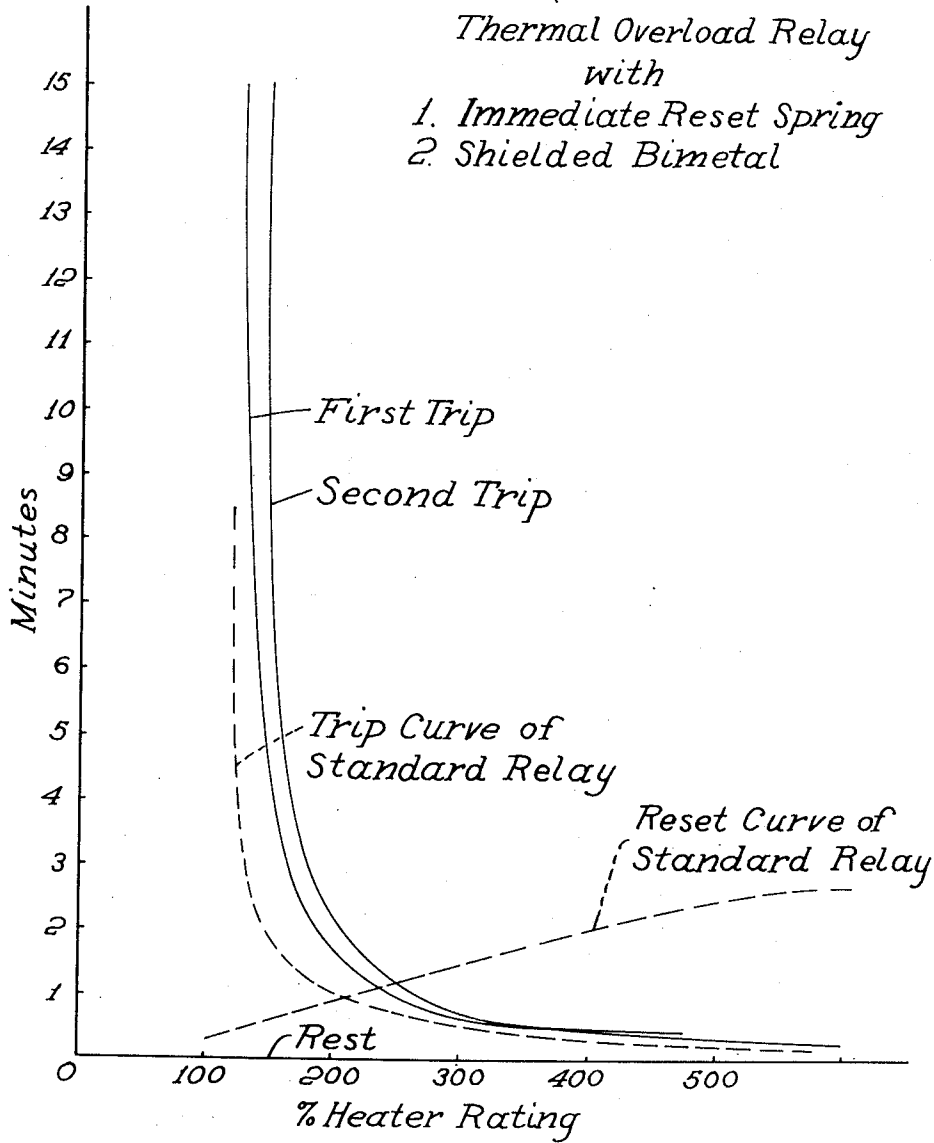
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2 Sheets-Sheet 2

Fig. 13.



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2,217,488

THERMAL OVERLOAD RELAY

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Application March 31, 1939, Serial No. 265,158

14 Claims. (Cl. 200—116)

My invention relates to a thermal overload relay and more specifically to a thermal overload relay mechanism which is adapted to be instantaneously reset and made to trip a second time in case the circuit to be protected is still overloaded after resetting.

Thermal overload relays with long tripping time usually have high thermal capacities, thus requiring comparatively long cooling periods before they can be reset. This delay in resetting is often disadvantageous.

An object of my invention is to provide a thermal overload relay which takes a comparatively long time to trip, but which is instantaneously resettable.

Another object of my invention is to provide a thermal overload relay which, after it has once tripped and been reset, is adapted to trip a second time in the event that an overload continues in the system.

Another object of my invention is to provide a heat conductive shield between the heater and thermal responsive element, which heat shield is metallically connected to an element having high thermal capacity, thereby providing a lag in response of the thermal responsive element to the heater.

Another object of my invention is to provide a thermal overload relay which is reliable in operation, which has relatively few and simple parts and which is economical to manufacture.

Other objects and advantages will become more apparent from a study of the following specification when considered in conjunction with the accompanying drawings, in which

Figure 1 is a front view of the thermal overload relay together with a schematic relay circuit.

Fig. 2 is a partial sectional view of the latch member and reset bar taken on line II—II of Fig. 1 shown broken away and in the normal reset or latched position.

Figs. 3 and 4 are front and side sectional views, respectively, of the elements shown in Fig. 2 except that the elements are in the tripped or unlatched position.

Fig. 5 is a side sectional view similar to Fig. 4 showing the elements in a reset or latched position after they have been tripped;

Fig. 6 is a view similar to Figs. 4 and 5, except that the elements are in a second tripped position;

Fig. 7 is a partial view similar to Fig. 1 showing a modification of the invention in which the thermal responsive element latch member and the

reset member are shown in the latched or reset position;

Fig. 8 is a side view taken on line VIII—VIII of Fig. 7;

Fig. 9 is a view similar to Fig. 7 showing the elements in a tripped position;

Fig. 10 is a view taken on line X—X of Fig. 9;

Fig. 11 is a view similar to Fig. 10 except that the elements are in the reset position;

Fig. 12 is a view similar to Fig. 10 except that the elements are in a second tripped position; and

Fig. 13 is a graph illustrating trip and reset characteristics of the device embodying my invention as compared to those of standard thermal overload relays.

Referring more particularly to Fig. 1, numeral 1 indicates an insulating plate or support member upon which is mounted a plurality of thermal responsive devices 2 and 3 (3 being shown partly broken away) each of which comprises an insulating supporting member of substantially U-shaped cross section supporting a heater element 4, a thermal responsive element 5 which may be bimetallic or the like which is substantially surrounded by the heater element and a pair of interposed heat conductive shields 6 which are made of copper or other relative high heat conductive metal. Metallically connected respectively to each of heat shields 6 are relatively massive bodies 7 having high thermal capacity. Bodies 7 have grooves, as shown, for accommodating shields 6 and heat responsive elements 5, the latter elements being secured to bodies 7 at the left ends thereof by any suitable means. Since the bimetallic thermal responsive elements have low heat conductivity, it was found that heat shields such as 6 not only protect the bimetal from direct heat radiation from the heater, but by the addition of metal bodies of high thermal capacity, such as 7, storage of heat and a lag of responsiveness of the thermal responsive element to the heater element is secured thereby necessitating a longer period of time for deflection of the thermal responsive element.

Mounted on plate 1 is a bracket 8 which carries a latch member 9 and a spring 10, which spring yieldingly holds latch member 9 in engagement with the lower part of bracket 8. A resilient drag member 29 is secured at one end of the latch member by means of suitable fastening means 30 and 31. Mounted on the second bracket 11 which is channel shaped is a reset bar 12 which, together with a contact member 13 is yieldingly held against the left side of bracket 11 by a spring 14. It will thus be seen that spring 14 yieldingly

presses reset bar 12 against a narrow end portion 15 of latch member 9 and is normally latched thereby as shown. In this latched or reset position contact member 13 engages a rounded contact member 16 thereby closing the following control circuit, from conductor 17 to terminal 18 of the heater elements 4 to the other terminal 19 thereof, conductor 20, terminal 21, flexible wire conductor 22, contact members 13 and 16, conductor 23, high resistance relay coil 24 to conductor 25. Thus relay coil 24 is energized, thereby closing line contact members 26, thereby completing the main supply circuit from conductors 17 and 25 through the load and heater. Carried by thermal responsive elements 5 and movable therewith is a cylindrical linkage member 27 having portions of narrowed diameter such as 28 which extend through suitable slots or holes in latch member 9 and drag member 29.

The operation of the device is as follows. During normal load the elements of the device are in the position shown in Fig. 1, that is the relay contact members 13 and 16 are in the closed position and likewise line contact members 26 are in the closed position and the line current goes through the heater and load. Upon overload, heater 4 by virtue of I^2R loss develops excessive heat which is conducted through heat conductive shields 6 to heat storage block 7, finally heating the thermal responsive element 5, thus causing an upward deflection of the thermal responsive element. In moving upwardly thermal responsive element 5 carries with it cylindrical member 27 which by virtue of its upper enlarged cylindrical portion moves latch member 9 and drag member 29 upwardly against the action of spring 14. Fig. 2 clearly shows the relative position of the latch member 9 to drag member 29 and of the lug 32 which lug is rigidly connected to reset bar 12.

After a predetermined amount of deflection of thermal responsive element 5, the end portion 15 of latch member 9 completes its sliding movement along the surface of reset bar 12, finally coming in registry with an aperture 33 in the reset bar, thereby releasing the reset bar 12 from its latched position allowing it to move to the left under the force of spring 14 into the position shown in Figs. 3 and 4. The movement of drag member 29 in the meanwhile has been arrested by lug 32. At the same time spring 14 also pushes contact member 13 away from contact member 16 thereby interrupting the circuit through relay coil 24 consequently deenergizing the coil and allowing line contact members 26 to open and interrupt the main circuit through the load. Reset bar 13 can be immediately reset by either manually or magnetically pushing it to the right thereby unlatching drag member 29 from the lug 32 which is now acting as a stop member therefor.

It should be noted that such resetting can be made immediately while the thermal responsive element and likewise latch member 9 are still in the deflected position as a result of the overload. After the reset member is pushed toward the right allowing unlatching of the drag member 29, the drag member by virtue of its resiliency springs towards the latch member 9 into such position that its end is in abutting or latched relation to the upper left edge of lug 32. Thus upon release of reset bar 12, it will still remain in the latched position by virtue of the edge to edge contact of elements 29 and 32, which position is shown more clearly in Fig. 5. Upon further deflection of the responsive element due to continued overload latch member 9 is moved upwardly

an additional amount, dragging with it the drag member 29 until the latter clears the upper edge of lug 32 thereby no longer effecting latching thereof and at which time reset bar 12 will again move to the left under the influence of spring 14 to a position similar to that shown in Fig. 3 thereby causing a second tripping of the reset bar. However, during this second tripping movement drag member 29 is situated above lug member 32 as shown in Fig. 6 instead of below as shown in Fig. 3. After such second tripping it is necessary that the overload be diminished or removed so as to lower latch members 9 and 29 before the relay can be reset again.

In order to provide adjustment as to the degree of overload which is necessary to effect tripping of the relay means are provided for adjustably moving reset bar 12 upwardly or downwardly relative to the latch member 9, such means comprise a base portion 34 of bracket 11 which is slidable in a groove 35 which is cut out of the insulating plate 1. An enlarged lever element 36 has a fixed pivot formed by a screw 37 projected therethrough. Force is applied to the lever by manually grasping it at its lower portion near the graduated scale by swinging it to the right or left which swinging is possible by virtue of a slot 38 in the lever which is movable relative to a fixed adjusting screw 39 screwed in the plate 1, which when screwed inwardly holds lever element 36 in a fixed position. The power output arm of lever 36 extends from the screw pivot 37 to a pin 40 extending from the rear of lever 36 into a slot 41 in the base portion 34. It will thus be seen, for example, that when lever arm 36 is manually moved in a counterclockwise direction about pivot 37 pin 40 will also move counterclockwise about the same pivot but will move to the left in slot 41 and at the same time will slide base portion 34 upwardly in groove 35 and carrying therewith bracket 11, reset bar 12 and contact member 13. Likewise in manually moving lever 36 in a clockwise direction, downward movement of the parts supported on base 34 including reset bar 12 is secured.

While only the upper heater element has been shown in the circuit of Fig. 1, it is obvious that the lower heater element can likewise be placed in a similar circuit or in the same circuit if desirable. In either event, it will be noted that the upward movement of either or both of the thermal responsive elements will affect an upward movement of cylindrical member 27. While only two heater elements are shown, it is obvious that any number of heater elements may be similarly mounted on plate 1 and arranged in like manner so that heating of any one of the heaters will affect tripping of the relays. By virtue of the narrowed portions 28 of the cylindrical member 27 it will be obvious that deflection of any one of the thermal responsive elements will have no effect on, that is, will not deflect any of the other thermal responsive elements.

Figs. 7 to 12 inclusive show a modification of the device illustrated in Figs. 1 to 6 inclusive. Referring more particularly to Fig. 7 thermal responsive element 50, which may be bimetallic, acts as a latch member and has secured thereto at point 51, a drag member 52 which is slightly longer than the thermal responsive element 50 and therefore which projects into a slot 53 in reset member 54 and is latched in said slot against upward movement while thermal responsive element 50 moves upwardly as a result of heating thereof, due, for example, to overload. A contact

member 55 is carried by reset member 54 which cooperates with a stationary contact member 56. In the position shown in Figs. 7 and 8 a normal load exists and thermal responsive element 50 latches reset member 54 thereby keeping contact members 55 and 56 separated, allowing the source of power to flow through line contact members 58 and through the load. Assuming now that an overload occurs in the system, heat developed as a result of overload is transferred to thermal responsive element 50 in any manner, for example, as shown in Fig. 1, thereby causing thermal responsive element 50 to move upwardly until its end comes into registry with a large slot 57 in reset member 54 at which time, by virtue of the bias of reset member 54 leftwardly by a spring, for example, such as shown in Fig. 1, the elements assume a position such as shown in Figs. 9 and 10 in which position contact members 55 and 56 are closed thereby completing a relay circuit which effects opening of line contact members 58 thus interrupting the main circuit. Reset bar 54 can now be reset by pushing it to the right against its normal biasing force thereby freeing drag member 52 from the upper edge of slot 53 and allowing it to spring by virtue of its resilience to a position such as shown in Fig. 11.

Upon further overload thermal responsive element 50 will be moved upwardly by an additional amount and will drag with it drag member 52 until the latter comes into registry with large slot 57 at which time reset member 54 is again moved to the left by its biasing means into a position similar to that shown in Fig. 9 except that now both the thermal responsive element 50 and the drag member 52 project through large slot 57 such as shown in Fig. 12. In order to reset the relay from this position, it is first necessary that the thermal responsive element be moved downwardly, that is that the overload is diminished or eliminated.

Fig. 13 is a graph showing trip and reset characteristics of the device illustrated in Fig. 1 (shown in full lines) as compared to trip and reset characteristics of standard thermal overload relays (shown in dotted lines). Time in minutes is plotted against percentage heater rating. As will appear from the graph the trip curves of both the standard relay and the presently described relay have drooping characteristics, that is to say, as the overload current is increased in the heater the time required for tripping the relay at particular values of overload current becomes correspondingly smaller. For a given value of overload current the time required for tripping a standard relay is less than that required to trip a relay in accordance with my invention because of the addition of the heat shields 6 and heat storing metallic body 7. Also for a given value of overload current, the time required for the first trip of a device in accordance with my invention is smaller than that required for a second trip after resetting because of the necessity for a greater deflection of the thermal responsive element for a second tripping. Referring to the standard reset curve (shown in dotted lines) it will be noted that as the overload current becomes greater, the time required for resetting becomes greater because of the larger amount of heat that must be dissipated by the relay before resetting is possible. In accordance with my invention, however, resetting is instantaneous up to about 500% heater rating and thereafter it gradually rises due to abnormal deflection of the thermal re-

sponsive element which results in movement of its drag member beyond its latching position.

I am, of course, aware that others, particularly after having had the benefit of the teachings of my invention, may devise other devices embodying my invention, and I therefore do not wish to be limited to the specific showings made in the drawings and the descriptive disclosure hereinbefore made, but wish to be limited only by the scope of the appended claims and such prior art that may be pertinent.

I claim as my invention:

1. A circuit breaker including, in combination, an operating mechanism which includes a thermal responsive element which deflects under the influence of heat thereby effecting operation of said circuit breaker, means for resetting said circuit breaker while said thermal responsive element is still in its deflected position, and means responsive to continued deflection of said same thermal responsive element from said deflected position for effecting by means of the same operating mechanism a second operation of said circuit breaker.

2. A thermal relay including, in combination, a thermal responsive operating mechanism which includes a thermal responsive element which is operated under the influence of heat to effect operation of said relay, means for resetting said relay to its inoperative position while said thermal responsive element is still in said operated position and means responsive to continued operation of said same thermal responsive element from said operated position for tripping said resetting means thereby effecting a second operation of said relay.

3. An overload responsive circuit breaker which includes a plurality of contact members and an operating mechanism therefor, said operating mechanism including a thermal responsive element which deflects under the influence of heat developed by overload current, a relay circuit which is closed in response to said deflection of said thermal responsive element, said plurality of circuit breaker contact members being operable in response to closure of said relay circuit, means for resetting said circuit breaker contact members to the closed position and for opening said relay circuit while said thermal responsive element is still in its deflected position, and means responsive to continued deflection of said same thermal responsive element from said deflected position for effecting by means of the same operating mechanism a second closure of said relay circuit thereby effecting a second opening of said circuit breaker contact members.

4. Operating mechanism for a thermal relay including, in combination, a thermal responsive element which deflects under the influence of heat, a reset member which is normally biased in contact relationship with said thermal responsive element, said reset member having a plurality of latching surfaces, means associated with said reset member for effecting unlatching thereof in response to a predetermined deflection of said thermal responsive element and for effecting a second unlatching of said thermal responsive element after said reset member has been reset to latching position while said thermal responsive element is in its deflected position, said second unlatching being responsive to continued deflection of said same thermal responsive element after said first unlatching and resetting.

5. Operating mechanism for a thermal relay

including, in combination, a thermal responsive element which deflects under the influence of heat, a reset member which is normally biased in contact relation with an end of said thermal responsive element, said reset member having a plurality of latching surfaces, means associated with said reset member for effecting unlatching thereof in response to a predetermined deflection of said thermal responsive element, said reset member being instantaneously resettable to latching position while said thermal responsive element is still in its deflected position, means responsive to continued deflection of said same thermal responsive element from said deflected position for effecting a second unlatching of said thermal responsive element.

6. A thermal switch comprising, in combination, a thermal responsive element which deflects under the influence of heat, a pair of contact members, a reset member which supports one of said contact members, said reset member being biased in contact relation with said thermal responsive element, a drag member which is movable by said thermal responsive element for normally latching said reset member thereby keeping said contact members at a definite relationship, opening means on said reset member through which said thermal responsive element and said drag member are adapted to project after a predetermined deflection of said thermal responsive element to allow said reset member, under the influence of its bias, to move towards said thermal responsive element thereby moving said contact members relative to each other.

7. A thermal switch comprising, in combination, a thermal responsive element which deflects under the influence of heat, a pair of contact members, a reset member which supports one of said contact members, said reset member being biased in contact relationship with an end of said thermal responsive element thereby separating said contact members, a drag member which is dragged by said thermal responsive element for normally latching said reset member thereby separating said contact members, opening means on said reset member through which said thermal responsive element and said drag member are adapted to project after a predetermined deflection of said thermal responsive element to allow said reset member, under the influence of its bias, to move towards said thermal responsive element thereby moving said contact members into engagement.

8. A thermal switch comprising, in combination, a thermal responsive element which deflects under the influence of heat, a pair of contact members, a reset member which supports one of said contact members, said reset member being biased in contact relationship with an end of said thermal responsive element thereby separating said contact members, a drag member which is dragged by said thermal responsive element for normally latching said reset member thereby separating said contact members, a pair of openings on said reset member through which said thermal responsive element and said drag member are adapted to project, one into each, after a predetermined deflection of said thermal responsive element to allow said reset member under the influence of its bias, to move towards said thermal responsive element thereby moving said contact members into contact relationship, said reset member being resettable by applying a force in a direction opposite its bias thereby relatching the same while same thermal responsive

element is still in its deflected position, said thermal responsive element, upon further deflection thereof, being effective, together with said drag member to project through one of said openings thereby allowing said reset member to move towards said thermal responsive element thereby moving said contact members into engagement.

9. A thermal switch comprising, in combination, a thermal responsive element which deflects under the influence of heat, a pair of contact members, a reset member which supports one of said contact members, said reset member being biased in contact relationship with an end of said thermal responsive element thereby separating said contact members, a drag member which is dragged by said thermal responsive element for normally latching said reset member thereby separating said contact members, a pair of openings on said reset member through which said thermal responsive element and said drag member are adapted to project, one into each, after a predetermined deflection of said thermal responsive element to allow said reset member under the influence of its bias, to move towards said thermal responsive element thereby moving said contact members into contact relationship, said reset member being resettable by applying a force in a direction opposite its bias thereby relatching the same while same thermal responsive element is still in its deflected position, said thermal responsive element, upon further deflection thereof, being effective, together with said drag member to project through only one of said openings thereby allowing said reset member to move towards said thermal responsive element thereby moving said contact members into engagement, said drag member being secured to said thermal responsive element in substantially parallel relationship both being arranged substantially at right angles to said reset member, said drag member being slightly longer than said thermal responsive element.

10. A thermal switch including, in combination, a pair of contact members, a thermal responsive element for moving said contact members into engagement, a heater element adjacent said thermal responsive element for supplying heat thereto, metallic shield means between said heater and thermal responsive element and which is in heat conductive relationship with the latter, and metallic means having substantial heat capacity and which is metalically connected to said shield means, thereby providing a lag in temperature response of said thermal responsive element to said heater element.

11. A thermal switch including, in combination, a thermal responsive element, a latch member which is movable by said thermal responsive element, a reset member which is yieldably held in engagement with said latch member, a pair of contact members one of which is carried by said reset member, a cut away portion on said reset member through which said latch member will protrude upon predetermined deflection of said thermal responsive element and said latch member thus causing said reset bar to trip and separate said contact members, said reset member being resettable to reclose said contact members while said thermal responsive element is still in its deflected position, coacting means on said latch member and on said reset member which are effective to cause a second tripping of said reset member after it is reset and a second opening of

said contact members as the result of further deflection of said thermal responsive element.

12. A thermal switch including, in combination, a thermal responsive element, a latch member, linkage means for transferring movement of said thermal responsive element to said latch member, a reset member having a surface which is yieldably held in engagement with an end of said latch member, a stationary contact member, a movable contact member which is mounted on said reset member, a cut away portion on said reset member through which said latch member will protrude upon predetermined deflection of said thermal responsive element and said latch member thus causing said reset bar to trip and separate said contact members from a closed position, said reset member being resettable to reclose said contact members while said thermal responsive element is still in its deflected position, coaxing means on said latch member and on said reset member which are effective to cause a second tripping of said reset member after it is reset to the contact closed position and a second opening of said contact members as the result of further deflection of said thermal responsive element from said deflected position.

13. A thermal switch including, in combination, a thermal responsive element, a latch member, linkage means for transferring movement of said thermal responsive element to said latch member, a reset member having a surface which is yieldably held in engagement with an end of said latch member, a stationary contact member, a movable contact member which is mounted on said reset member, a cut away portion on said reset member through which said latch member will protrude upon predetermined deflection of said thermal responsive element and said latch member, thus causing said reset bar to trip and separate said contact members from a closed position, said reset member being resettable to reclose said contact members while said thermal responsive element is still in its deflected position, a drag member which is secured to said latch member, a lug which projects from said reset member, said

drag member being effective, after said reset member has been reset, to abut said lug and latch said reset member in the contact closed position until a further predetermined movement of said thermal responsive element as the result of which further movement said drag member unlatches said lug, allowing said latch member again to protrude through said reset member thus effecting a second tripping thereof and a second opening of said contact member.

14. A thermal switch including, in combination, a plurality of thermal responsive elements, a pair of contact members, a latch member, linkage means for transferring movement of any of said thermal responsive elements to said latch member, a yieldable reset bar substantially at right angles to said trip member, spring means which continuously urges said reset bar against an end of said latch member to hold said contact members in a closed position, a cut away portion on said reset bar through which said end of said latch member protrudes as the result of predetermined deflection of one of said thermal responsive elements and said latch member thus causing said reset bar to trip and separate said contact members from a closed position, said reset bar being resettable to reclose said contact members while said thermal responsive element is still in its deflected position, a drag member which is secured to said latch member, a lug which projects from said reset member, said drag member being effective, after said reset member has been reset, to abut said lug and latch said reset member in the contact closed position until a further predetermined movement of said thermal responsive element as the result of which further movement said drag member unlatches said lug, allowing said latch member again to protrude through said reset member thus effecting a second tripping thereof and a second opening of said contact members, adjustable means for adjusting the relative positions of said latch member and reset bar.

KURT MAHNKE.

DISCLAIMER

2,217,488.—*Kurt Mahnke*, Forest Hills, Pa. THERMAL OVERLOAD RELAY. Patent dated October 8, 1940. Disclaimer filed May 3, 1941, by the assignee, *Westinghouse Electric & Manufacturing Company*.
Hereby enters this disclaimer to claims 1 and 2 of the patent specification.
[*Official Gazette May 27, 1941.*]

DISCLAIMER

2,217,488.—*Kurt Mahnke*, Forest Hills, Pa. THERMAL OVERLOAD RELAY. Patent dated October 8, 1940. Disclaimer filed May 3, 1941, by the assignee, *Westinghouse Electric & Manufacturing Company*.
Hereby enters this disclaimer to claims 1 and 2 of the patent specification.
[*Official Gazette May 27, 1941.*]