

June 30, 1931.

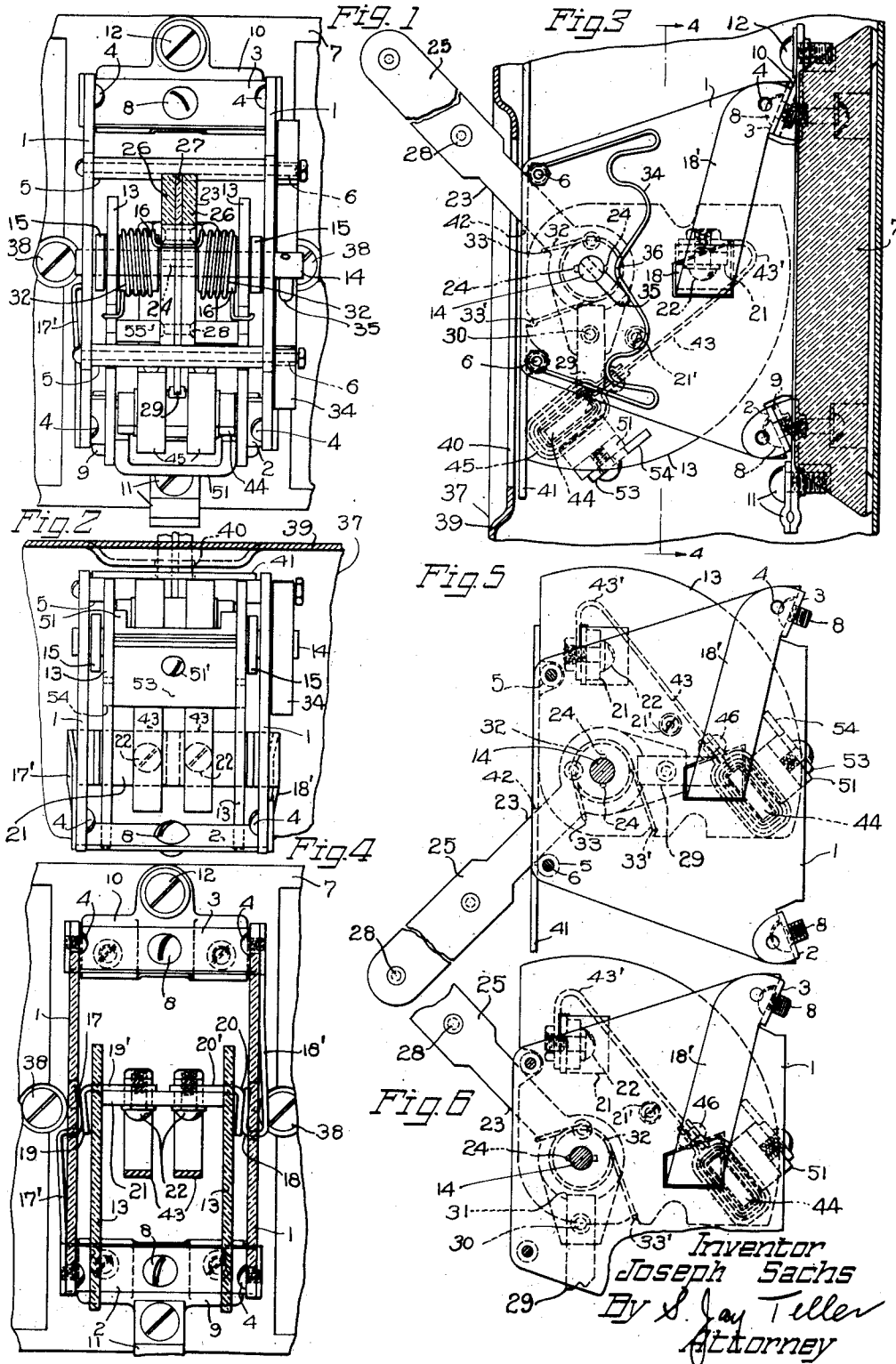
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ELECTRORESPONSIVELY CONTROLLED MECHANISM

Filed Feb. 7, 1929

2 Sheets-Sheet 1



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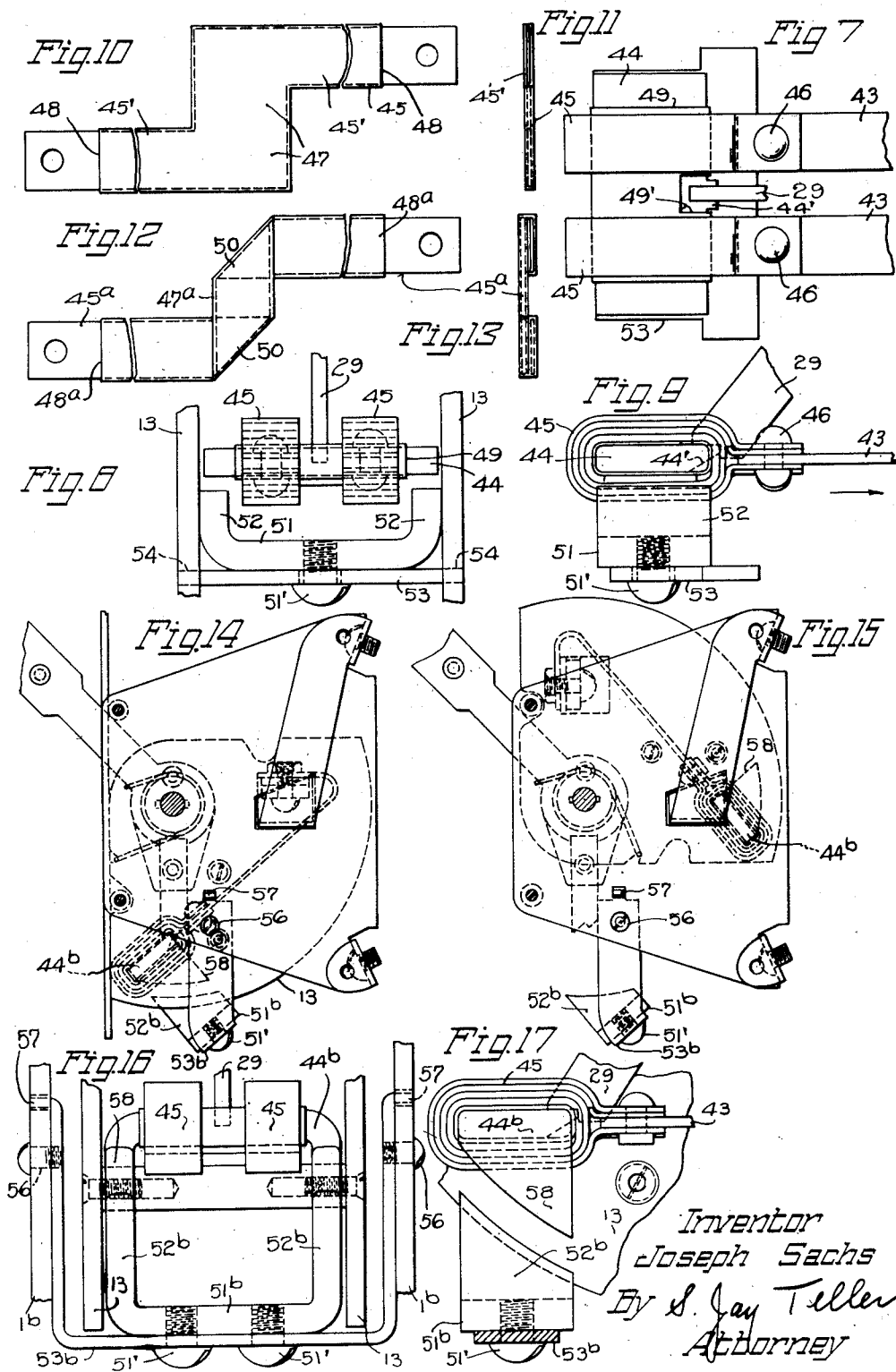
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ELECTRORESPONSIVELY CONTROLLED MECHANISM

Application filed February 7, 1929. Serial No. 338,314.

It has been heretofore proposed and practised in the design and construction of electro-responsively controlled mechanisms, such as automatic circuit breakers, to utilize both the electro-thermal effect and the electro-magnetic effect of the current to cause the automatic action of the mechanism, these two electro-responsive effects being operative in combination with each other or alternatively under different conditions. It has been proposed to obtain these two electro-responsive effects by the provision of two entirely separate devices, one an electro-thermal strip or its equivalent and the other an electro-magnet, and in cases where the electro-thermal strip was arranged to serve in and of itself as a releasable latch for normally holding an automatically movable member of the mechanism it has been proposed to so construct the magnet that it could serve either directly or indirectly to mechanically move the thermal strip to augment the tendency thereof to move under electro-thermal action.

The general object of the invention is to provide a simple, compact, reliable, efficient and inexpensive electro-responsively controlled unit, capable of being used in various devices for which electro-responsive control is desired. An automatic circuit breaker is an example of such a device. The aforesaid general object of the invention is accomplished by utilizing both the electro-thermal effect and the electro-magnetic effect of the current and by combining an electro-thermal element and the coil of an electro-magnet to form a single unit.

In accordance with one aspect of the invention the coil of the magnet is carried directly by the thermal element or is included in the structure thereof, and is electrically connected therewith between the same points of supply, and there is provided an armature cooperating with the coil, the result being that the current flowing through the thermal element and the coil tends to deflect the element as the result of the two distinct electro-responsive effects, one being the thermal effect of the current in the thermal element itself and the other being the magnetic effect of the current in the magnet coil.

As already stated, the invention is particularly well adapted for application to automatic circuit breakers and a further object of the invention is to provide a simple and reliable automatic circuit breaker having a combined unit of the character described.

In the accompanying drawings I have shown an automatic circuit breaker embodying the invention and I have also shown certain alternative details of construction, but it will be understood that the drawings are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

Fig. 1 is a front view of a circuit breaker embodying the invention, the enclosing cabinet and parts immediately associated therewith being omitted.

Fig. 2 is a bottom view of the circuit breaker with the supporting base omitted and with a portion of the enclosing cabinet shown in transverse section.

Fig. 3 is a side view of the circuit breaker as shown in Fig. 1, the supporting base and a portion of the enclosing cabinet being shown in vertical section.

Fig. 4 is a vertical sectional view taken along the line 4—4 of Fig. 3.

Figs. 5 and 6 are side views of the circuit breaker proper showing the parts in different relative positions. In these views the retaining spring for the handle is omitted for the sake of simplicity.

Figs. 7, 8 and 9 are enlarged fragmentary plan, end and side views respectively of the combined thermal magnetic device and associated parts.

Figs. 10 and 11 are plan and end views respectively of the conductor element from which the magnet coil is formed.

Figs. 12 and 13 are views similar respectively to Figs. 10 and 11 but showing an alternate construction.

Figs. 14 and 15 are views similar respectively to Figs. 3 and 6 and showing an alternate construction.

Figs. 16 and 17 are enlarged views similar respectively to Figs. 8 and 9 and showing the

combined thermal magnetic device as illustrated in Figs. 14 and 15.

Referring to the drawings particularly Figs. 1 to 6 thereof it will be observed that the main body of the circuit breaker unit comprises two spaced side plates 1, 1 and metallic cross members 2 and 3 connected at their ends with the side plates by means of screws 4, 4. The said side plates 1, 1 are additionally connected by means of spacing tubes 5, 5 having tie bolts 6, 6 extending therethrough. The said body of the circuit breaker unit is connected with a base 7 by means of screws 8, 8 extending through the members 2 and 3 and engaging metal plates 9 and 10 carried by the base. The plates 9 and 10 are provided respectively with wire terminals 11 and 12.

I provide a contact member which is movably mounted with respect to the body preferably being mounted for pivotal movement. As illustrated the contact member includes two side plates 13, 13 which are pivotally mounted upon a transverse rod 14 supported at its ends in bearing apertures in the side plates 1, 1 of the body. The side plates 13, 13 are spaced from the side plates 1, 1 by means of washers 15, 15 and are spaced from each other by means of bushings 16, 16.

Suitable electric contacts are provided, there preferably being two stationary contacts carried by the body of the circuit breaker and two movable contacts carried by the contact member and adapted to be engaged with and disengaged from the respective stationary contacts. The details of the contacts may be varied widely but as illustrated the two stationary contacts 17 and 18 are carried respectively by the two side plates 1, 1. The contact 17 at the left is formed as a part of a plate 17' which extends vertically along the outer surface of the left side plate 1 and is held by the corresponding screw 4 at the bottom. The said side plate 1 is formed with an opening therein and the strip 17' is bent to extend through the opening, the contact portion 17 of the strip being located at or near the plane of the inner face of the side plate. Similarly the contact 18 at the right is formed as a part of a strip 18' which extends vertically along the outer surface of the right side plate 1 and is held by the corresponding screw 4 at the top. The said side plate 1 is formed with an opening therein and the strip 18' is bent to extend through the opening, the contact portion 18 of the strip being located at or near the plane of the inner face of the side plate. It will be seen that by means of the construction shown the said contacts 17 and 18 are connected respectively with the cross members 2 and 3 and thus with the plates 9 and 10 and the terminals 11 and 12.

The movable electrical contacts are shown at 19 and 20 respectively these contacts pro-

jecting laterally from the said plates 13, 13 of the contact member and being adapted to respectively engage the stationary contacts 17 and 18 as shown most clearly in Fig. 4. Extending transversely between the two side plates 13, 13 is an insulating bar 21 and the two contacts 19 and 20 are extended inward as shown at 19', 20' through suitable apertures in the side plates so as to engage the bar 21 at the upper side thereof as shown in Fig. 4. The said contacts are held in place by means of screws 22, 22. The two plates 13, 13 may be additionally connected by means of a cross member 21'.

I provide a movable member 23 which I will term an actuator, this member serving as the means for moving or actuating the contact member for normal switching purposes or to effect the closing of the circuit after automatic opening thereof. This actuator is shown as being supported by the transverse rod 14 between the two bushings 16, 16 and thereby held against transverse movement. As illustrated the rod 14 is rotatably mounted and the actuator is connected thereto by means of keys as shown at 24, 24. The actuator 23 is manually operable and I have shown for this purpose a handle 25 directly connected therewith, but it will be understood that I do not limit myself to a direct rigid connection between the handle and the actuator. As illustrated the handle 25 and the main body of the actuator 23 are formed from two separate sheets or plates 26, 26 of material cut to the required shape and from a third similarly shaped spacing plate 27 between them. The said three plates are connected by means of rivets as shown at 28, 28. Mounted between the two main plates 26, 26 is a metal plate 29 held by a rivet 30 and having its inner end seated in a notch formed at 31 in the inner plate 27. The metal plate 29 forms an essential part of the actuator and it is rigidly connected with the handle for movement therewith. Movement of the handle and actuator is limited by the tubes 5, 5.

A spring means is provided for biasing the contact member, that is, the plates 13, 13 and the parts carried thereby, for automatic movement in the counter-clockwise circuit-opening direction. This spring means may be varied as to construction and mounting, but as shown there is a single spring having two separate coils 32, 32 respectively surrounding the two bushings 16, 16. The central connecting portion of the spring engages the handle as shown at 33 and the ends of the spring engage the respective plates 13, 13 as shown at 33', 33'. Thus the spring tends to move the contact member in the counter-clockwise direction with respect to the handle and actuator.

For normally mechanically connecting the contact member with the actuator in order to

prevent the automatic circuit-opening movement of the actuator and in order to enable the actuator to control the contact member for movement thereof for normal switching purposes I provide an electro-responsive control mechanism between the said actuator and the said contact member, which mechanical connection is automatically released upon the passage of excess current. Upon being released the contact member automatically moves to its circuit opening position entirely independently of the actuator under the influence of the springs 32, 32.

For yieldably holding the handle 25 in either its circuit-opening position or its circuit-closing position there is provided a spring member 34 which is held in place by means of the aforesaid tie bolts 6, 6. Carried by the spindle 14 is a pin 35 which engages at either side of a forward bent portion 36 of the spring member 34. With the handle in circuit-closing position as shown in Fig. 3 the said pin 35 engages the lower side of the said portion 36 and the handle is yieldably held. When the handle is moved downward to its circuit-opening position the pin 35 snaps over the portion 36 of the spring member and engages the upper side thereof thus yieldably holding the handle in its lower circuit-opening position.

The circuit breaker proper may be enclosed in a suitable cabinet such as the cabinet 37 of which portions are shown in Figs. 2 and 3. The base 7 is secured to the rear wall of the cabinet by suitable means such as screws 38, 38 shown in Fig. 1. The cabinet has a front cover 39 which is openable to permit access to the circuit breaker proper. The cover 39 has a vertical slot 40 therein through which the handle 25 projects. Preferably there is a vertical slide plate 41 adjacent the slot 40, this slide plate having a relatively small opening 42 therein through which the handle 25 projects. The slide plate 41 serves to substantially close the slot 40 and is vertically movable to permit movement of the handle. The plate 40 is guided at the sides by the plates 1, 1 of the circuit breaker body, is guided at the rear by the said spacing tubes 5, 5 extending between the said plates, and is guided at the front by the main cover 39.

The circuit breaker as thus far described is in many respects similar to those set forth in my copending applications for Automatic circuit breaker, Serial No. 271,819 filed April 21, 1928 and Serial No. 283,060 filed June 5, 1928. The mechanical details of construction as thus far described are not claimed as a part of the present invention being set forth in the aforesaid applications and in other prior applications therein referred to. As concerns the broader phases of the invention the circuit breaker as shown and described is to be regarded as merely typical or representative of that class of electro-respon-

sively controlled mechanisms to which the invention is applicable. As concerns the more specific phases of the invention the circuit breaker as shown and described is co-operatively combined with the novel features now to be described in detail.

In accordance with the invention I provide an electro-responsive device of peculiar construction which is adapted for a wide variety of uses but which is particularly adapted for use as a part of a circuit breaker of the type described. The novel electro-responsive device is shown in detail in Figs. 7 to 13, and these figures will now be particularly referred to. The electro-responsive unit comprises essentially an electro-thermally-responsive element, such as a bi-metallic strip, which is adapted to be moved or deflected by reason of the heating action of current therein in accordance with the well known action of such elements; and the said unit further comprises a magnet coil included in the structure of or carried by the said element and electrically connected therewith. By mounting or forming the coil directly upon or as a part of the thermal element structure I am enabled to utilize both the electro-thermal effect and the electro-magnetic effect of the current and at the same time I provide a unit which is compact, simple and inexpensive and which has numerous other advantages as will presently appear.

The details of the mechanical construction of the combined thermal magnetic unit may be widely varied but preferably and as shown the electro-thermal element comprises two parallel or substantially parallel bi-metallic strips 43, 43 adapted to be rigidly mounted at one end, as for instance the right hand end, these two strips or parts being adapted to be electrically connected so as to form portions of the electric circuit. The magnet coil is carried by the two strip parts 43, 43 and is electrically connected between them so as to complete the electric circuit.

As to the details of the magnet I do not necessarily narrowly limit myself but I prefer and have shown a magnet having a core 44 which extends transversely of the strip parts 43, 43 and which is parallel with the plane of the said parts. The coil of the magnet surrounds the core 44 and the said coil is preferably formed in two parts 45, 45 which parts are spaced transversely from each other as shown. Each of the two parts 45, 45 of the magnet coil is preferably formed of a flat strip of conducting material carried by and electrically connected with the corresponding part 43 of the thermal strip. The material forming each part 45 of the coil may be an integral extension of the corresponding part 43 of the thermal strip or it may be a separate strip of material secured to the corresponding part of the thermal strip by riveting or otherwise. As shown each part 45

of the coil is formed of material separate from the thermal strip, the material of the coil being connected to that of the strip by means of a rivet at 46.

5 It is convenient and preferable to form the two parts 45, 45 of the coil of a single piece of material such for instance as that illustrated in Figs. 10 and 11. It will be observed that this piece of metal comprises two
10 parallel parts 45', 45' extending in opposite directions and connected at their adjacent ends by means of a transverse portion 47. The two main parts 45', 45' of the strip are wound around the core 44 and then connected
15 with the thermal strip parts 43, 43 at 46, 46 as already stated. It will be observed that with the construction as shown in Figs. 10 and 11 the two parts 45, 45 of the coil are both wound in the same direction as is obviously necessary. The conducting element
20 or strip forming the coil is suitably insulated in any desired way as indicated at 48 prior to being wound on the core. The insulating of the said strip may be effected by winding it with a suitable insulating tape. If necessary
25 the coil parts may be further insulated from the core 44 by means of a sheet 49 of insulating material surrounding the core.

30 Figs. 12 and 13 show a construction alternative to that shown in Figs. 10 and 11 there being a single strip 45^a which is of uniform width throughout but which is folded over as indicated at 50, 50 to provide the required offset connection 47^a between the two
35 main portions thereof. This strip is similarly insulated as shown at 48^a.

The armature of the magnet is mounted in a relatively fixed position, that is, it is mounted so that it cannot move toward the
40 core and the coil. The armature is shown at 51 in Figs. 8 and 9, being formed with end portions 52, 52 adapted to directly cooperate with the end portions of the core 44.

The thermal magnetic unit which has been
45 described is adapted and intended for regulating or controlling purposes, as for instance for controlling or preventing relative movement between itself and some other element. I have shown it as serving to prevent relative movement between itself and
50 an element such as the before described actuator 29. For present purposes the element 29 may be regarded as normally stationary and the thermal magnetic device may be regarded as biased for movement toward the
55 right as indicated by the arrow in Fig. 9. As shown the element 29 is notched at its end so as to be adapted to directly engage with the exposed portion of the core 44 between the two parts 45, 45 of the magnet coil.
60 To facilitate proper engagement with the element 29 the core 34 may be extended toward the right as indicated at 44' and the insulation 49 may be cut away as indicated at 49'. It will be seen that when the core

44 is engaged with the element 29 as shown in Fig. 9 movement of the thermal magnetic device toward the right is positively prevented. When current is caused to flow through the two parts 43, 43 of the thermal
70 strip and through the magnet coil 45, 45 there is a tendency for the end portion of the thermal magnetic device to be moved downward. This tendency results partly from the tendency of the strip parts 43, 43
75 to bend downward upon being heated and partly from the magnetic action tending to draw the core 44 toward the armature 51.

The parts may be so constructed and adjusted that a moderate overload continued
80 for a considerable time will cause the bimetallic strip parts 43, 43 to deflect sufficiently to cause the disengagement of the core 34 from the element 29, this result being attained without any substantial assistance
85 from the magnetic action as the said magnetic action would be relatively small because of the comparatively low amperage and the small number of turns in the magnet coil. However, in the case of excessive overload
90 such as might be caused by a short circuit the resulting high amperage will instantly energize the magnet thus drawing the core 44 toward the armature 51 sufficiently to disengage it from the element 29. As soon as
95 the core is disengaged from the said element 29, whether by reason of the thermal action or by reason of the magnetic action or by reason of a combined thermal and magnetic action relative movement instantly takes
100 place automatically, the thermal-magnetic device being moved toward the right as already described.

When the electro-thermal unit forms a part of a circuit breaker of the type already described, and shown in Figs. 1 to 5, the ends of the thermal strip parts 43, 43 are connected
105 respectively with the contacts 19 and 20 by means of nuts on the aforesaid screws 22, 22. Thus the thermal magnetic unit is connected in series with and between the two movable
110 contacts 19 and 20. As illustrated the two strip parts 43, 43 are bent as indicated at 43' so as to be brought into proper relationship with the actuator 29. The said thermal magnetic unit engages the actuator 29 in the manner
115 already described in detail in conjunction with Figs. 7 to 9 and it thus serves as a mechanical connection between the actuator and the contact member of the
120 circuit breaker. The armature 51 of the magnet is mounted by means of a screw 51' upon a transverse plate 53 preferably of insulating material and having its ends seated in openings 54 in the two side
125 plates 13, 13 of the contact member. It will be seen that the entire magnet is movable with the contact member. When the actuator is moved by means of the handle 25 the contact member is correspondingly moved to
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open and close the circuit for ordinary switching purposes. The contact member is positively moved in the clockwise circuit-closing direction by reason of the direct engagement between the thermal magnetic device and the actuator and it is moved in the circuit-opening counter-clockwise direction by the springs 32, 32 acting under the control of the actuator.

Upon the passage of excess current the thermal magnetic unit is deflected in the manner already described in detail so that the core 44 is disengaged from the actuator 29. Thereupon the contact member instantly moves in the counter-clockwise direction to its circuit-opening position under the influence of the springs 30, 30. The circuit breaker can be restored to its circuit-closing position by first moving the handle 25 to the circuit-opening position so as to restore the engagement between the thermal magnetic device and the actuator and by then returning the handle to closed circuit position.

In Figs. 14 to 17 I have shown an alternative construction which is similar to that already described except for a difference in the construction and mounting of the core and armature of the magnet. The armature 51^b of the magnet instead of being mounted upon the contact member to be movable therewith is mounted upon the body of the circuit breaker so as to be stationary. As shown there is a yoke 53^b upon which the armature is mounted by means of screws 51', 51', the yoke being connected at each end to the corresponding side plate 1 by means of a screw 56 and a lug 57. The core 44^b is provided with outward extending flanges 58, 58 having arcuate outer edges which are substantially concentric with the pivotal axis of the contact member. The flanges 52^b, 52^b of the armature 51^b are similarly curved at their inner edges.

The action of the unit shown in Figs. 14 to 17 is identical with that already described, with the single exception that the armature 51^b does not move with the contact member. Upon the passage of excess current the core 44^b moves toward the armature 51^b to effect disengagement from the actuator 29 but as soon as released from the actuator the core and the coil of the magnet move away from the armature as clearly indicated in Fig. 15.

What I claim is:

1. As an article of manufacture, an electro-responsive unit comprising a current-carrying electro-thermal element and a magnet coil included in the structure of the said element and electrically connected in circuit therewith.

2. As an article of manufacture, an electro-responsive unit comprising a current-carrying electro-thermal strip and a magnet coil carried thereby and electrically connected in circuit therewith.

3. As an article of manufacture, an electro-responsive unit comprising an electro-thermal strip having two parts and a magnet coil carried by the two parts of the strip and electrically connected between them.

4. As an article of manufacture, an electro-responsive unit comprising an electro-thermal strip having two parallel parts, a magnet core carried by the two parts of the strip and extending transversely thereof and parallelly with the plane thereof, and a magnet coil surrounding the core and carried by the two parts of the strip in electrical connection between them.

5. As an article of manufacture, an electro-responsive unit comprising an electro-thermal strip having two parallel parts, a magnet core carried by the two parts of the strip and extending transversely thereof and parallelly with the plane thereof, and a magnet coil surrounding the core and having two parts spaced from each other with each part formed from a flat strip of material carried by and electrically connected with the corresponding part of the thermal strip.

6. An electro-responsively controlled mechanism, comprising in combination, a member biased for automatic movement, and releasable means normally serving to prevent such automatic movement and including an electro-responsive unit, the said unit comprising an electro-thermal element and a magnet coil included in the structure thereof and the said unit serving upon the passage of excess current through the thermal element and magnet coil to effect the release of the said releasable means and to thereby permit the automatic movement of the said movable member.

7. An electro-responsively controlled mechanism, comprising in combination, a member biased for automatic movement, and releasable means normally serving to prevent such automatic movement and including an electro-responsive unit, the said unit comprising an electro-thermal strip and a magnet coil carried thereby and the said unit serving upon the passage of excess current through the strip and magnet coil to effect the release of the said releasable means and to thereby permit the automatic movement of the said movable member.

8. An electro-responsively controlled mechanism as set forth in claim 7 wherein the thermal strip with the magnet coil thereon serves in and of itself as a releasable latch to prevent the automatic movement of the movable member.

9. An automatic circuit breaker comprising in combination, two electric contacts in engagement with each other and one of them biased for automatic movement out of such engagement to open the circuit, and releasable means normally serving to prevent such automatic movement and including an elec-

- tro-responsive unit, the said unit comprising an electro-thermal element and a magnet coil included in the structure thereof and the said unit serving upon the passage of excess current through the thermal element and magnet coil to effect the release of the said releasable means and to thereby permit the automatic circuit opening movement of the movable contact.
- 10 10. An automatic circuit breaker comprising in combination, two electric contacts in engagement with each other and one of them biased for automatic movement out of such engagement to open the circuit, and releasable means normally serving to prevent such automatic movement and including an electro-responsive unit, the said unit comprising an electro-thermal strip and a magnet coil carried thereby and the said unit serving upon the passage of excess current through the strip and magnet coil to effect the release of the said releasable means and to thereby permit the automatic circuit opening movement of the movable contact.
- 15 11. A circuit breaker as set forth in claim 10 wherein the thermal strip with the magnet coil therein serves in and of itself as a releasable latch to prevent the automatic movement of the movable contact.
- 20 12. A circuit breaker as set forth in claim 10 wherein the thermal strip comprises two parts and wherein the magnet coil is carried by and electrically connected between the said parts.
- 25 13. An automatic circuit breaker comprising in combination, two electric contacts in engagement with each other and one of them biased for automatic movement out of such engagement to open the circuit, and releasable electro-responsively controlled means normally serving to prevent such automatic movement and including an electro-thermal strip with two parts and also including a magnet having the core and coil thereof carried by the two parts of the strip with the latter electrically connected between them and having the armature thereof held against relative movement toward the strip, the said electro-thermal strip and magnet serving upon the passage of excess current there- through to effect the release of the said releasable means and to thereby permit the automatic circuit-opening movement of the movable contact.
- 30 14. An automatic circuit breaker comprising in combination, two electric contacts in engagement with each other and one of them biased for automatic movement out of such engagement to open the circuit, a manually operable actuator, and a releasable electro-responsive unit movable with the movable contact and the actuator and normally serving to mechanically connect them for normal switching movements, the said unit comprising an electro-thermal strip and a magnet coil carried thereby and the said unit serving upon the passage of excess current through the strip and coil to effect the release of the said movable contact from the actuator and to thereby permit the independent automatic circuit opening movement of the said contact.
- 35 15. A circuit breaker as set forth in claim 14 wherein the thermal strip with the magnet coil thereon is connected with the movable contact for movement therewith and serves in and of itself as a releasable latch normally engaging directly with the actuator.
- 40 16. A circuit breaker as set forth in claim 15 wherein the core of the magnet extends transversely of the strip and parallelly with the plane thereof, wherein the magnet coil is in two parts spaced from each other with the core exposed between them, and wherein the said exposed portion of the core has direct releasable engagement with the actuator.
- 45 17. An automatic circuit breaker comprising in combination, two electric contacts in engagement with each other and one of them biased for automatic movement out of such engagement to open the circuit, a manually operable actuator, and a releasable electro-responsive unit movable with the movable contact and the actuator and normally serving to mechanically connect them for normal switching movements, the said unit comprising an electro-thermal strip with two parts and also comprising a magnet having the core and coil thereof carried by the two parts of the strip with the latter electrically connected between them and having the armature thereof held against relative movement toward the strip and the said unit serving upon the passage of excess current through the strip and magnet coil to effect the release of the said movable contact from the actuator and to thereby permit the independent automatic circuit opening movement of the said contact.
- 50 In testimony whereof I have hereunto set my hand this 31st day of January, 1929.
- 55 JOSEPH SACHS.