

E. J. WALKER ET AL

CIRCUIT BREAKER WITH IMPROVED TRIP MEANS

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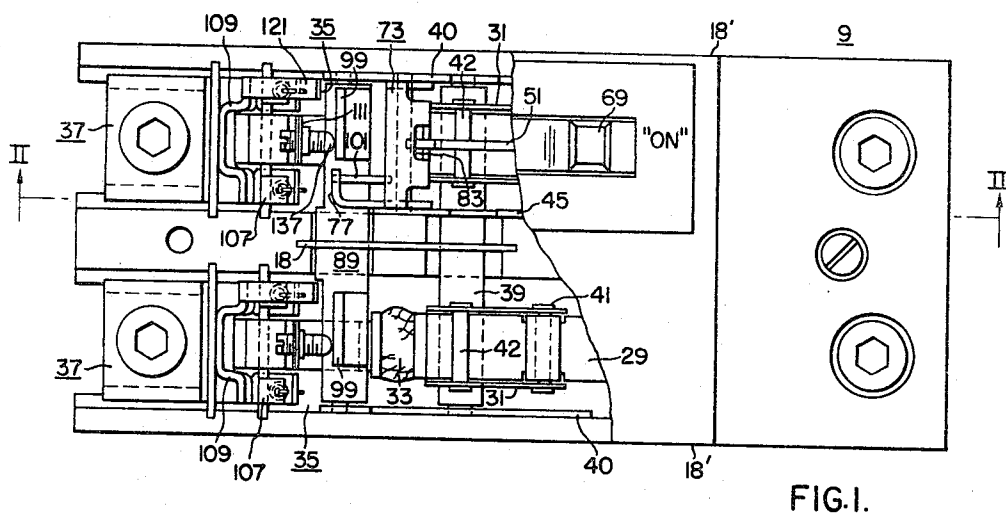


FIG. 1.

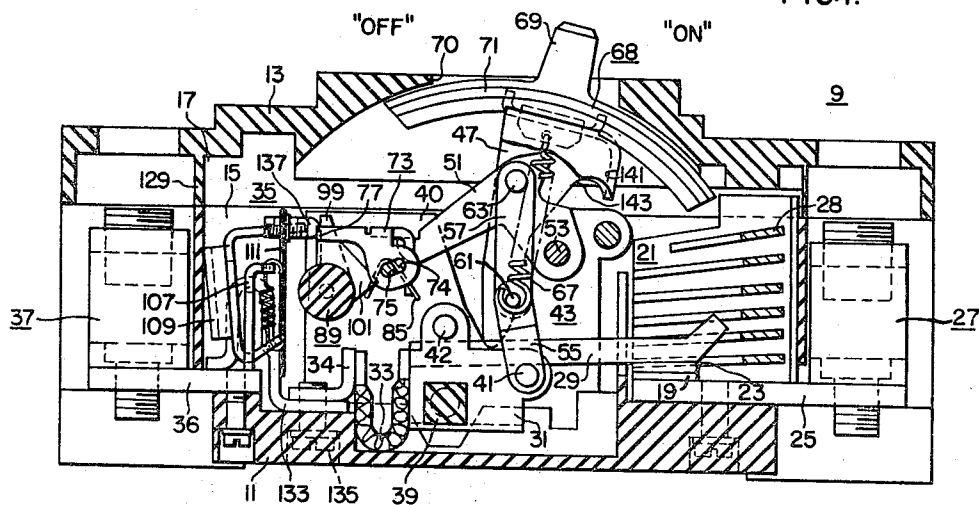


FIG.2.

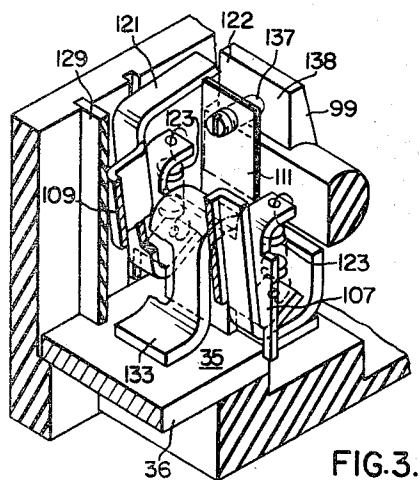


FIG.3.

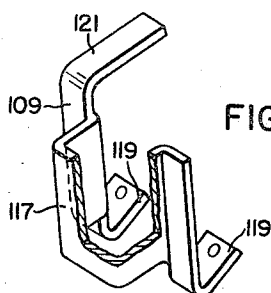


FIG.5.

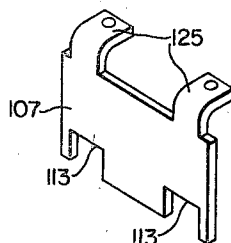


FIG.4.

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CIRCUIT BREAKER WITH IMPROVED
TRIP MEANS

Eugene J. Walker, Beaver, and John Majcher, Beaver
Falls, Pa., assignors to Westinghouse Electric Corpora- 5
tion, Pittsburgh, Pa., a corporation of Pennsylvania
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ABSTRACT OF THE DISCLOSURE

An improved circuit breaker comprises a tripping 10
electromagnet comprising a stationary magnetic member
and a movable magnetic member with spring means bias-
ing the movable magnetic member toward the front of 15
the breaker to pivotally support the movable magnetic
member on the stationary magnetic member.

An object of this invention is to provide an improved 20
circuit breaker having an improved compactly constructed
trip device that comprises a thermal time-delay trip for
automatically opening the breaker upon the occurrence
of lesser overload currents and a magnetic trip for auto- 25
matically and instantaneously opening the breaker upon
the occurrence of fault currents in the order of ten or
more times the normal current controlled by the breaker.

Another object of this invention is to provide a circuit 30
breaker having an improved compactly constructed mag-
netic trip device that comprises a first and stationarily
supported magnetic member and a second magnetic mem-
ber that is pivotally supported on the first magnetic mem-
ber, which second magnetic member is movable to effect
automatic opening of the circuit breaker upon the occur- 35
rence of overload currents above a predetermined value.

Another object of this invention is to provide an im- 40
proved circuit breaker of the molded-case type which
circuit breaker comprises an improved thermal and mag-
netic trip means that is compact in construction, relatively
easy to assemble, and dependable in operation.

The novel features that are considered characteristic 45
of the invention, both as to structure and operation, to-
gether with additional objects and advantages thereof, will
be best understood from the following detailed descrip-
tion when read in conjunction with the accompanying
drawings.

In said drawings:

FIGURE 1 is a top plan view, with parts broken away, 50
of a circuit breaker embodying principles of the subject
invention;

FIG. 2 is a side elevational view taken generally along 55
the line II—II of FIG. 1;

FIG. 3 is a perspective view, with parts broken away, 60
illustrating parts of the trip device of the circuit breaker
of FIGS. 1 and 2;

FIG. 4 is a perspective view of the stationary magnet 65
member of the trip device illustrated in FIGS 1-3; and

FIG. 5 is a perspective view, with parts broken away, 70
of the movable magnet member of the trip device illus-
trated in FIGS. 1-3.

Referring to FIGS. 1 and 2 of the drawings, there is
shown therein a two-pole circuit breaker 9 comprising a
molded insulating housing that comprises a base 11 and
a cover 13 both of molded insulating material. Between
the adjacent pole units, a barrier 15, that is molded
integral with the insulating base 11, cooperates with a
barrier 17, that is molded integral with the insulating
cover 13, to isolate the pole units. An insulating insert bar-
rier member 18 (FIG. 1) fits in suitable slots in the bar-
rier 15 to cooperate with the barrier 15 to close off the
lower portion of the internal housing space. The barriers

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15, 17, 18 divide the housing 11, 13 longitudinally into
two adjacent pole-unit compartments.

As will be understood with reference to FIGS. 1 and 2,
the sidewalls 18' and barriers 15, 17, 18 are generally
planar and the planes thereof are disposed normal to the
plane of the generally planar bottom of the housing.

Each pole of the circuit breaker (only one pole being
shown in FIG. 2) includes a stationary contact 19, an
arc-extinguisher 21, and a movable contact 23. The sta-
tionary contact 19 is mounted on the inner end of a con-
ducting strip 25. A well-known type of terminal con-
nector indicated generally at 27 is provided at the outer
end of the conducting strip 25 to enable connection of
the circuit breaker in an electric circuit. The arc-extin-
guisher 21 comprises a plurality of slotted plates 28 of
magnetic material, which plates are disposed such that the
movable contact 23 moves through the slots of the plates.
The arc drawn between the separating contacts is extin-
guished in the arc extinguisher 21 in a well known
manner. The movable contact 23 is carried at the free
end of a contact arm 29 that is suitably connected for
limited resilient movement on a U-shaped switch member
31. A flexible conductor 33 is connected at one end to
the contact arm 29 and at the other end to a terminal 34
that is connected to a trip device 35 that will be herein-
after more specifically described. The trip device 35 is
connected at the other end thereof to the inner end of a
terminal conductor 36. A terminal connector 37 is con-
nected to the external end of the conductor 36. The termi-
nal connector 37 is a well known type of solderless termi-
nal connector. The arc extinguishers, current-carrying parts
and trip devices of the two poles of the circuit breaker
are of substantially identical construction. Thus, only one
pole is herein specifically shown and described.

The two movable switch members 31 are fixedly
mounted on an insulating tie-bar 39 that extends across
the two pole units of the circuit breaker. The tie-bar 39
is supported for rotation about its longitudinal axis on two
support plates 40 that are disposed at the opposite sides of
the housing 11, 13. The two switch members 31 and con-
tact arms 29 are simultaneously moved to the open and
closed positions upon rotation of the tie-bar 39.

Each of the contact arms 29 is a rigid conductor that
is supported for pivotal movement on a pin 41 that is
supported between the legs of the associated switch mem-
ber 31. A suitable spring (not shown) is supported in
each pole to bias the associated contact arm 29 about the
pivot 41 in a clockwise (FIG. 2) direction to provide
contact pressure in the closed position. Clockwise move-
ment of each contact arm 29 about the associated pivot
39 is limited by engagement of the contact arm with a
stop pin 42 that is supported on the associated switch
member 31.

A single operating mechanism 43 is provided for
simultaneously actuating the contact arms 29 to the open
and closed positions. The operating mechanism 43 is sup-
ported at the side thereof on one of the plates 40 and at
the other side thereof on another support 45 (FIG. 1).
The support plates 40 and 45 that support the operating
mechanism 43 are disposed in the one pole unit compart-
ment. An inverted generally U-shaped operating member
47 is provided for manually operating the circuit breaker.
The operating member 47 is pivotally supported, at
the inner ends of the legs thereof, on pivot surfaces of
the support plates 40, 45. A releasable trip member 51
is supported on a pin 53 that is pivotally supported between
the support plates 40, 45. A pair of toggle links 55 and
57 are pivotally connected together by a knee pivot 61.
The upper toggle link 57 is pivotally connected to the
releasable trip member 51 by means of a pin 63. The
lower toggle link 55 is pivotally connected to the pin 41

that is supported on the switch member 31 of the one pole unit. Two tension springs 67 (only one being shown in FIG. 2) are connected at the inner ends thereof to the knee pivot 61 and at the outer ends thereof to the bight portion of the U-shaped operating member 47. A molded insulating operating handle 68 is suitably connected to the operating member 47. The handle 68 comprises an external handle part 69 that protrudes out through an opening 70 in the front of the housing cover 13. An annular shield part 71 is formed integral with the handle 68 to substantially close the opening 70 in all positions of the handle.

When the handle 68 is moved from the "off" position to the "on" position the operating member 47 and springs 67 are operated to move the toggle 55, 57 to the position seen in FIG. 2 with a snap action to simultaneously move the three contact arms 29 to the closed position. Upon counterclockwise movement of the handle structure 68 from the "on" to the "off" position, the operating member 47 and springs 67 are operated to effect a collapse of the toggle 55, 57 to simultaneously move the contact arms 29 to the open position. The operation of this general type of operating mechanism is more specifically described in the patent to Dyer et al., Patent No. 2,416,163.

A latch member 73 is provided with two depending spaced legs, each of which legs is provided with an elongated slot 74 (FIG. 2) therein. The slots 74 receive a pin 75 that is supported between the supporting plates 40, 45 to support the latch 73 on the supporting plates. The latch 73 is provided with a latch arm on one side of the pivot 75, which arm is bent-over at the external end 77 thereof (FIG. 1). The end 81 of the latch 73, that is disposed on the other side of the pivot pin 75, is provided with an opening 83 (FIG. 1) therein. A torsion spring 85, that is disposed on the pin 75, engages the latch 73 and a trip bar structure 89 to bias the latch 73 in a counterclockwise (FIG. 2) direction and to bias the trip bar structure 89 in a counterclockwise (FIG. 2) direction. The structure and operation of the torsion spring member 85 is more specifically disclosed in the copending application of John G. Salvati et al., W. E. case No. 37,944, Ser. No. 527,674, filed Feb. 16, 1966, and assigned to the assignee of the instant application.

The trip bar structure 89 comprises a molded insulating elongated main body part having two pins formed integral therewith at the opposite ends thereof that are disposed in suitable openings in the support plates 40 to support the trip bar structure 89 for rotation about its longitudinal axis. Two projections 99, that are molded as integral parts of the trip bar structure 89, extend upwardly to be engaged during tripping operations in a manner to be hereinafter described. There is a projection 99 in each of the two pole units of the circuit breaker. A latch part 101, that is molded as an integral part of the trip bar structure 89, is provided with an upper latch surface that is engaged by the bent-over part 77 of the latch 73 (FIG. 1) to latch the latch 73 in the latched position seen in FIGS. 1 and 2. As is best seen in FIG. 1, the free end of the releasable trip member 51 extends into the opening 83 in the latch 73. When the circuit breaker is in operating position, the springs 67 pull the knee pivots 61 to force the releasable trip member 51 in a clockwise (FIG. 2) direction about the pivot 53. This movement is prevented by engagement of the free end of the trip member 51 with the latch 73 tending to rotate the latch 73 in a counterclockwise (FIG. 2) direction about the pivot pin 75. This counterclockwise movement of the latch 73 is prevented by engagement of the bent-over end 77 with the latch part 101 of the trip bar structure 89. When the parts are in this operating position, the circuit breaker can be manually operated between the "on" and "off" positions in the same manner hereinbefore described.

The trip device 35 (FIGS. 1-3) comprises a stationary

sheet metal member 107 of magnetic material, a movable sheet-metal member 109 of magnetic material and a bimetal member 111. The stationary magnetic member 107 is stationarily supported on the bottom of the housing part 11 with the sides thereof being disposed in suitable slots in the opposite side walls of the associated pole-unit compartment. As can be seen in FIG. 4, the stationary magnetic member 107 is formed with two notches or openings 113 at the lower or back part thereof. The movable magnetic member 109 is a member of magnetic material that comprises a main body part that is bent-over to form a part 117 that is generally U-shaped in cross section. The magnetic member 109 is also formed with two integral lower leg parts 119 and an integral extension 121. The extension 121 is disposed opposite a surface 122 of the part 99 and the surface part 122 is engaged by the extension 121 during magnetic tripping operations. When the circuit breaker is assembled, the movable magnetic member 109 is positioned with the generally U-shaped main body part on one side of the stationary magnetic member 107 and with the pivot support means or lower leg parts 119 pivotally engaging the pivot surface means or upper edges of the openings 113, which leg parts 119 extend through the openings to the other side of the stationary magnetic member 107. Two tension springs 123 are connected to the members 109 and 107 to pivotally support the member 109 on the member 107. As can be seen in FIGS. 1-3, the springs 123 engage in suitable openings in the legs 119 and suitable openings in bent-over projections 125 on the stationary magnet member 107 to draw the movable magnet member 109 upward into pivotal support with the stationary magnet member 107 and to bias the movable magnet member 109 in a counterclockwise (FIG. 2) direction about the pivots 113. This counterclockwise pivotal movement of the movable magnet member 109 is limited by engagement of the member 109 with an insulating barrier 129 that is disposed in suitable slots in the housing 11, 13.

As can be seen in FIG. 2, the conducting member 34 is connected to a conductor 133, which members are secured to the base 11 by means of a screw 135. The conductor 133 is a looped rigid conductor with the loop extending upward over the main body part of the stationary magnet member 107 between the projections 125 of the member 107 and then downward between the opposite legs of the U-shaped part 117 of the movable magnet member 109 and then under the generally U-shaped part 117 of the movable magnet member 109 to a position where the conductor 133 is welded or otherwise fixedly secured to the terminal conductor 36. The bimetal member 111 is welded or otherwise fixedly secured to one flat side of the rigid looped conductor 133. The bimetal 111 extends upward alongside one side of the loop of the conductor 133, and a calibrating screw 137 is threaded into a tapped opening in the upper end of the bimetal member 111. The calibrating screw 137 is disposed adjacent a surface part 138 of the part 99, which surface part 138 is engaged by the screw 137 during thermal tripping operations. As can be seen in FIG. 3, the extension 121 of the movable magnet member 109 is disposed at one side of the bimetal 111 adjacent the screw 137. The actuating surface parts 122, 138 are adjacent integral surface parts of the trip bar part 99.

The circuit through each pole unit of the circuit breaker extends from the terminal 27 (FIG. 2) through the conductor 25, the stationary contact 19, the movable contact 23, the contact arm 29, the flexible conductor 33, the conductor 34, the looped conductor 133, the conductor 36 to the other terminal connector 37.

As can be seen in FIGS. 1 and 2 the trip bar structure 89 extends across both pole units of the circuit breaker through suitable opening means in the barriers 15, 18.

Upon the occurrence of a lesser overload current above a predetermined value (for example, upon the occurrence of a current of 125% of the normal current) the bimetal

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111, which is secured to the looped conductor 133 in a heat-conducting relationship with the conductor 133 and which extends along the one side of the looped conductor 133, becomes heated sufficiently to flex to the right (FIG. 2) whereupon the calibrating screw 137 engages the associated part 99 of the trip bar structure 89 to rotate the trip bar structure 89 in a clockwise (FIG. 2) direction to a tripped position to trip the circuit breaker. During this movement, the latch part 101 of the trip bar 89 clears the bent-over end 77 (FIG. 1) of the latch 73, and the latch 73 is then free to rotate in a counterclockwise (FIG. 2) direction. When the latch 73 is free for counterclockwise movement, the springs 67 operate through the toggle link 57 to rotate the trip member 51 clockwise (FIG. 2) and to rotate the latch 73 about the pivot 75 to release the trip member 51. The springs 67 rotate the trip member 51 in a clockwise direction moving the link 57 and springs 67 to effect collapse of the toggle 55, 57 and opening movement of the contact arms 29 in a well known manner. The handle structure 68 will be moved to an intermediate position between the "on" and "off" positions to give a visual indication that the circuit breaker has been tripped. The circuit breaker is trip-free in that the circuit breaker will trip open even if the handle 68 is held in the "on" position.

The mechanism is reset by moving the handle structure 68 slightly beyond the full "off" position. During this movement, a part 141 on the operating member 47 will engage a part 143 on the releasable trip member 51 to rotate the trip member 51 in a counterclockwise direction. Near the end of this movement, the free end of the trip member 51 will move into the opening 83 (FIG. 1) in the latch member 73 and engage the latch member 73 at the lower end of the opening to rotate the latch member 73 in a clockwise (FIG. 2) direction back to the latching position seen in FIG. 2. During this movement, the torsion spring 85, engaging the latching part 101 of the trip 89, will bias the trip bar 89 in a counterclockwise direction back to the latching position seen in FIG. 2. This movement of the trip bar to the latching position is limited by the engagement of the trip bar part 99 with the screw 137. Thereafter, upon release of the handle 68 the springs 67 will operate to bias the trip member 51 clockwise, which movement is prevented by the latch 73 that is biased in a counterclockwise direction, which movement is further prevented by the previously mentioned engagement of the latch arm part 77 of the latch 73 with the latch part 101 of the trip bar structure 89. After the circuit breaker has been reset, the circuit breaker can be manually operated in the same manner hereinbefore described. The above-mentioned thermal tripping operation occurs with a time delay in that the bimetal 111 will flex to the tripping position with a time delay.

Upon the occurrence of a severe overload or short circuit such, for example, as ten times the normal rated current, the current through the looped conductor 133 generates sufficient magnetic flux through the magnet members 109, 107 to instantaneously attract the movable magnet member 109 in a clockwise (FIG. 2) direction about the pivots 113 (FIG. 4). During this movement, the actuating part 121 (FIGS. 3 and 5) on the moveable, magnet member 109 will engage the associated part 99 of the trip bar structure 89 to move the trip bar structure 89 clockwise (FIG. 2) whereupon the circuit breaker will be tripped open in the same manner hereinbefore described. The circuit breaker may be reset in the same manner hereinbefore described after an instantaneous magnetic tripping operation.

As can be seen in FIG. 1, in the one pole-unit compartment that houses the operating and latching mechanisms, the latch parts 77, 101, thermal trip parts 111, 137, 138 and magnetic trip parts 121, 122 extend transversely across the compartment on the upper side of the trip bar structure 89 in a compact arrangement.

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From the foregoing, it can be understood that there is provided by this invention an improved circuit breaker comprising a novel compactly constructed trip device. In the pole unit compartment that houses the operating and latching mechanisms, the parts are constructed such that the magnetic actuating surface of the trip bar, the thermal actuating surface of the trip bar and the latch part of the trip bar all extend transversely across the compartment on the upper side of the trip bar in a compact arrangement. In the electromagnetic trip device, the movable magnet member comprises two spaced lower leg parts that extend through openings in the back of the stationary magnetic member to receive two tension springs which engage upper spaced extensions of the stationary magnetic member to draw the movable magnetic member upward toward the front of the circuit breaker into pivotal engagement with surfaces adjacent the back part of the stationary magnet member. A main body portion of the movable magnet member comprises a generally U-shaped part. An extension at the upper end of the main body part of the movable magnet member is disposed to actuate the trip bar when the movable magnet member is attracted toward the stationary magnet member during magnetic tripping operations. The electromagnet is energized by means of a looped conductor that passes generally between the lower spring supports of the movable magnet member and between the upper spring supports of the stationary magnet member on one side of the stationary magnet member and between the opposite legs of the generally U-shaped part of the movable magnet member on the other side of the stationary magnet member. A bimetal, that is mounted on the looped conductor in a heat conducting relationship with the looped conductor, extends upward to a position adjacent the actuating extension of the movable magnet member opposite a surface of the trip bar structure to actuate the trip bar structure upon the occurrence of lesser overload currents. The magnet members are sheet-metal structures that are relatively inexpensive to manufacture and easy to assemble in the circuit breaker.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in some of the structural details may be made without departing from the spirit of the invention.

We claim as our invention:

1. A circuit breaker comprising an insulating housing having a front and a back, a circuit breaker mechanism supported within said housing, said circuit breaker mechanism comprising a pair of contacts, a releasable member releasable to effect opening of said contacts, a stationary magnetic member supported at the back of said housing and extending toward the front of said housing, said stationary magnetic member having opening means therein in proximity to the back thereof, a movable magnetic member comprising a main-body part positioned on one side of said stationary magnetic member, said movable magnetic member comprising pivot-support means extending through said opening means to the opposite side of said stationary magnetic member, biasing means operating against said pivot-support means on said opposite side of said stationary magnetic member biasing said movable magnetic member toward the front of said housing to bias said pivot-support means into engagement with said stationary magnetic member at said opening means to pivotally support said movable magnetic member on said stationary magnetic member, a conductor in electrical series with said contacts and disposed to generate magnetic flux in said stationary and movable magnetic members, and upon the occurrence of an overload current above a predetermined value said movable magnetic member being attracted toward said stationary magnetic member against the bias of said biasing means to effect release of said releasable member.

2. A circuit breaker according to claim 1, said sta-

tionary magnetic member comprising spring support means, and said biasing means comprising tension-spring means supported between said spring support means of said stationary magnetic member and said pivot-support means of said movable magnetic member.

3. A circuit breaker comprising an insulating housing having a front and a back, a circuit breaker mechanism supported within said housing, said circuit breaker mechanism comprising a pair of contacts, a releasable member releasable to effect opening of said contacts, a stationary magnetic member supported at the back of said housing and extending toward the front of said housing, said stationary magnetic member having a pair of spaced pivot surfaces in proximity to the back thereof and a pair of spaced spring support parts in proximity to the front thereof, a movable magnetic member having a pair of spaced pivot support legs in proximity to the back thereof and an actuating extension in proximity to the front thereof, a pair of spaced tension springs on one side of said stationary magnetic member between said spaced spring support parts and said spaced pivot support legs to draw said movable magnetic member toward the front of said housing to bias said spaced pivot support legs into pivotal engagement with said spaced pivot surfaces to thereby pivotally support said movable magnetic member on said stationary magnetic member, a conductor in electrical series with said contacts and disposed to generate magnetic flux in said stationary and movable magnetic members, and upon the occurrence of an overload current above a predetermined value said movable magnetic member being attracted toward said stationary magnetic member against the bias of said pair of spaced tension springs during which movement said actuating extension operates to effect release of said releasable member.

4. A circuit breaker according to claim 3, said movable magnetic member comprising a generally U-shaped part on the side of said stationary magnetic member that is opposite said one side, and said conductor comprising a looped conductor positioned to energize said stationary and movable magnetic members with one side of said loop passing generally between said spaced spring support parts and the other side of said loop passing generally between the legs of said generally U-shaped part of said movable magnetic member.

5. A circuit breaker according to claim 4, thermal trip means comprising a bimetal member supported on said looped conductor at said one side of said looped conductor, and upon the occurrence of an overload current below said predetermined value said bimetal member being heated and flexing to effect release of said releasable member.

6. A circuit breaker comprising an insulating housing having a front and a back, a circuit breaker mechanism supported within said housing, said circuit breaker mechanism comprising a pair of contacts, a releasable member releasable to effect opening of said contacts, a stationary magnetic member comprising a sheet-metal type magnetic

member supported at the back of said insulating housing and extending toward the front of said insulating housing, said stationary magnetic member having opening means therein in proximity to the back thereof with pivot surface means at said opening means, a movable magnetic member comprising a sheet-metal type member comprising a main-body part positioned on a first side of said stationary magnetic member, said movable magnetic member comprising a pair of bent-over legs at the back thereof extending through said opening means to the second side of said stationary magnetic member opposite said first side, said movable magnetic member comprising a pair of bent-over spaced spring support parts at the front thereof, a pair of tension springs supported between said bent-over legs of said movable magnetic member and said bent-over spring support parts of said stationary magnetic member to draw said movable magnetic member toward the front of said housing to thereby draw said bent-over legs of said movable magnetic member into pivotal engagement with said pivot surfaces of said stationary magnetic member, said main-body part of said movable magnetic member comprising a part generally U-shaped in cross-section, said movable magnetic member having an actuating extension at the front thereof, a looped conductor in electrical series with said contacts and disposed to generate magnetic flux in said stationary and movable magnetic members, said looped conductor comprising a loop part looped over a part of said stationary magnetic member with one side of said loop passing between the bent-over spring support parts of said stationary magnetic member and with the other side of said loop passing generally between the opposite legs of said U-shaped part of said movable magnetic member, upon the occurrence of an overload current above a predetermined value the current in said looped conductor energizing said magnetic members and said movable magnetic member being attracted toward said stationary magnetic member against the bias of said tension springs whereupon said actuating extension is moved to effect release of said releasable member, a bimetal member supported directly on said looped conductor and extending generally upward toward the front of said housing, and upon the occurrence of an overload current below said predetermined value and above another predetermined value said bimetal member being heated and deflecting to effect release of said releasable member.

References Cited

UNITED STATES PATENTS

2,624,816	1/1953	Bingenheimer.
2,689,893	9/1954	Bodenschatz.
3,201,539	8/1965	Leonard.

BERNARD A. GILHEANY, *Primary Examiner.*

H. BROOME, *Assistant Examiner.*