Feb. 26, 1963 N. J. SCHWARTZ ET AL 3,079,479

CIRCUIT BREAKER

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Fig. 1.

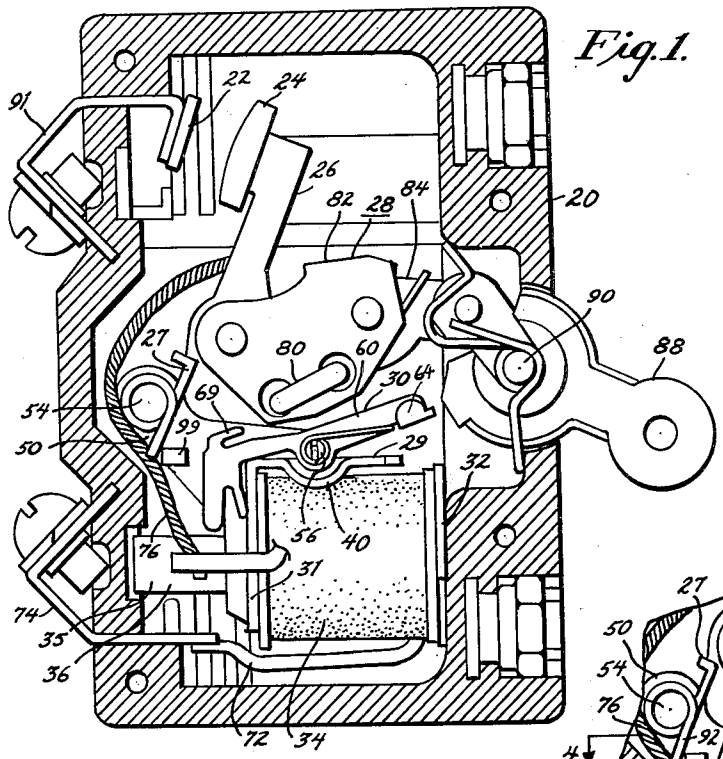
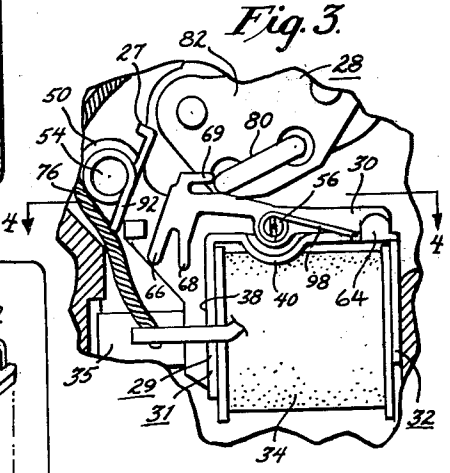


Fig. 3.



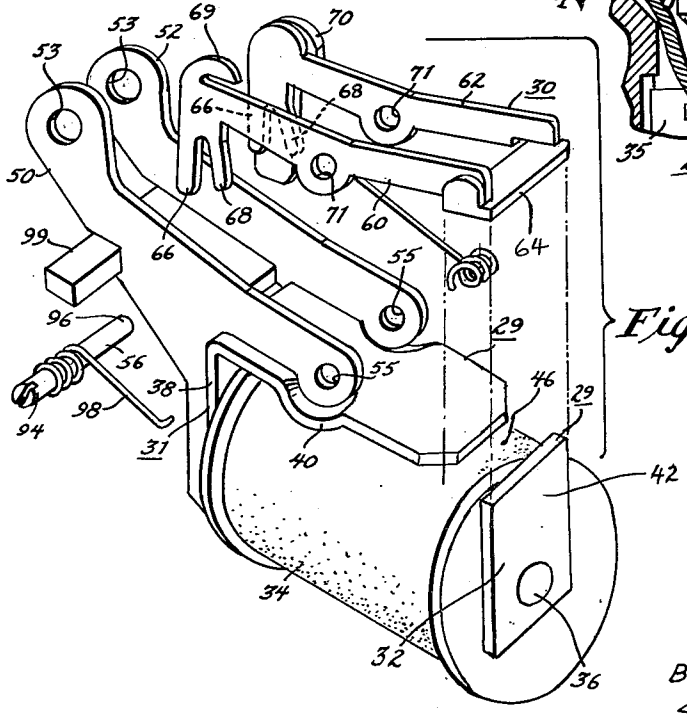


Fig. 2.

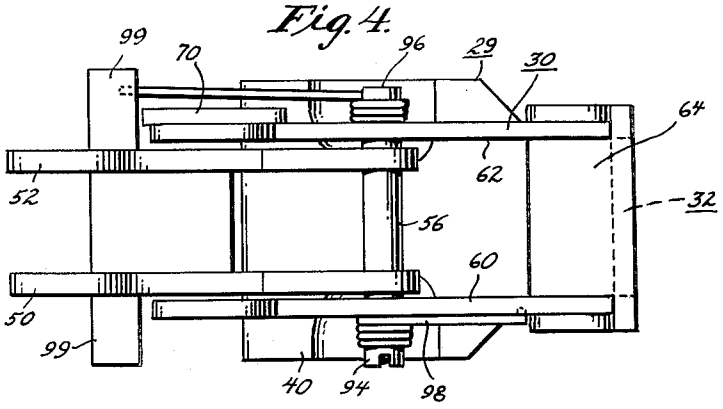
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Fig. 4.



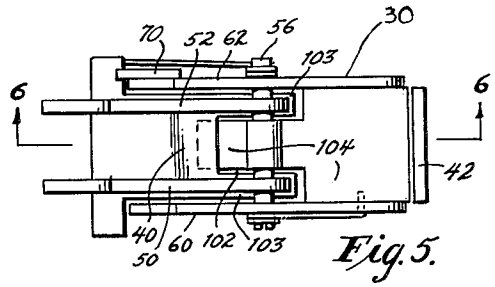
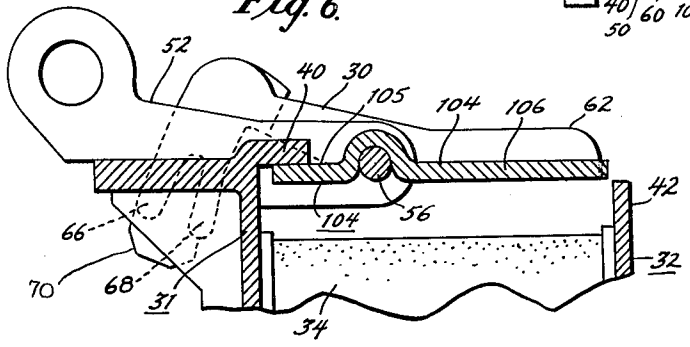


Fig. 5.

Fig. 6.



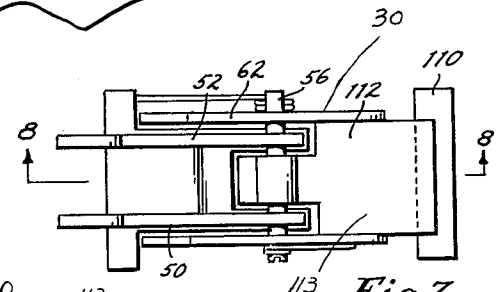
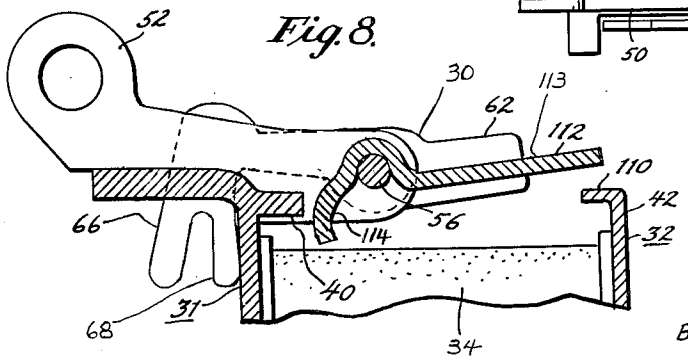


Fig. 7.

Fig. 8.



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CIRCUIT BREAKER

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7 Claims. (Cl. 200—106)

Our invention relates to circuit breakers employing magnetic means for sensing an overcurrent and, more particularly, to the armature thereof.

The invention is incorporated in a circuit breaker having operable contacts and a mechanism of the magnetic type for tripping the contacts to the open position upon the occurrence of an overload current, the circuit breaker being of the type illustrated in Patent No. 2,360,922. In such a circuit breaker the armature is attracted to one end of a solenoid when a short circuit or other serious overload condition is present. The solenoid of this invention is provided with frame members of magnetic material positioned to form an elongated U shape. Such frame members are secured to projecting ends of a nonmagnetic tube supporting the solenoid coil. Pivotally attached to the frame is an armature of magnetic material one end of which is designed to fit in a slot between the frame members.

In accordance with our invention, the other end of the armature is constructed, at least in part, of magnetic material and is designed to not only counterbalance the armature physically but also to serve as a magnetic counterbalance.

Upon an overload current both portions of the armature are attracted toward the solenoid coil and the frame members surrounding such coil but the opposite ends of the armature member tend to rotate in opposite directions. The result of the opposed attracting forces is to raise the instantaneous trip point of the armature. That is to say, the proportions between the counterbalancing ends of the armature and the opposite end are such that an increase in magnetic flux exerts more force on the end of the armature designed to fit into the slot between the frame members than on the counterbalancing end.

It is an object of our invention to provide an armature solenoid arrangement which will occupy a minimum amount of casing space.

A further object of the invention is to so shape the frame and the armature so as to provide substantial strength of the flux field in that area of the solenoid frame which is structurally desirable.

Another object of the invention is to increase the instantaneous trip point of the circuit breaker.

A still further object of the invention is to provide means for easily controlling the amount of rotation of the armature between non operable and tripping position.

The foregoing and other objects, the principles and characteristic features of our invention, and the best modes in which we have contemplated applying such principles will further appear from the following description and the accompanying drawing in illustration thereof.

FIG. 1 is a side elevation view, with one-half of the casing removed, showing the circuit breaker incorporating the armature construction in accordance with the invention;

FIG. 2 is an exploded perspective view showing the armature, frame and solenoid coil;

FIG. 3 is a fragmentary side elevation of a portion of the mechanism illustrated in FIG. 1 immediately after tripping;

FIG. 4 is a fragmentary plan view taken along the line 4—4 of FIG. 3;

FIG. 5 is a plan view similar to FIG. 4 but illustrating a second embodiment of the invention;

FIG. 6 is a fragmentary cross-sectional view taken along the line 6—6 of FIG. 5;

FIGS. 7 and 8 are fragmentary views similar to FIGS. 5 and 6 but illustrating another embodiment of the invention.

Referring to the drawings, our invention is embodied in a circuit breaker comprising a casing 20 enclosing a stationary contact 22 and a movable contact 24 secured to a movable arm 26. The movable arm 26 is biased by a spring 27 mounted on the pintle 54. On overload current the spring 27 actuates the arm 26 thereby opening the contacts 22 and 24 by carrying the arm 26 and contact 24 toward the handle 88. A latching mechanism 28, which when latched can hold the contact 24 in engagement with the contact 22 against the bias of the spring 27, is trippable by an armature 30 upon an overcurrent of a predetermined amount.

The overcurrent sensing device comprises a magnetically permeable frame 29 comprising opposed pole pieces or frame members 31 and 32, together forming an inverted U-shape, as best illustrated in FIGS. 2 and 3, the legs of which are in engagement with the ends of a solenoid coil 34.

The solenoid coil 34 is formed about a tube 35 (FIG. 3) having end portions 36 one of which extends through an aperture in the vertical portion of the frame member 31 and the other of which is secured to the vertical portion of the frame member 32. Within the tube 35 may be provided a core member that is attracted to one end of the solenoid by the magnetic flux generated by small overcurrents in the solenoid coil, as set forth in Patent No. 2,360,922.

As viewed in FIGS. 2 and 3, the left-hand L-shaped frame member 31 comprises vertical and horizontal portions 38 and 40, respectively, the horizontal portion being disposed above the solenoid coil and parallel to the longitudinal axis thereof. The pole piece member 32 comprises a vertical member 42.

Rigidly secured to the frame member 31 are upstanding spaced members 50 and 52 having holes forming bushings 53 (FIG. 2) for a pintle 54 (FIG. 1) providing for pivotable movement of the moveable contact arm 26. The opposite ends of the spaced members 50 and 52 have ears 55 (FIG. 2) for receiving a pintle 56 providing for pivotable movement of the armature 30 about the frame 29.

The armature comprises two generally L-shaped spaced members 60 and 62 intermediate which are positioned the spaced members 50 and 52. As illustrated by FIG. 2, the armature members 60 and 62 are connected on one end by a straddle or wedge portion 64, the leading edge of which may overlap the pole member 32 when in tripping position. On the opposite end the armature members 60 and 62 are formed with depending hairpin like projections 66 and 68, respectively. To the spaced member 62 there is added a balance and counter rotative portion 70 of magnetic material. The midportions of each of the armature members 60 and 62 are provided with aligned openings 71 for receiving the pintle 56.

The solenoid coil 34 has one end connected by a conductor 72 with an external terminal 74. The other end of the coil 34 is electrically connected by a flexible conductor 76 to the movable arm 26.

The wedge portion 64 of the armature 30 is adapted to substantially occupy the space 46 and to complete the magnetic circuit between the horizontal portion 40 and the vertical portion 42. The wedge 64 is shaped so that the leading edge may rest upon the top edge of the pole member 32 in tripping position. If desired the arma-

ture members 60 and 62 may be made to contact the horizontal portion of the frame member 31 immediately before the leading edge of the straddle 64 would otherwise make contact with the pole member 31.

Upon an overcurrent the armature 30 is rotated clockwise and a projecting member 69 thereof adjacent the hairpin portions 66, 68 contacts and rotates or rocks a latch pin 80 (FIGS. 1 and 3) for unlatching a toggle formed by links 82 and 84, the latter links connecting the movable arm 26 with an operating handle 88 mounted on a pintle 90. The details of the latch and the switching mechanism are more fully illustrated and set forth in the foregoing patent.

When the movable contact 24 is in engagement with the contact 22, current flows from the external terminal 91 through the contacts 22 and 24, the movable arm 26, the flexible conductor 76, the solenoid coil 34, and the conductor 72 to the external terminal 74. As long as the current does not exceed a predetermined amount, the contacts 22 and 24 will remain closed unless opened by rotation of the handle 88.

When an overload current substantially in excess of the predetermined permissible overload flows through the solenoid, a flux will be generated by the solenoid coil 34 sufficient to attract the straddle 64 thereby rotating the armature 30 its maximum amount. For example, if there should be a short circuit, the magnetic flux generated by the coil will be sufficient to instantly rotate the armature its full amount.

The rotation of the armature lifts the left-hand portion of the armature so that the projecting member 69 rotates the latch member 80 and unlatches the toggle formed by the links 82 and 84, permitting the spring 27 (FIG. 1) to move the movable arm 26 and its contact 24 away from the stationary contact 22.

As best illustrated in FIG. 4, the pintle 56 is provided with end portions 94 and 96 that extend beyond the spaced armature members 60 and 62. The lower end portion 94 of the pintle 56, as viewed in FIG. 4, is provided with a groove in which is disposed one end of a torsion spring 98, the other end of the torsion spring being biased against the under side of the right-hand portion of the armature member 60. The upper spring, as viewed in FIG. 4, tightly engages the end portion 96 and prevents rotation of the pintle 56 by having another end portion of the spring lodged between the upper surface (as viewed in FIG. 2) of the horizontal portion 40 and the lower surface of the laterally extending ears 99 formed on the member 52.

One or both of the hairpin members 68 may be twisted toward or away from the vertical frame member 38 so as to control the amount of upward movement of the wedge 64. Such adjustment permits variation of the flux force acting on the wedge 64 at any given amount of overcurrent and thereby varies the point at which the circuit breaker can be tripped.

The balance portion 70 also serves during rotation of the armature to be attracted by the frame member 31 in the direction of rotation opposite from that desired upon an overcurrent. This counter rotative effect of balance portion 70 introduces a further time delay until the clockwise moment exerted by the right-hand portion of the armature 30 about the pintle 56 exceeds the counter clockwise moment of the balance portion 70 sufficiently to rotate the wedge portion 64 into the space 46. As soon as the permeable member 70 begins to move away from the permeable frame 31 the attractive force on the member 70 drops rapidly thereby permitting the wedge 64 to proceed quickly toward the space 46 and trip the breaker.

It has been found that by utilizing a permeable frame and a wedge 64 to enter the opening 46 in the frame the magnetic flux and the force of attraction on the armature 30 is greatly increased over an armature that is not provided with the wedge 64 and the opening 46 in a frame.

In FIGS. 5 and 6 there is illustrated a modification of the present invention in which the forces on opposite ends of the armature are additive. Similar elements have been given similar reference numerals. In this embodiment the left-hand frame member 31 is provided with a horizontal portion 40 having a central opening 102 (FIG. 5) through which extends a permeable bridging member 104. The opening 102 is formed between legs 103 that support the spaced members 50 and 52. The right-hand frame member 32 comprises only the vertical portion 42. The bridging member 104 is rotatable as part of the armature 30 about the pintle 56 and secured thereto between the spaced members 60 and 62 so that when in the overload position the top side of the portion 105 to the left of the pintle 56 will be in contact with the underside of the horizontal portion 40 and the end portion 106 to the right of the pintle 56 will be in close proximity to the vertical portion 42. The bridging member 104 is spaced sufficiently from the solenoid coil 34 to allow it to clear the latter when it rotates.

Thus, upon an overload current the frame members 31 and 32 will attract both ends of the permeable member 104 and impose moments thereon tending to rotate the armature 30 in the same direction in order to bridge the air gap between the horizontal portion 40 and the vertical portion 42.

In FIGS. 7 and 8 there is illustrated a further modification of the invention. The left-hand frame member 31 is formed as in the second embodiment. The right-hand frame member 32 is formed with a vertical portion 42 and a horizontal portion 110, the latter being in the same plane as the horizontal portion 40.

The armature 30 is formed with a permeable bridging member 112 overlapping the top surface of the horizontal portion 110 and for bridging the horizontal portion 110 when in the tripping position. The bridging member 112 is rotatable about the pintle 56 and comprises a flat portion 113 extending between the pintle area and horizontal lip 110 and a depending leg section 114 projecting down from the pintle area toward the coil 34. The length of the flat member 113 is sufficiently great to overlap the edge of the lip 110 in tripping position. The depending leg 114 is preferably arcuate so as to provide a small, constant air gap between it and the end of the member 40 as the armature 30 rotates about the pintle 56. The end of the leg 114 is attracted by the flux of the coil 34 and such attraction serves as a counter rotative force similar to the counter rotative force on the member 70 in the first embodiment.

Having described our invention, we claim:

1. In a device of the character described, the combination of a magnetically permeable frame, said frame defining a space, a solenoid coil embraced by said frame for establishing a magnetic field, an armature operatively associated with said frame and pivotable thereon, said armature having a member for filling said space when rotated, and deformable means on said armature abuttable with a portion of said frame embracing said coil for controlling the amount of rotation away from said space.

2. In a device of the character described, the combination of a magnetically permeable frame having transverse legs, a solenoid coil positioned within said frame for establishing a magnetic field about said frame, and an armature operatively associated with said frame and pivotable thereon, said armature including a portion on one side of the pivot attractable by said magnetic field and said armature being partially deformable on the other side of the pivot abuttable with a portion of said frame for adjusting the extent of rotation in one direction of the armature.

3. The structure recited in claimed 2 wherein said frame defines a space, said armature portion that is at-

tracted by the magnetic field being outside of said space and movable into said space by said magnetic field to substantially fill said space.

4. The structure recited in claim 2 and further including a balance portion of magnetic material carried by the deformable portion of the armature and magnetically associated with said frame for delaying rotation of said armature at predetermined current conditions.

5. In a device of the character described, the combination of a magnetically permeable frame, a solenoid coil embraced by said frame for establishing a magnetic field about said frame, and an armature operatively associated with said frame, said armature including a portion attractable by said magnetic field for rotating the armature in one direction, said armature including another portion on the other side of the pivot for delaying rotation of said armature, said second armature portion defining an air gap together with a portion of said frame of constant size when said armature is rotated.

6. The structure recited in claim 5 and in addition a balance portion on the same side of said pivot as the said second portion of said armature for increasing the time delay.

7. In a device of the character described, the combination of a frame of magnetic material comprising a pair of frame members positioned generally to form a U-shape having a space in the base of the U, a solenoid coil positioned between the legs of said U-shaped frame for generating a flux, a support formed by one of said frame members, an armature rotatable about said support, said armature having first and second portions of magnetic material on opposite sides of said support and overlapping portions of said members, said first portion being positioned

outside of said space and movable into said space by predetermined current conditions, said second portion being magnetically attracted to one of the two frame members between which the coil is disposed to delay movement of the armature as the magnetic flux increases until a predetermined flux value is attained.

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