Sept. 14, 1954 K. W. WILCKENS 2,689,282

MULTIPOLE CIRCUIT BREAKER

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Fig. 1.

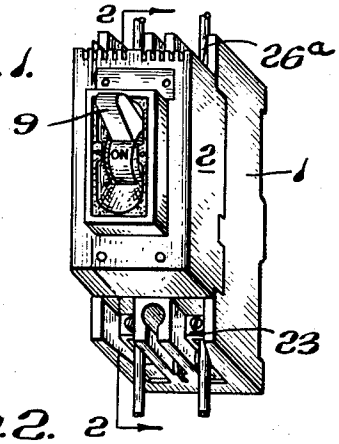


Fig. 2.

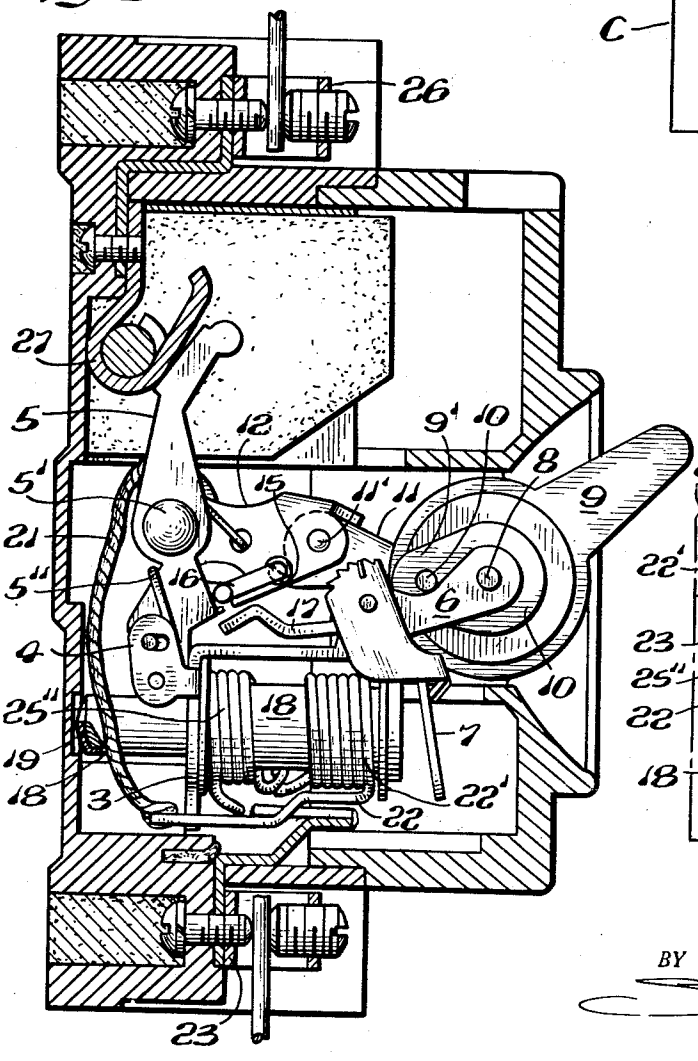


Fig. 3.

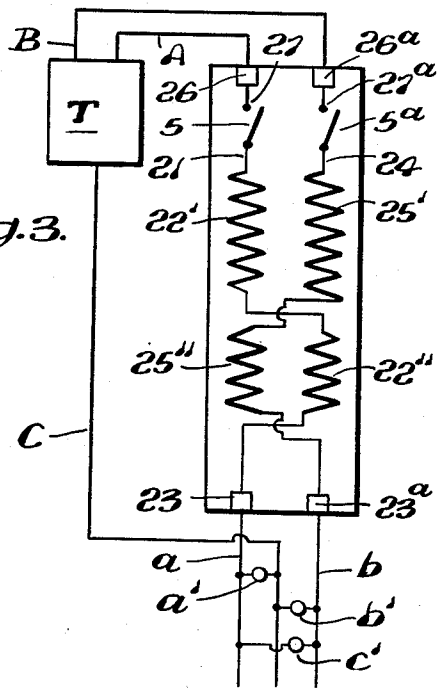
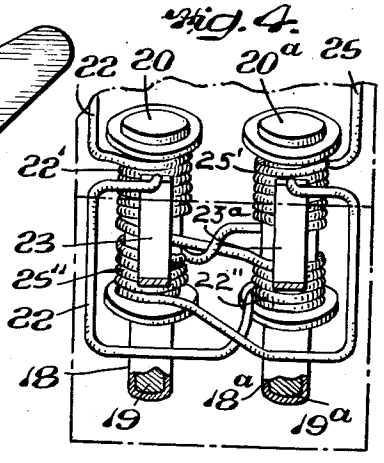


Fig. 4.



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Fig. 5.

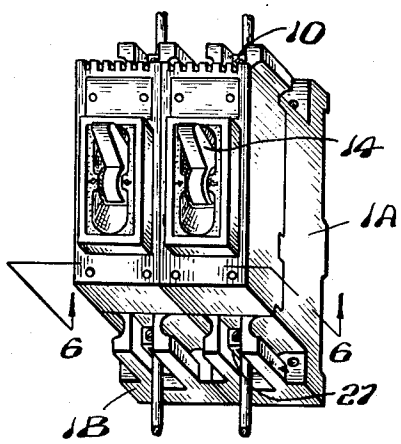


Fig. 8.

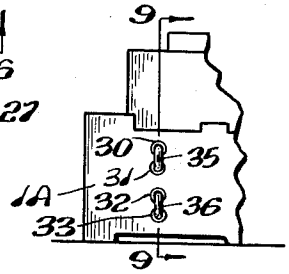


Fig. 7.

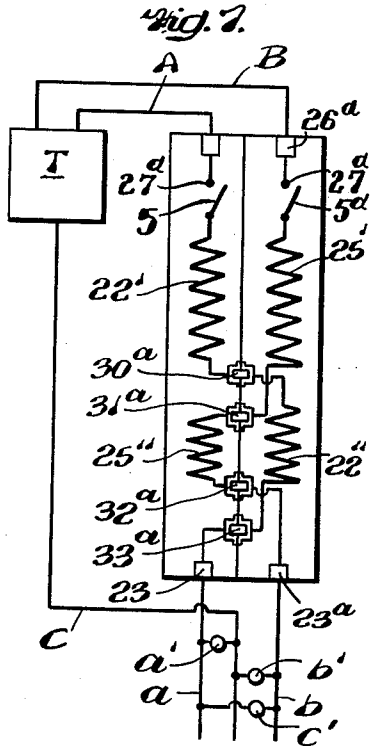


Fig. 6.

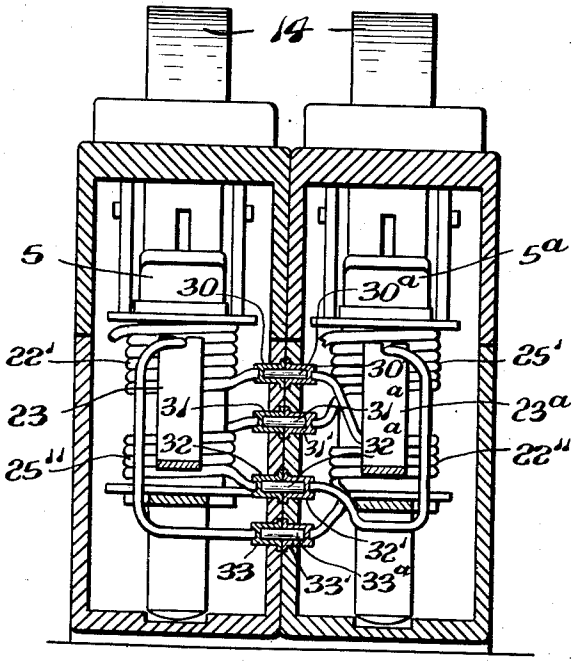


Fig. 9.

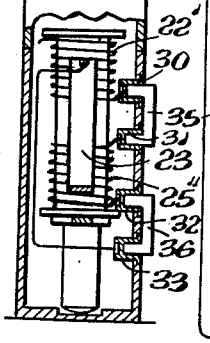
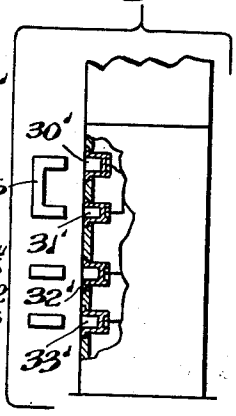


Fig. 10.



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UNITED STATES PATENT OFFICE

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MULTIPOLE CIRCUIT BREAKER

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Application December 23, 1950, Serial No. 202,542

8 Claims. (Cl. 200—107)

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My invention is a multi-pole circuit breaker for protecting equipment, such as a transformer, from injury due to overdrafts of current therefrom through a single lead or multiple leads, but permitting the operation of the equipment so long as the total current drawn through all the leads does not exceed a safe load for the protected equipment. The leading object of my invention is to permit a major portion or all of the rated capacity of a transformer to be drawn through either pole of the breaker when little or no current is flowing through the other pole; to permit the full rated capacity to be drawn from the transformer across the high voltage leads, or to permit the full rated capacity to be drawn across both high voltage leads and the neutral, or any combination of these arrangements, so long as the total current drawn does not exceed a predetermined maximum, but to trip the breaker should the total current drawn exceed the predetermined maximum for predetermined times, which are inversely proportional to the overloads.

In accordance with my invention, an electromagnet and complementary armature is provided for each pole (or blade) of a multi-pole breaker, and each blade is connected with windings on both electromagnets. Consequently the flux density tending to draw any armature toward its complementary electro-magnet its a product of the current flowing through both blades. The number of windings of each electro-magnet connected with a blade may be in any desired proportion so long as the total number of ampere turns on an electro-magnet will trip its complementary armature upon a total predetermined current flow therethrough, but for general use I have found it desirable that 60% of the turns on each electro-magnet be supplied with current through one blade and that 40% of the turns on the same electro-magnet be supplied with current from the other blade. With such an arrangement approximately 85% of the total rated current may flow through one blade without tripping the breaker, provided no current is simultaneously flowing through the other blade.

The rocking of either armature actuates a tripping mechanism which may be arranged to permit the opening of both blades or either of them.

My invention also comprehends a unit structure having ampere turns of a solenoid so connected with a switch blade and with terminals as to permit two units to be readily coupled together to form a multi-pole breaker of the type

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hereinbefore described or to permit the bridging of the terminals of a single unit to form a single pole breaker responsive solely to the flow through a single lead and preferably permitting continued flow therethrough of only half the rated capacity of the breaker.

The principles of my invention and the best mode in which I have contemplated putting such principles into practice will further appear from the following description and the accompanying drawings in illustration thereof.

In the drawings Fig. 1 is a perspective view of a multi-pole, single handle breaker embodying my invention; Fig. 2 is an enlarged, longitudinal sectional view taken on the line 2—2 of Fig. 1; Fig. 3 is a diagrammatic layout of the breaker of Fig. 1 connected with the leads of a transformer; Fig. 4 is a somewhat diagrammatic perspective view of the windings of the solenoids of the multi-pole breaker shown in Figs. 1 to 3; Fig. 5 is a perspective view of a pair of housed units coupled together to form a multi-pole breaker having separate handles and toggles; Fig. 6 is an enlarged transverse sectional view taken on the line 6—6 of Fig. 5; Fig. 7 is a diagrammatic layout of the breaker of Figs. 5 and 6 connected with the leads of a transformer; Fig. 8 is a fragmentary side elevation of the left hand unit shown in Fig. 5, turned around so that its base is downward and with bridges inserted to adapt such unit for single lead use; Fig. 9 is a transverse sectional view taken on the line 9—9 of Fig. 8; and Fig. 10 is a diagrammatic view illustrating how the winding terminals may be either bridged together in the same unit or coupled to a complementary unit.

In the embodiment of my invention illustrated in Figs. 1 to 4 of the drawings, an insulating casing 1 and cover 2 form a housing for a two pole, single handle, circuit breaker.

Each pole of the breaker comprises a magnetically permeable L-shaped frame 3 fixed in the casing and provided with ears 4 for supporting a biased, rocking switch blade 5 or 5a and with ears 6 for pivotally supporting an L-shaped armature 7. A shaft 8 is journalled in the outer ends of the ears 6 of the respective frames and has fixed thereto an operating handle 9 projecting through an opening in the cover 2. The handle 9 has fixed thereto a pair of bosses 9' forming, with the handle body, spaced bearings for a rod 10 on which a link 11 is pivotally mounted between the bosses 9'. The link 11 is pivotally connected by a pintle 11' with a link 12 whose other end is journalled on the middle

of a shaft 5' having its ends fixed to the blades 5 and 5a intermediate the ends thereof. The links 11 and 12 may be latched rigidly together by the engagement of a tooth on the link 11 with a convex surface of a shaft 15 journalled in the link 12 and provided with crank arms 16 in the path of the bent fingers 17 of the respective armatures 7. A portion of the peripheral face of the shaft 15 is flat so as to permit passage of the tooth when the shaft 15 is turned, as more fully set forth in my Letters Patent No. 2,360,922.

Each frame 3 has mounted therein a dash pot tube 18 or 18a which contains a magnetically permeable core 19 or 19a movable toward a pole piece 20 or 20a at the front of each tube adjacent to its armature 7.

Each pole of the breaker thus far described is generally similar to the single pole breaker shown in my Letters Patent No. 2,360,922.

In accordance with my present invention, the switch blade 5 is connected in series, through a pigtail 21, with an insulated conductor 22 which is wound counterclockwise on the tube 18 to form a coil or ampere turns 22'; is then wound counterclockwise on the tube 18a to form a coil or ampere turns 22'' and is then connected with the load terminal 23. The blade 5a is similarly connected through a pigtail 24 with a conductor 25 which is wound counterclockwise on the tube 18a to form a coil or ampere turns 25'; is wound on the tube 18 to form a coil or ampere turns 25'' and is then connected with the load terminal 23a.

The number of turns in the coil 22' should at least equal and should preferably slightly exceed the number of turns in the coil 25'' and the total number of turns in the coils 22' and 25'' should be great enough to trip the armature 7 complementary to the pole piece 20 whenever the total current flowing through both coils becomes great enough to deleteriously affect equipment protected by the breaker. If no current is flowing through the coil 25'', nearly the whole rated current of the arrester (viz., nearly double rated current for one pole) may flow through the coil 22' before the flux density generated thereby will trip the armature 7 complementary to the pole piece 20. When the flux density resulting from current flow through both or either coil on the tube 18 is sufficient to attract the complementary armature 7, the breaker will be tripped.

The number of turns in the coils 25' should approximate the number of turns in the coil 22' and the number of turns in the coil 22'' should approximate the number of turns in the coil 25'' so that the armature 7 complementary to the pole piece 20a will be tripped whenever the total current flowing through both coils. 25', 22' or through either coil exceeds the permissible total current that may be safely drawn from a source, such as the transformer T.

The transformer T has leads A and B connected with the breaker's line terminals 26 and 26a which are connected with line contacts 27, 27a complementary to the blades 5 and 5a. The generator is also provided with the neutral lead C with which the load leads a and b, leading from the breaker's load terminals 23, 23a, may be connected through the loads a', b'. A load c', requiring higher voltage, may be connected across the leads a, b.

So long as the total current drawn by the loads a', b', c' does not exceed the rated capacity of the transformer T by more than a permissible overload for an appropriate time, the flux density

at the pole pieces 20, 20a will be insufficient to attract either armature 7. If the current supplied through either blade of the breaker is decreased or eliminated, the current supplied through the other blade may be increased until the flux generated by the coil directly connected with such blade, plus any flux generated by the adjacent coil, is sufficient to attract the armature 7 complementary to such coils.

When either armature 7 is rocked, the finger 17 lifts a crank arm 16 and turns the shaft 15 so that its convex surface is disengaged from the tooth of the link 11, thereby unlatching the toggles and permitting the blades 5 and 5a to be opened by their biasing springs 5''.

In the embodiment of my invention illustrated in Figs. 5 to 10, separate breaker poles are mounted in individual cases 1A and 1B, and the blades 5 and 5a are individually controlled by individual trip mechanisms, as generally shown in my Letters Patent No. 2,360,922 excepting insofar as the solenoid coils are concerned.

In accordance with the present embodiment of my invention, the coil section 22' has one end connected with the blade 5 and its other end connected with a terminal socket 30 in the insulating wall of the casing 1B. The coil section 25'' has its opposite ends connected with terminal sockets 31 and 32 in the same insulating wall. The load terminal 23 is connected through a conductor with a terminal socket 33 in the same insulating wall. The ends of the coil section 25' are connected with the blade 5a and with a terminal socket 31' in the insulating wall of the casing 1A and adapted to be aligned with the terminal socket 31. The coil section 22'' has one end connected with a terminal socket 30; adapted to be aligned with the socket 30, and its other end connected with a terminal socket 33', adapted to be aligned with the socket 33. The load terminal 23a is connected by a conductor with a terminal socket 32' adapted to be aligned with the terminal socket 32.

All of the coils are wound in the same direction and are shown wound counterclockwise, but they may be all wound clockwise.

When the aligned sockets in the units 1A and 1B are connected by conducting pins 30a, 31a, 32a and 33a, as shown in Figs. 5, 6 and 7, the coil of each electro-magnet contains turns connected with both blades 5 and 5a as described in connection with Figs. 1 to 4. But when the pairs of sockets 30, 31 and 32, 33 of unit 1B or the pairs of sockets 30', 31' and 32', 33' of unit 1B are respectively connected by U-shaped conducting bridges 35 and 36 as indicated in Figs. 8, 9 and 10, each unit may be used as an individual circuit breaker having a rated capacity equal to one half of the total capacity of the multi-pole breaker formed by coupling the units.

Having described my invention, I claim:

1. A multi-pole circuit breaker comprising plural switch blades, trip mechanism mechanically connected with and controlling said blades and comprising an electro-magnet having a composite coil having independent windings in parallel with one another and respectively connected in series with the respective blades, and an armature responsive to current flow through both said windings both of said windings consisting of ampere turns wound in the same direction to create cumulative flux tending to move said armature.

2. A multi-pole circuit breaker comprising plural switch blades and trip mechanism mechan-

ically connected with and controlling said blades and comprising plural electro-magnets each having independent windings in parallel with one another and each electro-magnet being supplied with current through both of the plural switch blades, both windings of each electro-magnet aforesaid consisting of ampere turns wound in the same direction to create cumulative flux for operating trip mechanism aforesaid.

3. A multi-pole circuit breaker comprising plural switch blades each having a line terminal and a load terminal in operative association therewith and trip mechanism mechanically connected with and controlling said blades and including an armature complementary to each switch blade and a solenoid complementary to each armature, each solenoid including independent windings in parallel with one another, each winding of each solenoid being in series with only one of the plural switch blades, independent windings of each solenoid consisting of ampere turns wound in the same direction to create cumulative flux tending to move its complementary armature.

4. A circuit breaker comprising plural movable switch blades and trip mechanism mechanically connected with said switch blades and including plural independently movable armatures and solenoids each solenoid including a winding connected with a blade and a winding connected in series with a winding of the other solenoid, both windings of a solenoid aforesaid consisting of ampere turns wound in the same direction and in parallel with one another.

5. The combination of a pair of circuit breakers each comprising a movable switch blade and trip mechanism mechanically connected with said switch blade and including an armature movable independently of the other armature and a solenoid, the solenoid of each breaker including a winding having a permanent connection with the blade of such breaker and a winding having readily detachable connections with a winding of the other solenoid, both windings of each solenoid consisting of ampere turns wound in the same direction and in parallel with one another.

6. A circuit breaker adapted for use as an individual trip breaker or for assembly in a plural breaker tripped by the total flow of current and which comprises a movable switch blade and trip mechanism mechanically linked with the switch blade and comprising an armature, a solenoid complementary to said armature and including a

pair of windings in parallel, one of said windings being connected with said blade and with a terminal and the other of said windings being connected with a pair of terminals, and both windings of each solenoid consisting of ampere turns wound in the same direction.

7. A circuit breaker comprising a housing, a movable blade and a complementary contact within said housing and trip mechanism mechanically linked with said blade and comprising a solenoid having a pair of windings wound in the same direction, one of said windings being connected with said blade and having a terminal projecting through said housing and the other of said windings having a pair of terminals projecting through said housing.

8. The combination with a transformer having multiple leads, of switch blades respectively moveable into and out of series connection with one of said leads, multiple electro-magnets each including an ampere turn coil connected with a switch blade aforesaid and also including an ampere turn coil connected in series with an ampere turn coil of the other electro-magnet, the ampere turn coils of each electro-magnet being insulated from one another and wound in the same direction to produce a cumulative flux upon flow of current through both such coils, said electro-magnets each containing a hollow tube with a magnetically permeable core therein moveable by the cumulative flux of the ampere turn coils of such electro-magnet and trip mechanisms respectively operable by the respective fluxes of the respective electro-magnets.

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