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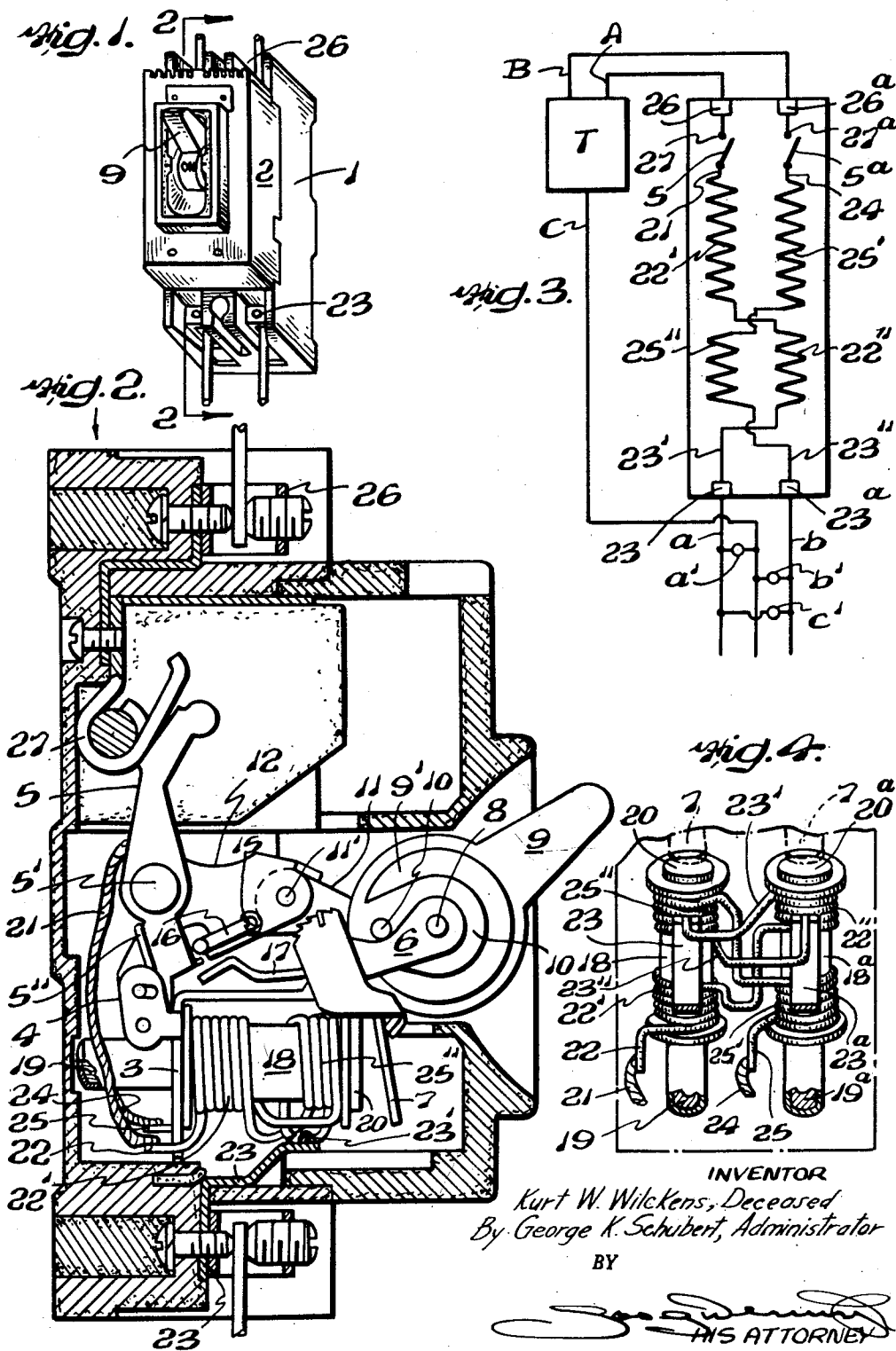
K. W. WILCKENS

2,817,730

MULTI-POLE CIRCUIT BREAKER

Filed June 17, 1954

2 Sheets-Sheet 1



INVENTOR
Kurt W. Wilckens, Deceased
By George K. Schubert, Administrator
BY

[Signature]
HIS ATTORNEY

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2 Sheets-Sheet 2

Fig. 5.

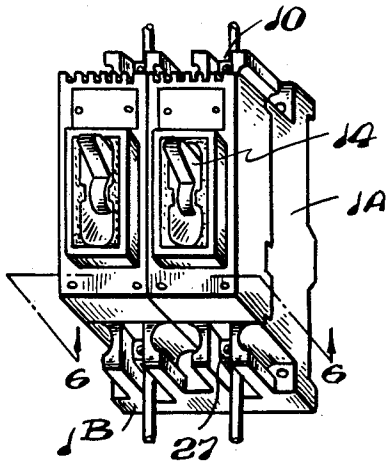


Fig. 6.

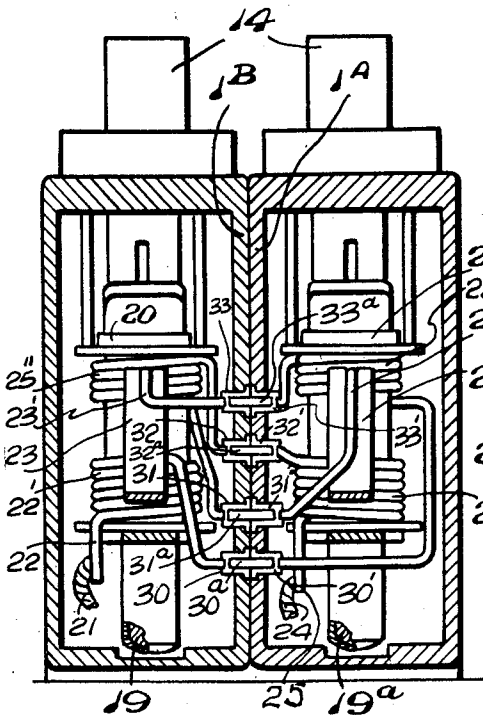


Fig. 7.

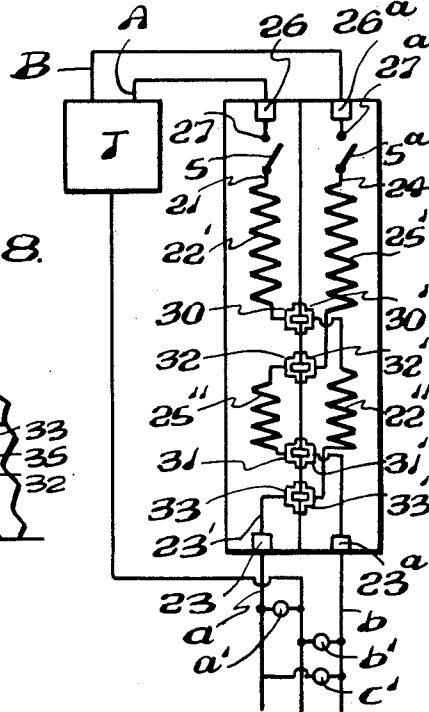


Fig. 8.

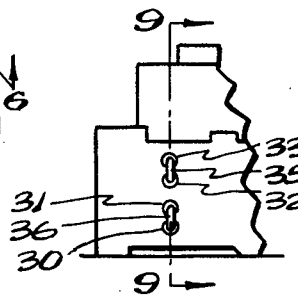


Fig. 9.

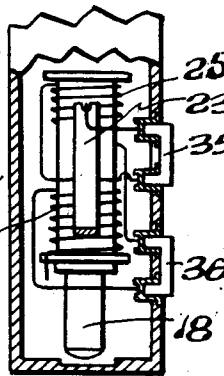
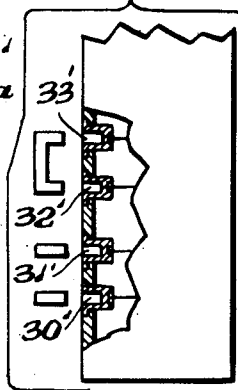


Fig. 10.



INVENTOR.

Kurt W. Wilckens, Deceased.
By George K. Schubert, Administrator
BY

[Signature]
HIS ATTORNEY

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MULTI-POLE CIRCUIT BREAKER

Kurt W. Wilckens, deceased, late of Morrisville, Pa., by George K. Schubert, administrator, Philadelphia, Pa., assignor to Heinemann Electric Company, Trenton, N. J.

Application June 17, 1954, Serial No. 437,313

6 Claims. (Cl. 200—107)

This 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 through 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 the invention is to permit a major portion 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 this invention, an electro-magnet and complementary armature is provided for each pole (or blade) of a multi-pole breaker, and each blade is connected with windings on both electro-magnets. Consequently the flux density tending to draw any armature toward its complementary electro-magnet is a product of the current flowing through the 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 it has been found 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.

The 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 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 the invention and the best mode contemplated of 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 the invention; Fig. 2 is an enlarged, longitudinal sectional view taken on the

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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 the 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 journaled 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 journaled 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 journaled 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 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 Letters Patent No. 2,360,922.

In accordance with the present invention, the switch blade 5 is connected in series, through a pigtail 21, with an insulated conductor 22 which is wound counterclockwise (toward and looking from the front, Fig. 2) on the tube 18 to form a coil or ampere turns 22'; is then wound counterclockwise (toward and looking from the front, Fig. 2) on the tube 18a to form a coil or ampere turns 22'' and is then connected through the conductor 23' with the load terminal 23. The blade 5a is similarly connected through a pigtail 24 with a conductor 25 which is wound clockwise (toward and looking from the front) on the tube 18a to form a coil or ampere turns 25'; is wound toward the rear clockwise (looking from the front) on the tube 18 to form a coil or ampere turns 25'' and is then connected through the conductor 23'' with the load terminal 23a.

The number of turns in the coil 22' should at least equal and should preferably exceed slightly the number of turns in the coil 25'' and the total number of turns in the coil 22' and 25'' should be great enough to trip the armature 7 complementary to the pole piece 20 when-

ever 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 ar-
rester (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 the coil 25' alone 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 for the passage of current creating opposite polarities at any given instant. The respective leads are 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 transformer T 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 drawn through either blade of the breaker is decreased or eliminated, the current drawn 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, its 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 spring 5".

In the embodiment of the 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 Letters Patent No. 2,360,922 excepting insofar as the solenoid coils are concerned.

In accordance with the present embodiment of the invention, a coil section 22' has one end connected with the blade 5 through a pigtail 21 as above described and is wound anticlockwise (looking from the front) on a tube 18. The other end of the coil section 22' is connected with a terminal socket 30 in the insulating wall of the casing 1B. A coil section 25' has its opposite ends connected with terminal sockets 31 and 32 in the same insulating wall and is wound clockwise, from front toward the rear (looking from the front). The load terminal 23 is connected through a conductor 23' with a terminal socket 33 in the same insulating wall 1B. The ends of the coil section 25' are connected with the blade 5a through a pigtail 24 as above described and with a terminal socket 32' in the insulating wall of the casing 1A and adapted to be aligned with the terminal socket 32. 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 23" with a terminal socket 31' adapted to be aligned with

the terminal socket 31. The coil section 25' is wound clockwise and the coil section 22" is wound anticlockwise on the tube 18a (looking from the front).

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.

What is claimed is:

1. The combination with a transformer having multiple leads for the flow of current creating opposite polarities at any given instant, of switch blades respectively movable into and out of series connection with the respective leads, multiple electromagnets each including an ampere turn coil connected with a switch blade aforesaid and also including an ampere turn coil wound oppositely to said first named ampere turn coil and 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 to produce a cumulative flux upon simultaneous flow of currents of instantaneously opposite direction through the respective coils of each electro-magnet, 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.

2. A circuit breaker for limiting the cumulative current flow through multiple leads of a transformer and current flow through fewer leads thereof which comprises a pair of switch blades, a pair of electro-magnets controlling said switch blades, each electro-magnet including ampere turns connected with both switch blades, the turns of each electro-magnet connected with the respective switch blades being wound in opposite directions and tending to create cumulative flux therein upon the simultaneous flow of currents of instantaneously opposite direction through the respective switch blades and trip mechanism mechanically connected with and controlling said blades and operable by said electro-magnets.

3. A multi-pole circuit breaker for protecting a multi-lead transformer and having a pair of switch blades for connection with such leads, a pair of electromagnets respectively complementary to the respective blades, each of said electromagnets including a tube encircled by a coil consisting of ampere turns connected in series with one of said blades and a coil consisting of ampere turns wound oppositely to said first named turns and connected in series with the other of said blades, a core in each tube and operable by the sum of the flux generated by both coils on such tube and also operable by flux generated by increased current flow-through one only of the coils on such tube, armatures movable by said electro-magnets respectively upon the movements of said cores, and trip mechanism controlling said blades and operable by the movements of said armatures.

4. A multi-pole circuit breaker for protecting a multi-lead transformer and comprising a pair of switch blades, a pair of hollow tubes respectively complementary to the respective switch blades, a conductor connected with one of said switch blades and wound around one and then around the other of said tubes in series and in the same direction, a conductor connected with the other of said switch blades and wound around one and then around the other of said tubes in series and in the same direction but reversely to the windings of said first conductor, a core and an armature complementary to each of said tubes and operable by the sum of the fluxes gen-

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erated by the passage of current through both coils on a tube and also operable by flux generated by the passage of greater current through one of the coils of such tube, and latching mechanism controlling said blades and operable by the movements of said armatures.

5. A multi-pole circuit breaker comprising a pair of housings each containing a switch blade, a load terminal in series with said blade, a latch mechanism controlling said blade, and electro-magnetic mechanism controlling said latch mechanism, each of said electro-magnetic mechanisms including a first coil consisting of ampere turns connected with its complementary blade and a second coil independent thereof and wound oppositely thereto, and detachable coupling means connecting the first coil in each of said housings with the second coil in the other housing and connecting the second coil in each of said housings with the load terminal of the other of said housings.

6. A circuit breaker usable as an individual trip free breaker or in coupled pairs as a multi-pole breaker and comprising a housing containing a load terminal, a switch

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blade, latching mechanism controlling said switch blade, and electro-magnetic mechanism controlling said latching mechanism, said electro-magnetic mechanism comprising a first coil having an end connected with said blade and an end connected with a coupling member, a second coil having both its ends connected with coupling members, and said load terminal being connected with a coupling member, all of said coupling members being accessible from the exterior of said housing for the connection of said second coil and with said first coil to form ampere turns wound in the same direction and with said load terminal or for the connection of similar breakers in coupled pairs with the first coil of each coupled with the second coil of the other to form in each housing ampere turns wound in opposite directions and with the second coil of each coupled with the load terminal of the other.

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