Jan. 4, 1949. C. L. STROUP 2,457,939

HIGH VOLTAGE SWITCH

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Fig. 1

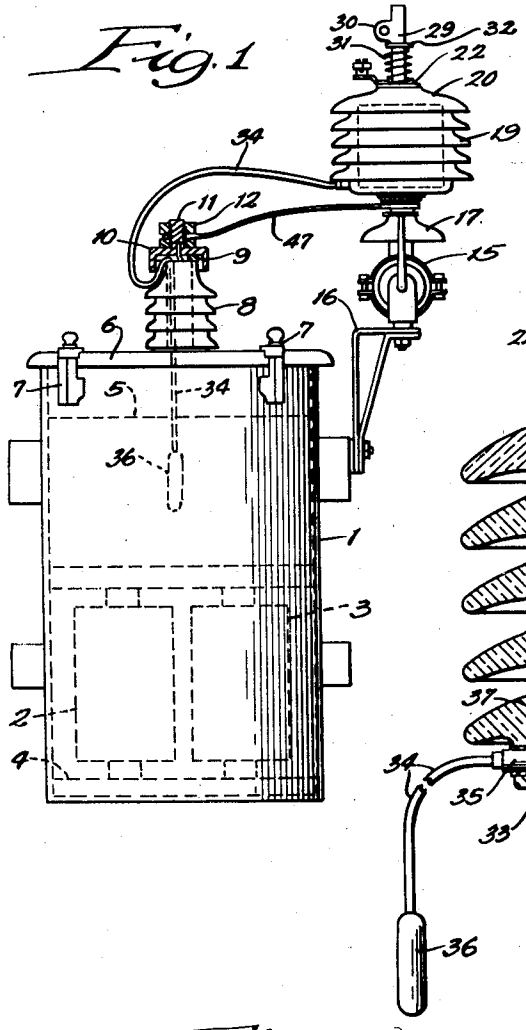


Fig. 2

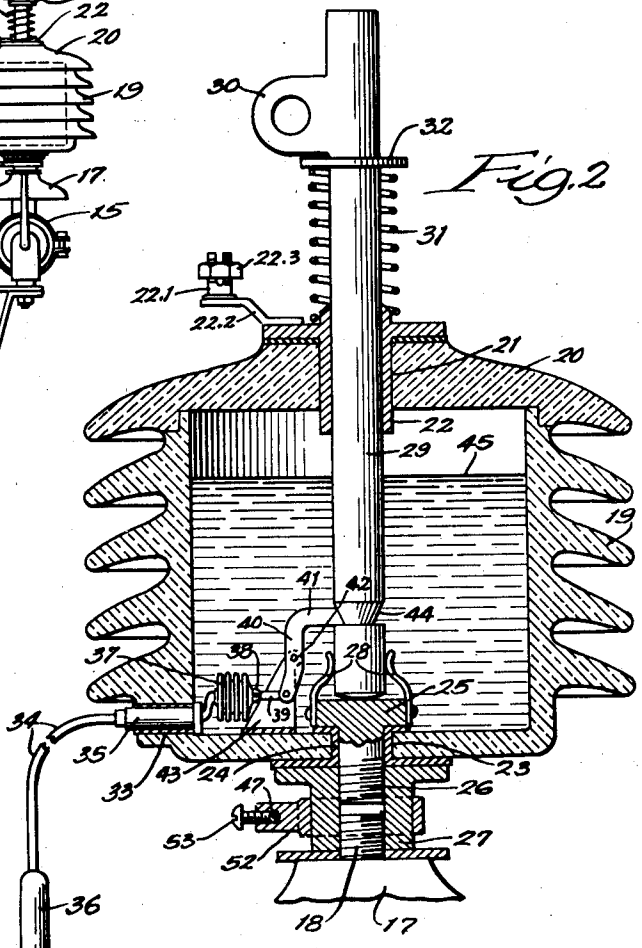
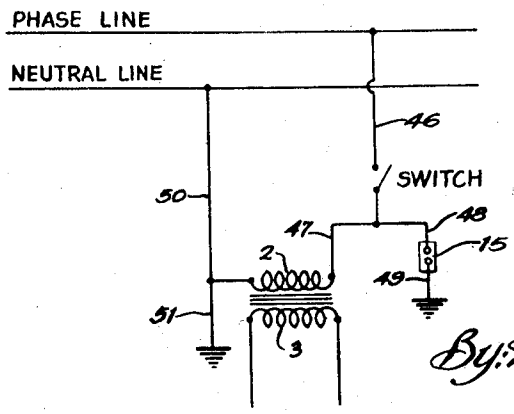


Fig. 3



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HIGH-VOLTAGE SWITCH

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8 Claims. (Cl. 200—140)

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This invention relates to improvements in high voltage thermally operated switches which are particularly adapted for use in connection with transformers of the type which are installed out of doors and used in circuits distributing electricity in urban and rural communities.

Transformers of this character are usually inexpensive, relatively small in size and have a low kva. capacity.

Protective apparatus have been employed in connection with transformers of this type in the form of fuses located in the "hot" or phase line to prevent overloads in the transformer. Fuse protection, however, is not entirely satisfactory because of its limitations. Lightning current will blow out the fuse even when the transformer is not affected by overloads and shorts. Furthermore, since fuses of a greater amperage are sometimes used in place of the proper size, to overcome as much as possible blowouts of the fuse caused by lightning currents and to protect the service line against failure caused by mechanical stress in small delicately constructed fuses, the use of such fuses of greater amperage will not protect the transformer when it becomes overloaded, due to a short circuit in the secondary of the transformer or because of an increase in load. The fuse will only disconnect the transformer itself from the phase line in the event the transformer itself fails, thus avoiding grounding the phase line and cutting off the current from other customers being served from the primary circuit.

It was to furnish complete protection at all times to the transformer itself and to avoid the heretofore set forth difficulties that I conceived the switch of my invention.

The main object of my invention is to provide a new and improved cut-out switch or circuit breaker located in the line between the phase or "hot" wire and the transformer and which is positively actuated by thermo-responsive means located in the liquid medium contained in the transformer housing and upon an abnormal rise in temperature of such liquid.

Other objects of my invention are to provide a simple mechanism for cutting out a transformer from the primary circuit of a high voltage distribution line upon abnormal rises in temperature in the transformer housing; to provide a simple inexpensive electrical cut-out mechanism of this character which can be added to a transformer of the character described and associated mechanism, without changing the standard fixtures thereof; to provide a cut-out switch mechanism of this character which will automatically disconnect the transformer from the primary supply circuit when either (1) the coil insulation of the transformer causes the transformer to overheat due to any condition such as by lightning current, or (2) when the secondary coil is shorted or overloaded and thereby overheats the coils; to provide a release mechanism of this character which is operable through a temperature rise of the liquid in an oil-filled transformer; to provide a releasing trigger mechanism in a device of this character which is actuated by a thermo-responsive device operable through a rise in temperature in the transformer housing; to provide an improved oil-filled primary circuit breaker of the thermal controlled type for cutting out a high voltage transformer when such transformer becomes overloaded, overheated, short circuited or any other condition wherein the transformer coils become abnormally overheated; and to provide a circuit breaker of this character which is relatively inexpensive to manufacture and may be readily installed on standard transformers of the type described.

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An illustrative embodiment of this invention is shown in the accompanying drawings in which:

Figure 1 is a side view of a transformer housing, the windings of the transformer being shown in dotted lines, and showing the switch of my invention secured thereto.

Fig. 2 is a vertical cross sectional view through the housing of my switch mechanism and showing the switch details in full lines.

Fig. 3 is a diagrammatic view showing the preferred manner of utilizing my invention.

Referring in detail to the drawings, the transformer being of the usual design employed in high voltage primary circuits is not shown in minute detail, and only enough detail is shown to illustrate its connection with the cut-out switch or circuit breaker of the present invention.

The transformer shown comprises a steel housing or tank 1 having the usual primary and secondary coils 2 and 3 with their cores anchored to the bottom of the housing 1 by core clamps 4. The housing 1 is substantially filled with oil 5, as is customary in transformers of this type, and the housing capped with a cover plate 6 and secured thereto by clamps 7. A high voltage porcelain insulator 8 is secured to cover plate 6 in the usual manner.

A gasket 9 is interposed between the upper end of the insulator 8 and the lower portion of cap 10. Cap 10 is provided with an axially positioned

terminal 11 in the form of a threaded stud carrying a nut 12.

A lightning arrestor 15 is almost universally used in connection with transformers of this character. However, it is to be understood that the cut-out switch, or circuit breaker, of my invention, although shown anchored to the arrestor 15, may be secured to the transformer housing in any convenient manner just so long as the lead line from the "hot" or phase wire passes through the switch before it is connected to the primary coil of the transformer, and the switch is insulated from the transformer housing.

The lightning arrestor 15 is secured and grounded to the transformer housing 1 by means of a hanger bracket 16 in the usual manner. The arrestor 15 is provided with the usual insulator 17 having a threaded stud 18 extending therefrom normally acting as a line terminal.

I have found it convenient to mount my cut-out switch and housing on this stud 18 in a manner as will hereinafter be described.

The housing or tank 19 of my switch is preferably constructed of porcelain and provided with a porcelain cover plate 20 having an axially located aperture 21 therein into which a bronze sleeve or bushing 22 is fitted. The bottom of my housing 19 is also provided with an axial aperture 23 into which an oil-tight gasket 24 is fitted. A stationary contact 25 is inserted therethrough and comprises a headed stud having a threaded shank 26 adapted for threaded engagement with the bronze coupler 27.

I find it desirable to mount a pair of upstanding heavy spring clips 28 to the head of the stud for receiving the lower end of the movable contact arm 29 and to make certain that an electrical connection between the contacts is effected. The movable contact arm 29 is preferably constructed of a copper rod of a length extending beyond the cover plate 20 of the housing 19. The arm 29 is arranged to be inserted through the sleeve 22 and have snug frictional engagement therewith and also form a wiping contact therewith, since the arm 29 moves along the vertical axis of housing at all times.

The upper end of the arm 29 is provided with an integrally formed reclosing ring 30, the purpose of which will be hereinafter described, and a heavy coiled spring 31 positioned thereon between the collar seat 32 and the upper edge of the sleeve 22 so as to normally urge the arm 29 away from the stationary contact 25.

I also provide an aperture 33 in the lower end of my housing 19 and sweat a bushing therein for the purpose of providing an opening for the tube 34 of my temperature-responsive device. The tube 34 is provided with a sleeve 35 which snugly holds the tube 34 in position, and also provides an oil-tight seal to prevent the oil from escaping from the housing 19.

My temperature-responsive device, as shown in the drawings, comprises a thermal bulb 36 containing an expansible gas under pressure, a length of capillary tubing 34, and an expansible bellows 37. The bulb is inserted through the hollow insulator 8 and suspended in the oil 5 above the transformer windings 2 and 3. The free end of the bellows 37 is provided with an ear 38 to which one end of a short link 39 is pivotally secured.

The other end of link 39 is pivotally secured to the lower end of the inverted L-shaped release trigger 40 having a leg 41 depending therefrom. The trigger 40 is pivotally secured as at 42 to a supporting bracket 43, as clearly shown in Fig. 2. The free end of leg 41 is arranged to move into and out of the notch or recess 44 contained in the arm 29, so that when the leg 41 is seated in the recess 44 the movable contact 29 and the stationary contact 25 are in electrical engagement with each other. As is customary in cut-out switches where high voltages are concerned, the switching elements are usually immersed in oil; therefore, I substantially fill the interior of my housing with oil, as indicated by the numeral 45. The oil acts as an insulator between the two contacts, when they are open, to prevent and minimize sparking, etc.

As shown in the drawings, the housing 19 is secured to the arrestor 15 by the coupling 27 which is threaded on the stud 18.

Fig. 3 illustrates the wiring diagram and shows that one side (the movable contact side) of the switch of my invention is directly connected to the phase or "hot" line of the primary circuit by conductor-wire 46. The actual connection is shown in Fig. 2 wherein the sleeve bushing 22 is provided with a threaded stud 22.1 integrally secured to the margin of the flange 22.2 The stud is cleft endwise and also carries a nut 22.3. By placing the end of conductor-wire 46 in the slot formed by cleaving and tightening the nut 22.3 the end of the conductor-wire 46 is securely anchored therein.

A conductor-wire 47 goes directly from the other side of the switch (the stationary contact side) to one side of the primary winding 2 of the transformer, the actual connection being from the collar 27 to stud 11; while conductor-wire 48 goes to the lightning arrestor 15 which is itself connected directly to the ground by conductor-wire 49. The neutral line is connected to the other side of the primary winding 2 by conductor-wire 50 and thence to the ground through conductor-wire 51.

Any form of connection between the stationary contact 25 and the primary winding of the transformer may be employed but I have illustrated a collar 52, anchored to the coupler 37, containing an aperture into which the wire 47 may be inserted and held in place therein by set screw 53.

The connection represented by conductor-wire 48 between the lightning arrestor 15 and stationary contact 25 is actually made by the coupler 27.

The gasket 9 is provided with a radial groove, not shown, in which the tube 34 seats so as not to be crushed when the cap 10 is placed on insulator 8.

In operation, as the thermal bulb 36 is immersed in the oil, indicated by the numeral 5, in the transformer housing above the coil windings, any circumstance happening in a transformer to cause it to overheat, such as by overloading or short-circuiting, will cause the oil in the transformer to become excessively warm, expanding the gas in the thermal bulb 36, thereby causing the bellows 37 to expand laterally, the lever 39 to move laterally and disengage the leg 41 of the tripping mechanism to move it out of its seat in the recess 44 of the movable contact arm 29.

The spring 31 will then cause the contact to shift upwardly, thereby breaking the connection between the movable contact and the stationary contact. It will, therefore, be seen that the transformer is cut out of the primary circuit by the opening of the contacts.

When this circumstance which caused the coils of the transformer to overheat has been elimin-

ated, the repair man merely places what is commonly called in the trade a "hot stick" in the reclosing ring 30 and pulls downwardly, thereby shifting the movable contact 29 and the stationary contact 25 into electrical engagement once again.

As the cause for overheating the coils of the transformer has been remedied, the oil in the transformer has returned to normal temperature causing the bellows 37 to contract and position the leg 41 of the release mechanism into the position shown in Fig. 2.

It is to be understood that there are other thermo-responsive means and release mechanisms which may be employed to cause the movable contact 29 and the stationary contact 25 to become disengaged, such as a mechanical arrangement whereby a rod is passed through a bushing, either by rotation or lateral movement of the rod, which movement is caused by the action of a thermostatic control mechanism in the transformer which will rotate or shift the rod so as to operate the switch. There are innumerable thermostatic mechanisms on the market which may be used for this purpose.

Although but one specific embodiment of this invention is herein shown and described, it will be understood that numerous details of the structure shown may be altered or omitted without departing from the spirit of the invention as defined by the following claims:

I claim:

1. A cut-out device for high voltage transformers wherein the windings of the transformer are immersed in a body of oil, said cut-out device comprising an insulated hollow housing closed at both ends and containing an arc-quenching medium therein, a stationary contact located in the medial lower end of said housing and provided with upstanding spring contact clips, an elongated movable contact arm axially positioned in said housing and in alinement with said stationary contact, the upper end of said arm extending through and beyond the upper end of said housing, an axially positioned bearing in the upper end of said housing in which said contact arm is movable, spring means surrounding the portion of said arm extending beyond the upper end of said housing to normally urge disengagement of said contact arm and stationary contact, a keeper formed on said contact arm adjacent the lower end thereof, a latch bar located within said housing, one end thereof arranged to seat in said keeper, and temperature-responsive means for solely actuating said latch bar upon abnormal rise in temperature of the oil in the transformer.

2. In a device of the class described a high voltage transformer, a housing therefor having a winding therein immersed in oil, a hollow porcelain bushing on said housing; in combination with a cut-out switch therefor located adjacent said transformer housing comprising a closed housing, a movable contact and a stationary contact disposed within said switch housing, latching means in said switch housing for normally holding said contacts in engagement with each other, said contacts and latching means being immersed in an arc quencing batch, thermo-responsive means comprising a gas filled "remote" bulb suspended in said transformer housing and immersed in said oil, expansion means located in said switch housing and operatively connected to said latching means, a capillary tube connecting said expansion means and said bulb and threaded through said hollow porcelain bushing;

whereby when the temperature of said oil in said transformer housing rises to an abnormal level, the thermo-responsive means will cause actuation of and release of said latch to disengage said contacts.

3. A self-contained high voltage switch and operating mechanism therefor for mounting as a unit out-of-doors on a transformer housing having a high voltage terminal supported on and insulated from the transformer housing by a high voltage porcelain insulator or the like comprising, in combination, a stationary contact adapted to be connected to said high voltage terminal and to be supported by said housing and insulated therefrom in part, at least, by said insulator, a movable contact normally in engagement with said stationary contact, and adapted to be connected to a high voltage line conductor, a weather tight housing for said contacts supported with said stationary contact and including insulating means for maintaining said contacts in insulated relation when they are separated, said movable contact having a portion extending through said weather tight housing, spring means reacting between said movable contact and said weather tight housing for biasing the former away from said stationary contact, latch means holding said contacts in engagement against the biasing force of said spring, means for tripping said latch means in response to the occurrence of a predetermined abnormal operating condition of said transformer to permit said spring means to separate said contacts and open the circuit from said high voltage conductor, and means operatively connected to said exteriorly extending portion of said movable contact for receiving a prong of a switch stick for restoring the same into engagement with said stationary contact and operating said latch means to maintain said engagement.

4. The invention, as set forth in claim 3, wherein the tripping means includes expansible bellows means operatively connected to the latch means, a bulb containing an expansible fluid arranged to be responsive to heat generated on the occurrence of an abnormal operating condition of said transformer, and a tube interconnecting said bellows and said bulb.

5. The invention, as set forth in claim 3, wherein the tripping means includes expansible bellows means operatively connected to the latch means, a bulb containing an expansible fluid for mounting in the transformer housing, and a tube extending through the high voltage insulator and interconnecting said bellows and said bulb.

6. In combination, a transformer having a housing and a high voltage terminal extending therethrough and insulated therefrom by a high voltage insulator bushing, a pair of separable contacts, one of said contacts being supported on said transformer housing at the insulation level of said terminal and connected thereto, the other of said contacts being connectable to a high voltage line conductor, means biasing said contacts apart, latch means for holding said contacts in engagement, expansible bellows means operatively connected to said latch means, a bulb containing an expansible fluid in said transformer housing, and a tube extending through said high voltage insulator bushing and interconnecting said expansible bellows means and said bulb whereby on the occurrence of a predetermined temperature within said transformer housing said fluid expands sufficiently to expand said bellows and trip said latch means.

7. A self-contained high voltage switch and op-

erating mechanism therefor for protecting an electrical device, such as a transformer having a high voltage terminal energized from a high voltage conductor, from functioning under abnormal operating conditions accompanied by the generation of excessive heat comprising, in combination, a stationary contact for connection to said high voltage terminal, a movable rod-like contact for connection to said high voltage conductor at one end and normally in engagement with said stationary contact at the other end, a weather tight housing for said contacts with said stationary contact mounted on one wall and said movable rod-like contact slidably mounted in the opposite wall, said housing including insulating means for maintaining said contacts in insulated relation when they are separated, spring means biasing said movable contact away from said stationary contact, latch means mounted on said housing and cooperating with said movable contact for holding the same in engagement with said fixed contact against the biasing force of said spring, an expansible bellows operatively connected to said latch means, and a bulb connected to said bellows and containing an expansible fluid and positioned to be responsive to heat generated on

the occurrence of an abnormal operating condition as aforesaid for expanding said bellows to trip said latch means and permit said biasing means to separate said contacts and open the circuit between said high voltage conductor and said high voltage terminal.

8. The invention, as set forth in claim 7, wherein the weather tight housing contains a liquid arc extinguishing medium and the contacts separate under its surface, and the biasing means comprises a coil compression spring surrounding the movable rod-like contact and it reacts between said contact and said housing.

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