May 17, 1938. G. S. VAN ANTWERP 2,117,583

ELECTRICAL TRANSFORMER

Filed Aug. 16, 1935 2 Sheets-Sheet 1

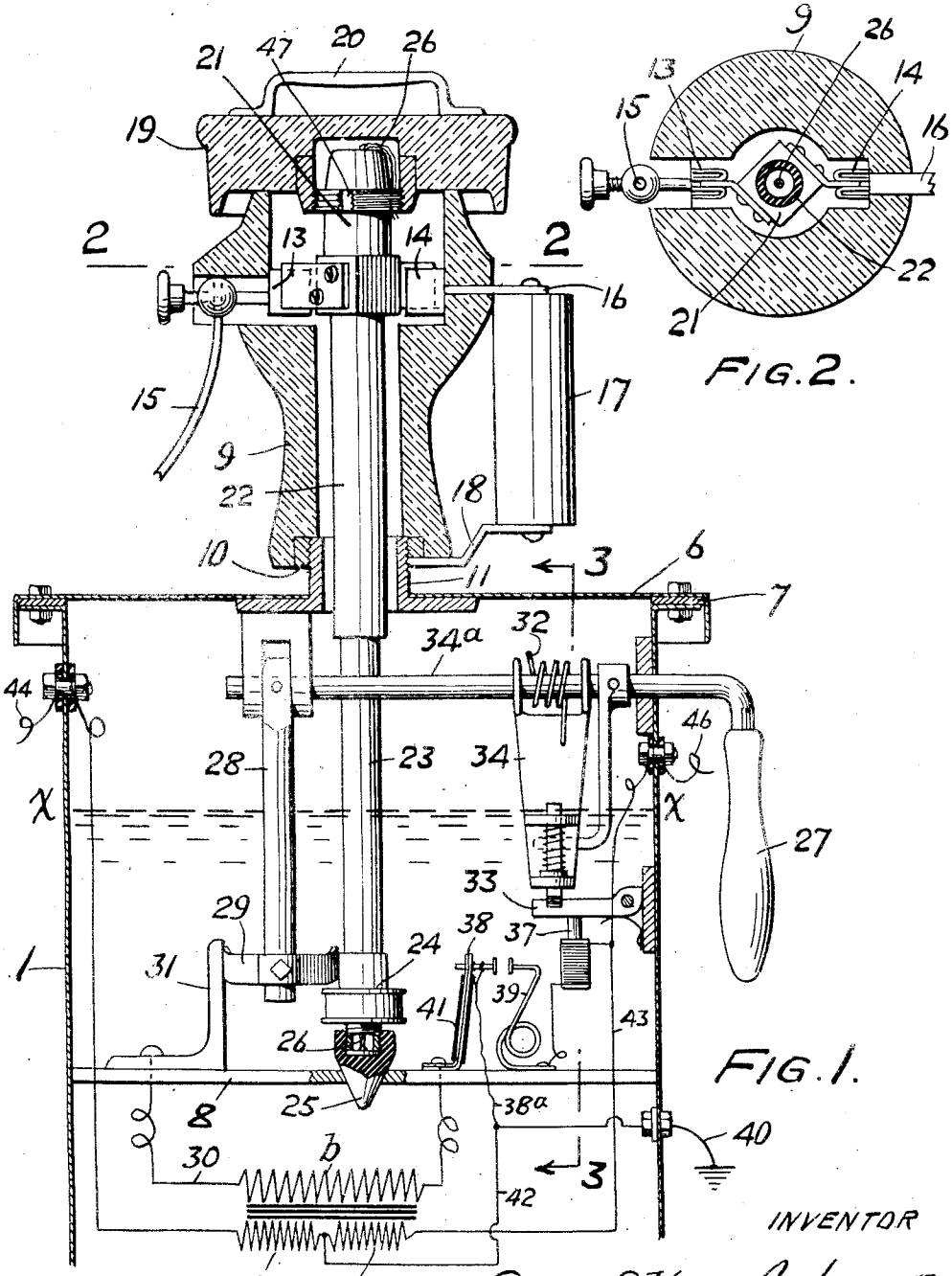


FIG. 1.

FIG. 2.

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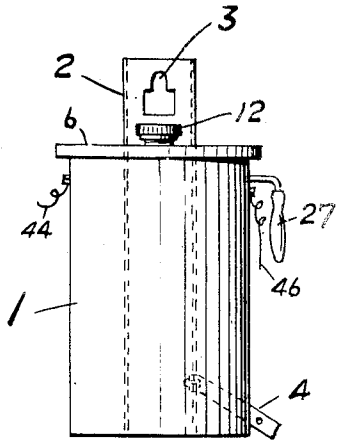


FIG. 5.

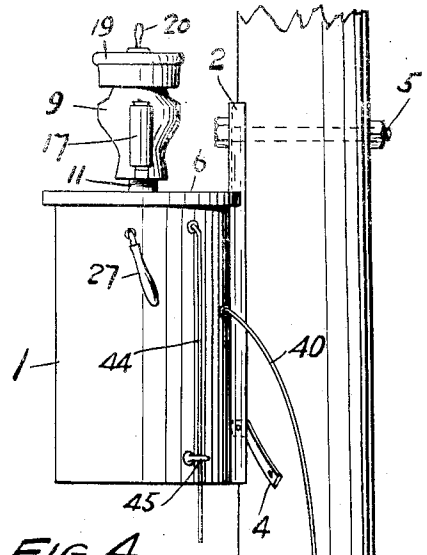


FIG. 4.

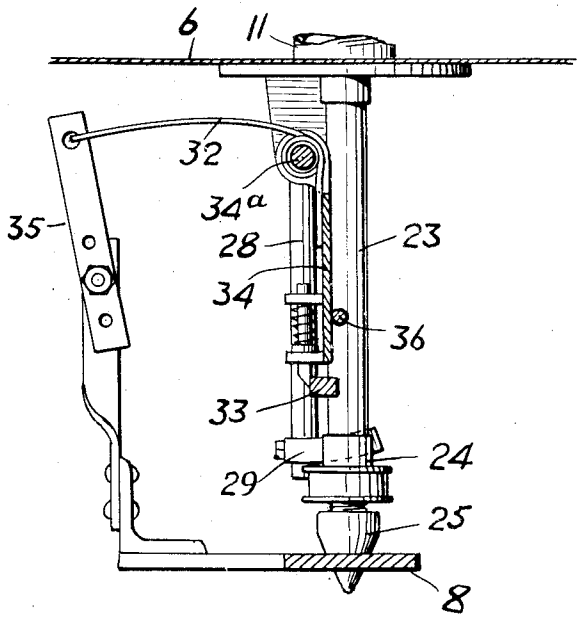


FIG. 3.

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UNITED STATES PATENT OFFICE

2,117,583

ELECTRICAL TRANSFORMER

George S. Van Antwerp, Norristown, Pa.

Application August 16, 1935, Serial No. 36,517

9 Claims. (Cl. 175—294)

Objects of the present invention are to provide a comparatively inexpensive, efficient and convenient transformer of the type usually employed on poles in connection with distribution systems, in which the mechanical structure and arrangement is simplified and made less costly and more effective, and in which the operation is more perfect and the protection given is more satisfactory, than heretofore.

Other objects are to dispense with the use of cross arms on the poles as a means for suspending the transformers; to provide an overload cut-out manually or automatically operated; to provide that a fuse shall blow in oil; to utilize the primary circuit in the automatic operation of the overload cut-out; to operate the overload cut-out in differential response to both the current in the primary circuit and to the sensible temperature of the oil; to simplify the construction of the tank and avoid the necessity for pockets in it; to improve the construction, arrangement and operation of the fuse holder and to conveniently locate the lightning arrester at the outside of the tank.

Other objects of the invention will appear from the following description at the end of which the invention will be claimed.

Generally stated the invention comprises a cylindrical tank provided with a T-slot suspension and with an insulating fuse holder detachably mounted at its top and including a lightning arrester, and the interior of the tank containing an oil supply and a frame submerged in the oil supply and arranged above the transformer coils and core, and externally of the tank there being provided a manual handle for operating a cut-out switch arm that breaks the primary circuit beneath the oil and serves to lock and unlock the fuse carrier and there is optionally provided a spring tending to throw the switch arm out and an electro-magnetic catch for detaining the spring, the electro-magnetic catch being operated by differential thermostats of which one is immersed in the oil and responds to its temperature, and of which the other is included in the primary circuit of the transformer, said thermostats controlling the circuit of the electro-magnetic catch.

The invention also comprises the improvements to be presently described and finally claimed.

Referring to the drawings,

Figure 1 is a view partly in section and partly in elevation illustrating the upper portion of a transformer embodying features of the invention and diagrammatically showing the transformer coils.

Figure 2 is a sectional view taken on the line 2—2 of Figure 1.

Figure 3 is a view partly in section on the line 3—3 of Figure 1 and partly in elevation.

Figure 4 is a view drawn to a reduced scale and illustrating the transformer in application to a pole, and

Figure 5 is a side view of the transformer shown in Figure 4.

Referring to the drawings, 1 is a tank of metal shown as externally provided with a channel piece 2 having a T slot 3 formed therein. The channel piece 2 is provided with pivotal extensions 4. This construction enables the transformer tank to be suspended in a readily detachable manner from a through bolt 5 extending through the pole. The channel piece finds a good support in respect to the pole and the extensions 4 may be employed as additional means for preventing the tank from swaying. The lid 6 of the tank is provided with a drip skirt and is shown as bolted to a flange at the top of the tank with the interposition of a gasket 7. Thus the interior of the tank is protected from the weather. The tank contains oil, the level of which is indicated at the line x—x. The tank also contains at the lower part thereof the core and the primary and secondary windings. The primary winding is indicated at b and the secondary winding is indicated at c and c'. 8 is a frame extending across the tank with space on each side of it. 9 is an insulator shown as cylindrical and it is detachably mounted on the top of the tank by means of a threaded metal ring 10 having screw threaded engagement with a metal neck 11 on the top 6 of the tank. Thus the cylindrical insulator 9 can be shipped detached from the tank and readily mounted in place. Use may be made of a closure 12 (Figure 5) for retaining the oil when the tank is shipped. The insulator 9 is fitted with spring contacts 13 and 14 (Figure 2) and the contact 13 is connected with the high tension line 15. The contact 14 is connected with the conductor 16 of the lightning arrester 17 of which the other conductor or terminal 18 is connected with the ring 10 and through the tank to ground. The cap 19 is shown as provided with a handle 20 and it is mounted on top of the insulator 9. The cap detachably carries a fuse and is in fact a fuse holder. The fuse includes a metallic head 21 having contact blades which are engaged by the contacts 13 and 14. The fuse also includes an

insulating tube 22 and 23 and at the lower end there is a metallic foot 24 having an insulating tip 25. The insulating tip 25 is seated in an aperture provided in the frame 8. The fuse proper 26 extends from the head 21 to the foot 24 and is included in the primary circuit of the transformer. The foot 24 is immersed in the oil. 27 is a handle turnably mounted and accessible from the exterior of the tank. 28 is a switch arm turnable with the handle and provided with a bridge contact 29 adapted to be interposed in the primary circuit 30. It bridges the circuit between the conducting post 31 and the metal foot 24. It may be remarked that when the bridge 29 is in position for closing the primary circuit the fuse may not be withdrawn because the bridge overlies the foot 24. The purpose of this is to ensure that the cap 19 and the fuse may not be withdrawn until after the primary circuit is broken, and it is broken in oil just as the fuse blows in oil. There is a spring 32 tending to turn the switch arm 28 into off position. This spring is set when the switch is closed and it is held in set position by a latch 33 operating upon a keeper 34. As shown the spring is a spiral spring wound around the shaft 34a and having one end connected with the keeper 34 and the other end connected with an adjustable tension device 35. The keeper 34 is turned to set the spring by a finger 36 fast on the shaft 34a and when released the keeper 34 shifts the finger 36 and with it the switch arm 28. The latch 33 is spring pressed and is part of an electro-magnetic device of which 37 is the solenoid. It will be understood that when the switch arm is turned to closed position the finger 36 shifts the keeper 34 to latched position provided that it is not already in latched position and when the keeper is released by the catch it turns the finger 36 and with it the switch arm 28 into open position. There are bi-metallic thermostats 38 and 39 mounted on the frame 8 and immersed in the oil. Between these thermostats are contacts for closing the circuit through the electro-magnet 37. The thermostat 39 responds to the temperature of the oil. The thermostat 38 is in the primary circuit and is grounded by way of conductors 38a and 40. The thermostat is provided with a jacket 41 made in similitude to the winding on the transformer coil b and it is heat insulated. The thermostat 38 is heated by the current in the primary circuit to substantially the same extent that the primary coil is heated. By the differential action of these thermostats the circuit through the electro-magnetic latch is closed permitting the switch arm 28 to be cut-out. In the event that the transformer, due to the load being carried, has increased the oil temperature, the thermostat 39 has partly closed and hence a short circuit or heavy load causes the thermostat 38 to function before damage is done to the transformer winding. If the oil is cold and a short circuit occurred the thermostat 38 will have comparatively far to travel and will consequently carry the load for a sufficient length of time before tripping the cut-out switch 28. In this way the thermostatic device is responsive to actual temperature conditions in the transformer and allows for the maximum carrying capacity of the winding of the transformer before tripping the switch arm 28. It is a feature that the switch arm 28 may be opened manually or automatically and it may be remarked that the provision for automatically opening the switch arm 28 may, if desired, be omitted. The center part of the secondary coil is grounded by 42 and 40 and the circuit for the electro-magnetic device 37 is from one end of the secondary by 43 and thence to ground by 39 when the contacts of the thermostats are closed. There are two leads for the secondary circuit of which one is shown at 44 and the other at 46 and in the form of covered wires they are carried through insulating guide eyes 45 on the outside of the tank 1. It may be remarked that the tank is grounded and that the parts which carry current are insulated from the frame 8.

The tank structure and its accessories and the electrical provisions are dependent upon each other and contribute to the improved result of the described transformer which involves not only safety in the distribution of high tension current but also convenience and safety in manipulation by those who have to install and service the devices on poles in all sorts or conditions of weather.

Oil may find its way into the lower part of the fuse tube 23, and when the fuse blows, if there is an explosion, it occurs remote from the gas space above the oil line x—x, and is vented through the notch 47 and by the lifting of the cap 19.

It will be obvious to those skilled in the art to which the invention relates that modifications may be made in details of construction and arrangement without departing from the spirit of the invention, which is not limited as to such matters or otherwise than the prior art and the appended claims may require.

I claim:

1. In a transformer of the type specified the combination of a tank provided internally with primary and secondary windings and with a core, and containing oil, an insulator mounted on the top of the tank, a cap detachably mounted on the insulator and provided with a depending fuse tube and a fuse having a metallic foot immersed in the oil, circuit connections from the primary circuit through the fuse to the foot, a handle turnably mounted and accessible from the exterior of the tank and having a switch arm inside the tank and in range of the foot, and a contact submerged in the oil and interposed in the primary circuit and disposed in the path of the switch arm, said switch arm and the metallic foot on the fuse tube constructed and arranged to interlock when the arm is in closed position.

2. In a transformer of the type specified the combination of a tank provided internally with primary and secondary windings and with a core and containing oil, a cap provided with a depending fuse tube and fuse having a metallic foot in the oil, circuit connections from the primary circuit through the fuse to the foot, a handle turnably mounted and accessible from the exterior of the tank and having a switch arm inside of the tank and in range of the foot, a contact submerged in the oil and disposed in the path of the switch arm and in the primary circuit, a spring and connections tending to turn the switch arm to off position, a keeper adapted to restrain the spring and permit free operation of the handle, an electro-magnetic latch for detaining the keeper, two thermostats having contacts and adapted to control the circuit of the electro-magnetic latch at a point submerged in the oil and of which one is responsive to the sensible temperature of the oil and of which the other is in the primary circuit and is responsive

to current in the primary transformer coil, and a circuit connected to and controlled by the electro-magnetic latch and through the contacts of the thermostats.

3. In a transformer of the type specified, the combination of a tank provided internally with primary and secondary windings and with a core and containing oil, a frame submerged in the oil and provided with a contact included in the primary circuit and with an aperture, a fuse provided with a fuse tube having a fuse included in the primary circuit and also having a metallic foot and an insulating tip adapted to seat in said aperture, a switch arm in range of the contact and foot and having an operating handle exterior of the tank, a spring and its keeper adapted when the spring is released to throw out the switch arm, an electro-magnetic latch device for the keeper, two thermostats mounted on the frame and of which one is responsive to the temperature of the oil and the other to current in the primary coil of the transformer and is in series therewith, circuit connections through the electro-magnetic device and controlled by the differential action of the thermostats, and circuit connections providing leads for said primary winding and for said secondary winding.

4. In a transformer of the type recited, the combination of a tank provided internally with primary and secondary windings and with a core and containing oil, a cap provided with a depending fuse tube and fuse having a metallic foot in the oil, a circuit connection from the primary circuit through the fuse to the foot, a handle turnably mounted and accessible from the exterior of the tank and having a switch arm inside of the tank and movable into and out of contact with the foot, a contact submerged in the oil and disposed in the path of the switch arm and connected to the primary winding, a spring and connections tending to turn the switch arm to off-position, an electro-mechanical latch device adapted to restrain the spring and permit free operation of the handle, two thermostats adapted to control the circuit of the electro-mechanical latch device and of which one is responsive to the sensible temperature of the oil and of which the other is in the primary circuit and is responsive to current in the primary transformer coil, and a circuit through the electro-mechanical latch device and connected to and controlled by the contacts of the thermostats.

5. In a transformer having primary and secondary windings, a tank suitable for enclosing the operating parts of the device and containing oil, a fuse tube supported by said tank and having a current-conducting portion projecting into the oil of said tank, a contact in said tank and located adjacent said portion, a switch arm arranged for movement into and out of engagement with said contact and said portion and which when in engaged position locks said portion and consequently said fuse tube against removal from said tank, and means operable from the exterior of said tank for moving said switch arm.

6. In a transformer having primary and secondary windings, a tank forming a casing and containing oil, a fuse tube having contacts thereon of which one is beneath the oil in said tank, a switch connected so as to control the connections between said fuse tube and the primary winding, means operable from outside said tank and controlling said switch, a spring and connections tending to turn said means and said switch to disengaged position, a latch restraining said spring from operation, a thermostat responsive to the temperature of the oil in said tank, a contact with which the thermostat co-operates, and electromechanical means having a circuit controlled by the thermostat at the last mentioned contact and controlling the operation of said latch.

7. In a transformer having primary and secondary windings, a tank forming a casing and containing oil, a fuse tube having contacts thereon of which one is beneath the oil in said tank, a switch in said tank and connected so as to control the connections between said fuse tube and the primary winding, means operable from outside said tank and controlling said switch, a spring and connections tending to turn said means and said switch to disengaged position, a latch restraining said spring from operation, a thermostat substantially heat insulated from the oil in said tank and responsive to the current in the primary winding and an electromechanical device having a circuit closed by the thermostat and controlling the operation of said latch.

8. In a protective system for an electric transformer, the combination of, a tank provided internally with primary and secondary coils and with a core co-operating with said coils and containing oil, an insulator mounted on the tank, a lightning arrester mounted on the insulator and electrically connected to the tank, a fuse tube supported by said insulator and having a conducting portion projecting into the oil of said tank, a contact in said tank located adjacent said portion, a switch arm arranged for movement into and out of engagement with said contact and said portion and which, when in engaged position, locks said portion and consequently said fuse tube against removal from said tank, and means operable on the exterior of said tank for moving said switch arm.

9. In a protective system for an electric transformer, the combination of, a tank containing oil and internally provided with primary and secondary coils and with a core co-operating with said coils, a hollow insulator mounted on said tank and having an outlet through one wall thereof, an imperforate cap detachably mounted on said insulator, a fuse tube mounted on said insulator and projecting through the hollow in said insulator, said fuse tube being provided with a vent adjacent said cap and communicating with the interior of said insulator, a metal foot mounted on said fuse tube in the oil in said tank, an electric connection mounted on said insulator and connected to said foot, a stationary contact mounted in the oil in said tank adjacent said foot, a metal bridge contact mounted for movement in said tank into and out of engagement with said foot and said stationary contact and arranged, when in engagement therewith, to lock said foot and consequently said fuse tube against removal from said tank, and means having a portion external to said tank for moving said bridge contact into and out of engaged position.

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