

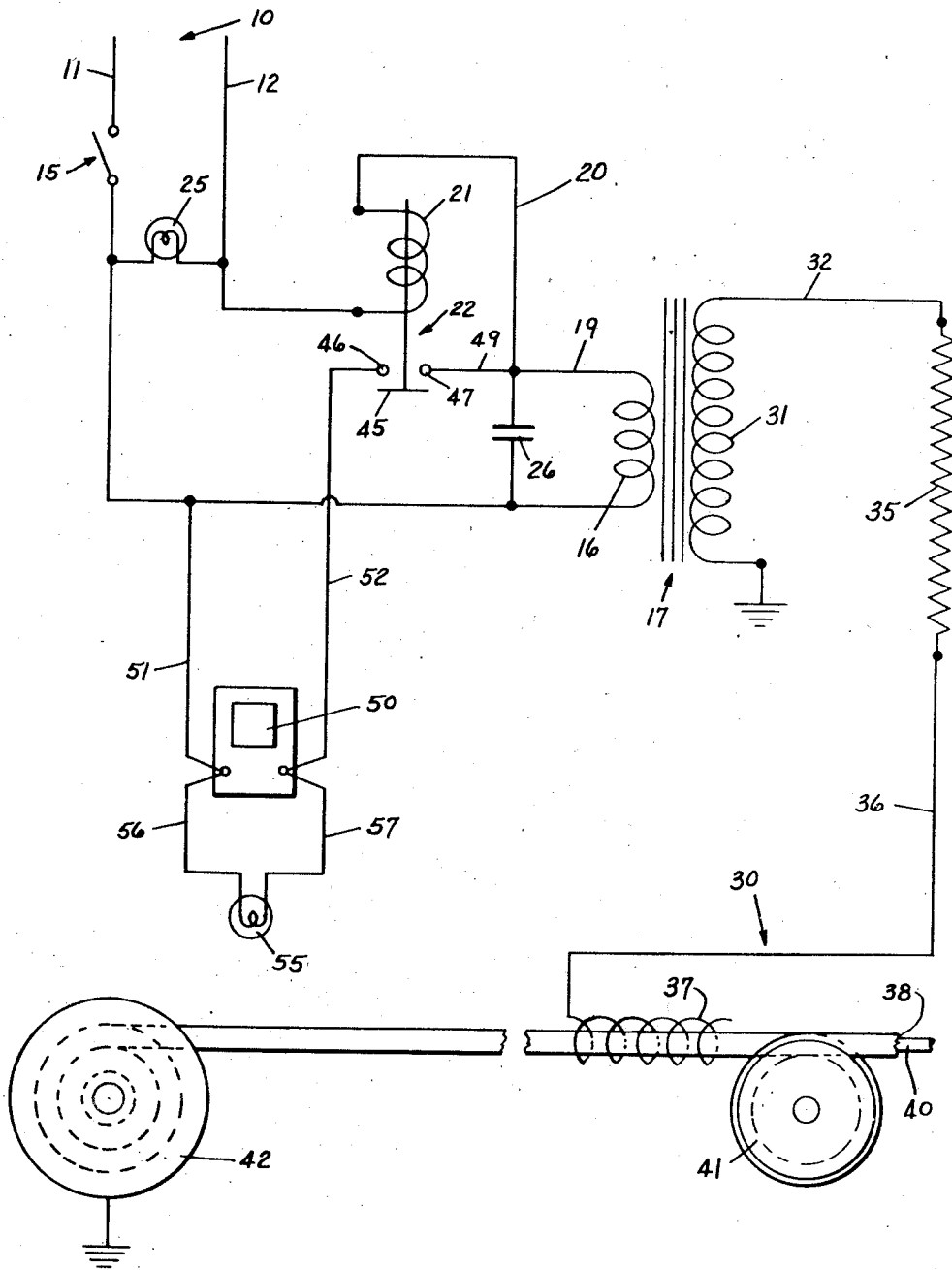
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APPARATUS FOR TESTING ELECTRICAL INSULATION

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## APPARATUS FOR TESTING ELECTRICAL INSULATION

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This invention relates to electrical insulation testing apparatus and more particularly to apparatus for testing insulating jackets of cables, and has for its object the provision of new and improved electrical insulation testing apparatus.

One apparatus embodying the invention includes a source of alternating current and a transformer whose primary winding is connected to the source of current. High-sensitivity means associated with the transformer are operable by an increased flow of current through the transformer and means are provided which prevent the operation of the last-mentioned means from a surge of transient current occurring when the transformer is energized initially.

A complete understanding of the invention may be obtained from the following detailed description of a specific embodiment thereof, when read in conjunction with the appended drawing, in which the single figure comprises a schematic view of a testing apparatus embodying the invention.

Referring more particularly to the drawing, a power line 10 comprising conductors 11 and 12 is connected to a source of 110 volt, 60 cycle alternating current (not shown). The conductor 11 has a manually operable switch 15 positioned therein and leads to an end of a primary winding 16 of a step-up transformer 17. A transformer which has been found to be suitable is a close-coupled, low-leakage, 60 cycle, 100 volt-ampere transformer and requires a current of not more than 50 milliamperes at 110 volts to be magnetized.

Conductors 19 and 20 connect the other end of the primary winding 16 to one end of a coil 21 of a current-responsive relay 22. A relay which has been found to be satisfactory is a sensitive relay with a coil to operate the relay on 108 milliamperes at 60 cycles. The other end of the coil 21 is connected to the conductor 12. When the switch 15 is closed, power is supplied to the primary winding 16 from the conductor 11 and from the conductor 12, the coil 21 and the conductors 20 and 19. A lamp 25 connected across the conductors 11 and 12 indicates when power is being supplied to the primary winding 16. A condenser 26 whose capacity is about 2 microfarads, is connected to the conductors 11, 19 and 20 in parallel with the primary winding 16 of the transformer 17.

A test circuit 30 includes a secondary winding 31 of the transformer 17. One end of the secondary winding 31 is grounded and the other end thereof is connected by a conductor 32 to one end of a resistance 35. The other end of the

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resistance 35 is connected by a conductor 36 to a contactor 37. The contactor 37 may be in the form of a chain electrode similar to the contactor shown in Patent No. 1,952,582, issued March 27, 1934.

The contactor 37 serves to contact the exterior portion of an insulating jacket 38, which serves to enclose a conductor 40. One end of the conductor 40 is grounded by being connected to a supply reel 42 which is grounded and the conductor 40 and the jacket 38 are moved past the contactor 37 by a capstan 41.

The current-responsive relay 22 includes a contactor 45, which is forced into engagement with contacts 46 and 47 when the relay 22 is actuated. The contact 47 is connected by a conductor 49 to the conductor 19. A conventional electric bell 50 is connected by conductors 51 and 52 to the conductor 11 and the contact 46, respectively, and a lamp 55 is connected by conductors 56 and 57 to the conductors 51 and 52, respectively, in parallel with the bell 50. When the contactor 45 is in engagement with the contacts 46 and 47, the bell 50 is rung and the lamp 55 is lighted by a circuit including the conductors 11, 51, 56, 57, 52, the contact 46, the contactor 45, the contact 47, the conductors 49 and 20, the coil 21 and the conductor 12.

When power is supplied to the transformer 17 by closing the switch 15, a transient magnetizing current of high frequency may occur which is superposed on the fundamental magnetizing current of the transformer, the value of which will depend upon the residual magnetism of the transformer core and the point on the voltage wave at which the switch 15 is closed. The transient magnetizing current is characterized by one or more harmonics of which the second is in general predominating. Consequently, the condenser 26 is turned with the primary winding 16 to form a parallel resonant circuit only when this transient high frequency magnetizing current occurs. The resonating circuit composed of the primary winding 16 and the condenser 26 provides a sufficiently high impedance only to the flow of the transient high frequency magnetizing current from the source of power so that the current-responsive relay 22 is not operated thereby. Since only the transient high frequency magnetizing current is controlled by the resonant circuit during the condition that may exist when power is first supplied to the transformer 17, the normal frequency current which flows through the primary winding 16 of the transformer and the relay 22 caused by a fault in the insulating jacket 38 appearing at the

contactor 37, is not affected by the resonant circuit and the current-responsive relay will be operated by this fault current.

The test circuit 30 is closed only when the contactor 37 encounters a fault in the jacket 38 and at that time the high potential induced in the test circuit by the transformer 17 causes a high current to flow through the fault to the conductor 40 and through that conductor to the grounded supply reel 42.

In the operation of the above described apparatus, one end of the conductor 40 is grounded by securing one end thereof to the grounded supply reel 42. The conductor 40 and the jacket 38 are then positioned with respect to the apparatus so that the contactor 37 engages the insulating jacket 38. The switch 15 is then closed to energize the primary winding 16 of the step-up transformer 17, whereby a high potential alternating current is induced in the secondary winding 31, and the contactor 37 is maintained at a high potential. The jacket 38 is drawn past the contactor 37 by the capstan 41, and if no fault is present in the insulating jacket 38, current does not flow through the test circuit 30.

However, when a portion of the insulating jacket 38 having a fault therein is drawn past the contactor 37, high potential applied to the contactor 37 will cause current to flow through the fault to the grounded conductor 40. This current will flow from ground through the secondary winding 31, the conductor 32, the resistance 35, the conductor 36, the contactor 37, the fault (not shown) in the jacket 38, and the conductor 40 to the grounded supply reel 42. The current flowing through the testing circuit 30 causes a much increased current in the primary winding 16 of the transformer 17 in accordance with accepted transformer theory. This increased current flows through the coil 21, which draws the contactor 45 into engagement with the contacts 46 and 47, whereby the bell 50 is rung and the lamp 55 is lighted to indicate the presence of the fault. The switch 15 then is opened to deenergize the bell 50 and the lamp 55. The portion of the cable containing the fault then may be tagged and after reclosing the switch 15 the test of the cable continued to locate any additional faults.

The above described apparatus serves to locate faults in insulating jackets of cables quickly and accurately and will not be operated falsely by a transient surge of high frequency current occurring when the transformer is energized initially and when there is no fault in an insulating jacket being tested. The apparatus obviously may be used to locate faults in cables or in multi-conductor insulated conductors as well as to locate faults in a single-conductor insulated conductor.

What is claimed is:

1. An apparatus for electrically testing the insulation of a conductor forming part of an electric cable, which comprises a testing circuit energizable to impress a high A. C. potential across the insulation and conductor of such a cable, a step-up transformer for energizing the testing circuit

the windings of which are subject to transient magnetizing currents upon initial energization of the primary winding, means for connecting the primary winding of said transformer to a suitable A. C. power supply, a current-responsive relay connected in series with the primary winding of said transformer and responsive to an increased current flow in the primary winding such as may be caused by the occurrence of a breakdown in the insulation of the conductor being tested, means operable by said current responsive relay to indicate when such a breakdown occurs, and a condenser connected in parallel with the primary winding of said transformer, said condenser being of such capacity that the parallel circuit which it forms with the primary winding is tuned to such a frequency that it prevents the transient magnetizing current occurring upon the initial energization of the primary winding from operating said current responsive relay.

2. In combination with a step-up transformer having its secondary winding arranged to impress a high potential across the insulation and conductor of a cable to be tested and its primary winding connected to an A. C. supply in series with a relay operable when an increased current flows in said primary winding such as an increased primary current due to a breakdown in the insulation of the cable being tested, which transformer windings are subject to transient magnetizing currents upon initial energization of the primary winding, and means operable by said current relay for indicating when such a breakdown occurs, a condenser connected in parallel with the primary winding of the transformer and tuned therewith to form a parallel resonant circuit for a predominant harmonic of the transient magnetizing current of the transformer, thereby preventing operation of the current responsive relay by said transient magnetizing currents, said parallel resonant circuit being ineffective to prevent operation of the current responsive relay with respect to said normal frequency increased current flow in the transformer windings.

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