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F. DUBSKÝ

1,482,462

ELECTRICAL TESTING DEVICE

Filed Jan. 31, 1921.

Fig. 1.

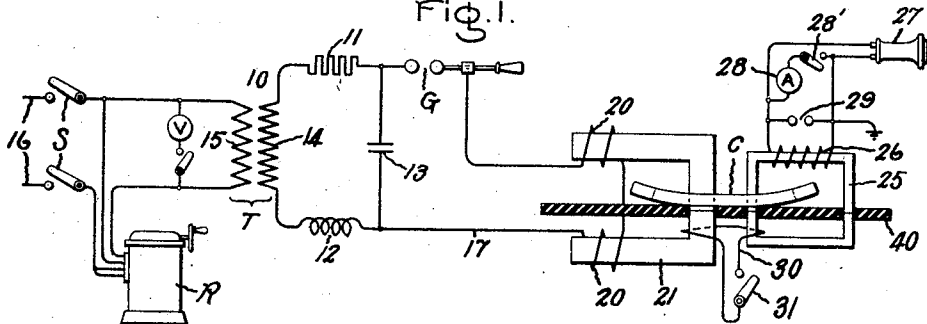


Fig. 2.

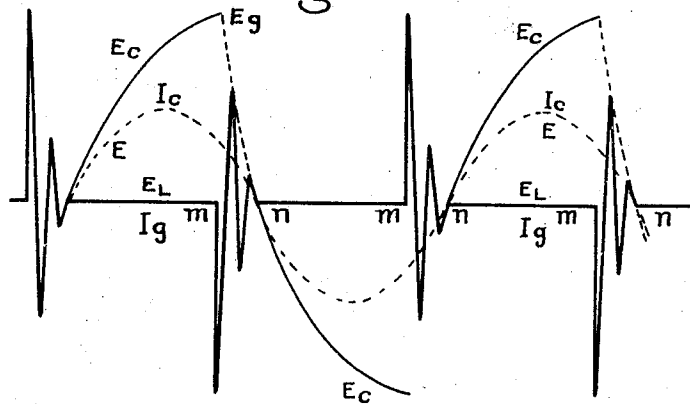


Fig. 3.

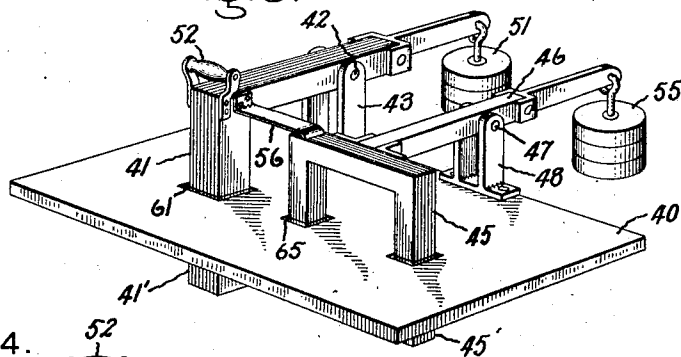
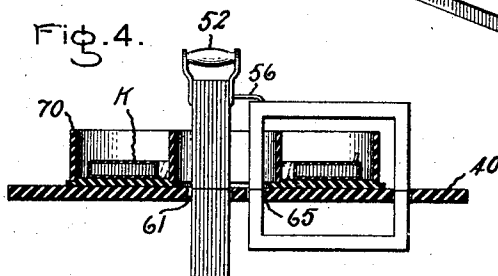


Fig. 4.



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UNITED STATES PATENT OFFICE.

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ELECTRICAL TESTING DEVICE.

Application filed January 31, 1921. Serial No. 441,256.

To all whom it may concern:

Be it known that I, FRANCIS DUBSKÝ, a citizen of the United States, residing at Pittsfield, county of Berkshire, State of Massachusetts, have invented certain new and useful Improvements in Electrical Testing Devices, of which the following is a specification.

My invention relates to electrical testing devices and has for its object an improved arrangement of parts which permits of readily making an effectual test without damage to the part tested.

More specifically my invention relates to voltage testing devices which are designed to ascertain whether a given winding or piece of apparatus will stand certain specified voltages without failure.

It has become standard practice to specify that windings or other parts of electrical apparatus shall withstand without failure certain multiples of the normal voltage at which they are to operate, such multiple voltages usually being applied for certain specified periods of time, in order thereby to make sure that insulation will withstand the normal voltage with the desired margin of safety.

Investigation, however, has disclosed that tests of this character are not always desirable by reason of the aging action which takes place in insulating material when subjected for continuous time intervals, though short, to excessive voltages. It has been observed in some instances that, although the insulating material on the winding or other part of the apparatus tested had successfully withstood the test, it had become so aged thereby as to be devoid thereafter of the desired margin of safety. A method of testing, as well as a device for carrying out the same which shall not only detect faulty apparatus but which insures the desired margin of safety without deleterious results, is accordingly a desideratum.

By my invention both a method and apparatus for making voltage tests within any desired range without aging or heating the insulation is accomplished. To this end I employ a highly damped high frequency electromotive force or oscillating voltage to induce in the winding or part of the electrical apparatus to be tested, the test voltage to be impressed. To observe the effect of this test voltage, I employ an exploring mag-

netic circuit which is linked with the winding or part under test, and has a winding and suitable indicating means associated therewith whereby the inductive effect of the test voltage may be observed should it set up any current in the winding or part under test.

For a more complete understanding of the nature and objects of my invention, reference should be had to the following detailed description when taken in connection with the accompanying drawing in which:

Fig. 1 is a representation, mainly symbolic, of an arrangement of apparatus for performing my invention, while Fig. 2 is an explanatory diagram; Fig. 3 is a view in perspective showing a detail of my apparatus; and Fig. 4 is a view mainly in vertical section of the apparatus of Fig. 3 when used in testing coils having a large number of turns.

Referring now to the drawing, and to Fig. 1 in particular, 10 denotes a charging circuit having a resistance 11, inductance 12 and capacitance 13 in series. This charging circuit is supplied with electrical energy from the secondary 14 of the step-up transformer T whose primary 15 is supplied with electric energy from the mains 16. The oscillating circuit 17 includes the condenser at 13, which it is arranged to discharge across the spark gap G, the latter being preferably made adjustable. The discharge across this spark gap initiates a damped high frequency oscillation whose character is determined by the capacitance 13 and the inductance 20 which are in series. The inductance 20 comprises a winding mounted on the core 21 of the open magnetic circuit type, which is traversed by the magnetic flux used to induce the high frequency test voltage in the winding or part of an apparatus to be tested, the latter being indicated as a coil C.

The coil C is normally open circuited so that no current flows therein under the stress of the induced test voltage unless a fault in the insulation develops.

The auxiliary or exploring magnetic circuit comprises a closed core 25, used to detect the existence of current in the coil C under test. The core 25, as shown, is normally linked with the coil C so as to have magnetic flux induced therein when current flows in coil C. A suitable indicating means is associated with the core 25 whereby the

presence of the induced flux can be observed. In the instance shown, this means comprises a winding 26 inductively related to this core, which winding has suitable current indicators in series therewith. As illustrated, a telephone 27 and a galvanometer or ammeter 28 are shown in parallel with each other but in series with winding 26. This winding is bridged by a protective gap 29 which permits a discharge thereacross should the induced voltage in the winding 26 exceed a certain safe predetermined maximum. A switch 28' is provided in series with the ammeter 28 as indicated so that it may be cut out of operation when desired. A normally open auxiliary circuit 30, closed by switch 31, is also preferably provided for testing to make sure that the indicating devices 27 and 28 are operative to detect the presence of induced current in a coil linking the cores 21 and 25. This test is made by momentarily closing switch 31.

The frequency of the voltage produced by the discharge in the oscillating circuit, and consequently that of the induced test voltage in coil C, is determined by the amount of capacitance and reactance at 13 and 20 respectively. The amplitude and consequently the magnitude of the test voltage produced by the oscillating circuit is a function of the spark-over voltage for the gap setting. The maximum spark-over voltage of the gap is proportional to the voltage of transformer T. It is therefore possible to measure the induced test voltage in terms of the impressed transformer voltage provided that the respective maximum gap settings are used. An induction regulator R is inserted in the supply circuit for varying the voltage across the transformer; the spark gap G in the oscillating circuit being made adjustable in order to obtain the respective maximum gap settings. Both the regulator R and the spark gap G are therefore used for controlling the induced voltage in the coil C.

The amount of damping obtained in the high frequency voltage generated is, of course, determined by the amount of effective resistance in the oscillating circuit.

The nature of the discharge in this circuit will be readily understood by reference to Fig. 2. The condenser charging current supplied from the transformer T is denoted by I_c . This charging current has the same frequency as the mains 16, which I will assume to be 60 cycles per second, and it is produced by the impressed electromotive force E_c of the transformer secondary. As soon as the condenser 13 is charged so that its voltage E_c reaches the spark-over voltage E_g of the gap setting at G, then an oscillatory discharge occurs between the condenser 13 and the inductance 29 through this gap. The frequency of this oscillation is determined by

the constants of the circuit as previously pointed out. The heavy line E_L , represents the voltage across the inductance 20 or it may represent the induced voltage across the coil C. The heavy line, assuming appropriate units, may also represent the oscillating current, I_g , which flows across the spark gap G. The damped oscillations endure only for the short time intervals denoted $m-n$. At the instant n all values become zero. Then the charging current I_c reverses and charges the condenser until its voltage E_c again reaches the spark-over voltage E_g which occurs at the next succeeding instant denoted m when another oscillatory discharge takes place; successive discharges starting in opposite directions, assuming that both the charging of the condenser and the discharge thereof across the spark gap G occurs every half cycle, i. e., 120 times a second where the frequency of the impressed electromotive force is 60 cycles.

Should however the spark gap G be made unsymmetrical, or the proportions of the oscillating circuit be made such that it cannot be fully charged after an oscillating discharge in the interval of a half cycle, then the frequency of the recurrence of oscillations will not be 120 a second but will be reduced to one oscillating discharge per cycle.

The oscillating current I_g flowing across gap G during a discharge transverses the winding 20 on the core 21 which was made an open magnetic circuit so the winding 20 would have relatively low reactance. The magnetic flux engendered by this oscillating current transverses the core 21 at a relatively high frequency and hence will induce a test voltage of the desired magnitude assuming proper proportions in a coil C, inserted to be tested. The intermittent character of the induced test voltage resulting from the oscillating discharge, which is itself intermittent, prevents heating or aging effects from developing in the insulation on the coil at C.

In order that the coils C may be readily inserted and removed during the course of the test, I have made both the cores 21 and 25 of separable parts pivotally related as indicated in Fig. 3.

Here each core is composed of separable upper and lower portions, denoted respectively 41 and 41' for core 21, and 45 and 45' for core 25. The lower portions 41' and 45' are secured to the under side of the test-table 40, while the upper portions are pivotally mounted thereon. Part 41 is pivoted at 42 to the standard 43, while part 45 has secured thereto an arm 46 pivoted at 47 to the standard 48. The parts 41 and 45 are counter-balanced on the other side of their pivotal supports by weights shown at 51 and

55 respectively. The counter-weight 51 is preferably slightly less in weight than that of its core part 41 so that the parts 41 and 41' normally engage in operative relation; a handle 52 being conveniently applied to open or separate the parts. The counter-weight 55, on the other hand, is made slightly greater than the weight of part 45 to be balanced. In order, therefore, to keep parts 45 and 45' in normal engagement, a leaf spring 56 is secured to part 41 and bears resiliently upon part 45, the weight differential which keeps parts 41 and 41' in engagement being sufficient to keep part 45 acting through spring 56 also in engagement with part 45'.

To insert a coil for test, an operator grabs the handle 52 and raises the core part 41 to open position, the core part 45 opening at the same time. The coil to be tested is then inserted so as to embrace one leg of each core, i. e. so as to encircle openings 61 and 65 in the test table. The core parts are then moved to closed position when induced test voltage is to be applied to the coil so inserted. The induction regulator R is now set to produce a test voltage of the desired magnitude and the switches S in the supply mains 16 closed.

Should the insulation on the coil under test be faulty, a short circuit current will flow in it which may be observed as a click in the telephone at 27 or by a deflection of the needle of the instrument at 28 if the switch 28' is closed. If nothing is observed on these indicating devices the coil under test shows no fault and is passed as without defect. To make sure that the indicating devices are functioning, the switch at 31 may be momentarily closed and their operation observed. Procedure in this manner enables a large number of coils or parts to be quickly and effectually tested without deleterious results to the same.

Should the coil or part under test be composed of so many turns that the induced electro-motive force therein during test is of such a magnitude as to produce a spark between terminals in air, as may occur when testing transformer coils, the safe procedure to test such coils according to my invention employs an oil bath in which the coil is immersed during test. This is illustrated in Fig. 4. In this figure an insulating receptacle 70 is shown on test table 40 embracing openings 61 and 65 therein. In the receptacle 70 is shown at K a transformer coil to be tested. This coil is immersed in oil (not shown in the interest of clearness) and the test applied as above described.

Having now described an embodiment of my invention which is at present the best means known to me for carrying the same into effect, I would have it understood that

this is merely illustrative and that I do not mean to be limited thereby to the precise details disclosed, nor restricted in the choice of recognized equivalents except as defined in my claims hereunto annexed.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. The method of testing windings and the like which consists in inducing therein a highly damped high frequency electromotive force and adjusting its magnitude to a predetermined desired value.

2. The method of testing open-circuited windings and the like which consists in inducing therein a highly damped high frequency electromotive force and observing whether a current flows in said winding in response to the induced electromotive force.

3. The method of testing open-circuited windings and the like which consists in inducing therein a highly damped high frequency electromotive force, adjusting the magnitude of the same to a predetermined value, and observing the inductive effects of said induced electro-motive force.

4. The method of testing open-circuited windings and the like which consists in inducing therein a highly damped high frequency electromotive force, adjusting the magnitude of the same to a predetermined value, and observing whether current flows in said winding in response to the induced electromotive force.

5. The method of testing open-circuited windings and the like which consists in inducing therein a highly damped high frequency electromotive force, insuring said winding against arc-over in air, and observing the inductive effects of the induced electromotive force in said winding.

6. The method of testing open-circuited windings and the like which consists in inducing therein a highly damped high frequency electromotive force, adjusting the magnitude of the same to a predetermined value, insuring said winding against arc-over in air, and observing whether current flows in said winding in response to the induced electromotive force.

7. A testing device for windings and the like comprising a source of electric energy, an oscillating circuit, a magnetic core inductively associated with said oscillating circuit and adapted to induce a test voltage in a winding to be tested, and an auxiliary magnetic circuit arranged to explore the inductive effects of the test voltage in said winding.

8. A testing device for windings and the like comprising a source of electric energy, an oscillating circuit, a magnetic core inductively associated with said oscillating circuit and adapted to induce a test voltage in a winding to be tested, and an auxiliary magnetic core arranged to link with the winding

to be tested and provided with means for indicating the inductive effects of the test voltage.

9. A testing device for windings and the like comprising a source of electric energy, an oscillating circuit, a magnetic core inductively associated with said oscillating circuit and adapted to induce a test voltage in a winding to be tested, and an auxiliary magnetic core arranged to link with the winding to be tested and provided with current indicating means in inductive relation therewith.

10. A testing device for windings and the like comprising a source of electric energy, an oscillating circuit, a magnetic core inductively associated with said oscillating circuit and adapted to induce a test voltage in a winding to be tested, an auxiliary magnetic core arranged to link with the winding to be tested, a winding on said auxiliary core, and current indicating means in series with said last named winding.

11. A testing device for windings and the like comprising a source of electric energy, an oscillating circuit, a magnetic core inductively associated with said oscillating circuit and adapted to induce a test voltage in a winding to be tested, an auxiliary magnetic core arranged to link with the winding to be tested, a winding on said auxiliary core, and current indicating means in series with said last named winding, both of said cores being composed of separable parts arranged to open to receive the winding to be tested.

12. A testing device for windings and the like comprising a source of electric energy, an oscillating circuit, a magnetic core inductively associated with said oscillating circuit and adapted to induce a test voltage in a winding to be tested, an auxiliary magnetic core arranged to link with the winding to be tested, a winding on said auxiliary core, and current indicating means in series with said last named winding, both of said cores being composed of separable parts pivotally disposed in operative positions and adapted to be opened to receive the winding to be tested.

13. The combination with a support, of two magnetic cores mounted thereon, each of said cores being composed of separable parts, each core having one part secured to said support and another part pivoted thereto to receive a winding to be tested, and means for automatically opening one of said pivoted parts when the other is opened.

14. The combination with a support, of two magnetic cores mounted thereon, each of said cores being composed of separable parts, each core having one part secured to said support and another part pivoted thereto to receive a winding to be tested, and means controlled by one of said pivoted parts for closing the other of said pivoted parts.

In witness whereof, I have hereunto set my hand this 27th day of Jan., 1921.

FRANCIS DUBSKÝ.