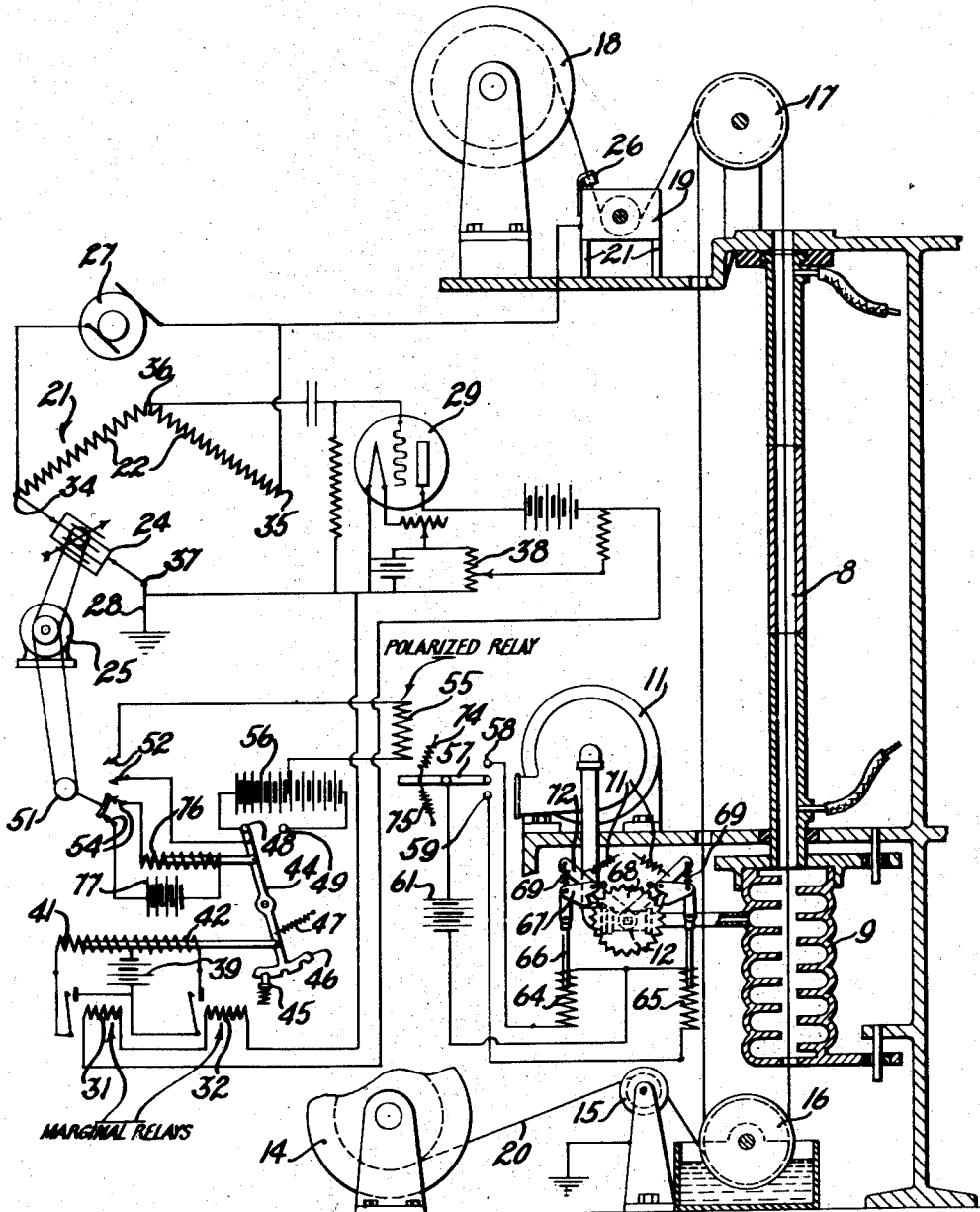


Sept. 11, 1928.

1,683,833

E. E. MANESCHI
METHOD OF AND APPARATUS FOR DETERMINING THE
ENERGY LOSSES IN DIELECTRIC MATERIALS
Filed Sept. 30, 1926



Inventor
Egidio E. Maneschi
by *H. S. Satter* Att'y.

UNITED STATES PATENT OFFICE.

EGIDIO EDWARD MANESCHI, OF LA GRANGE, ILLINOIS, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

METHOD OF AND APPARATUS FOR DETERMINING THE ENERGY LOSSES IN DIELECTRIC MATERIALS.

Application filed September 30, 1926. Serial No. 138,803.

This invention relates to a method of and apparatus for determining the energy losses in a dielectric material, and more particularly to a method of and an apparatus for determining the energy losses in a dielectric material and controlling a property related thereto in accordance therewith.

Experiments in connection with the application of enamel to electrical conductors and the baking thereof have conclusively established that the dielectric losses in the insulating material when the latter is subjected to the electrostatic influence of an alternating current are a decreasing function of the degree of hardness to which the material is baked. Objects of the present invention are to provide a method and a simple and reliable apparatus by which the method may be practised for determining the energy losses in a dielectric material and controlling the degree of hardness to which the material is baked in accordance therewith.

In practising the invention a portion of dielectric material is subjected to the stresses of an alternating electrostatic field and the hardness of the material is determined by the energy losses in the material. In accordance with one embodiment, the invention contemplates determining the dielectric losses in a portion of dielectric material surrounding an electrical conductor by immersing the material in a mercury bath to form an electrostatic condenser of which the conductor and the mercury constitute the plates, and controlling the temperature of a furnace used for baking the material in accordance with the power factor of the condenser which is proportional to the energy losses.

It is believed that a better understanding of the invention may be had by reference to the following description, taken in conjunction with the accompanying drawing, the single figure of which represents a side elevation, partially in section, of a furnace for baking enamel on a conductor and a diagrammatic view of a circuit and apparatus for controlling the temperature of the furnace.

The furnace may be of any well known type, the one illustrated is of the type disclosed in the application of R. D. Jessup, Serial No. 68,246, filed November 10, 1925. The wire to be enamelled is carried by a

supply reel 14 and passes over an idler sheave 15 to a sheave 16 partially immersed in enamelling compound of any suitable character, from which it is conducted through the furnace which comprises a heating chamber 8, a muffle 9 to prevent the rapid ingress of air into the heating chamber, and a suction blower 11 to retard the upward flow of air in the heating chamber. The amount of baking to which the enamel is subjected is controlled by a valve 12 which regulates the draft produced by the blower 11. When the enamelled wire emerges from the furnace it passes over a sheave 17 and it may either repeat the cycle to receive another coating of enamel or be conducted to the take-up spool 18. In either case before the wire is wound on the take-up reel it is passed through a receptacle 19 preferably of iron and containing mercury, which is supported on insulating rods of hard rubber 21—21. A wiper 26 is mounted on the cup through which the coated conductor passes to remove the mercury which might adhere thereto.

The apparatus for determining the dielectric losses in a portion of an enamel covering of a wire, comprises a Wheatstone bridge designated generally at 21 having two equal resistance branches 22—22. Of the remaining two branches of the bridge one contains a variable air condenser 24 grounded at 28 having negligible dielectric losses, which is rotated at the rate of one revolution every two minutes by a small motor 25 to continuously vary the capacity of the condenser from its maximum to its minimum value, and the other branch contains a condenser formed by the mercury receptacle 19 in which the mercury acts as one of the plates of a condenser and the wire 20 as the other plate, with the enamel covering the wire separating the plates and serving as the dielectric material. The wire 20 is grounded by grounding the idler sheave 15 to maintain the wire at substantially ground potential and the mercury receptacle is supported on rubber rods to reduce its capacity to ground as much as possible. A source of alternating current 27 is connected to the terminals 34 and 35 of the Wheatstone bridge, placing the resistances in parallel with the condensers, and the terminals 36 and 37 are connected to the input or grid circuit of a vacuum detec-

tor tube 29 of conventional design, the plate or output circuit if which includes a pair of marginal relays 31 and 32 which are so designed that a larger amount of current is required for the operation of the relay 31 than is required for the operation of the relay 32.

When an alternating electromotive force is impressed across the terminals 34—35 certain conditions determine the difference in potential of the points 36—37. If the characteristics of one resistance branch are the same as those of the other and the characteristics of the condenser branches are also similar there will be no difference in potential of the points 36—37. However, the air condenser by reason of the fact that air is a perfect dielectric has a substantially zero power factor while the power factor of the mercury condenser varies with the dielectric losses in the enamel which in turn vary with the degree of hardness to which the enamel is baked. It will therefore be seen that since the potential of the points 36—37 will vary with the power factor of the mercury condenser and consequently with the degree of hardness to which the enamel is baked, it affords a convenient means to regulate the amount of baking. Since the capacity of the mercury condenser may vary slightly due to the fact that the conductor is moving, the capacity of the condenser 24 is made variable between certain limits and is continuously varied so that the capacity of the mercury condenser will correspond with that of the condenser 24 at some point of its variation, provided the mercury condenser falls within the range of the variable condenser, at which time the difference in potential of the points 36—37 will depend solely on the power factor of the mercury condenser.

As the potential difference between the points 36—37 is increased the grid potential of the tube 29 will increase and decrease the current in the plate circuit and through the relays and as the potential difference is decreased the grid potential of the tube 29 will decrease and increase the current in the plate circuit and through the relays. A potentiometer 38 is inserted in the plate circuit of the detector tube 29 to shunt a portion of the direct current component of the varying current in the plate circuit, thus rendering the relays more responsive to the variations.

When the enamel on the wire is properly baked the power factor of the mercury condenser will have an intermediate value and the current in the relay circuit at the time the capacities of the condensers are equal will be such as to operate relay 31 energizing a coil 41 by means of a battery 39 in circuit therewith to move arm 44 to a neutral position against the action of a spring 47. When the enamel on the wire is baked too hard the power factor of the mercury condenser will

be low producing a low potential difference across the points 36—37 and allowing a large current to flow in the relay circuit at the time the capacities of the condensers are equal so that both relays 31 and 32 will be operated drawing the arm 44 into engagement with a contact 49. When the enamel on the wire is baked soft the power factor of the mercury condenser will be high and insufficient current will flow in the relay circuit to operate either relay and the arm 44 will remain in the position shown. A spring pressed plunger 45 is provided to engage a notched sector 46 carried by the arm 44 to retain the arm in the position it is moved against the action of the spring 47.

A contacting device 51 is rotated in a clockwise direction by the motor 25 at the rate of one revolution every two minutes, the same speed at which the variable condenser is rotated, bridging the gap between contacts 52 and 54 successively. When the gap between contacts 52 is bridged the energization of the polarized relay 55 will be determined by the position of the arm 44. If the arm 44 is in engagement with contact 48 corresponding to the condition of high power factor or soft enamel, battery 56 will energize the coil of the polarized relay 55 in such a direction as to cause its arm 57 to engage a contact 58 closing a circuit through a battery 61 and coil 64. The energization of coil 64 will actuate a plunger 66 to engage a pawl 67 with a sprocket wheel 68. A spring 69 is made weaker than a spring 71 so that the pawl 67 will be engaged with the sprocket wheel before an arm 72 is rotated to cause rotation of the sprocket wheel. The rotation of the sprocket wheel in a counter-clockwise direction will open the valve 12 to increase the baking effect. As soon as the contacting device has passed the contacts 52, relay 55 will be deenergized and springs 74 and 75 will restore the arm 57 to its neutral position, deenergizing coil 64 and allowing the arm 72 and pawl 67 to resume their normal position. If the arm 44 is in the neutral position corresponding to intermediate power factor or properly baked enamel when the contacts 52 are bridged the polarized relay will not be energized and the arm 57 will be held in neutral position by springs 74 and 75. If the arm 44 is in engagement with contact 49 corresponding to low power factor or hard baked enamel when the contacts 52 are bridged, the polarized relay will be energized to move arm 57 into engagement with contact 59 closing a circuit through battery 61 and coil 65 to rotate the sprocket wheel in a clockwise direction and decrease the baking effect in a manner similar to that described in connection with the energization of coil 64.

After the contacting device has bridged the gap between contacts 52 it passes on and immediately thereafter bridges the gap be-

tween contacts 54, energizing coil 76 by means of battery 77 to draw the arm 44 into engagement with contact 48 where it will either remain or be moved to another position when the capacities of the mercury and the air condensers are again made equal by the rotation of the variable condenser.

It will thus be seen that once every two minutes the time required for the contacting device to make one revolution, a regulation of the amount of baking will occur depending upon where the arm 44 has been set when the capacities of the condensers become equal during that interval. A limited amount of variation in the hardness of the enamel of commercial wire is permissible and the apparatus may be so adjusted that the baking effect is increased before the hardness of the enamel drops below the minimum limit or decreased before the hardness exceeds the maximum limit. In a furnace of the type described about sixty feet of wire is enamelled in two minutes so that a determination of the hardness of the enamel will take place every sixty feet.

It will be understood that the embodiment of the invention herein described and illustrated is merely a convenient and useful form of the invention, which is capable of many other modifications without departing from the spirit and scope of the invention.

What is claimed is:

1. A method of controlling the hardness of baked insulating material, which consists in determining the dielectric losses in the material when subjected to an alternating electrostatic field, and regulating the amount of baking of the material in accordance therewith.

2. An apparatus for controlling the hardness of baked insulating material comprising a condenser in which the material serves as a dielectric, and means responsive to the power factor of the condenser to regulate the amount of baking of the material.

3. An apparatus for controlling the hardness of baked insulating material comprising a Wheatstone bridge containing a mercury condenser in which the material acts as a dielectric and a variable condenser whose capacity may be made equal to that of the mercury condenser, and means responsive to the power factor of the mercury condenser when its capacity is equal to that of the variable condenser to regulate the amount of baking of the insulating material.

4. An apparatus for controlling the hardness of baked insulating material comprising a Wheatstone bridge containing a mercury condenser in which the material serves as a dielectric and a variable condenser, a detector tube having its grid circuit connected across the bridge to respond to the difference in potential produced by an unbalance of the power factor of the condensers, a pair of marginal relays in the plate circuit of the

tube, one of said relays being so adjusted as to close at an intermediate power factor value, the other of said relays being so adjusted as to close at a low power factor value and both of said relays being adjusted as to open at a high power factor value, and means responsive to the relays to regulate the amount of baking of the material.

5. An apparatus for controlling the hardness of insulating material baked on a conductor comprising a mercury bath for immersing a portion of the conductor to constitute a condenser, means for applying an alternating electromotive force to said condenser, and means for regulating the amount of baking in accordance with the power factor of the condenser.

6. An apparatus for controlling the hardness of insulating material baked on a conductor comprising a mercury bath for immersing a portion of the conductor to constitute a condenser, means for applying an alternating electromotive force to said condenser, means for maintaining the conductor at substantially constant potential, and means for controlling the amount of baking in accordance with the power factor of the condenser.

7. An apparatus for determining the hardness of insulating material comprising means for subjecting the material to the influence of an electrostatic field, and means for determining the energy losses in the material when subjected to the influence of the electrostatic field.

8. A method of controlling the hardness of insulating material, which consists of subjecting the material to an alternating electrostatic field, determining the dielectric losses in the material, and controlling the hardness of the material in accordance therewith.

9. In a device for controlling an enameling apparatus having a heating chamber, means for determining the hardness of the enamel, and means for regulating the amount of air admitted to the chamber in accordance with the hardness of the enamel.

10. In a device for controlling an apparatus for applying insulation to a conductor having a heating chamber, means for determining the hardness of the insulation, and means for regulating the temperature of the chamber in accordance with the hardness of the insulation.

11. In a device for controlling an apparatus for treating insulating material having means for affecting the hardness of the material, means for determining a property related to the hardness of the material, and means for regulating the apparatus in accordance with said property.

In witness whereof, I hereunto subscribe my name this 14th day of September, A. D. 1926.

EGIDIO EDWARD MANESCHI.