

Nov. 9, 1926.

1,606,393

V. G. APPLE

METHOD OF INSULATING ELECTRIC COILS

Filed August 20, 1920

Fig. 1.

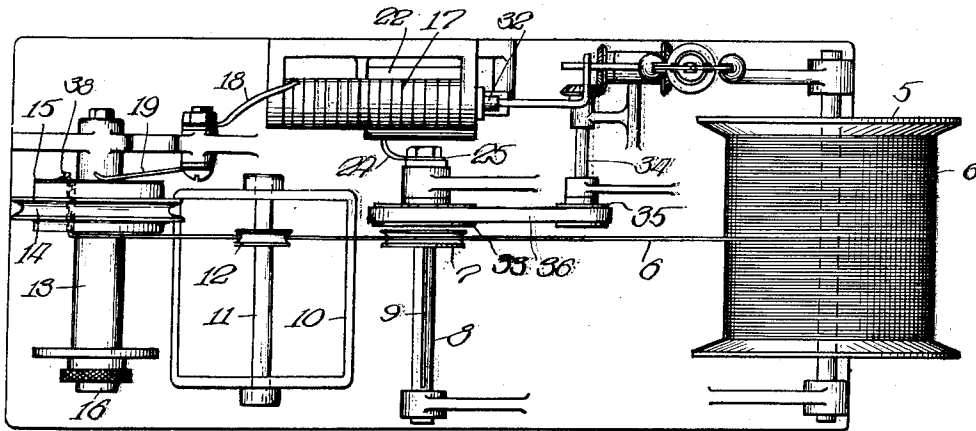
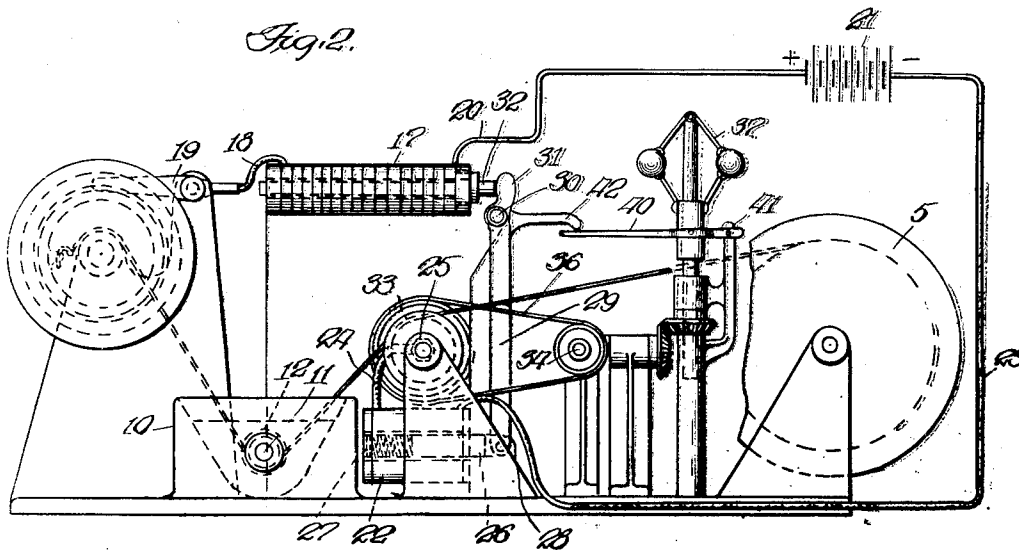


Fig. 2.



Inventor:
Vincent G. Apple
By *J. R. Rain* *Winkler*
Attys.

UNITED STATES PATENT OFFICE.

VINCENT G. APPLE, OF DAYTON, OHIO.

METHOD OF INSULATING ELECTRIC COILS.

Application filed August 20, 1920. Serial No. 404,939.

This invention relates to a method of and means for insulating electric coils, or coil windings.

One of the objects of the invention is to provide an improved method of and means for insulating the windings of electric coils in which the conductor, or conductors thereof, are embedded in a homogeneous mass of insulating material.

Another object is to provide a method of and means for applying a preliminary coating or film of insulating material to the wire, as it is wound upon the coil, and heating the wire during the winding operation to bake the coating of the insulation thereon.

Another object is to coat the heated wire with an excessive quantity of liquid insulation capable of being hardened by heat, as it is being wound into a coil, which excess, or as much thereof as required, is used to fill the interstices between adjacent convolutions of the coil and which is subsequently hardened by the maintenance of heat in the coil wire after it has been wound into a coil.

Another object is to heat the wire as it is being wound into a coil to cause a film or thin coating of relatively hard insulation to immediately adhere thereto and to vary the intensity of the applied heat in substantial proportion to the speed at which the wire is moved in the winding operation.

Another object is the provision of a method by which a self supporting coil is made.

Other, further and more specific objects of the invention will become readily apparent, to persons skilled in the art, from a consideration of the following description, when taken in conjunction with the drawings, wherein:—

Fig. 1 shows a plan view of an apparatus for carrying my invention into effect, and

Fig. 2 shows an elevation of the same with the battery and circuit shown in schematic relation thereto.

In both views the same reference characters are employed to indicate similar parts.

In the accompanying drawings I have shown one means or apparatus by which my method of procedure may conveniently be carried into effect, wherein 5 is a drum or spool containing uncovered wire or cable 6

to be subsequently wound upon a coil constituting a part of an electro-magnet.

The wire 6 passes from the reel or spool 5 over an axially movable pulley 7 which is adapted to move along the shaft 8, being splined thereto, as at 9, the shaft is rotated by movement of the wire over the pulley. The wire may have one or two turns around the pulley or sheave 7, for the purpose of positively rotating it. 10 is a tank containing the heat hardening insulating material, such for example, as a phenolic condensation product, which is a superior insulator and which becomes quickly hardened by the application of heat.

11 is a shaft near the bottom of the tank 10 which is shown to pass thru the tank, and upon which an axially movable sheave or pulley 12 is mounted and under which the wire 6 is passed. 13 is a form upon which to wind wire 6 into a magnet coil. 14 is the power pulley by which the apparatus is operated. It is part of a hub upon which the spool is mounted, and adjacent to which is a disc 15, rotatable therewith. The spool form 13 is held in place on the rotatable hub by means of a screw 16 which passes into the threaded end of the core of the electro-magnet to be made. Any suitable means for holding the part around which wire is to be wound to form the coil will serve for the purpose. A pile of carbon resistance plates 17 is connected by wire 18 to a brush 19, that bears upon the disc 15, and it is also connected by a wire 20 to a source of current supply such, as a battery 21. An electro-magnet 22 is connected in series with the carbon pile 17 by the wire 23. The other terminal 24, of the electro-magnet, is connected to the sheave 7, thru the shaft 8, as at 25. The electro-magnet, or solenoid 22, is provided with an axially movable core 26 which is pressed outwardly by spring 27 to compress the carbon pile. The outer end of the core is connected, as at 28, to a vertical lever 29 pivoted, as at 30, having a shorter end 31 bearing upon a part 32 to press the pile of carbon plates 17 to thereby decrease the resistance of the plates, as a whole, and permit a larger current to flow thru the circuit.

During the operation of winding the wire 6 into a coil the shaft 8 together with the grooved sheave 7 is rotated. Connected to the shaft 8 is a pulley 33 which rotates a

shaft 34 carrying a pulley 35, by a driving belt 36. The shaft 34 drives a speed governor 37, by the intervening train of gearing, so that the speed of the governor bears a proportionate relation to the speed of the shaft 8 and the wire 6 which rotates the shaft.

The end of the wire 6, to be wound into the coil is connected to the disc 15, as at 38, to complete circuit thru the entire coil winding.

Now, it will be observed that when the wire is wound onto the spool, that the current of electricity from the battery 21 will pass thru the carbon pile 17 and thru the wire 6 and the coil 22, in series therewith. As the electro-magnet 22, draws in its core 26, pressure of the carbon pile 17 is released, it being normally compressed by spring 27, and the resistance of the carbon pile is thereby increased and therefore the current flowing from the battery will be reduced in strength so that by this means an excessive current cannot be made to pass thru the wire 6. Now, it will be evident that if the wire 6 is wound more rapidly upon the spool 13, a greater current will be required to heat it to the proper temperature than if it is wound relatively slower upon the spool. Therefore the speed-responsive governor 37 is provided with a lever 40, pivoted as at 41, which makes contact with a projecting arm 42 from the vertical lever 29, and assists the spring 27, so as to increase the compression and decrease the resistance of the carbon pile and causes the flow of a stronger current thru the magnet wire. Increase of speed of the wire 6 will cause the governor to increase the current flowing thru the wire substantially in a direct proportion to the speed at which the wire is moving when it is being wound into a coil.

The tub, or vessel 10, is to be partially filled with a phenolic condensation product in liquid form or other similar heat hardening insulating material. The current will pass thru the wire 6 as it leaves the sheave 7 to its terminal end where it makes contact with the disc 15 and therefore the wire 6 will be heated, by the passage of the electric current between the sheave 7 and the magnet upon which it is being wound.

As the wire leaves the vat of insulating material the temperature, to which it has been heated, will cause a film of insulating material to hang or cleave tenaciously to the surface thereof, thereby producing a preliminary coating of insulation upon the heated wire. An amount of varnish or insulating material in excess of the coating will cleave to the wire and will be deposited upon the convolutions adjacent the wire as it is wound upon the coil. The heat that is maintained in the wire, or that portion of which has already been wound upon the

coil, will serve to harden this excessive amount of insulation which will fill the interstices between the wire convolutions, thereby producing a homogeneous insulation in which the wire is substantially embedded.

The thin hardened coating of material to which reference has heretofore been made, will separate the convolutions of the wire and the layers of wire, from each other. The current is maintained throughout the entire length of the wire during the winding operation, so that the wire that has been previously wound upon the coil will continue to be heated in order to harden the liquid insulation that has been thus deposited between the convolutions of wire. The time required for the wire to pass from the roller 12 to the spool 13 will be made to vary somewhat with the growing increase in size of convolutions of the wire on the spool 13. The wire rotates the sheave or grooved pulley 7, and that in turn rotates the speed responsive governor. Now when the governor balls fly outwardly, as a result of increased speed, the lever 40 is lifted, being fulcrumed or pivoted at the point 41 and this effect tends to raise the arm 42 to supplement the effect of the spring 27 and increases the pressure upon the carbon pile 17, thereby decreasing the resistance of that part of the circuit and causing larger current to flow thru the wire than formerly, so that as the speed of the wire increases, the value or strength of the current is made to increase correspondingly. By this means the thin film or coating of insulation on the wire as it leaves the tank 10, is hardened or set sufficiently to cause insulation to adhere thereto before the wire reaches the spool 13. Any means for guiding the wire on the spool 13 is within the contemplation of my invention and is not here of special interest, the object herein sought being the art of insulating the wire and winding it into coil form at the same time without requiring two separate and independent operations, and applying heat in any manner to harden the insulation.

When the wire has been wound into a coil the convolutions are, by effect of the insulating material, cemented together, so that the usual heads for the coils are really not essential, as the coil will be self supporting and maintain its form, as the result of the convolutions thereof being cemented together by the insulating material.

While I have herein disclosed a means for carrying my invention into effect, it will be manifest that other means than that shown may be employed for the same purpose.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. A method of insulating a metallic wire which consists in continuously moving the wire through a liquid material, heating said wire by the passage of electric current there-
5 through simultaneous with its movement through said insulating material, and controlling the magnitude of the current in said wire directly responsive to its rate of movement.
- 10 2. A method of making coils which consists in applying a liquid insulation to a continuously moving conductor to be wound into a coil, heating said conductor during and after the application of said liquid insulation, rendering the heating means di-
15 rectly proportional to the speed of said conductor, and moving said conductor at a rate to carry with it excess insulation to fill the voids between the conductor convolutions constituting the coil.
- 20 In testimony whereof I hereunto subscribe my name.

VINCENT G. APPLE.