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M. A. THOM

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PROCESS FOR DRYING COATED RESISTORS

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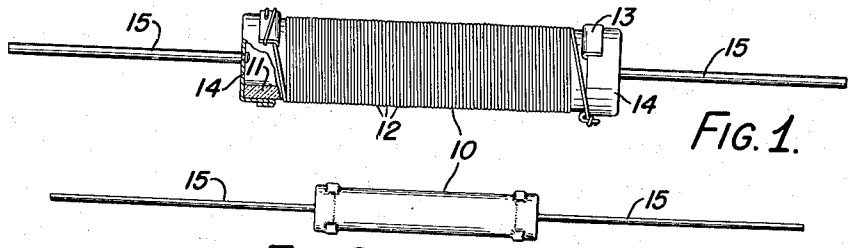


FIG. 1.

FIG. 2.

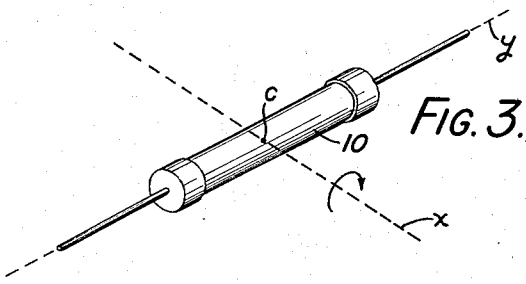


FIG. 3.

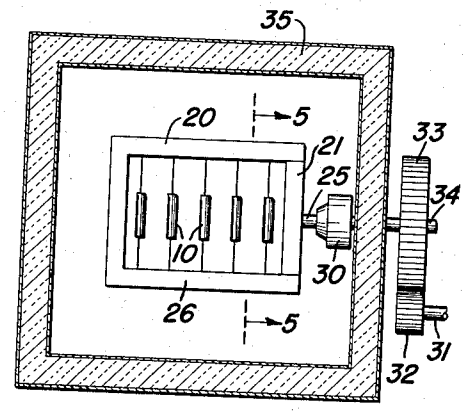


FIG. 4.

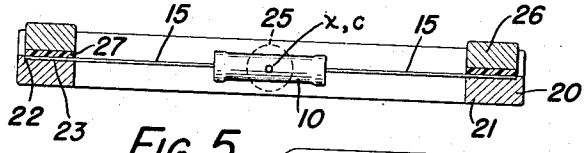


FIG. 5.

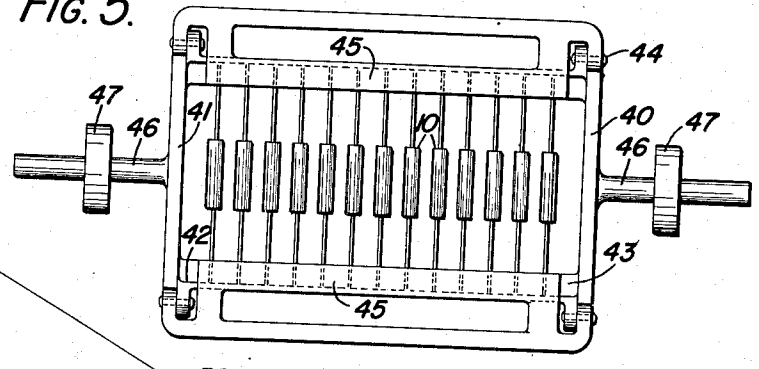


FIG. 6.

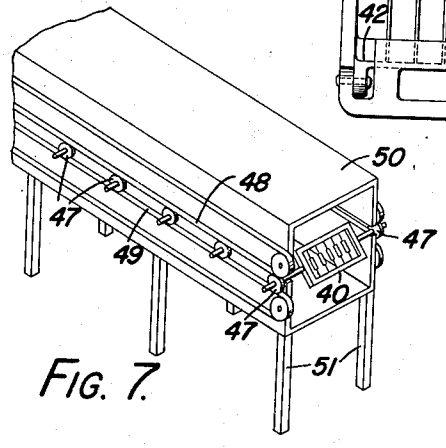


FIG. 7.

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PROCESS FOR DRYING COATED RESISTORS

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3 Claims. (Cl. 117—101)

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The present invention relates to the manufacture of wire-wound resistors and more particularly to a process for coating resistors with a protective varnish.

Wire-wound resistors are manufactured by winding a plurality of turns of wire upon a core of insulating material, which has metal caps at opposite ends to which the lead lines of the resistor and the opposite ends of the wire winding are attached, then coating the wire and caps with an insulating protective coating, such as varnish, and then curing the coating.

With conventional methods of manufacture, the insulating coating is applied by dipping the resistor into the coating material or pouring the coating material over the resistor, then letting the surplus coating drain off, and then drying and baking the coating. Sometimes after applying the coating the resistor is rotated on its axis for a few seconds at high speed to throw off the excess of the coating and shorten the draining time and is then dried and baked. In any case with conventional methods of manufacture only a very thin insulating coating can be applied at a time and several coatings are required to build up the necessary thickness of protection. After each coating is applied, of course, the coating has to be cured before the next coating can be applied and cured. Because of the curing between successive coatings, the coats sometimes do not adhere well to each other. Oftentimes the coatings strip in use causing exposure of the wire to corrosion. This is particularly likely to occur where the resistors are exposed to weather and to salt, as in naval usage. Of course, the greater the number of the coatings, the more the likelihood of stripping. The likelihood of stripping is increased too by the difficulty of coating both the wire winding and the terminals uniformly and of getting sufficient coating on the terminals to prevent exposure of the winding at its points of tie to the terminals. In any event, the necessity for applying coatings successively and for curing each one before applying another adds materially to the cost of a resistor.

One object of the present invention is to provide a process whereby a greater thickness of varnish may be applied to and retained on a resistor during drying and baking than has heretofore been possible in any known coating operation.

Another object of the invention is to provide a method for coating resistors which will permit applying the required thickness of protection to

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the resistor in a single coating particularly where a thermosetting varnish is employed.

Another object of the invention is to provide a process for coating resistors which permits control of the quantity of varnish or protective coating desired at the ends of the resistor.

A further object of the invention is to provide a process for coating resistors which will permit of obtaining an even protective coating from end to end of the resistor.

Other objects of the invention will be apparent hereinafter from the specification and from the recital of the appended claims.

In the drawings:

Fig. 1 is a view of a wire-wound resistor prior to its being coated;

Fig. 2 is a view on a reduced scale showing the resistor with a protective coating applied thereto;

Fig. 3 is a diagrammatic view in perspective illustrating how the resistor is rotated in the process of the present invention in order to retain the coating thereon during drying and in order to control the spread of the coating along the length of the resistor;

Fig. 4 is a more or less diagrammatic view on a still further reduced scale showing a rack for carrying a plurality of resistors mounted in a furnace or oven for drying simultaneously according to the process of this invention the coatings of a plurality of resistors;

Fig. 5 is a section through the rack taken on the line 5—5 of Fig. 4 but on an enlarged scale;

Fig. 6 is a plan view of a modified form of rack; and

Fig. 7 is a fragmentary perspective view illustrating diagrammatically the structure of a furnace or oven in which continuous drying or baking operations may be effected by the process of this invention.

Referring now to the drawings by numerals of reference, 10 denotes generally the resistor. This comprises an insulating core 11, which may be made of a ceramic or other suitable material, and upon which is wound a plurality of turns of fine wire 12. The ends of this wire are fastened to tabs 13 which are integral with metal caps 14 that are pressed on opposite ends of the core. The lead wires 15 of the resistor are secured in these caps.

The process of the present invention may be employed in the coating of resistors with various types of flowable insulating materials, but will be described particularly in connection with the coating of a resistor with a varnish. The varnish is applied to the wire-wound resistor at room

temperature. The varnish is allowed to partially drain from the resistor. Then the resistor is air-dried and baked while being rotated end over end about an axis x (Fig. 3) which extends at right angles to the axis y of the resistor and which intersects the axis y preferably in the mean point c of both the length and the diameter of the resistor, which is the center of gravity of the resistor.

The end over end motion of the resistor about an axis x intersecting its axis y causes the varnish to flow by centrifugal force outwardly from the center c toward both ends of the resistor. The speed of rotation of the resistor about axis x controls the extent of outward flow of the varnish. For an even coat of varnish over the resistor from end to end, the resistor is rotated for standard thermosetting varnishes at approximately thirty R. P. M. If it is desirable to have more varnish at the ends of the resistor, the speed of rotation must be increased. The speed of rotation is dependent, also, of course, upon the viscosity of the particular varnish or other insulating material used for the coating.

For production purposes, a plurality of resistors 10 are treated simultaneously. This is done by mounting the resistors in a rotatable rack of suitable construction so that they are centered axially and diametrically with reference to the axis x of rotation of the rack, and then rotating the rack while air-drying and baking the coatings of the resistors.

One type of rack that is suitable for the purpose, is illustrated in the drawings at 20. It comprises a base plate 21 and a U-shaped clamping plate 26. The base plate 21 has a shaft or shank 25 projecting centrally from one end by which it may be rotated. It has shoulders 22 on its upper face at opposite sides against which the ends of the lead wires 15 of the resistors are adapted to abut, thereby to center the resistors longitudinally in the rack. It also has an upper seating surface 23 upon which the lead wires 15 are adapted to rest. The height of this surface is such as to center the resistors vertically in the rack so that the axes y of the resistors will intersect the axis x of the shank or shaft 25 of the rack.

The resistors are held in the rack by the U-shaped clamping member 26, which may be hingedly or otherwise secured to the base plate 21 and which may be clamped in operative position to the base plate in any suitable manner, as by coil springs coaxial with the hinges. The undersurface of this clamping plate is adapted to engage the lead wires 15 of the resistors to hold the resistors on the base plate and may be covered with rubber or other suitable facing 27.

After the resistors have been placed in the rack or fixture 20 with their axes y intersecting at right angles the axis x of the bar or handle 25 and disposed so that they are central of this axis x, the varnish is applied to the resistors, as previously stated, at room temperature of approximately 70° F. Then the varnish is allowed to partially drain. The rack may then be turned by the operator in his hands once or twice just to spread the varnish. The rack is then chucked in a suitable power rotator so as to permit air-drying the varnish while it is being rotated on its axis x.

The air-drying may be done in the same oven 35 in which the varnish is later to be baked, air-drying being effected of course, with the heat turned off. The oven 35 illustrated in the drawing (Fig. 4) is shown as provided with a power-

driven chuck 30 which is adapted to be driven from power shaft 31 through a pair of change gears 32 and 33. Gear 32 is secured to the shaft 31 and gear 33 to shaft 34. The chuck 30 is mounted upon the latter shaft. For air-drying and baking, shank 25 of rack 20, then is chucked in chuck 30 so that the rack may be rotated about axis x.

The speed of rotation of the rack is determined by the quantity of varnish desired over the ends or caps of the resistors. For an even coat from end to end of a resistor, the speed of rotation needed for conventional types of thermosetting varnishes is approximately 30 R. P. M. If it is desirable to have more varnish at the ends of the resistors the speed of rotation must be increased.

For conventional types of thermosetting varnishes, the varnish is air-dried approximately one hour at room temperature. The length of time for the air drying is determined, of course, by the amount of solvent that is in the varnish. During the whole of the air-drying operation, the rack 20 is revolved on its axis x to revolve the resistors end over end about their centers c.

The varnish is then baked for approximately two hours with the rack or fixture 20 rotating continuously on its axis x. The baking temperature is raised constantly at a uniform rate from room temperature to approximately 150° C., over the period of approximately two hours, the temperature depending, of course, upon the type of varnish and the hardness of the bake desired.

A further baking period at the high temperature of say 150° C. may then be performed for approximately two hours. The resistors do not have to be rotated during this high-temperature baking period because the varnish has now become fixed. The length of the high-temperature bake is determined by the thickness of the varnish applied to the resistor.

The figure given above for the length of time for the air-drying, and baking, and for the temperatures of these operations are those that may be employed on a conventional type of thermosetting varnish. The process may be employed, also, where the resistors are coated with other varnishes as, for instance, silicone varnish. With thermosetting varnishes it is possible to apply all of the required protective varnish coating in a single coat. For silicone varnishes it may be necessary in some instances to apply two coats. In this case the first silicone varnish coating may be heated up to say 150° C. for baking and then the second coat may be applied, air-dried, and baked up to approximately 250° C. The resistors should be rotated during both baking operations until approximately 150° C. of heat is achieved.

For high production purposes, the process of the present invention may be carried on in a continuous oven or furnace. Such a furnace is illustrated diagrammatically in Fig. 7. For this purpose, a somewhat different type of fixture or rack 40 may be required, such as that shown in Fig. 6. This rack may be similar in construction to the rack 20 in so far as the base plate 41 of the rack may be provided with locating surfaces to locate the resistors longitudinally, that is, axially, as well as in a direction at right angles to their axes. The resistors may be clamped in the rack by clamping members 45. These clamping members may be spring pressed into clamping position. In the embodiment shown, there are two of these clamping members 45 pivotally connected by means of pins 44 to the

base at opposite sides thereof to clamp, respectively, opposite ends of the lead wires 15 of the resistors.

The rack 40 has shafts or shanks 46 projecting at opposite sides of the same which have rollers 47 integral with them. Each rack 40 is adapted to hold a plurality of resistors 10 and a plurality of racks 40 may be going through the oven 50 simultaneously. To drive the racks 40 through the furnace the racks may be positioned so that their shanks 46 project through longitudinal slots in the opposite side walls of the furnace and so that each of their rollers 47 engages between two endless belts 48 and 49, which are mounted outside the furnace. There is one pair of these belts at one side of the furnace and another pair at the opposite side thereof. The two belts of a pair may travel in opposite directions at different speeds or one belt of the pair may move faster than the other. In this way, the fixtures or racks 40 will be rolled from one end of the furnace to the other, the time of passage from one end of the furnace to the other depending upon the time required for the baking operation. As they roll, the resistors rotate about the axis x of the rack thereby causing even application of the varnish over the resistors. The speed of rolling, as before, determines the extent to which the varnish is applied over the caps and ends of the resistor. With this apparatus a plurality of racks can roll simultaneously through the furnace so that a great number of resistors can be treated simultaneously.

With the present invention, it is possible to put as much as a .015'' varnish coating on the resistors in a single coat. Heretofore this has required many coatings, many drying, many baking operations. The present invention, therefore, saves time and labor and very materially reduces the cost of resistors besides providing resistors which will meet naval specifications and stand up under most severe conditions.

Since air-drying and baking are both drying operations, the term "drying" is used in the claims generically to refer to either or both operations. When air-drying or baking are meant specifically, they will be referred to specifically. It will be understood, moreover, that the term "curing" covers whatever operation or operations are required to complete the drying of the insulating coating whether air-drying alone or air-drying and baking. It will be understood, also, that the term "varnish" is intended to cover lacquers and other types of protective coatings that are sufficiently fluid at normal room temperature to run.

While particular types of racks have been described, it will be understood that these are illustrative only. It will be understood further that while the racks described are provided with surfaces for locating the resistors longitudinally and diametrally by their lead wires, other means of locating in the racks may be employed if desired.

It will further be understood that while the invention has been described in connection with

particular embodiments thereof and a particular use therefor, it is capable of further modification and use, and this application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth and as fall within the scope of the invention or the limits of the appended claims.

Having thus described my invention what I claim is:

1. The method of coating a wire-wound resistor which comprises supporting the resistor by supporting means extending beyond the ends of the resistor and disposed axially of the resistor, applying a flowable insulating coating to the resistor and rotating the resistor about an axis which extends at right angles to the axis of the resistor and which intersects the axis of the resistor in its center while drying the resistor.

2. The method of coating a wire-wound resistor which comprises supporting the resistor by supporting means extending beyond the ends of the resistor and disposed axially of the resistor, applying a flowable insulating varnish to the resistor at normal room temperature, air-drying the resistor at normal room temperature while rotating the resistor about an axis which extends at right angles to the axis of the resistor and which intersects the axis of the resistor in its center, and then raising the temperature while continuing to rotate the resistor about said intersecting axis, to bake the coating on the resistor.

3. The method of coating a wire-wound resistor which comprises supporting the resistor by supporting means extending beyond the ends of the resistor and disposed axially of the resistor, applying a flowable insulating coating to the resistor, and drying the resistor while imparting a translatory rolling motion to the resistor in which the resistor revolves on an axis which extends at right angles to the resistor axis and intersects the resistor axis in the center of the resistor axis.

MELVIN A. THOM.

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