

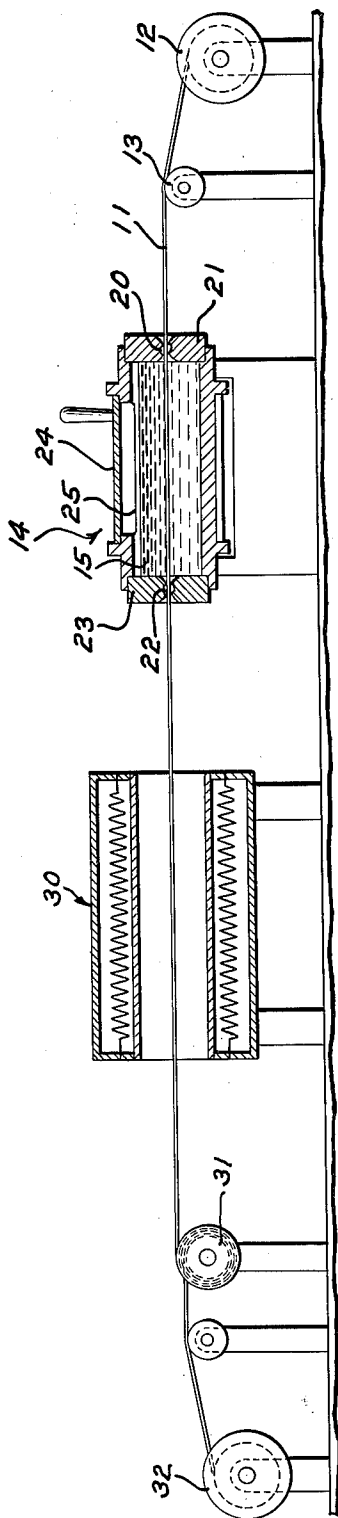
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METHOD OF INSULATING CONDUCTORS

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METHOD OF INSULATING CONDUCTORS

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This invention relates to insulated conductors and a method of insulating them, and more particularly to a conductor encased in a vitreous insulating enamel.

In the manufacture of wire wound vitreous enamel covered resistors, a limit on the maximum insulation between adjacent turns is often prescribed to permit the winding of compact resistors. These resistors are often made by winding bare wire in uniformly spaced turns around a ceramic core after which the whole is covered with an enamel and then fired to vitrify the enamel coating. However, due to a combination of factors such as a disparity between the relative coefficients of expansion of the wire and of the core and the high surface tension of the enamel, a condition known in the art as "wire pulling" takes place causing adjacent turns to come in contact with each other thereby causing undesirable short circuits between adjacent turns. Short circuits are also caused by adjacent turns touching due to slip and play in the wire winding mechanisms. Specifications calling for unusually close winding of turns of fine wire do not permit the use of ordinary well known wire coverings which are too thick. Any wire insulation used for this work must be relatively thin and heat resistant to withstand the firing temperatures and must tolerate a reasonable amount of flexure to permit the winding of fine wire on forms of relatively small diameter.

It is an object of the invention to provide an easily applied relatively thin heat resistant insulation which will withstand a reasonable amount of flexure and to provide a method for making the same.

In accordance with one embodiment of this invention an insulating composition is made by grinding a frit to the fineness of ceramic ink frits and mixing it with a linseed oil base ink varnish as a vehicle to form a coating bath. A measured thickness of the composition is then applied to a wire by passing the wire through the bath and wiping the excess composition off by pulling the wire through a die as it emerges from the bath. The coated wire is then passed directly from the bath through a furnace and subjected to a suitable temperature for the proper length of time to eliminate all organic components of the varnish and to produce a fully or partially vitrified coating of cohesive fused particles capable of adhering to the wire.

A complete understanding of the invention will be had by reference to the following detailed description taken in conjunction with the

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accompanying single-figure drawing which is illustrative of the invention.

As shown in the drawing a wire 11, which may be .0025" in diameter, is drawn from a rotatably mounted supply reel 12 and, after passing over a guide pulley 13, enters a cylindrical tank 14, containing a ceramic enamel slip 15, through a circular die 20, positioned below the liquid level in the end wall 21 of the tank. The die 20 which acts as a retainer to prevent the escape of the liquid contents of the tank should preferably be a diamond die having an opening .0031" in diameter. After passing through the ceramic enamel slip 15, the excess enamel is wiped from the wire by a circular die 22, preferably a diamond, having an opening about .00315" in diameter. Too large an opening will permit a thick coating to be applied to the wire which will cause "beading" on the wire because the surface tension of the enamel is greater than its holding qualities. The die 22 is disposed in an end wall 23 of the tank and its opening is in line with the opening of the die 20. A rotatable cylindrical cover 24 encircles the tank and is provided with an opening to match the opening 25 in the top of the tank when rotated to the open position.

After the coated wire emerges from the tank it is subjected to a predetermined temperature for a specific time period by passing it through an electric furnace 30 at a predetermined speed controlled by a capstan 31 around which the wire is passed before being wound on a take-up reel 32 which with the capstan is driven by some correlated means not shown.

The ceramic enamel slip may be prepared from any suitable frit. It has been found that a suitable frit may be made up of the following ingredients in parts by weight as indicated:

Ingredient:	Parts by weight
Flint	40.41
Red lead	19.07
Borax	30.46
Potassium nitrate	5.74
Boric acid	2.87
Chromium oxide	.93
Cobalt oxide	.52

The various ingredients in powder form are mixed together and the mixture is then heated until it melts whereupon it is allowed to flow into relatively cold water, thus "shattering" the frit. The frit is further ground and pulverized into particles of 6 microns or less in diameter.

Then the frit is mixed with any of the ink varnishes well known in the trade and which have

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a base composition of boiled linseed oil. The dispersion of the frit must be thorough so as to result in a homogeneous mixture. Such a mixture is known in the art as ceramic ink.

When hard, smooth wire is being coated, the enamel slip will "bead" on the wire if the liquid is too thin. The consistency of the ceramic enamel slip may be controlled by the blending of a number of ink varnishes having different grades of viscosity.

The speed with which the wire is to be drawn through the furnace, depends upon the temperature and length of the furnace. The temperature and the time interval during which the coated wire is subjected to that temperature should be correlated so as to eliminate all the organic components in the coating and produce a fully or partially vitrified coating of cohesive, fused particles adhering to the wire.

In the herein described embodiment of the invention, the length of the furnace is 12' and the following temperature and wire travel speed combinations were found to be successful: 103' per minute at a furnace temperature of 1440°-1460° F., 323' per minute at a furnace temperature of 1500° F. One may choose any combination of time and temperature that will drive off all the organic material from the ceramic enamel and produce the desired degree of cohesive fusion between the frit particles in the enamel and effect the necessary adherence to the wire.

It is not known whether this method provides a fully vitrified or partially vitrified coating. However, it does produce an enamel coating the particles of which are held together by at least partial fusion.

An important advantage of this coating material and method for applying the same is that very thin wire may be covered with a thin, relatively flexible insulation thus permitting the winding of small diameter resistors or other electrical parts having a minimum of insulation between adjacent turns which will not be short circuited in case the turns touch because of "wire pulling" or other causes.

What is claimed is:

1. A method of insulating a conductor com-

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prising applying to said conductor a ceramic enamel containing a frit reduced to particles 6 microns or less in diameter mixed with a boiled linseed oil base ink varnish, and heating said coated conductor to such a temperature as would be provided by moving said article through a 12' furnace within a range of speed and temperature in the furnace from 103 inches per minute and 1440° F. to 325 inches per minute and 1500° F.

2. A method of insulating a conductor comprising applying to said conductor a ceramic enamel containing a frit reduced to particles 6 microns or less in diameter mixed with a boiled linseed oil base ink varnish, and heating said coated conductor to such a temperature as would be provided by moving said article through a 12' furnace at a speed of 103' per minute, the temperature of said furnace being 1440° F.

3. A method of insulating a conductor comprising applying to said conductor a ceramic enamel containing a frit reduced to particles 6 microns or less in diameter mixed with a boiled linseed oil base ink varnish, and heating said coated conductor to such a temperature as would be provided by moving said article through a 12' furnace at a speed of 325' per minute, the temperature of said furnace being 1500° F.

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