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METHOD OF FORMING INSULATED WIRE

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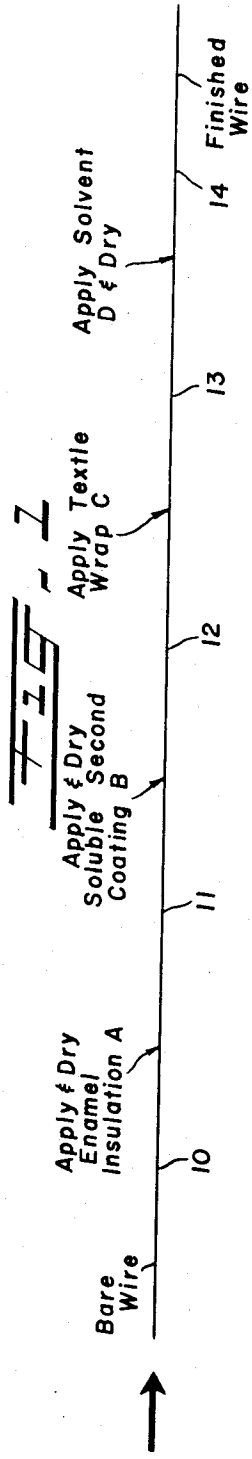


FIG. 1

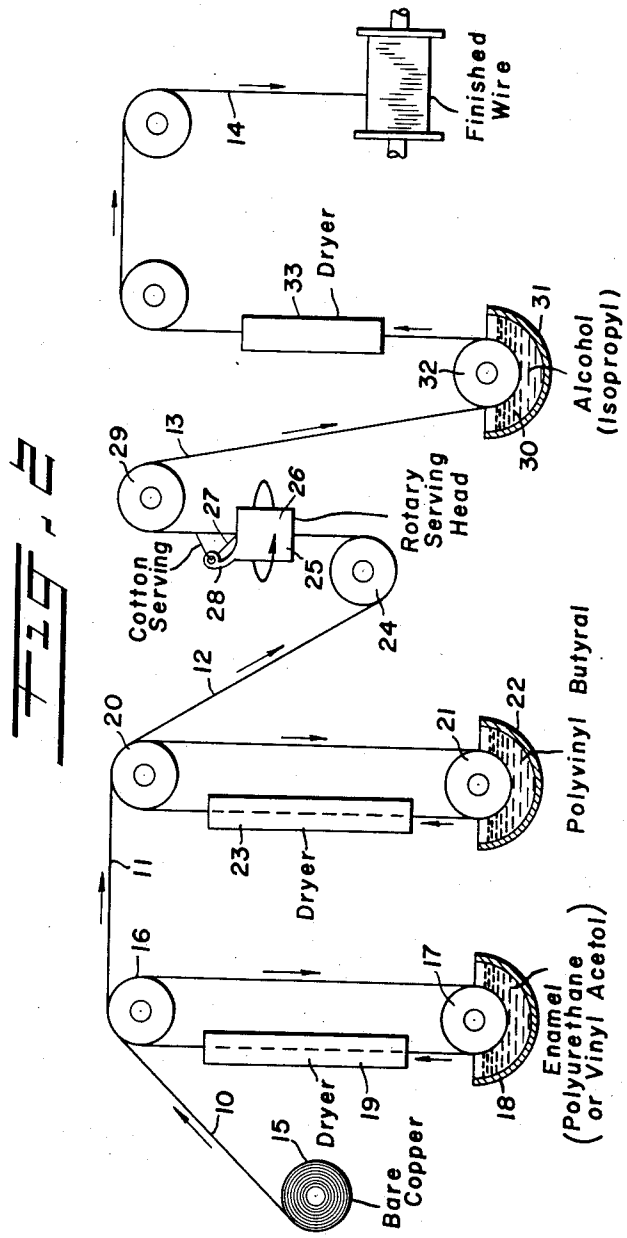


FIG. 2

INVENTORS
WARREN HAMMER
CHESTER F. SUDDS

BY

Soans, Anderson, Luedeka & Fitch

ATTORNEYS

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METHOD OF FORMING INSULATED WIRE

Warren Hammer, Hillside, and Chester F. Sudds, Wheaton, Ill., assignors to Belden Manufacturing Company, Chicago, Ill., a corporation of Illinois

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This invention relates to improvements in the manufacture of insulated wire and has its principal application in the manufacture of what is generally known in the trade as textile-wrapped, enameled magnet wire, i.e. an electrical conducting wire which is coated with a layer or film of enamel, using the word enamel in its broad sense as including any kind of lacquer or varnish or any of the usable synthetic insulations or other type of plastic substance as contrasted with textile coverings such as strands of silk, cotton or other natural or synthetic fibers, over which enamel coating there is applied by wrapping or braiding a textile covering generally known as a serving, and having as its main purpose the protection of the wire against mechanical abuse, coupled with some insulating value.

In the manufacture of insulated conductors having an enamel coating protected by a textile serving, it is desirable that the textile serving should be bonded or anchored in some way to the enamel layer or the surface thereof, so that if the wire is cut or damaged, the textile strands, individually or otherwise, will not fray or become unwrapped, and so that if any accident does result in a localized injury to the serving, such injury will be localized to that particular spot and will not extend further than the immediate injury.

Although attempts have been made to solve this problem, either the results have not been entirely satisfactory, or the cost of solving the problem has introduced manufacturing difficulties and other problems involved in the use of the product, or the expense of overcoming the difficulty has been out of line with the value of the product.

The principal object of the present invention is to provide a textile-covered, enameled magnet wire having an outer covering of high di-electric strength, of reasonable thickness and able to withstand the mechanical abuse to which wires of this class are subjected in the course of manufacture of the wire and in the use of the product.

Further objects of the invention are to enable a product of the desired quality to be manufactured by the use of types of machinery and other facilities and available material so that the desired result can be obtained at a reasonable cost.

In the accompanying drawings, which illustrate the improved process by means of which the foregoing desirable results are obtained;

Figure 1 is a diagrammatic flow sheet showing broadly the various steps utilized in practicing the process; and

Figure 2 is also a diagrammatic view in somewhat more detail, showing more specifically the apparatus employed in practicing the process.

Referring to the drawings, and first to Figure 1, it will be seen that a coating A of enamel insulation is applied to the bare conductor wire **10** and dried. The enameled wire **11** then travels to the next step of the process where there is applied a second coating B on top of the enamel insulation A, said second coating B being

also of the enamel type, but differing in composition from the insulation A in that the B coating is soluble in a liquid as to which the first coating A is practically insoluble or inert.

The wire **12** which now includes the first two coatings is then conducted to the next stage of the process where there is applied a wrap C of textile material such as has been described. At that point of the process, the textile wrap is retained on the wire **12** merely by reason of the fact that it is wrapped tightly, and preferably spirally, around the wire by the serving apparatus.

The wire **13**, which has been subjected to the first three steps of the process, i.e. A, B and C, is then dipped or otherwise contacted with a solvent D in which the second coating B is soluble and which will be rapidly absorbed by the serving and will pass through the interstices of the textile serving so as to partially dissolve the second coating and make it tacky for a sufficient length of time to anchor or bond the textile serving to the outer surface of the enamel coating. Excess liquid solvent is then eliminated by permitting the completed product **14** to dry naturally or, if necessary, by propelling the wire through a drying zone.

In the final dried finished product **14**, the second or intermediate plastic coating B constitutes a cementitious anchor or autogenous bond between the primary inner enamel coating A and the outer textile covering C.

In Figure 2 of the drawings, which illustrates the equipment employed in one particular application of the invention, the bare wire **10** is shown as coming from the bare wire supply spool as indicated at **15** to one of a set of sheaves **16** from which the wire travels downwardly to a lower set of sheaves **17** dipping into a trough **18** containing a supply of enameling liquid. Various types of enamel may be employed, as previously described, but we have found good commercial results from the use of reaction polymers of the polyurethane and also vinyl acetal types in a conventional vehicle such as cresylic acid with a suitable amount of a conventional aromatic hydrocarbon solvent.

As is customary in the use of various types of enamels, the wire travels around a number of sheaves, each upward pass being through an oven **19** heated to the proper degree to bake or set the film or coating of enamel on the wire or on the previous film, as the case may be.

When the bare wire has received enough coatings, the enameled wire **11** then goes to a second enameling apparatus, similar to the one previously described, and including a set of upper sheaves **20** and a set of lower sheaves **21** dipping into a trough **22** in which there is contained a bath of another type of enameled insulation which is soluble in alcohol. For example, a solution of polyvinyl butyral in the same type of solvent as is used as a vehicle for the enamel coating A, has been successfully employed to good advantage. In its upward travel between the sheaves **20** and **21**, the wire passes through an oven or drier **23**.

The wire **12** carrying the inner enamel coating and the superposed soluble coating B then passes around a sheave **24** and upwardly through a textile insulating head indicated diagrammatically at **25**. This may be of the conventional type employing an outer bowl **26** rotating at high speed and containing a tube of textile insulation, for example, in this instance cotton **27**, which is applied to the wire **12** by means of an upwardly extending finger or other device **28** rotating with the bowl **26**, the linear speed of the wire and the r.p.m. of the head being coordinated so that the spiral serving or wrap applied to the wire will not overlap at its edges and nevertheless will leave no significant space between adjacent turns or spirals of the serving.

The wire 13 which then carries the first enamel coating, the second soluble coating and the cotton serving, then passes over a guide spool 29 down to what may be termed an impregnating bath of alcohol 30 in a trough 31. The wire 13 passes downwardly into the trough 31 around a sheave 32 and upward through a pipe 33 which, if necessary, may be heated slightly in order to drive off all residual traces of excess alcohol taken up by the textile coating. However, the use of heat to drive off the last traces of solvent will not be required if a sufficiently volatile alcohol is employed.

Various types of alcohol may be employed, depending upon the exact composition of the second coating, and subject to particular operating conditions. For example, although we have successfully used isopropyl alcohol, other alcohols such as methyl or ethyl can be employed.

The foregoing process has been successfully used in producing an improved type of textile-covered enameled magnet wire in sizes ranging from No. 8 to No. 40. The process has the particular manufacturing advantage that in applying the textile serving, the normal operation of the serving head is not interfered with and proceeds with its usual efficiency, without any need to clean the head from time to time from accumulations of sticky adhesive material, nor does the final step of applying a non-sticky solution of alcohol present any significant problem.

The product produced by the foregoing process is of exceptionally high quality because of the efficiency of the serving head and the wire will stand severe tests in respect to the di-electric strength of the insulating sheath and its resistance to abrasion, scuffing or unwinding of the textile wrap.

Various features of the invention believed to be novel are set forth in the appended claims.

We claim:

1. The process of making textile-wrapped magnet wire having inherent superior ability to prevent unraveling of the textile wrap prior to the use of the process product, which process comprises,

first coating a metallic wire by passing it through a bath of a plastic di-electric enameling substance, and drying said di-electric coating to provide an enamel coating which is inert and insoluble during the remainder of the process,

then passing said coated wire through a bath of a different plastic substance to provide a second coating of a material which is capable of being softened by a volatile liquid solvent employed in a later step of the process, and drying said second coating,

then applying a porous textile serving over said second coating,

then contacting said product with a volatile liquid solvent which will penetrate said serving and soften said second coating, but which does not affect said first coating, and

subsequently permitting excess solvent to evaporate so as to effect a cementitious bond between said second coating and the inner surface of the serving while retaining the original properties of said first coating and said serving after such evaporation.

2. The improved process of making textile-wrapped magnet wire having inherent superior ability to prevent unraveling of the textile wrap prior to the use of the process product, which process comprises

first coating a metallic wire by passing it through a bath of a plastic di-electric substance which, when dried, is insoluble in an alcohol, and drying said coating,

then passing said coated wire through a bath of a plastic substance which, after drying, is soluble in said alcohol, so as to provide a second coating bonded to said first coating, and drying said coating, then applying a porous textile serving over said second coating,

then contacting said product with a supply of said alcohol so that it will penetrate said outer serving and partially dissolve said second coating, but which does not affect the first coating,

and subsequently permitting excess alcohol to evaporate so as to effect a cementitious bond between the second coating and the inner surface of said serving.

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