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(54) **Sleeving.**

(57) A method of coating a fibrous material tube for use as electrical insulation which comprises applying to the tube a solventless epoxy resin system an curing the resin. The instertices in the tube are sufficiently small that they do not allow full impregnation of the resin through to the inside of the tube before curing. The tube is preferably knitted on a circular knitting machine and thus may be produced continuously and coated continuously at a greater speed than was hitherto possible with graded tubes and solvent resin systems.

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SLEEVING

This invention relates to a method of producing coated sleeving in particular coated electrical sleeving.

Sleeving, for example for use as electrical insulation, has hitherto been produced from braided material, for example, glass fibre, which is then coated with an elastomeric composition. Common elastomers employed include silicone rubbers and acrylic latices, both of which are applied from solvent based systems. The elastomer solution is applied to the braiding and, before curing of the elastomer can take place, the solvent must be removed. This entails a relatively long residence time within an oven or other heating zone firstly to remove the solvent, and then to effect curing of the elastomer. In order to keep the heating zone down to a reasonable size, it is therefore necessary to ensure that the sleeving passes through the heating zone at a relatively slow rate, typically in the order of 1 meter per minute.

The invention seeks to provide a method of producing sleeving, suitable for use as electrical insulation, which is very much faster than known methods.

In its broadest aspect, the invention provides a method of coating a fibrous material tube which comprises applying to the tube a solventless epoxy resin system

and curing the resin, the interstices in the tube being sufficiently small that they do not allow full impregnation of the resin through to the inside of the tube before curing.

The tube may be braided or woven from fibrous materials but is preferably, according to the invention, a knitted tube produced on a circular knitting machine.

The fibrous materials employed may in general comprise any textile fibre, but for the properties of heat resistance required for electrical insulation it is preferred that textile fibres having high resistance to heat are employed or, preferably, that glass fibres are employed.

Consequently the invention also provides a process in which a tube is knitted from a glass fibre yarn on a circular knitting machine, a solvent free resin system is applied to the knitted tube, and the resin cured.

Employing the process of the invention enables sleeving to be produced at a much faster rate than hitherto. For example, employing a curing oven of approximately half the size of a conventional oven used for curing solvent based silicone rubber systems, a through-put speed in the order of 15 meters per minute can be obtained compared with conventional speeds of around 1 meter per minute.

Where the end use of the sleeving is for electrical insulation, this will have to meet specified voltage

resistance requirements. Commonly a voltage resistance in excess of 3000 volts is required. According to the process of the invention a voltage resistance in the order of 4000 volts is produced with one pass through the coating system and curing zone. With the conventional solvent based systems two or more passes would be needed through the coating and curing zone effectively reducing the rate of production.

In order to produce the very good coating according to the invention with one pass, the knitted tube presented to the coating zone should be of close mesh construction to prevent impregnation through to the inside of the tube. This will to some extent depend on the viscosity of the resin system used.

One marked advantage of using knitted tubes is that they may be produced both quickly and continuously in indefinite lengths. Thus long runs of tube may be coated and cured at the high speed possible with the resin system employed. Short runs are, in general, not economical since the handling between runs, which is labour intensive, is increased, and the resin system is itself more expensive than the conventional solution based systems. The particular combination of the preferred form of the invention employing long runs of knitted tube coated at high speed with an epoxy resin, enables a superior product to be obtained extremely economically.

The resin system employed in accordance with the invention is an epoxy resin, preferably a long chain epoxy resin with an acid polyester hardner. Such systems are solventless and are usually two-pack, but need not be so.

The following Example will illustrate the invention.

EXAMPLE:

A fibrous material tube was produced by knitting on a circular knitting machine in a continuous manner a glass fibre yarn. The bore of the tube knitted was 10 mm. and the average size of the interstices in the knitted structure was 0.1 x 0.2 mm.

To the knitted tube was applied a solventless epoxy resin and hardner system MS 7323 and MS 7108 (Ciba Geigy) under pressure evenly to coat the fabric tube. The resin system is a thixotropic paste. The coated tube is then cured by passing it through an oven maintained at 300° C at a rate of 12m/minute.

The product so produced was found to be evenly coated, flexible, and with no strike through of the resin into the bore of the tube. Other properties of the product were as follows:

Thermal classification	Class F (155° C)
Maximum short-term temperature	220° C
Electric strength at 20° C (1 min. proof)	4 kV

The product was produced continuously in long runs and thereafter cut into lengths and wound on standard reels.

CLAIMS

1. A method of coating a fibrous material tube which comprises applying to the tube a solventless epoxy resin system and curing the resin, the interstices in the tube being sufficiently small they do not allow full impregnation of the resin through to the inside of the tube before curing.

2. A method as claimed in claim 1 in which the tube is knitted from yarns or threads of a fibrous material.

3. A method as claimed in claim 2 in which the tube is knitted on a circular knitting machine.

4. A method as claimed in any one of claims 1 to 3 in which the fibrous material has high resistance to heat.

5. A method as claimed in claim 4 in which the fibrous material comprises glass fibres.

6. A method as claimed in any one of claims 1 to 5 in which the interstices in the tube are no greater than 0.01 x 0.02 mm.

7. A method as claimed in any one of claims 1 to 6 in which the resin employed is a long chain epoxy resin with an acid polyester hardener.

8. A method as claimed in any one of claims 1 to 7 in which curing takes place by heating in an oven in a

continuous manner.

9. A method as claimed in claim 8 in which the oven is maintained at a temperature of abour 300° C.

10. A methcd as claimed in any of claims 1 to 9 in which the coated is tube is produced continuously thereafter cut into desired lengths.

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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	DE - A - 1 635 671 (UNIROYAL, INC.) * Page 1, section 1; page 4, line 16 - page 6, line 16; page 8, line 9 - page 9, line 5; page 16, line 17 - page 17, line 15; page 21, line 13 - page 22, line 4; fig. 1,3 *	1-5,7, 8,10	D 06 M 15/42 D 06 N 3/12 D 04 B 9/44 C 03 C 25/02// H 01 B 3/40 H 01 B 3/48 H 01 B 19/04
A	US - A - 3 845 438 (MENDELSOHN) * Abstract; fig.; column 1, line 34 - column 3, line 39; column 4, lines 14-32; column 4, line 45 - column 5, line 33 *	1,4,5, 7	
A	CH - A5 - 617 101 (PROCESS SCIENTIFIC INNOVATIONS LIMITED) * Abstract; fig. 1,4; page 3, right column, line 29 - page 4, left column, line 12 *	1,4,5, 7	
A	DE - B2 - 2 440 998 (PALL CORP.) * Column 1, lines 63-68; column 3, lines 37-45; column 4, lines 22-30; column 7, line 43 - column 8, line 1; fig. 1 *	1,7,10	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

C 03 C
D 06 M
D 06 N
H 01 B
H 02 K
D 04 B
D 04 H
D 06 B
B 01 D
B 32 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	20-02-1984	HAUSWIRTH

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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