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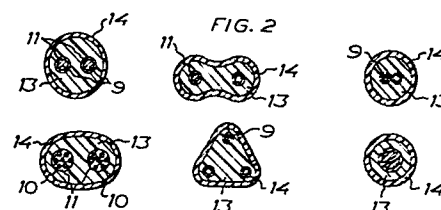
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(54) A heating cable and a method of making it.

(57) A heating cable has at least two electric conductors (9,10) extending longitudinally of each other in spaced relation. Each of the conductors (9, 10) has an insulating coating (11) which complete covers the respective conductors (9, 10) except for apertures (12) in the conductors (9, 10), which are spaced longitudinally thereof. The apertures (12) are arranged alternately in the conductors (9, 10) which are surrounded by a continuous plastic layer (13) or relatively low and substantially temperature-independent resistivity. The plastic layer (13) is in contact with the conductors (9, 10) through the apertures (12), and an electrically insulating outer layer (14) covers the plastic layer (13) completely.



A HEATING CABLE AND A METHOD OF MAKING IT

This invention relates to heating cables and methods of making such cables.

Heating cables have already been suggested, which include two electric conductors extending longitudinally of each other in spaced relation, each of said conductors having an insulating coating. These insulated conductors are further enclosed in a first insulating covering which forms a support for a resistance wire which is helically wound along the entire length of the cable and which in turn is surrounded by a main insulating sheath. The cable can also be reinforced with a shielding or reinforcing layer surrounding the main insulating sheath or layer, and said shielding or reinforcing layer may be provided with an outer corrosion proofing layer.

15 In this prior art heating cable the points of contact between the conductors and the resistance wire are arranged alternately along the length of the cable.

In view of the relatively low effect that a heating cable shall generate per length unit, a very thin and very densely wound resistance wire is usually required, but nevertheless the minimum distance between the points of contact will be relatively large or usually about one meter. This is a considerable drawback because one is restricted, when the cable is to be cut, in one's choice of point of cutting, i.e. the heated length of the cable can only be selected in steps of about one meter, and the points of contact must be marked on the outer side of the cable. Because of the thin resistance wire, the heating cable has a reduced flexibility and the risk for ruptures is great on exaggerated or repeated flexing of the cable.

Heating cables consisting of two parallel bare-wire conductors which are enclosed in an electrically semi-conductive composition of the PTC type, have also been

suggested already, cf. for example European application 8235. "PTC type" here means a markedly positive temperature coefficient for the resistivity of the composition, i.e. the resistivity increases relatively slowly up to
5 a certain critical temperature above which it increases very rapidly. In a heating cable of this type the current flow between the bare-wire conductors is directed at right angles to the longitudinal direction of the conductors, for which reason the composition must have so
10 high a resistivity as is reached only above said critical temperature. As a result, there will certainly be obtained an automatic temperature control in a heating cable and the cable can be cut at an optional point, but in practice such a heating cable is unreliable owing
15 to non-homogeneities along the length of the conductors.

Increased reliability can be attained according to U.S. patent specification 4,330,703 by introducing at least one further layer in addition to said PTC layer between the two conductors, and said further layer or
20 layers shall consist of a material of substantially temperature-independent resistivity. However, such a construction of the heating cable naturally involves increased complexity and increased costs for the manufacture of the cable.

25 The object of the present invention therefore is to provide a heating cable which has been considerably improved compared to the above-described known heating cables, and a method for making said improved heating cable.

30 This is realized in that a heating cable including at least two electric conductors extending longitudinally of each other in spaced relation, each of said electric conductors having an insulating coating, is given according to the present invention the characteristic
35 features that the coating completely covers the respective conductors except for apertures in said conductors, which are spaced longitudinally of and arranged alter-

nately in the conductors, that the conductors are surrounded by a continuous plastic layer of relatively low and substantially temperature-independent resistivity, said plastic layer being in contact with the conductors
5 in the apertures so that the current flow through the plastic layer is substantially longitudinally directed, and that an electrically insulated outer layer completely covers said plastic layer.

The method of making a heating cable which includes
10 at least two electric conductors extending longitudinally of each other in spaced relation, each of said conductors having an insulating coating, is characterised according to the invention in that apertures in the insulating coatings are provided alternately on the conductors at
15 intervals corresponding to the intended supply voltage and the desired effect at said voltage, that the conductors are provided with a surrounding continuous layer by extrusion of a plastic of relatively low and substantially temperature-independent resistivity, and that
20 an electrically insulating outer layer is applied by extrusion to cover said plastic layer.

As has been mentioned in the foregoing, it is certainly previously known to make cables and braided bands in conductive plastics by embedding therein current con-
25 ductors between which a given resistance value is built up via the electrically conductive plastic. These prior art constructions, however, presuppose that the plastic has a relatively high resistivity.

Applying the heating cable construction according
30 to the invention permits using electrically conductive plastic of relatively low and substantially temperature-independent resistivity. Still, the construction is such that an adaptation to any extra-low and low voltages in say the range of 12-440 V is possible. For example,
35 a plastic having a temperature coefficient lower than 5% can be used.

The heating cable according to the present invention besides eliminates substantially all disadvantages inherent in the conventional wire wound heating cable.

The invention will be more fully described hereinbelow with reference to the accompanying drawings in which:

Fig. 1 illustrates a wire wound heating cable according to prior art technique, stepwise stripped;

Fig. 2 shows cross-sectional views of embodiments, given by way of example, of the heating cable according to the invention;

Fig. 3 shows sideviews of embodiments, given by way of example, of apertures made in the high-insulating coating of a conductor; and

Fig. 4 shows by way of example the location of apertures.

Fig. 1, to which a first reference is made, illustrates a conventional heating cable 1 having two electric conductors 2 which are insulated by means of a high-insulating coating 3. The coatings and their insulations are embedded in a covering 4 which consists of say silicone rubber and forms a support for a resistance wire 5 which is helically wound along the entire length of the cable. The resistance wire 5 is surrounded by the main insulation 6 of the cable, which in turn is preferably surrounded by a shield or reinforcement 7 of say galvanized iron wire. On the outside, the cable has a corrosion proofing layer 8 of some suitable plastic.

Instead of a thin, helically wound resistance wire use is made according to the invention of an extrudable thermoplastic of relatively low resistivity. Fig. 2 shows some embodiments of the heating cable according to the invention in cross-section. As is apparent from these examples, the electric conductor may be a single conductor 9 or a conductor 10 composed of several strands. The conductors 9, 10 have a high-insulating coating 11 which may consist of lacquer, enamel, yarn, a chemical insulation or a plastic insulation. The coating 11 covers

the respective conductors completely except for apertures 12 which are spaced apart along the conductors in an alternating manner thereon, as is apparent from Fig. 4. As shown in Fig. 3, the apertures can be realized by abrasion of the high-insulating coating 11, by annular peeling thereof or by unilateral scraping off of the coating 11. By reason of the apertures 12 the electrically conductive plastic layer 13 thus is contact with the conductors 9 and 10 in said apertures, for which reason the current flow through the plastic layer 13 will be substantially longitudinally directed. An electrically insulating outer layer 14 covers the plastic layer 13 completely.

The plastic layer 13 may consist of a polyethylene plastic, in which case temperatures of up to about 90°C can be achieved in the cable, or silicone plastic, in which case higher temperatures of up to about 270°C can be achieved in the cable. An example of a usable plastic is a semi-conductive quality of an elastomeric thermoplastic with the designation XT6002:70. This plastic is available from ASEA KABEL AB and more particularly is a butyl-doped polyethylene plastic which is extrudable and has a volume resistivity of less than 10^3 ohm·cm. A typical temperature coefficient is 2.5-3.0% in the temperature range 25-75°C.

With a plastic of the kind exemplified it is possible to reach an effect of 5-30 W/m in a cable intended for the supply voltage 220 V. The intervals between the apertures may be reduced to about 1 dm, and compared with a conventional wire wound heating cable a reduction of the manufacturing cost by about 50% can be attained.

As the conductive plastic utilized is extrudable, a very rational manufacture of the heating cable according to the invention is made possible. More specifically, apertures may alternately be made in the insulating coatings of the conductors utilized, at intervals corresponding to the intended supply voltage and the

desired effect at this voltage. The apertures can be realized while the conductors are advanced through an extruding nozzle in which the plastic of relatively low resistivity is applied in a continuous layer surrounding
5 the conductors. The conductive plastic will thus make direct electric contact with the conductors through said apertures. In a subsequent extruding step an electrically insulating outer layer, for example of polyvinyl chloride, can be applied in order to cover the electrically
10 conductive plastic layer.

On extrusion of the electrically conductive plastic material one also chooses the cross-sectional area of the finished plastic layer with due regard to the desired effect generated and to the intended supply voltage.

15 It will be realized that the invention can be modified with respect to the embodiments described in the foregoing. Thus the invention is applicable for example to electric cables having more than two conductors.

CLAIMS

1. A heating cable including at least two electric conductors (9, 10) extending longitudinally of each other in spaced relation, each of said conductors having an insulating coating (11), c h a r a c t e r i s e d
5 in that the coating (11) completely covers the respective conductors (9, 10) except for apertures (12) in said conductors, which are spaced longitudinally of and arranged alternately in said conductors, that the conductors (9, 10) are surrounded by a continuous plastic layer
10 (13) of relatively low and substantially temperature-independent resistivity, said plastic layer being in contact with the conductors in said apertures so that the current flow through the plastic layer is substantially longitudinally directed, and that an electrically
15 insulating outer layer (14) completely covers said plastic layer.

2. A heating cable as claimed in claim 1, c h a r a c t e r i s e d in that the plastic layer consists of a polyethylene plastic or a PVC plastic.

20 3. A heating cable as claimed in claim 1, c h a r a c t e r i s e d in that the plastic layer consists of a silicone plastic.

4. A heating cable as claimed in any one of claims 1-3, c h a r a c t e r i s e d in that the apertures
25 are spaced apart a distance of about 1 dm.

5. A heating cable as claimed in any one of claims 1-4, c h a r a c t e r i s e d in that the plastic layer of relatively low resistivity is so dimensioned that the effect generated by the heating cable is about
30 5-30 W/m.

6. A method of making a heating cable including at least two electric conductors (9, 10) extending longitudinally of each other in spaced relation, each of said conductors having an insulating coating (11), c h a r a c t e r i s e d

r a c t e r i s e d in that apertures (12) in the insulating coatings are provided alternately on the conductors (9, 10) at intervals corresponding to the intended supply voltage and the desired effect at said voltage, that the conductors in a subsequent step are provided with a surrounding continuous layer (13) by extrusion of a plastic of relatively low and substantially temperature-independent resistivity, and that an electrically insulating outer layer (14) is applied by extrusion to cover said plastic layer.

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FIG. 1

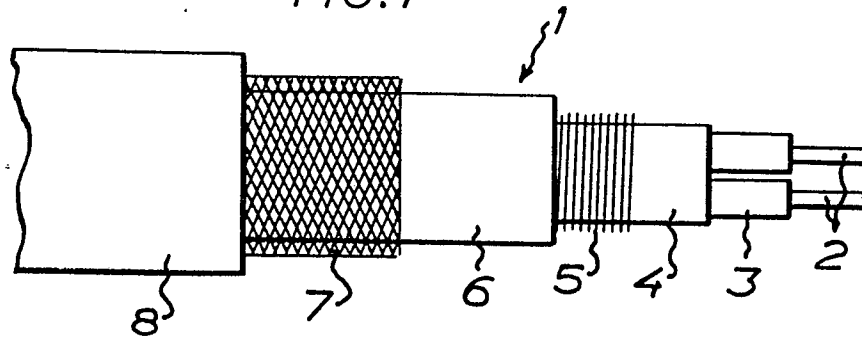


FIG. 2

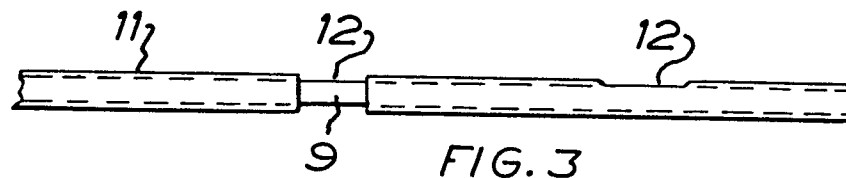
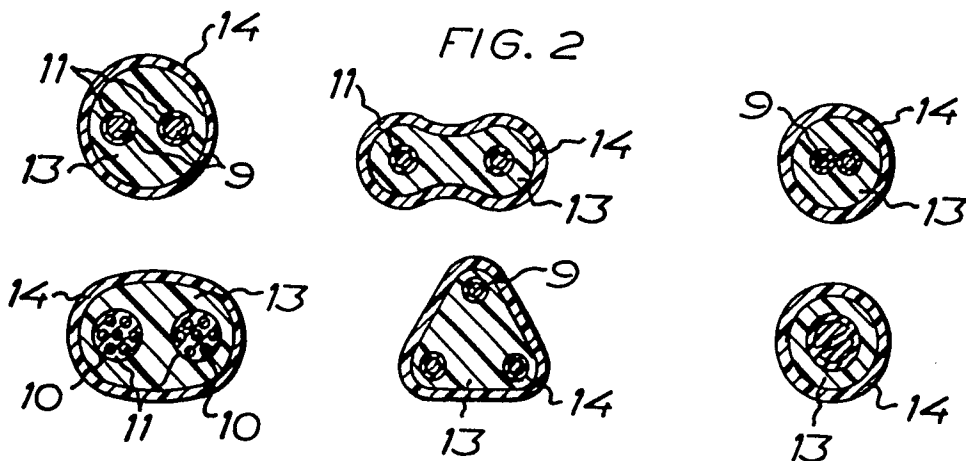


FIG. 3

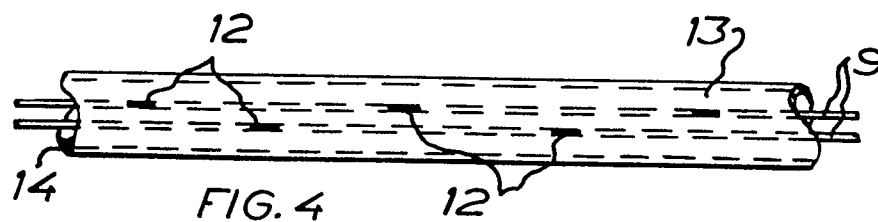


FIG. 4



European Patent
Office

EUROPEAN SEARCH REPORT

0098253

Application number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 83850178.1
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
A	DE - A1 - 3 017 826 (SUNBEAM CORP.) * Totality * --	1,2,6	H 05 B 3/56 H 05 B 3/10
A	US - A - 3 757 086 (INDOE) * Totality * --	1,6	
A	DE - A1 - 3 115 242 (SUNBEAM CORP.) * Pages 8-12; fig. 1,2 * --	1,2	
A	EP - A2 - 0 040 537 (RAYCHEM.) --		
A,D	US - A - 4 330 703 (RAYCHEM.) --		
A	US - A - 4 286 376 (RAYCHEM.) ----		
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 30-09-1983	Examiner TSILIDIS
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	