

PATENT SPECIFICATION

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DRAWINGS ATTACHED



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(54) IMPROVEMENTS IN OR RELATING TO TELECOMMUNICATION CABLES

(71) We, BRITISH INSULATED CABLES LIMITED, a British Company, of 21 Bloomsbury Street, London, W.C.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to telecommunication cables of the kind comprising a multiplicity of plastics insulated conductors enclosed within a water-proof sheath. If such cables, whether buried in the ground or drawn into ducts, become locally damaged to an extent to allow water to enter through the damaged sheath, the water will travel along the cable through the interstices between the insulated conductors and between the conductors and the sheath and so may have an adverse effect upon the electrical characteristics of the whole cable length, especially if there are pin holes in the plastics insulation of the conductors through which the water can permeate.

In the Complete Specification of our Patent No. 995,582 we describe and claim a plastics insulated multiple conductor telecommunication cable which has electrical characteristics equivalent or approximating to those of air-filled telecommunication cables of known construction but which prevents water from travelling along the cable away from its point of entry into the cable. According to the aforesaid Patent the telecommunication cable comprises a multiplicity of conductors each having a dielectric of plastics material of cellular form, a water-proof sheath enclosing the insulating conductors and, filling the interstices between these insulated conductors and between them and the cable sheath from end to end of the cable length, a water-impermeable medium which will not drain under the influence of gravity or such hydrostatic pressure as may arise in the event of damage to the cable sheath but which will permit relative sliding movement of the cellular plastics insulated conductors over one another during such bending of the cable as occurs during

manufacture and installation of the cable.

By making the conductor insulation of cellular plastics material, by which is meant of a material containing large numbers of non-interconnecting cells, the capacitance between the conductors of each pair or that between the conductors of each quad can be reduced to an extent substantially to compensate for the increase in inter-conductor capacitance due to the presence of water-impermeable medium in the conductor interstices throughout the cable length.

The present invention is an improvement in or modification of the telecommunication cable described and claimed in Patent No. 995,582 hereinafter referred to as the main patent, and has as its object the provision of a telecommunication cable which has all the advantages of the cable of the main patent and which is easier and cleaner to manipulate and/or handle both during manufacture and during subsequent installation of the cable.

In accordance with the invention our improved form of cable comprises two or more cable units laid up together and enclosed in a water-proof sheath, each cable unit comprising a multiplicity of conductors each having a dielectric of plastics material of cellular form, one or more layers of insulating tape surrounding the multiplicity of conductors and, filling the interstices between these insulated conductors and between the insulated conductors and the layer or layers of insulating tape from end to end of the cable unit length, a water-impermeable medium of the kind used in the cable of the main patent, the layer or layers of insulating tape being impregnated with the water-impermeable medium and constituting a barrier to the ingress of water.

The layer or layers of insulating tape of each cable unit serves or serve substantially to retain the water-impermeable medium within the unit during cabling and other handling of the unit during manufacture of a cable thereby substantially reducing the amount of water-impermeable medium likely to be in-

adventerly deposited on the cable-making machinery which might otherwise collect dust and other impurities and subsequently contaminate the cable and other cables made by the machinery. Substantial retention of the water-impermeable medium in each cable unit by the layer or layers of insulating tape also eliminates the necessity of applying further water-impermeable medium to the laid up cable units before the water-proof sheath is applied. Jointing and/or terminating of the cable is also facilitated because the cable units are cleaner and hence easier to handle and because, when terminating a cable, for instance in a terminating frame for an end of the cable in a telephone exchange, after cutting back the cable sheath there is no need to provide protective papers to the exposed conductors in order to prevent dust and other impurities contaminating the exposed conductors.

The invention also includes a method of manufacturing a telecommunication cable in accordance with the invention comprising: forming each of two or more cable units by introducing a water-impermeable medium into the interstices between a multiplicity of conductors, each have a dielectric of plastics material of cellular form, as each layer of the conductors is being assembled, and applying to the assembled conductors one or more layers of insulating tape having a porosity such that it will become impregnated with the water-impermeable medium and will constitute a barrier to the ingress of water; laying up the cable units so formed; and enclosing the laid-up cable units in a water-proof sheath.

In assembling a cable unit the insulating tape or tapes, preferably of paper, may be lapped helically about the assembled conductors but, for ease and speed of application and removal when required, we prefer to apply the or each tape longitudinally to the assembled conductors and to fold it transversely around them with an overlap, for instance of 6.35 mm (0.25 ins.). In the latter case the transversely-folded tape or tapes may be retained in the place by means of a binder, for instance a plastics tape, applied helically about the cable unit so formed. By way of example a paper having the required properties is extensible Kraft paper having an elongation at break in the region of 7 to 8%. Such a paper is sold under the trade name "Clupak". The word "Clupak" is a Registered Trade Mark.

The conductors are preferably of copper or of aluminium or an aluminium-based alloy of high conductivity, for instance a hard drawn aluminium which is at least 99.7% pure. The conductor insulation is preferably of cellular polythene, cellular polypropylene or cellular polyvinyl chloride.

The water-impermeable medium used to

fill the interstices within each cable unit should be one which, in addition to having the characteristics previously referred to, is compatible with the particular insulating material used to insulate the individual conductors, with the insulating material of the tape and with the material of the sheath; and which has a high co-efficient of bulk resistivity, a high dielectric strength, and preferably a low electrical permittivity.

Examples of compositions suitable for use as water impermeable media in cables whose conductors are insulated with cellular polythene, cellular polypropylene or cellular polyvinyl chloride are:

- (a) Mixtures of whiting and castor oil;
- (b) Microcrystalline petroleum waxes;
- (c) Mixtures of microcrystalline petroleum waxes and oils, for instance petroleum jelly;
- (d) Low molecular weight, high Melt Flow Index polyethylenes of a semi-solid or grease-like nature;
- (e) Mixtures of petroleum jelly, microcrystalline petroleum waxes, polyisobutylene and aluminium stearate;
- (f) Mixtures containing cumerone indene resins;
- (g) A blend of two or more of filling materials (a) to (f).

The water-impermeable medium may be blended with a flame-resistant medium, for instance chlorinated paraffin awx or halogenated diphenyl, to render the cable flame-retardant, in accordance with our Patent No. 1,175,850.

An example of a telecommunication cable in accordance with the invention will now be described with reference to the accompanying drawing, in which:—

Figure 1 is a cross-sectional view of the cable, and Figure 2 is a fragmental cross-sectional view of the cable drawn on a larger scale.

The cable comprises twelve cable units, four of which units 1 are of substantially sector-shaped cross-section and are laid up together to form a core and the remaining eight of which units 2 are of substantially segmental cross-section and are laid up about the core of units 1 with a lay opposite to that of the units 1.

Each cable unit 1 and 2 comprises a multiplicity of conductors 11 of hard drawn aluminium, each having a dielectric 12 of cellular polythene, the insulated conductors initially being arranged in layers. The insulated conductors of each unit are surrounded by a layer 14 of tape of extensible Kraft paper, the tape having been applied longitudinally to the assembled conductors and folded transversely around them with an overlap. The layer 14 of longitudinally applied paper tape is retained in place by an outer tape of polythene

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(not shown) applied helically about the cable unit.

The interstices between the insulated conductors of the cable unit and between them and the layer 14 of paper tape from end to end of the unit, are filled with petroleum jelly 15 which impregnates the layer 14 of paper tape so that it constitutes a barrier to the ingress of moisture. The petroleum jelly is applied to each layer of insulated conductors as it is being assembled.

The assembled cable units 1 and 2 are surrounded by a screen 3 formed from a polythene/aluminium laminated tape applied longitudinally with the polythene layer outermost and with an overlap. An extruded polythene sheath 4 is bonded to the outer polythene layer of the screen 3 and encloses the screened assembly of cable units. Petroleum jelly 16 that has, with time, exuded through the layer 14 of paper tape fills the interstices between the units 1 and 2 and between the units 2 and the sheath 4.

WHAT WE CLAIM IS:—

1. A telecommunication cable comprising two or more cable units laid up together and enclosed in a water-proof sheath, each cable unit comprising a multiplicity of conductors each having a dielectric of plastics material of cellular form one or more layers of insulating tape surrounding the multiplicity of conductors and, filling the interstices between these insulated conductors and between the insulated conductors and the layer or layers of insulating tape from end to end of the cable unit length, a water-impermeable medium which will not drain under the influence of gravity or such hydrostatic pressure as may arise in the event of damage to the cable sheath but which will permit relative sliding movement of the cellular plastics insulated conductors over one another during such bending of the cable as occurs during manufacture and installation of the cable, the layer or layers of insulating tape being impregnated with the water-impermeable medium and constituting a barrier to the ingress of water.

2. A telecommunication cable comprising two or more cable units laid up together and enclosed in a water-proof sheath, each cable unit comprising a multiplicity of conductors each having a dielectric of plastics material of cellular form, one or more layers of insulating tape surrounding the multiplicity of conductors, the or each layer comprising a tape applied longitudinally to and folded transversely around the multiplicity of conductors with an overlap and, filling the interstices between these insulated conductors and between the insulated conductors and the layer or layers of insulating tape from end to end of the cable

unit length, a water-impermeable medium which will not drain under the influence of gravity or such hydrostatic pressure as may arise in the event of damage to the cable sheath but which will permit relative sliding movement of the cellular plastics insulated conductors over one another during such bending of the cable as occurs during manufacture and installation of the cable, the layer or layers of insulating tape being impregnated with the water-impermeable medium and constituting a barrier to the ingress of water.

3. A telecommunication cable as claimed in Claim 2, wherein the transversely folded tape or tapes is or are retained in place by means of a binder applied helically about the cable unit.

4. A telecommunication cable as claimed in Claim 3, wherein the binder comprises a plastics tape.

5. A telecommunication cable as claimed in any one of the preceding Claims, wherein the insulating tape or tapes is or are of paper.

6. A telecommunication cable as claimed in Claim 5, wherein the paper is an extensible Kraft paper having an elongation at break in the region of 7 to 8%.

7. A telecommunication cable as claimed in any one of the preceding Claims, wherein the conductors are of aluminium or an aluminium-based alloy of high conductivity.

8. A telecommunication cable as claimed in any one of the preceding Claims, wherein the dielectric of the conductors is of cellular polythene, cellular polypropylene or cellular polyvinyl chloride.

9. A telecommunication cable as claimed in any one of the preceding Claims, wherein the water-impermeable medium is that recited in any one of Examples (a) to (g).

10. A telecommunication cable as claimed in any one of the preceding Claims, wherein the water-impermeable medium is blended with a flame-resistant medium to render the cable flame retardant.

11. A method of manufacturing a telecommunication cable in accordance with any one of the preceding Claims, comprising: forming each of two or more cable units by introducing a water-impermeable medium into the interstices between a multiplicity of conductors, each having a dielectric of plastic material of cellular form, each layer of the conductors is being assembled, and applying to the assembled conductors one or more layers of insulating tape having a porosity such that it will become impregnated with the water-impermeable medium and will constitute a barrier to the ingress of water; laying up the cable units so formed; and enclosing the laid-up cable units in a water-proof sheath.

(not shown) applied helically about the cable unit.

The interstices between the insulated conductors of the cable unit and between them and the layer 14 of paper tape from end to end of the unit, are filled with petroleum jelly 15 which impregnates the layer 14 of paper tape so that it constitutes a barrier to the ingress of moisture. The petroleum jelly is applied to each layer of insulated conductors as it is being assembled.

The assembled cable units 1 and 2 are surrounded by a screen 3 formed from a polythene/aluminium laminated tape applied longitudinally with the polythene layer outermost and with an overlap. An extruded polythene sheath 4 is bonded to the outer polythene layer of the screen 3 and encloses the screened assembly of cable units. Petroleum jelly 16 that has, with time, exuded through the layer 14 of paper tape fills the interstices between the units 1 and 2 and between the units 2 and the sheath 4.

WHAT WE CLAIM IS:—

1. A telecommunication cable comprising two or more cable units laid up together and enclosed in a water-proof sheath, each cable unit comprising a multiplicity of conductors each having a dielectric of plastics material of cellular form one or more layers of insulating tape surrounding the multiplicity of conductors and, filling the interstices between these insulated conductors and between the insulated conductors and the layer or layers of insulating tape from end to end of the cable unit length, a water-impermeable medium which will not drain under the influence of gravity or such hydrostatic pressure as may arise in the event of damage to the cable sheath but which will permit relative sliding movement of the cellular plastics insulated conductors over one another during such bending of the cable as occurs during manufacture and installation of the cable, the layer or layers of insulating tape being impregnated with the water impermeable medium and constituting a barrier to the ingress of water.

2. A telecommunication cable comprising two or more cable units laid up together and enclosed in a water-proof sheath, each cable unit comprising a multiplicity of conductors each having a dielectric of plastics material of cellular form, one or more layers of insulating tape surrounding the multiplicity of conductors, the or each layer comprising a tape applied longitudinally to and folded transversely around the multiplicity of conductors with an overlap and, filling the interstices between these insulated conductors and between the insulated conductors and the layer or layers of insulating tape from end to end of the cable

unit length, a water-impermeable medium which will not drain under the influence of gravity or such hydrostatic pressure as may arise in the event of damage to the cable sheath but which will permit relative sliding movement of the cellular plastics insulated conductors over one another during such bending of the cable as occurs during manufacture and installation of the cable, the layer or layers of insulating tape being impregnated with the water impermeable medium and constituting a barrier to the ingress of water.

3. A telecommunication cable as claimed in Claim 2, wherein the transversely folded tape or tapes is or are retained in place by means of a binder applied helically about the cable unit.

4. A telecommunication cable as claimed in Claim 3, wherein the binder comprises a plastics tape.

5. A telecommunication cable as claimed in any one of the preceding Claims, wherein the insulating tape or tapes is or are of paper.

6. A telecommunication cable as claimed in Claim 5, wherein the paper is an extensible Kraft paper having an elongation at break in the region of 7 to 8%.

7. A telecommunication cable as claimed in any one of the preceding Claims, wherein the conductors are of aluminium or an aluminium-based alloy of high conductivity.

8. A telecommunication cable as claimed in any one of the preceding Claims, wherein the dielectric of the conductors is of cellular polythene, cellular polypropylene or cellular polyvinyl chloride.

9. A telecommunication cable as claimed in any one of the preceding Claims, wherein the water impermeable medium is that recited in any one of Examples (a) to (g).

10. A telecommunication cable as claimed in any one of the preceding Claims, wherein the water-impermeable medium is blended with a flame-resistant medium to render the cable flame retardant.

11. A method of manufacturing a telecommunication cable in accordance with any one of the preceding Claims, comprising: forming each of two or more cable units by introducing a water-impermeable medium into the interstices between a multiplicity of conductors, each having a dielectric of plastic material of cellular form, each layer of the conductors is being assembled, and applying to the assembled conductors one or more layers of insulating tape having a porosity such that it will become impregnated with the water-impermeable medium and will constitute a barrier to the ingress of water; laying up the cable units so formed; and enclosing the laid-up cable units in a water-proof sheath.



12. A telecommunication cable substantially as hereinbefore described with reference to and as shown in the accompanying drawing.

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