

**SELF-SUPPORTING CABLE****FIELD OF INVENTION**

The present invention relates to self-supporting cables.

**BACKGROUND OF THE INVENTION**

5 As will be evident from FI 33129 and EP 0 461 794, for instance, it is known to make aerial cables self-supporting by integrating a support line in the cable. It is also known to provide cables of improved tensile strength by embedding tension force relieving members in the cable insulation, c.f.  
10 U.S. 4,956,523. It is also known to provide a cable of high tensile strength, by placing a reinforcement comprising, e.g., glass fibre wires immediately inwards of the outer jacket; c.f. DE 17 90 251 or EP 0 268 286.

SE 8105835-6 teaches a cable that includes a shield band  
15 about each insulated conductor of the cable. The cable is not self-supporting, however.

**SUMMARY OF THE INVENTION**

One problem with known self-supporting cables is that they consist of many different insulated conductors or many  
20 different layers. This makes the cable expensive and complicated to manufacture, and in some cases difficult to install.

One object of the present invention is to provide a self-supporting cable that can withstand the strain caused by a  
25 falling tree, for instance.

Another object of the present invention is to provide a self-supporting cable of simple and inexpensive manufacture and which can be easily installed.

5 These objects are achieved in accordance with the invention with a cable that comprises at least one insulated conductor where each insulated conductor includes a conductor that has a conductor insulation. A longitudinally extending shield band provided with grooves or corresponding undulations is applied around each insulated conductor, either completely or  
10 partially. The cable includes an outer extruded jacket. As the jacket is extruded, corresponding undulations are also formed in the jacket and in the conductor insulation. The undulations on the various cable conductors grip into one another when the cable is subjected to mechanical load, so as  
15 to prevent sliding or slippage between the various conductors. This enables the load generated by the weight of the cable to be transferred inwardly to the cable conductors as an axially directed force that the conductors carry by virtue of its inherent mechanical strength among other  
20 things.

The inventive self-supporting cable has the advantages of being simple and inexpensive in manufacture and of being easily installed. Other advantages are that the cable need not be made round and that the shield bands form a mechanical  
25 protection that is particularly effective against punctiform pressures.

The invention will now be described in more detail with reference to preferred exemplifying embodiments thereof and a also with reference to the accompanying drawings.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 is a perspective view of one cable embodiment.

Figure 2 is a cross-sectional view of one cable embodiment, taken on the lines A-A in Figure 3.

5     Figure 3 is a longitudinal sectional view of one cable embodiment.

**DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS****Cable**

10     Figure 1 is a perspective view of a cable, while Figure 2 is a cross-sectional view of the same cable, from which it will be seen that the cable includes three insulated conductors 1, 2, 3. The number of conductors may be more or fewer than three. Each conductor 1, 2, 3 includes a conductor 4 and a conductor insulation 5.

15     The conductor 4 is comprised of a plurality of drawn, combined and twisted wires 11, comprised of aluminium or copper, for instance. The illustrated embodiment includes nineteen wires. Although it is possible to use only one wire 11, mechanical strength will be enhanced by using a plurality  
20     of wires. Swell yarn or swell powder may be incorporated in conjunction with combining the wires, as protection against the ingress of water. An innermost semi-conductor layer 12 is extruded around a conductor 4. An insulating layer 13 is extruded around the innermost semiconductor layer 12, and an  
25     outer semiconductor layer 14 is extruded around said insulating layer 13. The two semiconductor layers 12, 14 may be comprised of an electrically conductive plastic and the insulating layer 13 may be comprised of cross-linked

polyethene (PEX). The three layers 12, 13, 14 make up the conductor insulation 5.

The cable conductors 1, 2, 3 are twisted, or twined, so as to enhance their mechanical strength. Each insulated conductor 1, 2, 3 is partially embraced by a shield band 6. Poorer mechanical strength can be expected when only one insulated conductor 1 is used and the shield band 6 should, in this case, fully embrace the conductor 1.

Although there will preferably be used one shield band 6 with each conductor 1, it is conceivable to use more or fewer shield bands 6 than the number of conductors 1 present.

The shield band 6 includes undulations 22, 23 such as grooves or the like that extend essentially tangentially and that are comprised, for instance, of a fabric of tin-plated copper wires. Alternatively, grooved metal foil or undulating copper wires between plastic foils may be used.

A jacket 7 is extruded around all conductors 1, 2, 3. The jacket 7 may conveniently be comprised of a strong polyethene or some other material with low cold-flow, so as to avoid deformation of the jacket in the passage of time. The material will also preferably have a certain degree of elasticity that will provide flexibility, see below.

The shield band 6 is sufficiently rigid in its radial direction to enable the undulations 22 thereon to be reproduced on the inner surface of the jacket 7, these undulations being referenced 21; see Figure 3. Grooves 24 are also preferably formed on the outer semiconductor layer 14, and hence this layer must be relatively soft. The outer semiconductor layer 14, however, must be sufficiently strong

to be prevent it from being easily broken, and it may also be strippable. These criteria are satisfied when the outer semiconductor layer 14 includes an inner relatively hard layer and an outer softer layer.

- 5 The shield bands 6 will also preferably be soft in an axial direction, so as to result in a flexible cable and so that the outermost semiconductor layers 14 will not be crushed when the cable bends or is subjected to load.

On the one hand the undulations 21 on the jacket 7 and the  
10 undulations 22 and on the other hand the undulations 23 on the shield bands and the undulations 24 on the outer semiconductor layers firmly grip in one another when the cable is subjected to load. This prevents undesired slippage or creepage between the different cable conductors, therewith  
15 enabling the jacket 7 to be extruded around the conductors more loosely than would otherwise have been necessary. The resultant cable is thus more flexible than it would have been in the absence of said undulations. This is because the jacket 7 is able to slide against the shield bands 6 to some  
20 extent, in the absence of load on the cable. This sliding of the jacket 7 is made possible because the undulations 21 on the jacket 7, which is slightly elastic, "jump" in the undulations 22 on the shield bands 6. Corresponding "jumps" can also occur between the shield band undulations 23 and the  
25 undulations 24 on the outer semiconductor layers. This is desirable, because undesirable tension and compression forces would otherwise occur as the cable is bent. Because the undulations 21, 22, 23, 24 are in mutual engagement after the cable has been bent, the extent to which the cable "springs  
30 back" when the bending force is relieved will be reduced.

The self-supporting capacity of the cable is achieved by virtue of the mutual engagement of on the one hand the jacket undulations 21 and the shield band undulations 22, and on the other hand the shield band undulations 23 and the undulations 24 on the outer semiconductor layers, when a weak radially acting compressive force is applied on cable fixing or installation points. This enables the gravitational force acting on the cable between the cable fixing or installation points as an axially acting force to be transmitted into the conductors 4 in the absence of sliding or slippage between the different cable layers, wherewith the cable becomes self-supporting by virtue of the inherent mechanical strength of the conductors 4.

The aforescribed use of shield bands 6 obviates the need for filling in order to maintain the integrity of the shield construction. The aforescribed use of shield bands 6 also enables the cable to be given for example a triangular cross-sectional shape, as shown in Figure 1, instead of needing to be round. When desiring a more watertight cable, the empty spaces 15 may be filled with swell yarn or swell powder.

#### **Cable manufacture**

In one method of manufacture, an electro-refined aluminium rod is first drawn to a wire of suitable diameter or thickness, preferably 2-3 mm. A plurality of wires 11, preferably 19 in number, are then brought together and twisted or twined to form a conductor 4, optionally with the inclusion of swell yarn 16 or swell powder.

The conductor 4 is then fed into an extruder in which three insulation layers 12, 13, 14 are extruded simultaneously on

the conductor 4. The thus produced cable conductor 1 is then cooled with water and thereafter wound onto a drum.

Three cable conductors 1, 2, 3 are then delivered to a cabling machine in which each of said conductors is provided with a respective shield band 6, whereafter the cable assembly is twisted about its longitudinal axis. The shield bands 6 are held in position by locking said bands securely at regular intervals with the aid of a thread or wire 31, preferably a non-spun thread, or a strip 31 of some suitable material. The strip 31 will preferably be made of a material similar to the jacket material, so that the strip is able to fuse into the jacket as the jacket is extruded thereon. Alternatively, metal strips or the like may be used.

The twisted or twined cable conductors 1, 2, 3 are then fed to another extruder, in which a jacket 7 is extruded at a pressure with which the shield band undulations 22 will be reproduced on the inner side of the jacket 7 in the form of undulations 21. It is also preferred to form undulations 24 on the outer semiconductor layer 14 at this stage of manufacture. The tightness with which the jacket is extruded on the cable conductors is a question of balance. If the jacket is extruded too tightly, the cable will become very rigid and "jumping" of the undulations 21, 22 over one another becomes difficult, as will be evident from the foregoing.

The manufactured cable is then cooled and wound onto a drum.



## CLAIMS

1. A self-supporting cable comprising at least one insulated conductor (1, 2, 3) that includes a conductor (4) having at least one wire (11) and a conductor-insulation (5),  
5 at least one longitudinally extending shield band (6), and a jacket (7), characterized in that each shield band (6) is provided with undulations (22, 23) that extend generally tangentially, and is radially rigid; and in that the jacket (7) has undulations (21) that correspond to the shield band  
10 undulations (22), wherein said jacket undulations (21) and said shield band undulations (22) grip into one another in response to relatively low radially acting pressure forces on the cable fixing points, such that tension forces and gravitational forces acting on the cable between said fixing  
15 points can be transmitted into the conductors (4) as an axially extending force in the absence of slippage between the different cable layers, wherewith the cable becomes self-supporting by virtue of the intrinsic mechanical strength of the conductors (4).
- 20 2. A self-supporting cable according to Claim 1, characterized in that the insulation (5) on said at least one conductor is comprised of an inner semiconductor layer (12), an insulating layer (13), and an outer semiconductor layer (14), wherein the inner and outer semiconductor layers (12,  
25 14) are preferably comprised of an electrically conductive plastic; and in that the outer semiconductor layer (14) includes undulations (24) that correspond to the shield band undulations (23), wherein the undulations (24) on the outer semiconductor layer grip with the shield band undulations  
30 (23) in response to pressure that acts radially on the cable.



3. A self-supporting cable according to Claim 2, characterized in that the outermost semiconductor layer (14) includes an inner relatively hard layer and an outer layer that is softer than said inner layer.
- 5 4. A self-supporting cable according to any one of Claims 2-3, characterized in that the shield band (6) has low rigidity in its axial direction, such as to provide a flexible cable.
- 10 5. A self-supporting cable according to any one of Claims 1-4, characterized in that the at least one shield band (6) is comprised of a woven metal wire fabric, preferably a woven fabric consisting of tin-plated copper wires.
- 15 6. A self-supporting cable according to any one of Claims 1-4, characterized in that said at least one shield band (6) includes undulating metal wires, preferably copper wires, disposed between plastic foils.
7. A self-supporting cable according to any one of Claims 1-4, characterized in that said at least one shield band (6) includes undulating metal foil.
- 20 8. A self-supporting cable according to any one of Claims 1-7, characterized in that the jacket undulations (21) grip in shield band undulations (22); and in that the elasticity of the jacket (7) is such as to enable the jacket undulations (21) to "jump" in the shield band undulations (22) as the
- 25 cable bends.
9. A method of manufacturing a self-supporting cable comprising at least one insulated conductor (1, 2, 3) that includes a conductor (4) having at least one wire (11) and a conductor-insulation (5), at least one longitudinally



extending shield band (6) that has essentially tangentially extending undulations (22, 23), and a jacket (7), comprising the steps of applying a shield band (6) around said at least one insulated conductor (1, 2, 3), either completely or  
5 partially, and locking said band in place; and extruding the jacket (7) around said shield band (6) with a degree of tightness that is sufficient to reproduce the shield band undulations (21) in the inner surface of the jacket (7).

10. A method of manufacturing a self-supporting cable  
10 according to Claim 9, characterized by extruding the jacket (7) around the shield band (6) with a degree of tightness that is sufficient to reproduce the shield band undulations (24) in the outer surface of the conductor-insulation (5).

11. A method of manufacturing a self-supporting cable in  
15 accordance with any one of Claims 9-10, characterized by locking the shield band (6) in place by means of a single wire.

12. A method of manufacturing a self-supporting cable in accordance with any one of Claims 9-10, characterized by  
20 locking the shield band (6) in place by means of a metal strip.

13. A method of manufacturing a self-supporting cable in accordance with any one of Claims 9-10, characterized by locking the shield band (6) in place with the aid of a strip  
25 of material that is similar to the jacket material, so that the strip will fuse with the jacket as the jacket is extruded on said strip.

14. A method of manufacturing a self-supporting cable in accordance with any one of Claims 9-13, characterized by



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extruding the jacket (7) around the shield band (6) to a balanced degree of tightness at which the jacket undulations (21) are able to "jump" in the shield band undulations (22) as the cable bends and at which spring-back of a bent cable is minimized by virtue of mutual gripping engagement of the jacket undulations (21) and the shield band undulations (22).