Cable and method of manufacturing a cable

The invention relates to a cable (100) comprising at least one primary electrical conductor (102), wherein said primary electrical conductor (102) has a basically tubular shape, and wherein said cable (100) comprises at least one rip cord (120) which is arranged in a radially inner section (102a) of said primary electrical conductor (102).

Fig. 1a
The present invention relates to a cable comprising at least one primary electrical conductor, wherein said primary electrical conductor has a basically tubular shape.

The present invention also relates to a method of manufacturing a cable of the aforementioned type.

Conventional cables of the aforementioned type require a comparatively complex configuration and installation procedure. For example, if a cable of the aforementioned type, e.g. a coaxial cable, is to be installed in the field, a rather complicated installation procedure is required which increases costs. Particularly, precisely removing parts of a primary electrical conductor with tubular shape such as an outer conductor of a coaxial cable, without damaging radially inner layers of the cable is very difficult.

Moreover, the quality of the installation and the reliability of the installed cable significantly depend on the quality of the workmanship.

Thus, it is an object of the present invention to provide an improved cable and an improved method of manufacturing a cable, which enable an easy and efficient installation of the cable even in the field.

Regarding the aforementioned cable, according to the embodiments, this object is achieved by said cable comprising at least one rip cord which is arranged in a radial inner section of said primary electrical conductor.

This advantageously enables to sever portions of the electrical conductor so that the electrical conductor can easily be removed from the remaining components of the cable. For example, the cable may comprise further components such as further conductors or optical fibres or the like which are comprised in a radially inner section with respect to the primary electrical conductor. In many cases, it is rather difficult to provide a circumferential cut only within said primary electrical conductor and to axially remove the piece of the conductor that has been separated from the rest of the cable by such cutting, i.e. by shifting it over the end portion of the cable. In some cases, especially with hybrid cables comprising pre-configured optical fibres which are provided at their ends with fibre connectors, it is impossible to shift the primary electrical conductor over the optical fibre connectors because the aggregated cross-section of the optical fibres’ connectors is larger than the free cross-section of the primary electrical conductor with its tubular shape.

Thus, the principle of the present embodiments, which enables to sever the primary electrical conductor, especially to provide a cut or a slit which extends substantially in an axial direction with respect to the cable, advantageously enables to remove the so cut out or severed primary electrical conductor from the cable without the requirement of shifting it over an end portion of the cable. According to applicant’s analysis, the principle according to the embodiments may even be applied to cables with electrical conductors that have a comparatively large wall thickness. Thus, advantageously, by severing the respective conductor in a basically axial direction, an easy removal of the electrical conductor from the rest of the cable is enabled, which greatly facilitates installation of a cable in the field.

According to a preferred embodiment, said at least one rip cord is suitable for splitting (i.e., severing) at least a portion of the primary electrical conductor and/or for splitting at least a portion of a component of said cable which is arranged radially outward of said primary electrical conductor. The splitting is preferably effected along a substantially axial direction with respect to the cable.

I.e., according to a further aspect of the embodiments, not only the primary electrical conductor itself may be severed by means of the rip cord, but also further layers of the cable which may e.g. surround the primary electrical conductor. Thus, by using the same rip cord, both the primary electrical conductor and potentially surrounding material such as an electrically isolating jacket or filling material and the like may be slitted or severed.

According to a further embodiment, more than one rip cord is arranged in a radially inner section of the primary electrical conductor, which enables to define various, preferably basically axial, slits within the electrical conductor. Thus, a basically tubular shaped electrical conductor may e.g. be cut into two pieces along a specific axial section of the cable whereby these pieces may easily be removed by pulling them away from the cable in a basically radial direction. For example, with a preferred embodiment, two rip cords are arranged in a radial opposite position, i.e. with a respective angular distance of about 180 degrees. Thus, by pulling both rip cords, the tubular shaped electrical conductor may be cut into two basically identical pieces each of which has the shape of a half portion of a hollow cylinder.

Of course, providing more than two rip cords in a radially inner section of a conductor is also possible according to further embodiments, whereby the conductor and its radially outward surrounding layers may be slitted into even smaller pieces for facilitating removal of these pieces.

According to still a further embodiment, at least two rip cords are arranged in said radially inner section of the primary electrical conductor with a relative angular distance of about 100 degrees to about 180 degrees, which facilitates removing the primary electrical conductor in respective sections of the cable.

According to a further embodiment, said cable
comprises at least one further electrical conductor, wherein said further electrical conductor has a basically tubular shape and is arranged substantially coaxial with respect to the primary electrical conductor (i.e., radially inside or radially outside thereof), and wherein at least one rip cord is provided which is arranged in a radially inner section of said further electrical conductor. Thus, also said further electrical conductor may advantageously be severed according to the principle of the embodiments, i.e., for a plurality of coaxially arranged electrical conductors of the cable, at least one respective rip cord may be provided within a radially inner section of the respective electrical conductor so that each of said conductors may be severed by applying a tensile force to the respective rip cord.

[0016] According to a further embodiment, there are two or more coaxially arranged electrical conductors, which may e.g. have a tubular shape each, and there is provided at least one rip cord only within a radially inner section of the radially innermost electrical conductor. In this way, no further rip cords have to be provided between the innermost electrical conductor and the further, radially outer conductors, while severing of all of said electrical conductors is possible by using one or more of the rip cords comprised within the radially inner section of the innermost electrical conductor.

[0017] According to a further embodiment, a wall thickness of at least one of said electrical conductor ranges from about 0.1 mm (millimeter) to about 2.0 mm, preferably from about 0.2 mm to about 0.8 mm. Applicant’s analysis has shown that it is possible to provide rip cords which are strong, i.e. stable, enough to provide tensile forces sufficient for severing even massive metallic electrical conductors of the aforementioned wall thickness ranges. According to further embodiments, by providing a suitably robust rip cord, even electrical conductors having larger wall thicknesses may be precisely severed.

[0018] According to a further embodiment, at least one of said electrical conductors of the cable comprises at least one length section that is corrugated, which enables easy bending and adaptation of the cable to a specific target system or mounting situation. According to applicant’s analysis, even corrugated electrical conductors may efficiently be severed by using one or more rip cords according to the embodiments.

[0019] According to a further advantageous embodiment, at least one of the rip cords comprises a length marking which visually indicates an axial length coordinate of said rip cord or said cable comprising the rip cord, respectively, which facilitates on-site installation of the cable. Advantageously, by evaluating the length marking of a rip cord that is pulled out of the cable according to the embodiments for severing one or more electrical conductors or further layers of the cable, a precise length of the already severed portion may be assessed by a craftsman without requiring further measurement equipment.

[0020] According to a further embodiment, at least one component of the cable, preferably at least one isolating jacket, comprises one or more bulges, which preferably extend radially outward from a radially outer surface of said isolating jacket. In the alternative, or additionally, one or more bulges may also extend radially inward from a radially inner surface of a respective component of the cable comprising said bulges.

[0021] The bulges advantageously allow easy manufacturing of the cable even with overlapping tolerance ranges of the various components of the cable without the risk of loosing axial friction force between the several coaxially arranged components of the cable. This is particularly important in such situations where the cable is to be installed in a vertical orientation, i.e. at an antenna tower of a base station of a cellular communications system and the like. In this case, an axial displacement of the different components of the cable would be disadvantageous. Thus, the bulges according to the embodiments prevent an axial relative displacement of the various components of the cable with respect to each other.

[0022] According to a further preferred embodiment, one or more bulges are provided in combination with using at least one corrugated electrical conductor, whereby said bulges advantageously cooperate with the corrugations of the electrical conductor to prevent an axial displacement of the components with respect to each other.

[0023] According to a further embodiment, two bulges are provided with an angular distance to each other of about 20 degrees or less, wherein a rip cord is arranged between said two bulges, which has the advantage that the rip cord stays at a specific position between said bulges, i.e. is locked in a circumferential position. Optionally, a radially outward layer of the cable may also comprise one or more material weakenings arranged close to the rip cord (e.g., in an axial fashion) or the angular center position between said bulges, whereby a particularly precise and easy removal of outer layers of the cable (both conducting and nonconducting) may be achieved.

[0024] A further aspect of the cable according to the embodiments is given by a cable which comprises at least one primary electrical conductor and an electrically isolating jacket, wherein said isolating jacket comprises one or more bulges, which preferably extend radially outward from a radially outer surface of said isolating jacket. Alternatively or in addition, bulges extending radially inward may also be provided. Especially, with this embodiment, it is not necessary to provide one or more rip cords within said cable.

[0025] Yet another solution to the object of the present is given by a method of manufacturing a cable, wherein
said method comprises the steps of providing at least one primary electrical conductor, wherein said primary electrical conductor has a basically tubular shape, and arranging at least one rip cord in a radially inner section of said primary electrical conductor.

According to a preferred embodiment, said at least one rip cord is arranged at a radially inner surface of the primary electrical conductor so that the primary electrical conductor can swiftly be severed or slitted by pulling out the rip cord of the cable.

**Brief description of the figures**

Further features, aspects and advantages of the present invention are given in the following detailed description with reference to the drawings in which:

- **Figure 1a** schematically depicts a cross-sectional view of a cable according to a first embodiment,
- **Figure 1b** schematically depicts the cable of figure 1a with an end portion of a rip cord pulled out,
- **Figure 2a** schematically depicts a cable according to a further embodiment having two rip cords,
- **Figure 2b** schematically depicts a cross-sectional view of a cable according to a further embodiment having three rip cords,
- **Figure 3** schematically depicts an operational scenario according to an embodiment,
- **Figure 4** schematically depicts a partially cross-sectional view of a cable according to a further embodiment,
- **Figure 5a to 5c** each schematically depict cross-sectional views of a cable according to further embodiments,
- **Figure 6** schematically depicts a cross-sectional detailed view of a rip cord according to an embodiment,
- **Figure 7** schematically depicts a side view of a cable according to a further embodiment, and
- **Figure 8** schematically depicts a simplified flow-chart according to an embodiment.

**Description of the embodiments**

**Figure 1a** schematically depicts a cross-sectional view of a cable 100 according to a first embodiment. The cable comprises a primary electrical conductor 102, which has a basically tubular shape, i.e. the shape of a hollow cylinder, presently a hollow circular cylinder.

**Figure 1b** depicts an operational state of the cable 100 of figure 1a, wherein an end portion of a rip cord 120 has been extracted from the cable 100, i.e. by manually pulling out said end portion 120’. By further pulling said rip cord 120, i.e. at its end
portion 120', for example in a radial outward direction (or in an axial direction directed into the drawing plane of Fig. 1b, or combinations thereof), the conductor 102 can be severed by means of the rip cord 120 thus defining a basically axial opening in the conductor 102 (figure 1a) which facilitates removing a corresponding portion of the conductor 102. Thus, access to radially inner components of the cable 100 (not shown in figure 1b) can be gained, i.e. for installation purposes and the like.

[0040] Figure 2a depicts a further embodiment 100a of a cable, which comprises a primary electrical conductor 102. A jacket 104 made of electrically isolating material is arranged radially outward of said conductor 102 to provide an electrical isolation of the conductor 102 with respect to the surroundings of the cable 100a.

[0041] As can be seen from figure 2a, the cable 100a comprises two rip cords 120a, 120b, either one of which can be used, i.e. pulled out, for slitting the conductor 102, and optionally also the isolating jacket 104. Thus, the components 102, 104 may efficiently be severed, or slitted, respectively, by using a respective one of said rip cords 120a, 120b.

[0042] However, when using both rip cords 120a, 120b, corresponding axial slits may be provided at both respective positions of the cable 100a, presently at radially opposing positions. Thus, an axial length section of the cable 100a, which is slitted by using the rip cords 120a, 120b can easily be "peeled off" due to the openings O1, O2 (figure 3) defined by the rip cord. Figure 3 depicts an operational state of the cable 100a of figure 2a after severing the components 102, 104 of the cable 100a. As can be seen from figure 3, using both rip cords 120a, 120b for defining the openings O1, O2 results in obtaining separated end portions 100', 100" of the cable 100a (figure 2a), which can easily be removed without the requirement of shifting a tubular segment of the conductor 102 or of the jacket 104 over the cable end. This is particularly important if the cable 100a comprises e.g. pre-configured optical fibres (not shown) with optical connectors already attached to the end portion of the optical fibres and the like.

[0043] Figure 2b depicts an embodiment of a cable 100b with three rip cords 120a, 120b, 120c, which are arranged with an angular distance of about 120 degrees between each other.

[0044] Figure 4 depicts a further cable 100c according to the embodiments.

[0045] Similar to the cables 100, 100a explained above with reference to figure 1a, figure 2a, the cable 110 according to figure 4 comprises a primary electrical conductor 102 with a basically tubular shape. Radially outward of said primary electrical conductor 102, an isolating jacket 104 is arranged which provides electrical isolation of the conductor 102 with respect to an area surrounding the cable 100c.

[0046] Radially inwards of said primary electrical conductor 102, a further jacket 106 of isolating material is provided. Radially inward of said further jacket 106, a second electrical conductor 108 is provided. Radially inward of said second electrical conductor 108, a filling component 110 is provided. Said filling component 110 may e.g. comprise foam material 110a or another, preferably electrically isolating, material.

[0047] At a core, the cable 100c comprises a plurality of optical fibres 114b, which are arranged in a filler material 114a protecting said optical fibres 114b. The components 114a, 114b define an optical cable 114 which at its radially outer section comprises a corresponding jacket material 112 that contacts the foam material 110a.

[0048] A first set of rip cords 120a, 120b is provided at a radially inner surface of the primary electrical conductor 102, wherein these rip cords 120a, 120b facilitate severing the components 102, 104 at the respective angular positions of the cable 110c.

[0049] Thus, by pulling out the rip cords 120a and/or 120b, the layers 102, 104 of the cable 100c may be slitted, i.e. for accessing the radially inner second electrical conductor 108 or the like.

[0050] A second set of rip cords 122a, 122b is provided at a radial outer surface of the jacket 112 of the optical cable 114. These further rip cords 122a, 122b facilitate severing the layers 110, 108, since they originate from a radially inner section 108a of the conductor 108, but may also be used for further severing the further radially outer layers 102, 104.

[0051] Other numbers of rip cords 120a, 120b, 122a, 122b and/or other angular positions or distances between adjacent rip cords within the cable 100c and the like are also possible.

[0052] Advantageously, by using a single one or both of the rip cords 120a, 120b, the outer layers 102, 104 of the cable 100c may be removed for a predetermined axial section of the cable 100c. Upon this removal, the further layers 106, 108, 110, 112, 114 of the cable may be accessed. Especially, when further using the rip cords 122a, 122b after having slitted the layers 102, 104, access to the optical cable 114 can be gained.

[0053] In any case, due to the basically axial slitting enabled by means of the rip cords, the separated portions of the cable 100c may be removed in a radially outer direction with respect to the cable 100c so that no tubular piece of any of the cut-off components 104, 102, 106, 108, 110 is required to be shifted in an axial direction over an end of the cable 100c, which facilitates installation of the cable.

[0054] Particularly, the cable 100c may comprise an optical cable 114 the optical fibres 114b of which are already pre-configured in that respective end portions of the optical fibres 114b comprise optical connectors 114c as depicted by figure 7. In this case, at least for a comparatively large number of optical fibres and already attached connectors 114c, it would be impossible to shift a tubular section of the cable over the optical fibres 114b with the attached connectors 114c, because the aggregated cross-section of the connectors 114c would exceed the free cross-section of any tubular component of
the cable. Thus, advantageously, as also depicted by figure 7, the rip cords 120a', 120b' may be used for applying axial slits to the cable. For this, particularly, the end portion 120a', 120b' may be grasped or applied to a winding tool and respective tensile forces may be applied to the rip cords 120a, 120b for slitting the outer layers of the cable. After this, i.e. if a predetermined section of the outer layers of the cable has been slitted or severed in this way, the slitted components may be removed in a radially outer direction, particularly without pulling over these pieces over the connectors 114c.

[0055] Thus, even pre-configured hybrid cables comprising an optical cable 114 and one or more electrical conductors 102, 108 (figure 4) may easily be conditioned for installation in the field, even if the optical fibres 114b of the optical cable 114 are already pre-configured in that they comprise spacious optical connectors and their ends. Figure 8 depicts a simplified flow chart of a method of manufacturing a cable according to an embodiment. In a first step 200, at least one primary electrical conductor 102 (figure 1a) is provided, wherein said primary electrical conductor 102 has a basically tubular shape.

[0056] In step 210 (figure 8), at least one rip cord 120 (figure 1a) is arranged in a radially inner section 102a of said primary electrical conductor 102.

[0057] Figure 5a depicts a further embodiment 100d. The cable 100d comprises a primary electrical conductor 102 and a second electrical conductor 108 arranged coaxially with respect to each other. As already mentioned above, especially the wall thicknesses of the layers are not necessarily drawn to scale for the sake of clarity. In a range, which is radially in between the conductors 102, 108, an isolating jacket 106 is provided. On a radially outer section of said isolating jacket 106, one or more bulges 130 (presently four bulges) are provided. The bulges 130 extend radially outward, i.e. in the direction of the radially inner surface of the primary electrical conductor 102. With respect to the manufacturing tolerances of the components 102, 106, 108 the bulges 130 are configured such that they may contact the radial inner surface of the conductor 102, whereby a friction force is effected which reduces a tendency of the components 102, 106 to be displaced with respect to each other in an axial direction of said cable 100d. This greatly facilitates mounting of the cable 100d particularly in a vertical orientation.

[0058] According to a further preferred embodiment, the conductor 102 may be a corrugated conductor so that the bulges 130 can cooperate with corresponding cavities of the corrugations of the conductor 102 to provide a positive locking between the components 106, 102 which prevents relative axial displacement.

[0059] Figure 5b depicts a further embodiment 100e. The cable 100e is similar to the configuration of figure 5a, however, in addition to the bulges 130, the cable 100e depicted by figure 5b also comprises rip cords 120a, 120b which are provided at a radially inner surface of the primary conductor 102 (figure 5a) thus enabling to sever the conductor 102 and optionally also the isolating jacket 104.

[0060] According to further embodiments, the cables depicted by figure 1a to figure 4 may also comprise at least one electrical conductor 102, 108, which is corrugated or comprises at least some longitudinal portions that are corrugated. According to yet further embodiments, the cables depicted by figure 1a to figure 4 may also comprise at least one bulge 130, either extending radially inward or outward from any of their layers.

[0061] Figure 5c depicts a further embodiment of a bulged cable 100e with rip cords 120a, 120b, wherein a non-vanishing distance between neighboring layers 102, 106 (Fig. 5a) is provided to define a free volume 116 of basically hollow cylinder shape. The bulges 130 extend through this free volume 116 and make contact with a radially inner surface of layer 102 (Fig. 5a) to prevent axial relative movement.

[0062] Further, the rip cords 120a, 120b are also arranged within said free volume 116, which enables to provide rip cords 120a, 120b with rather large diameters due to the free space of volume 116.

[0063] Figure 6 depicts a detail view of a further embodiment, wherein neighbouring bulges 130a, 130b are arranged such that a rip cord 120 may be arranged between the bulges 130a, 130b, whereby the rip cord 120 is advantageously secured at its intermediate position between the bulges 130a, 130b.

[0064] As can be seen, again, the bulges 130a, 130b are arranged on a radially outer surface 106a of a jacket 106. However, according to further embodiments, either with rip cords or without rip cords, bulges as depicted by figure 5a to figure 6 may also be arranged on radially inner surfaces of components of the cable.

[0065] Also, according to a further preferred embodiment, the bulges 130, 130a, 130b are made of the same material as the jacket on which they are arranged. Preferably, the bulges may be an integral part of the jacket material, i.e. jacket and bulge are one piece of material.

[0066] According to a further embodiment, bulges may also be formed in the conductors 102 and/or 108.

[0067] According to a further embodiment, at least onerip cord with non-uniform diameter over its length coordinate may also be provided, whereby length sections having a larger diameter may provide a similar effect to that of the bulges 130, i.e. providing friction force between radially neighboring layers between which the rip cord is arranged. In this case, an axial displacement of the layers may be prevented without providing bulges.

[0068] Of course, another number of conductors and/or isolating jackets and/or optical cables or optical fibres and the like may be provided within the cable according to the embodiments.

[0069] The cable according to the embodiments and the manufacturing method according to the embodiments eases a manufacturing process as elements (bulges) may be incorporated that compensate for typical manufacturing tolerances.
Moreover, the proposed solution enables a cable design where the number of factory connectorized optical fibres 114b is almost independent of the diameter of surrounding coaxial electrical conductors 102, 106. This particularly guarantees a very easy handling of over-lengths in the field, i.e. when a cable is to be installed. A specific length portion of the cable or its electrical conductors and electrically isolating jackets, which is not required at the specific installation site, may easily be removed by using the rip cord(s) according to the embodiments, and this process does not interfere with any number of already connected, i.e. pre-configured optical fibres.

The cable according to the embodiments, i.e. according to figure 4 especially, may e.g. be used to connect remote radio heads of base stations of cellular communications systems to signal processing units, wherein said remote radio heads are usually mounted on an antenna tower or a building top or the like, and wherein the further base station equipment may be located on the ground nearby or even remote to the antenna tower.

For example, the cable according to figure 4 advantageously enables electric power supply by means of its two electrical conductors 102, 108, and furthermore data transmission between the remote radio head (not shown) and the base station equipment is facilitated by a predetermined number of optical fibres in the form of the optical cable 114, which is integrated into the electrical conductors 102, 108 and which is protected thereby from mechanical and electrical influences.

The description and drawings merely illustrate the principles of the invention. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the principles of the invention and are included within its spirit and scope. Furthermore, all examples recited herein are principally intended expressly to be only for pedagogical purposes to aid the reader in understanding the principles of the invention and the concepts contributed by the inventor(s) to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions. Moreover, all statements herein reciting principles, aspects, and embodiments of the invention, as well as specific examples thereof, are intended to encompass equivalents thereof.

It should be appreciated by those skilled in the art that any block diagrams herein represent conceptual views of illustrative circuitry embodying the principles of the invention. Similarly, it will be appreciated that any flow charts, flow diagrams, state transition diagrams, pseudo code, and the like represent various processes which may be substantially represented in computer readable medium and so executed by a computer or processor, whether or not such computer or processor is explicitly shown.

Claims

1. Cable (100) comprising at least one primary electrical conductor (102), wherein said primary electrical conductor (102) has a basically tubular shape, and wherein said cable (100) comprises at least one rip cord (120) which is arranged in a radially inner section (102a) of said primary electrical conductor (102).

2. Cable (100) according to claim 1, wherein said at least one rip cord (120) is suitable for splitting at least a portion of said primary electrical conductor (102) and/or for splitting at least a portion of a component of said cable (100) which is arranged radially outward of said primary electrical conductor (102), wherein said splitting is effected along a substantially axial direction with respect to said cable (100).

3. Cable (100) according to one of the preceding claims, wherein at least one rip cord (120a, 120b, 120c) is arranged in a radially inner section (102a) of said primary electrical conductor (102).

4. Cable (100) according to claim 3, wherein at least two rip cords (120a, 120b) are arranged in said radially inner section (102a) of said primary electrical conductor (102) with a relative angular distance of about 90 degrees to about 180 degrees.

5. Cable (100) according to one of the preceding claims, wherein said cable (100) comprises at least one further electrical conductor (108), wherein said further electrical conductor (108) has a basically tubular shape and is arranged substantially coaxial with respect to the primary electrical conductor (102), and wherein at least one rip cord (122a, 122b) has a basically tubular shape, and wherein said cable (100) comprises at least one rip cord (120a, 120b) which is arranged in a radially inner section (108a) of said further electrical conductor (108).

6. Cable (100) according to claim 5, wherein said further electrical conductor (108) is arranged radially inward of said primary electrical conductor (102).

7. Cable (100) according to one of the preceding claims, wherein an electrically isolating jacket (106) is provided radially outward of an electrical conductor (108) of said cable (100), and wherein at least one rip cord (120a, 120b) is arranged on a substantially outer surface of said isolating jacket (106).

8. Cable (100) according to one of the preceding claims, wherein a wall thickness of at least one of said electrical conductors (102, 108) ranges from about 0.1 mm to about 2.0 mm.

9. Cable (100) according to one of the preceding claims, wherein at least one of said electrical conductors (102, 108) comprises at least one length sec-
tion that is corrugated.

10. Cable (100) according to one of the preceding claims, wherein at least one of said rip cords (120a, 120b, 120c) comprises a length marking.

11. Cable (100) according to one of the preceding claims, wherein at least one component (106) of said cable (100), comprises one or more bulges (130, 130a, 130b), which extend radially outward from a radially outer surface (106a) of said at least one component (106).

12. Cable (100) according to claim 11, wherein two bulges (130a, 130b) are provided with an angular distance to each other of about 20 degrees or less, wherein a rip cord (120) is arranged between said two bulges (130a, 130b).

13. Cable (100) comprising at least one primary electrical conductor (102) and an electrically isolating jacket (106), wherein said isolating jacket (106) comprises one or more bulges (130, 130a, 130b), which preferably extend radially outward from a radially outer surface (106a) of said isolating jacket (106).

14. Method of manufacturing a cable (100), comprising the steps of providing (200) at least one primary electrical conductor (102), wherein said primary electrical conductor (102) has a basically tubular shape, and arranging (210) at least one rip cord (120) in a radially inner section (102a) of said primary electrical conductor (102).

15. Method according to claim 14, wherein said at least one rip cord (120) is arranged at a radially inner surface of said primary electrical conductor (102).
## DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document with indication, where appropriate, of relevant passages</th>
<th>Relevant to claim</th>
<th>CLASSIFICATION OF THE APPLICATION (IPC)</th>
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<tr>
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<td>WO 92/10840 A1 (RAYCHEM LTD) 25 June 1992 (1992-06-25) * page 2, line 22 - line 24 * * page 3, line 14 - line 16 * * page 4, line 17 * * figures 1,2 *</td>
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<td>US 5 268 971 A (NILSSON RICHARD C [US] ET AL) 7 December 1993 (1993-12-07) * column 4, lines 3-4, 12-13 * * figure 1 *</td>
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The present search report has been drawn up for all claims.

Place of search: The Hague  
Date of completion of the search: 23 July 2013  
Examiner: Hillmayr, Heinrich

| CATEGORY OF CITED DOCUMENTS | T : theory or principle underlying the invention  
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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-12, 14, 15

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).
The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-12, 14, 15

   A cable comprising at least one rip cord which is arranged in a radially inner section of a primary electrical conductor, and method of manufacturing such a cable.

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2. claim: 13

   A cable comprising at electrical insulating jacket, wherein said jacket comprises one or more bulges.

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

<table>
<thead>
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