(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 431 980 A2

(12) # EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.03.2012 Bulletin 2012/12

(51) Int Cl.:
H01B 7/18 *(2006.01)* *H01B 13/10* *(2006.01)*

(21) Application number: **11306061.0**

(22) Date of filing: **23.08.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **17.09.2010 SE 1050973**

(71) Applicant: **Nexans**
75008 Paris (FR)

(72) Inventor: **Persson, Karl-Gustav**
332 92 Gislaved (SE)

(74) Representative: **Allain, Laurent et al**
Ferray Lenne Conseil
Le Centralis
63, avenue du Général Leclerc
FR-92340 Bourg-la-Reine (FR)

(54) **Cable and method of production thereof**

(57) A cable (10), including a shell (22) comprising a tube-shaped tape (24) of a material selected from a group of materials consisting of cellulose, synthetic resin or a combination thereof, a sheath (20) of synthetic resin enclosing the shell, and a cable body (12) inside the shell. According to the invention, the shell (22) has a resilience capable of yieldably resisting a compressive force from the sheath (20) when the sheath is shrinking during forming thereof, to thereby maintain a predetermined clearance (p2) to the cable body (12) and/or a resulting roundness of the sheath once the sheath has been hardened.

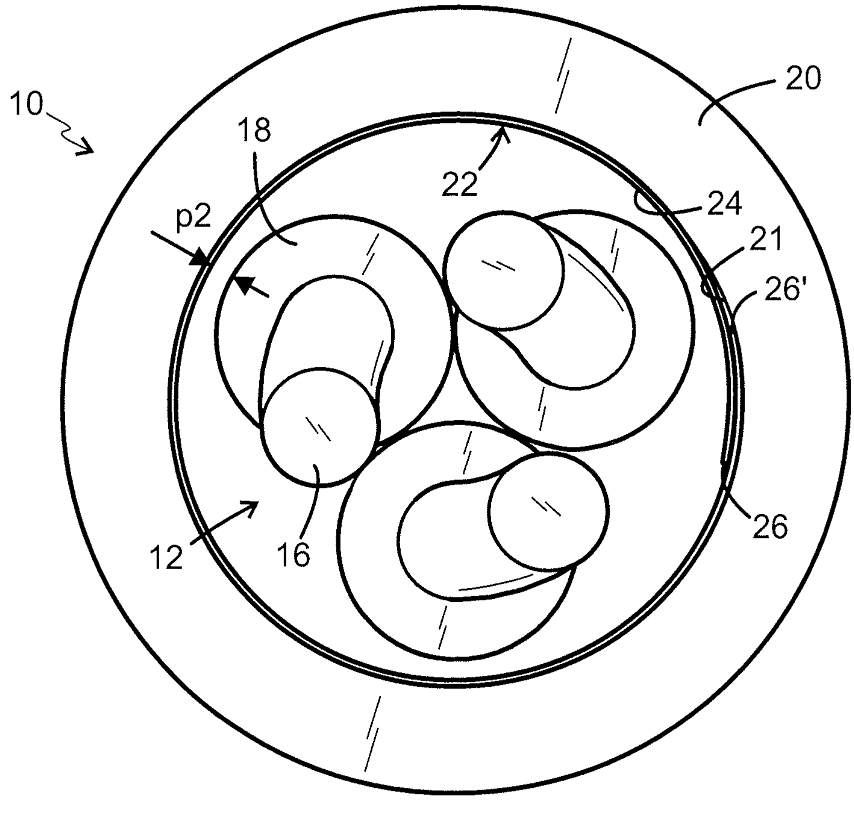

FIG. 5B

EP 2 431 980 A2

Description

TECHNICAL FIELD

[0001] This invention relates to a cable, including a shell comprising a tube-shaped tape of a material selected from a group of materials consisting of cellulose, synthetic resin or a combination thereof, a sheath of synthetic resin enclosing the shell, and a cable body inside the shell. The invention also relates to a method of producing such cable.

BACKGROUND

[0002] Cable sheaths are produced substantially by two different methods, compression extrusion and tube extrusion.

[0003] In forming a sheath by compression extrusion, a high pressure is applied to the plastics (synthetic resin / polymer) material so that when extruding the plastics material onto the cable body, all irregularities in or on the cable body are filled by the plastics material, and the outer face of the sheath becomes completely circular. An example of a cable formed by compression extrusion is shown in FIG. 1. As the cable body very rarely is completely circular, and as substantially all sheaths must have a specified thickness, depending on type of cable, it will be understood that a large amount of the sheath material is used to fill the irregularities of the cable body, and this amount may not be taken into account when the thickness of the sheath is to be determined.

[0004] In tube extrusion, another type of tool is selected for the extruder head, which tool forms a loose-fitting tube around the cable body. Due to the temperature, this tube has a quite instable consistency and may obtain an oval shape when the lower portion thereof depends from the cable body. To prevent this, the tube can be extruded with a smaller extrusion rate than the pulling rate of the cable body. In this way, the tube is stretched out and settles down around the cable body in a more form-stable manner. Such tube-extruded sheath will be uniformly thick and therefore use less material as compared to a compression-extruded sheath.

[0005] There is, however, a problem in connection with tube extrusion. As the cable body has not a precisely circular cylindrical shape, which is the usual case, nor the resulting tube-extruded sheath will be circular cylindrical. The exterior surface of the sheath will substantially follow the shape of the cable body. This behaviour is of no importance in many cable designs, but is not desirable in other cable designs. An example of such cable is shown in FIG. 2.

[0006] There is a frequently used method to obtain the circular shape of the exterior surface of the sheath. Provisions are made to give the irregular cable body a circular shape before the sheath is formed. This is accomplished by compression-extruding material onto the irregular cable body in an amount as small as possible but sufficient enough for the cable body to become circular. In this extrusion process, most often a low-cost material is used that is also easily torn off when a cable end is prepared for connection. Then the sheath may be formed on the now circular cable body. Compression or tube extrusion may be used optionally since both processes will result in a evenly thick and round sheath surface. An example of such cable is shown in FIG. 3.

[0007] There are also other methods for giving a cable body a circular shape. For example, filler strands of an inexpensive material can be positioned along the irregularities of the cable body. To keep the strands in place, the cable body can be wound concentrically, for example by a polymer, paper or textile tape, whereupon the sheath is formed on the now almost circular cable body.

[0008] Another phenomenon that is always present in cable production may be referred to as the "adhesion problem". Since both sheath and cable body comprise polymer materials, which often are of the same type, an adhesion problem arises. When the warm sheath is formed onto the cable body, the materials strive to melt together making it extremely difficult for the user when the sheath is to be stripped to expose the cable body prior to a connection operation. The adhesion also deteriorates the bending capability of the cable. Different methods are used to avoid the adhesion problem. Very often the cable body is coated by talc powder. The talc is capable of preventing adhesion. This method may be somewhat insecure when it comes to have every face of the cable body covered with talc.

[0009] Another method is to lengthwise or coaxially apply a foil of a polymer material that is not capable of adhering to the materials in question. Paper is also a useful material like any suitable textile. Also used are different polymer material additives having the task of preventing adhesion.

[0010] A cable according to the invention typically also comprise twisting or SZ twisting. To describe these processes, a typical cable may be selected. A very common cable is a so called white-cable. Such cable may include an EKK cable made of PVC, or an EQQ cable, i.e. an equivalent cable but made of another material, a so called halogen-free material. In these cables, the cable body has 2, 3, 4 or 5 solid copper conductors, each having an extruded insulation. Such insulated conductor may be referred to as a cable strand. In order that a finished cable can be bendable, the strands have to be twisted. The twisting may be accomplished by twisting the strands consistently in the same direction, cf. rope twisting. In this type of twisting, i.e. in the same direction, the process is performed in specific machinery and not in tandem with any other process. Since the EKK/EQQ cable type is sold in large quantities and accordingly is subjected to pressure on prices, the strands instead are subjected to twisting in a SZ twisting machine. The SZ twisting process can be performed in tandem with the forming of the sheath, and is therefore considered to be more rational.

[0011] SZ twisting implies that the twisting is not continually in the same direction, but in a direction changing from right to left with a small parallel distance between changes. For example, the twisting machine can go ten turns to the right and then ten turns to the left. If such a SZ twisted cable body is subjected to an excessively large tensional force in its longitudinal direction, the twisting will open so that the strands return to be parallel. To avoid this, the SZ twisted strands as soon as possible in the production line should enter a first extruder where the twisted strands are subjected to compression extrusion resulting in that the cable body obtains a circular shape. Accordingly, in addition of shaping a circular cable body, this compression extrusion also has the function of arresting the SZ twist and preventing it from opening when the cable body is subjected to a tensional force during production.

[0012] There are also other methods for arresting the SZ twist, for example winding/binding by tapes or strings.

[0013] An important property of a cable according to the invention is the stripping capability. Stripping is the work an electrician has to do on a cable end before a final connection operation. For example, when choosing a cable as described above, namely an EKK or EQQ cable, stripping of cable ends can be a very frequent operation for the electrician. A swiftly and easily performable stripping is highly appreciated by the electrician, and does not only facilitate the work but also saves costs.

[0014] Stripping of the above described cables is performed as follows: For example, when 1 m sheath is to be stripped, the electrician makes a slight cut around the sheath 1 m from the cable end. Then the electrician rocks the sheath back and forth a number of times so that the sheath cracks around the cut. Thereafter, the electrician tries to pull the 1 m length of sheath off the cable body. Most likely, the electrician is not able to pull off such a large length of sheath. The electrician, very likely, then tries to pull off a shorter length of sheath, and thereafter removes the sheath piece by piece until 1 m cable is stripped. If the talc coating is insufficient, the electrician will have problem also with a shorter length of sheath. In that case, the electrician tries to cut the sheath lengthwise with her/his knife, running the risk of compromising the integrity of the cable body.

[0015] When the sheath is stripped, the compression-extruded plastics material of poorer quality that gives the circular shape to the cable body should be removed. This can be troublesome if the used amount of talc is insufficient so that an adhesion problem is present. This layer is, however, generally quite easily removable, but the environment is usually soiled by the talc and hands tend to be rather talc-coated.

[0016] To give further background to the invention, it may be suitable to closer describe the EKK/EQQ cable mentioned above, and being an example of the type of cable to which the invention may be applied. FIG. 3 shows such cable as used today. A cable body 12 in this case comprises three cable strands 14, each having a copper conductor 16 and an insulation 18. A so called filler 17 has the function of making the cable body 12 round or circular and also of arresting the SZ twist during production. The necessary pulling force during production is transferred by the cable body 12. While FIG. 3 shows a three-strand cable, in other types of cable the cable body 12 may have many more strands 14 (not shown). By having a sufficiently number of strands 14, a more round cable body is formed, and the filler 17 may be superfluous. Otherwise a tape (not shown) may be wound coaxially around the strands 17 to retain the strands together, and thereby also to improve the roundness, but also to prevent adhesion to the surrounding sheath 20, and additionally, to prevent opening of the SZ twist.

[0017] Returning to the EKK/EQQ cable in FIG. 3, this type of cable generally has 2, 3, 4 or 5 strands and always has a filler 17. As mentioned above, the filler 17 is formed by compression extrusion to form the circular shape. Outside of the filler 17 is the sheath 20. Sheath 20 may be formed either by compression extrusion or tube extrusion. In both cases the outer surface of the sheath 20 will be circular. To prevent adhesion, the three strands 14 may be coated by talc against the filler 17. Moreover, the outer surface of the filler 17 may also be coated by talc before the sheath 20 is formed. Other known measures may also be taken to prevent adhesion.

[0018] The SZ twisting, the forming of the filler 17, the forming of the sheath 20 as well as the coating of talc is performed in the same process. Strands 14 are made in a previous process. As previously mentioned, this type of cable must be capable of being stripped, and the stripping generally works well, but never as well as desired by the electricians. The slightest imperfection in the talc coating may be devastating. There are also a plurality of other parameters that may negatively affect the stripping ability of a cable.

[0019] FIG. 1 shows an embodiment that is normally not used in connection with EKK/EQQ cables as it is considerably more expensive and almost impossible to strip. In this case, onto the cable body 12, a sheath 12 has been formed by compression extrusion to have a circular outer shape. Accordingly, In this case the sheath material is also used to have the circular outer shape of the cable 10. This embodiment is, however, used for electrical cords, for example a flexible lamp cord having three strands.

[0020] As already mentioned, the specified sheath thickness may be taken in account only from the dashed line around the strands 14 of FIG. 1.

[0021] FIG. 2 illustrates what may happen if a sheath 20 is formed by tube extrusion directly onto the cable body 12. In this case, an evenly thick sheath 20 is formed that has a tendency to shrink onto the cable body 12 and form a more or less triangular shape. This is not acceptable in an EKK/EQQ cable but may be acceptable in other types of cables.

[0022] In all of the commonly used cable types shown in FIGS. 1-3, the cable body 12 is at risk of adhering to the sheath 20 in the absence of specific measures. As mentioned in the foregoing, talc coating is commonly used, but also longitudinally applied tapes enclosing the cable body 12 and capable of preventing adhesion are common. Tapes having this capability may be of polymer material but may also be of paper.

[0023] FIGS. 1-3 also disclose the prior art option in of enclosing the cable strands/body by tapes 24 shown in phantom.

[0024] In FIG. 1, a paper tape 24 is applied around the three strands 14 whereupon the sheath 20 is formed by compression extrusion. The paper tape 24 will be applied by high pressure and will then be shaped conforming to the outline of three cable strands 14. In this case, preferably a soft and easily shaped paper is used. If a stiffer paper is used, the compression extrusion operation will still shape the paper in conformity to the outline of the strands 14.

[0025] In FIG. 2 in the same manner, a longitudinally oriented paper tape 24 is applied around the already circularly shaped cable body 12. Also in this case it is convenient to use a soft easily shaped paper in view of the tendency of the paper edge to rise.

[0026] These methods are well known and commonly used. Today, however, a polymer tape is used in preference to a paper tape as the polymer tape is stronger in the lengthwise direction and accordingly more production friendly.

DISCLOSURE OF THE INVENTION

[0027] An object of the invention is to provide a cable of the kind initially defined that is easy to strip and/or can be produced to low material costs.

[0028] Another object is to provide, in addition to low material costs, advantageous properties in cables where the stripping capability is of minor importance, such as improved roundness of the sheath and improved bending capability.

[0029] These objects are obtained by the features defined in the attached claims.

[0030] In an aspect of the invention, the shell is capable of yieldably resisting a compressive force from the extruded sheath when the sheath is shrinking during forming thereof, the shell being deformed under the sheath shrinking effect so as to thereby maintain a predetermined clearance to the cable body and/or a resulting roundness of the sheath once the sheath has been hardened

[0031] In another aspect of the invention, the shell is provided with a clearance to the cable body prior to forming the sheath, and also provided with a resilience capable of yieldably resisting a compressive force from the sheath when the sheath is shrinking during said forming to thereby maintain a resulting clearance to the cable body and/or a resulting roundness of the sheath until the sheath has been hardened.

[0032] By maintaining a play or clearance between the shell and the cable body, at least during the forming of the sheath, the sheath can be kept circular without bearing on the cable body via the shell and without the need of any supporting or friction-reducing material between the shell and the cable body. Thereby, the shell and the sheath can be more easily removed from the cable body during a stripping operation.

[0033] The knowledge forming the basis of the invention is that before the hardening, the shrinking soft sheath can be kept round at a desired inner diameter by relatively small counteracting forces. Accordingly, a soft, shrinking sheath can be supported by a resiliently stiff flexibly yieldable inner shell during the production phase. The shell is then like an arch capable of withstanding external pressure from the sheath by being subjected to flexural and compressive stress. Thereby, the shell can make resistance to the shrinking and prevent the sheath from clamping the cable body, and maintain the resulting clearance and/or the roundness of the cable. When finally the sheath is hardened, the shell has fulfilled its task so that thereafter the resulting clearance/roundness is maintained by the hardened sheath.

[0034] The shell can be resiliently flexible and compressed by flexing the tape to a smaller radius of curvature. The tape is thereby caused to slide in a circumferential direction along the interior face of the sheath so that the longitudinal edges of the tape will move towards or, in an overlapping manner, away from each other

[0035] In an embodiment of the invention, the shell is also provided with a tensional strength capable of withstanding pulling forces subjected to the cable during a production phase. This embodiment may be suitable for preventing a SZ twist from being opened, i.e. untwisted, by partially subjecting the shell to tensional forces, for example during a tube extrusion operation. The hot newly extruded sheath may otherwise be stretched when subjected to tensional stress and thereby cause opening of the SZ twist when the cable is pulled forward during the production process.

[0036] The tape can extend in the longitudinal direction of the cable. The tape may then be circularly curved across the longitudinal direction so that the longitudinal edges of the tape form a gap or an overlap that may be yieldably glued so that the shell may be compressed by a diameter-reducing sliding movement during the shrinking of the sheath. By a free gap or non-glued overlap, the low friction of the tape to the sheath can partially prevent that the shell is compressed more than allowable by the prestressing force from the sheath. Primarily, however, the tape may by suitable choice of material (paper quality or thickness, for example) have such a bending resiliency, that this bending resiliency alone prevents the shell from being compressed past an allowed limit of the resulting smaller clearance.

[0037] While the tape also could be made of a suitable polymer material or a combination of a polymer material and paper/cellulose, in one embodiment the tape is made of paper. A paper of a long-fibred type where the fibres are oriented in the pulling direction has shown to be especially suitable due to its tensional strength/stiffness and bending resiliency/stiffness and thereby its capability of resisting relatively high pressures in an arched shape. Such paper of such common quality is also capable of being curved or bent by suitable measures and of maintaining a circular tube shape. Paper is also relatively inexpensive.

[0038] A method of producing a cable according to the invention comprises:

providing a cable body;
enclosing the cable body by a resiliently compressible shell having an initial clearance to the cable body, the shell comprising a tube-shaped tape of a material selected from a group of materials consisting of cellulose, synthetic resin or a combination thereof;
forming a sheath of synthetic resin onto the shell; and
shrinking the sheath for resiliently compressing the shell, the shell being capable of resisting said shrinking to thereby maintain a resulting clearance to the cable body and/or a resulting roundness of the sheath once the sheath has been hardened.

[0039] In the method, the shell can be compressed by the tape being flexed to a smaller radius of curvature by sliding along a circular interior face of the sheath.

[0040] Other features and advantages of the invention may be apparent from the claims and the following description of exemplary embodiments.

BRIEF DESCRIPTION OF THE DRAWING

[0041]

FIG. 1 is a cross sectional view of a prior art cable formed by compression extrusion;

FIG. 2 is a perspective view of a cutaway length of a prior art cable having a sheath formed by tube extrusion;

FIG. 3 is a cross sectional view of a common variant of a EKK/EQQ cable;

FIG. 4 is a perspective view of a cable length according to the invention stripped in sections;

FIGS. 5A and 5B are respective diagrammatic end views at a larger scale of a cable approximately according to FIG. 4 before and after shrinking a sheath onto a shell having an overlap;

FIG. 6 is a diagrammatic perspective view of a process for forming a shell according the invention around a cable body;

FIGS. 7A and 7B are respective diagrammatic broken away cross sectional views showing a gap of a shell before and after shrinking a sheath onto the shell of a cable according to the invention;

FIG. 8 is a perspective view of a cutaway length of a cable according to the invention; and

FIG.9 is a diagrammatic end view of a cable according to the invention having an intermediate roundness.

[0042] In the drawing, same reference numerals are thoroughly used to designate parts having same or similar function.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0043] FIG. 4 shows an end portion of a cable 10 according to the invention. In this case, the three cable strands 14 forming the cable body 12 are SZ twisted. (They may, of course, also be conventionally twisted, but this is most often not rational for EKK/EQQ cables.) A paper tape 24 is bent around the cable body 12 in a manner that it forms a relatively compression-resistant tube or shell 22 in the cable 10. The tape 24 can be of a long-fibred type and have a thickness of typically about 0.05 to 0.25 mm. An example of such paper is a paper available from Munksjö Paper AB for use in cables as an insulation in high voltage (over 300 kV) cables.

[0044] In the example of FIG. 4, the longitudinal edges 26, 26' of the paper tape 24 are overlapped by a few mm. To prevent outer edge 26' of tape 24 from rising and penetrating into sheath 20 in a manner not desired, a bond in the shape of a yieldable glue string 28, for example, may be provided between the overlapping portions of edges 26, 26. By "yieldable" is understood that the bond may allow the overlapping portions to slide relative to each other without rising when the sheath 20 shrinks during the hardening process thereof.

[0045] FIG. 5A in an illustrating purpose shows a diagrammatic end view of a cable 10 approximately according to FIG. 4, in a condition when the sheath 20 starts to be extruded, for example by tube extrusion, and is in a warm non-hardened state. In this state, the cable body 12 is enclosed with an initial predetermined clearance p1 to the surrounding shell 22. For a cable having an outer diameter of about 10 to15 mm, the initial clearance p1 may amount to about 1 mm. When the sheath 20 starts cooling, it will shrink and apply an external pressure onto the shell 22. The shell 22 is then resiliently compressed by the paper tape 24 by flexing being forced to reduce its curvature radius, while the external surface of the tape 24 slides along the interior surface 21 of the sheath 20 and increases the overlapping portions of edges 26, 26'. During this course, the tape 24 makes more and more resistance to the compression by its flexing resiliency and by possible friction against the interior surface 21 of the sheath 20. As shown in FIG. 5B, when the sheath 20 finally has been fully shrinked, cooled and hardened, the clearance has reached its resulting value p2, which for the cable in question, having an outer diameter of about 10 to15 mm, may amount to about 0.5 mm. Accordingly, the shell is provided with such a compressive strength or bending rigidity that it can radially withstand a portion of the compressive force of the sheath 20 by being compressed from the larger initial radial clearance p1 to the smaller resulting clearance p2. The desired shrinking ratio may be decided, for example by tests and by choice of suitable paper quality and thickness, preparation of the paper as well as choice of suitable extrusion tools.

[0046] In FIGS. 5A and 5B the cable body 12 is shown "freely floating" inside the shell 22, but in practice it will, of course, be supported by the shell 22 at different points along the cable 10. The compressed shell 22 will maintain its round shape due to its inherent elasticity. In the ideal case the shell 22 is not compressed more than it still is free from the cable body 12. If, however, the shell 22 initially was allowed to bear on the cable body 12, the shrinking of the sheath 20 would further increase the pressure on the cable body 12, resulting in a deteriorated stripping capability.

[0047] In order to prevent the shell 22 from being deformed when forming the sheath 20, a paper tape 24 having a certain stiffness has to be provided. When such a paper tape 24 is formed to a circular shape, it will immediately tend to open, and the outer longitudinal edge 26' will tend to rise and penetrate the sheath 20. This problem may accordingly be solved by the edges 26, 26' being yieldably secured relative to each other, for example by the above mentioned glue string 28, or by any other suitable manner.

[0048] A method for forming the shell 22 is shown diagrammatically and simplified in FIG. 6. In this example, the shell 22 is formed from a paper tape 24 advanced from a roll 30 in parallel with a cable body 12 and through a tapering nozzle 32, in a manner that the tape 24 is formed to said tube 22 with the initial clearance around the cable body 12. A glue string 28 can be applied along the longitudinal edge 26' of tape 24. When passing the nozzle 32 and in the following shrinking of the sheath, glue string 28 and edge 26' will yieldably adhere to the other longitudinal edge 26 of tape 24 so that edge 26' will not rise. The tape 24 may alternatively be treated in other ways (not shown) to prevent edge 26' from being raised or to prevent excessive tendency of the tape 24 of returning to its planar shape.

[0049] While FIGS. 4 and 5A, 5B shows a band where the longitudinal edges 26, 26' are overlapping, it is also possible, as shown in FIGS. 7A and 7B, to leave a gap between the longitudinal edges 26, 26'. The sheath 20 is formed around the shell 22, for example by the tube extrusion process mentioned above, where the sheath 20, when shrinking, as in the above described example, will subject the shell 22 to an external pressure. When the sheath 20 starts forming, the shell 22 maintains the initial radial clearance p1 due to its flexing resiliency, as indicated in FIG. 7A. When the sheath 20 hardens, it will shrink against increasing resistance from the resilient shell 22 so that the gap between edges 26, 26' is reduced by the tape 24 is sliding along a circular interior face 21 (FIG. 7A) of the sheath 20, until the clearance finally reaches the resulting, desired predetermined value p2 when the sheath 20 is hardened, as is shown in FIG. 7B. Also in this case the tape 24 must be prepared in a manner that the edges do not raise or that the tendency of the tape 24 of returning to its planar shape is not excessive.

[0050] During the initial forming of the shell 22 as well as during the final forming of the sheath 20, the tensional forces acting on the cable 10 are partially taken up by the tensionally rigid shell 22, which is subjected to a pulling force F (FIG. 6) so that possible twisting in the cable body 12 is not at risk of being opened. This may otherwise be the case, especially in view of over-stretching the not yet hardened sheath 20.

[0051] A cable 10 as described in the foregoing accordingly has the advantage of having the cable body12 lying loosely inside the paper tube / shell 22, and thus loosely inside the sheath 20. When the sheath is pulled off during a stripping operation, the friction between the sheath 20 / paper tube 22 and the cable body 12 will be so small that sheath 20 and paper tube 22 can be easily pulled off. Moreover, a substantial save on material is obtained by the filler being superfluous. No talc coating is needed, which is highly important as to hygiene. In addition, the paper tape will fulfil another important function. A SZ twisted cable, for example, lies loosely inside the paper tape / sheath. If it would be theoretically possible to produce a circular sheath by tube extrusion where the cable body lies loose inside the sheath, but without any paper tube (this is possible with certain polymer materials), the tensional force necessary for pulling the cable during the production process would then subject the SZ twisted strands to a force resulting in an opening of the SZ twist. As long as the sheath is not cooled, it will not be capable of absorbing any tensional force. Accordingly, as long as the sheath is so warm that it can be stretched, it will be stretched and the SZ twist will be opened.

[0052] Since the paper tape that is used for forming the paper tube has a high tensional strength, the paper tube will absorb the necessary pulling force, and the SZ twist will be subjected to a negligible pulling force.

[0053] FIG. 8 shows a length of cable 10 according to the invention where not the stripping capability but rather the roundness and bending capability are given precedence. Cable 8 can be formed by tube extrusion and be twisted. In this case, the resulting clearance p2 (not shown) may further be zero or near zero. Compared to the prior art cable shown in FIG.2, however, during the production phase, the more rigid flexible shell 22 is now capable of more or less preventing the shrinking sheath 20 from being drawn into the cable body, as illustrated by the three line-hatched areas of FIG. 9, whereby the sheath 20 can be hardened to a fully round shape (FIG. 8) or a partially round shape (FIG. 9). While the roundness of the cable may be determined by various methods known in the art, measuring the thickness t of the hatched areas in FIG.9 in relation to a maximun diameter Dmax, for example, may be considered as one straightforward method of measuring of the roundness of the resulting cable 10. Another uncomplicated method may be to determine a relation between minimum and maximum outer diameters Dmax and Dmin of the cable. The three strand cable of FIG. 9 having a t to Dmax roundness ratio of roughly 0.075 may be an example of a cable meeting the requirements of a cable according to the invention.

[0054] A cable according to FIG. 8 may also be a thicker cable than those described in the above examples. Such thicker cable can have an irregular cable body. Also in this case there is no need for a good stripping capability, but need for saving material and the bending capability of the finished cable. The bending capability is improved according to the invention by the compressive pressure from the sheath being decreased, whereby the strands are allowed to slide more easily relative to each other and to the shell/sheath when the cable is bent. In such thicker cables, having a diameter of typically 40 to 45 mm, the sheaths have a considerably larger wall thickness. Then also the paper tape may be considerably thicker, for example 0.25 mm. The sheath may then be allowed to resiliently shrink the paper tube all the way into contact with the cable body so that the resulting clearance p2=0, but thanks to the larger paper thickness, the sheath will still not be able of destroying the circular shape of the paper tube.

[0055] The invention is not restricted to the types of cables described above but can also be implemented in other cables, for example optical cables, telecommunication cables and flexible cords as well as other electrical cables and combinations thereof.

[0056] The foregoing detailed description is given primarily for clearness of understanding and no unnecessary limitations are to be understood therefrom. Modifications will become obvious to those skilled in the art upon reading this disclosure and may be made without departing from the spirit of the invention or the scope of the appended claims.

Claims

1. A cable (10), including a compressible shell (22) comprising a tube-shaped tape (24) of a material selected from a group of materials comprising cellulose fibres, synthetic resin or a combination thereof, an extruded sheath (20) of synthetic resin enclosing the shell, and a cable body (12) inside the shell, **characterised by** the shell (22) being capable of yieldably resisting a compressive force from the sheath (20) when the sheath is shrinking during forming thereof, the shell being deformed under the sheath shrinking effect so as to thereby maintain a predetermined clearance (p2) to the cable body (12) and/or a resulting roundness of the sheath once the sheath has been hardened.

2. The cable according to claim 1, wherein the shell (22) is flexibly compressible and compressed by flexing the tape (24) to a smaller radius of curvature.

3. The cable according to claim 1 or 2, wherein the tape (24) extends in the longitudinal direction of the cable (10).

4. The cable according to any of the previous claims, wherein the tape (24) is also provided with a tensional strength capable of withstanding pulling forces subjected to the cable (10) during a production phase.

5. The cable according to any of the previous claims, wherein longitudinal edges (26, 26') of the tape (24) are overlapped.

6. The cable according to claim 5, wherein the longitudinal edges (26, 26') are bonded by a yieldable glue joint (28).

7. The cable according to any of claims 1-4, wherein longitudinal edges (26, 26') of the tape (24) are arranged with a gap there between.

8. The cable according to any of the previous claims, wherein the tape (24) is made of paper.

9. The cable according to claim 8, wherein the paper is a long-fibred paper.

10. The cable according to any of the previous claims, wherein the tape (24) has a thickness of approximately 0.05 to 0.25 mm.

11. The cable according to any of the previous claims, wherein the resulting clearance (p2) is radially approximately 0 to 0.5 mm.

12. A method of producing a cable (10), **characterised by**
providing a cable body (12);
enclosing the cable body (12) by a resiliently compressible shell (22) having an initial clearance (p1) to the cable body, the shell (22) comprising a tube-shaped tape (24) of a material selected from a group of materials consisting of cellulose, synthetic resin or a combination thereof;
forming a sheath (20) of synthetic resin onto the shell (22); and
shrinking the sheath (20) for resiliently compressing the shell (22), the shell being capable of resisting

said shrinking, to thereby maintain a resulting clearance (p2) to the cable body (12) and/or a resulting roundness of the sheath once the sheath has been hardened.

13. The method according to claim 12, wherein the shell (22) being compressed by the tape (24) being flexed to a smaller radius of curvature by sliding along a circular interior face (21) of the sheath (20).

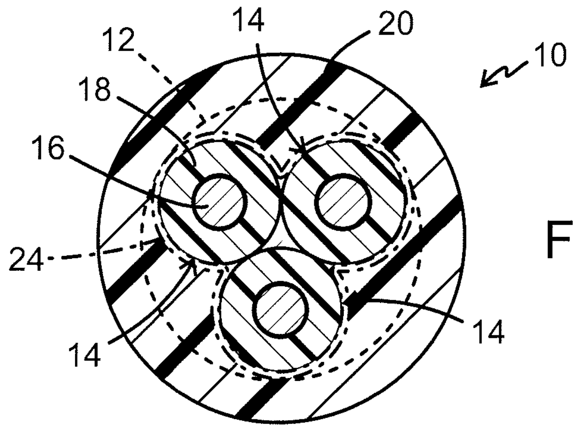

FIG. 1

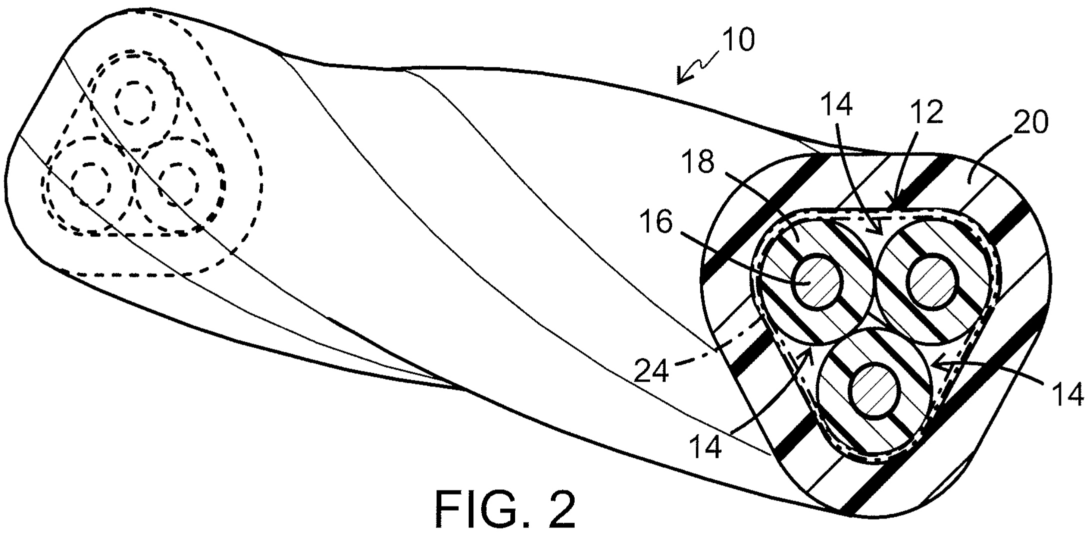

FIG. 2

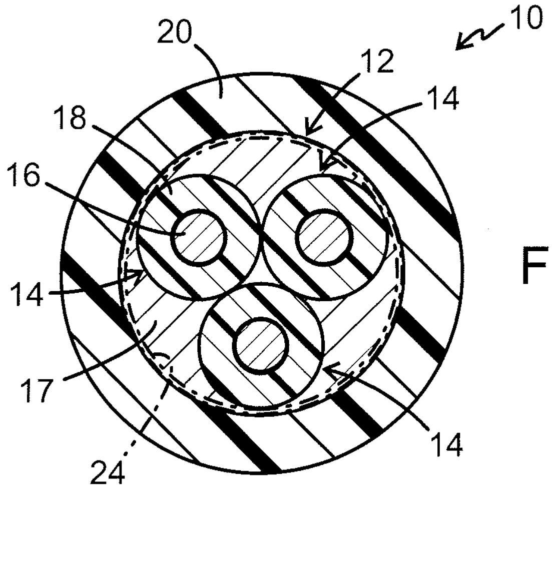

FIG. 3

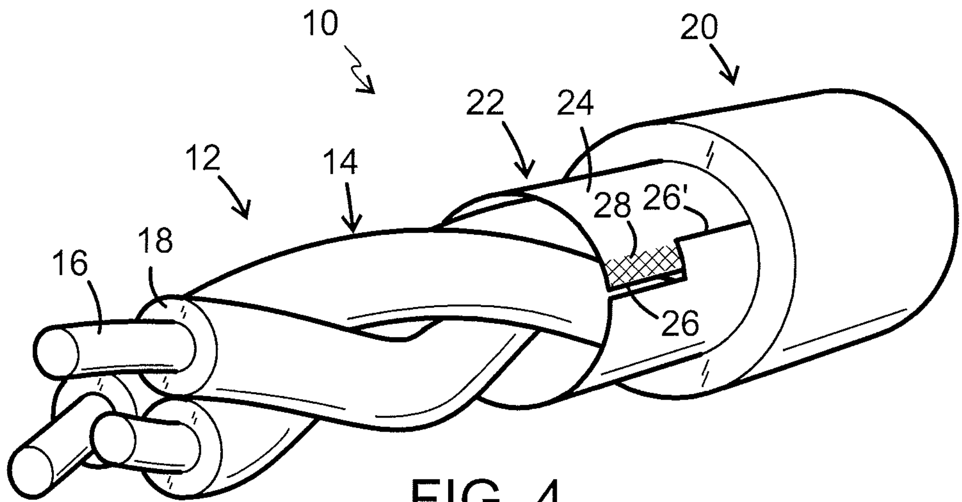

FIG. 4

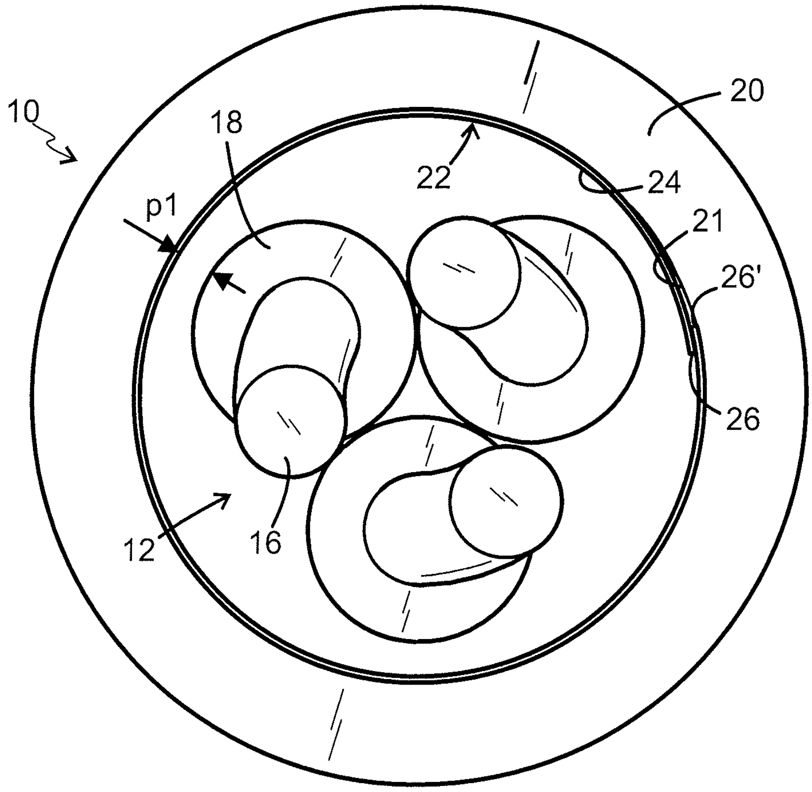

FIG. 5A

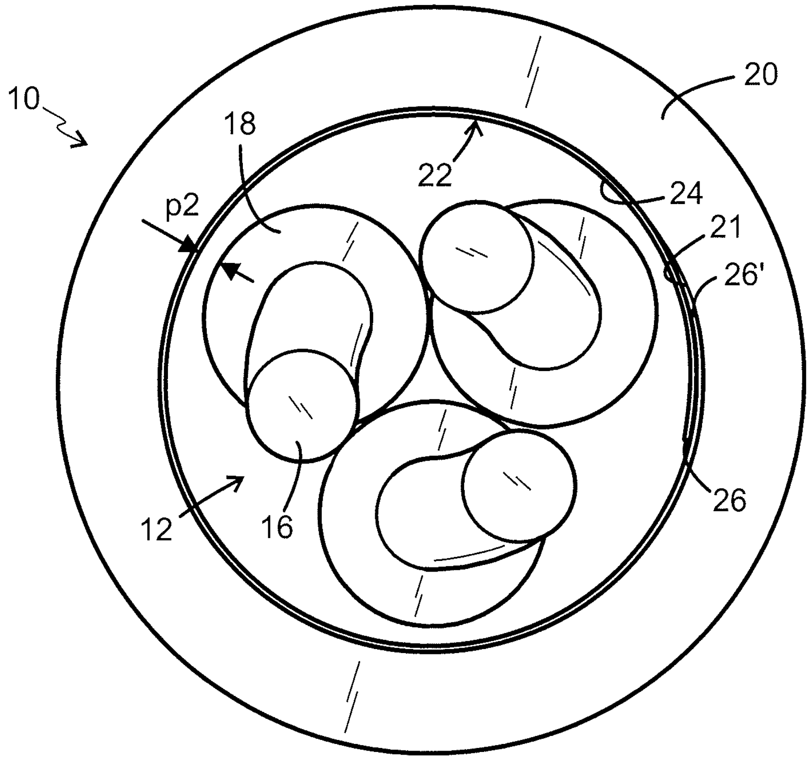

FIG. 5B

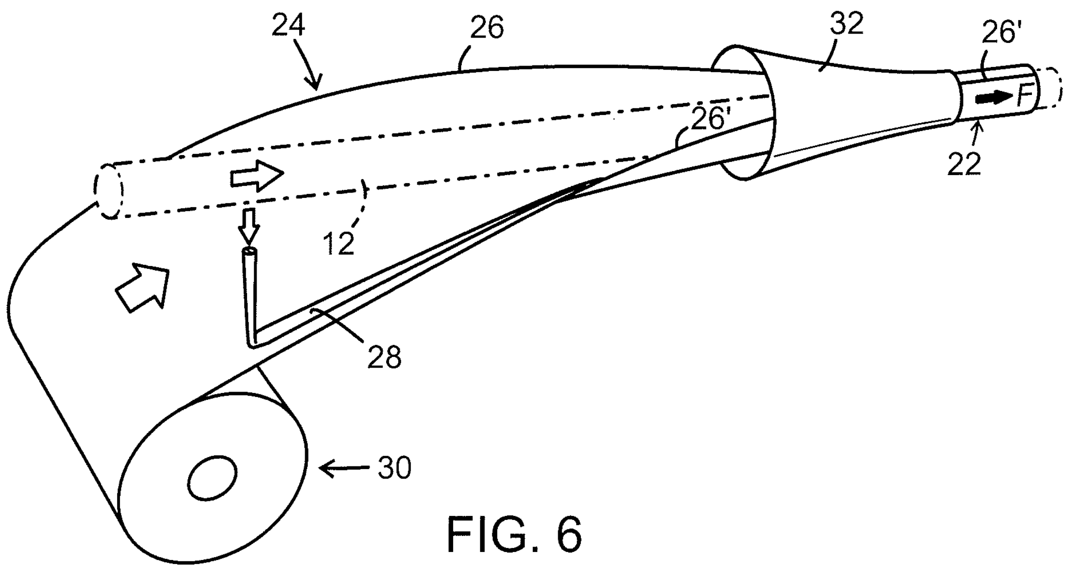

FIG. 6

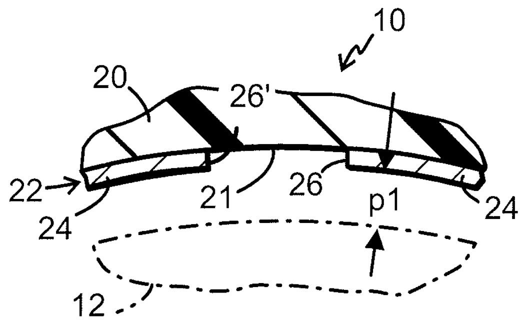

FIG. 7A

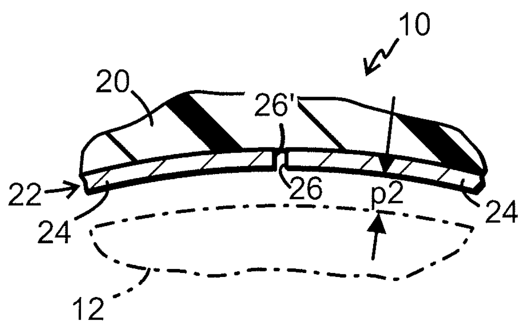

FIG. 7B

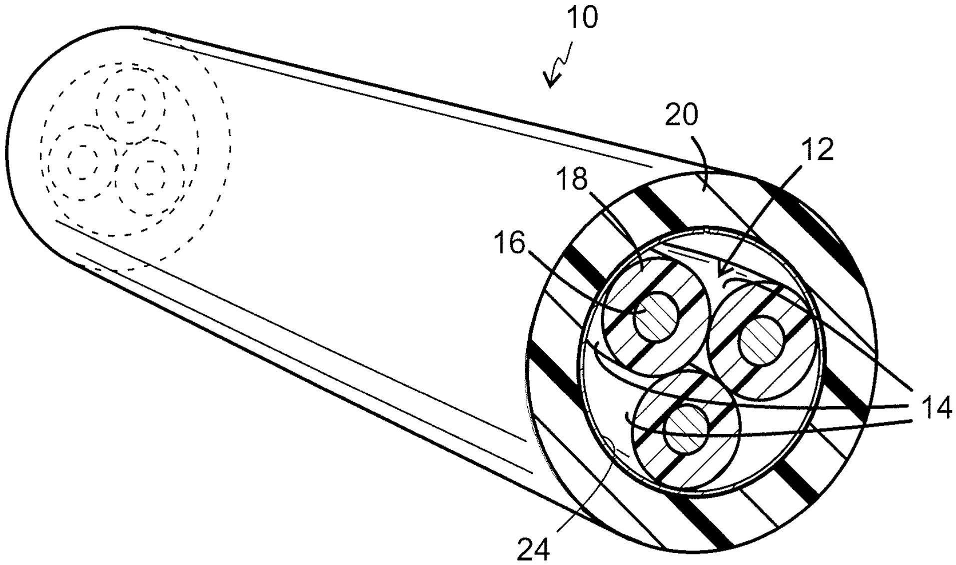

FIG. 8

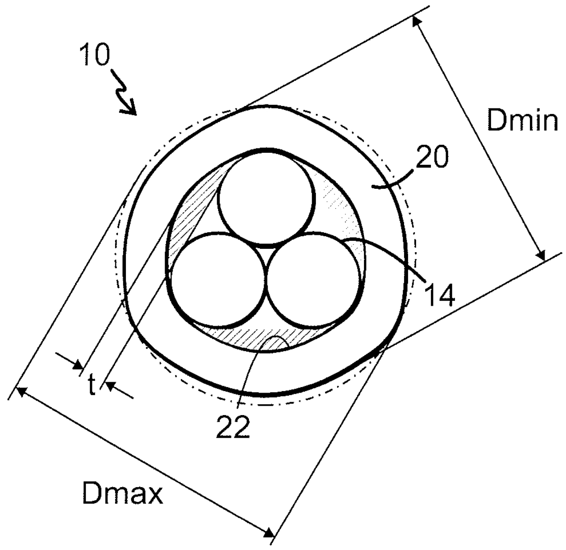

FIG. 9