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Cable, in particular underwater cable



Description

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- 5 The invention concerns a cable, in particular an underwater cable, according to the precharacterizing clause of Claim 1.

10 Underwater cables (so-called submarine cables) must be observed during laying, for inspection purposes and for tracing any defects. This takes place under water with remote-controlled cameras. The pictures taken by the cameras under water, in particular at great depths, often allow the underwater cable to be made out only
15 with difficulty, in particular whenever it has a customary black or dark outer sheath. This makes it difficult in particular to locate defective underwater cables.

20 Setting out from the above situation, the invention is based on the object of providing a cable, in particular an underwater cable (submarine cable), which can be made out well under water, even at great depths.

25 A cable serving to achieve this object, in particular an underwater cable or submarine cable, has the features of Claim 1. At least one externally visible marking of a different colour on the outer sheath makes the cable more easily visible, in particular in the
30 underwater area. The underwater cable according to the invention can be made out more easily on camera pictures, because the marking of a different colour provides the outer sheath with greater contrast.

35 The marking can be formed in a wide variety of ways. The marking preferably consists of one or more strips or lines extending continuously in the longitudinal direction of the outer sheath of the cable and

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preferably extending spirally around the cable. The marking comprising one or more spiral longitudinal strips or longitudinal lines on the outer sheath has the effect that the marking is always visible, irrespective of from which side the cable is viewed. Since submarine cables can turn about their longitudinal axis during laying, the longitudinal strips or longitudinal lines likewise running spirally around the longitudinal axis of the submarine cable represent a marking that is virtually always visible.

It is alternatively also conceivable to form the marking by transverse strips or transverse lines running in a cross-sectional direction around the cable. These are then in practice endless, coloured rings around the outer sheath. They are also always visible, irrespective of any turning of the cable. The peripheral transverse strips or transverse lines have the advantage that turning of the submarine cable during laying does not become visible and as a result does not disturb the viewer.

It is likewise conceivable to form the marking from straight longitudinal strips or longitudinal lines. In order that a straight longitudinal strip or longitudinal line is always visible in each case, a corresponding number of longitudinal strips or longitudinal lines are arranged evenly distributed on the circumference of the outer sheath. The longitudinal strips or longitudinal lines or transverse strips or transverse lines can also be produced from at least one series of two-dimensional formations following one another at intervals. The two-dimensional formations may have any desired base areas, and in particular be round, elliptical, square or rectangular. Similarly, the intervals between the two-dimensional formations may be as desired.

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Finally, it is also conceivable to provide the entire outer sheath with a marking comprising dots of any desired shape. In this case, the dots are arranged in a uniform grid, which preferably extends over the entire circumference of the outer sheath. Such a grid also has the advantage that the marking is always visible and turns of the submarine cable during laying do not become evident and do not in this case detract from the observation of laying.

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Any type of marking can be formed by a dye sprayed or printed onto the outer sheath after it has been produced. For this purpose, a dye which is permanently resistant to sea water is used. It is also conceivable, after applying the dye forming the marking, to provide the entire outer sheath with a transparent protective layer, which also covers the coloured marking.

20 It is also possible to form the marking from a plastic of a different colour during the production of the outer sheath. The outer sheath is then made up of differently coloured plastic materials. For example, this can be achieved by coextrusion of the outer sheath or by sintering the plastic of a different colour onto the surface of the outer sheath. The types of marking mentioned then have virtually the same sea-water resistance as the outer sheath.

30 According to a preferred development of the invention, the respective marking has a lighter colour than the outer sheath. It is also advantageous if the lighter colour of the marking has fluorescent properties. As a result, the marking of the submarine cable becomes visible even at great depths if searchlights of an underwater camera shine on it.

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In the case of submarine cables with a usually black outer sheath, a yellow colour, in particular a

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fluorescent yellow colour which offers easily visible contrast together with the black colour of the outer sheath, is preferably chosen for the lighter colour of the marking.

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The marking may also be formed by mixing colour particles or colour pigments in with the raw material of the plastic for forming the outer sheath. Such an outer sheath then has an essentially regular
10 distribution of coloured locations, in particular small dots. The embedding of the colour particles or colour pigments in the plastic material for forming the outer sheath ensures a permanent bonding of the marking to the submarine cable.

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In an alternative development of the submarine cable according to the invention, the marking is formed by a netting applied to the outer sheath. The netting surrounds the entire outer sheath and extends
20 uninterruptedly in the longitudinal direction of the submarine cable. The netting produces on the outside of the outer sheath of the submarine cable peripheral transverse strands and rectilinear longitudinal strands with preferably a round cross section, although other
25 cross sections, for example square, are also conceivable. If the netting is of a different colour, the crossing longitudinal and transverse strands form the marking.

30 Preferred exemplary embodiments of the cable according to the invention are explained in more detail below with reference to the drawing, in which:

Figure 1 shows a portion of a submarine cable in a
35 side view,

Figure 2 shows a side view of a portion of a submarine cable according to a second exemplary embodiment of the invention,

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Figure 3 shows the submarine cable of Figure 2 in a side view turned through 90° ,

5 Figure 4 shows a side view of a portion of a submarine cable according to a third exemplary embodiment of the invention,

10 Figure 5 shows a side view of the submarine cable of Figure 4, turned through 90° with respect to Figure 4,

Figure 6 shows a portion of a submarine cable according to a fourth exemplary embodiment of the invention, and

15 Figure 7 shows a portion of a submarine cable according to a fifth exemplary embodiment of the invention.

20 The figures show cables for underwater use, namely submarine cables of any desired construction. In particular, the submarine cables may have in the interior a core of any desired construction. For example, the core may have both electrical conductors
25 and optical waveguides or combinations of the two. In addition, the core has at least one armouring or reinforcement for protection against mechanical influences. The core with the reinforcement or armouring is surrounded by a closed outer sheath, which
30 consists essentially of plastic. The outer sheath is usually black.

Figure 1 shows a submarine cable 10, the outer sheath 11 of which is provided with an externally visible
35 marking. In the exemplary embodiment shown, the marking is formed by a longitudinal strip 13 running spirally around the outer sheath 11 in the longitudinal direction, in other words along the longitudinal centre axis 12 of the submarine cable 10. The single

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longitudinal strip 13 in the exemplary embodiment of Figure 1 has, depending on the diameter of the submarine cable 10, a width of between 1 and 5 mm. The longitudinal strip 13 preferably has a width which corresponds approximately to one-quarter to one-fifth of the diameter of the submarine cable 10. In the exemplary embodiment shown, the pitch of the spiral helix of the longitudinal strip 13 around the submarine cable 10 is chosen such that, over a length of the submarine cable 10 which is approximately three to ten times, preferably approximately eight times, the diameter of the said cable, the longitudinal strip 13 has run once around the outer sheath 11 of the submarine cable 10.

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Figures 2 and 3 show a submarine cable 14 according to a second exemplary embodiment of the invention. The internals of the submarine cable 14 - which may be of any desired construction - are not represented in any more detail in the figures mentioned (or in any of the other figures). Only the outer sheath 15 with markings according to the invention is shown. In the present exemplary embodiment as well, the marking is formed by longitudinal strips running in a serpentine manner around the outer sheath 15 along the longitudinal centre axis 16, to be precise two longitudinal strips 17 and 18. For reasons of simple representation, the longitudinal strips 17 and 18 are only indicated by lines. In fact, they have a width which, depending on the diameter of the submarine cable 14, may be between 1 and 5 mm. It is also conceivable to make the individual longitudinal strips 17 and 18 of different widths.

35 The two longitudinal strips 17 and 18 run in different directions around the outer sheath 15. While the longitudinal strip 17 snakes clockwise around the outer sheath 15, the longitudinal strip 18 runs anti-clockwise around the outer sheath 15. Both

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longitudinal strips 17 and 18 have the same pitch, which is indicated in Figures 2 and 3 by the dimension L. This means that, on a portion L of the submarine cable 14, the longitudinal strip 17 wraps once right
5 around the submarine cable 14 in one direction and the longitudinal strip 18 wraps once right around the submarine cable 14 in the other direction. The different wrapping directions of the longitudinal strips 17, 18 around the submarine cable 14 lead in the
10 case of torsion or twisting of the submarine cable 14 to the originally identical pitches of the two longitudinal strips 17, 18 differing from each other. In an extreme case, a longitudinal strip 17, 18 may extend approximately in a straight line along the
15 submarine cable 14, while the other longitudinal strip 17, 18 runs around the sheath of the submarine cable 14 with a smaller pitch (in a serpentine manner). In this way it is always ensured that one longitudinal strip 17 or 18 runs in a helical manner around the submarine
20 cable and, as a result, is constantly visible. In addition, it can easily be visually established from deviations in the pitches of the longitudinal strips 17, 18 to what extent the submarine cable 14 is subjected to torsion or twisted.

25 The longitudinal strips 17 and 18, which follow an identical path, cross at common nodes 19, the intervals of which have half the dimension L of a complete revolution of the respective longitudinal strip 17 and
30 18 around the outer sheath 15.

The design and arrangement described of the longitudinal strips 17 and 18 on the submarine cable 14 have the effect that, depending on the viewing
35 direction towards the side of the submarine cable 14, the two oppositely running longitudinal strips 17 and 18 have different paths. It can be seen from the representation in Figure 2 that both longitudinal strips 17 and 18 are simultaneously visible in the same

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region of the length of the submarine cable 14. Between two successive visible portions of the longitudinal strips 17 and 18, both longitudinal strips 17 and 18 disappear entirely to the invisible rear side of the submarine cable 14. The length of this invisible region is half the length of one complete revolution of the respective longitudinal strip 17 and 18 around the submarine cable 14. If the submarine cable 14 represented in Figure 2 is viewed from below, one of the two longitudinal strips 17 or 18 is always visible. The serpentine or sinusoidal path shown in the figure is thereby obtained. Thus, from certain views of the submarine cable 14, the two longitudinal strips 17 and 18 extending in opposite directions have the effect that either only a single longitudinal strip 17 or 18 is visible or both longitudinal strips 17, 18 are only partially visible.

Figures 4 and 5 show a third exemplary embodiment of a submarine cable 20, in which the marking has four longitudinal strips 21 to 24. The longitudinal strips 21 and 22 correspond to the longitudinal strips 17 and 18 of the exemplary embodiment of Figures 2 and 3. The longitudinal strips 21 and 22 become visible in the left-hand half of the dimension L of Figure 4. Located invisibly behind them, with the same path, are the longitudinal strips 23 and 24. In the right-hand half of the dimension L in Figure 4, the longitudinal strips 21 and 22 disappear invisibly to the rear side of the outer sheath 25 of the submarine cable 20. In this region, the longitudinal strips 23 and 24 appear visibly on the front side of the outer sheath 25. Behind the dimension L in Figure 4, these strips disappear again to the rear side of the outer sheath 25 and the longitudinal strips 21 and 22 visibly reemerge.

The longitudinal strips 21 and 22 on the one hand and 23 and 24 on the other hand are all of the same design as one another. The longitudinal strips 21, 22, 23, 24

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wrap around the outer sheath 25 in the direction of the longitudinal centre axis 32 of the submarine cable 20. The only difference that, at the upper (left-hand) node 26 in Figure 4, the longitudinal strip 21 begins in one
5 direction and the longitudinal strip 23 begins in another direction. Extending from the node 27 lying below it in Figure 4 are the longitudinal strips 22 and 24, to be precise in such a way that they wrap around the submarine cable 20 in opposite directions. As a
10 result, there are always two nodes 26 and 27 diametrically opposite one another on the outer sheath 25 of the submarine cable 20. The nodes 26 and 27 are always offset by the dimension L-quarter in the direction of the longitudinal centre axis 16 of the
15 submarine cable 20 and also always turned through 90°.

The four longitudinal strips 21, 22, 23 and 24, which are of the same design and are just directed differently, or extend from different nodes 26 to 27,
20 achieve the effect that the marking of the outer sheath 25 is continuously visible from every side of the submarine cable 20, to be precise with the same pattern, as clearly illustrated by Figures 4 and 5, which show the submarine cable 20 from two viewing
25 directions respectively offset by 90°.

The longitudinal strips 21, 22, 23 and 24, again shown only as lines in Figures 4 and 5 for reasons of simplification, are in fact designed as wider strips,
30 to be precise with a width of preferably 1 to 5 mm. In the case of relatively thick submarine cables 20, the strips may be even wider. The same also applies to the other exemplary embodiments of the invention. It is conceivable to make the individual longitudinal strips
35 21, 22, 23 and 24 of different widths.

Figure 6 shows a fourth exemplary embodiment of a submarine cable 28. This submarine cable 28 has on an outer sheath 29 a marking comprising a multiplicity of

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round dots 30. The dots 30 are distributed uniformly over the entire length of the submarine cable 28 along its longitudinal centre axis 31 over the entire circumference of the outer sheath 29. For this purpose, in the exemplary embodiment shown, the dots 30 are arranged in a uniform grid. This is made up of a plurality of rows of dots 30, following one another at uniform intervals, the said rows extending parallel to the longitudinal centre axis 16 and the dots 30 of adjacent rows being offset by half the interval between pairs of dots 30, in other words are arranged such that they are staggered. The interval between neighbouring dots 30 is slightly greater than the diameter of the same. The dots 30, which are the same as one another, have in each case a diameter of preferably 1 to 10 mm. The interval between the dots 30 may also be greater than their diameter; preferably, the interval between the dots 30 is five to twenty times as great as their diameter.

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While the outer sheaths of the submarine cables shown are black, the markings, in other words the longitudinal strips 13, 17, 18, 21, 22, 23, 24, or the dots 30, have a lighter colour. The longitudinal strips 13, 17, 18, 21, 22, 23, 24 or the dots 30 are made yellow. This may be a shade of yellow which has fluorescent or retro-reflective properties.

It is also conceivable to provide in particular the submarine cables 14 and 20 with a plurality of longitudinal strips 17, 18 or 21, 22, 23 and 24, respectively, as shown in Figures 1 to 5. The individual longitudinal strips 17, 18, 21, 22, 23 or 24 may also be provided with different colours, which however are to be significantly lighter than the black colour of the outer sheaths. The dots 30 on the outer sheath 29 of the submarine cable 28 may also be of different colours.

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The markings are continuously applied to the outer sheaths of the submarine cables while they are being produced, or are made in the outer sheaths. This may take place during or after the production of the
5 respective outer sheath.

After the production of the respective outer sheath, the marking may be printed or sprayed onto the the outside of the respective outer sheath in the form of
10 longitudinal strips 13, 17, 18, 21, 22, 23, 24 or dots 30. In this case, the marking is formed from a coating of a corresponding colour or from liquid plastic. The coating or the liquid plastic must be of such a nature that it adheres well to the outer sheaths and is
15 indelible, even in salty sea water.

It is also conceivable to produce the marking by sintering onto the respective outer sheath. This also takes place preferably after the production of the
20 outer sheath. In this case, the sintering-on can be performed while the outer sheath has not yet fully cured.

The marking may also be produced during the production
25 of the respective outer sheath of the submarine cable, by the respective outer sheath being formed from plastics of different colours. Then the outer sheath is formed, for example by the coextrusion process, simultaneously from the black plastic and the
30 differently coloured, for example yellow, plastic for forming the marking, in particular the longitudinal strips 13, 17, 18, 21, 22, 23, 24.

The longitudinal strips 13, 17, 18, 21, 22, 23, 24
35 shown in Figures 1 to 5 extend continuously over the entire length of the respective submarine cable, in other words snake constantly, that is to say repeatedly or many times, around the outer sheath.

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Figure 7 shows a submarine cable 33 in which the marking is formed by a netting 34. The netting 34 surrounds the outer sheath 35 of the submarine cable 33. In the exemplary embodiment shown, the netting is formed by longitudinal strands 36, extending in the longitudinal direction of the submarine cable 33, and transverse strands 37, directed transversely thereto, which surround the outer sheath 35 uninterruptedly. In the present case, the interval between pairs of neighbouring, parallel longitudinal strands 36 is approximately the same size as the interval between two neighbouring, parallel transverse strands 37. As a result, rectangular openings 38 are created between the longitudinal strands 36 and transverse strands 37. It is also possible, however, to choose the intervals between neighbouring longitudinal strands 36 to be less or greater than the intervals between neighbouring transverse strands 37. Similarly, the longitudinal strands may also extend obliquely with respect to the longitudinal axis of the submarine cable 33 or wrap around it in a serpentine manner. Such longitudinal strands are also joined by transverse strands, which, if appropriate, may extend obliquely with respect to the longitudinal axis of the submarine cable 33 in order that they intersect the longitudinal strips at right angles.

The longitudinal strands 36 and transverse strands 37 intersect at nodes 39. At these nodes 39, the longitudinal strands 36 are at the same time integrally joined to the transverse strands 37. The longitudinal strands 36 and the transverse strands 37 preferably have round cross sections of the same size.

The netting 34 is applied to the outer sheath 35 after the said sheath has been produced. For this purpose, after extrusion of the outer sheath 35 onto the core of the submarine cable 37, the netting 34 is extruded onto

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the outside of the outer sheath 35 in a second extrusion step.

5 The netting 34 and the outer sheath 35 are preferably formed from plastic, in particular an identical plastic. With regard to colour, the netting 34 differs from the outer sheath 35. For example, the netting 34 is of a yellow colour, if appropriate with fluorescent properties, while the outer sheath 35 is black. The
10 openings 38 between the longitudinal strands 36 and the transverse strands 37 then appear black, while between neighbouring openings 38 there is the yellow marking formed by the longitudinal strands 36 and the transverse strands 37.

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As a departure from the exemplary embodiments shown, the markings may take any other desired form. For example, transverse strips, longitudinal strips which extend in a straight line parallel to the longitudinal
20 centre axis of the submarine cable or dots with square or non-round surface areas may be used. It is also conceivable to form the longitudinal strips or other strips by a row of dots following one another at short intervals or to interrupt the continuous longitudinal
25 or transverse strips occasionally. In addition, it is conceivable to vary the number of longitudinal strips as desired or to combine longitudinal strips and dots with one another.

30 An alternative development of the invention, not shown in the figures but preferred, envisages providing the outer circumferential surface of the submarine cable not only with one or more spiral longitudinal strips (for example according to Figures 1-5) but also with at
35 least one longitudinal strip extending in a straight line parallel to the longitudinal centre axis of the submarine cable. The submarine cable is then provided with both spiral and longitudinal strips. The straight longitudinal strips allow twisting or torsion to be

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identified during the laying of the cable, in that the straight longitudinal strip is also made to run spirally with a relatively great pitch. When the submarine cable has been laid, the spiral longitudinal
5 strip or strips then serve for allowing it to be identified in any desired position under water.

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List of reference numerals

- 10 Submarine cable
- 11 Outer sheath
- 12 Longitudinal centre axis
- 13 Longitudinal strip
- 14 Submarine cable
- 15 Outer sheath
- 16 Longitudinal centre axis
- 17 Longitudinal strip
- 18 Longitudinal strip
- 19 Node
- 20 Submarine cable
- 21 Longitudinal strip
- 22 Longitudinal strip
- 23 Longitudinal strip
- 24 Longitudinal strip
- 25 Outer sheath
- 26 Node
- 27 Node
- 28 Submarine cable
- 29 Outer sheath
- 30 Dot
- 31 Longitudinal centre axis
- 32 Longitudinal centre axis
- 33 Submarine cable
- 34 Netting
- 35 Outer sheath
- 36 Longitudinal strand
- 37 Transverse strand
- 38 Opening
- 39 Node

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Claims

1. Cable, in particular underwater cable, with a cable core, having at least one conductor, and an
5 outer sheath (11, 15, 25, 29), characterized in that the outer sheath (11, 15, 25, 29) has at least one externally visible marking, which is of a colour standing out from the colour of the outer sheath (11, 15, 25, 29).
- 10 2. Cable according to Claim 1, characterized in that the marking is formed by at least one longitudinal strip (13; 17, 18; 21, 22, 23, 24) extending continuously in the longitudinal direction of the
15 outer sheath (11, 15, 25).
3. Cable according to Claim 2, characterized in that the at least one longitudinal strip (13; 17, 18; 21, 22, 23, 24) extends spirally, preferably
20 repeatedly and spirally, around the outer sheath (11, 15, 25).
4. Cable according to Claim 2, characterized in that a plurality of longitudinal strips (13; 17, 18; 21, 22, 23, 24), preferably two, continuously run
25 in opposite coiling directions and spirally around the outer sheath (11, 15, 25).
5. Cable according to Claim 2, characterized in that a plurality of spiral longitudinal strips (17, 18; 21, 22, 23, 24) are provided adjacently to one
30 another, the spiral longitudinal strips (17, 18; 21, 22, 23, 24) being assigned in such a way that at least some of the longitudinal strips (17, 18; 21, 22, 23, 24) cross in certain regions.
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6. Cable according to Claim 1, characterized in that the marking is formed by a multiplicity of two-dimensional formations.

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7. Cable according to Claim 6, characterized in that the two-dimensional formations are arranged in rows in the longitudinal direction in such a way that they form at least one interrupted spiral line around the outer sheath.
8. Cable according to Claim 6, characterized in that the two-dimensional formations are arranged in a grid extending over the surface area of the outer sheath.
9. Cable according to Claim 6, characterized in that the two-dimensional formations are distributed randomly on the outer sheath.
10. Cable according to Claim 1, characterized in that the marking is in the form of a netting (34) surrounding the outer sheath (35).
11. Cable according to Claim 1, characterized in that the marking is formed by dye applied externally to the outer sheath (11, 15, 25, 29).
12. Cable according to Claim 1, characterized in that the marking is formed during the production of the outer sheath (11, 15, 25, 29) from a material of a colour differing from the colour of the outer sheath (11, 15, 25, 29).
13. Cable according to Claim 1, characterized in that the marking, of a material of a different colour, is applied to the surface of the outer sheath (11, 15, 25, 29) by extrusion.
14. Cable according to Claim 1, characterized in that the marking, of a material of a different colour is applied to the surface of the outer sheath (11, 15, 25, 29) by sintering.

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5 15. Cable according to Claim 1, characterized in that the marking is formed by a multiplicity of colour particles mixed into the plastic material for producing the outer sheath (11, 15, 25, 29).

16. Cable according to Claim 1, characterized in that the marking is of a lighter colour than the outer sheath (11, 15, 25, 29).

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17. Cable according to Claim 16, characterized in that the lighter colour of the marking has reflective properties

15 18. Cable according to Claim 16, characterized in that the lighter colour of the marking has fluorescent properties.

20 19. Cable according to Claim 1, characterized in that, if the outer sheath (11, 15, 25, 29) is of a black colour, the marking is of a yellow colour.