

The invention relates to an additional armour for cables, in particular for submarine cables, the cable to be armoured being inserted in receptacles of this longitudinally extending additional armour.

5 It is known to provide cables for special applications, for example when laying on the sea bed, with additional armour or protective means with the aid of which the cables initially not suitable for this purpose can then nevertheless be used. One such
10 additional protective measure for a cable is described in DE-A-3,145,022. There, a tubular stiffening device is arranged around the cable in the zones of the cable, which correspond to the uneven regions of the sea bed. These tubes used have a rigidity which is greater than
15 the rigidity of the cable. However, in assembling the tubular device itself, as in inserting the cable into this tubular device, these stiffening devices give rise to certain problems, which require a corresponding outlay.

20 It is also known for lightweight cables to be provided for the purpose of sinking in water bodies with sinking weights which are fixed to the cable likewise subsequently, specifically only when required. Such sinking weights are described in more detail in
25 EP 0,001,541. Use is made there of an elongated, cylindrical and weighted body which has a longitudinally extending receptacle into which the cable is inserted. This embodiment is relatively rigid, very heavy in accordance with its purpose, and can be used in each case
30 only for a specific cable, so that a plurality of types are to be made available.

 It is therefore the object of the present invention to provide an additional armour for cables, in particular submarine cables, which can be used in wide
35 fields for arbitrary cable embodiments, the aim being in the overall combination for this additional armour to lend the cable, in addition to the increased mechanical protection, an increased tensile strength in conjunction

with good flexibility. The object set is achieved with the aid of an additional armour of the type outlined at the beginning due to the fact that the additional armour has longitudinally aligned, tension-proof elements, and
5 that the receptacles are arranged running continuously in the main direction.

Transmission of messages under water, for example from island to island or from the mainland to an island is performed, for example, with the aid of unarmoured
10 deep-sea cables and using shore-end cables with moderate to heavy armour. Reasons for the armour reside, inter alia, in the fact that the cables need to be protected against damage by anchors, stakes, trawls, etc. This armour also has disadvantages, however, since it is
15 permanently connected to the respective cable and therefore cannot be omitted at any desired point. If follows herefrom, for example, that it may be necessary to store different types of cable which then have to be cut and spliced on board in the event of laying from a
20 ship. This also has the result that in certain circumstances high-quality cables are used where the function could also be fulfilled by cables of lesser quality. However, in the case of very small cables subsequent application of armour with a high tensile
25 strength is particularly problematical. In accordance with the invention, the aim is therefore for light or heavy armour to be applied depending on the application on the laying device, for example the ship, the aim being for no expensive machines such as, for example, stranding
30 devices or the like to be used. This concept can be applied for all cables; however, it is particularly advantageous, for example, when using optical fibre cables, since the transmission of large numbers of signals over long distances can be performed without
35 intermediate amplifiers, the cable itself having very small dimensions. Armour already existing in the cable itself is not disruptive in this case, since in accordance with the invention this adds to the effect of the

additional armour. Thus, it is therefore possible subsequently to adapt a cable to the particular required conditions accordingly depending on its field of application without a large outlay with respect to its armour and thus its mechanical properties. Thus, these conditions are already fulfilled in accordance with the invention by a simple flat profile to which the cable is attached, but the use of the embodiments described in more detail below is to be recommended, since they cover all requirements simultaneously. The advantages of the additional armour in accordance with the invention are obvious; the point is that the armour can be adapted to the actual requirement on the laying means, it also being possible for the required number of cables to be calculated at the same time. Depending on the exemplary embodiment, an arbitrary number of cables can simultaneously be provided with a single additional armour. A suitable closure is attached at the beginning and at the end of the applied additional armour as required, in each case. The additional armour itself is protected against corrosion by appropriate coatings, for example made from plastic, these coatings additionally being configured such that as a result, fixing of the inserted cable is made possible. The longitudinally extending receptacles for the cable are constructed such that the cables can be inserted and fixed in a simple way, it being ensured that water can also penetrate into the receptacles, so that no extra lift can be produced by air inclusions.

The invention will now be explained in more detail with the aid of ten figures, wherein:-

- Figure 1 shows applications for additional armour in accordance with the invention,
Figure 2 shows an additional armour with deformable receptacles for fixing an inserted cable,
Figure 3 shows an additional armour with a resilient fixing for inserted cables,
Figures 4 and 5 show exemplary embodiments of additional armour which is suitable for receiving

a plurality of cables,

Figure 6 shows an exemplary embodiment with a central tension-proof element,

5 Figure 7 shows an exemplary embodiment with two tension-proof elements extending next to one another and two receptacles for cables,

Figure 8 shows an exemplary embodiment for three tension-proof elements and three receptacles for cables,

10 Figure 9 shows a further exemplary embodiment with a multiplicity of individual tension-proof elements,

Figure 10 shows an exemplary embodiment with concentrically distributed tension-proof elements,

15 Figure 11 shows an exemplary embodiment with deformable limbs,

Figure 12 shows an exemplary embodiment with resilient limbs,

20 Figure 13 shows an exemplary embodiment with an additional armour constructed as a snap element,

Figure 14 shows a starting or end piece for fixing additional armour to the inserted cables, and

25 Figure 15 shows a further closure for the additional armour.

Figure 1 shows how a cable 4 can be adapted to the conditions in a water body W with the aid of the additional armour 1 in accordance with the invention. The risk of damage is particularly high in the vicinity of the shore, so that here the cable 4 is provided with the additional armour 1, whereas in deeper regions the cable's own armour is completely adequate. A further piece of the additional armour 1 can be applied again, for example, in intermediate regions with a higher risk due to obstacles on the bed GB of the water body. It is possible in this way to match the entire length of the cable to the conditions with a single type of cable which is completely adequate for normal conditions, without

30

35

splicing, when the cable 4 is laid.

Figure 2 shows a first exemplary embodiment of the invention for an additional armour 1a in which there are two possibilities for receiving a cable 4. The additional armour 1a has two limbs 2a attached in the shape of U, so that two longitudinally aligned U-shaped receptacles 3a are produced for the cables 4. These limbs 2a increase the tensile strength of the additional armour 1a, as well as thereby of the cables 4 inserted therein. The two internal limbs 2a of the two receptacles 3a are expediently configured deformably, so that the inserted cables 4 can be fixed inside the receptacles by bending in - as indicated by the arrows. This additional armour, like all subsequent exemplary embodiments, is also brought together running in parallel on the laying means, for example a ship, and brought into mutual engagement as required, so that the additional armour can be applied and cut back at any desired time.

Figure 3 shows a second exemplary embodiment in which the actual additional armour 1b has two protruding limbs 2b which are arranged in a mutually resilient fashion. Thus, a longitudinally extending receptacle 3b is formed here, in which a plurality of cables 4 can be inserted depending on the length of the limbs 2b. Arranged on the ends of the limbs 2b are projections 6 which prevent the cables 4 from sliding out. However, this closure due to the projections 6 is constructed in such a way that water can penetrate into the receptacle 3b, so that the formation of air inclusions promoting lift is prevented during laying.

Figure 4 shows the front view of an additional armour 1c having limbs 2c protruding in the shape of a star. It is possible in this way to construct a plurality of - in this case 4 - receptacles 3c for cables 4. Again, closure-like constrictions which prevent the inserted cables 4 from sliding out are provided on the receptacles 3c by appropriate undercuts of the limbs 2c or - as is shown here - by swellings 7 of applied coatings 5. This

construction, too, is configured in a particularly tension-proof fashion due to the attached limbs 2c, and forms an adequate protection for the unarmoured or weakly armoured cables.

5 Figure 5 illustrates in a front view an additional armour 1d having tension-proof limbs 2d integrally formed in the shape of a H, so that in this way two groove-shaped receptacles 3d are formed in which the cables 4 to be armoured are inserted. The entire
10 additional armour 1d is surrounded by a coating 5 which produces overall a round - here, oval - basic shape. As a result, it is possible, in particular, to reduce frictional losses on the bed of the water body. Here, again, the coating 5 is swollen in turn at the entrances
15 to the receptacles 3d and shaped into specially shaped inlet channels in order to prevent the cables 4 from sliding out unintentionally.

 Figures 6 to 9 show exemplary embodiments in which separate tension-proof elements 2e, 2f, 2g and 2h
20 are embedded in the additional armour 1e, 1f, 1g and 1h. These tension-proof elements consist either of individual elements or of a plurality of fibres or filaments which are embedded inside the additional armour running in parallel or mutually stranded. The longitudinally aligned
25 receptacles 3e, 3f, 3g and 3h in which the cables 4 to be armoured are inserted are then respectively introduced in the additional armour. It is possible by means of such a construction, in particular by stranding individual thin tension-proof elements, for the entire arrangement of the
30 additional armour to be kept very flexible without the tensile strength or the protective capability being impaired. The details of these exemplary embodiments are explained in more detail below.

 Figure 6 shows in front view an inherently
35 compact additional armour 1e having an approximately round cross-section, which is equipped in the interior with the tension-proof elements 2e described above and which has, for example, four longitudinally extending

receptacles 3e on the circumference for the cables 4. Again, the receptacles 3e can be provided with corresponding undercuts at the openings. It is also possible to construct these receptacles 3e as closed channels which
5 are then cut open using an aid when laying, it being expedient for the cables 4 to be subsequently inserted immediately. However, these channels are preferably provided with openings so that water can penetrate the cables so armoured when they are laid in the water. A
10 kind of perforation can, for example, be provided for this purpose.

Figure 7 shows the front view of an exemplary embodiment in accordance with the invention, in which two tension-proof elements 2f are inserted situated next to
15 one another in the additional armour 1f. With this construction, the receptacles 3f are arranged in the interstices between the two tension-proof elements 2f. The embodiments of these receptacles 3f and of the tension-proof elements 2f can likewise be constructed in
20 accordance with the variants already described.

The exemplary embodiment according to Figure 8 shows the front view of an additional armour 1g having three tension-proof elements 2g which can likewise be correspondingly varied. It is possible, moreover, to
25 strand these tension-proof elements 2g mutually in accordance with principles known per se, so as in this case, too, to produce on the circumference for the longitudinally aligned receptacles 3g a longitudinal displacement corresponding to the type of stranding. For
30 example, the receptacles 3g are again provided with a slot 8 by means of which the cables 4 are prevented from sliding out, it being possible for water to penetrate into the interior.

Figure 9 shows a further exemplary embodiment, in
35 which a multiplicity of tension-proof elements 2h are arranged in the shape of an H in the additional armour 1h. Given appropriate recessing, two slot-shaped receptacles 3h into which the cables 4 can be inserted are

produced in accordance with the H-shape. A locking closure 9, for example, could be constructed as a safeguard for the cables. Here, in the groove-shaped receptacle, 3h a locking element, for example a round section or also balls, is then pressed into the outer region of the receptacle 3h, it being preferred for grooves or something similar in the wall of the receptacles 3h to increase the locking effect.

Figure 10 conveys an exemplary embodiment in which the tension-proof elements 2m constructed as additional armour 1 are arranged inside two tubular plastic tubes 5m and 5n constructed as a coating. The tension-proof elements 2m are arranged and distributed concentrically in the circumference either uniformly or at variable intervals. The longitudinally extending receptacle 3m for the cable to be armoured is located in the interior of the internal tube 5n. Depending on the type of laying, it is also possible, for example, to insert into the receptacle 3m a draw wire 11, which then also makes it possible for the cable to be armoured not to be inserted until later. This method is particularly practical when the submarine cable is to be protected only in the region of the shore in each case. Thus, this exemplary embodiment in accordance with the invention also enables subsequent insertion of the cable, it being the case that all the previously described features apply with respect to the material of the individual elements and to the fulfilment of the object. The two plastic tubes 5m and 5n can also be constructed as a compact tensile load element if the tension-proof elements 2m are embedded directly in the material of the jacket 5. This embedding can then already be taken into account during the production of the additional armour when the plastic tube is being extruded.

Figure 11 shows an exemplary embodiment with deformable limbs 2i which resembles the example according to Figure 1 [sic]. However, here the limbs 2i are arranged in a circular fashion and initially form a

longitudinally extending gap through which the cable 4 to be armoured can be inserted into the longitudinally extending receptacle 3i. After insertion, the two limbs 2i are pressed against one another, so that the cable 4 cannot emerge by accident. The limbs 2i, which are constructed as tension-proof elements, are preferably surrounded by a protective layer 5, for example a plastic, as corrosion protection.

Figure 12 shows a modified exemplary embodiment according to Figure 3. The principle for the receptacle 3k of the cable 4 is the same; it is a longitudinally extending cavity which is constructed by resilient limbs 2k, arranged in the shape of a U, as a locking closure at one end. The limbs 2k are embedded in a corrosion protection which also forms the locking closure. The external contours are rounded as far as possible, in order to reduce friction at edges and the like.

Figure 13 shows an exemplary embodiment in which a plastic section 5l which is snapped like a claw onto the tension-proof element 2l is used as the fixing element for cables 4 and the tension-proof element 2l. In this case, the internal profile is adapted to the tension-proof element 2l which is pressed in after the cable 4, so that it simultaneously serves as closure for the recessed receptacle 3l which accommodates the cable 4. The tension-proof element 2l can be constructed as an individual element or from a multiplicity of fibre-shaped elements, for example as steel cable, in the manner already described.

It is further illustrated in Figure 14 that the ends or the starting pieces of the additional armour 1 to be applied are secured and possibly also closed. This is performed, for example, with the aid of a cast resin seal 10 by means of which the additional armour 1 is fixed together with the cables 4.

Shown in Figure 15 is a further end closure 13 by means of which an additional armour, in this case according to Figure 7, for example, is fixed at its end.

Here, the additional armour has, for example, two longitudinally extending tension-proof elements 2f which comprise individual elements. Inserted in one of the longitudinally extending receptacles 3f is a cable 4
5 which is to be armoured and which is further laid at the end of the additional armour without the latter. In order then to fix this end of the additional armour, a winding tape 13, for example made from an elastomer, is wrapped here and fixed by means of a clamp 14. It is also
10 indicated that the receptacles of the additional armour are secured with the aid of clamps 12, which are folded on, for example. These clamps 12 are applied at appropriate intervals depending on need. Such a closure can be mounted both at the start and at the end of the
15 additional armour, so that the latter is adequately protected against inadvertently sliding off the cable.

It is, of course, possible to combine the variants discussed in the individual exemplary embodiments, so that sensible and optimised combinations
20 can also be produced for the application currently required.

The tension-proof elements of the exemplary embodiments according to Figures 2 to 5 preferably comprise rolled steel, possibly hot-galvanised or
25 bitumenised, and are sheathed in polyethylene or polypropylene. In the exemplary embodiments according to Figures 6 to 9, it is preferred to use steel cables, also possibly hot-galvanised, bitumenised and sheathed in polyolefin. Stainless steel is used in the event of
30 special quality requirements. Tension-proof filaments and ropes made from glass or plastic yarns can likewise be used.

29 patent claims

15 figures

86 P 1391 E

	1, 1a, 1b, 1e, 1f, 1g, 1h	Additional armour
	2, 2a - 2l	Limbs
	3a - 3m	Receptacle
5	4	Cable
	5, 5l - 5n	Coating
	6	Projection
	7	Swelling
	8	Slot
10	9	Locking closure
	10	Cast resin seal
	11	Draw wire
	12	Clamp
	13	Winding tape
15	14	Clamp
	GB	Bed of water body
	W	Water body

Patent claims

1. Additional armour (1) for cables, in particular submarine cables, the cable (4) being inserted in receptacles (3) of this longitudinally extending additional
5 armour (1), characterised in that the additional armour (1) has longitudinally aligned, tension-proof elements (2), and in that the receptacles (3) are arranged running continuously in the main direction.
2. Additional armour according to Claim 1, characterised in that the receptacles (3) for the cables (4)
10 are constructed as U-shaped channels from protruding limbs (2) of the additional armour (1).
3. Additional armour according to Claim 2, characterised in that the limbs (2) are deformable.
- 15 4. Additional armour according to Claim 2, characterised in that the limbs (2) are constructed resiliently for the purpose of fixing the cables (4).
5. Additional armour according to one of the preceding claims, characterised in that a plurality of limbs
20 (2) protrude in the shape of a star from a central additional armour (1) in order to form a plurality of receptacles (3).
6. Additional armour according to one of the preceding claims, characterised in that the receptacles (3)
25 are constructed as longitudinally extending cavities in the additional armour (1), the cavities having a longitudinally extending weak point (8) which can be split open.
7. Additional armour according to Claim 6, characterised in that the weak point (8) has outwardly directed
30 openings at intervals.
8. Additional armour according to one of the preceding claims, characterised in that the limbs (2a, 2b, 2c, 2d) of the receptacles (3a, 3b, 3c, 3d) and the
additional armour (1a, 1b, 1c, 1d) comprise tension-
35 proof, preferably identical material.
9. Additional armour according to one of Claims 1 to 7, characterised in that separate tension-proof elements (2e, 2f, 2g, 2h), in particular constructed like fibres





or filaments, are embedded in the additional armour (1e, 1f, 1g, 1h).

10. Additional armour according to one of the preceding claims, characterised in that the tension-proof
5 elements (2e, 2f, 2g, 2h) comprise mutually stranded fibres or filaments of tension-proof materials.

11. Additional armour according to one of the preceding claims, characterised in that a tension-proof
10 element (2e) is arranged centrally in the additional armour (1e).

12. Additional armour according to one of Claims 1 to 10, characterised in that a plurality of tension-proof
elements (2f, 2g, 2h) are arranged in the additional
armour (1f, 1g, 1h).

13. Additional armour according to Claim 12, characterised in that two tension-proof elements (2f) are
15 arranged next to one another in the additional armour (1f), and in that the receptacles (3f) extend in the interstices between the two tension-proof elements (2f).

14. Additional armour according to Claim 12, characterised in that three tension-proof elements (2g) are
20 arranged, preferably mutually stranded, in the additional armour (1g), and in that the receptacles (3g) are arranged in the outer interstices.

15. Additional armour according to Claim 12, characterised in that the tension-proof elements (2h) are
25 arranged in the shape of an H in the additional armour (1h), and in that the slot-shaped receptacles (3h) thereby formed can be provided with closing elements (9).

16. Additional armour according to Claim 15, characterised in that spherical closing elements can be
30 wedged at an interval from one another in the outer regions of the receptacles (3h).

17. Additional armour according to Claim 15, characterised in that strip-shaped closing elements (9) can be
35 wedged in.

18. Additional armour according to one of Claims 1 to 10, characterised in that the tension-proof elements (2m)



are arranged concentrically about a tubularly constructed receptacle (3m).

19. Additional armour according to Claim 18, characterised in that a draw wire (11) is arranged in the
5 receptacle (3m).

20. Additional armour according to one of Claims 18 or 19, characterised in that the tension-proof elements (2m) are embedded between two concentrically arranged jackets (5m, 5n).

10 21. Additional armour according to one of Claims 18 or 19, characterised in that the tension-proof elements (2m) are embedded in a jacket (5m).

22. Additional armour according to one of the preceding claims, characterised in that it (1) can be
15 separated and fitted at any desired point.

23. Additional armour according to Claim 22, characterised in that it (1) is fixed at its ends to the cable (4) by means of a closure (10), in particular a cast resin seal.

20 24. Additional armour according to Claim 22, characterised in that it (1) is secured at its ends by means of a winding tape (13) and a fixing clamp (14).

25. Additional armour according to one of the preceding claims, characterised in that clamps (12) are
25 applied at intervals.

26. Additional armour according to one of the preceding claims, characterised in that the tension-proof elements (2) comprise rolled steel, preferably hot-galvanised or bituminised.

30 27. Additional armour according to one of Claims 1 to 25, characterised in that the tension-proof elements (2) comprise steel cables, preferably hot-galvanised or bituminised.

35 28. Additional armour according to one of the preceding claims, characterised in that the tension-proof elements (2) are sheathed in a plastic, preferably polyethylene or polypropylene or polyolefin.



29. Additional armour according to one of Claims 7 to 25, characterised in that the tension-proof elements (2) are formed from individual glass or plastic yarns.