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54 **Tension cable.**

57 A cable for relaying signals or power from one fixed point (18) below sea water level and another fixed point (16) above sea water level wherein the cable is maintained under tension between the two fixed points. The tensioned cable is of use on offshore structures such as production platforms and drilling rigs.

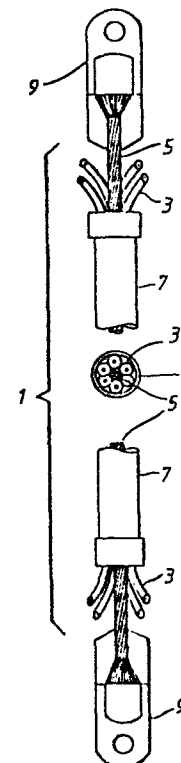


FIG. 1

TENSION CABLE

This invention relates to a method for transmitting electrical signals, optical signals, electrical power and other utilities through the splash zone from one fixed point below the water to another fixed point above the tide on a gravity or floating structure or from the sea bed to a fixed point above the surface.

Offshore structures such as production platforms and drilling rigs can find themselves subjected, for long periods and large parts of the year to forceful battering by the sea in the "splash zone" which is the region reached by the waves in the cycle of the tide.

In stormy regions such as the North Sea, it is generally considered that non-structural auxiliary fixtures to offshore structures attached subsequent to float-out and location rarely survive a whole year in the splash zone. Further, observation transducers, instruments, cabling and the like are never expected to survive the first storm if they are left attached to the structure in this splash zone. This is a particular problem in the field of instrumentation such as non-destructive examination and crack monitoring because it means that divers must be sent down to perform measurements and the instruments then returned; this is very expensive and inconvenient, whether the measurements are to be made near the splash zone or sea bed owing to the weather at the surface and the additional difficulty of saturation diving at depth. The analog information is usually relayed to measurement instrumentation on a support vessel or platform by a cable. Furthermore, if it is cracks that are to be measured, the propagation of cracks is of greatest interest during the stormy or harsh winter weather

when diving is not possible.

Attempts have been made in the past to provide cables to instruments by fixing a conduit, or other attachment to the leg of the structure but unless
5 such attachments are incorporated into the jacket as major structural features at the fabrication stage they have suffered the fate already described. Thus the present attitude in the industry is that use of permanent monitoring and other instrumentation
10 requiring such cables is generally impractical and such instrumentation should be used only in good weather.

According to the present invention there is provided a cable for relaying signals or power
15 between one fixed point at or below water level and another fixed point above water, wherein said cable is under tension between the said two fixed points sufficient to resist damage from waves.

According to a second aspect of the invention
20 there is provided a method of relaying power or signals between one fixed point at or below water level and another fixed point above water which comprises providing a power or signal cable between said two fixed points and maintaining the cable
25 under tension.

The invention is suitable for relaying signals, power or utilities. Electromechanical cables themselves are known but have always been used to support or tow vessels, instruments and
30 objects and never for the stated application. They usually have a central galvanised high tensile steel wire rope around which conductors are wound. Figure 1 shows such a cable. In that Figure, there is shown a cable (1) comprising conductors (3) twisted
35 around a wire rope (5) and surrounded by an

insulating jacket (7); at either end there is a tensioning and securing tab (9). However, at the high tension required in the applications, with which the present invention is concerned, the cable of Figure 1 would not be suitable for tensioning around a drum or capstan due to the strong likelihood of the wire rope crushing and damaging the conductors. It could be tensioned, however, by using a threaded lug/bolt arrangement for example.

5
10 Preferably the cable of the invention comprises conductors surrounded by steel wire for tensile strength.

An embodiment of the invention will now be described, by way of example, with reference to
15 Figures 2, 3 and 4 of the accompanying drawings in which:-

Figure 2 is a cable suitable for use in the present invention;

Figure 3 is an elevation of a cable attached
20 to a structure, according to the invention; and

Figure 4 is a perspective view of the portion of a deep water structure underwater and a cable according to the invention.

Referring to Figure 2, a tension cable
25 assembly is shown comprising known half-locked armour (10) and a tough waterproof insulating jacket (12), suitably 2 to 3mm thickness of polyethylene or polyurethane, surrounding conductors (14). At the upper end (at the platform), the cable terminates in
30 a flame-proof junction box incorporated into the drum (16) of a capstan where the tension is monitored. At the lower (underwater) end, there is a header (18) to which the armour (10) is connected for tension and through which the conductors are
35 distributed. The header (18) also has a

hydro-static pressure sensor (20) giving the head of water above the attachment to monitor wave height.

5 The breaking strength of the armour (10) is preferably at least 10 times the normal operating static load on the cable (typically 0.5 metre tonnes) and three times the maximum dynamic stress to which the complete electromechanical cable is subjected under worst sea state conditions typically 1.5 metric tonnes for a 25 mm o.d. cable running
10 from -12 metres to +30 metres in 10 metre waves and hurricane force 12 winds. In the case of small electrical signal or power cables, the armour can be two or more conventional wraps of suitable high strength steel wire, as required to give this level
15 of mechanical strength or alternatively one or more wraps of half or full locked wires.

 The cable is fitted to the structure as follows.

20 The underwater header is secured to the structure at a safe, unexposed point below the water, for example to a tubular brace using a "Terylene", "Nylon", or metallic loop sling (preferably mild steel for compatibility with the structures impressed cathodic protection) with ring
25 and shackle or fitted directly to a convenient weldment on the structure, or to a separate anchorage on the sea bed. This is illustrated in Figure 3 which shows a leg (22) and cross braces (24) of a structure, two cables (1a, 1b), the first
30 attached directly to a convenient ancillary weldment on the leg (22) and the second attached to a brace by a sling (26) with a shackle (28). Figure 3 also shows four conductors (14) leading to acoustic transducers (30) on the structure and a cable tie
35 (32) securing the conductors (14).

 The transducers (30) are suitably of the type

described in our co-pending application 84 0186448
filed concurrently herewith.

5 The cable is next tensioned at the surface by
means of its delivery drum. The working tension in
the cable is decided by: the modulus of elasticity
of the combination such that none of the constituent
conductors are at any time subjected to loads in
excess of 30% of their yield stress; the peak
displacement of the cable under tension when excited
10 dynamically, preferably less than or approximately
equal to 1000 mm; and the maximum permitted loading
of the points of attachment. To avoid any
likelihood of damage to the structure as a result of
mis-use or accident the cable is either designed to
15 fail first or the tensioning device designed so as
to release the cable when a pre-set maximum
permissible tension is exceeded. The normal
operating static load on the tension cable would
typically be 500Kg to 1000Kg for applications
20 involving light signal cables (od 25 mm).

In situations requiring long lengths of cable,
such as deep water installations, a "node point" is
suitably created at a safe point close to the
surface by pulling the tension cable to a convenient
25 member of the structure via a free sliding, low
friction ring on the cable. This is shown in Figure
4. By this means the peak displacement can be
limited to 1000 mm without excessive tension being
required.

30 In the case of a subsea production
installation, the tension cable method permits rapid
installation of transducers and high integrity, high
speed data transmission from the sea bed to the
surface.

35 The tension cable method permits fibre optic

cables to be used for signal and low power transmission, thus greatly improving the speed and quality of signal and data transmission, along a communication umbilical.

It will, of course, be understood that the present invention has been described above purely by way of example, and modifications of detail can be made within the scope and spirit of the invention.

CLAIMS:-

1. A cable to relay signals or power, which cable is disposed between one fixed point at or below water level and another fixed point above
5 water, said cable being under tension between the said two fixed points.
2. A cable according to claim 1 wherein said another fixed point is disposed on an offshore structure.
- 10 3. A cable according to claim 1 or 2 wherein the static tension is from 500Kg to 1000Kg and the peak displacement in the direction of wave movement is less than 1000 mm in severe weather conditions.
4. A cable according to any one of claims 1,
15 2 and 3 comprising one or more conductors strengthened by wire extending the length of the cable.
5. A cable according to claim 4 wherein said wire helically encloses said conductors.
- 20 6. A cable according to claims 4 or 5 being connected at said one fixed point to a header by means of the said wire, which header protects the conductors in the region of the one fixed point.
7. A cable according to claim 5 having,
25 disposed at said another fixed point, a means for coiling and tensioning the cable.
8. A cable according to any of the preceding claims further having means to maintain a specified static tension in the cable and to release the cable
30 when a predetermined tension is exceeded.
9. A cable according to any one of the preceding claims wherein the conductors are optical fibres.
10. A cable substantially as hereinbefore
35 described with reference to Figure 1 or 2 with 3 and

4 of the accompanying drawings.

11. A method of relaying power or signals between one fixed point at or below water level and another fixed point above water which comprises providing a power or signal cable between said two fixed points and maintaining the cable under tension.

12. A method according to claim 11 wherein said another fixed point is disposed on an offshore structure.

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FIG. 1

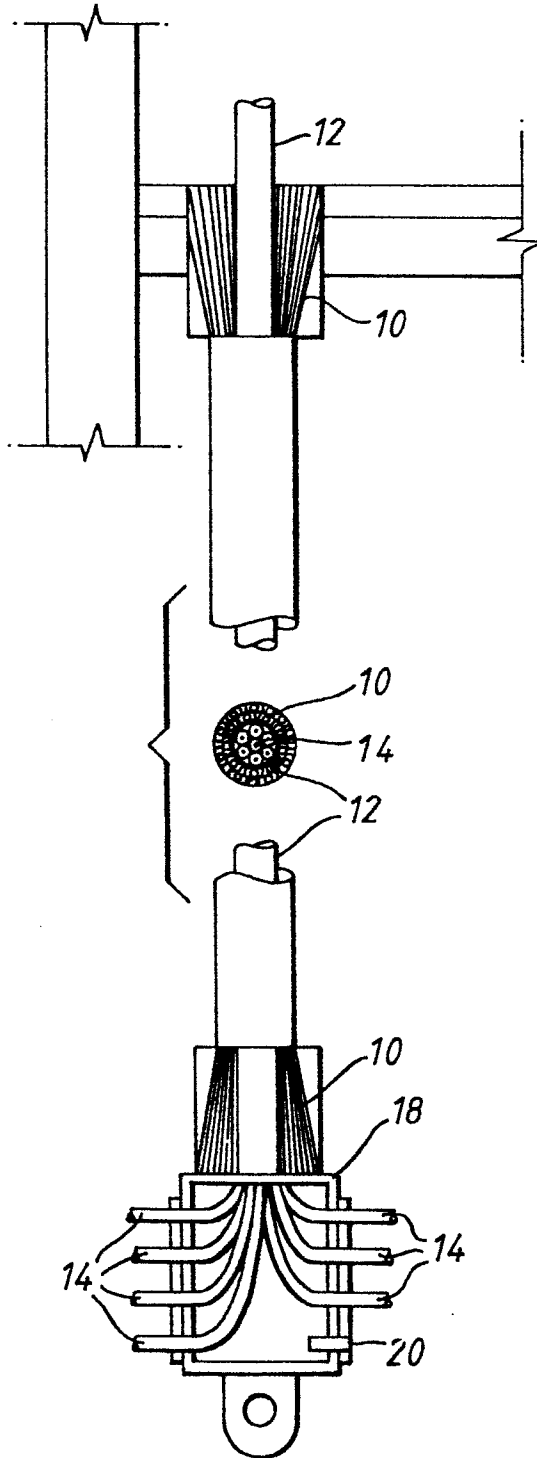
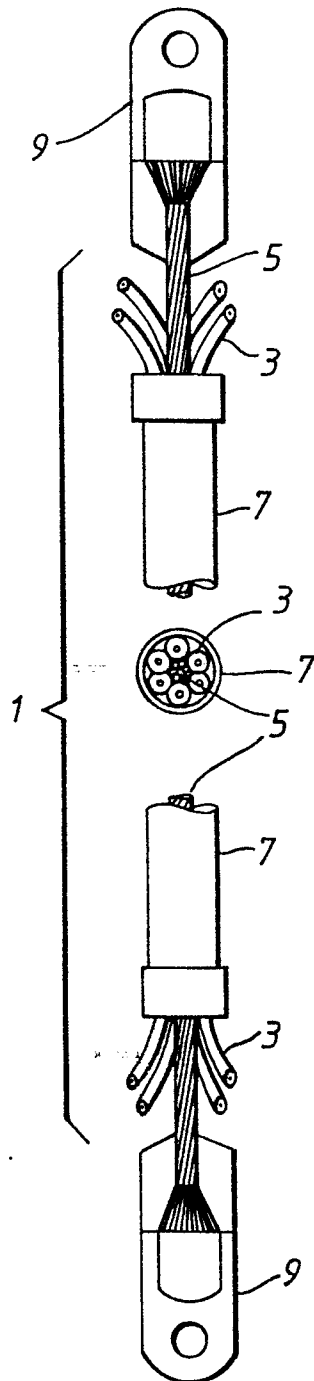


FIG. 2

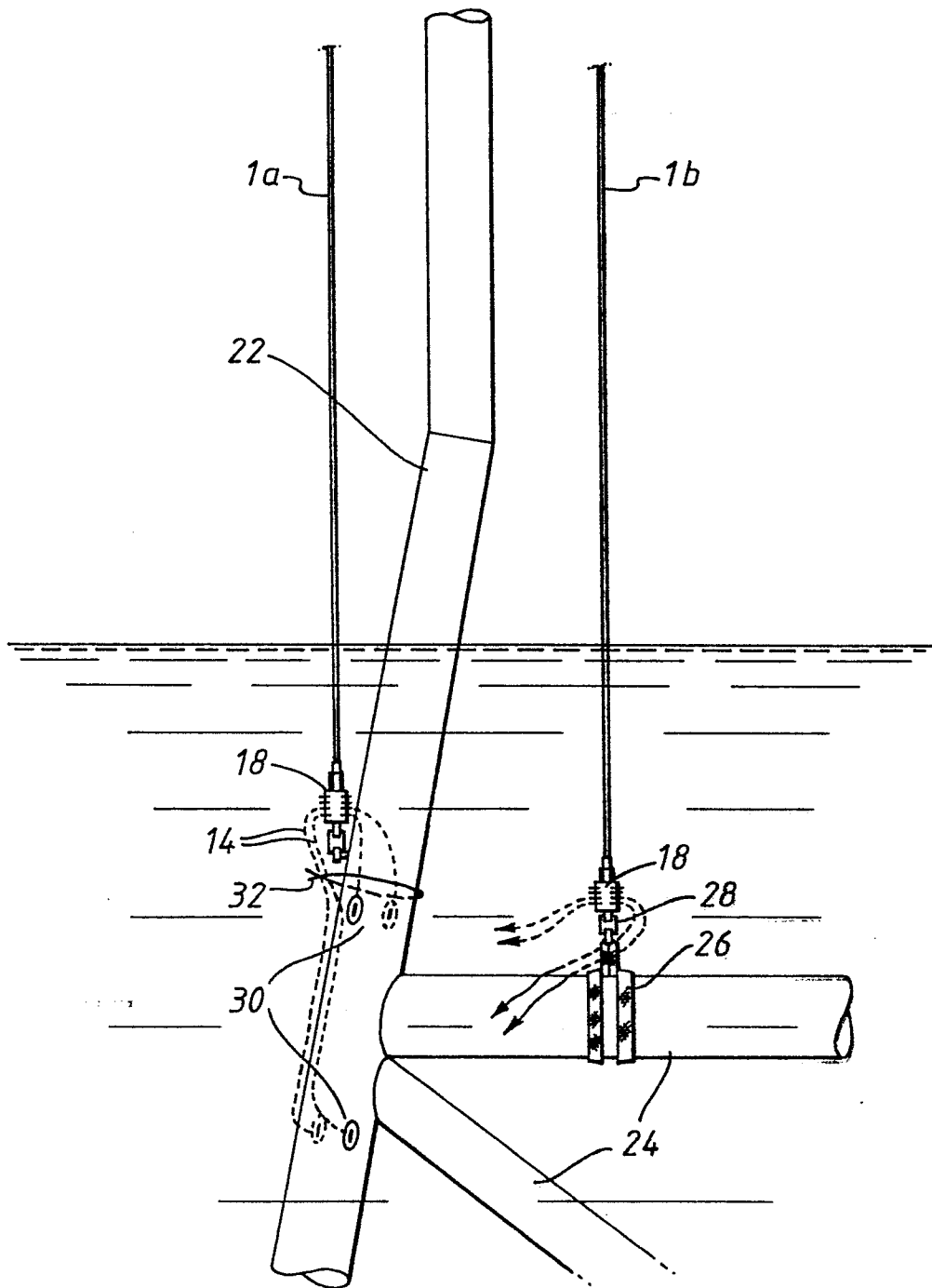


FIG. 3

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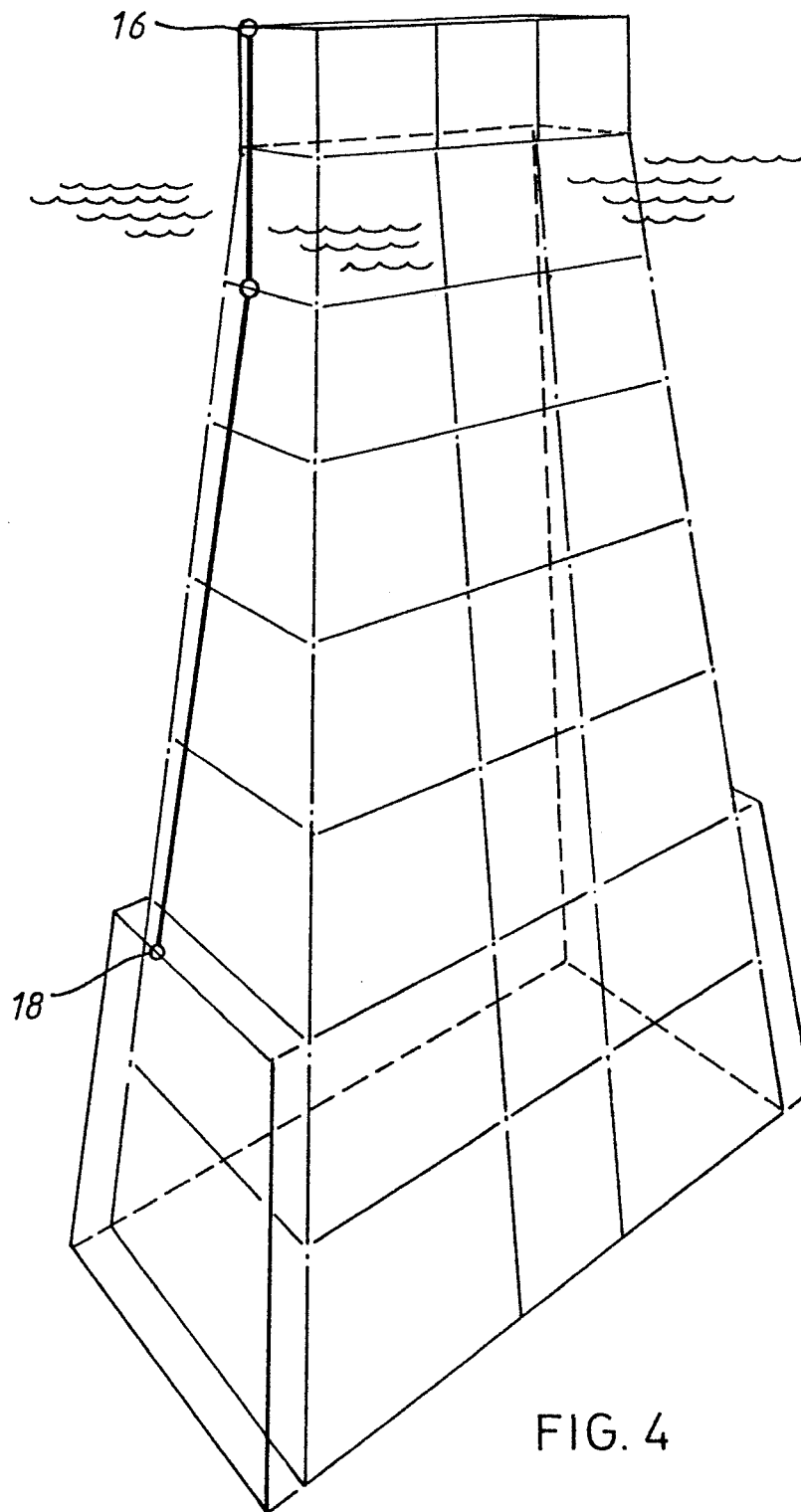


FIG. 4