Dec. 14, 1971 W. BROWN 3,626,527

METHOD AND APPARATUS FOR INSTALLING GUIDELINES AT UNDERWATER WELLHEADS

Filed June 5, 1970 4 Sheets-Sheet 1

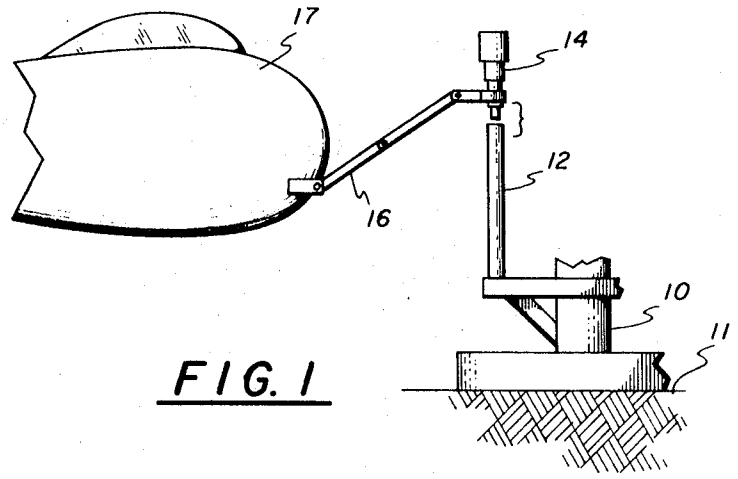


FIG. 1

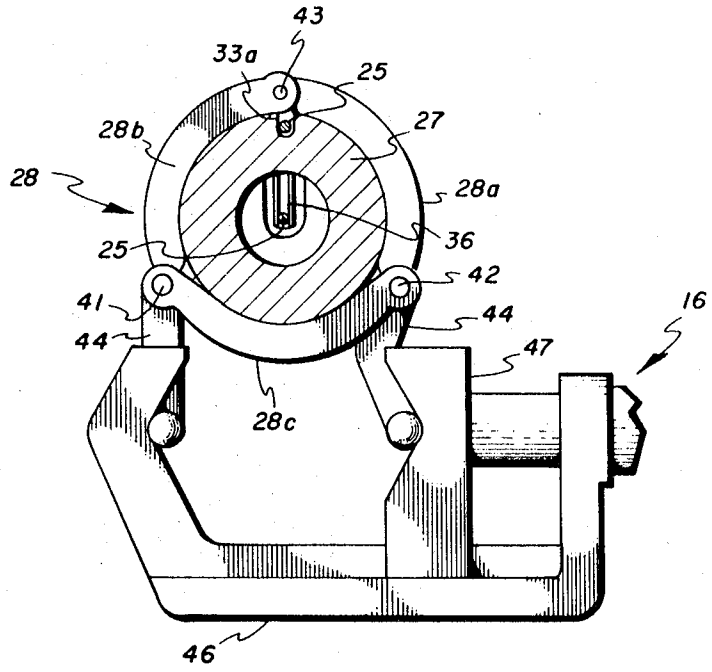


FIG. 3

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Dec. 14, 1971 W. BROWN 3,626,527
METHOD AND APPARATUS FOR INSTALLING GUIDELINES
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Filed June 5, 1970 4 Sheets-Sheet 2

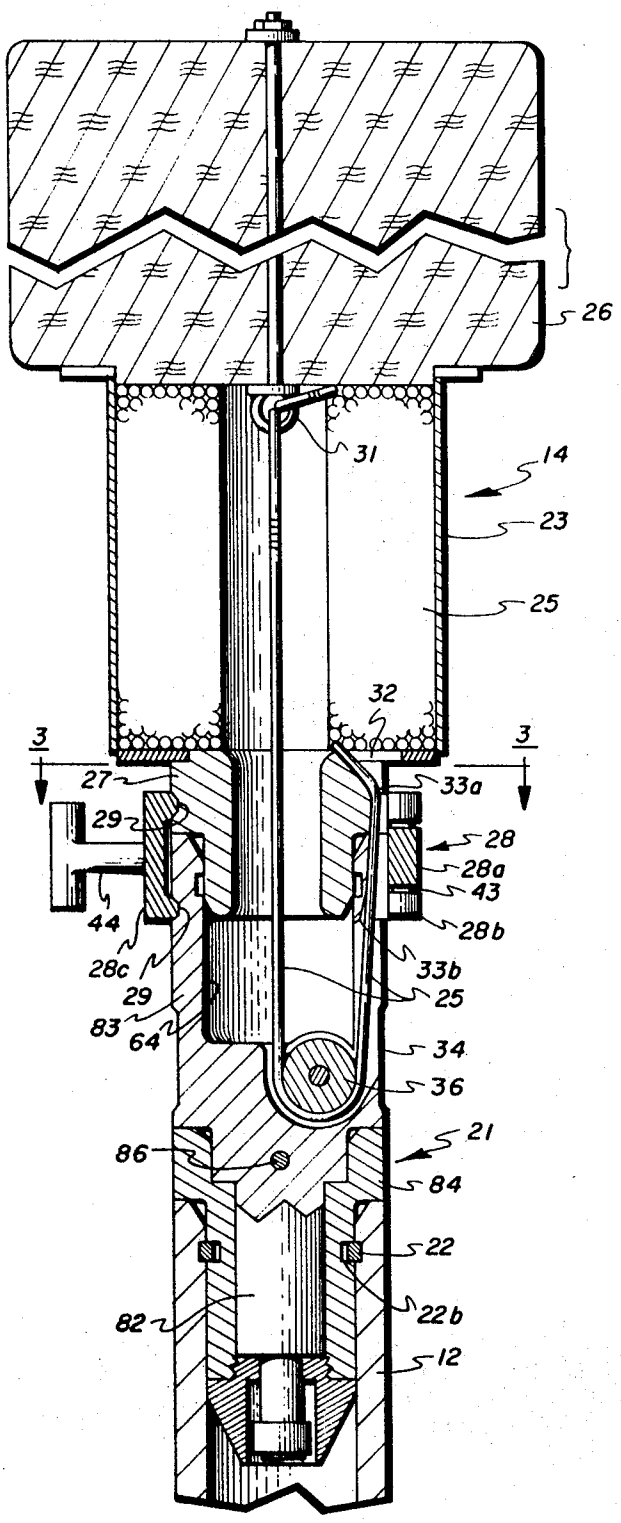


FIG. 2

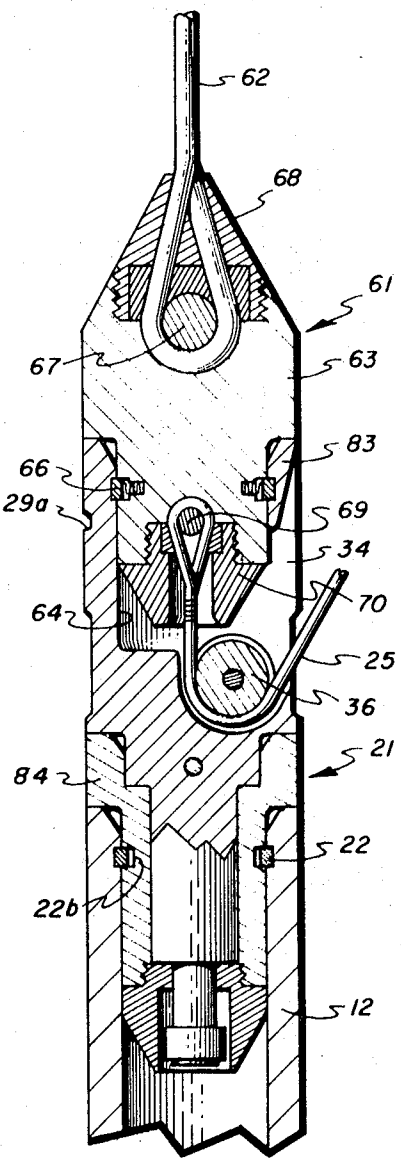


FIG. 4

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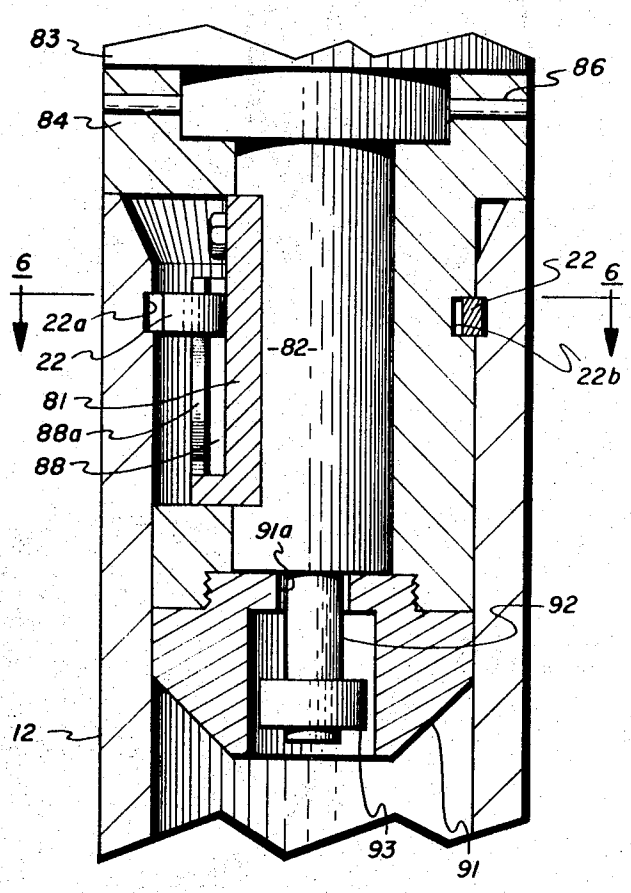


FIG. 5

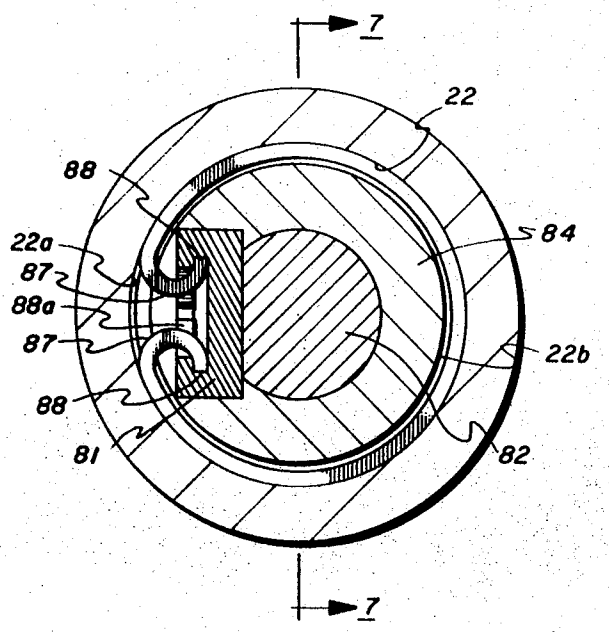


FIG. 6

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Dec. 14, 1971 W. BROWN 3,626,527
METHOD AND APPARATUS FOR INSTALLING GUIDELINES AT UNDERWATER WELLHEADS
Filed June 5, 1970 4 Sheets-Sheet 4

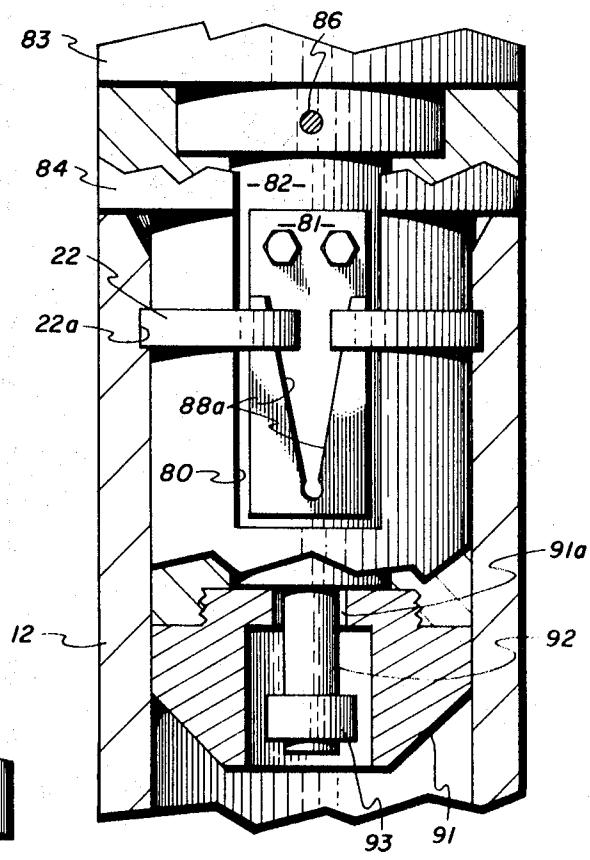


FIG. 7

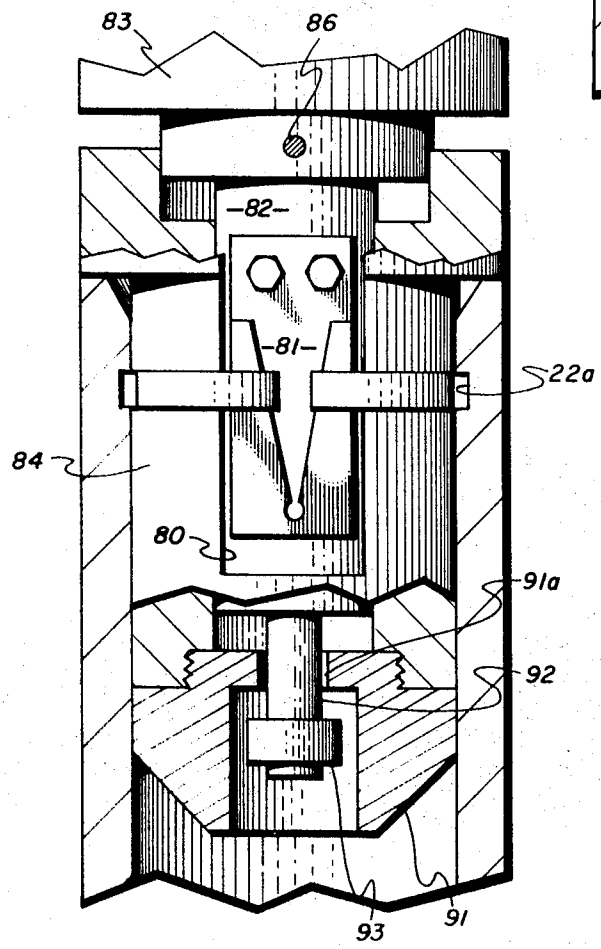


FIG. 8

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United States Patent Office 3,626,527
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3,626,527

METHOD AND APPARATUS FOR INSTALLING GUIDELINES AT UNDERWATER WELLHEADS

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Filed June 5, 1970, Ser. No. 29,206
Int. Cl. B63b 21/52
U.S. Cl. 9—8 8 Claims

ABSTRACT OF THE DISCLOSURE

There is provided a simple, reliable and compact member having a plug-in portion that plugs into an underwater guide post, and, releasably fixed to an upper part thereof, there is a coil of relatively light line enclosed within a can. One end of the line is connected directly to a buoy and the other end is also connected to the same buoy after the end passes through a pulley mounted onto the plug-in portion. The compact member is adapted to be plugged into the guide post by a submarine that afterwards releases the buoy and coil of line from the plug-in portion. On the surface, a working guideline is fixed to one end of the light line and the guideline is pulled and secured to the plug-in portion by pulling on the other end of the light line. Means are incorporated in the plug-in portion to allow it to be released from the guide post by pulling on a guideline with a force greater than the threshold force built into the system.

This invention relates to underwater operations such as drilling, producing, servicing and maintaining underwater wells and pertains, more particularly, to the art of making contact with underwater structures that are fixed to the ocean floor.

There are disclosed in U.S. Pat. Nos. 3,050,140 and 3,358,752 methods and apparatus for installing guidelines at underwater wellheads. Each patent teaches the use of at least one permanent guideline extending from the ocean floor to the surface. For example, Pat. No. 3,050,140 suggests the use of a buoyed guideline that is enclosed in a suitable container which is part of the underwater structure around the wellhead. The buoy is released by remote means and one end of the guideline rises to the surface. This guideline is used to install other guidelines that have means that allow them to be released remotely. However, the original guideline is not releasable so that a guideline always remains at each station. If this permanent guideline breaks, the installation of another line would be difficult and would be extremely difficult in very deep water, deeper than a diver can descend.

An object of this invention is to provide a means that allows for the removal of all underwater guidelines and for the reinstallation of the lines, as required.

Another object of this invention is to provide an economical and simple means that allows for the installation of guidelines in relatively deep water.

These and other objects and features of advantage will become apparent from the following detailed description of an illustrative embodiment of the invention, reference being made to the accompanying drawings wherein:

FIG. 1 is a schematic showing a deep-water submarine installing one of the novel compact members into an underwater guide post;

FIG. 2 is an axial section of the compact member, installed into a guide post;

FIG. 3 is a sectional view taken in the direction of the arrows and on line 6—6 of FIG. 5.

FIG. 4 is an axial section of the guide post, the lower

portion of the compact member, and the lower fixture of the working guideline installed ready for use;

FIG. 5 is an enlarged axial section of the lower portion of the compact member rotated 90° from the position shown in FIG. 2;

FIG. 6 is a section view taken in the direction of the arrows and on line 6—6 of FIG. 5.

FIG. 7 is a partial axial section taken in the direction of the arrows 7—7 in FIG. 6;

FIG. 8 is similar to FIG. 7 showing the locking means between the guide post and the member in the unlocked position.

Referring now to the drawings, and to FIG. 1 in particular, item **10** schematically represents, for example, an underwater wellhead located at the ocean floor **11**. On the wellhead **10** is located one or more guide posts **12** which are rigidly fixed and extend vertically. In this embodiment, the upper end of post **12** has been formed into a suitable socket (as shown in FIG. 2) which receives a novel compact member **14**. Member **14** is shown held on the end of a manipulator arm **16** which is fixed to a submarine **17**. A typical submarine **17** and manipulator arm **16** may be as disclosed in United States Patent No. 3,158,123. Since the member **14** is compact, it presents practically no drag to the submarine. This is a useful feature especially when the submarine is designed to operate at depths of more than 2,000 feet. The submarine inherently develops very low power and, therefore, additional drag such as producd by dragging a light line depending from the ocean surface would greatly hamper the mobility of the submarine. In addition. energy should be conserved so the whole operation can be economical.

Referring now to FIG. 2, a detail description of the compact member **14** will be described. The member **14** has a lower plug-in portion **21** that engages the socket in post **12**. The two are locked together by a spring type locking ring **22**, preferably of the type that expands outwardly to engage a suitable groove **22***a* (more clearly shown in FIG. 5) in post **12** in a standard manner. However, the holding action of the locking ring **22** can be released and the description and operation of the novel means to perform this function will be described hereinafter. Disposed over the top of the plug-in portion **21** is a cylindrical can **23** in which is stored a coil of light line **25**, made of a polyester material, such as nylon, a trademark of E. I. DuPont de Nemours and Company. The can **23** is suitably fixed at its top end to a buoy **26** and at its lower end to sleeve **27**.

The sleeve **27** is detachably held to the plug-in portion **21** by an external ring assembly **28** that has suitable inwardly extending projections **29** that engage external circumferential grooves **29***a* (as shown in FIG. 4) on both the sleeve **27** and a socket **83** in the plug-in portion **21**. A detailed description and operation of the ring assembly **28** will be described hereinafter.

Both ends of line **25** are secured to an eye bolt **31** that extends through and is secured to the buoy **26**. The end of the line **25**, protruding from the bottom of the can **23**, passes through an opening **32** in the can bottom, down an axially aligned groove **33***a* (more clearly shown in FIG. 3) in sleeve **27** and groove **33***b* in plug-in portion **21**. The portion **21** has an opening **34** through which the line **25** passes to engage a pulley or sheave **36** and then the line is fixed to the eyebolt **31**. The pulley **36** is fixed to rotate relative to the plug-in portion **21**.

The buoy **26** is released by removing the ring assembly **28** which also functions as a handle means for the submarine. Referring to FIG. 3, the ring assembly **28** has a novel construction which allows the operator of the submarine **17** to remove the ring assembly **28** and also insert the compact member **14** into the guide post **12**. The ring assembly consists of three segments **28***a*, **28***b*, **28***c*. Seg-

ments 28*a* and 28*b* are hinged to segment 28*c* by hinge pins 41 and 42, respectively. A shear pin 43 holds segments 28*a* and 28*b* together. A lever 44 is fixed to each segment 28*a* and 28*b* and both levers 44 are shaped so that they can be held by manipulator arm 16. The end of the arm 16 has preferably a fixed claw 46 and a movable claw 47 and can positively engage the ends of the levers 44 and draw them together. When this force is sufficiently large, the shear pin 43 shears and the ring assembly 28 falls apart to release the buoy 26, can 23, and line 25. The buoy 26 rises to the ocean surface carrying both ends of line 25 with it. The bight part of the line 25 engages the pulley 36 at the ocean floor.

With both ends of the line 25 disposed at the surface, one skilled in the art obviously understands how anything tied to one end of line 25 can be drawn down to the ocean floor by hauling in the other end of line 25. Referring to FIG. 4, there is shown the preferred embodiment of a fixture 61 that should be fixed to the end of a working guideline 62. The fixture 61 is made so that it can be readily secured to the plug-in portion 21 by pulling on line 25, while the line 62 is strong enough to allow large and heavy structures to be lowered and installed on the ocean floor. The fixture 61 has a cylindrical body 63 which has preferably a smaller diameter at its lower end than at its upper end in order to provide a shoulder which stops on the top of the socket 83. The small diameter end of body 63 is capable of being inserted into a bore 64 of the socket 83. When the body 63 is fully inserted, a standard spring type ring 66 locks the two in place, as shown. The working guideline 62 is attached to body 63 by a pin 67 and an upper conical nut 68 which threads into the body 63. The line 25 is attached to body 63 substantially the same way, by a pin 69 and conical nut 70. As shown in the drawing, the end of line 25 that extends upwards through the bore 64 is the end fixed to fixture 61. The two ends of line 25 can be readily distinguished by the use of a color code. Now, as the line 25 is hauled into a barge (not shown) on the surface, fixture 61 descends to the bottom and the conical shape on nut 70 allows the body 63 to readily slip into the bore 64. The ring 66, which is carried in a suitable groove, expands into an internal groove in bore 64 and locks the two pieces together. Line 25, being a relatively light line, is expendable and can be broken away to prevent interference with the operating equipment. Now with the working guideline 62 in place, the equipment can be lowered to the bottom as is standard in the art so that the various guide posts, such as post 12, could accurately position the various structures relative to each other.

After the equipment is in place on the ocean floor, the working guidelines 62 are no longer needed. As mentioned above, novel means are provided to release the guidelines 62 from the guide posts 12 so that the lines 62 may be used again. Referring to FIGS. 5, 6, 7, and 8, the preferred embodiment of the means for releasing is shown. In particular, the means acts on the locking ring 22 to compress it until the ring disengages the inner circumferential groove 22*a* in the post 12. The means includes an unlocking plate 81 secured on a milled flat surface (see FIG. 6) on a stem 82 that is an integral part of socket 83. Stem 82 is slidably disposed within a sleeve 84. Sleeve 84 has a window 80 (more clearly shown in FIG. 7) in which the plate 81 is disposed and has an external groove 22*b* which carries the ring 22. Initially, stem 83 and sleeve 84 are locked together by a shear pin 86. On the ends of the ring 22 are formed hooks 87 (FIG. 6) that engages suitable surfaces 88 on the plate 81 that are disposed relative to each other to form a V, as shown more clearly in FIG. 7. Protruding from surfaces 88 are suitable flanges 88*a* to allow hooks 87 on the ring 22 to form a more positive engagement therewith. The plug-in portion 21 also has a conical nut 91 which is threaded into sleeve 84. A rod 92 integral with the stem 82 is disposed through a hole 91*a* in nut 91 and has pressfitted on the end thereof a collar 93 for reasons that will become apparent hereinafter.

As mentioned above, plug-in portion 21 is disengaged when the tension force on the guideline 62 is above a threshold force. This is necessary since the lines 62 need to be under constant tension when equipment is being lowered, for obvious reasons. However, the line 62 is not to become disengaged until its usefulness is completed. Then, after the operation is completed, more tension is placed on the line 62 by pulling it. The shear pin 86, being the weakest part, shears at some known given tension value in the line 62, which is the value of the threshold force. The stem 82 is now free to move upward axially relative to the sleeve 84. The unlocking plate 81 moves upward with the stem 83. The surfaces 88 and flanges 88*a*, since they converge towards each other at their lower edges, draw the hooks 87 together, as shown in FIG. 8. The ring 22 becomes totally disposed in groove 22*b* (see FIG. 5) in sleeve 84 so that the sleeve 84 is free also to move upward. The collar 93 ensures that the sleeve 84 would follow the stem 82.

Although only a preferred embodiment of the apparatus has been shown and described, the present invention is not to be limited to the apparatus as described but rather only by the scope of the appended claims.

What is claimed is:

1. Apparatus for disconnectably connecting a guideline to an underwater structure comprising:
- a vertical post disposed underwater and having a groove;
- a compact member having a plug-in portion adapted to be clamped to said post and having a detachable buoy and a coil of light line lighter than said guideline;
- said light line having both ends tied to said buoy with a bight portion engaging said plug-in portion;
- said portion having a first and a second part and both both parts being adapted to axially slide with respect to each other,
- a shear pin fastening said first and second parts together to prevent axial movement therebetween,
- a locking means carried by one of said parts and disposed to engage said groove, and
- unlocking means carried by the other of said parts to unlock said locking means when said shear pin has been sheared to allow said parts to move axially relative to each other.

2. The apparatus of claim 1 wherein:
- said post has a substantially cylindrical socket formed at its upper end and said groove is circumferential and is disposed on the inside cylindrical wall,
- said first part is a cylindrical stem and said second part is a substantially cylindrical sleeve and adapted to fit inside said socket,
- said locking means is an expandable ring carried within a circumferential groove formed on the cylindrical wall of said sleeve.

3. The apparatus of claim 2 wherein:
- said sleeve has a radial opening exposing a portion of said stem,
- said ring having hooks on its ends which are turned radially inward into said opening,
- said stem having two surfaces disposed in a V converging at their lower end, and
- said hooks engage said two surfaces.

4. Apparatus for connecting a guideline having a fixture means at one end to an underwater post having a socket formed at its upper end thereof, said apparatus including:
- a plug-in portion adapted to be inserted into said socket,
- a detachable buoy mounted to said plug-in portion,
- means for detaching said buoy from said plug-in portion,
- a coil of light line having its ends attached to said

buoy and forming a bight portion which engages said plug-in portion,

means on said plug-in portion for engaging said fixture means when said fixture means is hauled underwater by having one end of said light line fixed thereto while the other end of the line is being pulled up out of the water.

5. The apparatus of claim **4** wherein:

said plug-in portion includes a stem integral with said means for engaging said fixture means and a sleeve into which said stem is disposed in sliding axial movement therewith,

said sleeve is adapted to fit inside said socket,

a locking means carried by said sleeve and disposed to engage said socket.

6. The apparatus of claim **5** wherein:

said sleeve has a radial opening exposing a portion of said stem,

said locking means is an expandable ring having hooks on its ends which are turned radially inward into said opening,

said socket having a circumferential groove for engaging said ring,

said stem having two surfaces disposed in a V converging at their lower end, and

said hooks engage said two surfaces.

7. The apparatus of claim **6** wherein:

said means for engaging has a well extending downward from the upper end thereof, and a second radial opening communicating with said well;

a sheave is disposed at the bottom of said well; and

said bight portion engages said sheave with one end of the light line protruding upward from said well and the other end radially from said second radial opening.

8. The apparatus of claim **7** wherein:

said fixture has an expansion ring carried in a groove formed thereon,

said well has a circumferential groove to engage the expansion ring on said fixture,

said fixture has a means for securing said light line therethrough and a nut with an axial opening engaging said fixture, and

said light line protrudes through said axial opening to cause the fixture to radially slip into said well by pulling on the light line.

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MILTON BUCHLER, Primary Examiner

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U.S. Cl. X.R.

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