

[54] UNDERWATER ELECTRICAL CONNECTOR

[72] Inventor: James H. Elkins, Lynn Haven, Fla.

[73] Assignee: The United States of America as represented by the Secretary of the Navy

[22] Filed: Mar. 22, 1971

[21] Appl. No.: 126,762

[52] U.S. Cl. 339/12 V, 339/60 M, 339/75 M, 339/94 M, 339/117 P, 339/182 R

[51] Int. Cl. H01r 13/54

[58] Field of Search 339/12, 59-61, 339/75, 94, 117, 182, 183

[56] References Cited

UNITED STATES PATENTS

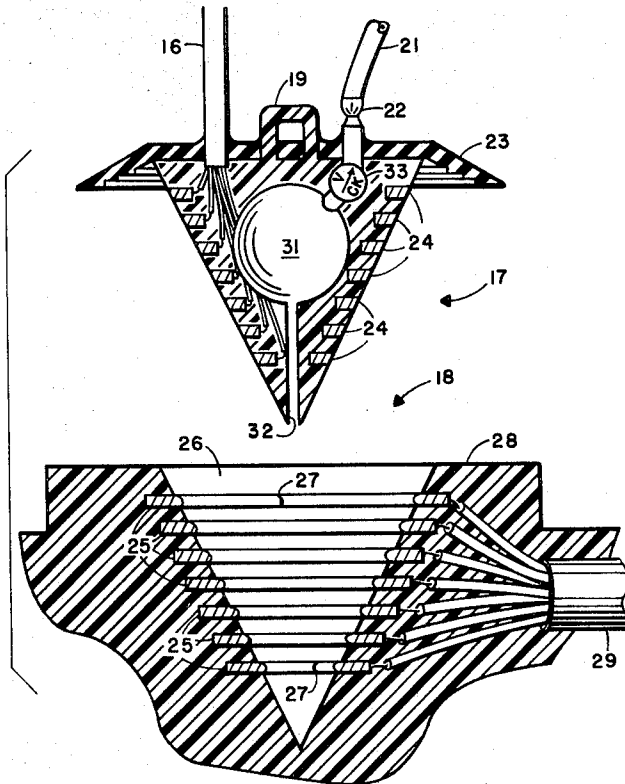
2,892,990	6/1959	Werndl.....	339/60 M
3,588,781	6/1971	Williams.....	339/117 P

Primary Examiner—Joseph H. McGlynn
Attorney—Richard S. Sciascia, William T. Skeer and Don D. Doty

[57] ABSTRACT

An electrical connector system for use at great depths beneath the surface of the sea is disclosed. A conical plug is disclosed as having spaced contact rings and a vacuum attachment chuck to seat the plug in a mating socket. A sealing ring provides watertight cooperation between the plug and socket in such a manner as to retain the plug in place by hydrostatic pressure.

10 Claims, 3 Drawing Figures



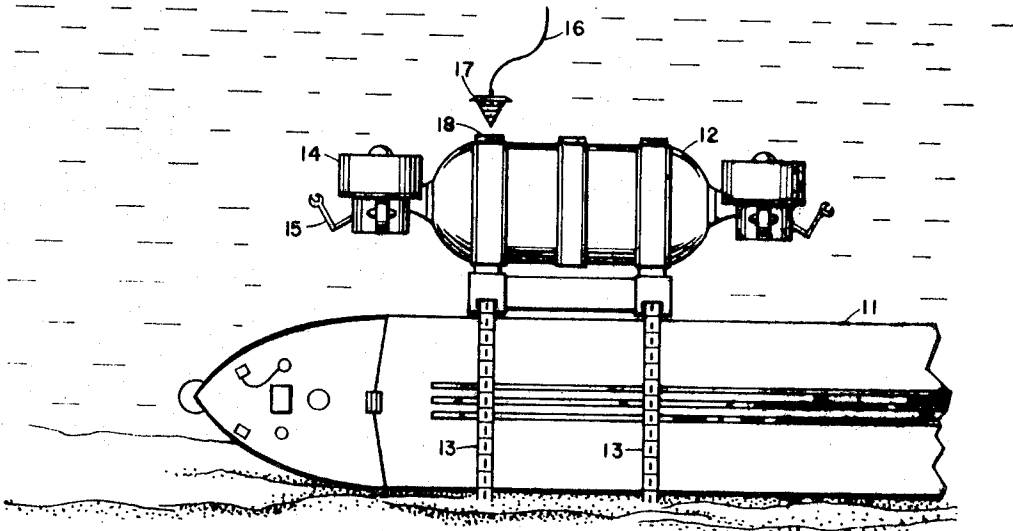


FIG. 1

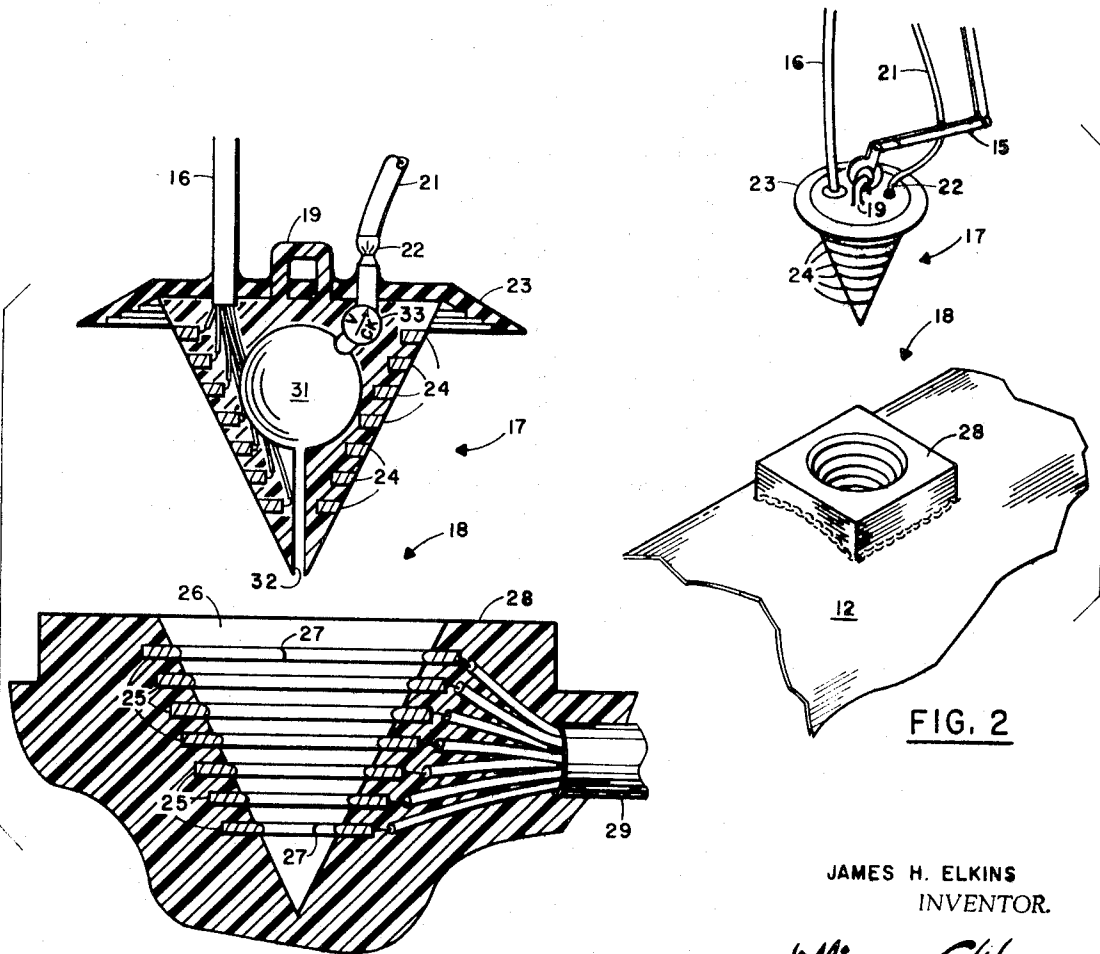


FIG. 3

JAMES H. ELKINS
INVENTOR.

BY *William T. Skue*
AGENT
David D. Ostry
ATTORNEY

UNDERWATER ELECTRICAL CONNECTOR

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America governmental purposes without the payment of any royalties thereon or therefor.

FIELD OF THE INVENTION

This invention pertains to an electrical connector. More particularly, the invention pertains to an electrical connector to be used in an underwater environment. The invention contemplates a multi-contact electrical plug and socket which may be inserted into a receptacle at great depths by semiautomatic or remotely controlled operating means.

DESCRIPTION OF THE PRIOR ART

Previous methods for making underwater electrical connections have employed a diver manually establishing the connections with prior art hardware. Many of the plugs require indexing with respect to their receptacle. In instances where the operational depth is in excess of diver capability, the connections are made at shallower depth and the device to which the cable is attached is lowered with the electrical cables attached thereto.

In salvage operations, and other applications, as well, there is considerable risk that the electrical conductors will become fouled on the wreck or other bottom formations. Such entanglement risks breakage and electrical short circuiting of the cable resulting in damage to the equipment and, often times, requires the repetition of the entire operation. It is, therefore, desirable to make the required electrical connections when the object is in position on the bottom.

SUMMARY OF THE INVENTION

This invention comprises a conical plug with a series of contact rings extending around the surface of the cone and parallel to the base thereof. Of course, a complementary receptacle is provided with a similar shape into which the plug fits. A vacuum seal at the outer end of the plug cooperates with a planar surface surrounding the receptacle to prevent water leakage and provide retaining pressure on the plug and receptacle. Suitable manipulation means is mounted on the plug to permit it to be positioned by an external manipulation arm mounted on a deep submergence vehicle.

With the foregoing description in mind, it is an object of this invention to provide an improved electrical connector.

Another object of this invention is to provide an improved electrical connector which may be used underwater.

Yet another object of this invention is to provide an electrical connector and receptacle which may be used at great depths in the ocean or elsewhere where the ambient pressure is great.

A further object of the present invention is the provision of an electrical connector which may complete a plurality of electrical circuits without resorting to indexing means.

A further object of this invention is the provision of an electrical connector useful in establishing command circuit connections with a salvage pontoon.

Another object of this invention is the provision of an electrical connector having pressure assistance means to force the mating parts into cooperative engagement.

A further object of this invention is the provision of an electrical connector pair having conical mating surfaces.

Still another object of this invention is the provision of an electrical connector pair having a flexible vacuum seal as a component part thereof.

A further object of this invention is the provision of an electrical connector having operating means permitting the connector to be operated by the external manipulation arm of a deep submergence vehicle.

Other objects and many of the attendant advantages will be readily appreciated as the subject invention becomes better understood by reference to the following detailed description, when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view showing the environment in which the connector of the invention is used;

FIG. 2 is a partial perspective view showing the connector of the invention being joined by the manipulation arm of the deep submergence vehicle; and

FIG. 3 is a sectional view through the plug and receptacle of the invention which, together, comprise the connector of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a load, such as a sunken ship 11, to be raised is shown as resting on the sea bottom. A salvage pontoon 12 is attached thereto by suitable arms 13. A deep submergence vehicle 14 is attached to pontoon 12 for positioning thereof relative to ship 12 prior to the attachment of arms 13 thereto. Deep submergence vehicle 14 has an external manipulator arm 15 which is used for attaching arms 13 to ship 11. When pontoon 12 is positioned in cooperative relation to ship 11, deep submergence vehicle 14 may separate therefrom and maneuver independently.

An electrical conductor 16 is lowered from the sea surface and has a connector plug 17 secured to the distal end thereof. As will be presently described, plug 17 is grasped by arm 15 and inserted into a receptacle 18, which is mounted on pontoon 12.

Referring to FIGS. 2 and 3, it may be seen that plug 17 is generally conical in shape with an attachment means 19 at the basal end thereof. As shown, arm 15 engages attachment means 19 for positioning of plug 17. A flexible tube 21 is also attached to plug 17 by means of a quick disconnect fitting 22, which may be of any commonly available type designed for underwater applications. A flexible seal 23 extends outwardly from the top of plug 17 in a collar-like fashion. A plurality of metallic electrical contacts 24 which are frusto-conically shaped so as to extend circumferentially about the conical surface of plug 17 and be flush with the surface thereof.

Receptacle 18, to be more completely described with reference to FIG. 3, forms a watertight seal with the wall of pontoon 12. This seal may be effected by molding the receptacle in place within a suitable aperture within the hull of pontoon 12. Alternatively, receptacle 18 may be held in place with conventional fasteners and constructional techniques, if desired.

Referring now to FIG. 3, a longitudinal sectional view of plug 17 and receptacle 18, further constructional details of the connector according to the invention will be described. Receptacle 18 will be seen to have a series of spaced contact rings 25 extending about the interior of a conical hollow depression 26. Contact rings are frusto-conically shaped to receive and closely fit about the conical plug 17. Contact rings 25 extend somewhat into depression 26 but have sufficient resiliency to permit the conical surface of plug 17 to force them into their mounting recesses in the walls of depression 26. In this position the frusto-conical surface thereof becomes coextensive with the surface of the walls of conical depression 26. This resiliency may be provided by the natural resiliency of contact ring 25 or by an expansion slot 27 cut therein. For purposes of simplicity of illustration, expansion slots 27 are only shown on two contact rings 25, however, it should be understood that they may be used on all rings, if the natural resiliency of the contact is insufficient to provide the aforescribed expansion.

The body portion of receptacle 18 is made of a high density plastic material such as polyvinyl chloride, fiberglass, or equivalent material. A flat surface 28 on the upper portion of

receptacle 18 cooperates with seal 23 on plug 17 in a manner to be described. A multiconductor cable 29 is molded into the body of receptacle 18, or otherwise secured therein. Each conductor of cable 29 is joined to a preselected contact ring 25. Seven contacts are shown for plug 17 and receptacle 18, but, quite naturally, the connector may be made for as many circuits as any specific application might require. The attachment of the individual conductors of cable 29 to contact rings 25 may be made by any conventional method, such as soldering or small mechanical connectors, which may be a part of each contact ring, as is common in the art.

Whereas contacts 25 are shown as rings extending around the circumference of depression 26, they may be only single point contacts or shorter segments of the complete rings shown. The correct matching of contacts 24 and 25 is dependent only on the axial spacing so long as one of the contact sets extends in a complete circle. As will be obvious to a skilled worker, neither contact system requires indexing plug 17 with respect to receptacle 18.

Plug 17, which is made from a similar material as receptacle 18, likewise, has each of the conductors of cable 16 joined to a contact ring 24 in a similar fashion to that used in the construction of receptacle 18. A central chamber 31 in plug 17 communicates to the apex of the conical surface thereof via conduit 32. Chamber 31 is also joined to fitting 22, and flexible tube 21 therethrough, by means of a check valve 33. A flexible seal 23 extends across the top of plug 17 and has passages for cable 16, attachment means 19, and fitting 22. Seal 23 is made of a flexible synthetic rubber material and is constructed such that the outer portions thereof are normally biased downwardly toward the apex of plug 17, like a shallow inverted bowl.

Attachment means 19 is shown as being made of the same material as the body of plug 17. This is an exemplary construction and may, in reality, be made of a stronger material and joined to plug 17's body material by conventional bonding techniques. Likewise, the shape of attachment means 19 is shown as an inverted U shape for purposes of cooperation with the particular manipulation arm 15 shown in the illustration. The shape of attachment means 19 may be modified to fit other arm arrangements or complementary structure on arm 15 of manned vehicle 14. Likewise, fitting 22 and flexible tube 21 may be configured differently than shown and may, for example, be made integral with arm 15 (shown in FIG. 2), so that only a single engagement with plug 17 need be made by the vehicle. Such changes, while altering the appearance of plug 17 somewhat, do not detract from its function or cooperation with receptacle 18.

Plug 17 and receptacle 18 may be brightly colored or illuminated by photoluminescent or chemiluminescent heatings in such a manner as to facilitate their location and relative movement by personnel within deep submergence vehicle 14.

By virtue of the complementary shape of the mating surfaces and the spacing of the rings, the plug 17 and receptacle 18 provide a self-aligning, multiple-circuit connection without mutual indexing. This permits the connection to be made with a minimum of precision motions. The exact manner in which this may be accomplished will be made clear in reference to the description of the mode of operation.

MODE OF OPERATION

The foregoing description, although sufficient to permit the construction and use of the device of the invention, will be more fully understood when considered together with the following description of the contemplated mode of operation.

When pontoon 12 is in position on ship 11, cable 16 with plug 17 attached is lowered from the surface. Manned vehicle 14 detaches itself from pontoon 12 and locates plug 17 and grasps it with manipulator arm 15. Flexible line 22, which extends from vehicle 14, is also attached to plug 17 via fitting 22. Vehicle 14 is then maneuvered to be placed in a working relationship with receptacle 18. Manipulator arm 15 is controlled

to place plug 17 in receptacle 18. Plug 17 is forced into receptacle 18 to its maximum extent or until seal 23 rests on surface 28. In some instances, depending on the position of pontoon 12, plug 17 may be allowed to seat itself under the influence of gravity.

When plug 17 is thus seated in receptacle 18, flexible tube 21 is connected to a vacuum, effected, for instance, by means of a suitable pump within vehicle 14 (not shown), and the remaining water between plug 17 and receptacle 18 is drawn within chamber 31 thereby.

The action of seal 23 and surface 28 prevents outside water ambient to the pontoon from rushing into the connector assembly to replace the water drawn therefrom. Check valve 33 prevents water from entering via fitting 22 when tube 21 is removed. The resulting difference in hydrostatic pressure between the ambient water and chamber 31 causes plug 17 to be forced into maximum contact with receptacle 18 and maintained in such engagement.

It may be noted that the residual film of sea water bridging the contacts provides some current leakage between the various electrical circuits. However, due to the low impedance of the electrical circuits used in the control of salvage pontoon 12, no adverse effects have been observed because of current leakage across such paths. Further, such leakage paths are soon opened by the heating caused, in turn, by said leakage currents.

Obviously, other embodiments and modifications of the subject invention will readily come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing description and the drawings. It is, therefore, to be understood that this invention is not to be limited thereto and that said modifications and embodiments are intended to be included within the scope of the appended claims.

What is claimed is:

1. An electrical connector comprising:

body means having a flat base portion and a right conical portion for support of electrical contacts thereon;

first electrical conductor means extending within said body means for the conduction of electrical current therethrough;

first contact means located on the surface of the conical portion of said body means and in electrical contact with said conductor means for making electrical current transfer therebetween;

hollow chamber means located within the center of said body means for maintaining a low pressure therein; communicating between said hollow chamber means and the apex of said conical portion of said body means for drawing fluid therethrough;

fitting means located on the base portion of said body means for attachment of flexible tube means thereto;

check valve means connected between said hollow chamber means and said fitting means for effecting the one way passage of fluid therethrough in such a manner as to exhaust said chamber means;

attachment means extending from the base portion of said body means and adapted to be grasped by a suitable manipulator for the moving of said body means;

receptacle means having a conical depression therein for receiving and closely fitting about the conical portion of said body means;

second contact means mounted in the conical depression of said receptacle means and spaced in such manner as to cooperate with said first contact means when the conical portion of said body means is placed therein for effecting transfer of electrical current therethrough;

second electrical conductor means extending within said receptacle means and in electrical contact with said second contact means for conduction of electrical current therefrom;

flat surface means extending completely around the conical depression of said receptacle means for forming a sealing surface thereabout; and

flexible seal means extending across the base portion of said body means and resiliently biased to extend toward the apex of said conical body means for providing a fluid tight seal with said flat surface means when said body means is disposed within said conical depression.

2. An electrical connector according to claim 1 in which said body means is constructed of high density polyvinylchloride.

3. An electrical connector according to claim 1 in which said first contact means comprises a plurality of metallic frusto-conical bands extending circumferentially about said conical surface portion and axially spaced from one another.

4. An electrical connector according to claim 1 in which said attachment means is of an inverted "U" shape.

5. An electrical connector according to claim 1 in which said receptacle means is constructed of high density polyvinylchloride.

6. An electrical connector according to claim 1 in which said receptacle means is mounted in the outer surface of a salvage pontoon.

7. An electrical connector according to claim 1 in which said second contact means comprises axially spaced, frusto-conical bands extending around the interior of said conical depression.

8. An electrical connector according to claim 1 in which said second contact means extends slightly into the conical depression of said receptacle means and is capable of being resiliently pressed into the walls thereof.

9. An electrical connector according to claim 1 in which said second contact means comprises a series of axially spaced frusto-conical bands which extend slightly within the conical depression of said receptacle means and which have expansion means therein for permitting said frusto-conical bands to expand under the pressure of said body means until their frusto-conical surfaces are substantially coextensive with the surface of the conical depression within said receptacle means.

10. An electrical connector according to claim 1 in which said flexible seal means is made of a synthetic rubber material.

20

* * * * *

25

30

35

40

45

50

55

60

65

70

75