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UNDERWATER ELECTRICAL CONNECTOR

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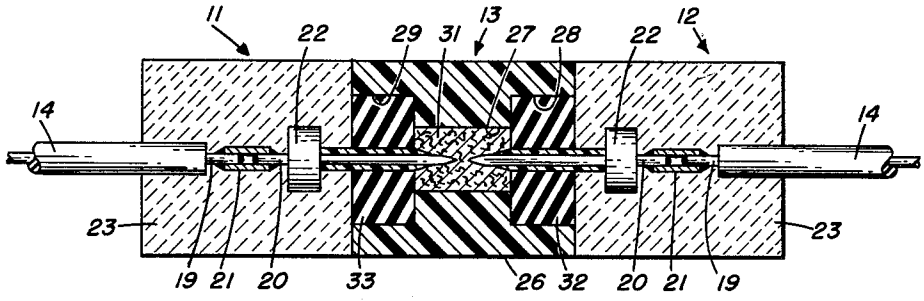


FIG. 1

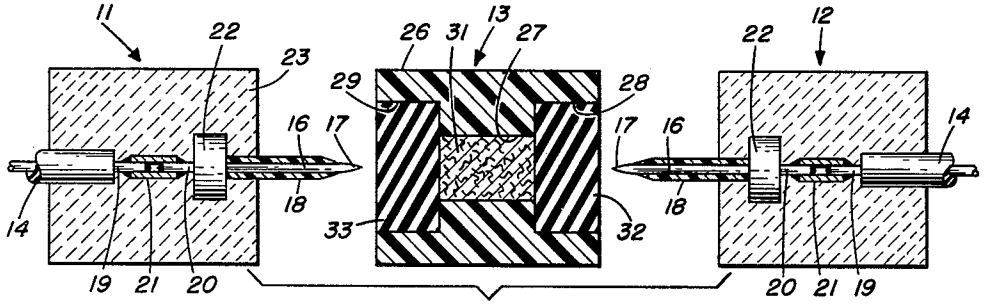


FIG. 2

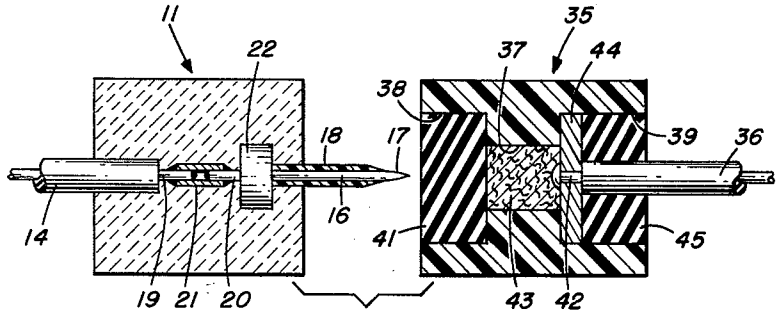


FIG. 3

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UNDERWATER ELECTRICAL CONNECTOR

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1 Claim. (Cl. 339—96)

This invention relates to underwater electrical connectors and more particularly to underwater electrical connectors of the kind whereby circuit connections may be made underwater or in other electrically conductive atmospheres without the danger of short circuits or current leakage.

Electrical connectors that are designed to be used in a conductive atmosphere, such as salt water, must be capable of completely isolating the conductors that have been connected so as to prevent current leakage into the surrounding atmosphere. If several conductors are to be connected in such an atmosphere, current leakage between these conductors will seriously degrade the functions of the circuits. Connectors of this type should be capable of being connected and disconnected while in the conductive atmosphere without exposing both sides of the circuit to the atmosphere and without introducing the conductive atmosphere into parts of the connector that may be adversely affected thereby. Such a connector must also be capable of withstanding hydrostatic pressure.

Heretofore, connectors of this type have utilized complex mechanisms to seal off the connector from the atmosphere. In an effort to prevent corrosion and damage to moving parts, such as springs and sliding members, these parts were plated with precious metals. This is an expensive expedient, however, especially where the connectors are subject to being lost or damaged in use. Some prior art connectors have required considerable force to operate, due to the nature of the contacts. In an attempt to overcome these difficulties it has been suggested that conductive liquid, such as mercury, be used as a link in the conductive chain. Liquid mercury is difficult to handle, however, and leakage from a defective connector utilizing such a liquid can result in the production of highly toxic oxides.

The present invention avoids these shortcomings by providing a connector having a socket in which a fibrous conductive substance is located. This substance is isolated from the atmosphere by a resilient packing that is maintained in radial compression to enhance its self-sealing qualities. The plug portion includes a slender needle-like member for penetrating the packing and making conductive contact with the fibrous substance.

It is an object of this invention to provide a connector that accomplishes isolation of the circuit from the atmosphere surrounding the connector.

It is another object of this invention to provide a connector that will prevent current leakage when the connector is placed in a conductive atmosphere.

A further object of this invention is the provision of a connector that is especially suited for underwater operation and usage.

Another object of this invention is the provision of a connector that has no moving parts and is of simple and inexpensive construction.

Still another object of this invention is the provision of a connector that is relatively easy to operate and that requires only moderate mechanical pressure for such operation.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

FIG. 1 shows a longitudinal sectional view of an embodiment of the present invention with the separable elements being connected;

FIG. 2 shows a sectional view of the embodiment of FIG. 1 but with the elements in disconnected form; and

FIG. 3 shows a sectional view of a modified embodiment of the invention in disconnected form.

Referring to the drawings and particularly to FIGS. 1 and 2, there is shown a connector consisting of two substantially similar plug portions **11** and **12** and a socket portion **13** used to electrically connect two portions of an insulated conductor **14**. Each plug portion is provided with a needle-like conductive member **16** which terminates in a pointed end **17**. This member **16** is preferably made of a relatively strong, corrosion-resistant metal such as stainless steel or the like. A thin sheath of insulation **18** is bonded onto member **16** over a substantial portion of the length thereof, end **17** remaining free of insulation. An end **19** of conductor **14** is connected to the other end **20** of member **16** by appropriate means, such as placing ends **19** and **20** in a metallic sleeve **21** and soldering both ends thereto. This portion of the plug is potted or cast in an insulating material such as Scotchcast, or the like, to form a solid, integral plug **23** that is preferably cylindrical in radial section.

Member **16** includes an anchor **22** in the form of a disc-like member rigidly attached thereto adjacent end **20** and included within plug **11**. This anchor serves to prevent member **16** from being dislodged from plug **11** when the connector portions **11**, **12** and **13** are being assembled or disassembled. It will be noted that the sheath of insulation **18** extends well into the potted plug **11**, thus insuring that all conductive elements except pointed end **17** are effectively insulated from the atmosphere.

Socket portion **13** includes a rigid housing **26** made of a suitable nonconductive substance such as plastic, nylon or the like. This housing **26** is preferably cylindrical in radial section and is of approximately the same outside diameter as plugs **11** and **12**. Contained within housing **26** is a bore **27** and a pair of counterbores **28** and **29**, it being understood that the terms "bore" and "counterbore" are used only in the descriptive sense and are not intended to limit the process by which the housing may be fabricated.

Contained with bore **27** is a quantity of fibrous electrically conductive material **31** which may consist of steel wool, copper wool, or a similar substance providing a relatively homogeneous area into which end **17** of member **16** may be inserted when the plug and socket portions are connected.

Each of the counterbores **28** and **29** has disposed therein a packing respectively designated **32** and **33**. This packing is in the shape of a round cylindrical plug which is of slightly larger diameter than the diameter of the counterbore into which it is installed and is made of a resilient rubber-like material exhibiting self-sealing qualities such as material being exemplified by neoprene and silicone rubber. The inherent self-sealing characteristics of the packing material are enhanced by the fact that packings **32** and **33** are force fits when installed within their respective counterbores and are thus subjected to inwardly directed radial pressure from the walls of the counterbores.

In the operation of the embodiment described above, each end of a conductor **14** to be connected is fitted with a plug portion as shown at **11** and **12**. The needle-like member **16** of one of the plugs is then forced through one of the packings **32**, **33** until end **17** projects into the conductive material **31** and makes electrical contact therewith. As the insulated sheath **18** of member **16** penetrates the packing, it is wiped clean thereby and a seal is

maintained between the packing and the sheath so that no conductive particles will be carried through the packing by the passage of member **16** or by the force of external hydrostatic pressure. In a similar manner the member **16** of the other plug is forced through the other of the packings **32**, **33** and into conductive relationship with material **31**, thereby establishing a connected electrical circuit. To disconnect this circuit requires only the withdrawal of either of plugs **11** and **12** from socket **13**, the packing being self-sealing due to its selected qualities and the fact that it is under radial compression.

In the embodiment of FIG. 3 is shown a socket portion **35** which differs from that of the first described embodiment in that it is intended to be permanently attached to an insulated conductor **36**. In this embodiment socket **35** includes a bore **37** and counterbores **38** and **39**. Counterbore **38** has disposed therein a packing **41**, which packing is similar to the packings **32**, **33** and is a force fit within counterbore **38**. An end of conductor **36** is stripped of insulation to provide an exposed wire portion **42** and this portion is placed in conductive relationship with a quantity of fibrous electrically conductive material **43** to be inserted in the bore, as set forth above. Material **43** is of sufficient shape and quantity so as to substantially fully occupy bore **37** when the socket is assembled. A metallic washer **44** is placed over exposed wire **42** before the material **43** is placed therearound; after both the material **43** and washer **44** are in place they are soldered to the wire **42**. Conductor **36** passes through an annular packing **45** which may be made of the same material as packings **32**, **33** and **41** and which is a force fit when inserted into counterbore **39**. This insures that no leakage into socket **35** can occur.

For many applications the embodiment of FIG. 3 will be satisfactory. Since only the socket **35** is fully insulated from the atmosphere when the connector is disconnected, the socket must be made the hot end of the circuit to be connected. The connector of this embodiment may be connected or disconnected while submerged without exposing the circuit to water.

If the connector is intended for many cycles of use without the risk of failure, the embodiment of FIGS. 1 and 2 is preferred. If for some reason one of packings **32**, **33** were to fail, then the entire socket **13** could be discarded and another one substituted without the loss of an expensive component or of the time required to prepare and attach an end of the conductor to a socket portion. By initially connecting socket **13** to the plug bearing the hot side of the circuit while in a nonconductive atmosphere, e.g., above the surface of the water, the electrical connection can then be made or broken while underwater.

As an example of a typical connector made according to this invention, plugs **11** and **12** will have members **16** which are about $\frac{1}{32}$ of an inch in diameter and which protrude about $\frac{3}{8}$ of an inch from plug **11** while packings **32**, **33** and **41** may be about $\frac{1}{4}$ of an inch in thickness. Other dimensions may be appropriately scaled.

It will be noted that precise alignment of the plug and socket prior to connection is not necessary, it being only required that end **17** penetrate the packing in the region of the bore **27** (or **37**). If desired, this connector or a plurality of such connectors can be enclosed in a metal housing which would withstand tensile forces applied to the connector from external sources.

Obviously many modifications and variations of the

present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described.

What is claimed is:

An underwater electrical connector for connecting a pair of insulated electrical conductors comprising:

a plug member;

a needle-like conductive member within said plug member and having one end thereof shaped in a point and the other end thereof connected to one of said electrical conductors;

insulating means disposed adjacent said other end of said one conductive member to render this end and the connection thereto fully isolated from an atmosphere of use;

an insulating sheath disposed on said conductive member and extending therealong from just short of said pointed end at least to said insulating means;

a socket member including a rigid non-conductive portion having a chamber disposed therein and a pair of openings into said chamber, said chamber containing a quantity of a fibrous conductive substance;

one of said openings being substantially completely filled with a resilient rubber-like substance that has self-sealing qualities;

sealing means insertable within said other opening comprising an annular gasket having a central aperture through which the other insulated conductor can pass, the external dimensions of said gasket being such that it forms a force fit in said other opening with said other insulated conductor passing therethrough; and

a rigid washer disposed within said other opening and retained therein by said gasket, said washer being soldered to said portion of said other conductor and in electrical contact with the fibrous conductive substance filling the chamber;

whereby said washer acts as a retainer to prevent said other insulated conductor from inadvertently being pulled from said socket and at the same time to serve as an electrical contact for the socket.

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