United States Patent

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[54] **MEANS AND METHOD FOR INSULATING CONNECTORS FROM AMBIENT ATMOSPHERE DURING MATING**
6 Claims, 7 Drawing Figs.

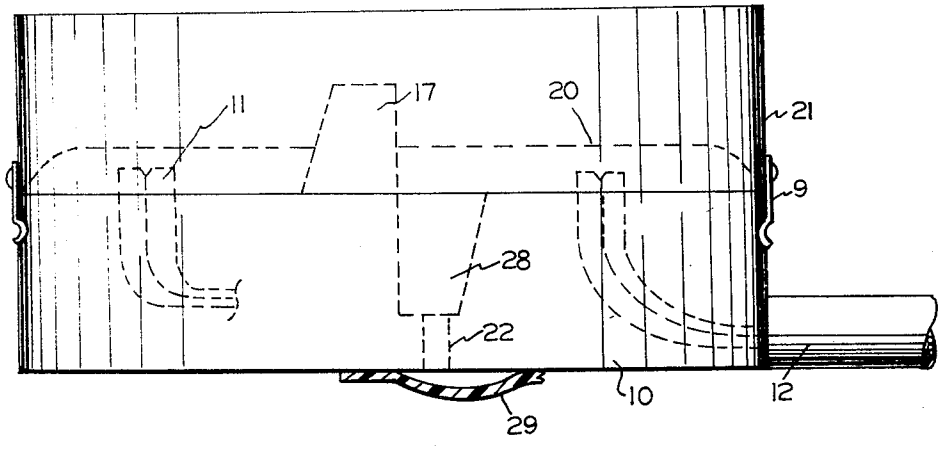
[52] **U.S. Cl.** **339/36,** 339/49, 339/94, 339/96
[51] **Int. Cl.** **H01r 13/52**
[50] **Field of Search** ..... 339/36, 47—49, 60, 94, 96

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ABSTRACT: Connector means in a hermaphroditic embodiment provides for insulating connector terminals from ambient atmosphere such as salt water during mating by means of a covering of mastic insulation over exposed terminals. The mastic is displaced by frictional pressure during connection to provide a continuous insulation film surrounding all exposed electrical terminals.



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2 Sheets-Sheet 1

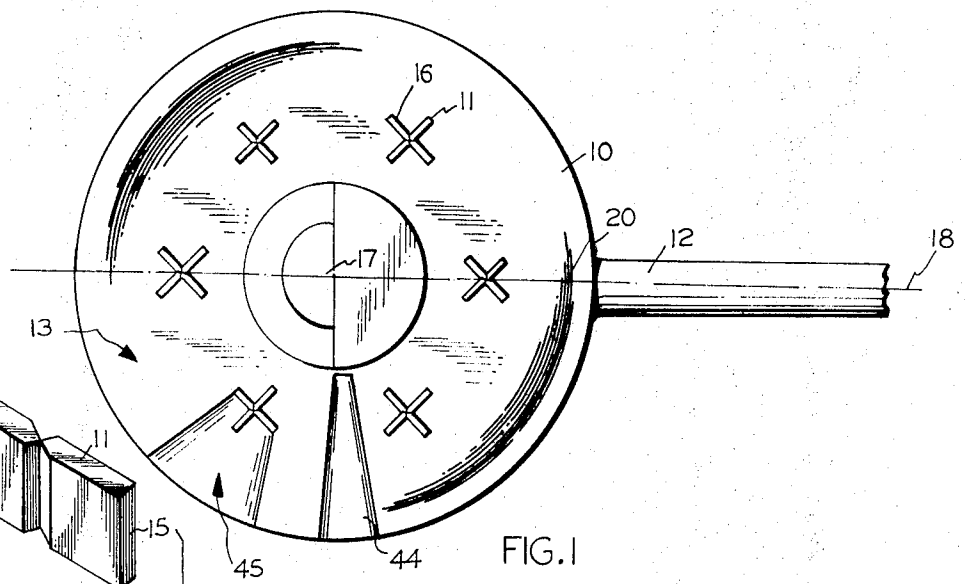


FIG. 1

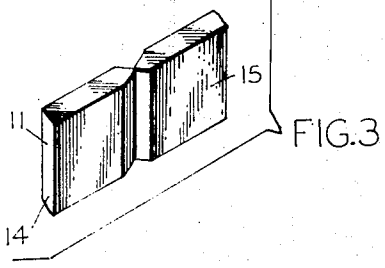


FIG. 3

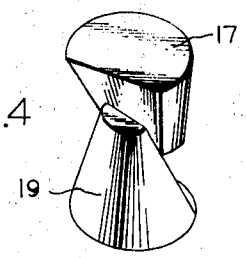


FIG. 4

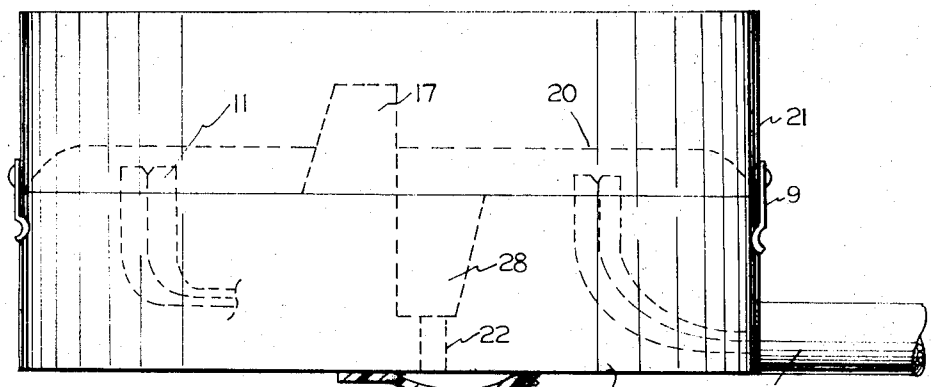


FIG. 2

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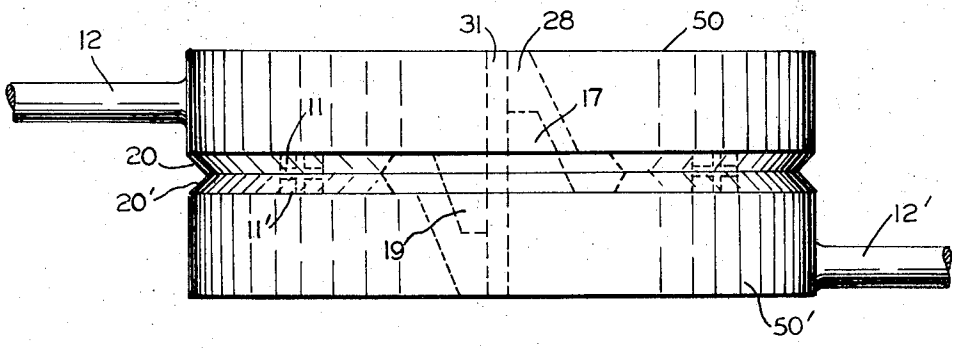


FIG.5

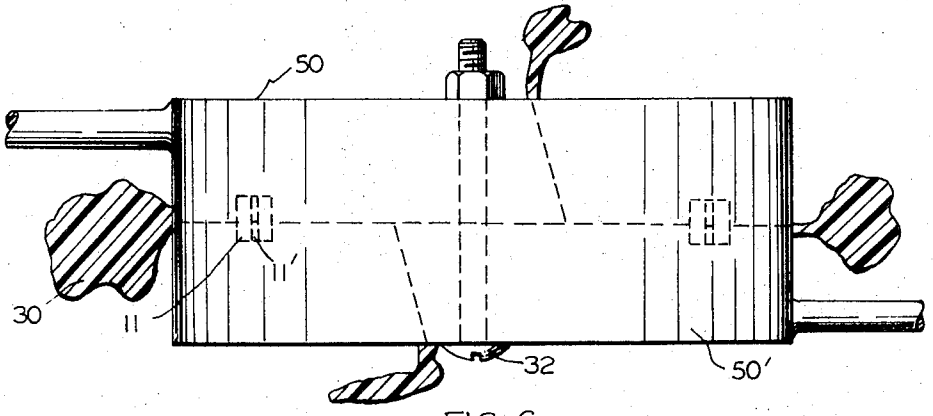


FIG.6

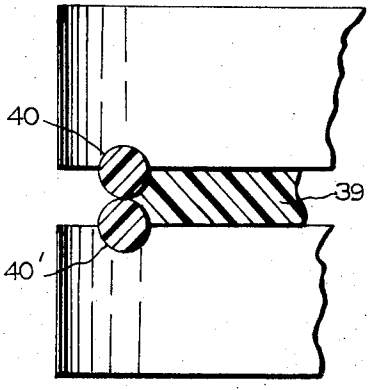


FIG.7

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MEANS AND METHOD FOR INSULATING CONNECTORS FROM AMBIENT ATMOSPHERE DURING MATING

This invention relates to electrical connectors and more particularly it relates to electrical connectors that may be mated without contamination or coaction with ambient atmosphere. Atmosphere as used herein includes surrounding media such as gas, air, water and explosive contaminant corrosive substances.

In undersea exploration for gas and oil it is necessary to extend cables of various length under water to connect with undersea electrical apparatus. Ordinary connectors cannot be used since salt water creeping between terminals will produce conductive paths, corrosion and plug failure. In the past it has been burdensome to splice or connect such cables underwater, and a significant problem is introduced if the cables need be surfaced for connection. If the depths are great it is difficult for a diver to stay down long or to effect extensive splicing, cleaning and purging operations. Also it has been a problem to retain the waterproofing about splices or connectors disposed at great depths undersea for long periods of time.

A similar problem exists when electrical connections are to be made in an explosive media between two plugs which may be carrying current. The contacts should be completely insulated from the surrounding atmosphere during mating to avoid sparking.

Furthermore, the extent of labor and logistics required to stock and splice conventional cables or plugs is significant, particularly where a multiplicity of different kinds of parts need be supplied. The provision of a connector of universal qualities to be used for both connectors is preferred over the use of separate male and female configurations.

Underwater pressures are also significant at the depths now commonly in use in undersea gas and oil well-drilling operations, and thus significant care must be taken to prevent pressure differentials that could result from the connection process or structure if pockets of substance at a pressure other than the surrounding water are introduced.

It is therefore a general object of this invention to provide improved means and method of making electrical connections between two plugs or cables while isolating the connector terminals from ambient atmosphere.

A more specific object of the invention is to provide simple and improved underwater connector plugs and methods.

Another object of the invention is to provide means and method for making underwater and like connections with little effort and simple equipment.

Thus in accordance with the invention there is provided an underwater connector comprising a hermaphroditic plug element with an insulated case and projecting mating terminals intimately covered with a pliable mastic insulation material that may be squeezed out and away from the terminals when two connector plugs are frictionally joined to permit the terminals to penetrate the surrounding mastic material and mate in electrical contact. This structure permits the undersea connection process to be self purging by forcing the salt water out and away from the vicinity of the terminal conductors.

Further details, objects and features of the invention will be found in the following description of a particular embodiment, from which reference is made to the accompanying drawing, wherein:

FIG. 1 is a top view sketch of a hermaphroditic connector constructed in accordance with one embodiment of the invention;

FIG. 2 is an elevation view of the connector with a protective cap in place;

FIG. 3 is a perspective detail sketch of the connector terminal construction used in this embodiment of the invention;

FIG. 4 is a perspective detail view of the mating guides used in this embodiment;

FIGS. 5 and 6 are side views respectively of a pair of modified connectors before and after the mating procedure; and

FIG. 7 is an enlarged detail fragmentary view in section illustrating a water pressure seal feature.

Now with reference to the drawing, FIG. 1 shows one hermaphroditic connector body 10 of insulating material with projecting conductive terminals 11 thereon connected to cable 12. One such terminal connector could be on an apparatus or both could be on the ends of cables to be connected together. The terminals 11 which are shown in greater detail in FIG. 3, comprise a split metallic member presenting two contiguous blades 14 and 15 which are oriented on the face 13 of connector 10 to engage similar terminals 11' on a paired connector in mating position at substantially perpendicular orientation. To assure good electrical connection these terminals are shaped so that they are spread apart slightly upon connection to assure a sliding frictional engagement of the metal surfaces. Thus, the contiguous split blade portions 14, 15 of the two connectors mesh in mating position to produce good electrical contact when covered with the mastic material later described. Apertures 16 may be provided, if desired, in the insulating body 10 for receiving and registering the terminals 11 of the mating connector, but are not necessary. The orientation of the blades 11 at each position on the connector body 10 is such that they are normally disposed in a mating connector body in face-to-face contact therewith with extending cables 12 oppositely directed along the axis 18.

Registering structure comprising members 17, 19 is provided as shown in FIGS. 2 and 4. The central mating boss structure 17, 19 aligns the two similar hermaphroditic connector plugs 10. Each boss 17, 19 is of tapered half-conical shape generally disposed to align two cables 12 along the axis 18 to extend in diametrically opposed directions, so that two cables may be joined together by simply frictionally pressing together similar connectors on the respective ends of the cables. The plugs are tapered and/or grooved to introduce a controlled flow and flushing of mastic material, as hereinafter described.

For underwater installations, conventional means of insulating and waterproofing the cables and body are employed, such as casting a common waterproof housing of rubber or plastic insulation material about the cable and terminals. However, if one attempted to make a connection in salt water, because of the extending terminal conductors 11, the connector would fail in operation due to conductive salt residues upon the face 13 tending to bridge the terminals 11. It is desirable to flush out all the salt water and seal the plug to prevent it from creeping in after the connection is made. Thus, in accordance with this invention, a mass of plastic deformable insulating mastic substance, comprising in this embodiment a layer 20, is used to envelop and intimately contact the projecting terminals 11. As shown in FIG. 2, a protective cap 21 may be used in transit and storage to engage plug 10 by means of clamps 9 to protect the mastic mass, which covers the end of the terminals 11.

Because of significant pressures encountered in such applications as underwater drilling for gas and oil at great depths, the connector can be damaged if small entrapped pockets of low-pressure sea water or air exist internally. Therefore the cover body 10 may have, as shown in this embodiment, a pressure equalization port 22 and an expandable diaphragm 29 for storing excessive mastic pushed out of the cavity 28 when two connector plugs are mated. This permits the tapered or grooved mating 19 to enter cavity 28 and cause mastic material from layer 20 to flow through port 22 and inside bellows 29 with little tendency to introduce pockets where pressures can build up different from that of the outside ambient atmosphere within large changes of pressure ranges such an encountered in different ocean depths. Significant changes of pressures between pockets within the plug and the atmosphere could cause damage by breaking of deforming the housing thus introducing leakage. The flow direction of the mastic 20 into the diaphragm 29 is encouraged as a result of the tapers or grooves in registration bosses 17, 19.

It is desirable to fasten two plug connectors together by a bolt 32 or similar means such as shown in FIGS. 5 and 6. Also a simpler but effective plug structure variation therein shown

can be used when the mastic material itself is of a nature withstanding seepage of the atmosphere into the connection terminals at the required pressures, temperatures, etc.

In FIGS. 5 and 6, the act of mating two connectors is illustrated by the respective start and finish positions, where the frictional force of pressing together connectors **50** and **50'** will displace the mastic placed in ridges **20** and **20'** about terminals **11** and **11'** to extrude the excess mastic material **30** from between the surfaces of the connectors, thereby causing terminals **11** and **11'** to penetrate through the mastic substance which continuously forms an insulation barrier surrounding the terminals. The connectors thus mate without exposing the terminals at any time to the surrounding ambient atmosphere, which may be, for example, salt sea water or explosive gases. A central aperture **31** may be provided substantially axially through the generally cylindrically shaped connector body to receive a fastener such as bolt **32**.

The ideal mastic material is a substance of high viscosity, very low solubility, high electrical resistance and low dielectric coefficience. The potting of this material about the terminals may comprise a uniform thickness mass rather than the ridges **20** illustrated in this embodiment, but in any case it intimately surrounds and contacts terminal conductors **11** on both connector plugs **50** and **50'**. Upon contact of the two potted mastic masses **20**, **20'**, the connectors are forced towards each other in respective face-to-face alignment as positioned by bosses **17**, **19** to extrude excess potting substance **30** around the perimeter of the connector and cavities **28**.

The tapered conical plugs **17**, **19** serve the dual purpose of registering the two connector plugs and enhancing dispersal of the mastic substance by generating a pressure movement of the viscose potting substance adjacent to their surfaces. This movement is greatest at a circle identified by the midline intersection point of the meshing inverted tapers of the conical displacement plug members **17**, **19**. The outward pressure of the potting substance at the midline between the two connectors provides a positive flushing of all liquids and contaminants out of the interconnector cavity before complete meshing of the connectors extrudes all but a small residual amount of potting substance and thus affords a tight seal about the connector housing.

As seen from FIG. **1**, the face **13** of the connector body may have outwardly tapered radial grooves or ridges **44** or **45** extending from the interior portion or the apertures **16** respectively to guide and discharge the flow of excess mastic substance also in the direction of the periphery of the plug housing **10**. These grooves serve to move the substance outwardly and to facilitate the closure of two connectors in mating position without excessive frictional force.

One material suitable for mastic purposes that is chemically and physically stable over large ranges of temperature and serves to wet adjacent surfaces to prevent moisture creepage into the connector is sold and available as Silicone putty. Materials of different viscosity may be formed with petroleum derivates, rubber compounds and epoxies. The housings and insulating portions of the connectors may be formed of styrene butadine rubber, or the like, and the housing and cable cover may be molded in a unitary piece to produce waterproofing.

If the small amount of residual mastic material **39** retained between connector bodies is subject to gradual erosion by force of sea water and pressure, etc., an auxiliary seal around the connector periphery may be provided such as the O-rings **40**, **40'** shown in FIG. **7**, which press together to form a hermetic-type seal supplementing that of the mastic residue.

It is clear from the foregoing examples and description, that the state of the art has been advanced by introduction of novel connector construction and improved cable connection methods, and therefore those novel aspects believed descriptive of the spirit and nature of the invention are defined with particularity in the appended claims.

I claim:

1. Connector means for making electrically connective contact between mating electrical terminals without exposure of the terminals during connection to ambient atmosphere for connection in underwater or explosive atmosphere conditions, or the like, comprising in combination, two mating connectors each including an insulating cover body and at least one electrically conductive terminal exposed from said insulating cover for mating in electrical contact with a further terminal of the other mating connector when brought together in mating position therewith, a displaceable mass of pliable and flowable insulating material covering and intimately contacting said exposed terminal in each connector that the insulating material will flow out of the region between the two connectors when they are brought together in mating position, and means for bringing the insulating material of both said connectors together to merge into a common pliable flowable mass with the terminals in position to engage in mating electrical contact upon application of frictional pressure between the two connectors thereby displacing at least a portion of said pliable material covering said terminals away from the space between the connectors and causing the conductive terminals to penetrate through the common flowable mass to engage in electrical contact while maintaining an insulation barrier between said terminals and the ambient atmosphere about said connectors by a portion of the common insulating material mass retained between said connectors.

2. Connector means as defined in claim **1** including a resilient sealing member coacting with the insulating cover to surround said pliable material and seal said terminal from the atmosphere when said two connectors are brought into mating position.

3. Connector means as defined in claim **1**, including expandible diaphragm means retaining said pliable material displaced upon said frictional pressure for equalizing pressure of said material contained between two connector plugs after the mating of the two connector plugs with the pressure of the ambient atmosphere.

4. Connector means as defined in claim **1** wherein said one connector and said further connector have hermaphroditic structure for aligning the two connectors in mating position.

5. Connector means as defined in claim **4** wherein the connector plugs are each disposed at the end of a cable and have a plurality of terminal connectors, and the configuration of the plug is such that the plugs are mated with the cables extending in diametrically opposed directions.

6. The method of making connections between two electrical connector plugs, each having at least one terminal conductor, without exposing the terminal conductors to the surrounding atmosphere during mating of the plugs, comprising the steps of, covering the exposed terminal conductors of each connector plug with a pliable and flowable substance of insulating material, bringing the substance of said two connector plugs into contact to merge into a common pliable flowable mass with the terminal conductors in position to engage in mating electrical contact upon application of frictional pressure between the two connectors, and applying frictional pressure to penetrate said terminal conductors through the common flowable mass and displace part of said mass from the space between the two plugs to bring said two plugs into mating position with the terminal conductors of the two plugs in electrical contact while preventing any contact of the terminal conductors with the ambient atmosphere surrounding the plugs during the mating thereof.