

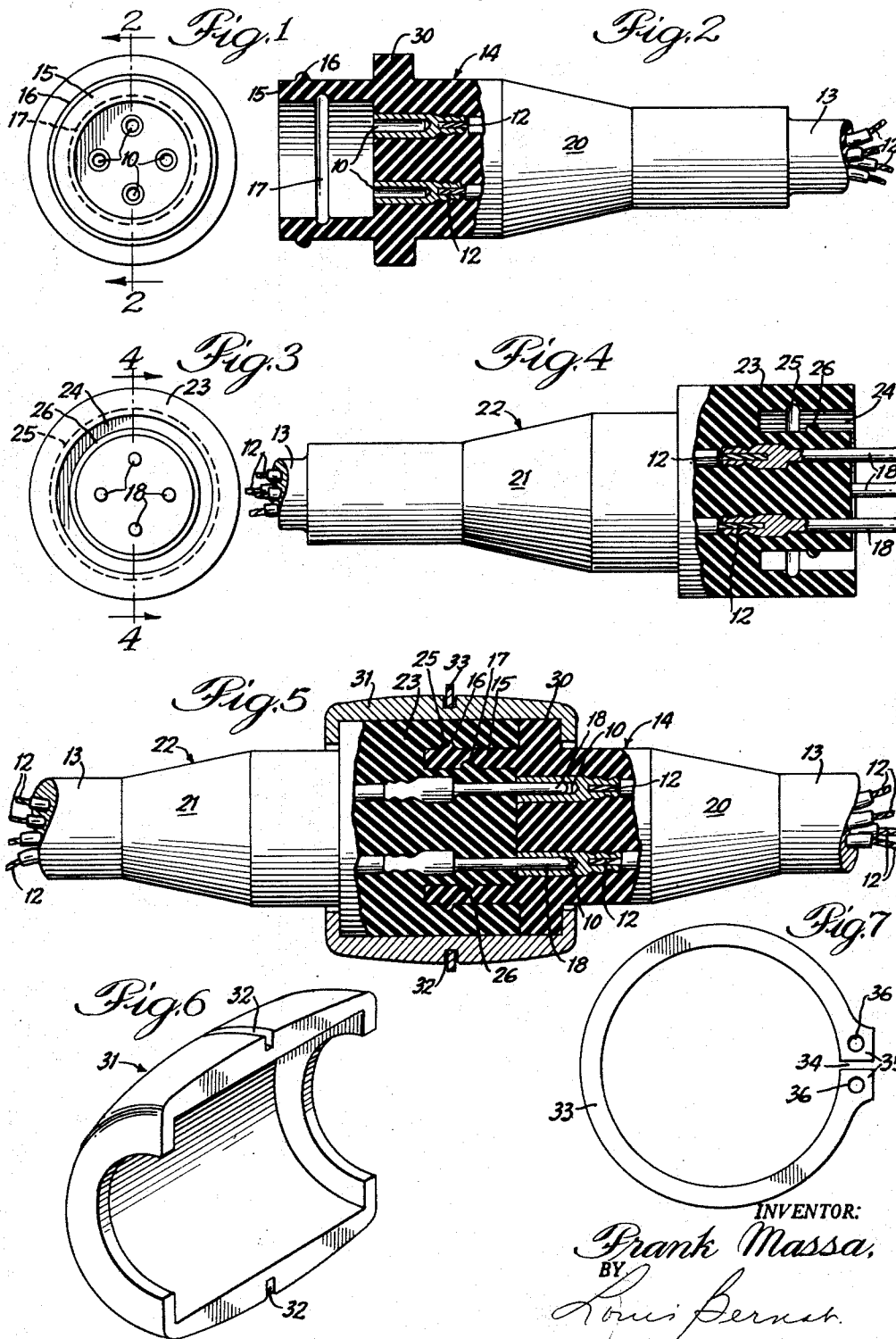
March 10, 1964

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3,124,405

UNDERWATER SEPARABLE CONNECTOR

Filed May 3, 1961



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3,124,405

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Filed May 3, 1961, Ser. No. 107,398

2 Claims. (Cl. 339—60)

This invention relates generally to underwater separable electrical connectors and more particularly to new and improved cable connectors which possess a very high degree of reliability and are leak-proof to submerged water pressures in excess of 5,000 p.s.i.

It is a general object of this invention to improve the construction of underwater cable connectors to increase the reliability of operation over that of conventional prior art connectors used for this purpose.

It is another object of this invention to provide a plural seal arrangement in a plug-in type of cable connector to the end that if one seal is damaged, another seal insures the satisfactory operation of the plug.

It is a further object of this invention to increase the reliability of an underwater cable connector by providing unique means for eliminating the accidental pulling apart of the connector after it is installed.

It is a still further object of this invention to provide a multi-terminal underwater cable connector which withstands very high hydrostatic pressures without leakage into the connector and without damage to the wiring.

Other objects of the invention will become evident in the following specification. The novel features that are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, as well as advantages thereof, will best be understood from the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is an end view of the female portion of an illustrative connector embodying the teachings of this invention;

FIGURE 2 is an elevational view, partly in section as taken on the line 2—2 of FIGURE 1;

FIGURE 3 is an end view of the male portion of an illustrative connector embodying the teachings of this invention;

FIGURE 4 is an elevational view, partly in section as taken on the line 4—4 of FIGURE 3;

FIGURE 5 is a partial cross-section showing the assembly of the male and female connectors and also showing an illustrative retaining clamp device embodying a further feature of this invention adapted for preventing accidental separation of the assembled plug;

FIGURE 6 is a perspective view of one retaining shell of the clamp device used for securing the assembled connector to prevent accidental separation of the plug; and

FIGURE 7 is a plan view of an illustrative spring ring used for locking the retaining shells of the retaining clamp device.

Referring now to the drawing, and more particularly FIGURES 1 through 5, the reference numeral 10 represents a female socket terminal, of which several are spaced in a desired manner as shown in FIGURES 1 and 2. A conductor 12 from the underwater cable 13 is electrically connected, as by soldering or any other satisfactory means, to each terminal 10, as shown in FIGURE 2. After the conductors 12 are connected to their respective socket terminals 10, the electrical assembly advantageously is held in a mold which is adapted for molding a resilient electrical insulating body 14, as of rubber, which seals all the space between the socket terminals 10 and also provides an outer resilient jacket which becomes bonded to the outer insulating jacket of the cable 13.

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In order to provide a reliable underwater seal for the separable cable connector member 20, it is advantageous to provide an outwardly projecting shell 15, which may be an integral part of the molded body 14. Advantageously, projecting shell 15 is provided with a peripherally molded bead 16 as illustrated. In accordance with a feature of the invention, the inner periphery of the projecting shell 15 is molded with a recessed groove 17. Further, an outwardly extending stop flange 30 is molded around body 14 at the shell 15.

Cable connector member 20 is provided with a mating cable connector member 21. As illustrated in FIGURES 4 and 5, cable connector 21 includes a sealed underwater cable 13, of which the conductors 12 are electrically connected to respective male pin terminals 18.

Those skilled in the art will appreciate that the male pin terminals 18 are located in the same spaced relationship as the location of the female socket terminals 10 of FIGURE 1. The pin terminals 18 advantageously are formed to make a sliding spring contact with the openings in the socket terminals 10 of FIGURE 1. After the pin terminals 18 are securely held in their proper relationship in a suitable mold, a flexible water impervious compound is molded into a plug member 23 to fill all the space between the assembled terminal pins 18 and also to form an outer waterproof electrical insulating body 22 which is bonded to the jacket of the underwater cable 13.

Preferably, the shape of the plug member 23 which contains the terminal pins 18 is formed with a cavity 24 which is of a shape and size to mate exactly with the projecting shell 15 of the cable connector member 20. The outer wall of the formed cavity 24 is provided with a recessed groove 25 which is located and shaped to mate with the peripheral bead 16 of cable connector member 20 when the two connector members are assembled. A projecting peripheral bead 26 is provided on the inner wall of the formed cavity 24, and is located to mate with the groove 17 when the connector members are assembled.

The tolerances on the dimensions of the projecting shell 15 are such that there is a slight interference when the flexible connector member 20 is engaged with the flexible cable connector member 21. This slight interference in dimensions will cause the bead 26 to seal against the recessed groove 17 and will also cause the bead 16 to seal against the recessed groove 25.

A partial cross-section of the mated connector members is shown in FIGURE 5 which illustrates the plural seal that is provided by the double projecting bead arrangement described hereinabove. In addition to giving an increased factor of safety in preventing leakage by use of the dual seals, those skilled in the art will appreciate that the invention also provides an additional advantage in which the bead 26 is completely protected from being scratched or damaged, as is also the mating groove 17, since neither of these surfaces are exposed to external abrasion by ordinary handling. When the mating connector members 20 and 21 are assembled as illustrated in FIGURE 5, an essentially solid resilient water-proof body is produced which encloses and seals the electrical connections.

Experimental tests conducted on connectors made in accordance with the teachings of this invention have satisfactorily withstood underwater pressures in excess of 10,000 p.s.i. without leakage or damage to the electrical connections. In order to provide an additional mechanical lock to prevent the cable connector from being accidentally pulled apart under extreme conditions of handling, a pair of cylindrical half shells 31 of the type illustratively shown in FIGURE 6 may be provided to fit over the outer portions of the assembled connectors. This is particularly illustrated in the partial section of FIGURE 5. Each half shell 31 advantageously is formed with a shaped

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groove 32 around its periphery into which a spring ring-type clamp 33 is placed to hold the outer shells in position as a retaining clamp. Manifestly, clamp 33 may be formed as a C-clamp having the open ends 34 and 35 provided with suitable openings 36 to permit the clamp 33 to be sprung apart with a suitable spreading tool in the openings 36. After opening the ring clamp 33 to fit over the assembled body of the half shells 31, the clamp is allowed to collapse into the slot 32 to hold the assembled shells in permanent contact.

This invention has been described in connection with particular embodiments which have been chosen to illustrate the basic principles of the invention. However, it will be obvious to those skilled in the art that numerous deviations will be possible from the particular embodiments shown, and therefore, the invention shall not be limited except insofar as is made necessary by the spirit and scope of the appended claims.

What is claimed as the invention is:

1. The improvement of a separable waterproof electrical connector comprising the combination of a first set of terminals, a second set of terminals formed to mate with said first set of terminals, electrical conductor means connected to said first set of terminals, electrical conductor means connected to said second set of terminals, flexible waterproof insulation means securely bonded to said first set of mating terminals to form a unitized, waterproof plug assembly, flexible waterproof insulation means securely bonded to said second set of mating terminals to form a unitized waterproof socket assembly, said plug and socket assemblies being capable of being nested to establish a waterproof electrical connection between said first set of terminals and said second set of terminals, at least one member of the two piece plug and socket assembly comprising a central insulating portion enclosing a set of terminals and peripherally spaced outer flexible skirt sealed to one end of said central insulating portion and extending therefrom to form an annular opening at the other end of said central insulating portion, said cen-

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tral insulating portion comprising a first bead extending outwardly around its periphery and said outer flexible skirt being formed with a first recessed groove extending around its inner periphery, and the other member of the two piece plug and socket assembly comprising a projecting shell adapted to be snugly fitted within said annular opening when the plug and socket members are operatively coupled to each other, the outer periphery of said projecting shell comprising a second bead extending outwardly for mating with said first recessed groove of the outer flexible skirt and the inner periphery of said projecting shell being formed with a second recessed groove extending therearound for mating with said first bead of the central insulating portion to provide a dual waterproof seal when the plug and socket members are operatively coupled together.

2. The improvement of a separable waterproof electrical connector in accordance with claim 1 wherein said plug and socket assemblies each comprise a planar shoulder portion extending around its outer periphery to provide a pair of opposed parallel end surfaces in said plug and socket assembly, a shell-like member having inwardly extending end flanges adapted to engage the opposite parallel end surfaces of said planar shoulder portion when said shell-like member is placed over said plug and socket assembly, and clamp means for holding said shell-like member in close proximity to the outer surfaces of said plug and socket assembly.

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