

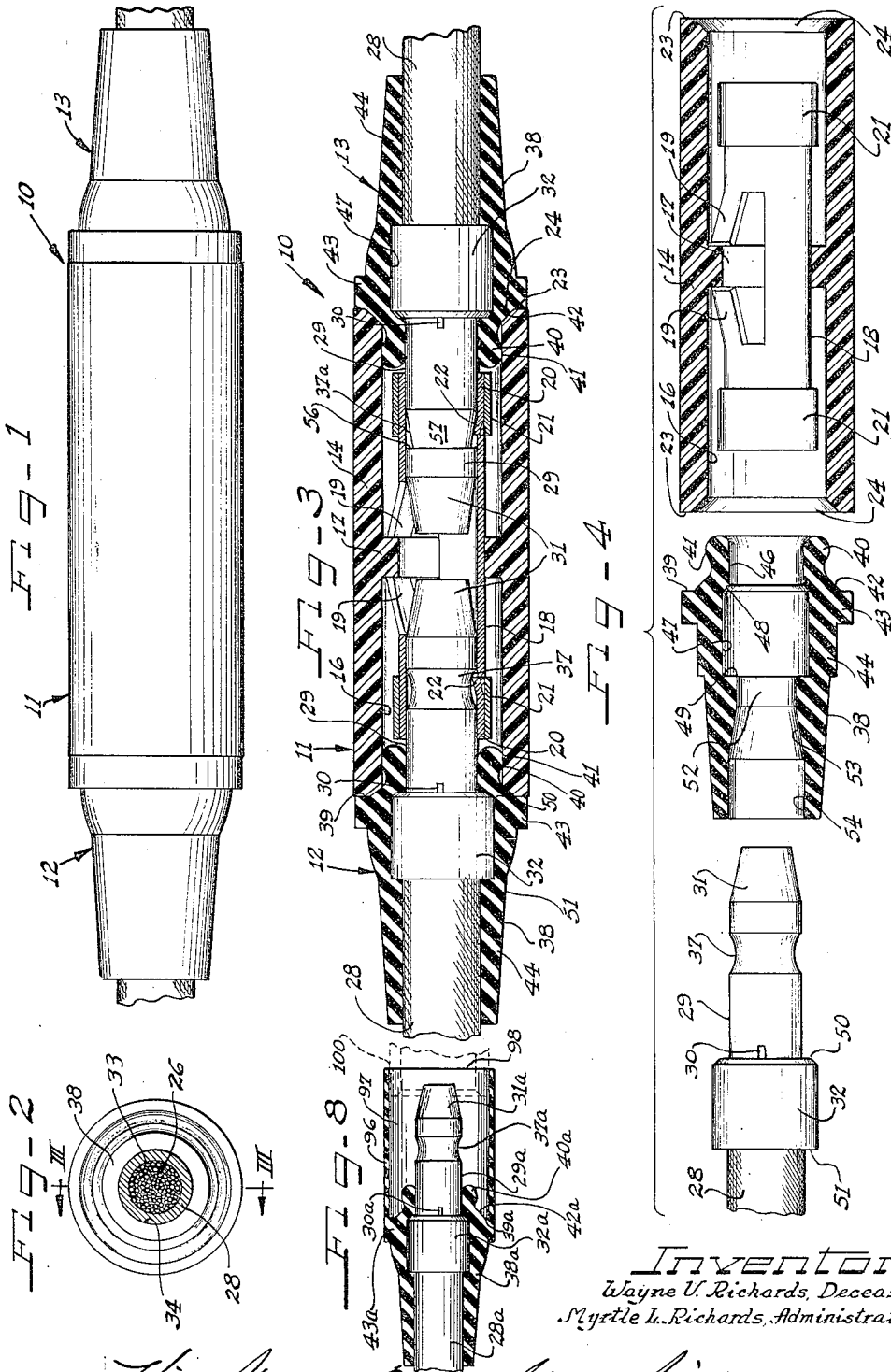
Aug. 7, 1956

W. V. RICHARDS  
WATERPROOF CONNECTOR

2,758,291

Filed Sept. 10, 1952

2 Sheets-Sheet 1



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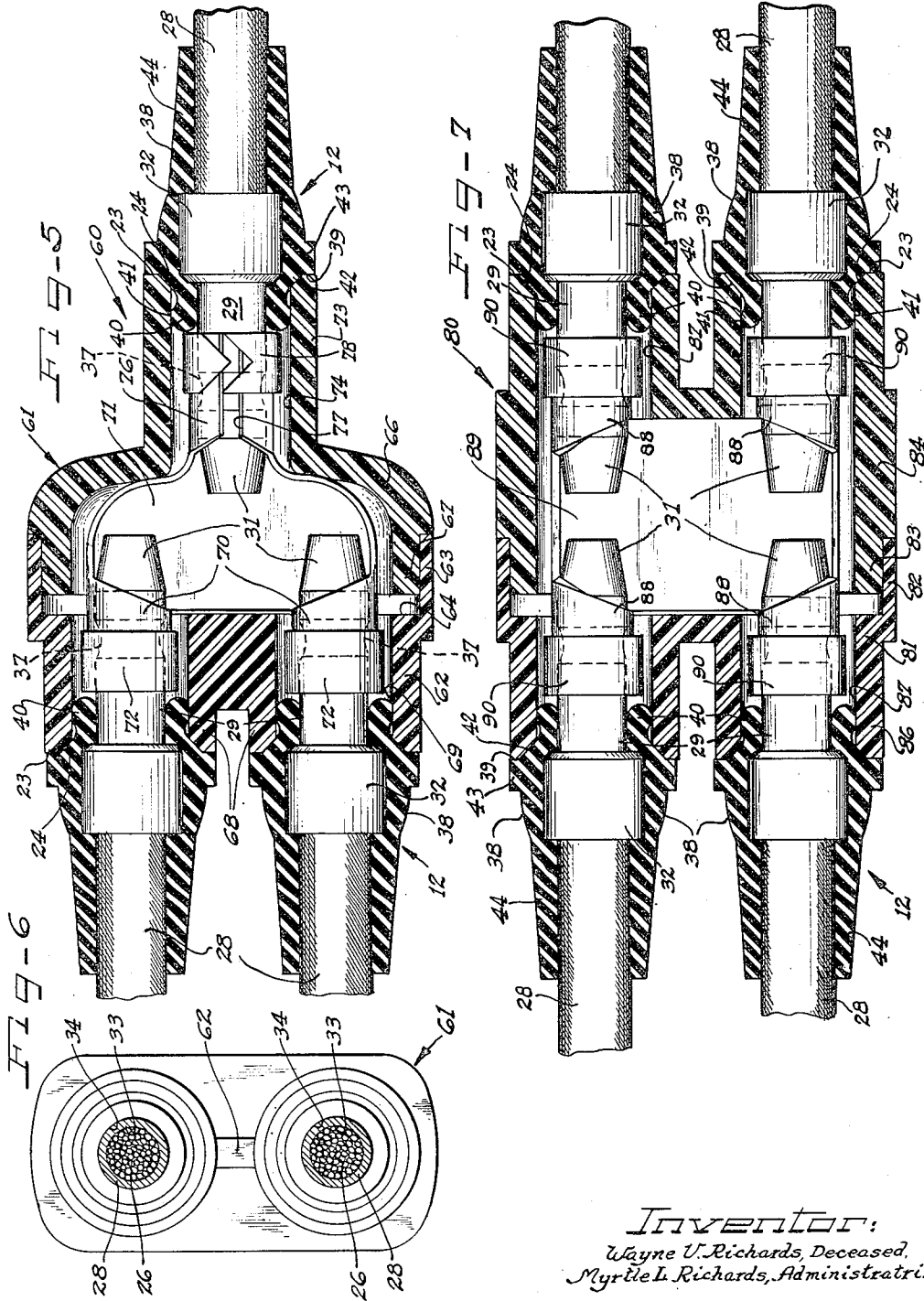
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2,758,291

## WATERPROOF CONNECTOR

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Application September 10, 1952, Serial No. 308,866

12 Claims. (Cl. 339-94)

This invention relates generally to separable connectors and particularly to a separable connector having component parts assembled in a novel manner in which certain of the parts are arranged to provide a water-tight seal when the connector is placed in assembled relationship.

According to the general principles of the present invention, a waterproof connector is provided including a plug and a socket having intermating current carrying means, a grommet is provided on the plug and abuts against the ends of the socket to provide a first seal joint between the socket and the plug. The grommet is made of resilient elastic material such as rubber or neoprene and includes a protruding skirt portion which is generally in the cross-sectional configuration of an O ring and which is received in the socket to provide a second seal between the longitudinally extending surfaces of the socket and the plug.

The current carrying means of the plug and socket preferably comprise male and female members having intermating means tending to draw the plug and the socket together against the bias of the resilient grommet. There is thus provided a very effective form of seal between the plug and socket so that no liquid will penetrate the enclosure in which the current carrying means are housed.

It is an object of the present invention to provide an improved waterproof connector which is formed of a reduced number of greatly simplified parts and which will be effectively sealed against fluid infiltration.

Another object of the present invention is to provide a simplified multi-wire terminal connector which is inexpensive to manufacture and which is completely waterproof when assembled.

Another object of the present invention is to provide a separable connector having a plurality of waterproof joints forming a seal between the separable elements of the connector.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which a preferred structural embodiment incorporating the principles of my invention is shown by way of illustrative example.

On the drawings:

Figure 1 is an elevational view of a two-wire connector incorporating the principles of the present invention;

Figure 2 is an end elevational view of the two-wire connector shown in Figure 1;

Figure 3 is a cross-sectional view taken substantially on line III-III of Figure 2 with parts shown in elevation revealing additional details of structure of the two-wire connector shown in Figure 1;

Figure 4 is an exploded view showing additional construction details of some of the elements utilized in accordance with the principles of the present invention;

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Figure 5 is a cross sectional view with parts shown in elevation of a three-wire connector provided in accordance with the principles of the present invention;

Figure 6 is an end elevational view of the three-wire connector shown in Figure 5;

Figure 7 is a four-wire connector provided in accordance with the principles of the present invention; and

Figure 8 is a cross-sectional view of a modified grommet provided in accordance with the principles of the present invention.

As shown on the drawings:

In Figure 1 a two-wire connector is indicated generally at 10 and comprises a socket member 11 receiving a first plug member 12 in one end and a second plug member 13 in the other end. Each of the plug members 12 and 13 is identical insofar as structural detail is concerned and, accordingly, only a single set of reference numerals will be applied in further describing same.

Referring now to Figures 3 and 4, it will be noted that the two-wire connector 10 comprises a generally tubular housing 14 made of insulating material and having an open ended bore 16 provided with an internal medial shoulder or annular rib 17.

A current continuing member indicated generally at 18 is inserted into the housing. The current continuing member 18 preferably comprises a formed cylindrical tube having opposed struck-out ears indicated at 19 which engage opposite sides of the shoulder 17, thereby to retain the current continuing member 18 firmly in place within the housing 14. The current continuing member 18 is preferably made out of an electrically conductive metal embodying sufficient resilience so that insertion of the current continuing member 18 into the housing 14 may be effected even though the tongues 19 extend radially outwardly beyond the inner diameter of the annular shoulder 17. Thus, as the current continuing member 18 is inserted into the housing 14, the tongues 19 will be depressed in passing the shoulder 17 and will snap in behind the shoulder 17 so that the oppositely disposed tongues 19 will engage opposite sides of the annular shoulder 17.

On each end of the current continuing member 18 is provided a generally cylindrical socket portion 20 which is surrounded by a sleeve 21 adapted to improve the resilience of the respective socket portions 20.

Each of the socket portions 20 is provided with a radially inwardly extending embossment or struck-out portion providing an ear 22 which is adapted to cooperate with a plug member received in the socket portion 20 as will be more fully described hereinafter. Each socket portion 20 is longitudinally split to resiliently engage the plug member.

In connection with the housing 14, it may be noted that each end of the housing 14 is provided with a transverse sealing face 23 which lies on a plane normal to the axis of the tubular housing 14. Additionally, each end of the housing 14 is provided with a tapered mouth 24 which not only assists in locating a plug member inserted into the housing 14 for cooperation with the current continuing member 18 but also which forms a sealing face lying on a plane intersecting the plane of the sealing face 23 and also intersecting the longitudinal plane including the axis of the tubular housing 14.

Each of the plug members 12 and 13 comprise the terminal ends of a conductor wire indicated at 26. The conductor wire 26 is preferably covered by a layer of insulating material forming a cylindrical sheath 28. In making up the plug members 12 and 13, the conductor wire 26 is bared near the terminal end thereof by removing a portion of the cylindrical sheath 28 whereupon a generally tubular current carrying member 29 is swaged to the con-

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ductor wire 26 as at a plurality of circumferentially spaced points indicated generally at 30.

The current carrying member 29 has a closed tapered finding end 31 and a generally cylindrical body portion which terminates in an enlarged annular rib indicated at 32. The current carrying member 29 is provided with a recess 33 receiving the wire conductor 26, which recess is enlarged in the rib 32 as is indicated at 34 so as to accommodate not only the wire conductor 26 but also a portion of the insulating material or sheath 28 covering the wire.

A medial annular groove 37 is provided in the body portion of the current carrying member 29 and is longitudinally aligned in predetermined spaced relation to the rib 32. The groove 37 cooperates with the embossments or tongues 22 which are formed in the socket portion 20 of the current continuing member 18, thereby to exert an additional retaining force on the current carrying member 29 which supplements the forces tending to retain the current carrying member 29 in inserted assembly with respect to the current continuing member 18.

Since each of the socket portions 20 takes the form of a split cylindrical tube surrounded by the sleeve 21, it is preferred that the mating parts are proportioned to resiliently engage one another when the current carrying member 29 is inserted into the socket portion 20 of the current continuing member 18.

In order to isolate the current carrying components of the connector 10 in a water tight sealed relation within the housing 14, each of the plug members 12 and 13 carries a grommet indicated generally at 38 which is made of a resilient and elastic material such as rubber or an oil-resistant material such as "neoprene," or the like.

In Figure 4, the particular details of construction of the grommet 38 are shown. The grommet 38 preferably takes the form of a generally cylindrical tube having a first sealing face 39 lying on a plane generally transverse to the axis thereof and which is adapted to engagingly abut the corresponding face 23 of the housing 14 of the socket member 11.

Protruding from the sealing face 39 is a skirt or bead portion 40 shaped to conform generally with the shape of the open ended bore extending through the housing 14 in the socket member 11 and received in the bore 16 to sealingly engage the walls of the bore 16, thereby providing a second sealing face 41 which is generally longitudinally disposed with respect to the axis of both the grommet 38 and the housing 14. It will be appreciated that for best sealing results, the bead 40 may be made slightly larger than the bore 16 so as to be deformably compressed against both the current carrying member 29 and the housing 14, thereby forming a tight seal between the plug members 12 and 13 and the socket member 11. In cross section, the bead 40 resembles an O ring.

The grommet 38 additionally provides a tapered sealing surface 42 which lies generally between the sealing face 39 and the head 40 and which is angularly disposed so as to lie in a plane intersecting the plane including the sealing face 39 and the plane including the sealing face 41. The sealing face 42 abuttingly engages the corresponding tapered throat or sealing face 24 of the housing 14 of the socket member 11.

In the particular embodiment herein disclosed, the sealing face 39 is provided on one side of an annular rib 43 located adjacent one end of the grommet 38. Such embodiment further includes a skirt portion 44 of somewhat smaller size which extends away from the annular rib 43, the skirt portion 44 being adapted to surround and engage the insulation sheath 28 surrounding the conductor wire 26.

The grommet 38 is provided with an open ended bore extending therethrough and which is somewhat complexly shaped, one end of the open ended bore including a generally cylindrical recess portion 46 adapted to snugly surround the body portion of the current carrying member

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29. There is also provided a recess 47 in the open ended bore which corresponds in configuration to the enlarged annular rib 32 and which is adapted to snugly receive the rib 32. It will be noted that the recess 47 includes a shoulder 48 and a shoulder 49 at the opposite respective ends thereof, which shoulders engage corresponding shoulders 50 and 51 respectively on opposite sides of the annular rib 32 so as to lock the grommet 38 and the current carrying member 39 in fixed longitudinal alignment.

The open ended bore of the grommet 38 further includes a reduced neck portion 52 which snugly engages the insulation sheath 28 immediately behind the annular rib 32. As shown in Figure 4, the reduced neck 52 diverges outwardly as at 53 and terminates in a generally cylindrical recess portion 54.

After the grommet 38 has been assembled on the plug member 12 or the plug member 13, insertion of the plug member 12 or 13 into the socket 11 can be effected whereupon the sealing faces 23 and 39 will cooperatively engage one another, the sealing faces 42 and 24 will cooperatively engage one another, and the sealing face 41 and the inner bore 16 of the housing 14 will cooperatively engage one another. Thus, effective seal will be provided between the socket 11 and the plug 12 precluding the entry of fluid into the interior of the housing 40 between these two components.

The fitted relationship of the grommet 38 on the current carrying member 29 and the sheath 28 will also preclude leakage of fluid axially along the peripheral surface of the plug member 12.

According to the principles of the present invention, the cooperation between the groove 37 and the embossments or tongues 22 may develop an additional function in drawing the plug member 12 and the socket member 11 together axially. It will be noted that the groove 37 provided in the body portion of the current carrying member 29 is arcuately shaped in cross section. This particular configuration provides a camming surface which, upon engaging the embossments or tongues 22 develops a wedging action tending to draw the plug member 12 and the socket member 11 together axially, thereby urging the housing 14 against the resilient bias of the grommet 38 in promoting a particularly efficient water tight seal at the sealing surfaces 23, 39, 24 and 42.

In many uses in the field, it is desirable that one terminal be the so called "hot" terminal and in order to designate same, the appropriate grommet 38 affixed to the "hot" terminal may be made of a different colored resilient elastic material.

Furthermore, since it is desirable that the "hot" terminal not be subject to inadvertent or accidental removal with the consequent possibility of grounding against an adjacent metal part, it may be desirable to modify the groove 37 provided in the current carrying member 29 as is indicated on the right hand side of Figure 3. It will be noted that the annular groove provided in the shoulder portion of the current carrying member 29 on the right hand side of Figure 3 includes a recess 37a having a shoulder 56 at one end thereof so that the embossments or tongues 22 can snap in behind the shoulder to retain the "hot" terminal in assembly therewith. The annular groove 37a is further provided with a tapered camming surface diverging away from the shoulder 56 which is indicated at 57. Such camming surface operates to tend to draw the plug and socket together against the resilience of the grommet.

In Figure 5 is shown a three-wire connector indicated generally by the reference numeral 60. A housing 61 comprises a housing member 62 having a flange 63 at one end adjacent a shoulder 64. A second housing member 66 is provided with a flange 67 complementary in configuration to the flange 63 and arranged to be telescopically received therein. It will be noted that the peripheral surface of the flange 63 and the peripheral surface of the body member 66 lie flush with one another after

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the body members 62 and 66 are assembled together. In order to retain the body members 62 and 66 in firm assembly, a suitable cementing compound or adhesive may be provided at the flanges 63 and 67.

It will be noted that the body member 62 is provided with a plurality of protruding boss portions which are indicated at 68. Each of the boss portions 68 has a generally cylindrical recess 69 formed therein and opening outwardly thereof so as to receive a socket portion 70 of a current continuing member 71.

The current continuing member 71 is preferably formed from a sheet like material made of metal or the like and may comprise a stamping having the socket portions 70 formed as cylindrical portions having a longitudinal slit therein. Each of the socket portions 70 is surrounded by a sleeve 72 which enhances the resilient assembly of a plug member indicated generally at 12.

The body member 66 is provided with a reduced neck 73 having a recess formed therein indicated at 74 receiving a socket portion 76 provided by the current continuing member 71. The socket portion 76 is longitudinally split as at 77 and is surrounded by a sleeve 78 which enhances the electrical connection between the socket portion 76 and the plug member 12 received therein.

In Figure 7, a four-wire connector is indicated generally by the reference numeral 80. A first body member indicated at 81 has a flange 82 at one end thereof receiving a complementary shaped flange 83 of a second body member 84. Each of the housing members 81 and 84 is provided with a plurality of boss portions 86 each being provided with a recess 87 adapted to receive a socket portion 88 formed on the corner portions of a stamped current continuing member 89. The respective socket portions 88 are each surrounded by a metal sleeve 90 which operates to improve the electrical contact between the socket portions 88 and each of the plug members 12 inserted into the socket portions.

In each of the embodiments shown, the various plug members 12 are sealed with respect to the housing members in the same manner as has been described in detail in connection with the embodiment shown in Figures 1-4. Body members 62 and 66 of Figure 5, and body members 81 and 84 of Figure 7 provide the sealing faces 23 and 24 at the end of the recesses 69, 74, 87 and these sealing faces cooperate with each of the grommets 38 so as to isolate the current continuing members 71 and 89 against leakage within the housings.

In Figure 8 is shown an embodiment of the principles of the present invention suitable for use with a single connector. The current carrying member is indicated at 29a and is carried on the end of a conductor wire covered by an insulating sheet 28a. The current carrying member 29a is swaged as at 30a and includes a closed tapered end 31a at one end and an enlarged rib 32a at the other end. A medial groove 37a is provided on the body portion of the current carrying member 29a. The sealing grommet is indicated at 38a and structurally is very similar to the grommet 38 described in connection with the other embodiments of the invention. Similar reference numerals bearing the suffix "a" have been applied to the grommet wherever the structural features are identical, however, it will be noted that the grommet 38a is provided with an additional structural feature which comprises an enlarged flexible skirt portion 96 which extends axially away from the shoulder 43a so as to provide a recess 97 around the end of the current carrying member 29a.

The end of the skirt 96 is indicated at 98 and it will be noted that the end portion 98 extends beyond the end of the current carrying member 29a.

A pocket member indicated in phantom and identified by the reference numeral 100 will be received in the skirt 96.

Although various minor structural modifications might be suggested by those versed in the art, it should be under-

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stood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. In a waterproof connector, a conductor having a plug swaged on the end thereof, said plug comprising a generally cylindrical current carrying member having a medial annular groove formed in the peripheral surface thereof and terminating in an enlarged annular rib, said conductor having a sheath of insulating material extending away from said annular rib, and a grommet on said conductor comprising a sleeve made of resilient elastic material and having a skirt portion engaging said insulating material, and an internal recess conforming in shape to said annular rib and receiving same to lock said grommet against axial displacement on said conductor, an annular shoulder on said grommet, a bead formed to provide an integral O ring on said grommet adjacent said shoulder and surrounding said current carrying member in spaced relation to said annular groove, a socket having a current continuing member provided with a tongue seating in said annular groove, and a housing for said socket having a sealing face engaging said shoulder and a recess receiving said current carrying member and said bead, said recess conforming in shape to said bead but being of slightly smaller size to promote a seal between said plug and said socket.

2. In a waterproof connector as defined in claim 1, said annular groove being arcuately shaped in cross-section to provide a curved camming surface cooperatively engaging said tongue for drawing said socket and said plug together against the resilience of the grommet.

3. In a waterproof connector as defined in claim 1, said annular groove having a retainer shoulder and said tongue being resilient and snapping in behind said shoulder to retain said plug in said socket in assembled relation.

4. In a waterproof connector as defined in claim 3, said annular groove also having a tapered camming surface diverging away from the said retainer shoulder thereof and cooperating with said tongue to draw said plug and said socket together against the resilience of said grommet.

5. A line connector comprising, an open-ended tubular housing providing an open-ended bore having an internal medial shoulder therein, a current continuing member assembled in said housing and having socket portions at opposite ends thereof, said current continuing member further including ears engaging opposite sides of said shoulder, each of said socket portions having a tongue extending inwardly into the respective socket portion, a terminal plug inserted into each end of said housing and each having a current carrying member engaging a corresponding socket portion of said current continuing member, each of said current carrying members having an annular groove formed therein cooperating with a corresponding one of said tongues to retain said plugs and said socket in assembly, and a grommet on each terminal plug made of elastic resilient material, said grommet having an annular shoulder engaging a corresponding end of said housing to provide a radially extending sealed joint and a bead on said grommet formed to provide an integral O ring corresponding in shape to said bore and received therein, said bead engaging said housing to provide a longitudinally extending sealed joint between said terminal plug and said housing.

6. A line connector as defined in claim 5 wherein said tubular housing is provided with a tapered mouth in the opposite ends of said open-ended bore and said grommet includes a correspondingly shaped tapered seating surface between said shoulder and said bead engaging said tapered seat to provide a tapered sealing joint between said plug and said housing.

7. A waterproof connector comprising a socket, a plug,

and a grommet on said plug abutting against the end of said socket and forming together therewith a radially extending sealed joint between the socket and the grommet, said grommet being made of resilient elastic material and including a first skirt portion received in said socket and forming together with the socket a longitudinally extending sealing surface between the socket and the plug, said grommet including a concentrically outwardly spaced second skirt portion providing a recess for receiving at least a portion of said socket.

8. A waterproof connector comprising a socket, a plug, and a grommet on said plug abutting the end of said socket and forming together therewith a first radially extending sealing joint between the socket and the grommet, said grommet being made of resilient elastic material and including a first skirt portion formed to provide an integral O ring received in said socket and forming together therewith a longitudinally extending sealing surface between the socket and the plug, said plug having a current carrying member extending through said first skirt portion, said socket having a current carrying member receiving the current carrying member of said plug, and a concentrically outwardly spaced second skirt portion on said grommet extending beyond the end of said current carrying member of said plug and forming a recess around said current carrying member of said plug, at least a portion of said socket being received in said second skirt portion.

9. A waterproof connector comprising a rigid generally tubular receptacle, a pair of conductors, a pair of plugs on the ends of said conductors and received in opposite ends of said rigid tubular receptacle, a resilient grommet snapped on each of said plugs, each grommet comprising a cylindrical sleeve concentric to said conductors, and an integral O ring section projection at one end thereof received inside of and resiliently engaging said rigid tubular receptacle, and interlocking detent means between said plugs and said receptacle resiliently biased when in locked together relationship by said grommets, said grommets being resiliently deformed against said receptacle to form a water-tight joint around said conductors, said grommet having a skirt portion formed to receive the adjoining end portion of said tubular receptacle.

10. A separable connector comprising, in combination, an open-ended tubular socket having continuous generally cylindrical walls, a current continuing member therein, a plug inserted in each end of said socket and received by said current continuing member, resilient grommet means carried by each of said plugs and engaging said socket, and interlocking members between said current continuing member and said plugs elastically deforming said grommet means, thereby forming a water-tight seal between said plugs and said socket, said grommet means each having an integral O ring section projection received in and resiliently engaging the cylindrical walls of said socket, said seal being resiliently locked by a positive resilient locking bias provided by the deformation of

said grommet means and further including a skirt portion concentrically outwardly of said O ring projection to receive an adjoining end of said socket therein.

11. A separable connector comprising a socket having a wall formed to provide a recess at opposite ends thereof, a plug received in each said recess and having a resilient elastic grommet engaging said wall at the edges of said recess to provide a first sealing joint between the plug and the socket, an integral O ring protuberance formed on said grommet and received in said recess and being complementary in shape thereto, said protuberance forming together with said socket a second sealing joint between said plug and said socket, and intermating current continuing means between said said socket and said plugs interlocked against the resilient bias of said grommets, thereby deforming said grommets to form a water-tight seal at the locale of said socket and plugs, said grommet having a skirt portion concentrically outwardly of said protuberance to receive an adjoining portion of said wall of said socket therein.

12. A line connector comprising, an open-ended tubular housing providing an open-ended bore having an internal medial shoulder therein, a current-continuing member assembled in said housing and having socket portions at opposite ends thereof, said current-continuing member further including ears engaging opposite sides of said shoulder, each of said socket portions having an ear extending inwardly into the respective socket portion, a terminal plug inserted into each end of said housing and each having a current-carrying member engaging a corresponding socket portion of said current-continuing member, each of said current-carrying members having an annular groove formed therein cooperating with a corresponding one of said ears to retain said plugs and said socket in assembly, and a grommet on each terminal plug made of elastic resilient material and having a first skirt portion for engaging a corresponding terminal plug and a second skirt portion of larger diameter than said first skirt portion and spaced concentrically outwardly of said current-carrying member of the corresponding terminal plug to receive and seal against the adjoining peripheral surface of a corresponding end of said tubular housing.

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