

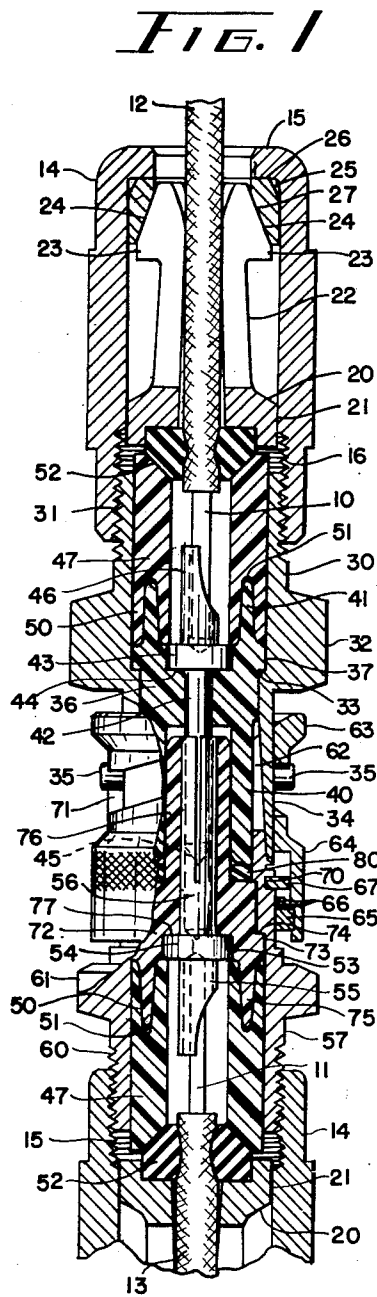
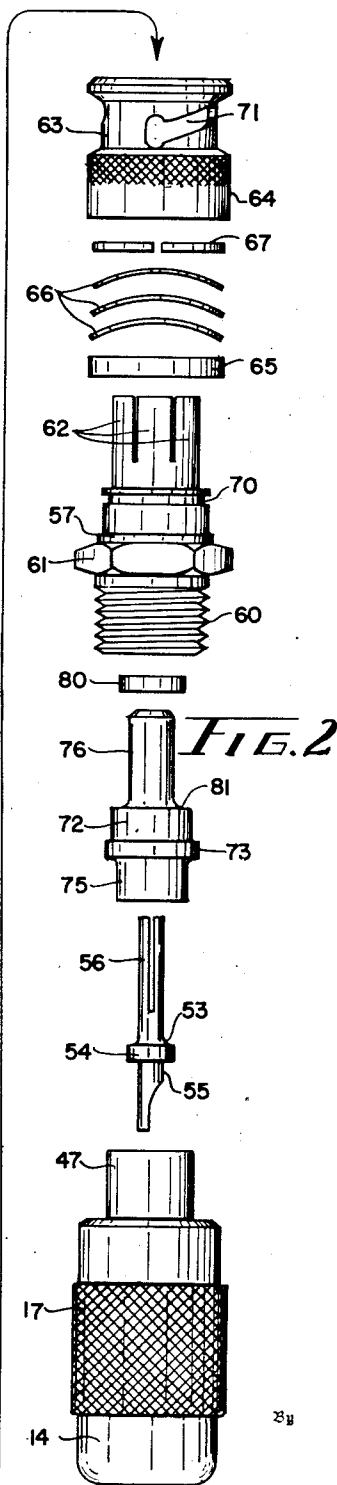
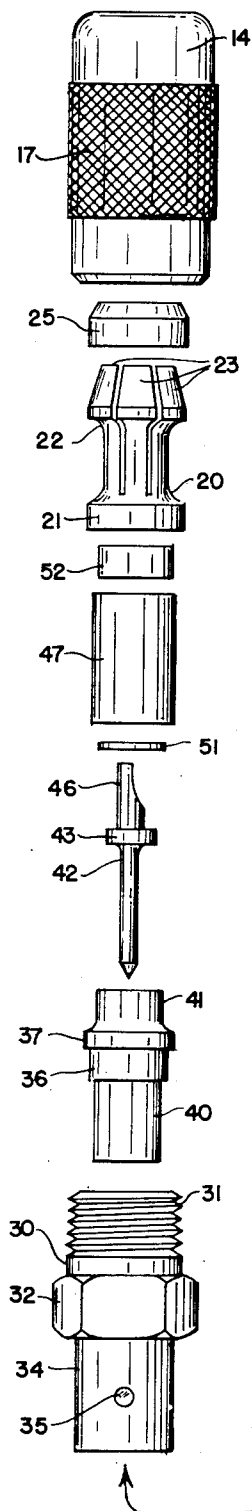
June 16, 1953

E. C. BOWAR
ELECTRICAL CONNECTOR

2,642,474

Filed Sept. 14, 1949

2 Sheets-Sheet 1



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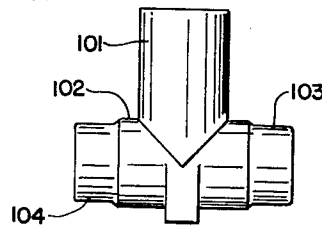
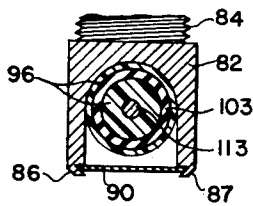
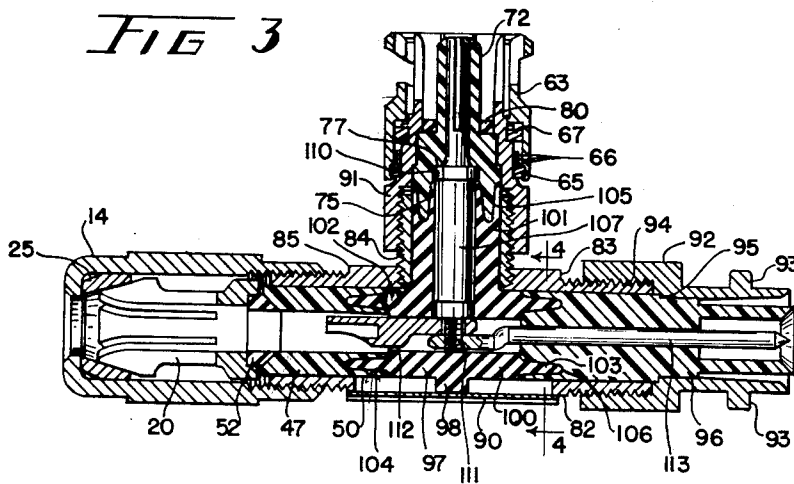
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UNITED STATES PATENT OFFICE

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ELECTRICAL CONNECTOR

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5 Claims. (Cl. 339-107)

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This invention is concerned with electrical connectors and more specifically with fluid tight connectors.

Heretofore as far as applicant has been aware there have been no small, lightweight quick-disconnect type of electrical connectors which were fluid tight in aromatic fuels, gripped an insulated conductor tightly, and provided a long electrical leakage path between the metallic portions of the connector and the conductor.

It is therefore an object of the invention to provide a connector which will not permit liquid to seep through to the bared conductor within the connector.

Another object of the present invention is to provide a connector which has a long electrical leakage path between the metallic portions of the connector and the conductor.

Another object is to provide a connector in which the various portions of the connector are centered with respect to each other when the connector is put together.

Another object is to provide a connector in which the insulated portions butt together with the mechanical stress on these portions maintained along the length of the insulators.

These objects are accomplished by providing the long insulators which are used in the connectors with tongues and grooves at the ends of these insulators which meet. This provides a long electrical leakage path between the metallic portions of the connector and the bared conductor inside. The tongue and groove point between the insulators also serves to center these insulators with respect to each other and also all other parts within these insulators and also causes an even distribution of the mechanical stress between these insulators. A compressed resilient insulator is placed along all joints along the insulation path between the metallic portions of the connector and the bared conductor for the purpose of preventing liquid from seeping through.

Another object of the invention is to provide a connector which tightly grips the insulated conductor and removes any strain from the soldered joint between the conductor and the pin in the connector.

This object is accomplished by using a bushing in the connector which clamps down on the conductor and holds it firmly when the various parts of the connector are put together.

For a more complete understanding of the invention reference is made to the following detailed description taken in conjunction with the accompanying drawings in which:

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Figure 1 shows a pair of assembled connectors, mostly in cross-section, joined together with a portion of one connector which is identical with the other connector cut away;

5 Figure 2 is an exploded view of the pair of connectors shown in Figure 1;

Figure 3 is a cross-sectional view of a T connector embodying various features of the invention;

10 Figure 4 is a cross-sectional view of the T connector of Figure 3 taken along line 4-4; and

Figure 5 is a full view of the center insulator of the T connector.

Description of Figures 1 and 2

Figure 1 shows a pair of conductors 10 and 11 brought electrically together by a pair of connectors. Conductor 10 is covered by insulation 12 and conductor 11 is covered by insulation 13. The upper connector in Figure 1, which is the connector shown at the left in Figure 2 will be described first.

A generally cylindrical ferrule 14 is shown to be turned inwardly at end 15 to form an annular abutment and the opposite end thereof is threaded internally at 16. Ferrule 14 also has a knurled portion 17 for ease in turning the ferrule manually when it is being threaded to a shell or plug 30.

20 Within the ferrule is a collet 20 having an annular base 21 which fits closely within the confines of ferrule 14. Collet 20 also has a number of resilient arms 22 which clamp down upon the insulated portion of conductor 10. The end of each arm 22 opposite the annular ring 21 is enlarged as at head 23 which has bevelled surfaces 24 for a purpose presently to be described.

Also within ferrule 14 is an annular actuator 25 which fits snugly within the ferrule 14 and abuts against a surface 26 of the turned-in portion 15 of the ferrule. The inner surface of the actuator is bevelled as at surface 27 to make sliding contact with surfaces 24 of collet 20 to force the arms 22 inwardly against the insulated conductor 10 as the ferrule is tightened on the shell 30.

The shell 30 has a threaded connection 31 with the upper ferrule. The shell 30 has a hexagonal surface 32 to facilitate holding the shell 30 when turning ferrule 14 with respect thereto. Shell 30 also has an internal shoulder 33 and an extending cylindrical portion 34 opposite the threaded end at 31. A pair of ears 35 extend outwardly from the cylindrical portion 34 of the shell 30 and form part of a bayonet

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connection with the other connector as will appear hereinafter.

Located within shell 30 is an insulator 36 of relatively rigid material such as molded nylon having an enlarged portion 37 butting against the shoulder 33 within shell 30. At the lower end of the insulator 36 is an extending cylinder 40 having an outside diameter smaller than the inside diameter of the cylindrical portion 34 of shell 30. It should be noted that the inner surface of the cylindrical portion 34 on shell 30 is bevelled so that the inside diameter of the end of the cylindrical portion 34 away from the hexagonal portion 32 is greater than the inside diameter of the end of the cylindrical portion adjacent the hexagonal portion 32. At the end of insulator 36 opposite the cylindrical portion 40 is an annular tongue 41 for purposes presently to be described.

Inside insulator 36 is a pin 42 having an enlarged portion 43 butting against a shoulder 44 of the insulator. The end of the pin 42 extends within the cylindrical portion 40 of the insulator and comes to a point 45 near the outer end of the cylindrical portion 40 of the insulator 36. On the other side of the enlarged portion 43 of the pin is a solder pot 46 to which the conductor 10 is soldered.

Also within shell 30 is a second cylindrical insulator 47 which may be made of the same material as insulator 36 having an annular grooved end 50 for cooperating with tongue 41 of insulator 36. At the base of the groove 50 is a resilient washer 51 which is compressed when insulators 36 and 47 are forced together.

The end of insulator 47 opposite the grooved end is bevelled inwardly and engages a resilient gasket 52 which fits within an enlarged annular hollow portion within base 21 of collet 20 and is compressed against the insulated conductor 10 when compressed between insulator 47 and collet 20 to form a fluid tight seal between the insulator 47 and the wire insulation 12. The connector is assembled as follows. The conductor 10 is first passed through the ferrule 14 with the bared end of the conductor extending from the threaded end of the ferrule. The actuator 25, the collet 20, the gasket 52 and the insulator 47 are then passed over the conductor. The insulator 51 is placed within the grooved portion 50 of insulator 47.

After the actuator, collet, gasket and insulator have been passed over the conductor the bared end of the conductor is soldered into the solder pot 46 of the pin 42.

The insulator 36 is placed within the shell 30 from the threaded end 31 so that the enlarged portion 37 butts against shoulder 33 of the shell and the cylindrical portion 40 is within the cylindrical portion 34 of the shell. The ferrule and shell are then threaded together with the tongue 41 of insulator 36 fitting into the grooved portion 50 of insulator 47, the gasket 51 forming a pressure tight seal between the insulators 36 and 47. The pin on the end of the conductor extends so that the point 45 of the pin is approximately flush with the end of the cylindrical portions 40 and 34 of insulator 36 and shell 30 respectively.

Several parts of the connector shown in the lower portion of Figure 1 and in the right hand portion of Figure 2 are identical to parts already described and the same reference numerals are used for their designation. The ferrule 14, actuator 25, collet 20, gasket 52, insulator

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47 and washer 51 are all identical to the corresponding parts in the connector in the upper portion of Figure 1 and left hand portion of Figure 2 and therefore a portion of these parts have been cut away in Figure 1 and are shown in the assembled position in Figure 2.

A socket 53 has an enlarged central portion 54 and a solder pot 55 on its lower end to which conductor 11 is soldered. At the end of the socket opposite the solder pot is a cylindrical portion 56 which is bifurcated for most of its length and is adapted to grasp the pin 42 of the upper connector resiliently when the two connectors are fastened together to complete an electrical connection between conductors 10 and 11.

A shell 57 has an externally threaded portion 60 by which it is threaded to ferrule 14. The shell also has a hexagonal portion 61 for ease in threading the shell to the ferrule. The end of shell 57 opposite the threaded portion is cylindrical and is divided into a number of resilient arms 62.

A ring 63 having an enlarged lower end 64 is fastened over the shell 57. This is accomplished as follows. A washer 65 is passed over the cylindrical portion of the shell 57 and is followed by three spring washers 66, and then by a split washer 67 which is fitted into a groove 70 in the shell. The ring is then passed over the various washers and is spun over the end of washer 65. The three spring washers 66 permit the ring a small freedom of longitudinal movement on the shell 57. This is for a purpose to be described later. The ring 63 has a pair of slanting grooves 71 into which the ears 35 of shell 30 can be inserted to lock the two connectors together. This type of fastening two connectors together is old in the art and is merely discussed here briefly.

An insulator 72 has an enlarged portion 73 which fits against a shoulder 74 inside shell 57. Adjacent the enlarged portion of insulator 72 is an annular tongue 75 which is fitted into the groove 50 of the insulator 47 and against the washer 51. At the end of insulator 72 opposite the tongue 75 is a cylindrical portion 76 having an outside diameter approximately equal to the inside diameter of the cylindrical portion 40 of insulator 36 in the first described connector and fits within it when the two connectors are joined together. The inside diameter of this cylindrical portion 76 is approximately equal to the outside diameter of the cylindrical portion 56 of socket 53. A shoulder 77 inside insulator 72 is butted against by the enlarged portion 54 of socket 53 to hold the socket firmly in place against the upper end of insulator 47.

A gasket 80 of resilient material is placed about the cylindrical portion 76 of insulator 72 and butts against a shoulder 81 of this insulator. Washer 80 is compressed between the shoulder 81 and the end of the cylindrical portion 40 of insulator 36 when the two connectors are fastened together to form a fluid tight seal between the insulators 36 and 72.

This connector is put together in the same manner as previously described in connection with the upper connector. The conductor 11 is passed through ferrule 14 and then the actuator, collet, grommet, and insulator 47 are passed over the conductor as has been described with respect to the previously described connector. The socket 53 is then soldered to the conductor 11 and the insulator 72 is passed over the socket and the washer 80 is passed over the cylindrical por-

tion of the insulator 72. The shell 57 is then threaded to the ferrule 14.

In certain respects both connectors operate in the same manner. When the ferrule is tightened on the shell the bevelled surface 27 of the collet actuator is forced against the bevelled surface 24 of the collet to cause the arms 22 of the collet to move inwardly to grasp firmly the insulation on the conductors 10 or 11. This holds the conductor firmly in the connector and prevents stress being applied to the soldered junction.

Tightening the ferrule on the shell also moves the collet longitudinally to compress the gasket 52 against the end of the insulator 47. The gasket expands laterally to engage the insulated surface of the conductor and forms a fluid tight seal between the insulated surface of the conductor and the gasket and between the gasket and the insulator 47. At the same time the washer 51 is compressed between insulator 47 and either insulator 36 or 72 to form a fluid tight seal between these insulators. When the two connectors are joined together, washer 80 is compressed between insulators 36 and 72 to form a fluid tight path between these two insulators. It is thus seen that all of the paths by which fluid might get to the bare metal conductors or the pin or socket from outside the connectors have been made fluid tight.

Wires having different diameter insulation may be used in these connectors merely by using collets 20 and gaskets 52 having appropriate inside diameters, the remaining parts of the connectors all being of single standard sizes. If a shielded cable is used a longitudinally split collet is substituted for the single member collet. The shielding is cut back sufficiently so that the collet grasps the shielded portion of the cable but the gasket 52 grasps the insulated portion of the cable and makes a fluid tight path between the gasket and the insulation. The shielding of the cable is continued through the outer portions of the connectors.

An electrical surface leakage path exists along all paths between two members of different potential. It is desirable to have as high a resistance along these paths as may be feasibly possible to keep the current drainage to a minimum. One method of increasing the resistance of this path is to increase the length of the path. The tongue and groove connection between the insulators of each connector provide a comparatively long electrical leakage path between the conductor and the outer portions of each connector and in addition increase the mechanical strength of the connector. A long electrical leakage path between the connection of the pin and socket of the connectors and the outer portions of the connectors is provided in that the path lies along almost the entire length of the cylindrical portions of insulators 36 and 72.

These connectors are also adaptable for connecting together tubing capable of carrying some sort of fluid. The end of the tubing would extend past the gasket 52 which would effectively seal the end of the tubing from the ferrule end of the connector and prevent any fluid from escaping out along the tubing. The other paths from the center to the outside have already been shown to be fluid tight. The collet would clamp down on the tubing and hold it firmly in the connector.

Description of Figures 3, 4 and 5

Figure 3 shows a T connector embodying various features of this invention. Here again many of the parts used in the two connectors previously

discussed may be used, and identical parts are given the same reference numerals.

The left arm of the T connector has a ferrule 14, a collet actuator 25, a collet 20, a grommet 52 and an insulator 47 all identical with those used in the connectors shown in Figures 1 and 2.

In the upper arm of the T connector parts identical with the lower connector shown in Figure 1 and the right hand connector shown in Figure 2 are the ring 63, the split washer 67, the three spring washers 66, the washer 65, the resilient washer 80 and the insulator 72.

The T connector here shown comprises a shell 82 having arms 83, 84 and 85 all of which are externally threaded. As seen more clearly in Figure 4 the lower portion of the shell 82 is open but the lower portions 86 and 87 of the shell are bent inwardly to hold a plate 90.

A shell 91 is similar to shell 57 shown in the lower connector of Figure 1 and the right hand connector of Figure 2 with the exception that shell 91 is internally threaded rather than being externally threaded as is shell 57. The ring 63 is, however, fastened onto shell 91 in the same manner as it can be fastened onto shell 57. Shell 91 is threaded onto the upper arm of shell 82.

A shell or plug 92 having ears 93 is internally threaded as at 94 and is shown to be threaded onto the right hand arm 83 of shell 82. Plug 92 has a shoulder 95 on its inner surface. An insulator 96 fits within plug 92 and seats against the shoulder 95 which holds it in the connector. The outside diameter of the end of insulator 96 is decreased to permit the insertion of the resilient arms 62 of a shell 57 of a connector such as shown in the lower portion of Figure 1 when such a connector is joined to this arm of the T connector.

An insulator 97 having three arms 100, 101 and 102 is placed within shell 82 with arm 100 extending in the direction of arm 83 of the shell, arm 101 extending in the direction of arm 84 of the shell and arm 102 extending in the direction of arm 85 of the shell. Arms 100 and 102 have annular tongues 103 and 104 respectively, at their extremities. Arm 101 has an annular groove 105 at its extremity. On the side of the insulator away from arm 101 is a centrally positioned boss 98.

Tongue 103 of insulator 97 fits into a groove 106 of insulator 96 while groove 105 and tongue 75 of insulator 72 cooperate as do tongue 104 and groove 50 of insulator 47. The insulator 97 is molded of resilient material so no separate gaskets are required in the tongue and groove joints.

Within the insulator 97 and extending upward into arm 101 of insulator 97 is a socket 107 having an enlarged portion 110 which butts against shoulder 77 of insulator 72. Socket 107 has a screw-threaded portion 111 at the end within the insulator 97. A solder pot 112 to which a conductor extending through ferrule 14 may be soldered is shown to extend into arm 102 of insulator 97. This solder pot 112 has an aperture at the end within the center of the insulator 97 such that it may be passed over the threaded portion 111 of socket 107. A pin 113 extends from arm 100 of insulator 97 and through the center of insulator 96. Pin 113 has a threaded aperture at its end within the center of the insulator 97 into which threaded portion 111 of socket 107 is threaded.

This connector is assembled as follows. The insulator 97 is passed up into shell 82 through the open bottom of shell 82. The metal plate 90 is then placed over the opening on the bottom of shell 82 and the ears 86 and 87 are crimped

inwardly to hold the plate firmly in position and provides a seat for boss 98 to hold insulator 97 in position and provide a firm base for the threaded connection between socket 107 and pin 113. Solder pot 112 and pin 113 are placed into arms 100 and 102 of insulator 97 and socket 107 is extended down through the upper arm 101 of the insulator, through the aperture in the end of solder pot 112 and threaded into the aperture in the end of pin 113. The assembling of the various arms of the connector is the same as that described for the connectors shown in Figures 1 and 2.

Obviously, if it is so desired, an extension such as is on the left arm 85 of shell 82 may also be placed on the right arm 83 of the shell as the fittings are identical. Also if so desired an extension such as is on the right hand arm 83 of the shell could also be placed on the left arm 85.

A pin could replace socket 107 in the upper arm merely by replacing insulator 72 with insulator 36. It should also be obvious that in the connectors shown in Figures 1 and 2 the pin and socket could be interchanged merely by interchanging insulators 36 and 72. Likewise, shell 57, washers 65, 66 and 67 and jack 63 could be substituted for plug 39 and vice versa. Thus it can be seen that a jack and pin or jack and socket or plug and pin or plug and socket type of connector can be made from a minimum number of parts. Also, various sizes of insulated conductors may be accommodated in the connector merely by using different sized collets and washers 52.

It can be seen with respect to the T connector that by use of the tongue and groove connection between insulators a long electrical leakage path has been obtained.

Because insulator 97 is of a resilient material no washer is required in the bottom of the groove of the insulators joining with this insulator in order to obtain a fluid tight path. Because of the tongue and groove type of connection between the various insulators the stress against the insulators is maintained along the length of the insulators to increase their mechanical strength.

It is thus seen that I have provided a small, light weight quick-disconnect type of electrical connector which grips insulated conductors tightly, is fluid tight and provides a long electrical leakage path from the conductor to ground.

Though the above disclosure shows the preferred manner of using the present invention in connectors it is to be understood that I limit myself only to the extent of the appended claims.

I claim as my invention:

1. An electrical connector comprising in combination: a shell; a ferrule having one end to be joined to said shell, the end of the ferrule remote from the shell being turned inwardly to form an annular abutment; an actuator having a frusto-conically shaped inner surface at the inwardly turned portion of the ferrule; a pair of insulators carried by said shell and provided with a centrally extending contact, the insulators completely containing the contact, one of said insulators having an annular tongue at one end thereof and the other insulator having an annular groove at one end thereof for cooperating with the tongue on said one insulator; and a collet, one portion of which is frusto-conical in shape and the balance cylindrical and having a plurality of slots extending substantially the length of the collet, said collet being confined

within said ferrule with the frusto-conical portion of said collet adjacent the inner surface of the actuator such that joining said shell and said ferrule together causes the collet to firmly grip a conductor entering said connector, seat the tongue and groove connection between the insulators to effect a fluid tight seal therebetween, permit an even distribution of mechanical stress against the sides of the groove and provide a substantially long electrical leakage path between said shell and said conductor.

2. An electrical connector comprising in combination: a shell; a ferrule having one end to be joined to said shell, the end of the ferrule remote from the shell being turned inwardly to form an annular abutment; an actuator having a frusto-conically shaped inner surface at the inwardly turned portion of the ferrule; a pair of insulators carried by said shell and provided with a centrally extending contact, the insulators completely containing the contact, one of said insulators having an annular tongue at one end and the other insulator having an annular groove at one end for cooperating with the tongue on said one insulator; a gasket at the ferrule end of said insulators; and a collet, one portion of which is frusto-conical in shape and the balance cylindrical and having a plurality of slots extending substantially the length of the collet, said collet being confined within said ferrule with the frusto-conical portion of said collet adjacent the inner surface of the actuator such that joining said shell and said ferrule together causes the collet to firmly grip a conductor entering said connector, compress the gasket radially against the conductor to grip the conductor and form a fluid tight seal about the conductor, seat the tongue and groove connection between the insulators to effect a fluid tight seal therebetween, cause an even distribution of mechanical stress against the sides of the groove, and provide a substantially long electrical leakage path between said shell and said conductor.

3. An electrical connector comprising in combination: a shell having a plurality of hollow extensions and an aperture on one side opposite one of the extensions and a detachable plate for covering the aperture; an insulator containing a plurality of hollow extensions, each extension of said insulator fitting within an extension of said shell, various of said insulator extensions having tongued ends and the remainder having grooved ends, the insulator being insertable within said shell through the aperture; further insulators joining said first insulator at the ends of its extensions and cooperating with the tongued and grooved ends; a contact within each of said extensions, said contacts being electrically connected together within said connector; and a plurality of housings to be so connected to the extensions of said shell as to force said insulators together and effect a fluid tight seal between said insulators.

4. An electrical connector comprising in combination: a shell having an internal abutment; a ferrule having one end to be joined to said shell, the end of the ferrule remote from the shell being turned inwardly to form an annular abutment; an actuator having a frusto-conically shaped inner surface at the inwardly turned portion of the ferrule; a first insulating member within said shell and having an abutment cooperating with the internal abutment on said shell and having an internal abutment and having an annular tongue at one end; a conducting member

having an external enlarged portion forming an

abutment cooperating with the internal abutment on said first insulating member; a second insulating member having an annular groove at one end for cooperating with the tongue on said one insulating member within said shell and having an internal abutment engaging the external abutment formed by the enlarged portion of said conducting member to retain said conducting member in fixed relation to said insulating members; a gasket engaging the second end of said second insulating member; and a collet, one portion of which is frusto-conical in shape and the balance cylindrical and having a plurality of slots extending substantially the length of the collet, said collet being confined within said ferrule with the frusto-conical portion of said collet adjacent the inner surface of the actuator such that joining said shell and said ferrule together causes the collet to firmly grip a conductor entering said connector, compress the gasket radially against the conductor to grip the conductor and form a tight seal about the conductor, seat the tongue and groove connection between the insulators to effect a fluid tight seal therebetween, cause an even distribution of mechanical stress against the sides of the groove, and provide a substantially long electrical leakage path between said shell and said conductor.

5. An electrical connector comprising in combination: a shell having an internal abutment; a ferrule having one end to be joined to said shell, the end of the ferrule remote from the shell being turned inwardly to form an annular abutment; an actuator having a frusto-conically shaped inner surface at the inwardly turned portion of the ferrule; a first insulating member within said shell and having an abutment cooperating with the internal abutment on said shell and having an internal abutment and having an annular tongue at one end; a conducting member having an external enlarged portion forming an abutment cooperating with the internal abutment on said first insulating member; a second insulating member having an annular groove at one end for cooperating with the tongue on said one insulating member within said shell and

having an internal abutment engaging the external abutment formed by the enlarged portion of said conducting member to retain said conducting member in fixed relation to said insulating members; a gasket coacting with the second end of said second insulating member; and a collet, one portion of which is frusto-conical in shape and the balance cylindrical and having a plurality of slots extending substantially the length of the collet, said collet being confined within said ferrule with the frusto-conical portion of said collet adjacent the inner surface of the actuator such that joining said shell and said ferrule together causes the collet to firmly grip a conductor entering said connector and compress the gasket radially against the conductor to grip the conductor and form a fluid tight seal about the conductor.

EARL C. BOWAR.

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