Nov. 17, 1964 W. B. HARRISON, SR., ETAL 3,157,450

ELECTRIC CABLE CONNECTOR

Filed May 2, 1961 2 Sheets-Sheet 1

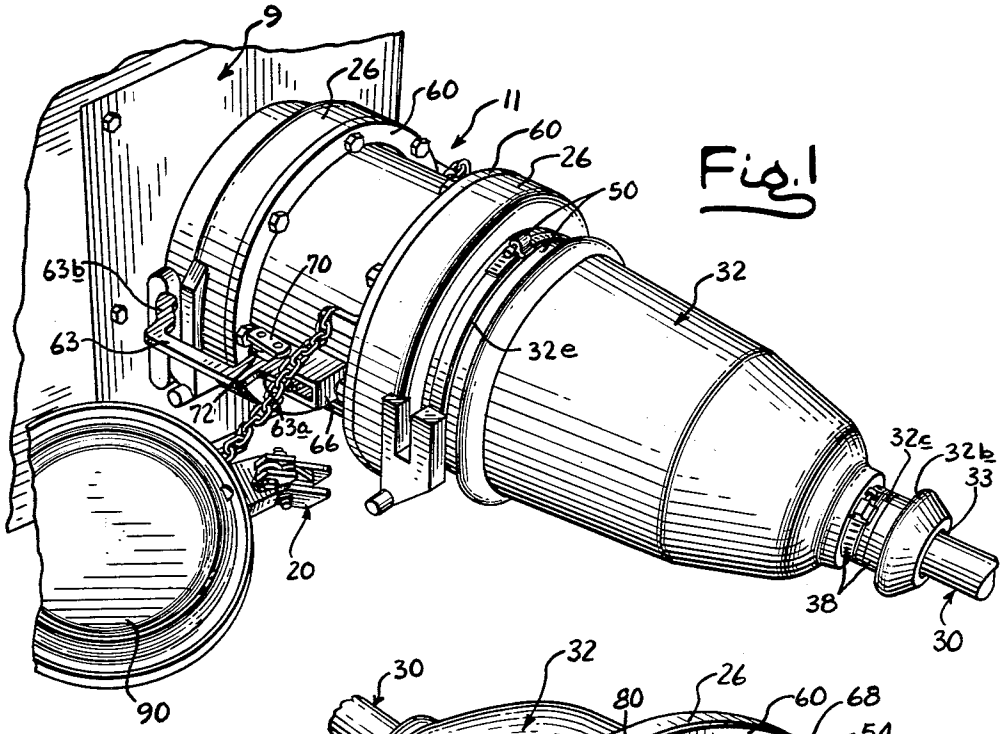


Fig. 1

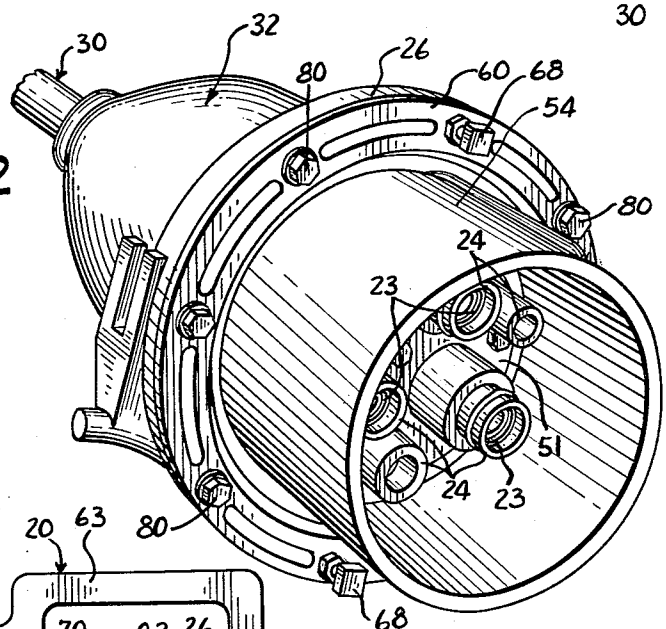


Fig. 2

Fig. 6a

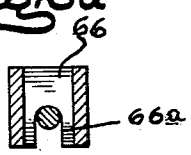
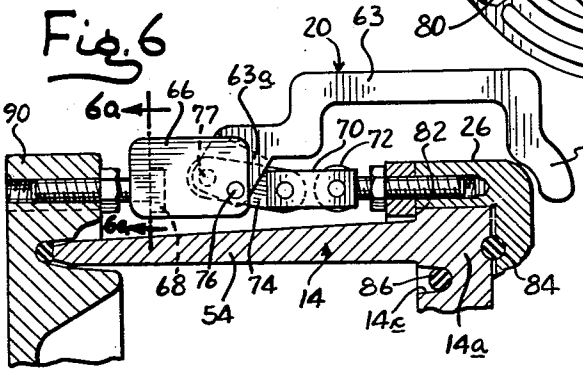


Fig. 6



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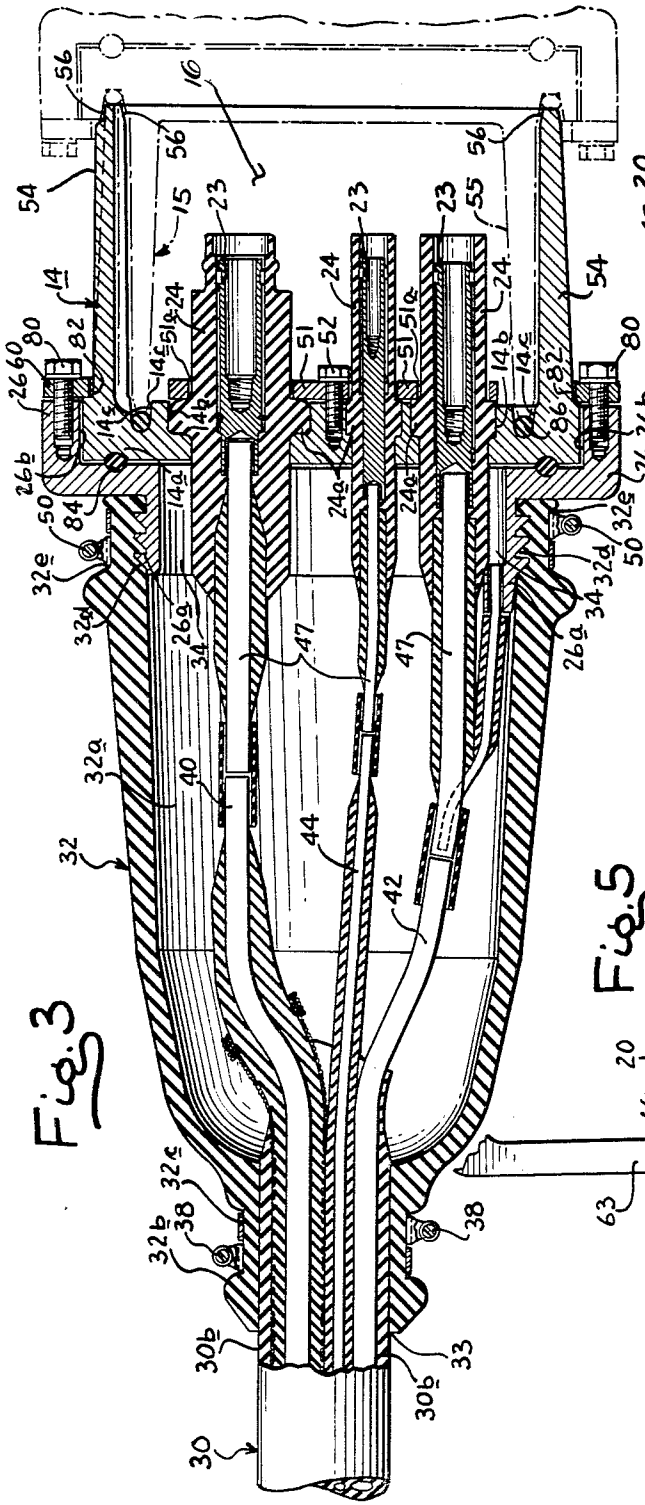


Fig. 3

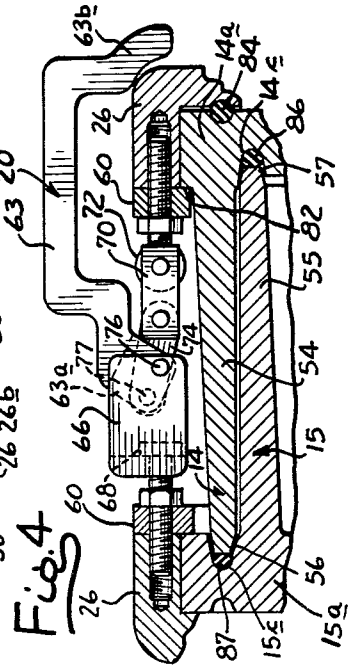


Fig. 4

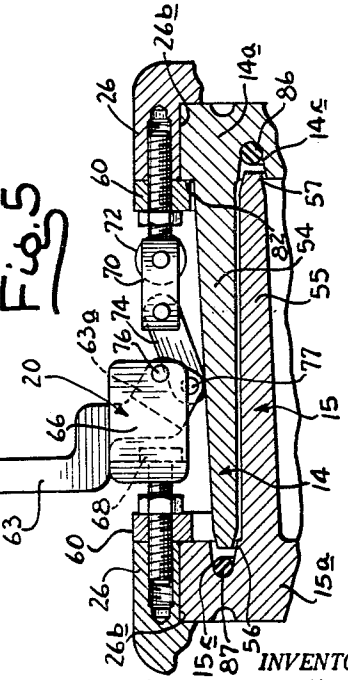


Fig. 5

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United States Patent Office 3,157,450 Patented Nov. 17, 1964

3,157,450

ELECTRIC CABLE CONNECTOR

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Filed May 2, 1961, Ser. No. 107,171
3 Claims. (Cl. 339—94)

This invention relates to electric cable connectors and more particularly it relates to high voltage connectors that may be utilized for electrically and mechanically connecting different lengths of cable to each other or for connecting a cable to a stationary connector such as may be provided at a source of power supply or on a machine.

In the past, it has been a deep seated practice to employ potting compounds for insulating the conductors in the wiring chamber of the high voltage electrical connectors. While connectors of this type have been generally satisfactory for certain purposes, they have not been entirely satisfactory because among other things the shrinkage which results from the use of potting compounds creates voids through which moisture can travel by such means as capillary action between two energized conductors, thereby creating an electrical circuit therebetween. Also, this old type of connector is not easily assembled and disassembled. When the contacting portions thereof had to be replaced because of wear or other reasons, the potting compounds had to be burned out to enable such replacement. Once the contacting portions were replaced new potting compound was added for nesting the contacting portions.

Even though potting compounds have the disadvantage of trapping liquid in them and of preventing speedy replacement of contacting members oddly enough they have been used for many years because this was the easiest and most convenient method of preventing water from contacting the conductors in the wiring chamber. A high voltage connector which obviated the necessity of using potting compounds was thought of as impractical because there did not appear to be a simpler and more efficient way of insulating the conductors.

Our invention eliminates the use of potting compounds as a means of insulation in the wiring chamber of a high voltage connector, thereby obviating the shortcomings which are incident to the use of potting compounds. We have produced a simple and efficient high voltage connector which is liquid sealed and which has its electrical conductors in its wiring chamber surrounded and insulated by air rather than by potting compounds or the like. We have also provided a novel locking means to hold together two cylindrically shaped dielectric sealing members in the connector in a hermetically sealed relationship, thereby decreasing the probabilities of water entering the wiring chamber of the connector through the openings provided for the connecting members.

Furthermore, even though our connector is liquid sealed, it can be put together and taken apart very quickly.

It is therefore an object of this invention to provide a new and improved electrical connector.

It is another object of this invention to provide a new and improved electrical connector for high voltage cables.

It is another object of this invention to provide a high voltage connector which eliminates the use of potting compounds for insulating the conductors in its wiring chamber.

It is still another object of this invention to provide a high voltage connector which has air insulated conductors therein.

Still further, it is an object of this invention to provide a liquid sealed high voltage connector which has air insulated conductors and which is simple in construction so that it can be taken apart and put together quickly and conveniently.

It is another object of this invention to provide a new and improved means for holding the mating parts of an electrical connector tightly together.

Still even further it is an object of this invention to provide in a structure for a high voltage connector a means of nesting that enables integrally insulated connecting members to be spliced with cable conductors in an air insulated wiring chamber of a connector and thereby be conveniently assembled or disassembled.

Other objects and advantages will be readily apparent to one skilled in the high voltage connector art upon reading the following specification and its appended claims wherein:

FIG. 1 is a perspective view of the connector illustrating the parts thereof in a connected or assembled relationship.

FIG. 2 is a perspective view which clearly illustrates the end of one of the parts of our connector.

FIG. 3 is a side view in section of the part of our connector illustrated in FIG. 2, the view also showing another mating portion of the connector with invisible lines.

FIG. 4 is a side elevational view of one of a pair of over center locking mechanisms which are used for the purpose of tightly holding together the electrical connector's mating parts. Said locking mechanism is illustrated in its closed position with respect to said connector's mating parts.

FIG. 5 is a side elevational view which is the same as FIG. 4 except said locking lever mechanism is illustrated in its open position.

FIG. 6 is a side elevational view illustrating how a safety cover can be easily locked on to said part of said electrical connector illustrated in FIGS. 2 and 3.

FIG. 6*a* is a sectional view taken on a plane through the lines 6*a*—6*a* in FIG. 6 and looking in the direction of the arrows.

Referring generally to the accompanying drawings, we have preferably illustrated our electrical connector as having one liquid sealed rubber boot which has air insulated conductors in its wiring chamber, said boot having female connecting members protruding outward therefrom and being locked in contact with male connecting members by an over center locking mechanism, as will be fully described hereinafter. However, it is to be understood that the scope of our invention shall include any high voltage electrical connector wherein the conductors in the wiring chamber are air insulated and liquid sealed, thereby obviating the use of potting compounds. Also, we intend the scope of our invention to include an over center locking mechanism which is to be used with all types of electrical connectors rather than just merely used in combination with the high voltage type.

Our usage of "wiring chamber" is intended to describe that portion of the electrical connector that envelops those portions of the electrical conductors that project out of the cable jacket of the electrical cable and are attached to the plug or socket connecting members of the connector. The "wiring chamber" also envelops the leads from the plug or socket connecting members.

Referring more in detail to the accompanying drawings; our invention comprises, among other things, an electrical connector **11** which has at least one liquid sealed air insulated boot **32** and two mating cylindrical shaped sealing members **14** and **15** made of dielectric material which fit together to form a liquid sealed dielectric chamber **16**, the members being held together by a pair of over center locking mechanisms **20**. Removable connecting members such as plug members (not shown) and

the socket members 23 protrude through each of the bases 14*a* and 15*a* of the sealing members 14 and 15 to make electrical contact inside of said liquid sealed chamber 16. However, for the purpose of this invention, any type of connecting members may be used and their placement is not critical. It will be seen that the removable connecting members are integrally molded with insulation and have integral leads which are spliced with the conductors of high voltage cables in the air insulated wiring chamber, thereby enabling the connecting members to be installed or replaced easily.

Cylindrical shaped frame members 26 are attached to each of the bases 14*a* and 15*a* of the sealing members 14 and 15. As seen from FIG. 1, one of the frame members is attached to a cable (not shown) which is coming from a stationary source 9 while another frame member is attached to a bell shaped boot 32 which is clamped to movable cable 30. Although we have illustrated one of the frames 26 as movable and the other as stationary, this is strictly a matter of choice. Both frames can be movable. Also, it is to be understood that our connector can comprise more than one boot.

As seen from FIG. 3, the boot 32, which can be made of any dielectric thermosetting material such as neoprene rubber, has a liquid sealed wiring chamber 32*a* which has air therein to insulate the individual conductors of the cable 30.

It has a first open end 33 with a sleeve 32*b* that surrounds the cable jacket 30*b* of the cable 30. The sleeve 32*b* has a substantially circular groove 32*c* for positioning the clamps 38 whereby the clamps hold the neoprene boot 32 securely to the cable jacket 30*b* and prevent anything from entering the boot's wiring chamber 32*a*. The individual conductors comprise three individual phase wires 40 (only one shown in FIG. 3) a ground wire 42 and one or two pilot wires 44 (only one pilot wire shown in FIG. 3). The neoprene boot 32 has a second open end 34 with an inside threaded portion 32*d* which is screwed on to a threaded bushing portion 26*a* of one of the cylindrical shaped frame members 26. A circular groove 32*e* is also molded on this end of the boot in order that the clamps 50 may be fastened thereto for further insuring against anything entering the wiring chamber 32*a* of the boot 32.

As seen in FIGS. 1 or 3, each of the cylindrical frame members 26 has a sleeve portion 26*b* which receives one of the bases 14*a* or 15*a* of the mating sealing members 14 and 15. Both bases 14*a* and 15*a* are almost alike and they have recessed apertures therein for enabling connecting members to protrude therethrough for electrical contact. As seen from FIGS. 2 and 3, the base 14*a* has a plurality of socket type female connecting members 23, which have insulating jackets 24, protruding through its recessed apertures 14*b*. The female socket type connecting members 23 have leads 47 which are spliced inside the wiring chamber 32*a* to the individual conductors of the cable 30.

In order to keep the base 14*a* of the mating cylindrical sealing member 14 securely retained in the sleeve portion 26*b*, a locking ring 60 is bolted to the sleeve portion 26*b* of the cylindrical frame member 26 by the bolts 80. As seen from FIG. 3, the sealing member 14 has a shoulder portion 82 which is retained by the locking ring 60 when it is fastened to the cylindrical frame 26. Further measures are taken for insuring against entrance of liquid into the wiring chamber 32*a* by providing the retaining plate 51 which is removably fastened to the base 14*a* of the sealing member by a plurality of bolts 52. This plate 51 firmly locks the cylindrical sealing member 14 with the insulating jackets 24 of the female socket type connecting members 23. The retaining plate 51 has apertures 51*a* that permit the female socket type connecting members 23 to protrude out of the liquid sealed wiring chamber 32*a*. The insulating jackets 24 have projecting hub portions 24*a* which are received by the recessed apertures 14*b* in base 14*a* of the sealing member 14.

An O ring 84 is interposed between the base 14*a* and the cylindrical frame 26. Also, as seen from FIGS. 3 and 4, both of the mating cylindrical sealing members have cylindrical walls 54 and 55 which have one tapered side and one straight side. The straight sides are flush with each other when the mating sealing parts 14 and 15 are held together. The base 14*a* of the sealing member 14 has a tapered circular groove 14*c* with an O ring 86 inserted therein. As seen from FIG. 4, the base 15*a* of sealing member 15 also has a similar tapered circular groove 15*c* which has an O ring 87 in it. However, its groove is disposed outside of its cylindrical wall to receive the edge of wall 54. The walls 54 and 55 have tapered edges 56 and 57 which fit into their respective grooves 14*c* and 15*c* when the mating members 14 and 15 are held together. Thus it will be seen that when the cylindrical sealing members 14 and 15 are held together, the tapered edges 56 and 57 cannot be forced to penetrate any farther than the sides of the tapered circular grooves permit, thereby preventing the crushing of the O rings.

Although we have not gone into as much detail with describing member 15, it should be understood that it has connecting members protruding through it and it is mounted in a frame 26 in the same manner as sealing member 14. Also, it is to be understood that the frame members 26 which receive the sealing members can either be attached to a stationary source as a switchgear or else they can be attached to another boot which, in turn, could be attached to a movable cable.

Although any means can be used to hold the mating parts of our connector together, we have provided a pair of novel over center locking mechanisms 20 that enable our connector to be held tightly together. With these mechanisms incorporated in our connector, our connector can be taken apart and put together quickly and securely without having to be unduly complicated in construction.

The pair of over center locking mechanisms 20 are attached to the cylindrical frame members 26 of the connector. As seen from FIGS. 4 and 5, each of the over center locking mechanisms 20 have a handle member 63 which is pivotally mounted at one end 63*a* and which has an arcuate shaped locking end 63*b* that is free to rotate. A first link member 66 which has a slot 66*a* (as seen from FIG. 6*a*) is slipped under a square headed anchor bolt 68 which is threaded into one of the frames 26 and removably fastened thereto, this link not having any relative motion with respect to said bolt once it is fastened thereto. A second link member 70 is rigidly attached at one of its ends to an eye headed anchor bolt 72 that is threaded into the other frame member 26, as seen in FIGS. 4 and 5. The handle member 63 is pivotally mounted to a third link 74 at point 77. The third link 74 is shown pivotally mounted to the first link 66 and to the second link 70. The handle member 63 is also pivotally mounted to the same link that said third link is mounted to, it being illustrated as mounted on said first link member 66 at point 76. We contemplate, however, that the handle member 63 could be mounted on the second link 70. In which case, the third link 74 would be pivotally mounted to the second link 70.

Thus, it will be seen that we have provided an improved locking mechanism which enables the separate parts of our high voltage connector 11 to be tightly held together in a hermetically sealed relationship. This mechanism may be operated very quickly to either lock the high voltage connector's separate parts together or to enable quick disassembly. As seen in FIG. 4, our linkage is in its closed position when its handle member has its arcuate shaped locking end 63*b* latched onto one of the cylindrical frames 26. In order to close the locking mechanism, our handle member is pivoted from its position shown in FIG. 5 to the position shown in FIG. 4, whereupon the third link 74 passes over the main line of force between links 70 and 66 to enable arcuate por-

tion 63*b* to latch onto one of the frame members 26 and achieve an over center locking effect. Although it is not necessary for the anchor bolts 68 and 72 to secure our locking mechanism, the bolts provide an advantage because the locking mechanism may be adjusted to exert a tighter or looser grip on the connector by simply turning the bolts.

In order to disassemble our connector, it is essential to move the link 74 over the main line of force and then remove the locking mechanisms by sliding it out of the slot 66*a*. Since this cannot be done unless it is intentionally desired, we have provided a locking mechanism that is very secure because of its over center locking effect but yet it still enables quick and easy disassembling of the connector.

FIG. 6 shows one portion of our connector 11 with a safety cover 90 locked onto it. In the past, these covers had to be screwed to the live end of the connector or else there were elaborate systems for locking the covers on. Since it is easy to use our locking mechanisms to hold this cover tightly to our connector, we have found that a connector having our locking mechanism is safer than those in the past because when the connector is disassembled, the safety cover can be quickly and easily attached to the connector.

Thus we have provided an improved high voltage connector which has an air insulated wiring chamber and integrally insulated connectors nested therein that can easily be replaced or removed and we have provided a locking mechanism which enables the connector to be easily assembled and disassembled.

Also, our connector has mating sealing parts which fit together to form a liquid sealed dielectric chamber that seals the connecting members of our connector when they make contact. Furthermore, our connector avoids the entrance of liquid into the wiring chamber when the connector is disconnected by having a structure which has a sealed relationship at those portions where its connecting members protrude to make electrical contact.

Although an exemplary form of the present invention has been shown in the accompanying drawings and described in detail in the foregoing specification, it should be understood that the invention is capable of embodying various modifications in detail or design without departing from the spirit of the present invention or the scope of the appended claims.

What we claim and desire to secure by United States Letters Patent is:

1. An electrical connector for high voltage cables comprising: at least one bell shaped boot made of insulating material, said boot having a first open end that is fastened to the cable jacket of one of said cables in a liquid sealed relationship, said boot having an air insulated wiring chamber, said boot having a second open end with connecting members protruding therefrom, said connecting members having integrally molded insulating jackets with projecting hub portions therearound, said connecting members having integral leads electrically connected to said high voltage cable's conductors inside of said wiring chamber, said boot's second open end being associated with a first sealing member in a liquid sealed relationship, said first sealing member being cylindrically shaped and having a base with recessed apertures therein to allow said connecting members to protrude therethrough and have said hub portions of said insulating jackets nested in the recesses of said apertures, a retaining plate fastened to said first sealing member and having openings therein which are disposed so that the connecting members together with their integrally molded insulating jackets may protrude therethrough, said retaining plate creating a gasket effect between said hub portions of said insulating jackets and said recessed openings of said first sealing member to insure against the entrance of liquid into said wiring chamber through said first sealing member's recessed

apertures, said first sealing member having a cylindrical wall which is tapered on one side and straight on the other, said wall having a tapered edge portion, said first sealing member's base having a tapered cylindrical groove with an O ring disposed therein, and a second sealing member having mating connecting members protruding through its base and being associated with a cable, said second sealing member also having a cylindrical wall which is tapered on one side and straight on the other, said second sealing cylindrical member's base also having a tapered cylindrical groove with an O ring disposed therein, said second cylindrical sealing member's wall also having a tapered edge portion, said first and second cylindrical sealing members fitting together to form a chamber to enable the connecting members that are fastened to different cables to have electric contact inside of said chamber, said tapered edges of said walls of each of said sealing members fitting in said tapered O ring grooves of each other and said O ring grooves being sized and tapered to engage said tapered edges of said walls to enable said walls to contact said rings to compress them without crushing said O rings when said sealing cylindrical members are held tightly together and means to hold said sealing members in tight engagement.

2. An electrical connector for high voltage cables comprising: at least one bell shaped boot made of insulating material, said boot having a first open end that is fastened to the cable jacket of one of said cables in a liquid sealed relationship, said boot having a second open end with connecting members protruding therefrom, said connecting members having integrally molded insulating jackets with projecting hub portions therearound, said connecting members having integral leads electrically connected to said high voltage cable's conductors inside of said wiring chamber, said boot's second open end having an inside threaded portion, a first cylindrical frame member having a threaded bushing portion which is threaded with the inside threaded portion of said second open end, said first cylindrical frame member having a sleeve portion, a first cylindrical sealing member having its base fastened to and received by said sleeve portion of said first cylindrical frame member to form a liquid sealed wiring chamber, said first sealing member's base having recessed apertures therein to allow said connecting members to protrude therethrough and have said hub portions of said insulating jackets positioned in the recesses of said apertures, a retaining plate fastened to said base of said first sealing member and having openings therein which are disposed so that the connecting members and their insulting jackets may protrude therethrough, said retaining plate creating a gasket effect between said hub portions of said insulating jackets and said recessed openings of said sealing member to insure against the entrance of liquid into said wiring chamber through said first sealing member's recessed apertures, a locking ring attached to said cylindrical frame to hold said first sealing member together therewith, said first cylindrical sealing member having a cylindrical wall, said wall having a tapered edge portion, said base having a tapered cylindrical groove with an O-ring disposed therein, a second sealing cylindrical member having mating connecting members protruding through its base and being attached to a cable, said second sealing member being received and held by a second cylindrical frame of the same construction as said first cylindrical frame, said second sealing cylindrical member's base also having a tapered cylindrical groove with an O-ring disposed therein, said second cylindrical sealing member's walls also having a tapered edge portion, said second sealing cylindrical member having mating connecting members protruding through its base and being attached to a cable, said first and second cylindrical sealing members fitting together to form a sealed chamber to enable the connecting members that are fastened to different cables to have electrical contact inside of said chamber, said tapered edges of said walls fitting in said

O-ring grooves of each other, said O-ring grooves being sized and tapered to engage said tapered edges of said walls to enable said walls to contact said O-rings to compress them without crushing said O-rings when said sealing cylindrical members are held tightly together, and means to hold said sealing members in tight engagement.

3. An electrical connector for high voltage cables comprising: at least one bell shaped boot made of insulating material, said boot having a first open end that is sealed to the cable jacket of one of said cables, said boot having an air insulated wiring chamber, said boot having a second open end with connecting members protruding therefrom, said connecting members being integrally molded with insulating jackets with projecting hub portions molded therearound, said connecting members having integral leads electrically connected to said high voltage cable's conductors inside of said wiring chamber, said boot's second open end being associated with a first sealing member in a sealed relationship, said first sealing member being cylindrically shaped and having a base with recessed apertures therein to allow said connecting members to protrude therethrough and have said hub portions of said insulating jackets nested in the recesses of said apertures, a retaining plate compressibly fastened to said first sealing member and having openings therein which are disposed so that the connecting members together with their integrally molded insulating jackets may protrude therethrough, said retaining plate creating a casket effect between said hub portions of said insulating jackets and said recessed openings of said first sealing member, said first sealing member having a cylindrical wall which is tapered on one side and straight on the other, said wall having a tapered edge portion, said first sealing member's base having a tapered cylindrical groove with an O-ring disposed therein, and a second sealing member having mating connecting members protruding

through its base and being associated with a cable, said second sealing cylindrical member also having a cylindrical wall which is tapered on one side and straight on the other, said second sealing cylindrical member also having a tapered cylindrical groove with an O-ring disposed therein, said second cylindrical sealing member's wall also having a tapered edge portion, the tapered sides of said walls of said first and second cylindrical sealing members fitting together to form a chamber to enable the connecting members that are fastened to different cables to have electric contact inside of said chamber, said tapered edges of said walls of each of said sealing members fitting in said tapered O-ring grooves of each other, said O-ring grooves being sized and tapered to engage said tapered edges of said walls to enable said walls to contact said O-rings to compress them without crushing said O-rings when said sealing cylindrical members are held tightly together by said tapered edges and O-ring grooves, and means for holding said cylindrical sealing members tightly together.

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