

[54] **HIGH VOLTAGE CONNECTOR**

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[56]

References Cited

UNITED STATES PATENTS

3,474,386	10/1969	Link	339/60 R
3,533,047	10/1970	McFarlane	339/94 C

FOREIGN PATENTS OR APPLICATIONS

172,661	9/1960	Sweden	339/94 R
1,092,090	11/1960	Germany	339/94 A

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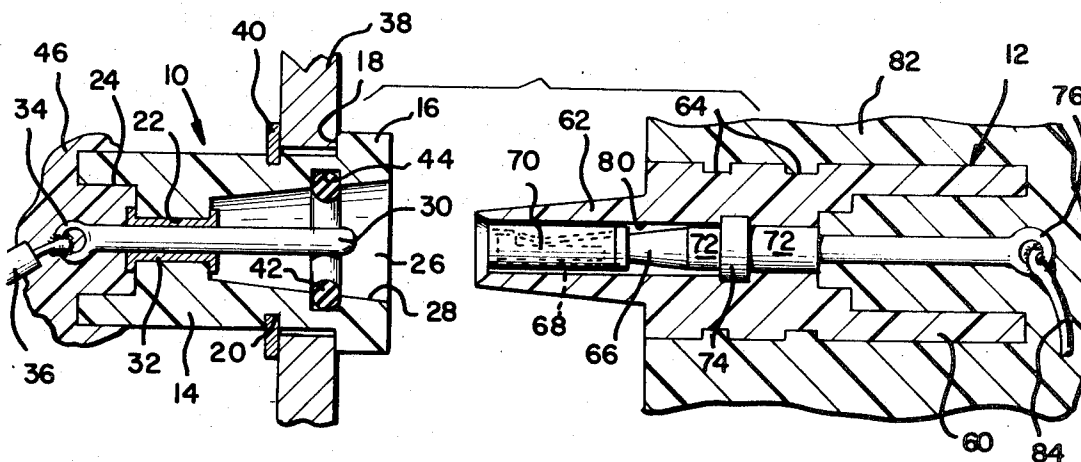
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ABSTRACT

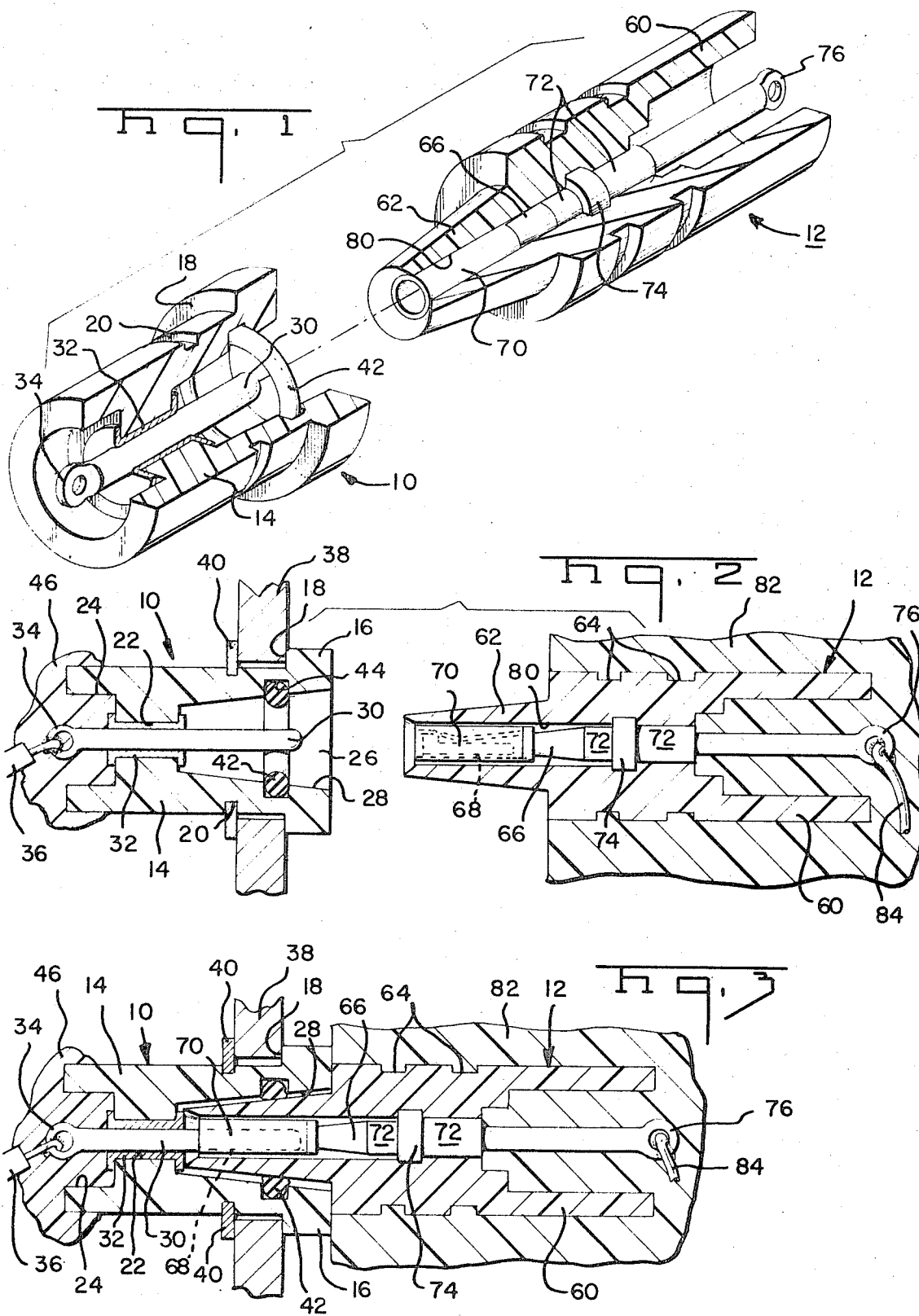
A high voltage high altitude electrical connector is provided which comprises a pair of insulating bushings with complementary and intermatable portions, one bushing constituting a receptacle and the other the mating plug therefor. The plug bushing has a central cavity with a tapered side wall and an electrically conductive contact pin mounted on its center axis. A sealing means is provided at an intermediate position in the cavity wall and surrounding one end of the contact pin. The receptacle bushing has a forward protrusion, the outside surface of which is tapered and shaped to be complementary to the plug cavity. A metal socket contact member which receives the contact pin therein is mounted centrally in the receptacle bushing. Suitable termination means are provided at the opposite ends of the pin and the socket.

2 Claims, 3 Drawing Figures



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HIGH VOLTAGE CONNECTOR

BACKGROUND OF THE INVENTION

The present invention relates in general to electrical connectors, and more particularly to electrical connector assemblies which are arranged to withstand high voltages impressed thereon, even under reduced atmospheric pressure conditions such as occur at high altitudes.

Despite the existence of numerous prior art connector designs which have attempted to prevent corona and arcing when subjected to high voltages and high altitudes, the corona problem remains a serious one. Accordingly there is a long-felt need for a simple and effective, pluggable electrical connection for use in high voltage applications which will eliminate the corona problem, even under conditions of reduced atmospheric pressure.

SUMMARY OF THE INVENTION

As will be seen subsequently herein, the connector assembly of the invention fulfills the above described need with a receptacle and mating plug structure which employs pin and socket contacts and which is adaptable to a wide variety of uses. As one important aspect of the invention, the zone in which the interconnected pin and socket contacts are located is sealed off within the connector assembly, upon mating of the plug with the receptacle, in a manner which maintains atmospheric pressure in the contact zone and thereby eliminates the problem of corona and arcing.

The plug half of the connector comprises a bushing which contains a central cavity of a conical shape, i.e., with an inwardly tapering wall. A metal contact pin is mounted centrally of the bushing to extend into the cavity, and a sealing means in the form of a partially recessed O-ring is located at an intermediate position in the cavity wall. The receptacle half is a cylindrical bushing formed with a forward protrusion having tapered walls complementary to the shape of the plug cavity. The receptacle includes a metal socket contact member disposed centrally of its bushing. The mouth of the pin-receiving bore in the socket member faces outwardly of the said forward protrusion of the bushing.

The connector assembly of the invention is arranged to serve as a rack and panel connector, as a simple free standing in-line splice, and in many other applications. In the rack and panel application, the provision of the tapered plug cavity means that exact alignment of the rack with the panel is no longer required. Also, the O-ring seal is so arranged that bottoming of the plug in the receptacle is unnecessary, thereby avoiding the need for a stop means to accurately control the closed position of the rack. When using the invention assembly as an in-line splice, the O-ring element, in addition to functioning as an environmental seal, provides a pop-on closure feature. That is, if frictionally holes both halves of the connector assembly together with adequate retention force, so that the need for separate locking means such as jack screws, clips, etc., is also eliminated.

Therefore an object of the present invention is to provide an improved electrical connector assembly which is pluggable and which is suitable for use with high voltages and under conditions of reduced atmospheric pressure.

Another object is to provide such an assembly which includes intermatable bushings employing pin and socket contact members, said assembly having an improved environmental sealing means which also provides a closure retention feature, avoiding the need for separate locking means.

A further object is to provide a pluggable electrical connector assembly which may serve as a fluid-tight lead-in to sealed electrical units requiring high voltage and employed in high altitude aircraft, guided missiles, and the like.

Another object is to provide an electrical connector assembly of high quality and effectiveness which still is of simple construction and is inexpensive to manufacture.

Another object of the invention is to provide a pluggable electrical connector assembly, one with intermatable bushings as aforesaid, which further contains an improved sealing means adapted to maintain atmospheric pressure in the zone of the mated pin and socket contacts, thereby eliminating the problem of corona and arcing under high voltage.

An additional object is to provide a pluggable electrical connector assembly of the type mentioned having self-aligning properties in rack and panel applications.

Another object is to provide such a connector assembly which is reliable in operation for high voltage connections over a wide temperature range and despite conditions of low ambient pressure and high relative humidity.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there is shown and described an illustrative embodiment of the invention; it is to be understood, however, that this embodiment is not intended to be exhaustive nor limiting of the invention but is given for purpose of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an exploded view, in perspective, of two halves of the connector assembly of the invention;

FIG. 2 is a longitudinal sectional view of the connector assembly with the two bushings disengaged; and

FIG. 3 is a longitudinal sectional view similar to FIG. 2 but after closure of the two halves to complete the connection.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, the numeral 10 designates the plug half of the connector and numeral 12 designates the intermating receptacle half. The described embodiment is shown as a typical rack and panel application, although it is understood that the connector may also serve as an in-line splice, or in any other desired fashion.

Referring first to the plug 10, it comprises a generally cylindrical bushing 14 of insulating material enlarged at one end by a flange 16 extending outward to form a shoulder 18. A groove 20 is spaced a predetermined distance from shoulder 18 for a purpose to be de-

scribed. Centrally of the bushing 14 there is an axial bore 22 communicating at the rear end of the bushing with a counterbored opening 24 of larger diameter. Forward of the central bore portion 22 is located a conically shaped cavity or chamber 26 formed with an inwardly tapering side wall 28. A metal contact pin 30 is mounted on the center axis of bushing 14 to extend well forward in chamber 26 at the zone of contact with the associated socket member, to be described, in the other half 12 of the connector assembly. The contact pin 30 is held in position in bushing 14 by a tubular metal mounting element 32 having upturned end flanges engaging the bottom walls of cavity 26 and counterbore 24. The contact pin 30 has a wire termination means at the rear end thereof, shown as a pretinned eyelet 34 to which an insulated lead-in wire 36 may be soldered. Of course, if desired, pin 30 could have a wire barrel at the rear with which to make a crimped wire connection.

The pin 30 is soldered within mounting element 32, the element 32 being initially rivet-shaped without the rear end flange. The assembled pin 30 and element 32 can be inserted into place through cavity 26, after which the rear end flange shown in FIG. 2 is formed by bending of the end of element 32. This will lock the assembly 30-32 in place.

The plug 10 is mounted in an aperture in a bulkhead 38 with shoulder 18 abutting the bulkhead surface. A removable metal retaining ring 40 fitted into groove 20 rigidly holds the plug in the bulkhead aperture, the connecting circuit wire 36 being soldered to eyelet 34.

The chamber 26 contains an improved contact sealing means which comprises an O-ring 42 of silicone rubber of any equivalent elastomer. The O-ring 42 is partially recessed within the side wall 28, intermediate the ends of chamber 26. This is accomplished by providing a groove 44 in the wall 28, as shown in FIG. 2, at a point to surround the outer end of contact pin 30. The rubber sealing ring 42 is a course fitted within this groove 44.

The insulated bushing 14 is composed of any suitable dielectric material with adequate mechanical properties to be machinable. If a thermoset material is preferred for a machined bushing, a glass epoxy such as G10 or Epial is used. If the bushing 14 is to be formed by injection molding, then a thermoplastic material such as a Phenolic should be employed. In this case, mounting element 32 could be dispensed with, the pin 30 being held in the mold and the bushing contacting the pin directly in the region of passage 22.

A plotting compound 45 can be inserted into opening 24 to fill it and extend out over the eyelet 34 and the stripped end of wire 36 to seal the rear end of the plug.

The other half of the connector assembly, the receptacle 12, is formed in the following manner. The receptacle includes a bushing 60 in the form of a cylindrical body having a forward protrusion or extension 62. This extension 62 is of a tapered, conical shape dimensioned to be complementary to cavity 26 and to fit relatively snugly therein when the connector is plugged together as shown by FIG. 3. The body 60 contains a pair of external grooves 64. The socket contact member 66 of electrically conductive metal is disposed along the longitudinal center axis of the bushing 60. The socket contact includes a forward pin-receiving bore 68, internal of which is mounted a cantilever-beam contact spring 70, as well as a center portion 72 with a retaining shoulder

74 and a rear wire receiving portion with a solder eyelet 76 (similar to eyelet 34). The bushing 60 must be provided with a central opening 80 to receive socket member 66 with the mouth of bore 68 facing outwardly of 62, the pin-receiving section of the socket member 66 being located in the protrusion 62. The opening 80 may have one or more enlarged diameter sections toward the rear as shown in FIGS. 2 and 3. The bushing 60 is preferably formed by injection molding of a Phenolic material, with the socket member 66 held in the mold and thus located in the bushing as shown by being molded in place. Shoulder 74 will lock the socket 66 in place. In the rack and panel embodiment shown, the bushing 60 is part of an encapsulated circuit package indicated at 82. A circuit wire 84 leads to electrical and electronic components potted within this circuit package, and is soldered to eyelet 76. The encapsulant will extend into the rear enlargements of opening 80 to seal the rear of the receptacle bushing.

In operation, a circuit package as described having the receptacle 80 integral therewith can be plugged into the bulkhead or panel 38. The connector assembly described and shown will effect an electrical interconnection of wires 36 and 84, to circuits not shown. This is achieved by protrusion 62 fitting into cavity 26 to bring contact pin 30 within bore 68 where it will engage the internal contact spring 70 of the socket member.

During the movement of closure of the two connector halves 10 and 12, the outer surface of the receptacle protrusion 62 will engage the O-ring 42 and compress it within its groove as seen in FIG. 3. This action, due to the taper of 62 and of 28, will compress the gas (air, for instance) behind the O-ring in the plug 10 and trap it in place within cavity 26 in the zone where the mated contacts 30, 66 are located. The result is a tight environmental seal, and further, one which holds atmospheric pressure at the region or zone of contact so that corona and arcing due to reduced pressure cannot occur. The connection is also sealed with respect to contaminants such as dirt, moisture, and the like. Finally, the O-ring 42 provides a frictional locking function to hold the connector halves together once the receptacle is forced into the plug cavity. The connector mates with a "pop-on" action, and the frictional engagement with the rubber sealing ring creates a retention force so that separate locking means become unnecessary. With this seal, also, bottoming of the plug and receptacle is not necessary, eliminating the need for a separate stop means to accurately control the closed position of the rack.

Whereas the plug is shown mounted in the panel or bulkhead 38, the relative positions of plug and receptacle may easily be reversed. This a reason for the grooves 64, so that a pair of retaining rings such as the ring 40, can be fitted therein on each side of the panel holding the receptacle in place. The grooves 64 also better hold the receptacle in the encapsulant 82, in the version shown in FIG. 3.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the particular embodiment of the invention, which is shown and described herein, is intended as merely illustrative and not as restrictive of the invention.

We claim:

1. An electrical connector assembly suitable for use with high voltages at high altitudes, said connector as-

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sembly comprising a plug member of insulating material and an interconnectable mating receptacle member also of insulating material, said receptacle member containing therein a socket contact member of electrically conductive material and said plug member containing therein an electrical contact pin adapted to mate with said socket contact member, said plug member having a central axial opening to receive said contact pin, said plug member further having a forward central cavity communicating with said opening, said cavity being of conical shape with an inwardly tapering wall, said contact pin having a forward portion engageable with said socket member that extends forward into said cavity, said receptacle member having a cylindrical body with a forward extension of conical shape adapted to fit within said plug cavity when the plug and receptacle members are interconnected, the outer surface of said forward extension then being spaced

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slightly from said substantially parallel to the side wall of said cavity, and a combined sealing and frictional locking means mounted in the side wall of said cavity in position to surround said contact pin rearwardly of its free end, and seal a predetermined volume of gas within said connector assembly while frictionally holding said receptacle in engagement with said plug member, the contact pin and socket contact member both terminating within their respective plug and receptacle members.

2. The electrical bushing of claim 1 wherein said sealing means comprises an O-ring of an elastomeric material, said cavity side wall having an annular groove therein intermediate the ends of the cavity, the said O-ring being disposed in said groove to be partially recessed within said cavity side walls.

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