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HIGH VOLTAGE, HIGH ALTITUDE BUSHING

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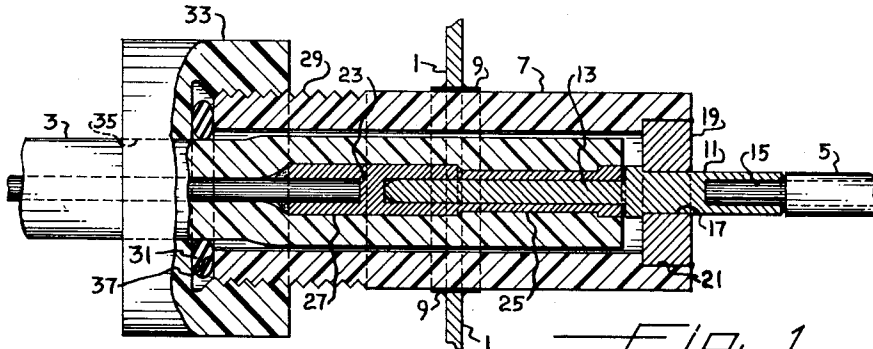


Fig. 1

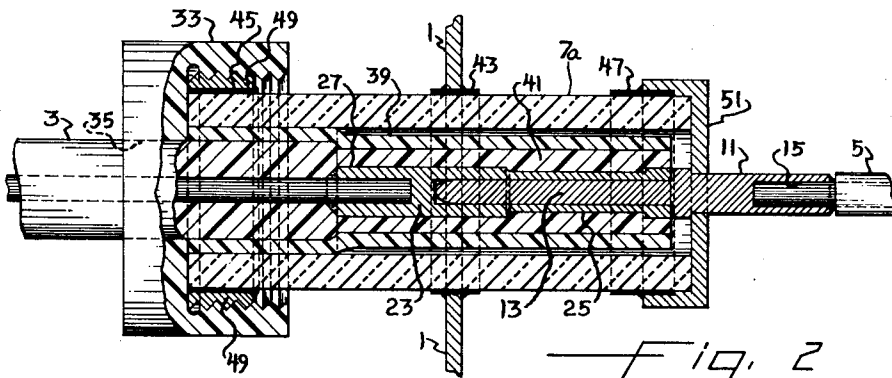


Fig. 2

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2 Claims. (Cl. 339-89)

This invention relates in general to electrical connections, and in particular to high altitude high voltage bushings for providing a fluid-tight lead-in to sealed electrical units, such as are employed in high altitude aircraft, guided missiles and the like.

The deterioration of the insulation qualities of air caused by the drop in atmospheric pressure on reaching the higher altitudes now attainable has rendered inadequate high voltage lead-in connectors as have been heretofore employed. For example, studs brought out through ceramic insulators are subject to arcing from stud to stud or from stud to the metal casing where reliance is placed in whole or in part on the dielectric strength of air. Also commonly employed as high voltage connectors are plug-type arrangements where the connection is provided with a surrounding insulating sleeve, the assembly being enclosed in a supporting metal jacket. The free path from connection to jacket within such connectors is subject to arcing at high altitudes, and furthermore, the seal against oil seepage for hermetically sealed oil-filled units has in general been found to be unsatisfactory.

It is, therefore, an object of the present invention to provide an improved bushing assembly suitable for use with high voltages at high altitudes.

Another object is to provide a lead-in bushing assembly for hermetically sealed electrical units wherein reliance on an air-gap as a dielectric material is avoided.

Another object is to provide a lead-in bushing which is of high quality and effectiveness yet simple in construction and inexpensive to produce.

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 several embodiments; it is to be understood, however, that these embodiments are not intended to be exhaustive or limiting of the invention but are given for purposes 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.

In the drawings:

Figure 1 is a partial sectional view of a lead-in bushing according to the present invention; and

Figure 2 is a partial sectional view of another embodiment of the invention.

Corresponding parts in the figures are indicated by similar reference characters.

With reference to Figure 1, numeral 1 designates the casing of a sealed electrical unit through which the bushing of the invention provides for the coupling of an external lead 3 with the lead 5 connected to the electrical components of the unit, not shown. The bushing includes a cylindrical hollow body portion 7 of a suitable

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dielectric material, preferably of a type which can be threaded, molded in plastic, and subjected to the wide range of temperatures encountered in high altitude applications and bonding operations, e.g. soldering, without cracking, such as a laminated phenolic-base resin, steatite ceramic and the like. The dielectric material selected will, however, depend to some extent on the method employed to seal the electrical unit. For example, if the unit is encased in a metal can for hermetic sealing, a steatite ceramic metalized to provide a surface 9 extending circumferentially of portion 7 which is solderable to casing 1 thereby to achieve a fluid-tight seal preventing seepage of oil around the bushing. Alternatively, a laminated phenolic suffices where the electrical unit is embedded, or potted, in plastic.

To effect the electrical coupling of leads 3 and 5 within body portion 7, there is provided a separable contact assembly, preferably of the receptacle and mating pin type, which includes plug 11 having at one end a contact pin 13 and at the other end a solder well 15 in which lead 5 is soldered. Plug 11 is rigidly maintained, as by soldering or brazing, in the aperture 17 of a disc-like contact retainer 19 which snugly fits within the internally enlarged end 21 of body portion 7. To perfect the sealing of the bushing, relative to inside of casing 1, end 21 is metalized in a conventional manner whereby contact retainer 19 may be soldered in place thus rigidly disposing pin 13 in mating position coaxially in the bushing.

The receptacle portion 23 of the contact assembly includes at one end a socket 25 having a cylindrical bore for receiving pin 13 and at the other end a solder well 27 in which the wire core of external lead 3 is soldered. Serving to secure lead 3 within and to seal the outer end 29 of the bushing is a fitting which includes a resilient O-ring 31 of a size to fit tightly about the insulation of lead 3, and a cap 33, of a dielectric material similar to body portion 7, cap 33 having a central aperture 35 through which lead 3 may be inserted and being internally threaded for cooperation with external threads cut on end 29 of body portion 7.

Ring 31 is slipped back along the insulation of lead 3 until it will abut end face 37 of body portion 7 as pin 13 becomes fully seated in socket 25. Tightening cap 33 on threaded end 29 serves to compress and flatten ring 31 against face 37, the consequent radial extrusion of ring 31 into the insulation of lead 3 effecting a fluid-tight seal at outside end of body portion 7.

To assure maximum protection against arcing it is preferred that body portion 7 be filled as completely as possible with solid dielectric encompassing the metallic elements of the contact assembly, and with any remaining air space being replaced by any suitable viscous dielectric material chemically non-reactive with dielectrics forming the bushing structure. To this end, the inside diameter of body portion 7 is only sufficiently larger than the insulation diameter of lead 3 to admit the lead without difficulty so that with an insulating jacket covering receptacle 23 to the mouth of socket 25, substantially all the space within the bushing will be occupied with dielectric material. Preferably the insulation jacketing receptacle 23 comprises the unbroken insulation covering of lead 3, which insulation is slipped over the receptacle by any suitable method according to the type of materials employed. By way of example, typical insulating materials utilized for high voltage leads are silicone-rubber or natural rubber compositions which expand upon soaking in temporary liquid plasticizers, such as the aromatic liquids toluene, benzene, or their derivatives. Accordingly, after stripping the end of lead 3 of insulation to expose the wire core for soldering in well 27, expand-

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ing the remaining insulation, as by soaking a silicone-rubber composition in toluene, permits the insulation to be easily pulled along the wire core and over receptacle 23. Upon evaporation of the toluene, the insulation composition shrinks to its original diameter into tight engagement with the wire core and contact receptacle as shown. Alternatively, for short lead lengths the insulation may simply be forced mechanically along the wire after soldering receptacle 23 to the wire core. Where a silicone-rubber composition is employed as the insulation for lead 3, a silicone grease is suitable for filling any voids remaining upon assembly of the bushing.

With reference to Figure 2, for lead insulation materials which are not conveniently movable relative to the associated wire core, an insulating jacket for receptacle 23 may be built up with sleeves 39 and 41 of suitable plastic material maintained in place by a force-fit engagement with the parts. For example, sleeves 39 and 41 may be vinyl-base plastics shrunk into place after expansion by soaking in a suitable plasticiser as is conventional in the art, sleeve 39 providing the main insulation jacket surrounding receptacle 23 and part of lead 3 and sleeve 41 serving as a filler to increase the effective diameter of receptacle 23 to substantially the lead insulation diameter.

In the alternative embodiment shown in Figure 2, where increased dielectric strength and resistance to charring is desired, body portion 7 may be formed of glass. To provide surfaces on which bonding operations, such as soldering, may be performed circumferential bands 43, 45 and 47 of the glass body are fired with silver by conventional techniques, bands 43, 45 and 47 respectively providing surfaces for bonding the bushing to casing 1, threaded metallic ferrule 49 to the outer end of body portion 7, and contact retainer 51 to the inside end of body portion 7. Contact retainer 51 supports plug 11 and the threads on ferrule 49 serve as the means by which cap 33 is attached to the bushing.

Sleeve 39 extends sufficiently far back along the lead to provide a stop for cap 33 which during assembly of the bushing abuts the end of sleeve 39 before the threads on ferrule 49 are exhausted. Further tightening of cap 33 jams sleeve 39 into forceful engagement with body portion 7a thereby effecting a fluid-tight seal at the cap end of the bushing. The bonding at bands 43, 45 and 47 render the bushing completely sealed against penetration of any foreign matter.

We claim:

1. An electrical bushing comprising a rigid tubular

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member of insulating material, a pin contact element disposed at one end of said member and sealed therein, external thread means at the other end of said member, means for closing said other end including cap means threadable on said other end and having a central opening admitting therethrough an insulated conductor of like diameter, said conductor insulation substantially extending the length of said member, and a socket contact element affixed to the core of said conductor for mating engagement at said one end with said pin contact element, the insulation of said conductor extending continuously beyond the end of the core thereof substantially to encompass the length of said socket element.

2. An electrical bushing comprising a rigid tubular member of insulating material, a pin contact element disposed at one end of said member and sealed therein, exterior means intermediate the length of said member unitable in a fluid-tight seal with the casing of an enclosed electrical unit, external thread means at the other end of said member, means for closing said other end including cap means of insulating material threadable on said other end and having a central opening admitting therethrough an insulated conductor of like diameter, said conductor insulation substantially extending the length of said members, and a socket contact element affixed to the core of said conductor for mating engagement at said one end with said pin contact element, the insulation of said conductor extending continuously beyond the end of the core thereof substantially to encompass the length of said socket element.

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