

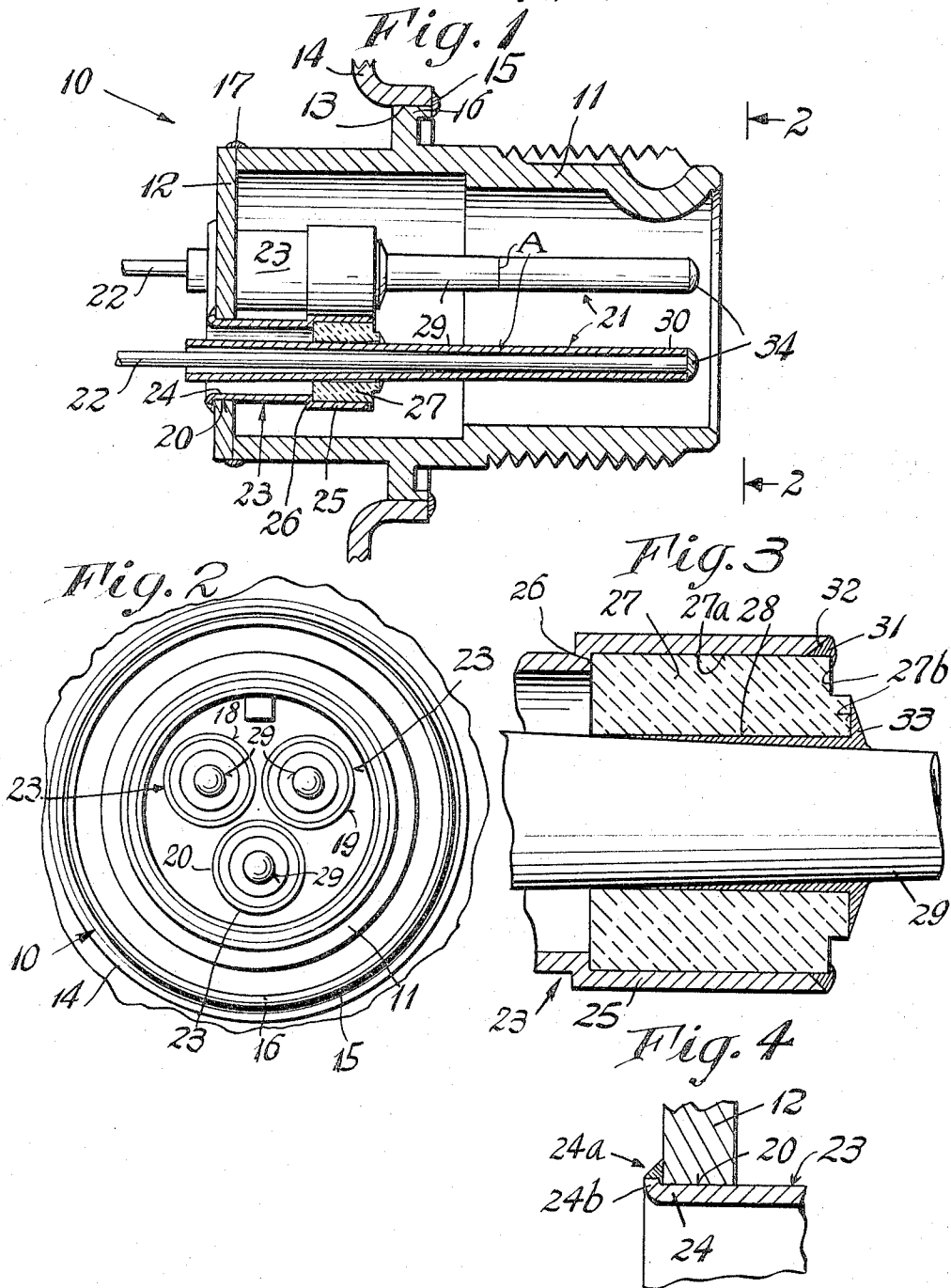
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FLUID-TIGHT ELECTRICAL FITTING

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ABSTRACT OF THE DISCLOSURE

An electrical fitting for providing a releasable electrical connection through a wall that is maintained hermetically sealed over a wide temperature range by the use of a sleeve connected to the wall and supporting an insulating annulus that in turn supports a tube with a wire conductor projecting through the wall to be secured in and to the tube.

In many applications where there is a container that is hermetically sealed, a detachable electrical connection must be made to the container to provide electrical access thereto. While a container may be easily hermetically sealed, the providing of an electrical fitting which may be mounted for example in a wall of the container and which still maintains the container hermetically sealed, has heretofore not been found especially satisfying. Thus for example, over a wide range of ambient temperatures from minus 300° to plus 1000° many electrical fittings have been physically unable to withstand such a temperature range or if they were able and though initially fluid-tight, have been rendered leakable by the temperature changes and/or physical forces and thus caused the destruction of the hermetic sealing of the container.

As used herein the term electrical fitting denotes a structure which has one or more electrical terminals mounted to be in electrically insulated spaced relation and the fitting may be either independent or secured in the wall of the container, with a portion of the wall in the latter instance forming part of the fitting.

It is accordingly an object of the present invention to provide an electrical fitting which is fluid-tight not only over a wide range of ambient temperatures but also for an extended period of use and temperature changes.

Another object of the present invention is to provide an electrical fitting in which any number of terminals may be easily incorporated to form a multiple terminal fitting having the desired number of terminals and in which each terminal is individually secured and capable of being removed and replaced if found to be malfunctioning without disturbing any other terminal.

A further object of the present invention is to provide an electrical fitting having terminals which achieves the above objects but yet which is still capable of withstanding physical abuse including vibration and which is relatively economical to manufacture.

In carrying out the present invention a feature thereof resides in a terminal which is securable in a wall of a container or a base of a fitting and provides a male pin to which a female connector may be releasably secured. The terminal specifically consists of a tubular sleeve which has one end secured to the base as by a fused metal joint and positioned adjacent its other end is an annulus formed of ceramic material, such as alumina. The annulus has its outer periphery secured to the inner periphery by a fused metal joint while extending through the center opening of the annulus is an elongate tube that is also connected to the annulus by a fused metal joint. The tube has a forward portion which extends substantially beyond

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the annulus and forms the male pin of the terminal while a rearward portion extends from the other side of the annulus to be within and preferably at least long enough to extend to the one end of the sleeve. A length of electrical conducting wire is positioned within the tube to have its forward end terminate substantially at the forward end of the tube and is secured to the tube as by a fused metal joint with its other end portion projecting rearwardly from the base. Thus the wire is electrically connected to the tube, with the latter being mounted in electrical insulating relationship to the sleeve by reason of the insulating ceramic annulus.

Other features of the present invention reside not only in the hereinafter disclosed materials from which the sleeve, annulus, tube and wire connector are made to render them compatible but in addition in the detailed structure of the tube. More particularly the annulus is shorter than the sleeve, while the tube is substantially longer than the sleeve and for a substantial portion of its length, the tube is of increasing diameter. It has been found that with this construction of the tube and with the annulus having a cylindrical opening that not only may the fluid-tight, fused metal joint between the tube and the annulus be effectively accomplished but in addition any bending strain on the tube is substantially prevented from breaking or otherwise detrimentally effecting the fused metal joint. Moreover, the particular construction of the tube has a special utility when another connector is being detached therefrom as it limits the "seizing" between the two connectors which may occur at high temperatures, thus minimizing the possible destruction of the fused metal joint with accompanying possibility of fluid leakage occurring.

Other features and advantages will hereinafter appear.

In the drawing:

FIGURE 1 is a cross-section of an electrical fitting of the present invention containing a plurality of terminals.

FIG. 2 is an end view thereof taken in the direction of the arrows 2-2 of FIG. 1.

FIG. 3 is a cross-sectional detail showing the front portion of the annulus of a terminal, somewhat enlarged.

FIG. 4 is a cross-sectional detail showing the joint between the sleeve and the base.

Referring to the drawing, the electrical fitting of the present invention is generally indicated by the reference numeral 10 and in the specific embodiment shown includes a screw type shell 11 having a base 12. The fitting 10 is preferably mounted in an opening 13 in a wall 14, as for example a wall of a container which is hermetically sealed with the fitting providing electrical connection between the inside and outside of the wall. The fitting is secured in leakproof relation with the wall, as by a welding bead 15 between the wall 14 and a flange 16 formed integral with the shell 11. The base 12 is secured to the shell, as by another welding bead 17 though it will be appreciated that, if desired, the base may be made integral with the shell. Moreover, if a threaded shell is not desired, the base itself may be connected to the wall 14 as by welding or in fact may be a part of the wall.

In the specific embodiment of the fitting herein described, three electrical connections are desired to be made through the base 12 and accordingly it has formed therein three circular apertures 18, 19 and 20 that are arranged concentrically. Mounted within each of the apertures is a terminal 21 and accordingly there are three terminals but as each of the terminals is identical, they have been given the same reference number 21. Each terminal 21 provides an electrical connection for a conducting wire 22 from one side of the wall to the other side, with each connecting wire being electrically insulated not only from the wall but also from each other. Each terminal 21 includes a substantially cylindrical sleeve 23 having a rear-end portion 24 whose outer periphery is of

substantially the same size as an opening 20 and which is secured as by a fused metal joint 24a to the base 12. Preferably the sleeve is provided with a flaring lip 24b which may overlie the edges of the aperture 20 and enable forming an assured leakproof joint therebetween.

The forward end portion 25 of the sleeve is of somewhat larger diameter to provide a step 26 against which an annulus 27 abuts. The annulus 27 is formed of ceramic material, such as alumina, to have an axial cylindrical opening 28 in which an elongate tube 29 is supported. The conducting wire 22 extends from the base through the tube 29 to terminate approximately at the forward end portion 30 of the tube. At the end portion 30 there is provided a fused metal joint which closes the open forward end of the tube and also serves to electrically and mechanically connect the wire 22 to the tube 29 with a joint that is fluid-tight.

Referring to the tube 29, it will be appreciated that the end portion 30 extends for a length which may be for example $\frac{1}{3}$ its length to have a constant diameter and thereafter as from approximately the point A, the tube flares outwardly as it extends rearwardly to increase its external and internal diameters. Its largest outside diameter at its rearward end is larger than the diameter of the opening 28 while its internal diameter at the forward end 30 approximates the diameter of the wire 22.

In the manufacture of a terminal 21 the annulus 27 has dispersed along its outer periphery 27a, its front surface 27b and the sides defining the opening 28 a metal coating such as molybdenum-manganese plated with nickel. After the annulus has been positioned in the front portion 25 of the sleeve to abut the step 26, a fused metal joint 31 is effected between the sleeve and the annulus surfaces 27a and 27b as by brazing with a gold nickel alloy. Preferably the end of the sleeve is inwardly beveled as at 32 to provide a larger area for the brazing alloy to contact the annulus and in addition it will be appreciated that the brazing material, when heated, may also flow between the adjacent surfaces of the annulus and the sleeve, being stopped by the step 26 to thereby form the fluid-tight seal of substantial length between the tube and the annulus.

The tube 29 is then inserted into the opening 28 a distance sufficient to effect a wedge fit between the flaring outer surface of the tube and the rearward edge of the opening 28. A seal is effected by another brazed joint 33 to thus secure the tube to the annulus. It will be understood that the joint 33 is circular and in cross-section is wedge shaped thereby providing a long joint that is both fluid-tight and mechanically strong. The wire 22 is inserted into the rearward end of the tube 29 and is forced therein until its forward end substantially abuts the front end 30 of the tube. With the wire thereby positioned, it will be appreciated that from the point A forwardly that the wire diameter and the inner diameter of the tube are such as to cause a substantially tight fit while rearwardly of the point A the tube diameter increases, permitting freedom of sidewise movement of the wire with respect to the tube. A sealed connection is effected between the end of the tube and the wire by a fused metal joint 34 which also closes the end of the tube. After the terminal has been completed it may be mounted in any one of the apertures 18, 19 or 20 of the base 12, with the joint 24a effecting a fluid-tight connection.

While the fused metal joints 31, 33 and 34 have been set forth as being performed sequentially, they may if desired be effected simultaneously, as in a vacuum furnace.

It will be appreciated that with the above construction that the width of the annulus, i.e. axial length, is less than that of the sleeve and thus the annulus is spaced forwardly from the base. In addition, the tube 29 is of a substantially greater length than the sleeve 23 and thus extends substantially forwardly of the front end of the sleeve and while shown extending beyond the rear end of the sleeve, if desired, it may terminate adjacent the end or within the sleeve.

While the above-described structure is both mechanically strong and leakproof in order to prevent changes in temperature within a wide temperature range from changing their characteristics, it has been found that the annulus may be advantageously formed of alumina with the fused material thereon being nickel. In addition, it has been found that the sleeve 23, the tube 29 and the wire 22 may also be preferably formed of nickel so that temperature expansion characteristics of these materials are substantially similar. The base 12 and the sleeve 11 may be formed of stainless steel or other material capable of retaining their physical properties over a wide range of ambient temperatures.

The fused metal joints 31, 33 and 34 are preferably formed of a gold alloy brazing material which is substantially non-corrosive and which also retains its physical characteristics at the temperature within the range. More particularly, it has been found that use of gold nickel alloy having a composition of 85% gold and 15% nickel is satisfactory. Also such an alloy has a temperature coefficient of expansion that is greater than the ceramic material of the annulus 27 and thus it renders the joint 31 compressive to contract around the periphery of the annulus. The joint 24 may be welded using material compatible with the stainless steel base or silver solder applied by brazing may be employed.

The terminal of the present invention has been found capable, by reason of its construction, to be able to withstand rough usage and vibration without disturbing its fluid-tight joints. This is achieved by the annulus being shorter in axial length than the sleeve and with the tube being of a length larger than the sleeve and having a wedge fit with the annulus. Thus if the end 30 is subjected to a bending movement, the strain thereof is passed from the tube to the annulus 27 through the wedge shaped joint 33 and the annulus, by reason of it being spaced substantially forwardly of the rearwardly connected end of the sleeve, is capable of transmitting the bending movement to the intermediate portion of the sleeve thereby preventing one of the seals from being forced to accommodate the bending movement. Moreover, by reason of the flaring of the tube 29 if the wire 22 is subjected to a bending movement, the movement initially effects just the portion of the wire 22 within the confines of the tube 29 from the point A rearwardly, with the tube 29 limiting the extent of the bending or flexing.

Though the terminals of the present invention are fluid-tight when properly constructed, if one should prove not to be, such a terminal can be easily replaced in the base 12 without disturbing the other terminals. Thus only the joint 24a need be broken, as by drilling, the unacceptable terminal removed and a new terminal inserted into the base and secured thereto by a new joint 24a.

It will accordingly be appreciated that there has been disclosed an electrical fitting which is mechanically strong and leakproof even over a wide range of ambient temperatures for an extended period of use. The fitting includes at least one terminal that has a sleeve, a ceramic annulus positioned in the front end portion of the sleeve and an elongate tube that projects on both sides of the annulus. A conducting wire is inserted in the tube and with the forward end of the tube forms a male electrical pin to which a releasable connection may be made. Leakproof fused metal joints are effected between the sleeve and annulus, the annulus and tube and the tube and conducting wire which also secure these parts together. The conducting wire thus extends on one side of the base of the fitting to which an electrical connection may be made and also extends on the other side of the base for permitting electrical connection thereto and yet is electrically insulated from the base and any other terminals mounted on the base.

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. A fluid-tight electrical fitting comprising a base formed with an aperture extending therethrough, a tubular metal sleeve positioned in said aperture and having its rear end portion connected thereto by a fused metal joint, an annulus formed of electrical insulating material having a central opening positioned within the front end portion of the sleeve and being connected thereto by a fused metal joint, said annulus being smaller in length than said sleeve, a tube positioned within the opening and being connected thereto by a fused metal joint, said tube being longer than said sleeve to have a forward portion projecting substantially forwardly of said annulus to form at least in part a releasable electrical connection and having at least an intermediate portion that is longer than the annulus to project from both ends thereof with the intermediate portion flaring outwardly as it extends rearwardly, a conducting wire extending through the aperture into said tube, said conducting wire being connected to said forward portion of said tube by a fused metal joint to close the forward end of said tube, in which the opening in the annulus is cylindrical, the intermediate portion of the tube has a wedge fit therein and the tube is brazed to the annulus by a joint that is wedge-shaped in cross-section, in which the interior of the forward portion of the tube defines a substantially constant cross-sectional cavity

that corresponds with the exterior of conducting wire inserted therein and in which the intermediate portion defines a cavity increasingly larger than the cross-section of the wire positioned therein, wherein said wire is transversely moveable within the cavity of said intermediate portion.

2. The invention as defined in claim 1 in which the tube, sleeve and conducting wire are each formed of metal having a substantially similar coefficient of expansion as a ceramic material forming the annulus.

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