May 13, 1952 T. H. BRIGGS, JR 2,596,758

TUBULAR METAL-TO-GLASS SEALING CONSTRUCTION

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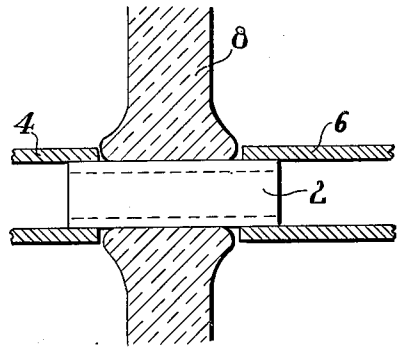


Fig. 1.

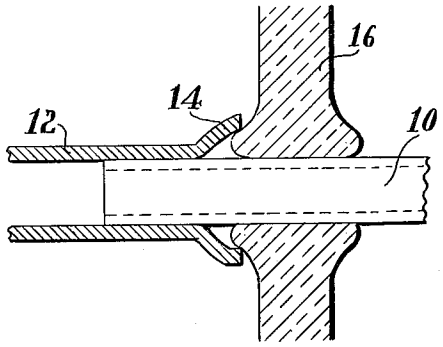


Fig. 2.

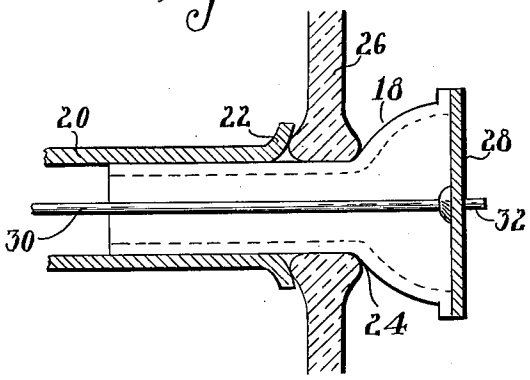


Fig. 3.

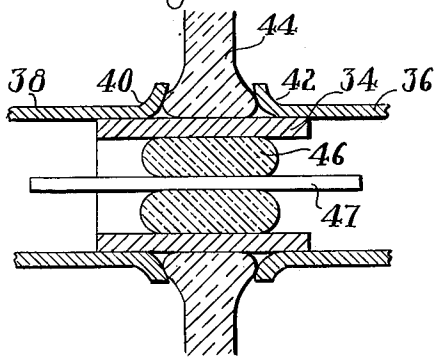


Fig. 4.

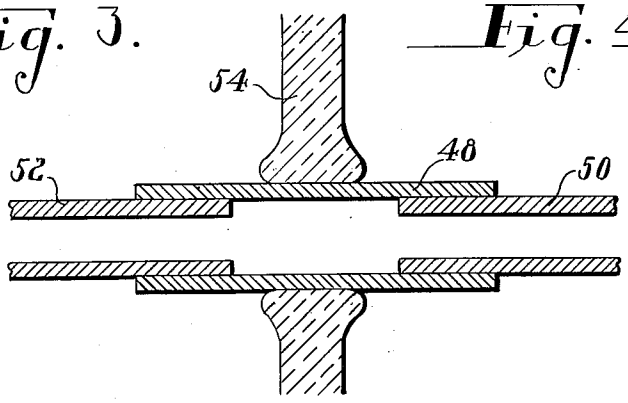


Fig. 5.

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TUBULAR METAL-TO-GLASS SEALING CONSTRUCTION

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2 Claims. (Cl. 189—36.5)

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This invention relates to a sealing construction whereby metallic tubes may be sealed to glass.

In vacuum tubes or other electrical devices having glass envelopes there is encountered the problem of sealing through the envelopes metal elements in such fashion that hermetic seals are maintained despite substantial changes in temperature at the joints.

A series of alloys have been developed which seal satisfactorily to glasses having corresponding coefficients of expansion over the useful range of temperatures.

It is frequently necessary to form particular metal oxides on the surfaces of these alloys to promote the desired reactions with the oxides contained in the glasses and hence obtain a hermetic seal. These metal oxides in many common glass-sealing alloys are those of chromium. As is well known the chromium oxides are difficult to remove and when present prevent tinning or soldering. They are also likely to be poor conductors of ultra-high frequency currents.

To avoid formation of chromium oxides and their disadvantages it is possible to coat the glass sealing metal alloy with a thin deposit of silver. During the sealing operation silver oxide is formed which permits a joint with the glass. If sufficiently thin the change in coefficient of expansion will not be deleterious.

The above procedures are expensive since the glass-sealing metal alloys are costly and their processing after sealing is troublesome.

In the case of wires sealed through glass it has been customary to form a combination in which only the wire actually sealed into the glass is of the matched coefficient of expansion. This reduces material cost and avoids post-sealing cleaning procedures.

The present invention relates in particular to the sealing of metal tubing through glass, as required for various purposes. For example, the tube may constitute the outer section of a coaxial cable or wave guide or may itself be a conductor of ultra-high frequencies or may be required to serve for the passage of a mechanically movable element such as a rod acting upon a diaphragm or the like. The invention is also adopted for situations in which the interior of the envelope contains gases above atmospheric pressure instead of below.

One of the chief requirements in the sealing of glass around metal leads, especially those of large diameter or irregular shape, is that the

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glass be properly contoured at the edges of the joint to avoid mechanical weakness or internal strains. Control of these contours for these reasons and for simplicity of mass production and uniform appearance is one of the objects of this invention.

The foregoing general objects, as well as other objects relating to details, will become apparent from the following description read in conjunction with the accompanying drawing in which:

Figure 1 is a fragmentary sectional view showing the assembly of a tubular member with the wall of a glass envelope;

Figure 2 is a similar section showing a modification in accordance with the invention;

Figure 3 is a further similar view showing an arrangement whereby mechanical motion may be transmitted through a glass envelope;

Figure 4 is a similar view showing both internal and external assembly with glass; and

Figure 5 is a further similar section showing still another modification.

Referring first to Figure 1 there is illustrated at 2 a short length of tube formed of one of the alloys previously indicated as suitable for providing a joint with the particular glass used for the envelope. As examples, an alloy for soft glass is so-called "#4 alloy" or for hard glass the alloy may be "Kovar." These alloys are well known to the art, the composition of the "#4 alloy" being disclosed in Patent No. 2,394,919 and the composition of the "Kovar" alloy being disclosed in Patents No. 1,942,260, No. 2,062,335 and No. 2,217,421. This tube 2 at its ends is connected with tubes 4 and 6 of other metals which may, for example, be nickel, copper, stainless steel or the like. The junctions of these tubes may be formed by brazing, using copper or silver or other hard solders or welding prior to the treatment of the glass sealing metal, of which the tube 2 is formed, to produce its suitable glass sealing oxide. If oxides should be formed on the adjacent tubes they are readily removed in ways well known in the art.

Following surface preparation of the metal, the glass is melted and pressed upon tube 2 in conventional fashion.

If the tubes 4 and 6 are of sufficient wall thickness, the glass may be properly confined between their ends to form a good junction. However, generally these tubes are quite thin and, consequently, in order to secure a good joint and to avoid thin, tapered, weak sections of glass there may be adopted a construction such as illustrated in Figure 2 in which the tube

10 of glass-sealing metal such as above described is brazed to a non-sealing tube 12 provided with a flange 14 under which the glass edge of the envelope 16 may be confined in the molding operation, thus providing a seal of good strength and appearance. The tubing 12 may then be tinned or otherwise treated after a cleaning to promote corrosion resistance, soldering ability and dimensional uniformity. The various steps may be identical with those described in connection with Figure 1 and, of course, if desired, there may be secured to the tube 10 two tubes such as 12 instead of the one indicated.

Figure 3 shows a further construction and in particular illustrates the fashion in which a diaphragm may be secured to the glass-sealing tube for the purpose of permitting the transmission through the envelope of mechanical motions. The glass-sealing tube in this case is expanded as indicated at 18 and has brazed to it the tube 20 of non-sealing metal which is provided with a flange 22 between which and the shoulder 24 provided by the expansion of the tube 18 there may be sealed the glass envelope 26. Prior to the silver plating or oxide formation on the tube 18 there may be brazed to its end as indicated a diaphragm 28 which, by connecting rods 30 and 32, may serve to provide a flexible seal for the transmission of mechanical movement. Here again the steps in the formation of the seal may be as previously described. It will, of course, be apparent that the diaphragm or other arrangement may involve the securing of another non-sealing metal tube or structure to the sealing metal.

Figure 4 illustrates still another adaptation of the invention in which the glass-sealing tube 34 is brazed to tubes 36 and 38 provided with flanges 40 and 42 between which there is confined the glass envelope 44, the construction being attained in the fashions previously described. In this case, the tube 34 is silver or oxide coated internally for sealing to a glass nipple 46 which, in turn, may be sealed to an internal wire or tube in the same general fashion as heretofore described or may merely provide a connection for exhaustion of the apparatus.

In some cases, the glass sealing tube may be external rather than internal with respect to the associated tube or tubes of non-sealing metal. This is illustrated in Figure 5 in which the glass sealing tube 48 has brazed within its ends the tubes 50 and 52, the envelope 54 being bonded to the outside of the tube 48. The assembly is secured in one of the fashions previously indicated.

It will be clear from the foregoing that there is provided in accordance with the invention an arrangement for sealing through a glass envelope a tube which, except in the region of bonding to the glass, may be of any desired type of metal having properties which are satisfactory for various purposes as contrasted with the frequently unsatisfactory properties of the glass-sealing metal. For example, the tube projecting internally and externally from the envelope may be soldered or otherwise secured to other metal elements or may have desired electrical, magnetic or mechanical characteristics. It will be evident that the invention offers also a wide latitude of dimensions of both the tubes and the glass envelope which may be made of sufficient thickness to withstand mechanical and thermal forces as well as large pressure differentials.

What I claim and desire to protect by Letters Patent is:

1. An assembly comprising a glass member, a sleeve of an alloy passing through said glass member and in engagement therewith, said sleeve having substantially the same expansion characteristics as the glass member and being oxide coated to provide a hermetic seal to the glass, and a tube having an end portion annularly hermetically secured to an end portion of said sleeve, said tube being of a metal having expansion characteristics differing substantially from those of the glass member, said tube being outside said sleeve, overlapping said sleeve at its junction therewith and provided with a flange for confining said glass member sealed to said sleeve.

2. An assembly comprising a glass member, a sleeve of an alloy passing through said glass member and in engagement therewith, said sleeve having substantially the same expansion characteristics as the glass member and being oxide coated on its external surface to provide a hermetic seal to the glass, a tube having an end portion annularly hermetically secured to an end portion of said sleeve, said tube being of a metal having expansion characteristics differing substantially from those of said glass member, a glass nipple mounted internally of said sleeve, said sleeve being oxide coated on its internal surface to provide a hermetic seal to the glass nipple, and an element passing through and supported by said glass nipple.

THOMAS H. BRIGGS, JR.

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