May 8, 1951 M. KÜHNER 2,551,611

GLASS TO METAL SEAL IN A COAXIAL CABLE

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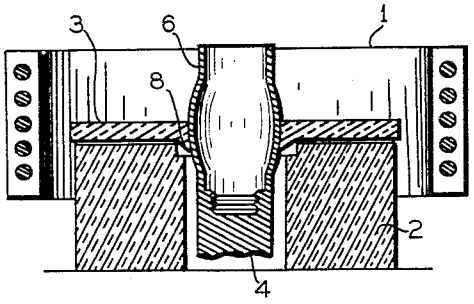


FIG. 2

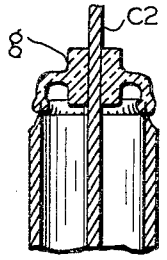


FIG. 1

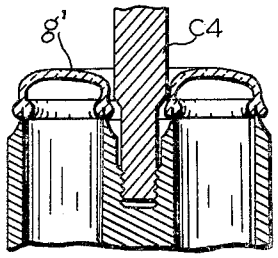


FIG. 1A

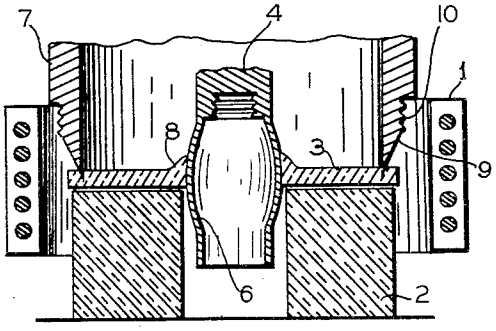


FIG. 3

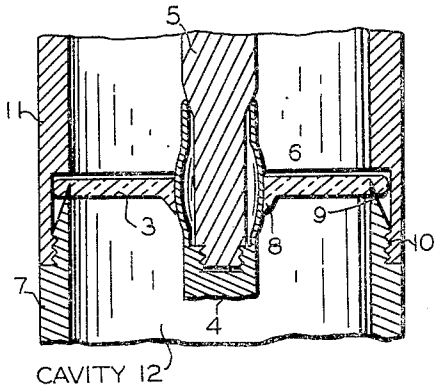


FIG. 4

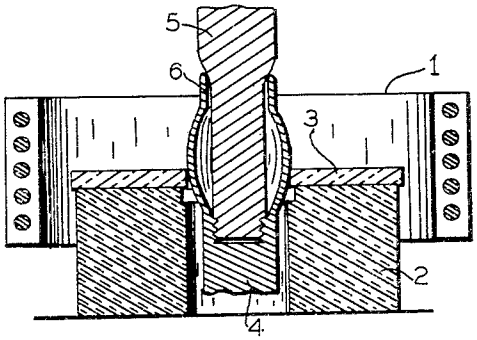


FIG. 2A

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GLASS TO METAL SEAL IN A COAXIAL CABLE

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2 Claims. (Cl. 174—22)

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The present invention relates to processes for assembling a body of metallic material and another body of non-metallic material, and to the structure of the materials so assembled. It particularly applies to the welding to a metal support of plates of glass, whether optically plane or otherwise formed. In cathode ray oscillographs or iconoscopes, for example, my novel process is found to be particularly advantageous. It also applies to the construction of hermetic lead-in joints where it is necessary to form a seal between an insulating part and a conductive part, particularly a glass-to-metal seal. The invention also involves a novel combination of means suitable for carrying out the processes.

The present invention aims particularly at constructing a type of coaxial lead-in joint that limits the high frequency losses and the dampings. It accordingly provides for reducing to a minimum the insulating mass, which is assumed to be glass in order to make the explanation more understandable, and for selection of its location so as to place it in the most favorable field zone.

It also provides a sealing process, e. g. of glass to metal, that makes possible the construction of coaxial lead-in joints, particularly for collecting the high frequency power available within electric discharge vessels and resonant cavities, or for forming coaxial cavities of variable length for variable wave-length tubes, for example a tube of the type disclosed in copending U. S. application No. 680,360 filed June 29, 1946, now abandoned.

The coaxial lead-in joints that serve for collecting the power generated within a resonant chamber that forms part of an electric discharge vessel, e. g. a vacuum tube, require the use of a hermetic sealing. They consequently necessitate the presence in the high frequency field of a glass mass that occasions losses and dampings.

In describing my invention I shall make reference to the accompanying drawings in which—

Figs. 1 and 1*a* show in cross section coaxial conductors for very high frequency, wherein the sealing process has been performed according to the prior art,

Figs. 2 and 2*a* illustrate coaxial conductors and a heating element whereby my novel process is exemplified,

Fig. 3 illustrates the manner of sealing between a glass plate and the outer conductor of a coaxial system, and

Fig. 4 shows the structure of a coaxial lead-in joint assembly as fabricated by my novel process.

The customary methods of sealing, as shown

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in Figs. 1 and 1*a*, make it difficult to eliminate the above-mentioned drawbacks. Indeed, the glass mass 3 (Fig. 1) is of considerable size and occupies quite a little space along the axis of the coaxial inner conductor. Furthermore, in the field of ultra-high frequencies, it is difficult to localize the seal in a zone where the electric field is of zero intensity, or at most is very weak. Another drawback heretofore encountered, which the present invention aims to overcome, has to do with the energy losses due to wave reflections where the inner conductor element 4 must be reduced in diameter at the end in order to be screwed into another inner conductor element 2.

According to one of its features, the invention provides for the use as the glass mass of a flat disc of slight thickness which can be positioned in the most favorable part of the electric field.

According to another feature of the invention, the sealing of the central conductor of the coaxial system and the glass plate is effected on an expanded sleeve threaded on one of the elements of the central conductor and integral with another element of the central conductor.

According to another feature of the invention, the walls of the sleeve are thin, not only for facilitating the sealing but also for insuring the continuity of the diameter of the central conductor of the coaxial system.

According to another feature of the invention, one of the elements of the outer conductor of the coaxial system is sealed to the glass plate, while at the same time providing by any suitable means the possibility of an electric connection between the sealed part and another element of the outer conductor.

According to another feature of the invention, the sealing is effected by any suitable welding means, and particularly by high frequency heating accompanied by the use of known pressure means, or else, according to a preferred embodiment of the invention, by the weight itself of the parts to be welded to the glass plate.

In Fig. 2, a high frequency oven 1 is shown as a cylindrical holder for a wire heating coil. On a steatite mold 2 there is placed a glass plate 3 orificed in the middle by a circular hole having a diameter very slightly larger than that of the central conductor of the coaxial system. This central conductor consists of two separable elements 4 and 5 which may be screwed together or otherwise inter-connected. The electrical connection between the elements is effected by giving a slightly conical shape to element 5 so that it can be forced into sleeve 6, it being possible, if

necessary, to make this electric contact more perfect by welding sleeve 6 to element 5 of the conductor. Sleeve 6 is given a somewhat expanded shape in order that its diameter may be slightly greater than that of the cylindrical hole provided in the glass plate 3.

Fig. 2a illustrates, with the same reference numbers, element 4 of the central conductor of the coaxial system once the sealing is done. In order to effect the welding, it is sufficient to heat the assembly of the parts to be welded, e. g. by means of the high frequency oven 1. The weight of the central conductive element 5 is usually sufficient to effect the sealing between the glass plate 3 and the wall of sleeve 6. It will be understood, however, where the weight of the element 5 may be insufficient, pressure may be applied in any suitable manner in order to effect the sealing together of the parts. Furthermore it will be observed that the glass plate may be located with sufficient precision, disregarding its thickness, so that it will occupy the most favorable electric field zone of the coaxial system. It is also evident, as a result of the formation of the central conductor and the means employed for obtaining electric continuity of the conductor's two elements, that no partial reflection of the transmitted wave will occur, and that the losses of high frequency power in the coaxial system will accordingly be reduced to a minimum.

Fig. 3 illustrates the manner of sealing the outer conductor of the coaxial system. The glass plate 3, to which element 4 of the central conductor has been sealed, is turned over and is laid on the steatite mold 2, as in the case of Fig. 2. Element 7 of the outer conductor, which has its end beveled or otherwise suitably shaped, is placed on the glass plate 3 within the high frequency oven 1. The sealing is effected in the manner already explained for the central conductor, the beveled portion 9 is pressed into the glass plate. A threaded portion 10 of larger diameter than the plate 3 is left free to be screwed into an internally threaded connecting member 11 as shown in Fig. 4, whereby continuity of the outer conductor is obtained.

It is evident that the manner of sealing shown in Fig. 3, with the central conductor left out, is applicable to the assembling of any disc, of glass or any other material, with any metallic support, and particularly to the sealing of plates that are optically plane or have any other shape that it is desired to make with precision.

Fig. 4 illustrates, with the same reference numbers as in the preceding figures, the coaxial lead-in joint assembly after the conductors of the coaxial system are sealed to the glass plate 3. The glass plate 3 when welded at points 8 and 9, serves to complete the enclosure of an hermetically sealed cavity 12, within the outer conductor 7. The high frequency power generated within the resonant cavity is transmitted to outside by means of element 5 of the central conductor and element 11 of the outer conductor of the coaxial system.

The field of application of the present invention is not restricted to the particular embodiments explained above. These applications are given only by way of example and without intending to limit the scope of the invention.

By those skilled in the art, the processes set forth above and the product itself may be varied considerably without departing from the spirit of my invention.

I claim:

1. Micro-wave transmission apparatus having coaxial conductors at least one section of which is to be hermetically sealed against the surrounding atmosphere, said apparatus having its inner conductor sections male-and-female threaded for joining together, the section which is female-threaded being provided with a thin-walled metal sleeve which extends beyond the threaded portion, a relatively thin annular disc of insulating material transversely across the space between said sleeve and said outer conductor, said outer conductor being sectioned and formed with male-and-female threaded ends for joining together, the root diameter of the male threads being greater than the diameter of said insulating disc, and the section end which is male-threaded having a beveled wall sealed in the face of said disc close to the periphery thereof.

2. Apparatus according to claim 1 wherein said sleeve is substantially barrel-shaped and its outer wall provides continuity of wave-conducting surfaces with respect to an adjoining inner conductor section, which section is of reduced diameter at the end which is enclosed within said sleeve.

MAXIME KÜHNER.

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