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LEAD WIRE CONSTRUCTION

Filed March 9, 1938

Fig. 1.

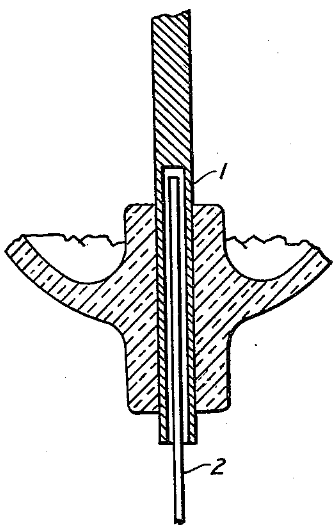
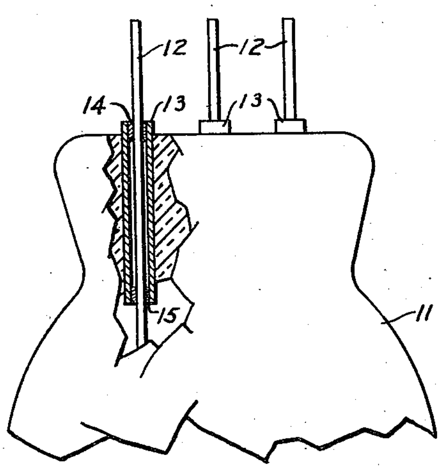


Fig. 2.



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LEAD WIRE CONSTRUCTION

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3 Claims. (Cl. 250—27.5)

The invention relates to sealing-in wires and especially sealing-in wires for discharge tubes operating on short and ultra-short waves.

An object of the invention is to provide a sealing-in wire that will not have the high losses of magnetic material when used with short waves and on the other hand will have an expansion coefficient suitable for sealing with the glass casing or the glass utilized as vacuum-tight sealing material around the wire with casings of other material.

Other objects and advantages of the invention will be apparent from the following description and drawing, in which:

Figure 1 is a cross-section through the press of a discharge tube illustrating the preferred embodiment of the invention; and

Fig. 2 is an elevation with parts in cross-section of a press of a discharge tube illustrating another modification of the invention.

The sealing-in wires for discharge tubes are usually made of certain materials, such as, for instance, alloys of iron or chromium, which are magnetic and which cannot be used, therefore, in the case of tubes that operate on short and ultra-short electric waves, because in this case their use would involve high losses. On the other hand, non-magnetic materials, such as copper, which have been proposed for the purpose just mentioned have the disadvantage that their expansion coefficients differ too much from the expansion coefficient of glass, so that if sealing-in leads in the form of wires or rods made of such a material are used, difficulties will be encountered when the seals are made, while afterwards the seals may start to leak.

The present invention covers an alloy whose expansion coefficient is about equal to the expansion coefficients of the ordinary commercial grades of glass, while on the other hand the alloy is practically non-magnetic. In line with the invention, a sealing-in wire for short-wave discharge tubes is made of a material obtained by alloying iron or nickel either with tantalum, or with columbium (also called niobium), or with tantalum and columbium, the iron or nickel content, or the content of iron and nickel in combination, being not higher than 30%. It has been found that the expansion of an alloy of this kind is such that the alloy is a very suitable material to be sealed in by fusing in ordinary commercial grades of glass. The alloy should contain a smaller or larger amount of nickel or iron, depending on the grade of glass. This content of iron or nickel should not exceed 30% in order to obtain a material having non-magnetic properties. It has been found that a content of 10–20% nickel is especially advantageous for ordinary grades of soft glass, because in this case the expansion coefficient of the metal is most closely equal to that of the glass. But the content of iron or nickel, in percent, should never be less than 5%.

In those cases where it should not be possible to make the expansion coefficient of the metal exactly equal to that of a given grade of glass by properly choosing the iron or nickel content, it may be advisable to use a sealing-in wire in the form of a rod-shaped core onto which has been shoved a tube-shaped sheath having a length corresponding to that of the fused seal. The ends of this sheath must be joined to the core, for instance, by soldering or by welding; this will produce proper seals at these ends. The sheath should be so thin that after being fused-in it can yield under the influences of the stresses set up in the glass, while on the other hand the core inside the sheath can contract freely without endangering the permanent tightness of the seal.

If the sealed-in lead should be called upon to carry, in addition to a high-frequency current, a strong current of normal frequency 50 or 60 cycles say, it would be advisable to use a lead in the form of a tube made of an alloy covered by this invention into which has been shoved a core of copper. An example of such a lead-arrangement is represented in Fig. 1 on the drawing. Here the tube made of non-magnetic alloy described in this specification is designated by 1, and the copper core by 2. Air-tight joints between these two parts can be made in any suitable manner. The use of this copper core offers the advantage that a highly conductive lead is obtained, a point of great importance if the lead must carry heavy currents, while the tube-shaped sheath of the lead, which is made of an alloy covered by this invention, is very well suitable for sealing-in purposes insofar as the expansive properties of the material are concerned.

The construction in Fig. 2 makes it possible to use any non-magnetic material, and especially for sealing-in leads in the form of rods for high-frequency tubes. In line wtih the present invention, a sealing-in lead for electric discharge vessels, and especially for discharge vessels that must operate at high frequencies, consists of a tube-shaped outer part into which has been shoved with some clearance a rod-shaped or tube-shaped core, whereupon the clearance space between core and sheath has been closed by soldering the ends of the latter to the core. The effect which application of the method covered by this invention will have will be better understood if reference is made to the drawing. It shows the stem 11 of a tube into which a plurality of leads have been sealed by fusion. Each of these leads consists of a core 12 of wire which is surrounded by a tube-shaped sheath 13 over the entire length of the lead that is fused into the glass. The external diameter of the rod 12 and the internal diameter of the sheath 13 have been so chosen that the sheath can be shoved onto the rod without difficulty. The clearance space is closed at the one end by means of solder 14 and at the other end by means of solder 15. This double seal is very reliable for the solder will be drawn into the clearance space between the bodies 12 and 13, due to the "slit-effect", and for this reason the opening will be filled up in quite satisfactory manner. At the same time the little tube 13 will be supported by the rod 12 at the soldered joints.

The method involved is carried out as follows: When a lead consisting of the two parts just described is being sealed into the glass by fusion, the little tube 13 rests directly against the rod 12 and is supported for this reason by the rod; consequently, the leads can be sealed into the stem of the tube by fusion under high pressure, for instance, with the aid of a pair of squeezing tongs, without danger that the little tube 13 might be deformed. This is an advantage not shared by other known methods of sealing in leads by fusion, because in the latter cases there is from the beginning an air-gap between the core and the sheath surrounding the core. If then, after the seal has been made, the rod cools off, the lead will contract more strongly than the glass, if it is assumed that copper is being used. This means that if the lead should have been provided in the form of a solid rod, stresses would be set up which would ultimately lead to cracks. In the present case, however, the rod 12 can contract freely inside the sheath 13, while the sheath itself, which is relatively thin and, therefore, plastic, will adhere rigidly to the glass; as a result, a small clearance space will be formed between the rod 12 and the sheath 13 after the seal is made, but this clearance space is not at all objectionable.

All difficulties encountered as a consequence of the difference between the expansion coefficients of the metal and the glass will be eliminated by applying the method covered by the present invention. Therefore, in making such seals, the metal parts to be fused into the glass can be made of a material chosen exclusively on the basis of its conductivity and of its adhesion to glass. From this viewpoint, a very suitable material is copper, for it is known that copper has the property of adhering very tightly to glass.

Concerning the choice of the thickness-ratio of rod and sheath, the statement can be made that it has been found to be advantageous to make the wall of the sheath 13 not thicker than ⅕ of the diameter of the core 12.

Application of the method covered by this invention makes it possible and advantageous to seal a plurality of leads simultaneously into glass for the process involved is very simple and can be carried out with the aid of a pair of squeezing tongs. Furthermore, sealing-in wires in line with the invention are especially well suited for high-voltage tubes, because they will not soon give rise to corona discharges.

It is apparent that modifications may be made in the details and arrangement of the preferred embodiments illustrated in the drawing. The invention may have many applications besides the particular use illustrated. No limitations are accordingly intended on the following claims except as are necessitated by the prior art.

We claim as our invention:

1. A sealing-in wire for tubes formed from a sheath of an alloy of 5% to 30% from the iron group and the remainder from the group consisting of tantalum and columbium and a conductive core for said sheath.

2. A sealing-in wire for tubes formed from a sheath of an alloy of 5% to 30% from the iron group and the remainder from the group consisting of tantalum and columbium and a conductive core of copper for said sheath.

3. A sealing-in wire for tubes formed from an alloy of which 5% to 30% is a metal selected from the group consisting of iron and nickel and the remainder is from the group consisting of tantalum and columbium.

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