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C. V. LITTON

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VACUUM TUBE SEAL AND METHOD

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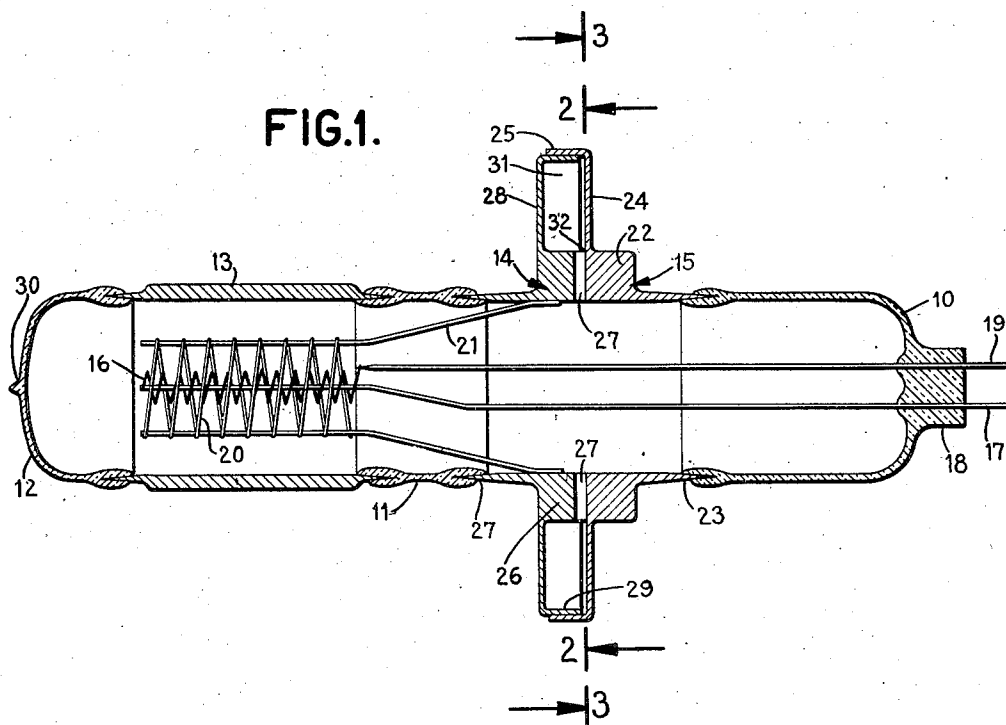


FIG.2.

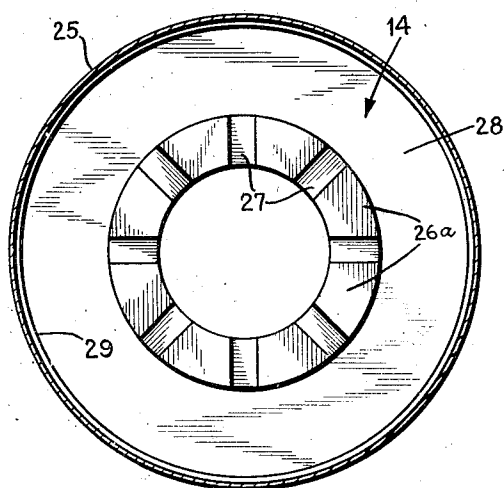
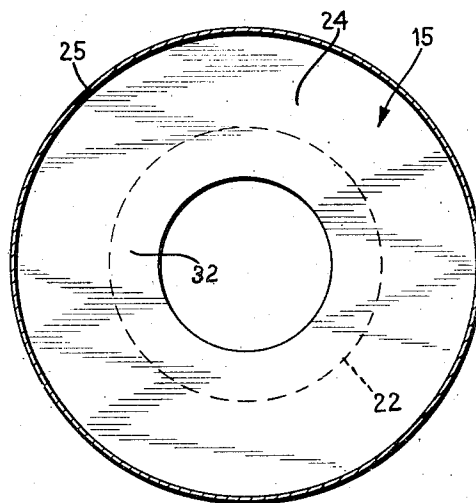


FIG.3.



BY

INVENTOR.
CHARLES V. LITTON

R. H. Morris
ATTORNEY.

UNITED STATES PATENT OFFICE

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VACUUM TUBE SEAL AND METHOD

Charles V. Litton, Redwood City, Calif., assignor
to International Standard Electric Corporation,
New York, N. Y., a corporation of Delaware

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6 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and a method of making them, and has for its principal object to facilitate the assembly of vacuum tubes.

Vacuum tubes have heretofore been made with a glass envelope for the evacuated vessel inside of which the electrodes have been supported by suitable means, either by extending directly through the glass wall or by mounting on metal sections sealed between sections of the glass. The final step in completing the tube envelope has been the creation of the final glass seal with the electrodes inside the envelope, after which the vessel has been evacuated in a well-known manner. The making of the final glass seal has presented some difficulty, particularly in very small tubes such as those commonly used at ultra high frequency.

In accordance with this invention, the assembly of the tube is facilitated by providing a metallic envelope section in two complementary parts, joining each part to its adjacent vitreous section and then sealing the metallic parts together. By using this invention a vacuum tube can be completely assembled with all its electrodes attached to their supporting members and the final seal can then be made as a metal-to-metal seal between two metal parts.

A feature of the construction is an arrangement of the complementary metal seal members such that the location of the metal seal portion is away from the glass seals, and at a position where it can easily be worked on, and is separated from the glass by a thin metal section. A related feature is the provision of a supporting construction to prevent any appreciable yielding of the thin parts of the complementary metal seal members when the tube is evacuated.

The invention will be understood from the detailed description and the accompanying drawing, of which

Fig. 1 illustrates in longitudinal section a vacuum tube made with a metal seal in accordance with this invention,

Fig. 2 is a cross section of the metal seal means taken at arrows 2—2 of Fig. 1; and

Fig. 3 is a section looking in the direction of arrows 3—3 of Fig. 1.

Fig. 1 illustrates a vacuum tube comprising glass envelope sections 10, 11 and 12, and a metal section 13, so that the envelope is in the general form of a cylinder closed at both ends. The envelope of the tube is completed by complementary metallic seal members 14 and 15, preferably copper, forming a section of the envelope. The

shape of the tube and its electrodes is not of special importance in so far as the present invention is concerned, and is shown for exemplary purposes only. The tube is shown in a conventional form with a cathode in the form of a filament 16 connected at one end to a rod terminal 17, passing through the glass stem 18, and connected at the other end to the similar filament terminal lead 19 passing through the stem. Around the filament is a control electrode or grid shown in the form of a wire helix 20 supported on rods 21 which are carried by the inner surface of member 14. The metallic section 13 is used as an anode in the arrangement shown.

The assembling of such a tube is greatly facilitated in accordance with this invention by the use of the metal members 14 and 15, particularly when the tube is of very small size. End views of members 14 and 15 are illustrated in Figs. 2 and 3, respectively. Member 15 comprises an annular body portion in the form of a ring 22 tapering to a feather edge at 23 adapted to be readily sealed to the glass section 10, and relatively thin annular disc portion 24 extending radially outwardly from the ring 22. The outer portion of 24 is bent over to form a flange 25 which may be cylindrical as shown.

The complementary member 14 likewise comprises a body portion in the form of a ring 26 of substantially the same diameter as ring 22, and terminating in a feather edge 27 similar to edge 23 for sealing with the glass section 11. A thin annular disc portion 28 extends radially from the side of the ring portion 26 at a position somewhat spaced from disc 24, and the disc 28 is bent over to form a flange 29 which corresponds and contacts with the circumferential surface of flange 25. The arrangement might, if desired, be made by placing part 29 outside of part 25, instead of inside as shown; or if desired, the parts 25 and 29 might have some other shape than cylindrical flanges, so long as there are provided continuous complementary sealing surfaces around the outside of the envelope. The ring portion 26 is provided with radial slots 27 providing solid abutting portions 26a which lie against the flat surface 32 of member 15; and the slots provide communication from the annular cavity 31 formed between members 24 and 28, to the main portion of the vessel. The bent-over flanges 25 and 29 are sealed together as by brazing.

The use of the seal members 14 and 15 provide a very easy method of assembling the tube as the last step in the completion of the tube

envelope may be the metal sealing of flanges 25 and 29, which are of relatively large diameter and removed from the rest of the tube. Thus, the filament and its leads may be sealed through the glass stem 13, and the section 10 of the glass may be sealed to the member 15; and likewise any other desired attachments or seals may be made at this part of the tube. Likewise, glass section 12 may be sealed to metal section 13 and metal sections 13 and 14 may be sealed to the glass section 11, with the grid fastened in place by the attachment of grid supports 21 to member 14; and any other desired attachments may be made to this part of the tube. Then the complementary members 14 and 15 may be brought together into the position of Fig. 1 and sealed as by brazing together members 25 and 29 to complete the tube. The heat required for such brazing operation will not injure the glass seals at feather edges 23 and 27 because of the distance of flanges 25 and 29 from the glass, and the thinness of the disc portions 24 and 28, which will not rapidly conduct heat to the glass.

Then the tube may be evacuated as by attaching a vacuum pump in a well-known manner at the position 30 of glass section 12. The gases and air are completely evacuated from the tube, and also from the cavity 31 formed between discs 28 and 24 through the radial slots 27. Except for the presence of abutments 26a against surface 32 the thinness of walls 24 and 28 might tend to make these walls collapse under the pressure due to the vacuum. Such collapse is prevented, however, by the abutments 26a because these abutments are located at positions of great strength of the member 14, and are flat against the solid portion 22 of member 15, external air pressure on 24 and 28 tending to press the parts 22 and 26a together.

By the use of this invention the assembly of the tube is greatly facilitated especially when the size of the tube is small, for it is much easier to make the metal seal around the relatively large diameter sealing flanges than to make the final seal of glass of much smaller diameter. Moreover, in small tubes it is difficult to prevent softening of the glass envelope while making conventional seals. The location of the metal seal at such a distance from the glass beyond the relatively heavy mass of members 14 and 15 and separated from these members by the thin discs protects the glass from the heat used in making the metal seal and permits high temperatures to be used on the metal without injury to the glass.

It will be understood that the invention is not limited to the particular arrangement shown, which is given for the purpose of illustration, but extends to other arrangements within the scope of the following claims. It is furthermore not required that an electrode be attached to the complementary seal members.

What is claimed is:

1. In a vacuum tube having vitreous sections in the tube envelope, means for joining two of said vitreous sections together comprising a metallic member sealed to each of said sections, each of said metallic members having a body portion adjacent the vitreous section, and a thin

disc-like portion extending outwardly from the body portion, said disc-like portions having contacting surfaces which are sealed to each other, one of the body portions having abutments which lie against the other body portion and having passages between said abutments leading from the evacuated vessel to the cavity between said disc-like portions.

2. A vacuum tube comprising a pair of complementary tubular metal members adapted to abut each other, reinforcing annular members formed at the abutting edges of said tubes to resist air pressure, a relatively thin disc-like metal member formed coaxially on each of said annular members, and a seal connecting the outer edges of said disc-like members.

3. A vacuum tube comprising a pair of tubular metal members each terminating in a metal ring of substantially greater thickness than the tube walls, a relatively thin metal disc formed coaxially on the outer surface of each ring, and a seal connecting said discs in an area adjacent to the outer edges thereof.

4. Means for sealing two sections of a vacuum tube comprising a pair of tubular metal members terminating in complementary metal rings of substantially greater thickness than the walls of said tubular members, a flange of relatively thin metal projecting from the outer surface of each ring, and a seal connecting said flanges near the outer edges thereof the metal mass of said rings serving to dissipate heat conducted thereto by said flanges during the sealing operation and also to reinforce said flanges and said tubular members to resist the effects of external air pressure.

5. Means for sealing two sections of a vacuum tube in which each section terminates in a tubular metal member having edges adapted to abut each other, a metal ring of substantially greater thickness than the walls of said tubular members formed at the abutting edge of each tubular member, a flange of relatively thin metal formed on the outer surface of each ring, a seal connecting said flanges near the outer edges thereof and air passages formed between the adjacent surfaces of said rings connecting the interior of said tubular members and the adjacent surfaces of said flanges.

6. Means for sealing two sections of a vacuum tube in which each section terminates in a tubular metal member having edges adapted to abut each other, a metal ring of substantially greater thickness than the walls of said tubular members, formed at the abutting edge of each tubular member, a flange of relatively thin metal formed on the outer surface of each ring, said flanges being disposed so that they are in spaced relationship to each other, air channel means connecting the interior of said tubular members with the space between said flanges, means disposed at the outer edges thereof to maintain the spaced relationship between said flanges and a seal sealing said flanges together at their peripheries, the arrangement being such that external air pressure on the surface of said flanges tends to press the two tube sections together.

CHARLES V. LITTON.