June 29, 1937. H. ROTHE 2,085,231

MECHANICAL MOUNTING OF ELECTRODES IN DISCHARGE TUBES

Filed Sept. 24, 1932

Fig. 1

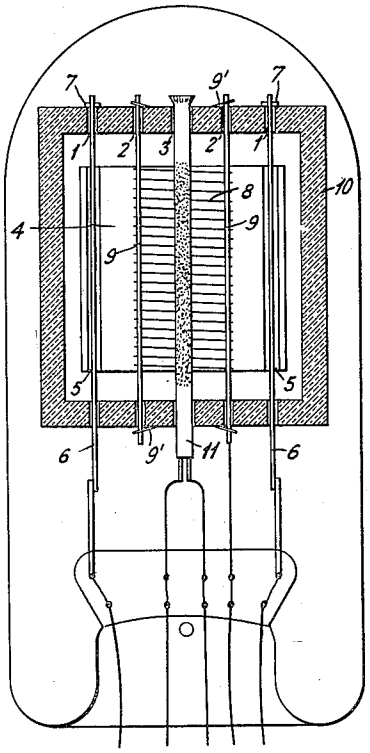


Fig. 2a

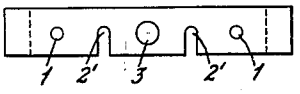


Fig. 2b

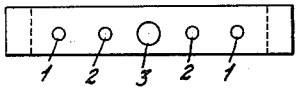


Fig. 2c

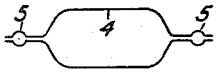


Fig. 2d

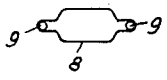


Fig. 3

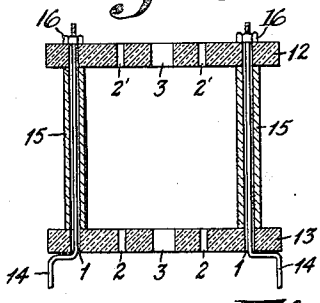


Fig. 4

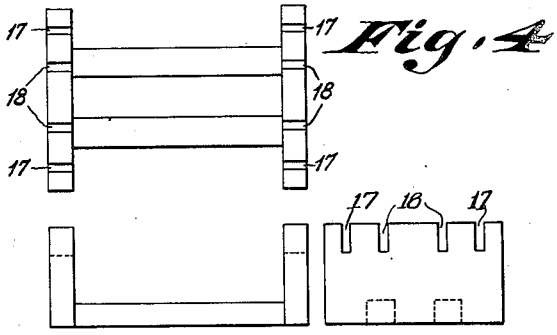
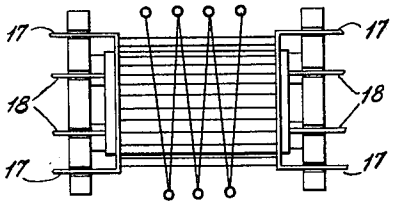


Fig. 5



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MECHANICAL MOUNTING OF ELECTRODES IN DISCHARGE TUBES

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8 Claims. (Cl. 250—27.5)

The mechanical mounting of the electrodes in discharge tubes, e. g., amplifier tubes which comprise a filament, a grid and a plate, as a general rule proceeds in this way. Starting from a press, in which the electrode supply leads and the requisite number of supporting or anchor wires are sealed by fusion, the electrode structure is made and effected by the welding together of the constituent parts with the supply lead-ins and anchor wires. This mounting is comparatively difficult to make because the welds or closures whereby the constituent electrodes are united with the anchor wires in the press, must be effected with extremely great accuracy because of the small distances between the various electrodes in order that the requisite uniformity in manufacture of the tubes may be insured. The making of such high-precision welds requires highly trained and expert labor, not to mention the fact that it is relatively tedious, time-consuming and thus costly. Another point is that the mounting when using permissible wire gauges is comparatively unstable so that the tubes which are thus manufactured without the aid of extensive supporting structures exhibit a great tendency to vibrate and produce microphonic noises.

The mechanical mounting of the electrodes in discharge tubes according to the present invention, is made simpler and easier in that the work of mounting is started from a frame construction consisting of insulation material or a combination of metal and insulation material rather than being started from the press of the surrounding glass bulb, the said frame construction having recesses and notches adapted to receive the electrodes and thus locking them absolutely in their relative positions.

Other objects and structural details of the invention will be apparent from the following description when read in connection with the accompanying drawing, wherein:

Fig. 1 is an electrode assembly of the unitary mount,

Figs. 2*a*, *b*, *c*, and *d* are details of constructions shown in Fig. 1,

Fig. 3 shows a second modification of the invention,

Fig. 4 discloses top, front and side views of a framework suitable for directly heated cathodes, and

Fig. 5 shows the assembly of the framework shown in Fig. 4 and the electrodes mounted in place.

Referring now to Fig. 1, 10 is the rectangular frame of insulating material within which are mounted the several electrodes. The two opposite short sides which are arranged transversely to the tube axis are provided with holes or recesses into which the plate, the grid, and the filament may be fitted.

Fig. 2*c* shows the shape of the anode or plate that may be used, and Fig. 2*d*, the shape of the grid electrode. The plate 4 consists of two symmetrical parts having raised portions 5 at their ends for accommodating the support or anchor wires 6. During the work of mounting, these plate anchor wires are first shifted through holes 1 of the frame and by the aid of small collars, screws or rivets 7, welded thereto, the anchor wires are firmly held in position on one side of the frame, whereas on the other or opposite side the anchor wires pass through corresponding holes in the lower frame so that they may slide therein due to thermal expansion. The holes 1 should be of such size that the said anchor wires will just snugly fit therein without having lateral movement. After these plate support wires have been mounted, grid 8 comprising the two support wires 9 and the grid wire wound thereon, is positioned within the frame. To make this possible, the latter at its lower end has the two holes 2 into which the lower ends of the grid support wires are introduced, while at its upper end it has two recesses 2′ into which the grid wires are laid. By means of suitable spring members 9′ previously arranged on the upper and lower frame members adjacent the grid supports, the grid will be so retained in the recesses that it will be permitted to yield longitudinally to thermal expansion, at the same time being firmly retained and prevented from moving laterally. The indirectly heated cathode 11 which, for instance, may consist of a nickel sleeve bespattered with electron emitting substance, is thereupon shifted into the holes 3 which should be of suitable diameter and may be retained therein by suitable yielding members within the holes, not shown. The two plate sections are thereupon welded fast to the anchor wires 6 by simple welds to insure rigid support. However, owing to the depressed form of the parts of the plate, this welding work is readily accomplishable; it requires no precision work whatever inasmuch as the frame guarantees the proper spaced relation of all of the electrodes so that the work of assembly is greatly simplified. No precision welds are needed, while yet the electrodes are absolutely firmly supported in their mutual relations and insulated from one another.

The entire frame, after the electrodes have been

built-in, can be firmly mounted upon the usual press by means of extensions of the plate support rods, although it could also be held therein by additional supports, while the leads or terminals of the other electrodes may be led through the press in the usual manner.

The arrangement above described may be further simplified in that only the upper and lower parts of the insulating frame having holes or recesses are made of ceramic material and are held together by the two plate anchor or support wires. As shown in Fig. 3, 12 and 13 represent the upper and the lower frame members or cross-pieces. As in Fig. 1, the upper member has the holes 1 and 3 and notches 2', and the lower member is provided with holes 1, 2 and 3. These two ceramic parts are united by means of two metallic braces 14 which have cranked or elbow portions at the lower ends, while in their central portion they have metallic elongated bushings 15 for spacing apart or maintaining the two ceramic cross-pieces in fixed spaced relation. By means of the nuts 16 at the other ends of the braces or supports 14, the frame is held rigid. By means of the holes and notches 2, 2' and 3, the grid and the cathode are fitted in position, whereas the two halves of the plate are welded as above onto the bushings 15 by means of simple welds. The two anchoring wires 14 may then be welded together with lead-ins sealed in the press as in Fig. 1. However, they could also from the outset be fused and sealed into the press of the glass bulb or be squeezed into the press after the assembly of the whole system.

In a further and simplified embodiment of the invention employing the mounting principle underlying the same, the lower ceramic supporting piece 13 in Fig. 3 could itself be supported directly on the press, with the two anchor wires 14 being directly sealed by fusion therein and serving to support the corresponding top piece 12 made of ceramic material. Secured in the press by squeezing are a requisite number of supporting braces, and these are so prepared, for instance, by the bending or eyelets or the fitting-on of metallic sleeves or bushings or the like so that they will fulfill the same function and purpose as the ceramic supporting piece above referred to, that is to say, insure a perfectly rigid support of the various electrodes relative to one another without difficult precision welds being required therefor. Also in this form of construction the principle of using a rugged and closed frame piece for the supporting of the electrodes has been adopted.

In the embodiments heretofore described, the plane of the frame was disposed in the longitudinal direction of the press, though it is not absolutely necessary to use this arrangement. Indeed, the plane of the frame could also be inclined or be positioned at right angles to the longitudinal direction of the press. In many instances, especially in connection with directly heated filaments, the disposition of the frame at right angles to the longitudinal axis of the press is considerably more advantageous.

A special form of construction of the frame is required in a tube furnished with a directly heated filament in which a great number of heating wire sections is disposed zig-zag fashion. These filament sections must be resiliently supported and for this reason they should not be laid directly around corresponding points of the ceramic frame. It is therefore more advantageous not to support a filament of this kind inside the framework, but rather by braces as in the conventional mode of mounting, with the anchoring braces being sealed directly in the press, whereas the other electrodes, i. e., grid and plate, are supported in the insulating framework which is firmly fixed to the press.

Fig. 4 illustrates the frame as required for such a triode tube in plan and in both end elevations, notches 18 serving to accommodate the plate supporting means and recesses 17 for receiving the grid supporting means. In Fig. 5 the electrodes are shown in position. The plate supporting means is shown engaged in the notches 18, and the grid supporting means is shown engaged in the notches 17. The filament is stretched out zig-zag fashion between suitable anchor wires (not shown) in the press.

The framework construction shown in Fig. 5 offers particular advantages for not only one grid, but for several grids, e. g., a control grid, a screen grid and a space-charge or suppressor grid. For all support strips suitable recesses are provided in which all of the electrodes can be firmly locked in their relative positions. If filaments made by the barium vaporizing method are to be used in the tubes then this point should be observed in the frame construction, namely, that between the various electrodes no conducting bridges consisting of metal, deposits should be allowed to arise. This is insurable in a simple manner by choosing suitable sections for the frame.

What I claim is:

1. A unitary mount for the electrodes of a vacuum tube adapted to be mounted on a press, comprising a quadrangularly-shaped framework provided with a pair of spaced parallel end members of insulating material which are disposed transversely of the tube axis and with a pair of insulating side members which are disposed longitudinally of the tube axis, a plurality of electrode support rods extending all the way between and carried solely by said transverse end members, and additional support rods which also extend all the way between said end members and beyond also one of said members for connection to the press whereby said last mentioned support rods constitute the sole supporting means for said framework.

2. In an electron discharge tube, a supporting framework for a plurality of electrodes having a pair of members of insulating material disposed in spaced parallel relation, said insulating members being provided with apertures, corresponding ones of which are coaxial, and a plurality of electrode supporting rods extending all the way between said insulating members and through certain of said apertures, certain of said supporting rods at one end being immovably fixed to one of said insulating members while at the other end said supporting rods slidably engage with the corresponding apertures in the other insulating member said last mentioned supporting rods serving as the sole supporting means for said framework.

3. In an electron discharge tube, a supporting framework for a plurality of electrodes having a pair of insulating members disposed in spaced parallel relation, said insulating members being provided with apertures, corresponding ones of which are coaxial, an electron emitter extending between said insulating members and through corresponding apertures therein, grid and anode electrodes surrounding said emitter and disposed in the space between the insulating members,

support rods for said grid and anode electrodes extending all the way between said insulating members and through certain of said apertures, certain of said support rods being immovably fixed at one end to one of said insulating members while said support rods slidably engage at the other end with the corresponding apertures in the other insulating member.

4. In an electron discharge tube, a pair of end members of refractory insulation material, said members being provided with a plurality of corresponding apertures arranged in alignment, a pair of side members extending between said end members for rigidly fixing and maintaining said end members in spaced parallel relation, and a plurality of electrode supporting rods extending all the way between said end members and through certain of said apertures, certain of said supporting rods at one end being immovably fixed to one of said end members while at the other end said supporting rods slidably engage with the corresponding apertures in the other end member, said last mentioned supporting rods serving as the sole supporting means for said side and end members.

5. In an electron discharge tube, a pair of end members of refractory insulation material, said members being provided with a plurality of corresponding apertures arranged in alignment, a pair of said members integrally formed with the end members for rigidly fixing and maintaining said end members in spaced parallel relation, and a plurality of electrode supporting rods extending all the way between said end members and through certain of said apertures, certain of said supporting rods having means engaging therewith at one end permitting longitudinal movement thereof but preventing lateral movement, while at the other end said supporting rods slidably engage with the corresponding apertures in the other end member.

6. A unitary mount for the electrodes of a vacuum tube adapted to be mounted on a press, comprising a pair of vertically extending support rods having their lower ends sealed within the press, the lower portion of each rod adjacent the press being provided with a shoulder, a horizontally disposed insulating cross-member having apertures engaging with said support rods and adapted to rest on said shoulders, an elongated bushing fitted over each support rod and resting upon said insulating member, a second horizontally disposed insulating cross-member having apertures aligned with those of the first-mentioned cross-member and engaging with the upper ends of said support rods and adapted to rest on said elongated bushings, and fastening means at the upper ends of said support rods for clamping together in rigid relation both insulating cross-members and said bushings.

7. A unitary mount for the electrodes of a vacuum tube adapted to be mounted on a press, comprising a rectangular framework of insulating material having its upper and lower side members disposed transversely of the tube axis, a plurality of electrode support rods extending all the way between and carried solely by said transverse side members, and additional electrode support rods which also extend all the way between said side members and beyond also one of said members for connection to the press whereby said last mentioned support rods constitute the sole supporting means for said insulating framework.

8. An electrode assembly for electron discharge devices comprising a pair of insulating members having apertures therein, means supporting said members in spaced relation, an electrode having a portion fitted in an aperture in one of said insulating members and another portion extending loosely through an aperture in the other of said insulating members, and a resilient member mounted on said other insulating member and frictionally engaging said second portion.

HORST ROTHE.