

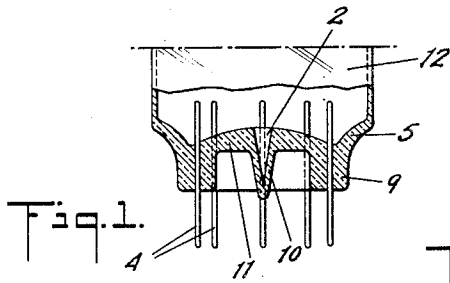
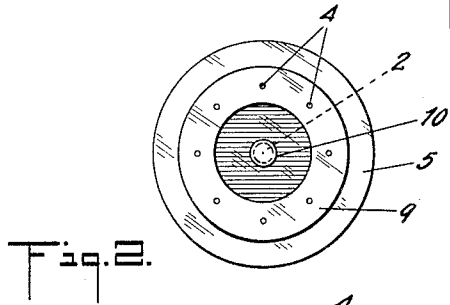
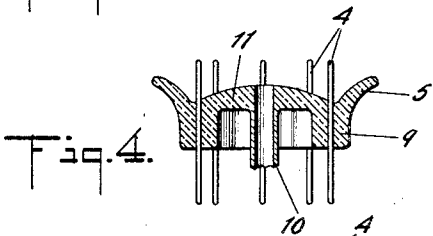
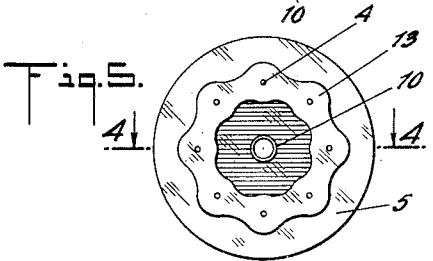
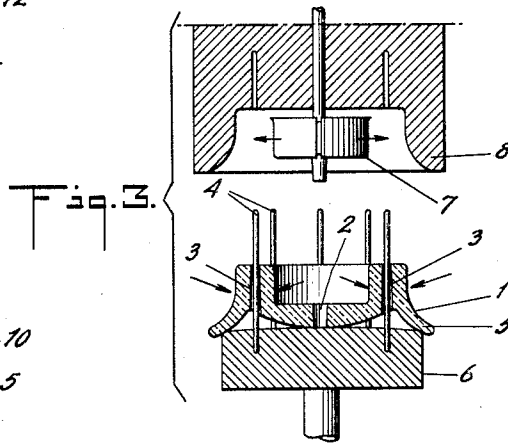
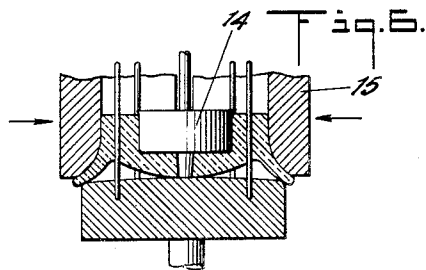
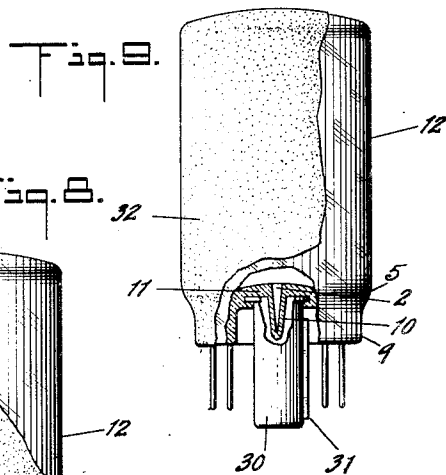
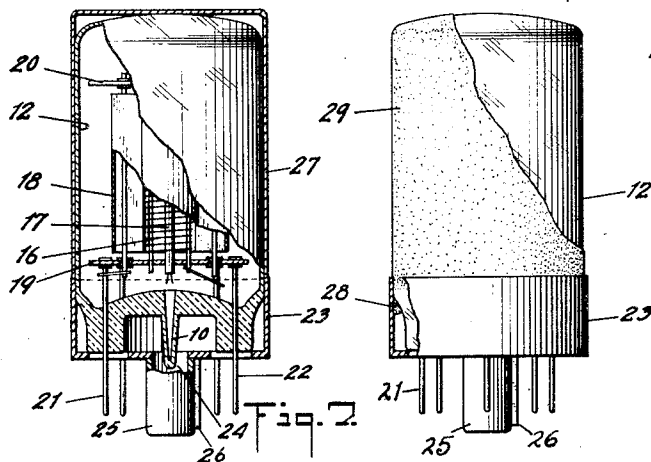
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2,250,183

ELECTRON DISCHARGE TUBE AND METHOD OF MANUFACTURE

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ELECTRON DISCHARGE TUBE AND METHOD
OF MANUFACTURE

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8 Claims. (Cl. 250—27.5)

This invention relates to electron discharge de-
vices, and more especially to such devices as radio
tubes and the like and is in the nature of an im-
provement on the tube structures disclosed in
U. S. Patent No. 2,238,025.

A principal object of the invention is to pro-
vide an electron discharge device of the radio
tube type, which is economical to manufacture
in large quantities.

Another object is to provide an improved form
of stem for a radio tube and the like, which stem
also forms the pronged contact base for the tube.

Another object is to provide an improved
method of forming a composite stem-base for a
radio tube whereby rigid metal contact prongs
can be sealed through the stem-base with a
minimum of "shrinkage."

A further object is to provide an electron dis-
charge tube of the glass bulb type, wherein the
electrical elements of the tube are electrostatically
shielded to a maximum extent.

A feature relates to the method of sealing a
plurality of rigid metal contact prongs directly
into a composite stem-base, and without employ-
ing any special grading glasses or beads between
the prongs and the body of the stem-base.

Another feature relates to an improved method
for directly sealing a plurality of rigid metal con-
tact prongs into a composite stem-base of a radio
tube, whereby low density areas of glass around
the prongs are avoided.

Another feature relates to an improved method
of forming a composite stem-base for a radio
tube with the rigid metal contact prongs sealed
therein in a vacuum-tight manner and disposed
around a common center.

A further feature relates to an improved com-
posite stem-base for glass bulb radio tubes
wherein the base is formed with a peripheral
flange to protect the usual exhaust tubulation.

Other features and advantages not specifically
enumerated will be apparent after a considera-
tion of the following detailed descriptions and
the appended claims.

In the drawing, which represents typical em-
bodiments of the invention,

Fig. 1 is a vertical view, in elevation, of the
lower portion of a radio tube embodying features
of the invention.

Fig. 2 is a bottom plan view of Fig. 1.

Fig. 3 is a diagrammatic view of apparatus that
may be used to form the composite stem-base
of Fig. 2.

Fig. 4 is a modification of the composite stem-
base of Figs. 1 and 2.

Fig. 5 is a bottom plan view of Fig. 4.

Fig. 6 shows a modified apparatus for forming
the composite stem-bases.

Fig. 7 shows the composite stem-base of Figs.
1 and 2 embodied in a totally shielded radio
tube.

Fig. 8 is a modification of the tube of Fig. 7.
Fig. 9 is another modification of Fig. 7.

It has been the usual practice in radio receiv-
ing tubes of the glass bulb type, to employ a
separate pronged member which is fastened to
the bulb, usually by a special basing cement. In
other words, the evacuated or gas-filled glass
bulb is usually provided with a reentrant stem
terminating in a substantially flat press wherein
the relatively thin and soft lead-in wires are
sealed. This construction has a number of draw-
backs which increase very materially the cost of
manufacture. One of these drawbacks is that
because of the flat nature of the press it is pos-
sible to seal the lead-in wires therein in sub-
stantially only a straight line. Consequently in
order to make a radio tube of relatively small
dimensions, it is necessary to have a relatively
small press, and therefore the lead-in wires must
be of correspondingly small diameter. Inasmuch
as practically all radio receivers are equipped
with tube sockets of a standard type, that is
with the contacts arranged around a common
center, it becomes necessary to attach to the
tube per se, the separate pronged base men-
tioned above. Since the separate base is usually
of Bakelite or similar material it is not feasible
to exhaust and seal the tube under the ordinary
exhaust schedules, with the base attached ther-
eto, because the temperature of the exhaust sched-
ule would ruin the material of the base. For
these and other reasons, it is necessary after
exhaustion and sealing of the tube, to subject
it to an entirely separate "basing" operation.
Apart from the increased cost of the base itself,
is the cost of the basing operation which re-
quires that the bulb be axially aligned with the
base, and then the relatively thin lead-in wires
must be threaded into the contact prongs car-
ried by the base and then soldered thereto.

There is disclosed in my U. S. Patent No.
2,238,025 a tube structure wherein the above-
noted drawbacks are overcome. In general the
said structure consists of a small glass envelope
or bulb which has fused or sealed thereto at its
lower end, a substantially flat composite stem-
base through which are directly sealed a plu-

rality of rigid rods which extend outwardly beyond the base to serve directly as contact prongs, and also extend inwardly of the bulb to serve as support or lead-in connections for the various electrodes of the tube mount. This arrangement therefore, completely avoids the usual separate pronged base. However, because of the fact that the prongs are sealed directly into the glass base, and since they are, during the plugging-in of the tube, subjected to considerable strains, it becomes important to provide a reliable and effective vacuum-tight seal between the prongs and the glass bulb base.

I have found that in order to produce the most effective vacuum-tight seal between the contact prongs and the glass base, it is important to avoid any areas of glass of low or non-uniform density in the regions where the prongs are sealed. For this purpose there is shown in Fig. 3 the preferred manner of effecting the seal-in. A previously prepared glass blank 1 of the shape shown in Fig. 3 is provided with a central opening 2 to receive the exhaust tubulation, and a series of smaller openings 3 to receive the rigid contact prongs 4. Preferably the blank is provided with a skirt or rim 5. The prongs 4 are placed in the corresponding openings in the lower chuck member 6 which may be carried by a rotatable shaft, and the glass blank 1 is then assembled over the prongs as shown. The blank is then heated at the regions indicated by the arrows and during the heating, the chuck 6 with the blank may be rotated. It will be understood that any well-known method of heating the glass to its plastic temperature may be employed, for example heating torches may be disposed around the blank or the glass may be heated by electrical means.

I have found that in order to attain the required uniformity of glass density around each prong, it is necessary that the glass be heated uniformly where it is to contact with the prong during the sealing operation. For this purpose, it is preferable to make the openings 3 in the glass blank of tapered formation so that the portion of the prong adjacent the chuck 6 is spaced away from the glass 3 to a greater extent than is the upper end of the prong. If the openings 3 were uniform and in substantial contact with the prong throughout their length, when the glass 3 is heated as above described, the lower end of the prong will be at a lower temperature than the upper end because of the heat conduction through the chuck 6. By employing slightly tapered openings 3, as the glass 3 is heated, a more uniform temperature gradient is attained in the area of the glass adjacent each prong.

When the glass becomes plastic, the expansible chuck member 7 and the shaping member 8 are lowered, whereupon the chuck 7 is expanded radially in any well-known manner thus forcing the molten glass radially outward and compressing it against the contact prongs which are wetted thereby. If desired, the chuck members 6, 7 and 8 may be heated to prevent strains being formed in the glass when these parts contact therewith as above described. The chucks are then separated and upon cooling and annealing in any well-known manner the formed base is removed, with the prongs effectively sealed therein in a vacuum-tight manner. The glass blank is thus provided with an annular shoulder 9 into and through which the contact prongs 4 are directly sealed. Because of the radial pressure exerted on the molten glass by the expansi-

ble chuck 7, the glass is distributed around each prong with substantially uniform thickness and uniform density. It will be understood of course that the prongs may be oxidized prior to their insertion into the chuck 6, to facilitate sealing as described in detail in U. S. Patent No. 2,219,574.

A short length of exhaust tubing 10 (Fig. 1) may then be sealed to the portion 11 of the base, in alignment with opening 2 and tipped-off in any well-known manner after the bulb has been evacuated. Any well-known type of radio tube mount or electrode assembly may be connected to the upper ends of prongs 4 whereupon the glass bulb or envelope 12 is assembled over the mount and sealed to the skirt 5, as partially shown in Fig. 1. It will be noted that after the exhaust tubulation 10 is tipped-off, it is protected throughout the greater part of its length by the annular rim 9, and if desired the tubulation may be tipped-off so that it does not extend downwardly beyond the said rim.

Instead of forming the rim 9 with an annular wall of uniform thickness, as shown in Figs. 4 and 5 this rim may be formed with increased thickness at the regions where the prongs are sealed therethrough, as indicated by the numeral 13. It will be understood of course that the outer face of the expanding chuck 7 and the inner face of member 8 will be shaped to produce the shape of the rim 9 as shown in Figs. 4 and 5.

Instead of employing an inner expansible chuck such as chuck 7, and an outer shaping member 8, thus forcing the molten glass radially outward, the glass may be forced radially inward. Such an arrangement of apparatus is diagrammatically shown in Fig. 6. In this embodiment the member 14 may be a simple plunger. The outer annular shaped member 15 is made up of a plurality of chuck jaws which are capable of being forced inwardly in the direction of the arrows to compress the molten glass radially inwards against the contact prongs. In the event that both inward and outward radial pressures are desired, then both the member 14 and the member 15 may be expansible, so that as the member 14 is expanding radially outward, the member 15 is being contracted radially inward. In either of the embodiments of Figs. 3 or 6 the members 7, 8 and the members 14, 15 may be rotated during the expanding operations, if desired.

While the composite stem-base formed as above described, may be incorporated in any well known type of radio tube, certain typical embodiments are shown in Figs. 7, 8 and 9. Inasmuch as the present invention is concerned mainly with the structure of the composite stem-base to be incorporated in a glass envelope, it will be obvious that any well-known form of electrode assembly may be supported on the inwardly projecting ends of the contact prongs. Thus there is shown in Fig. 7 an electrode assembly of the triode type comprising the indirectly heated cathode 17, a wire-wound control grid 18 and tubular plate or anode 19. Preferably, although not necessarily, these electrodes are assembled as a unitary mount between lower and upper mica disc spacers 20, 21 as described in detail, for example in Patent No. 2,084,734. The unitary mount may be supported on the upper ends of the inwardly projecting contact prongs 21, 22 as for example by eyelets fastened into the mica disc 19. The electrodes of the mount are then connected by short metal wires

to the ends of the respective contact prongs. In order to shield the electrodes electrostatically, after the tube has been subjected to the usual exhaust schedule and the exhaust tubulation 10 has been tipped-off, the glass bulb is enclosed in a metal sheath comprising a metal cup-shaped base member 23 having a series of openings in its bottom to allow the contact prongs 21, 22 etc. to project therethrough without being short-circuited. The bottom of member 23 is provided with a circular opening 24 to accommodate the lower end of the tipped-off tubulation 10. Preferably there is attached to the bottom of member 23 a hollow metal boss 25, having an integral key 26 formed on one side. If desired the member 23, with members 25 and 26 can be formed as one piece from the same metal blank. Welded or otherwise electrically joined to the rim of member 23 is an inverted metal cup 27 which preferably engages the upper end of the glass bulb 12, thus completing the electrostatic shielding and preventing rattling of the bulb within the sheath. For a detailed description of the member 23, reference may be had to U. S. Patent No. 2,238,025.

Instead of completing the electrostatic shielding of the glass envelope by a separate cup-shaped member such as member 27, the metal base member 23 may be fastened to the glass bulb 12 by a ring of cement 28, and the glass bulb being provided on its outer surface with a conductive coating 29. It will be understood that the coating 29 extends downwardly to overlap the rim of the base 28 with which it is therefore in electrical connection, and of course this coating is not applied to the composite stem-base as the rim of member 23 completes the electrostatic shielding.

In certain cases it may be possible to delete the metal base 23 entirely. Such an arrangement is shown in Fig. 9 wherein the glass bulb with the composite stem-base sealed thereto is the same as the corresponding parts in Fig. 7. In this embodiment, the metal boss 30 with its integral key 31 is imbedded in the portion 11 of the stem-base, it being understood that the member 30 is imbedded after the exhaust tubulation has been tipped-off. The glass bulb is coated on its top and on its peripheral wall with a conductive material 32 to complete the electrostatic shielding. Preferably also a conductive connection is made between the member 30 and the conductive coating 32, whereby the coating and member 30 can be grounded or connected to some other suitable base potential to effect the necessary electrostatic shielding. If desired the member 30 may be connected by a metal strap to the particular one of the contact prongs which is grounded during the normal use of the tube.

While certain specific embodiments of the inventive method and apparatus have been disclosed, it will be understood that various changes and modifications may be made therein. For example, while the method of forming the composite stem-base has been described as employing a previously formed glass blank which is heated to render it plastic, at the sealing-in regions the blank may be formed and the lead wires simultaneously sealed therein by the process disclosed in U. S. Patent No. 2,219,574.

What I claim is:

1. A composite unitary stem-base for an electron discharge tube comprising a glass bottom flattened in a plane substantially transverse to

the vertical axis of the tube and having a plurality of rigid conductors directly sealed therethrough in a vacuum-tight manner with the external ends of said conductors serving directly as rigid contact prongs for the tube, the transverse thickness of said bottom being increased where the prongs pass and being preformed with transverse perforations to receive said prongs so that said glass bottom can be molded directly around said prongs in a vacuum-tight manner, said bottom having a substantially uniform density of glass in substantially the entire transverse thickness surrounding each prong.

2. A composite stem-base according to claim 1, in which said glass bottom is provided with preformed transverse tapered perforations whereby said bottom can be molded around said rods to provide seals free from glass of non-uniform density.

3. An envelope for an electron-discharge device comprising a thin-walled glass bulb, a preformed composite base and closure for the open end of said bulb comprising a thick glass disc integrally joined as a unit to a thin rim, said rim being sealed directly to the lip of said bulb in a vacuum-tight seal, a plurality of rigid metal rods arranged in a circle around the center of said disc with the material of said disc molded around said rods and sealed directly thereto in a vacuum-tight manner, said disc having its transverse thickness materially increased and proportioned where said rods pass therethrough to provide a sufficiently strong mechanical support for the externally projecting ends of said rods, whereby said rods can be used directly as plug-in contacts for the tube without danger of weakening said seals and with substantially the entire transverse thickness of the glass surrounding each plug-in contact of uniform density.

4. An envelope for an electron discharge tube comprising a glass bulb, a cup-shaped glass header for closing the end of said envelope comprising a vitreous disc having integrally formed therewith a rim of a diameter substantially the same as the diameter of the open end of said bulb the said bulb and said rim being relatively thin said rim being flared and sealed in a vacuum-tight manner to the edge of said open end, a plurality of relatively heavy rigid contact prongs extending through said header with the material of the header molded around and sealed vacuum-tight directly to each conductor the junction between the glass and conductors being extensive to provide a strong mechanical support for the external ends of said prongs with substantially the entire transverse thickness of the header around each prong being of uniform density.

5. An envelope according to claim 4 in which the central part of said header is relatively thin and has sealed thereto a tipped-off exhaust tubulation while the peripheral region of said header has a downwardly extending thick shoulder to provide a protecting recess for said tubulation.

6. An electron discharge tube comprising a tubular envelope, a relatively thick glass disc-like header sealed vacuum-tight to and closing one end of said tube, rigid contact pins arranged around the center of said header and sealed directly therethrough in a vacuum-tight manner, the under surface of said header having a shoulder defining a central recess, and means for shielding said pins comprising a tubular metal member extending from near the external ends

of said prongs into said recess whereby a substantial part of the length of one of said prongs in the region passing through said header is electrostatically shielded from a substantial part of the length of another of said prongs in the region passing through said header. 5

7. A unitary stem-base for the bulb of an electron discharge tube comprising a glass header having a central substantially flattened disc-like portion to which an exhaust tubulation is attached, a plurality of rigid conductors sealed directly through said header in a circle around the center thereof, the outer ends of said conductors serving directly as contact prongs for the tube, said header having on its under face a reentrant 15

recess, a metal cylinder attached centrally to said header and extending downwardly thereof to at least the end portions of said prongs said cylinder serving to shield the external portion of the control-grid prong from the external portion of the plate prong as well as a substantial portion of the control-grid prong where it passes through the header from a corresponding substantial portion of the plate prong where it passes through the header.

8. A unitary stem-base according to claim 7 in which one of the prongs is a grounding prong and is electrically connected to said metal cylinder.

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