Feb. 18, 1941. A. FEINDEL 2,232,220

MULTIPLE UNIT RADIO TUBE

Filed Jan. 3, 1939 2 Sheets-Sheet 1

Fig. 1.

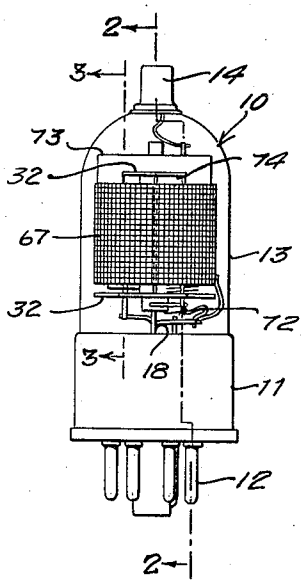
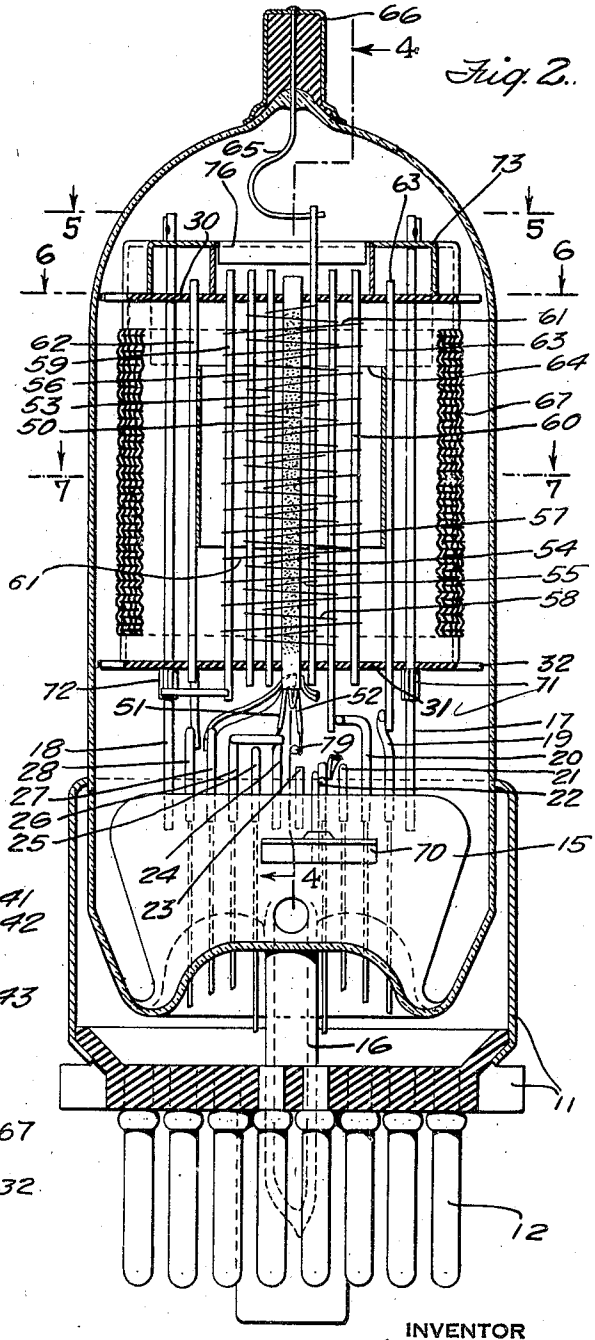


Fig. 2.



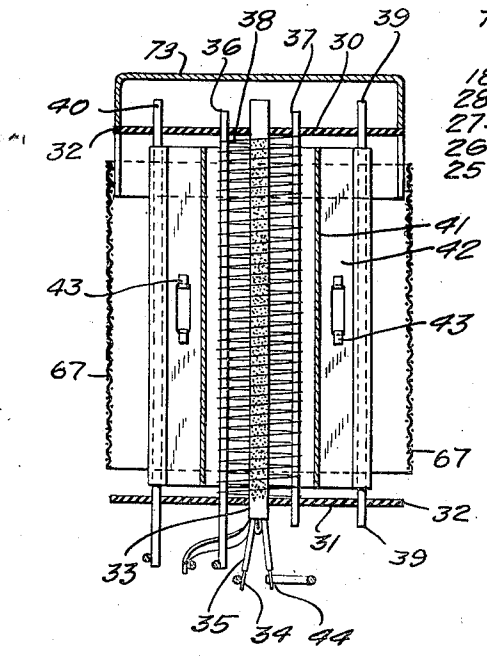


Fig. 3.

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Filed Jan. 3, 1939 2 Sheets-Sheet 2

Fig. 4.

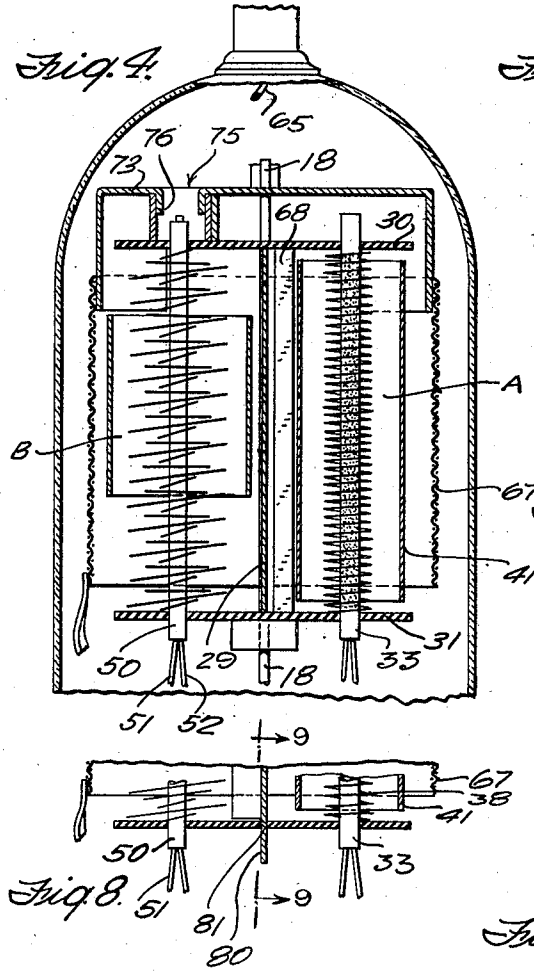


Fig. 5.

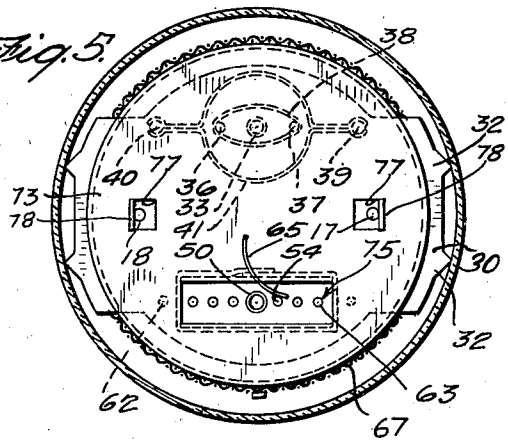


Fig. 6.

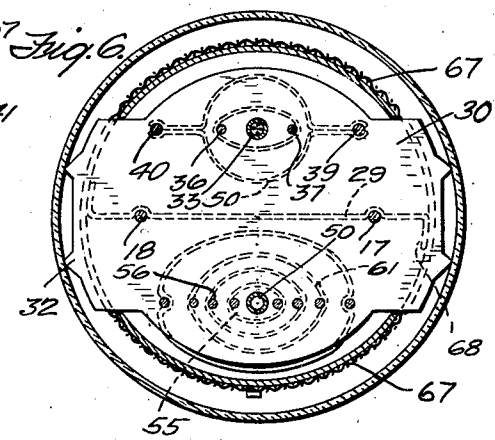


Fig. 8.

Fig. 7.

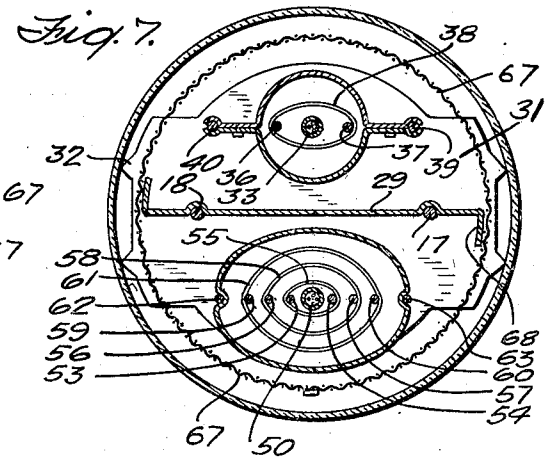


Fig. 9.

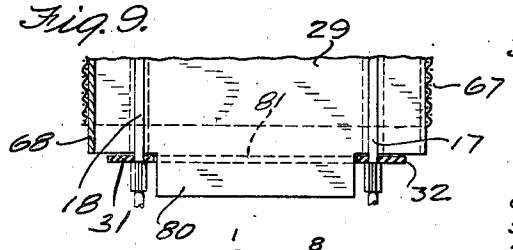
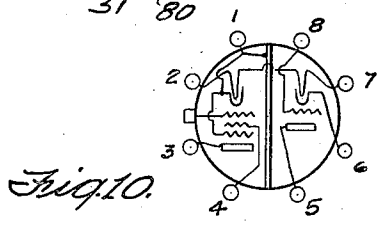


Fig. 10.



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MULTIPLE UNIT RADIO TUBE

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Application January 3, 1939, Serial No. 248,981

10 Claims. (Cl. 250—27.5)

This invention relates to thermionic devices. More specifically, the invention relates to radio tubes wherein multiple units are combined and integrated so as to utilize common parts.

Heretofore in the construction of radio tube units it has been found desirable to maintain a complete separation therebetween because of the extreme sensitivity of the elements in relation to each other, particularly when such elements were utilized in radio frequency amplification or detection of radio signals. To this end it has been common practice to enclose these elements in separate tubes and shield the tubes one from the other and from external electrical disturbances. In some cases a degree of integration has been established as between rectifier tubes or even amplifying tubes where the different units were positioned along a common axis. Previously, however, there have been no successful constructions in which multiple radio units having amplifying and detecting functions have been combined between common end planes in parallel physical relationship and within a common envelope.

Accordingly, the objects of this invention contemplate the provision of a radio tube construction or device in which separate self-functioning units are combined physically in parallel relationship about a common axis; the provision of a multiple tube construction employing a common base support stem; the provision of a multiple tube element construction wherein a single tubular shield is employed for all electrical units of the construction; the provision in a multiple tube construction having a common base of means for effectively shielding an amplifier unit from a detector unit or another amplifier unit while at the same time utilizing a grid connection through the top of the tube to a cap terminal; the provision of an inter-unit shield as a common enclosure member of the multiple tube unit; and other objects which will become apparent on consideration of the following description of a modification which may be preferred, and inspection of the drawings, in which:

Fig. 1 is an elevation of a radio tube incorporating the multiple units;

Fig. 2 is a section in elevation along lines 2—2 of Fig. 1 showing the amplifier unit;

Fig. 3 is a section along lines 3—3 of Fig. 1 showing the detector unit;

Fig. 4 is a section through the radio tube along lines 4—4 of Fig. 2;

Fig. 5 is a plan sectional view taken along lines 5—5 of Fig. 2;

Fig. 6 is a sectional view taken along lines 6—6 of Fig. 2;

Fig. 7 is a sectional view taken along lines 7—7 of Fig. 2;

Fig. 8 is a detail showing a portion of a modified shield between the electrical units;

Fig. 9 is another view of the modification along lines 9—9 of Fig. 8; and

Fig. 10 is a wiring diagram of the electrical connections in the tube.

Referring to Fig. 1, I have shown in elevation the radio tube generally indicated by the numeral 10 which is shown provided with a base 11 made of ceramics, composition or other substances, having protruding terminals 12, envelope 13 and grid terminal cap 14. Within the envelope, as more clearly shown in Fig. 2, there is provided the stem 15 carrying the pendant exhaust tube 16, and on the press the support rods 17 and 18 and the various lead-in wires designated respectively as 19, 20, 21, 22, 25, 26, 27 and 28, and the filament support wires 23 and 24. In the modification shown there are two electrical units in the tube, as clearly indicated in Fig. 4 and generally designated by the letters "A" and "B." A is illustrated as a detector unit and B as a pentode amplifier unit, the flat metal shield plate 29 supported by support rods 17 and 18 forming a barrier at the mid-point of separation of these two units. At the top and bottom of these units A and B are insulation mica plates 30 and 31. These plates are approximately circular in shape and are provided with protruding fingers 32 adapted to form a spacer or shock absorbing contacts with the inner surface of the glass envelope 13, thus supporting the tube units at the top as well as at the base. These mica support plates are apertured to receive the various anode, grid and cathode support rods which extend through and beyond these plates to such an extent as is required for frictional holding of the parts or for welding to the lead-in wires.

Unit A comprises the usual essential parts of a detector unit, including anode, grid, cathode and heater. The cathode tube 33 is externally coated with the usual electron emitting substances and is dimensioned to receive the double hairpin filamentary heater 34 insulated as at 35 to bring the external coating of the cathode up to electron emitting temperature. Support rods 36 and 37 carry the grid 38 and rods 39 and 40 support the anode 41. The anode follows the usual construction consisting of a single sheet of metal bent back on itself to form a central

tube enclosing the grid and cathode and wing plates 42 enclosing and supported by the rods 39 and 40. The double wing plates are secured together by bent back tongues 43 stamped out of the wing material, as shown in Fig. 3. The anode support rod 40 is welded or otherwise attached to lead-in wire 28; grid support rod 36 is welded to lead-in wire 25; cathode 33 is electrically connected to lead-in wire 27; and the heater end 44 is connected to lead-in wire 21.

The B or amplifying unit includes an anode, three grids, a cathode tube and heater. As illustrated in Fig. 2, the cathode 50, which is coated with electron emitting material, passes through the insulation plates 30 and 31 at either end. At the base end the insulation coated double hairpin filamentary heater having terminals 51 and 52 enters the cathode for the purpose of heating the same to electron emitting temperature. Surrounding the cathode and supported by rods 53 and 54 is the control grid 55. Enclosing the control grid 55 and supported by rods 56 and 57 is the screen grid 58. Surrounding grid 58 and supported by rods 59 and 60 is the suppressor grid 61. Surrounding grid 61 and supported by rods 62 and 63 is the imperforate metal plate 64 forming the usual anode. As shown, this anode does not extend the full length of the grid elements since a high anode impedance is desirable.

The various support rods pass through apertures in the end support plates 30 and 31, wherein they are frictionally held from movement. Heater end 51 connects to lead-in wire 26; cathode 50 is electrically connected to lead-in wire 22; control grid rod 54 extends upwardly at the top of the tube to connect with the lead-in wire 65, passing out through the top of the envelope and connecting with the cap terminal 66. Rod 57 of the screen grid 58 connects to lead-in wire 20; rod 59 of the suppressor grid 61 connects to main support rod 18, grounding on the inter-unit shield 29.

Enclosing both units between the top and bottom mica plates 30 and 31 is a perforated cylindrical shield 67 which is welded to the edge flanges 68 of the inter-unit shield 29. The base of this cylindrical shield is electrically connected to the B cathode, and consequently to lead-in wire 22. Lead-in wire 22 also connects to the getter flag 70, so that lead-in wire 22 has joint connections to the flag 70, the B unit cathode 50, the suppressor grid 61 and the external cylindrical shield 67. As previously indicated, the rods 17 and 18 afford the main support for the multiple units hereinabove described, these rods passing through both mica plates 30 and 31 and rigidly holding these units in place by means of base strips 71 and 72 welded to the rods below mica plate 31 and welded connections above the mica plate 30, as will be hereinafter described.

In order effectively to free the A and B units from the inter-action of electrostatic and electromagnetic effects of the various elements, particularly the grids, while the tube is in operation, I have provided at the top of the assembly a metal shield 73 which is adapted to be positioned above the mica plate 30. This shield is roughly cup-shaped, being formed of a circular flat metal disc with a circumferential skirt, opposite sections of the skirt being cut out to form elongated notches 74, as shown best in Fig. 1. The flat portion of the shield is also provided with an elongated slot 75 having downwardly depending side and end walls 76, the length of the slot being such as to overlie the various support rods 60, 57, 54, 53, 56 and 59, as well as the cathode 50 of the B unit pentode. The width of the slot is sufficient to overlie the control grid. Consequently, it is apparent that when this end shield 73 is in position on the top mica plate 30 the detector unit A is effectively shielded from the control grid lead-in wire 65, as well as the protruding support rod 54 of the B unit. In addition the control grid and connecting wire 65 are shielded from the anode 64 and anode support rods. The shield 73 is also provided on its flat portion with openings 77 to permit the protrusion of the main support rods 17 and 18 which are welded to the tabs 78 stamped out of these apertures. In this manner, in conjunction with the base strips 71 and 72, the units are held securely in place in the tube.

It will be seen from Fig. 10 of the drawings that the heaters of the two units are connected in series, this series connection being between the lead-in wire 26 in the B or pentode unit and the lead-in wire 21 of the A or detector unit, the wire connection being made by the cross wire 79 welded to the stem support wire 23. Wire 23 at its outer end is in supporting contact with the mica plate 31. Fig. 10 also indicates the grounding of the cathode and suppressor grid on the inter-unit shield plate 29, and consequently the outer cylindrical shield 67.

It will now be apparent that the two electrical units are effectively shielded one from the other. The A or detector unit is enclosed by the inter-unit shield plate 29 and the half section of the external shield 67 on the side. On the ends a further shielding closure is provided by the cup-shaped member 73 provided with the depending walls 76 for intercepting electrical effects between the detector unit and the control grid of the amplifier. Similarly, the B or pentode amplifier unit is shielded on the side by the inter-unit shield 29 and the external perforated shield 67, and on the top the control grid and its lead-in wire 65 are shielded from the A unit by means of the top-shield plate 73 with the depending walls of the slot 75 enclosing the ends of the grid support rods 53, 54, 56, 57, 59 and 60 of the pentode, and shielding the control grid from the anode 64.

In the modification illustrated in Figs. 8 and 9 I have shown an extension of the inter-unit shield 29 below the base mica plate 31 so as to obviate all possibility of electrostatic or electromagnetic effects between the filaments and the active elements of the units. This extension takes the form, as shown in Fig. 9, of a tongue 80 extending approximately the full distance between the main support rods 17 and 18 through a slot 81 formed in the mica plate 31. The added shield of the modification is not essential but may be desirable in the case of certain tube assemblies.

While the inter-unit shield 29 and cylindrical shield 67 are shown as imperforate and perforated respectively, shield 29 may be perforated and shield 67 may be imperforate.

Modifications other than hereinabove described may be made and I do not desire, therefore, to be limited to the precise embodiments shown other than as required by the scope of the claims hereto appended.

I claim as my invention:

1. A radio tube comprising multiple thermionic

units positioned side by side in parallel arrangement, said units each having at least one grid and a support rod therefor, a common base for said units and a common grounded screen for said units, said screen including a metal casing adapted to receive said units, a metal inter-unit plate and a metal end plate, said end plate overlying said units at the end opposite said base and having a stamped-out portion with walls for shielding the projecting support rod of the grid of one of said units.

2. A thermionic device comprising plural thermionic units including an amplifying unit, a common base for said units, a common envelope enclosing said units, a stem extending from said base, main support rods and lead-in wires projecting from said stem into the envelope, a cylindrical shield mounted on said main support rods, mica end plates at the ends of said cylindrical shield, a flat shield bridging said main support rods and dividing the cylindrical shield into two compartments, thermionic units each including a heater, a cathode, a grid and an anode mounted on support rods within each compartment, the ends of the support rods protruding through apertures formed in the end plates, and a metal shield forming a common closure for the outer ends of said units, said end closure comprising a plate having an edge flange and struck-out portions forming an opening in the plate surface with depending side and end walls adapted to overlie the thermioic elements of one of said units and enclose the protruding ends of the support rods of said elements, whereby the inter-unit electrostatic and electro-magnetic effects are effectively reduced.

3. A thermionic tube comprising a base having external terminals therein, an envelope mounted on said base, a reentrant stem within said envelope, lead-in wires and main support rods mounted on said stem, a flat metal shield extending between said support rods, a metal cylinder enclosing said shield, thermionic units within the compartments formed between the cylinder and shield, insulation plates at each end of said thermionic units provided with apertures and envelope-engaging fingers to form support and spacing means for the elements of said units, and a metal shield plate overlying the end of the thermionic units opposite from the base, said end plate having depending walls completely enclosing the end portions of the elements of one of said units.

4. A thermionic device comprising a base, electrode terminals mounted in said base, an envelope mounted on said base, a stem within said envelope, main support rods extending from said stem, a metal shield extending between said main support rods, a cylinder enclosing said shield and forming dual chambers, a thermionic unit including heater, cathode, grid and anode elements mounted in each of said chambers, support rods for each of the elements of said units, insulation plates overlying each end of the shield cylinder, said plates having apertures adapted to receive the protruding ends of the support rods of the elements of said units, and a metal plate overlying the insulation plate at the end of the tube opposite from the base, said end plate having a struck-out portion with depending walls forming a closure for the protruding ends of the element supports, including the control grid support, of one of said units, and means for connecting said control grid support rod end to a terminal other than the base terminals.

5. A thermionic device comprising an elongated envelope, a base at one end of the envelope, wire terminals in said base, a stem in the base end of the envelope, main support rods and lead-in wires mounted on said stem, a plate joining said main supports, thermionic units containing grid elements mounted one on each side of the plate, a cylindrical shield surrounding said units and plate, and a top shield overlying the ends of both units, said top shield having depending sections enclosing the end of the grid element of one of said units.

6. A thermionic device comprising an elongated envelope, a base at one end of the envelope, wire terminals in said base, a stem in the base end of the envelope, main support rods and lead-in wires mounted on said stem, a plate joining said main supports, thermionic units containing grid elements mounted one on each side of the plate, a cylindrical shield surrounding said units and plate, and a top shield overlying the ends of both units, said top shield having a depending edge flange joining the cylindrical shield and depending inner flanges adapted to enclose the adjacent control grid end of one of said units.

7. A thermionic device comprising an envelope, a stem support therein, main support rods mounted on said stem, a metal plate between said rods, a metal cylinder enclosing said plate forming dual compartments, a metal end plate closing the end of the cylinder opposite from the stem, therminoic units including grid elements within each of said compartments, lead-in wires entering the envelope at the stem and at a point spaced from the stem, terminals attached to said lead-in wires, said metal end plate having a portion struck out to form an opening with a projecting wall, the opening permitting emergence of the ends of the grid elements of one of said units, and the wall forming a shield between the emergent grid element end and the grid elements of the other unit.

8. A thermionic device comprising an elongated envelope, a base plate at the base end of said envelope, terminals mounted in said plate, a terminal mounted at the top end of said envelope, a support stem at the base end of the envelope, support rods and lead-in wires passing through and supported by said stem, a metal plate extending between and joining said support rods, a cylindrical shield enclosing said plate and forming therewith two adjacent compartments, a thermionic detector assembly in one of said compartments including cathode, grid and anode elements, a thermionic amplifier in the other compartment including cathode, control grid, screen grid, suppressor grid and anode, a lead-in wire connecting the control grid of the amplifier to the top terminal, lead-in wires connecting the other elements to the base terminals, and a top plate having a depending flange overlying the top end of the two compartments containing the thermionic units, said top plate having a slotted portion with depending sides adapted to overlie and include the control grid lead-in wire of one of said units, thereby forming a shield between said control grid wire and the elements of the detector unit.

9. A radio tube comprising multiple thermionic units, each unit having at least one grid and a support rod therefor, a common base for said units and a common shield for said units, said shield including a metal casing adapted to receive said units, a metal plate interposed between said units, and a metal end plate closing the top

end of said casing, said end plate having a stamped-out portion with depending walls enclosing the projecting support rod of the grid of one of said units.

10. A radio tube comprising multiple thermionic units positioned side by side in parallel arrangement, said units each having one grid and a support rod therefor, a common base for said units and a common screen for said units, said screen including a metal casing adapted to receive said units, a metal inter-unit plate and a metal end plate, said end plate overlying said opening with a projecting wall, the opening permitting emergence of the grid support rod end of one of said units and the wall forming a shield between said rod end and the grid of the other of said units.

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