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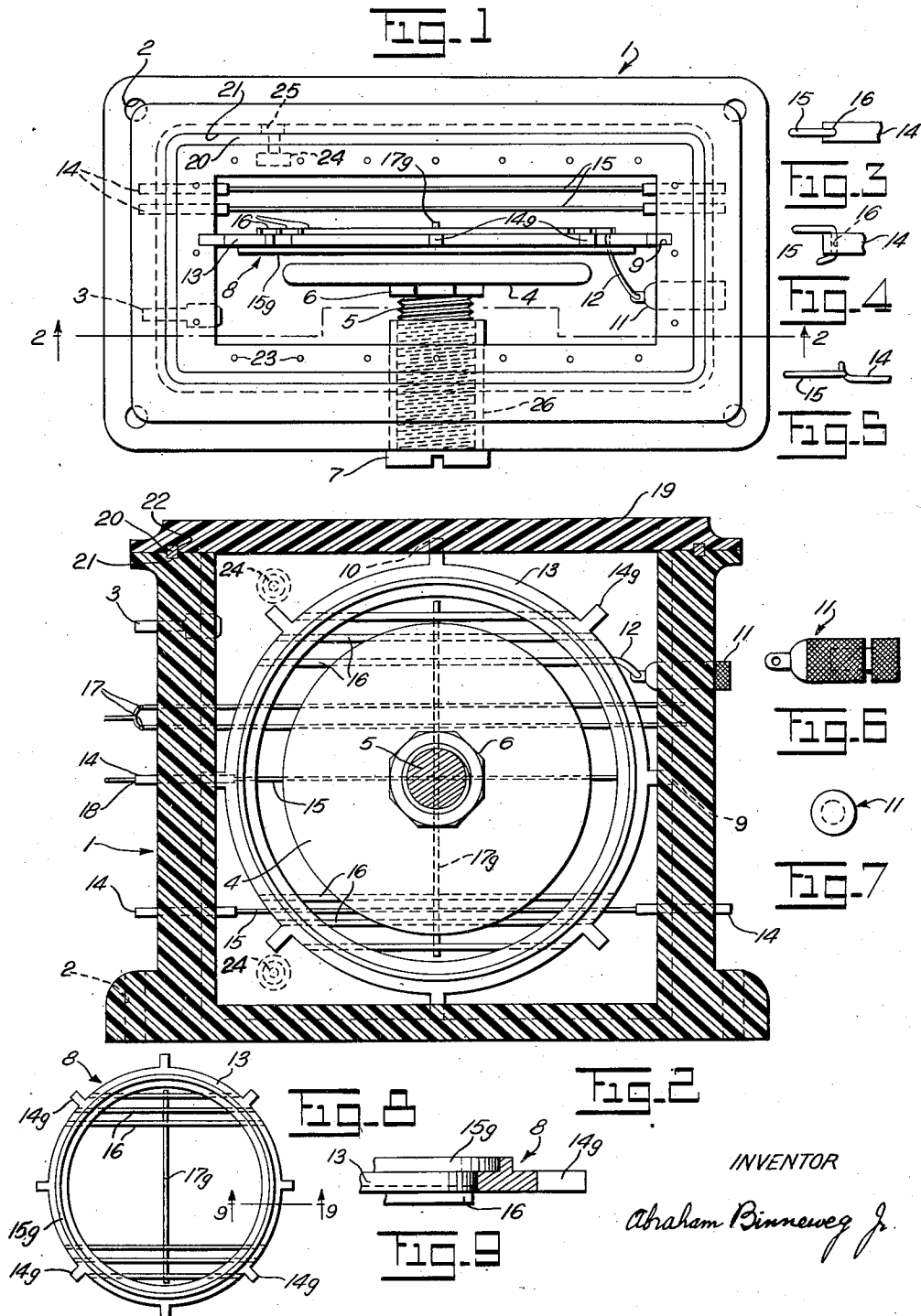
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2,467,420

SHORT-WAVE ADJUSTABLE RADIO TUBE

Filed Nov. 18, 1943

2 Sheets-Sheet 1



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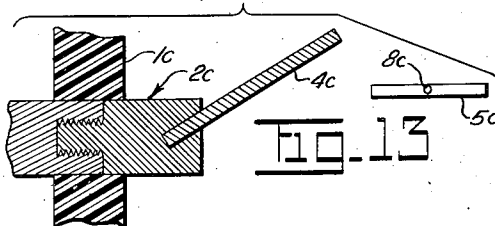
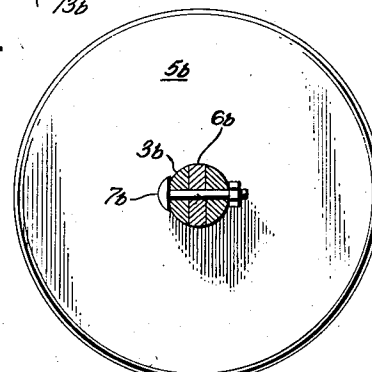
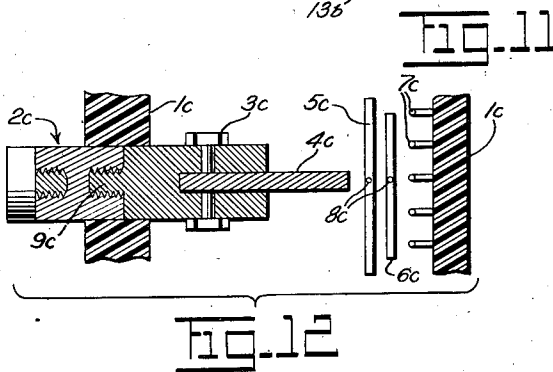
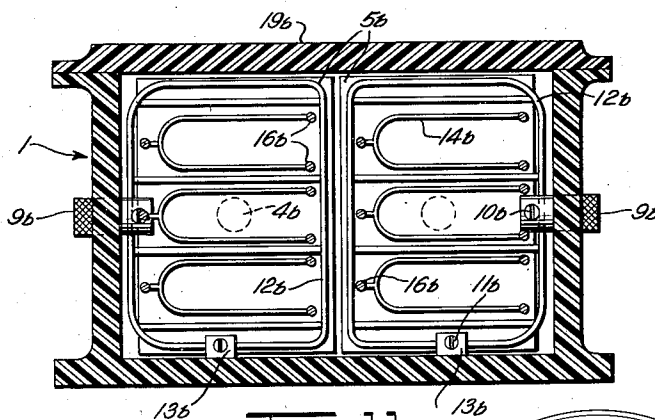
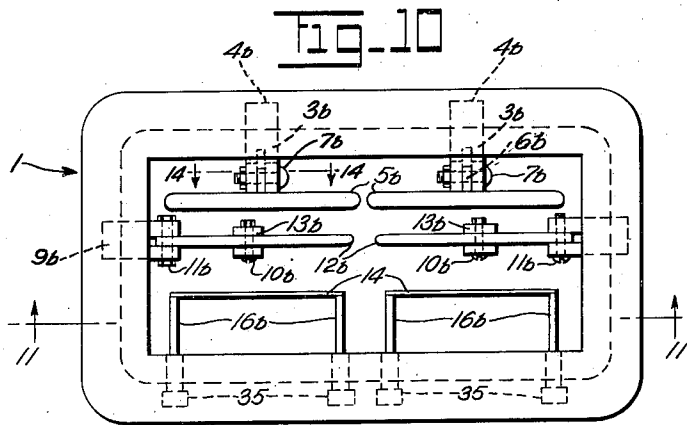


Fig. 14

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SHORT-WAVE ADJUSTABLE RADIO TUBE

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11 Claims. (Cl. 250—27.5)

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The present invention relates to an ultra-high frequency or short-wave radio tube having unusually low grid and plate lead inductance because of short leads, means for adjusting the distances between elements before the tube is sealed and exhausted, flat grids and flat anodes having rounded edges and parts, also duplicate filaments if desired.

This tube has the following objects and advantages. It has flat anodes and flat grids, both having edges which are rounded. This allows these elements to be placed close together so the tube requires lower anode voltage for a given power output. The anode is adjustable as to distance from the grid so the tube can be arranged to produce various power outputs, depending upon the anode's distance from the grid and filament elements, which distance is adjustable before the tube is closed and sealed. The anode is supported from one heavy lead, and is adjustable along this lead. The grid is supported from the side, or from the side and bottom, providing for rigid support as well as wide spacing between anode and grid leads in the dielectric of the envelope. Either single wire, or hairpin filament singly, or in multiple, provides for even electron currents over the surface of grids and anodes. The tube is versatile as to output, because its power output can be varied by adjusting element distances and because it uses one or more filaments or cathodes, or both filaments and cathodes. By arranging slots for the element adjustment screws, element position, as well as element distances, can be adjusted. In one form of the invention, two anodes, two grids and two separate sets of filaments are used providing for edge-to-edge low capacity between elements as well as widely-spaced leads in the dielectric of the envelope. This particular type of push-pull tube functions with high efficiency at ultra-high frequency. Obviously, any number of anodes, grids, and filaments can be similarly arranged in an envelope. A very good ultra-high-frequency rectifier tube is provided by omitting the grid in any of the tube forms illustrated.

The material of the radio tube envelope can be mica, wood, cardboard, plastic, transparent polystyrene plastic, glass, isolantite, steatite, or any similar material. The filaments are of thoriated tungsten wire, for example, or ordinary cathodes are used. The grid wires are of thoriated tungsten, tantalum, steel or round brass or graphite rods, or other metal material. The anode is of steel, copper, brass, tantalum, or any metal such as copper plate or coated with a desirable surface material. The anode might of graphite. Cavities are provided in the envelope material near the anode but insulated and separated from the anode lead, so that water could circulate in the material to keep the material, or the case cool, as

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shown by 24 in Fig. 1. There is an opening at 25, and a similar opening 25 at the top of the tube, so heated water or air, can rise and then pass out of the tube. This is clear if one uses an envelope which is quite thick and small pipes are used that thread into the case at top and bottom entrances. Similar case hollows may be used in other parts of any envelope herein illustrated, near heated internal parts, or at heated parts of the envelope.

Fig. 1 is the radio tube 1, in plan view with cover removed.

Fig. 2 is the radio tube of Fig. 1 in a vertical section.

Fig. 3 illustrates a method of joining a thoriated tungsten filament wire to an insert in the tube, also shown in the side view of Fig. 4.

Fig. 5 shows how a filament wire end is joined by welding it to its support wire.

Fig. 6 shows an insert binding post knurled for properly holding it in the case material; Fig. 7 is the end view.

Fig. 8 is the grid having a circular plastic frame and imbedded metal wires. Section 9—9 is shown in Fig. 9.

Fig. 10 shows plan view of a modification of the invention having anodes and grids mounted edge-to-edge and adjustable, and removable filament supports.

Fig. 11 is a vertical section of Fig. 10.

Fig. 12 shows a two-grid tube with its envelope cut away having a plate arranged edgewise to its grids. This form has greatly reduced capacity between anode and other elements.

Fig. 13 shows a single grid tube with the case cut away having an anode at a slight angle and a grid arranged edgewise to its filament.

Figures 12 and 13 are otherwise similar to the other drawings, except that the anodes are mounted on their edges, and the grids have small rods which allow them to rotate in sockets similar to the ones shown for the other tubes.

Figure 14 is a view taken on line 14—14 of Figure 10.

In Fig. 1 and Fig. 2, 1 is the radio tube, and 2 are its fastening holes. 3 is the knurled metal exhaust tube which is imbedded in the envelope material. 4 is the anode of the tube. The threaded rod 5 is screwed into the anode 4, the locknut 6 holding the plate securely to the end of the rod. This rod screws into the knurled post 26 which passes through the envelope wall. A groove headed set screw 7 screws into the outside end of the post and serves as a terminal for anode connection. 8 is the grid, although two or more grids might be used in spaced relation, or the grid 8 might, as a modification have two separate parts insulated from each other similarly arranged. The grid fits down into slots 9 in the envelope and slot 10 in the top. The

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binding post of Fig. 6 and shown at 11 in Fig. 2 connects to a grid wire by means of a lead 12 which may be soldered at the binding post and to one grid wire or across several grid wires so these will function together. Fig. 8 shows the grid itself having an insulating ring 13, having projections 14g, and reinforcing rib 15g, also shown in section in Fig. 9. The metal, or metal coated grid wires 16 are each insulated from the other, although they might as a modification be connected together by a cross wire like 17g in Fig. 8. If two binding posts like 11 are used, one on each side of the case, two grids could be used, each post connecting with that half of the total grid wires near that particular post. The upper half of the grid wires in Fig. 8 might as a modification go to one post and the lower half of the grid wires in Fig. 8 should then go to the other post. Evidently, if more posts are used, various grids can be arranged, and these may vary as to number of wires in them, and the spacing of the wires. If desired, one or more grid wires at the center are omitted as shown in Fig. 8 so there is a space between the two separate grid parts. The wires are preferably circular in section, and are preferably mounted in one plane. When circular in section, and mounted in a plane, the grid may be placed close to the anode without having an arc pass between grid and anode.

One complete grid as in Fig. 8 may be used, acting as a simple or a multiple grid since any number of entirely separate grids composed of separate insulated wires may be operated side by side. If these grids have different numbers of wires in them, different wire spacings or both, the type of tube as well as the highest frequency at which it will operate as an oscillator, can be changed.

In Fig. 1, the thoriated tungsten filament wires are each supported between two spaced rows of metal inserts 14 which have small holes in the end of them. The thoriated tungsten wires 15 are passed through the holes 16 (Fig. 3) after which the inserts 14 are pressed closed to securely hold the wires, any number of which can be arranged in one, two or more rows to secure the best spacing from the grid. The filament supports may be spaced and arranged as desired.

Inserted binding posts 35 in Fig. 10 are arranged and small pieces 16 screwed into them, to which the filaments are welded or passed through holes in them as in Fig. 3 and as described. Fig. 5 shows how a filament 15 can be welded to an insert 14 in the case, instead of being arranged as otherwise described. As shown at 17 and 18, in Fig. 2, the filament wires are connected in parallel, used separately, or connected in series.

Fig. 10 is another form of the invention where 1 is the case, shown with cover removed; and with cover 19b in place in Fig. 11. This tube differs in that metal rods 3b are used instead of ordinary binding posts. Screws 4b thread into the long narrow rods. The anodes 5b of the tube have extensions 6b at the rear which extensions fit into the slots in rods 3b. The bolts 7b, hold the extensions 6b on the plates to the rods 3b. The holes in 6 and 3b through which the screws pass, could be vertically slotted so the plates 5b could be moved up and down in the slots of the rods 3b. This provides for vertical adjustment. If the holes in 6b are larger than necessary, or there are horizontal slots in 6b, the plates could

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also be adjusted as to their distance from the grids.

Grids 12b fit into the slotted binding posts 9b. The grids may be also slotted so they can be moved both vertically and horizontally in the slots, for adjustment purposes. When properly lined up, screws 10b and 11b are tightened, and the grids are then securely held. Supports 13b extend from the walls of the envelope 1 to assist in holding the grids 12b.

The grid wires of the grid of Fig. 8 may all be arranged parallel, or some be arranged at an angle with the others, or all arranged radially, either contacting each other at the center, or each wire being insulated from all the others. The filaments may be simple straight wires, cathodes, or hairpin U-turns as shown by 14b in Fig. 11 and any number used, stretched across both anodes or only across part of the anode. 35 are binding posts which are imbedded in the case material and provided with screw tops.

The filament supplies may be arranged for minimum hum. The use of several separate filaments or cathodes together with the present rigid, unbreakable envelope and element structure, provides a tube having an unusually long life which is ideally suited for not only ordinary frequencies and circuits, but is very useful at the highest of radio frequencies now in use, and in circuits especially suitable for such frequencies. In some applications of these tubes, it may be desired to mount four anodes in a row like 5, 5 are mounted in Fig. 10.

It may be desired, for some applications, to bring out every grid wire of the grid of Fig. 8, for example, to a separate binding post. In this way, for certain applications, it is not necessary to provide a separate grid for coupling purposes, for example. Coupling is accomplished by connecting the external circuit to one grid wire at high frequencies.

The screw idea of Fig. 1, where the plates are held by a locknut or locknuts on a threaded terminal are applicable to the Fig. 10 tube.

Referring to Fig. 2, the cover 19 of the radio tube is cemented to the lower receptacle 1. If cover 19 and lower receptacle 1, are of suitable plastic material, heating around the edges will allow top and receptacle to be pressed together, so sealing them together. To prevent possible deformation of the envelope, the metal ring 20 in Fig. 1 and Fig. 2 is set down in a slot 21 in top of the receptacle 1, and also fits up into a slot 22 in the cover 19 of the receptacle, 1. Thus, the tube can be heated around the outer edges of cover and receptacle, and then be pressed together without bending the receptacle, or the cover, undesirably. Any similar stiffening means such as a row of metal inserts or wires could as modifications be used. Other parts of the case, if of plastic material, could as modifications be strengthened by using metal wires or metal pieces imbedded in the case material like wire, rod or tube 23 in Fig. 1.

Fig. 12 shows an elevation view of a two-grid tube having a cut-away tube 1c, having an imbedded binding post terminal 2c, with distance from grid or grids 5c and 6c, adjustment bolt, 3c, an edgewise mounted anode, 4c, and mounted filaments 7c, 7c, 7c, 7c. The tube is otherwise similar to the tube of Fig. 1. The ends 8c, of the grids 5c and 6c are like 14g in Fig. 8. Note that when only ends 8c in Fig. 12 are inserted in slots in the envelope, that the grids are rotatable on a line through the ends 8c as an axis. The ter-

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minals 9b, of Fig. 10, are arranged with round holes having threads so the grids 5c and 6c (Fig. 12), a similar terminal for each, may each be rotated to a proper position before the tubes are exhausted. The end of the terminal 9b (Fig. 12) fits snugly into terminal 2c, so anode 4c can be rotated around rod end 9b. Thus the anode 4c can be placed in any desired direction. Adjustments made before the tube is closed or by opening and reevacuation.

Figure 13 shows a cut-away envelope 1c, in sectional view having terminal 2c like the similar terminal in Fig. 12. Anode 4c is held at an angle by a groove cut obliquely in the post 2c, and there is only one rotatable grid, 5c. Both grid and anode are mounted edgewise, hence the capacity between them is greatly reduced.

The tubes of Fig. 12 and Fig. 13 are otherwise similar to the tubes of Fig. 1 and Fig. 10, the sectional views being taken from the right side of these tubes.

I claim:

1. A radio tube having an envelope, a cathode comprising a plurality of insulated, parallel filament wires within said envelope, a grid comprising a plurality of insulated wires near said cathode, a threaded rod projecting from a wall of the envelope and screwed into the wall, and an anode attached to the end of said rod at an adjustable distance from said grid.

2. An electron discharge tube having an envelope, a cathode comprising a plurality of parallel insulated filament wires within said envelope, a wire grid near said cathode, an internally threaded block inserted in the wall of said envelope, a threaded rod held by said block, an anode attached at right angles to the end of said rod at an adjustable distance from said grid.

3. A radio tube having within an envelope a cathode, a grid near said cathode comprising a dielectric ring with insulated wires stretched thereacross, grooves in the walls of said envelope, holding the edges of said grid, a flat circular anode parallel to said grid, and a threaded rod projecting from the wall of said envelope and supporting said anode at an adjustable distance from said grid.

4. A radio tube having an envelope, dielectric walls for said envelope, a water channel in one of said walls, vertical grooves on the inner surface of the other of said walls, a flattened grid held by said grooves, filament wires stretched from wall to wall athwart said envelope parallel to said grid, an internally threaded block inserted in still another wall of said envelope, a screw held by said block, and an anode attached at right angles to the end of said screw.

5. A radio tube having a receptacle, an airtight cover therefor, a groove in the under surface of said cover near the rim, a corresponding groove on the lip of said receptacle, a metal ring fitting half in one and half in the other of said grooves, vertical grooves in said receptacle, a flattened grid held by said vertical grooves, a cathode on one side of said grid, and an anode on the opposite side.

6. An electron discharge tube having an envelope, a cathode comprising a plurality of parallel insulated filament wires within said envelope, inserts passing through the walls of said envelope at opposite ends of said filament wires, serving as both supports and leads for said filament wires, a wire grid near said cathode, an internally threaded block inserted in the wall of

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said envelope, a threaded rod held by said block, and an anode attached at right angles to the end of said rod at an adjustable distance from said grid.

7. A radio tube having an envelope rectangular in plan view, dielectric walls for said envelope, a water channel in one of said walls, vertical grooves on the inner surface of the other of said walls, a flattened grid held by said grooves, filament wires stretched from wall to wall athwart said envelope parallel to said grid, an internally threaded block inserted in still another wall of said envelope, a screw held by said block, and an anode attached at right angles to the end of said screw.

8. A radio tube having within an envelope a cathode comprising a plurality of horizontal wires mounted in a vertical plane, a grid near said cathode also comprising a plurality of horizontal wires in a vertical plane parallel to the plane of said cathode wires, a flat circular anode parallel to said grid, and a threaded rod projecting from the wall of said envelope and supporting said anode at an adjustable distance from said grid.

9. A radio tube having a receptacle, an airtight cover therefor, a groove in the under surface of said cover near the rim, a corresponding groove on the lip of said receptacle, a metal ring fitting half in one and half in the other of said grooves, vertical grooves in said receptacle, a flattened grid held by said vertical grooves, a cathode on one side of said grid, and a flat, polished anode with rounded edges on the opposite side of said grid.

10. A radio tube having an envelope, dielectric walls for said envelope, a tube for exhausting said envelope of air threaded into the wall of said envelope, vertical grooves on the inner surface of opposite walls of said envelope, a flattened grid held by said grooves, filament wires stretched from wall to wall athwart said envelope parallel to said grid, a threaded block inserted in still another wall of said envelope, a screw held by said block, and an anode attached at right angles to the end of said screw.

11. A radio tube having an envelope, a cathode within said envelope, a grid near said cathode having various of its wires connected to binding posts on the walls of the envelope, and an anode near said grid.

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