

March 5, 1946.

M. BAREISS

2,395,835

THERMIONIC TUBE

Filed Feb. 2, 1942

3 Sheets-Sheet 1

Fig. 1.

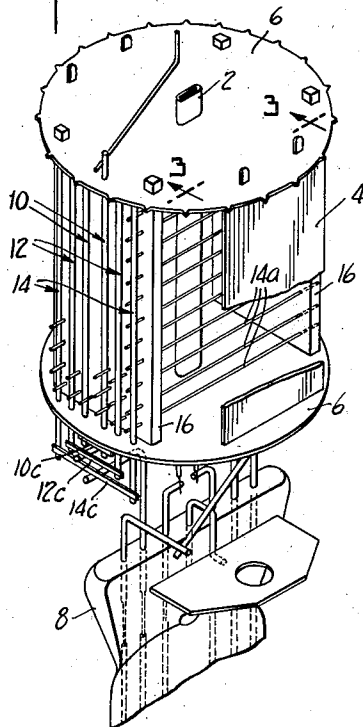
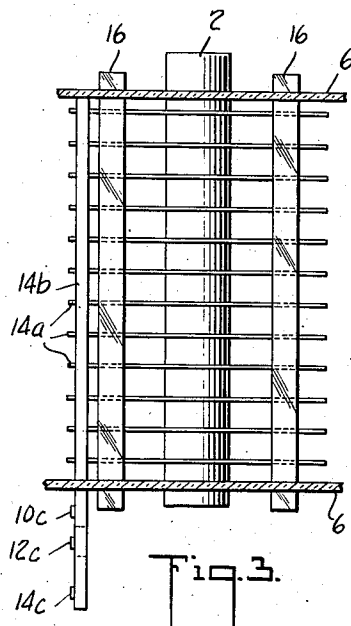


Fig. 2.

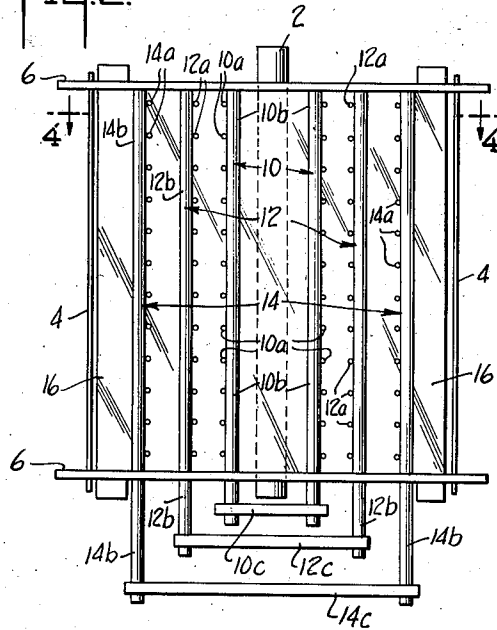


Fig. 4.

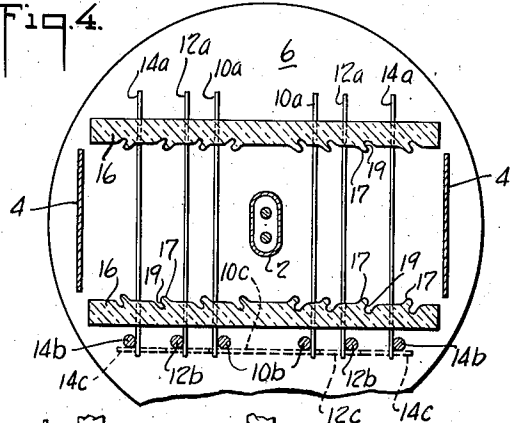
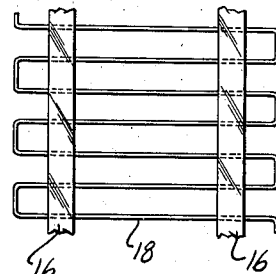


Fig. 5.

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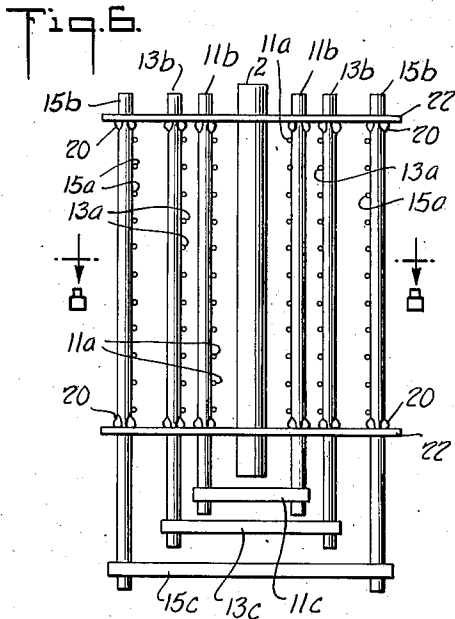
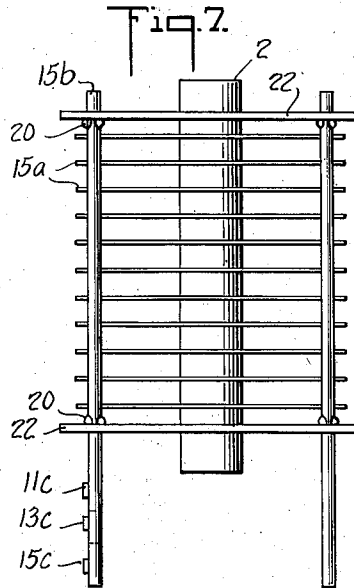
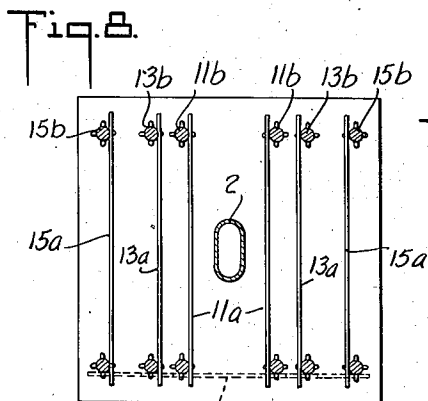
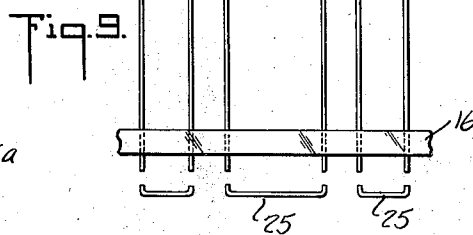
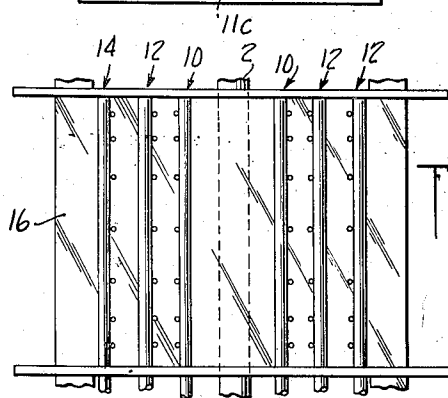
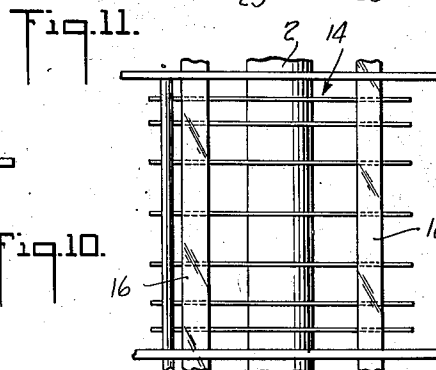
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THERMIONIC TUBE

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3 Sheets-Sheet 2



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THERMIONIC TUBE

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Fig. 12.

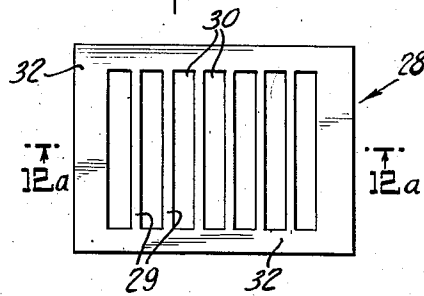


Fig. 12a.

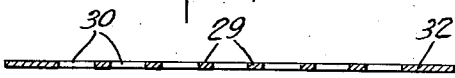


Fig. 12b.

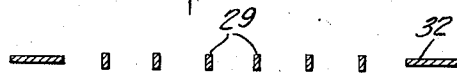


Fig. 13.

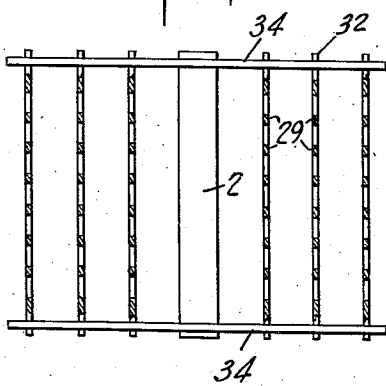


Fig. 14.

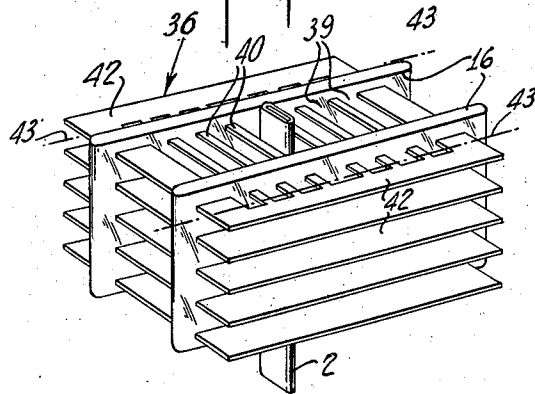
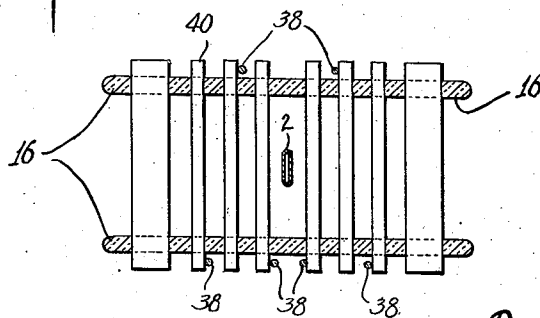


Fig. 15.



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## UNITED STATES PATENT OFFICE

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## THERMIONIC TUBE

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Application February 2, 1942, Serial No. 429,346

7 Claims. (Cl. 250—27.5)

The present invention relates to thermionic tubes and comprises an improved grid construction for radio or other thermionic tubes employing a plurality of grids.

This application is a continuation in part of application Ser. No. 319,998, filed February 21, 1940.

One object of the invention is a novel and improved grid structure for radio tubes whereby the lateral wires or elements may be accurately lined for efficient tube operation irrespective of the number of grids employed.

A further object of the invention is a novel and improved unitary multiple grid structure capable of being mounted as a unit with the grid elements thereof pre-formed and spaced with respect to each other.

A further object of the invention is a novel and improved multiple grid structure characterized by fusing of insulating spacers about the grid elements to form a rigid unitary structure.

A further object of the invention is the production of a multiple grid thermionic tube by pre-forming a multiple grid unit with the elements of the grid supported and spaced from each other by means of suitable insulating devices and then mounting the grid unit in a thermionic tube in operative relation with the other elements of the tube.

Other objects of the invention will hereinafter appear.

A further object is a grid structure which is characterized by its simplicity in construction and assembly.

The improved construction may be employed in tubes having uniform spacing between the various grids and between the lateral wires or elements of each grid or in tubes where the grids are non-uniformly spaced or the vertical distances between lateral wires or elements of each grid are varied.

For an understanding of the invention reference may be had to the accompanying drawings in which various embodiments of the invention are illustrated.

Fig. 1 is a perspective view, partly broken away of an electrode assembly of a three grid radio tube provided with an improved grid construction embodying the invention;

Fig. 2 is a side view of the assembly of Fig. 1;

Fig. 3 is a vertical sectional view taken along the line 3—3 of Fig. 1;

Fig. 4 is a horizontal sectional view taken along the line 4—4 of Fig. 2;

Fig. 5 is a fragmentary view illustrating a modified construction of grid;

Fig. 6 is a side view of an assembly embodying another modification of the invention;

Fig. 7 is a view of the assembly of Fig. 6 taken at right angles thereto;

Fig. 8 is a horizontal sectional view taken along the line 8—8 of Fig. 6;

Fig. 9 is a fragmentary plan view illustrating a novel method of constructing a plurality of grids;

Fig. 10 is a side view of a grid assembly incorporating the construction of Fig. 9;

Fig. 11 is a side view of the assembly of Fig. 10 taken at right angles thereto;

Fig. 12 is a view of a grid illustrating another embodiment of the invention;

Fig. 12a is a diagrammatic sectional view along the line 12a—12a of Fig. 12;

Fig. 12b is a view similar to Fig. 12a but showing the individual elements of the grid of Fig. 12 turned through ninety degrees;

Fig. 13 is a side view of a grid assembly incorporating the construction of Fig. 12;

Fig. 14 is a perspective view illustrating the method of mounting grids of the type of that of Fig. 12 to form an assembly differing from that of Fig. 13; and

Fig. 15 is a horizontal sectional view of a grid assembly constructed by the method illustrated in Fig. 14.

The radio tube electrode assembly of Figs. 1 to 4 inclusive is shown as including a conventional cathode 2, and anodes 4 carried between the usual spacing discs 6 of mica or other insulating material and mounted on a press 8. In accordance with the invention, the three grids 10, 12 and 14 are each composed of two sets of lateral wires 10a, 12a and 14a and the wires of each set are electrically connected by vertical rods or posts 10b, 12b and 14b. The sets of grid 10 are electrically connected beneath the lower disc 6 by a cross wire 10c connecting the posts 10b. Similarly, posts 12b are connected by cross wires 12c and posts 14b are connected by cross wire 14c; the cross wires 10c, 12c and 14c forming convenient points of connection for the lead-in wires of the tube. The wires 10a, 12a and 14a are connected to the rods 10b, 12b and 14b respectively in any suitable manner, as by welding or swaging into cuts on the rods. Mounted between the discs 6 are two vertical insulating sheets 16 of glass or other ceramic material through which pass the ends of all the lateral grid wires and to which these wires are fused. As shown best in Fig. 2 each lateral wire

10a is aligned with one of the wires 12a of each set of grid 12, with one of the wires 14a of each set of grid 14 and with one of the wires 10a of the other set of grid 10. The fusing of the ends of the lateral wires in the sheets 16 insures this parallel alignment of the various lateral wires and gives a sturdy and compact construction of the grid assembly.

As shown in Fig. 4, the sheets or plates 16 are provided with rough surfaces to decrease electrical leakage currents due to material deposited from hot parts such as the cathode coating. As shown upstanding ribs 17 are upset along the inner surfaces to shield the grooves 19 against deposit, and roughened surfaces may also be provided on the other side.

In the embodiment of the invention illustrated in Figs. 1 to 4 inclusive each grid is constructed of a plurality of separate lateral wires. In Fig. 5 is illustrated a grid 18 in which the lateral wires are made from a single wire which is threaded back and forth through the sheet 16 with the horizontal reaches parallel and equidistant. One or more of the grids 10, 12 or 14 could be constructed like grid 18 of Fig. 5 in which case the vertical rods 10b, 12b and 14b could be omitted except for suitable provision for electrically connecting the sets of each grid together and to the lead-in wires.

The elements of the multiple grid unit thus formed are firmly and rigidly supported and spaced from each other in a permanent manner and the same may be readily mounted in the tube without dislocation or shifting of the elements with respect to each other. Moreover, the relation of the elements of the grid with respect to each other are retained permanently in the position to give the accuracy in function and results desired. The insulating sheets 16, for example, being fused about the wires of the grids, retains them during the life of the tube in the exact pre-determined relationship. After the preforming of the multiple grid unit comprising the insulating sheets 16, which are fused to the elements of the grids, the next step is the assembling of this unit into the thermionic device and this may be effected with great facility because it is only necessary to adjust the multiple grid unit and anode with respect to each other, the multiple grid having previously been formed into a rigid precision structure.

In Figs. 6, 7 and 8 an alternative construction embodying the invention is illustrated. In this arrangement, the spacing and supporting sheets 16 for the lateral grid wires are omitted and conducting posts 11b, 13b and 15b are provided for supporting the lateral wires 11a, 13a and 15a respectively of the grids. Each post 11b, 13b and 15b is provided at each end with pinched out portions 20 which provide stops for engagement with upper and lower insulating spacers 22 of mica or the like to insure a line-up of all the lateral grid wires. The lateral wires 11a, 13a and 15a are welded to the rods 11b, 13b and 15b respectively or swaged into cuts therein as in the embodiment of the invention illustrated in Figs. 1 to 4. For simplicity the lead-in wire connections and other elements of the tube, except the cathode 2, have been omitted from these as well as from other figures of the drawings as forming no part of the present invention.

If remote cut-off characteristics are desired, the vertical spacing between the lateral wires may be varied as indicated in the modification of Figs. 10 and 11. In this arrangement the lateral wires

of the various grids 10, 12 and 14 are all aligned in horizontal planes as in the other modifications of the invention, but the vertical spacing between the horizontal planes varies, adjacent wires being closer together at the top and bottom than in the middle. This type of construction will also result in lower random tube noise. The lateral wires of the grids are shown mounted in the insulating sheets 16 as with the embodiment of Figs. 1 to 4, but the alternative construction of Figs. 6 and 7 could as well be employed with the spacing arrangement of Figs. 10 and 11.

In the embodiments of the invention above set forth the lateral wires are shown as not only aligned with each other on either side of the cathode, but the wires on one side are aligned with the wires on the other side of the cathode, as well. This is desirable from the standpoint of manufacture, but from that of operation it is not essential that the lateral wires on one side of the grid be aligned with those on the other, though it is important that the lateral wires on one side of the cathode be aligned with each other.

In Fig. 9 is illustrated a convenient method of constructing the grids 10, 12 and 14 which insures the proper lateral alignment of the wires. A single wire 24 is passed back and forth through the sheets 16 with the lengths between the sheets kept parallel and spaced corresponding to the desired distance between the grids. The connecting portions 25 are then cut off so that the resulting individual lengths become the aligned lateral wires of the various grids. It will be understood, of course, that additional layers of the grids are then built up to provide the complete grid assembly and that connecting pieces have to be provided as described above.

In addition to the other advantages the improved grid has the advantage that it is possible to devise equipment to assemble the whole grid structure without the use of skilled labor.

In Figs. 12 and 12a is illustrated a grid 28 formed by stamping thin sheet metal so as to leave the thin parallel strips 29 separated by openings 30 and held together by the uncut sides and ends 32 of the plate. A plurality of these grids 28 may be conveniently mounted in vertical spaced relation between mica or other insulating plates 34 as shown in Fig. 13 to form a grid assembly in which the individual elements 29 of the various grids lie in parallel planes as do the horizontal grid wires of the embodiments of the invention illustrated in Figs. 1 to 11. If desired in order to decrease the grid area interposed to the electron stream from the cathode, the strips or elements 29, prior to mounting of the grids 28 may be twisted through ninety degrees as indicated in Fig. 12b.

In Figs. 14 and 15 is illustrated an alternative method of constructing a grid assembly from stamped metal sheets. In this method the stamped sheets 36 are first positioned in horizontal planes and held in spaced relation by any suitable jig. Supporting sheets 16 of insulating material, such as described in connection with Figs. 1 to 5 and 9 to 11 are then fused about the ends of the strips 40 of the sheets 36. The material of which the sheets 16 are made may be glass, ceramic material, or other fusible insulating material capable of being fused about the grid elements. The sides 42 of the plates 36 are then sheared off to separate the strips or elements 40, as indicated by the dotted lines 43 in Fig. 14. Metal wires or rods 38 are then welded

or otherwise secured to the ends of strips 40 protruding through the sheets 16. The resulting structure, mounted between insulating plates 34, such as shown in Fig. 13, is a grid assembly in which each grid is formed of one element 40 from each sheet 36 connected electrically by the rods 38 and supported by the insulating sheets 16. Each element of each grid is thus necessarily parallel with and in the same plane with an element of another grid, because having been formed from the same horizontal sheet.

The invention has now been described in connection with various embodiments thereof, obviously various changes might be made in the particular constructions illustrated without departing from the spirit of the invention as defined in the accompanying claims.

I claim:

1. A grid assembly for vacuum tubes comprising in combination a grid formed of a plurality of parallel lateral wires and a vertical conducting rod to which each of said wires is secured, a pair of spaced insulating sheets fused to said wires adjacent opposite ends thereof to support the same, and a second grid formed of a plurality of parallel lateral wires and a second conducting rod to which said last mentioned wires are secured, said last mentioned wires being likewise fused to and supported by said insulating sheets, each lateral wire of said first mentioned grid being disposed parallel to and in the same horizontal plane with a lateral wire of said second mentioned grid.

2. A grid assembly for vacuum tubes comprising in combination a grid formed of a plurality of parallel lateral wires and a vertical conducting rod to which each of said wires is secured, a pair of spaced insulating sheets fused to said wires adjacent opposite ends thereof to support the same, a second grid formed of a plurality of parallel lateral wires and a second conducting rod to which said last mentioned wires are secured, said last mentioned wires being likewise fused to and supported by said insulating sheets, each lateral wire of said first mentioned grid being disposed parallel to and in the same horizontal plane with a lateral wire of said second mentioned grid, and a third grid likewise composed of a plurality of parallel lateral wires and a vertical conducting rod secured thereto, said wires of said

third grid being likewise fused within and supported by said insulating sheets with each wire disposed parallel to and in the same plane with a wire of each of said first mentioned grids.

3. A grid assembly for vacuum tubes comprising in combination a plurality of grids each comprising a plurality of parallel lateral wires electrically connected together and insulating sheets of ceramic material fused about the ends of all of said lateral wires of all of said grids for supporting and spacing the same, the ends of said wires being electrically connected beyond one of said sheets.

4. A step in the method of forming a plurality of grids with aligned lateral wires which comprises weaving a wire back and forth in a horizontal plane through spaced vertical sheets of ceramic material while keeping parallel the lengths of the wire between the sheets, fusing the ceramic material to the wire and then cutting off the connecting portions of wire beyond the sheets.

5. In a thermionic tube, an improved multiple grid construction comprising in combination a plurality of lateral wires aligned in different vertical planes, means electrically connecting the wires of each plane to form a grid, and combined supporting and aligning means for the multiple grid construction serving to maintain each lateral wire of one grid in the same plane with a lateral wire of another grid, said supporting and aligning means comprising sheets of insulating material fused about said lateral wires to support and hold the same in alignment.

6. A unitary grid structure for thermionic tubes comprising a plurality of parallel lateral wires arranged in horizontal and vertical planes, vertically disposed sheets of ceramic material fused about the ends of said wires to support and align the same, means electrically connecting the wires of each vertical plane together to form a grid, and horizontal insulating spacing members engaging said ceramic sheets at opposite ends thereof.

7. A unitary multiple grid structure for use in thermionic tubes comprising a plurality of grids each composed of a plurality of electrically connected grid elements and insulators fused to said elements for supporting and spacing the same.

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