May 22, 1928. 1,670,503

J. W. GREENBOWE

MULTIPLE GRID ELECTRODE

Filed Oct. 17, 1924

FIG. 1.

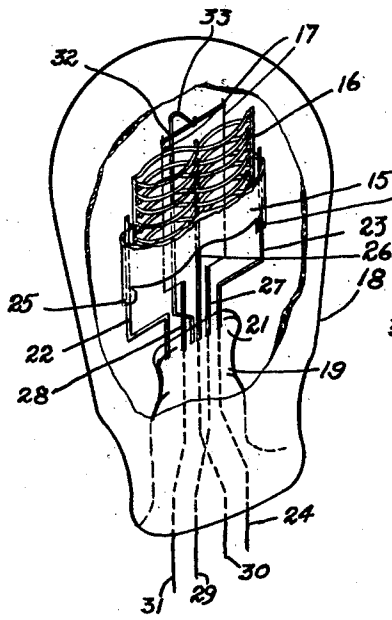


FIG. 2.

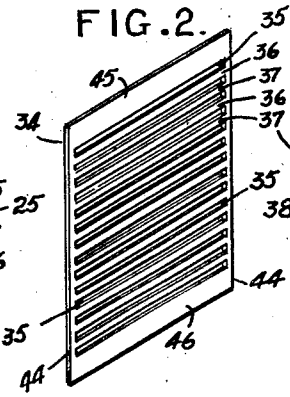


FIG. 3.

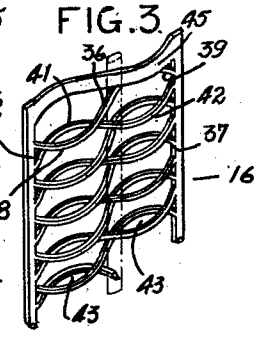
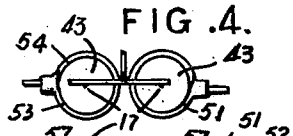


FIG. 4.



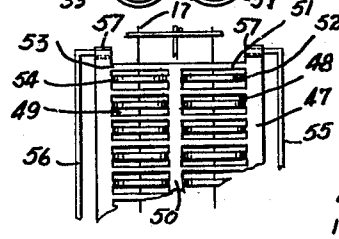
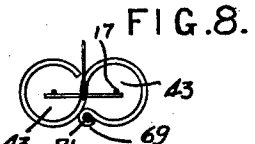


FIG. 5

FIG. 8.



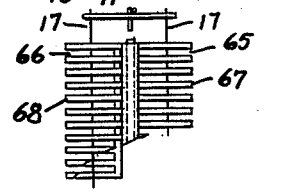
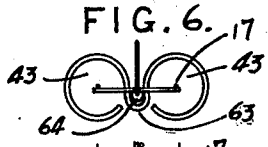


FIG. 9

FIG. 6.



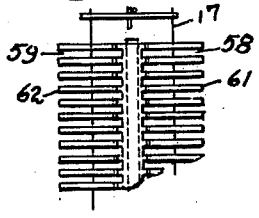


FIG. 7

INVENTOR
J. WALTER GREENBOWE
BY
ATTORNEY

Patented May 22, 1928. 1,670,503

UNITED STATES PATENT OFFICE.

JAMES WALTER GREENBOWE, OF BAYONNE, NEW JERSEY, ASSIGNOR TO WESTINGHOUSE LAMP COMPANY, A CORPORATION OF PENNSYLVANIA.

MULTIPLE GRID ELECTRODE.

Application filed October 17, 1924. Serial No. 744,155.

This invention relates to electron discharge devices such as radio tubes used as detectors or as audio or radio frequency amplifiers and more particularly to radio tubes employing more than one grid electrode.

An object of the invention is to simplify the construction of a double or multiple electrode.

Another object of the invention is to provide an electrode having a plurality of integral tubular cathode receiving portions.

A further object of the invention is to provide a grid element which may be accurately and quickly produced.

Other objects and advantages of the invention will be apparent as the description proceeds.

When producing a radio tube, it is desirable to obtain a maximum mutual conductance, with a given amplification constant as well as to reduce the plate resistance and to provide as large an electron emitting surface as is possible.

It has been found that by multiplying certain of the elements within a tube, conditions may be provided to give the results desired.

In tubes in which a relatively long cathode is required, it is obviously necessary to make the plate electrode and consequently the grid of such proper shape as to be in close proximity to the entire length of the filament.

Owing to the necessity of employing relatively fine wire as the cathode, it has been found impractical to make the cathode of comparatively great length since the cathode has a tendency to sag by reason of the weight of the wire. This disadvantage is, however, greatly reduced when several relatively short cathodes or filaments are used. It therefore becomes necessary to provide other elements such as the plate and grid of such construction as to be quickly and accurately made for use with the short filaments.

The present invention aims to provide a simplified form of grid which may be quickly made at low cost and which will answer the requirements of grids as heretofore produced for radio tubes employing a single filament.

The present invention contemplates the formation of a multiple grid from a single sheet of stamped metal and is an application, generally, of the idea embodied in my copending application Serial No. 694,552, filed February 23, 1924 and assigned to the same assignee as is the present application.

The present embodiment of the invention includes the formation from a single sheet of metal, a plurality of tubular shaped grids for surrounding electrodes.

The invention will be more fully understood by reference to the accompanying drawing, in which

Fig. 1 is a perspective view of thermonic tube partly broken away and showing the elements therein, some of which are also shown broken away;

Fig. 2 shows a plate punched and ready to have cross bars bent to grid shape;

Fig. 3 is a perspective of a portion of a double grid;

Fig. 4 is a plan view of a double grid having tubular portions formed from a single plate;

Fig. 5 is an elevational view of the grid shown in Fig. 4;

Fig. 6 is a plan view of a double grid having tubular portions formed from a single piece of perforated metal;

Fig. 7 is an elevational view of Fig. 6;

Fig. 8 is a plan view of a double grid formed from oppositely bent portions of a sheet of perforated metal, and

Fig. 9 is an elevational view of the grid shown in Fig. 8.

As shown, the various elements of a discharge tube may include an anode or plate 15, a grid 16 and one or more cathodes or filaments 17. These elements are suitably mounted within an evacuated envelope 18 including a pedestal 19 terminating in a press 21 having embedded therein, the several various support members upon which the electrodes are mounted, the plate being carried on supports 22 and 23, the latter having a conductor 24 connected thereto. The plate may be provided with lips 25 at its upper and lower edges which may be bent to grip the supports 22 and 23 and a welding operation may be performed for more securely joining the supports to the lips.

The grid 16 may be mounted on a rigid support member 26 and secured thereto in

a manner hereinafter more fully described. A conductor 30 may be provided and connected to the support 26.

Filaments 17 may have their lower ends fastened to supports 27 and 28 to which conductors 29 and 31, respectively, are attached and the upper ends of the filaments may be secured to a cross bar 32 which in turn is supported by a comparatively rigid member 33 having its lower end secured in the press.

A grid for enclosing a plurality of filaments is, according to the present invention, produced by piercing a plate 34 (see Fig. 2) of suitable material with a plurality of apertures 35 to provide cross bars 36 and 37. The cross bars will initially be positioned in a common plane before the plate 34 is formed to provide a grid.

When the forming operation has been accomplished, each cross bar will be bent into an opposite sinuous form. For example, as shown more clearly in Fig. 3, the cross bar 36 will be formed with a bend 38 at one side of a common plane and a bend 39 at the opposite side of the plane. The cross bar 37 will have a bend 41 upon one side of the plane opposite to the bend 38 and a bend 42 on one side of the plane opposite to that to which the bend 39 is disposed. Each alternate bar having an opposite sinuous shape provides tubular grid passages 43 in which the filaments 17 may be positioned. It will, of course, be understood that when desirable, a grid may, in the above manner, be formed with more than two grid passages by providing cross bars 36 and 37 of suitable length to allow for a plurality of bends in alternate bars and thus a series of grid passages may be formed.

Furthermore, in order to expedite manufacture, it may be desirable to provide grids by having a plurality of sets of slots 35 separated by connector strips 44. A continuous strip 34 may, therefore, be punched from a sheet and as each set of cross bars is formed, the same may be severed from the strip and bent into grids.

Although a grid made in accordance with the present invention may be supported in various ways, one mode of attachment to a support consists in providing relatively broad upper and lower cross pieces 45 and 46 to which the support member 26 may be welded or otherwise secured.

As shown in Figs. 4 and 5, a modified form of the grid is shown having a plurality of grid passages 43. This is accomplished by punching a plate 47 with two sets of elongated apertures 48 and 49 in spaced relation to provide cross bars 51 and 52, apertures 48 resulting in cross bars 51 and 52 therebetween, and apertures 49 providing cross bars 53 and 54 therebetween. Grid passages 43 are provided by bending the cross bars 51 and 53 into loops at the opposite side of the plane, a central separator strip 50 being provided. When desirable, the grid may be supported by securing a support wire to the said separator strip. Any other form of support may be provided, however, as, for example, one comprised of support-members 55 and 56 secured at one end in a press and having their other ends inserted in tubular pockets 57 integral with the grid.

As shown in Figs. 6 and 7, double grid passages 43 may be provided by piercing a plate to provide two sets of apertures 58 and 59 to give cross bars 61 and 62. Each series of cross bars may be bent to substantially circular form and the plate may be bent to provide a loop 63 in which a support member 64 may be welded or otherwise secured.

Figs. 8 and 9 show a grid having double grid passages 43, the grid also being formed from a plate having two sets of slots or apertures 65 and 66 and cross bars 67 and 68. The cross bars may be bent to provide an S-shaped grid in transverse cross section and one edge of the plate from which the grid is formed may be bent to provide a tubular aperture 69 to receive a support 71.

The present invention makes it possible to provide a double or multiple grid or plate having all of its members integral and at the same time providing enclosures for the filament.

Inasmuch as it has been found advantageous to bring a plate and grid into close relation, the advantage of the present form of grid will be evident. Plates having contours to correspond to the present forms of grid may be quickly and conveniently produced.

It will further be appreciated that a relatively few operations are necessary to manufacture the present form of grid and that all operations may be quickly and automatically performed. The desirability of accurately positioning the cross-bars of a grid is well recognized, particularly is it desirable in the manufacture of a double grid to be able to positively and precisely position the many cross pieces which constitute the grid.

When manufacturing a grid adapted to surround a filament, it is no simple matter to properly and dependably construct a grid. The operation of winding a wire about support members to form a grid is not only more costly inasmuch as the wire must be automatically secured to the supports, but it is not always possible to depend upon the accurate position of one turn of wire with relation to another and the spacing between the wires is frequently not uniform.

With the present grid, however, it is obvious that by bending the cross pieces to

their proper position, an accuracy and precision in the disposition of the members is possible due to the mechanical elements such as the dies which perform the bending operation. By reason of this construction, a grid is produced which when used in a tube, will give uniform characteristics answering the requirements of standard practice. A grid or plate produced in accordance with the present invention is of a seamless character and provides a plurality of endless encircling members.

The present construction of grid makes it possible to produce the same at a relatively high rate of speed and with a single operation of a punch press.

Furthermore, the rigid cross bars will be accurately positioned with respect to each other and will resist displacement during the essential handling during assembly, to a greater extent than will grids as heretofore constructed of wire wound on and secured to supports.

The accurate disposition of the cross bars combined wtih the rapidity with which the grid can be produced makes the present invention an important advance step in radio tube manufacture.

It will be understood that plates as well as grids may be made in accordance with the present invention and that the relative positions of the cross bars on the grid and plate when mounted in a thermionic tube may be easily positioned in the most effective manner.

It is to be understood that although a preferred embodiment of the invention is shown, such modifications as above set forth or others may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. An electrode for an electron discharge device formed from a sheet of material and comprising support members disposed in a common plane and connected by a plurality of cross-members punched from said sheet, said cross-members being bent to dispose portions thereof at opposite sides of said plane to constitute a plurality of enclosures.

2. An electrode comprising a sheet of metal and comprising support members connected by a plurality of cross-members punched from said sheet, said cross-members being reversely bent to extend from opposite sides of said sheet to provide a plurality of enclosures.

3. An electron discharge device comprising an anode, a plurality of cathodes and a control electrode formed from a sheet of metal, said control electrode having a pair of support-members connected by cross-bars punched from said sheet disposed in spaced relation and bent to extend from opposite sides of said sheet to provide a plurality of enclosures for said cathodes and an anode having the wall thereof shaped for disposition in symmetric spaced relation about said grid.

4. An electron discharge device comprising an anode, a plurality of cathodes, and a control electrode formed from a sheet of metal, said control electrode having a pair of support members disposed in a common plane and connected by a plurality of cross-bars punched from said sheet and disposed in spaced relation, said cross-bars being of reverse curvature form, the curvature of each alternate cross-bar being in an opposite direction to provide a plurality of enclosures and an anode having the wall thereof formed for disposition in symmetric spaced relation to said grid.

5. The method of forming a control element for an electron discharge device which comprises punching a plurality of apertures in a sheet of material to provide spaced connector members and bending said members to bring a portion of each member on an opposite side of the normal plane of the members to provide a plurality of enclosures.

In testimony whereof, I have hereunto subscribed my name this 15th day of October 1924.

JAMES WALTER GREENBOWE.