March 21, 1961 M. E. WEISS ET AL 2,976,452

CERAMIC ROD SPACERS FOR USE IN MASS PRODUCIBLE ELECTRON TUBES

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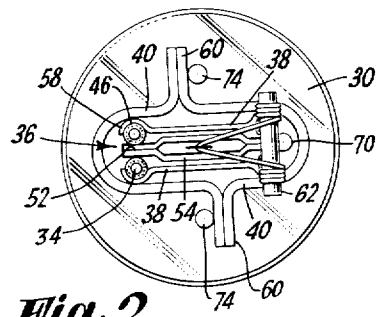


Fig. 2

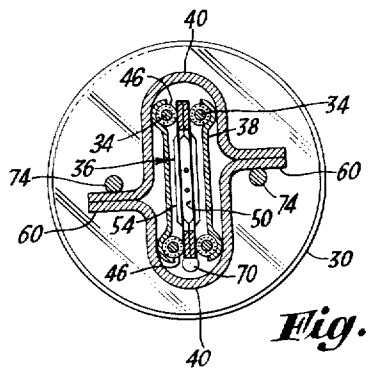


Fig. 4

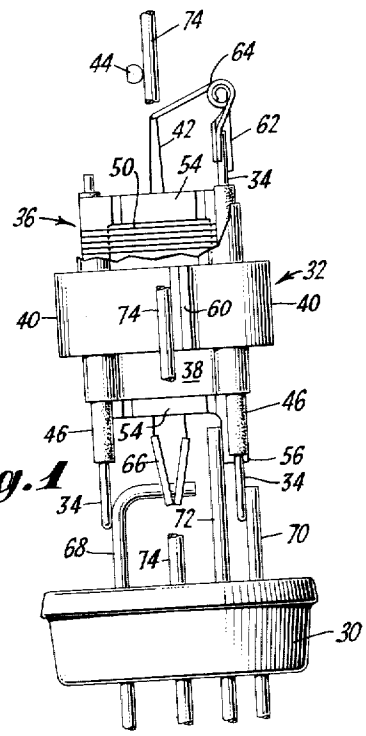


Fig. 1

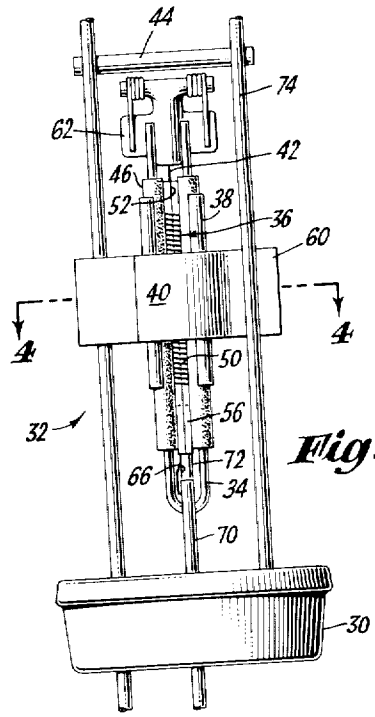


Fig. 3

INVENTORS
CRAIG M. GARRETSON
MORTIMER E. WEISS
BY
Michael Hertz
ATTORNEY

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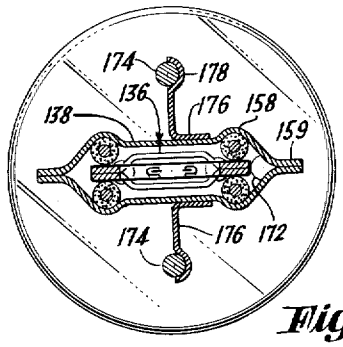


Fig. 6

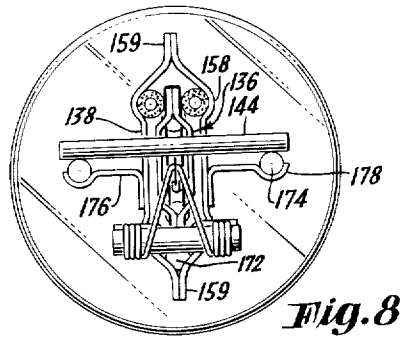


Fig. 8

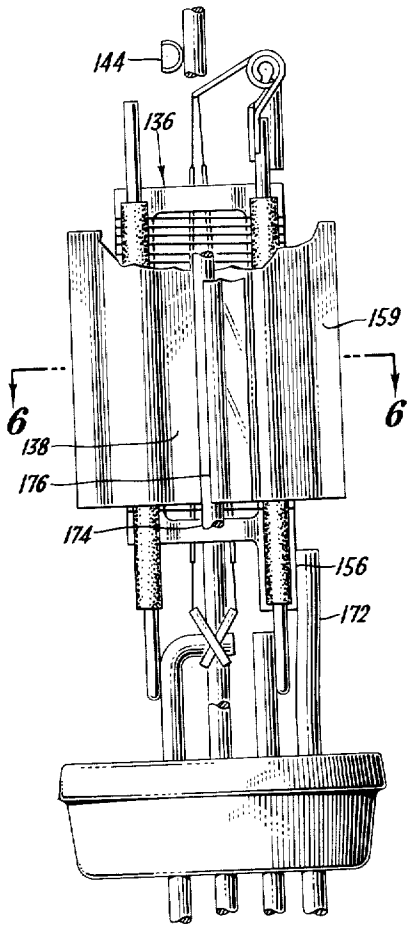


Fig. 5

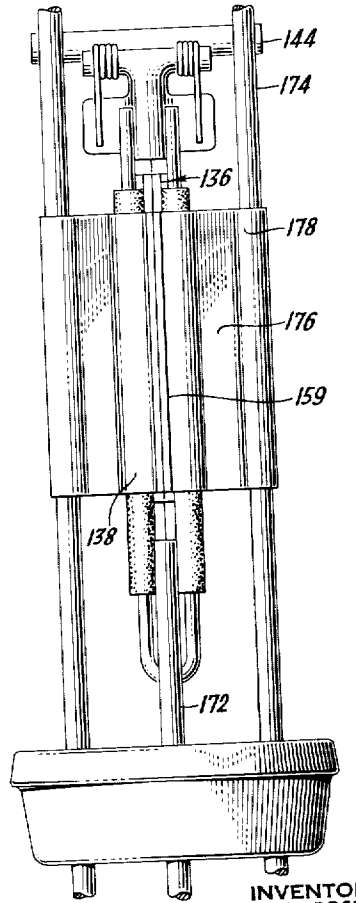


Fig. 7

INVENTORS
CRAIG M. GARRETSON
MORTIMER E. WEISS
BY
Michael Hertz,
ATTORNEY

March 21, 1961 M. E. WEISS ET AL 2,976,452

CERAMIC ROD SPACERS FOR USE IN MASS PRODUCIBLE ELECTRON TUBES

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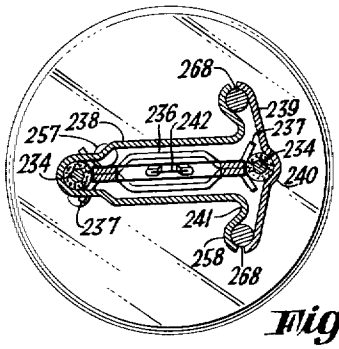


Fig. 10

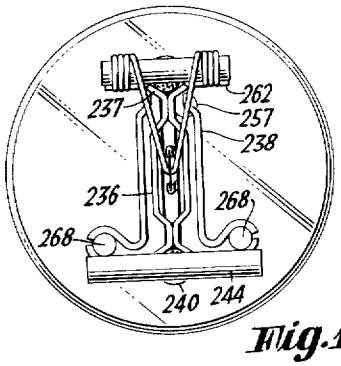


Fig. 12

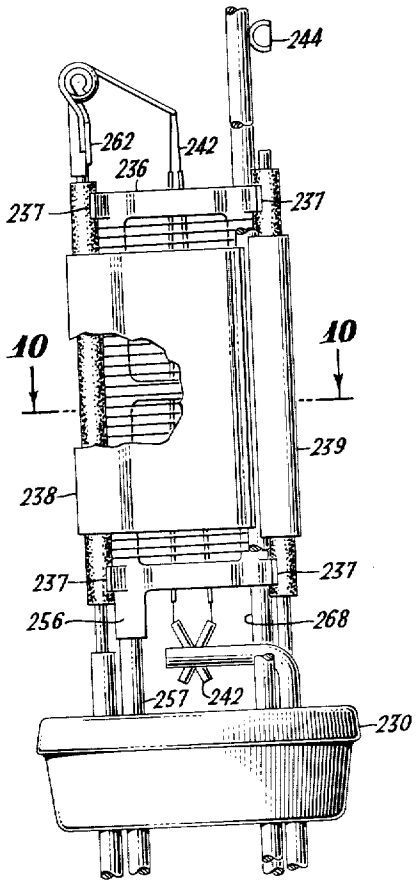


Fig. 9

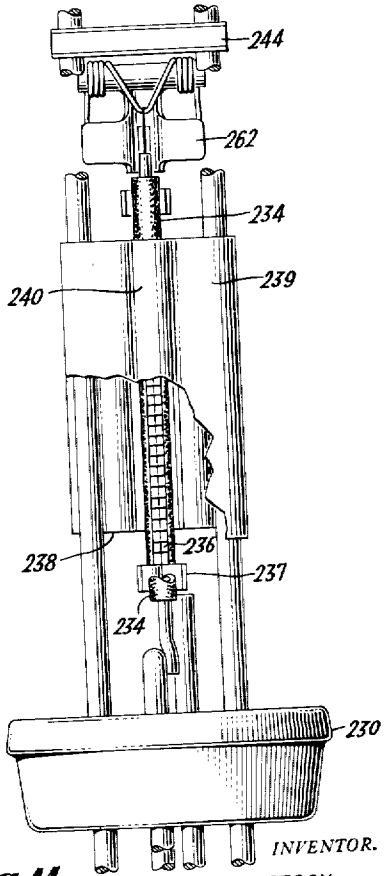


Fig. 11

INVENTOR.
CRAIG M. GARRETSON
MORTIMER E. WEISS

BY Michael Hartz
ATTORNEY

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CERAMIC ROD SPACERS FOR USE IN MASS PRODUCIBLE ELECTRON TUBES

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Fig. 14

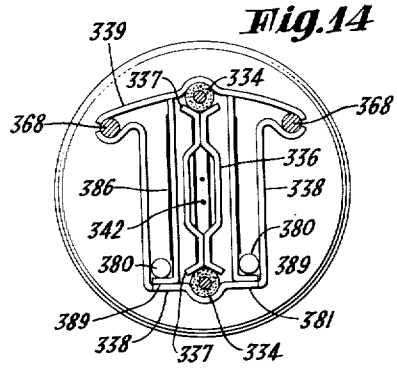
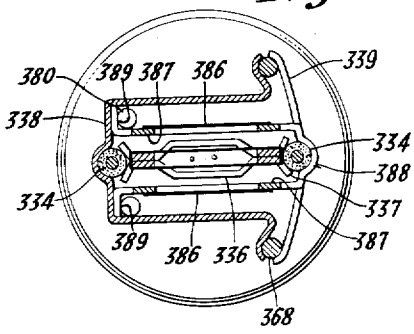


Fig. 16



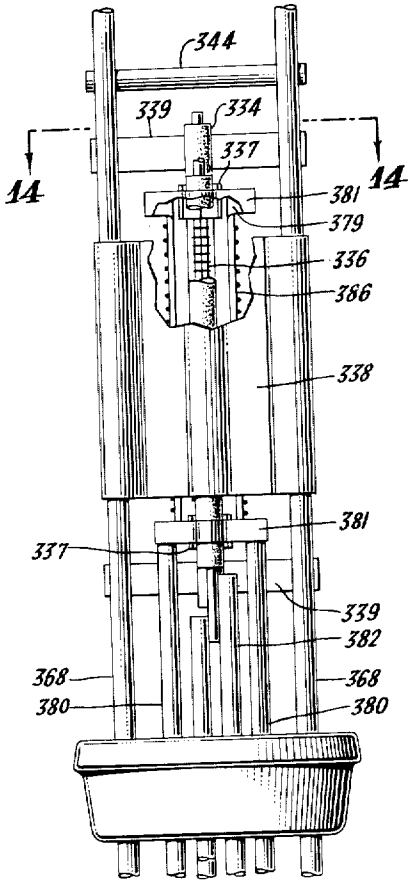


Fig. 13

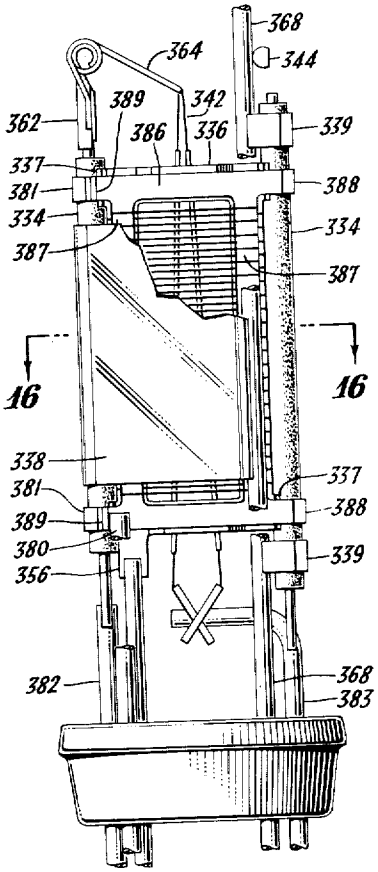


Fig. 15

INVENTORS
CRAIG M. GARRETSON
MORTIMER E. WEISS
BY
Michael Hertz
ATTORNEY

March 21, 1961 M. E. WEISS ET AL 2,976,452

CERAMIC ROD SPACERS FOR USE IN MASS PRODUCIBLE ELECTRON TUBES

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Fig. 19

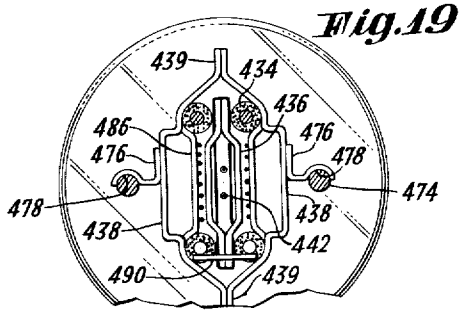
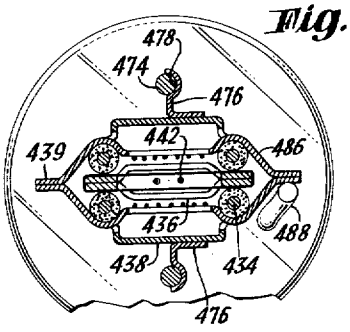


Fig. 20



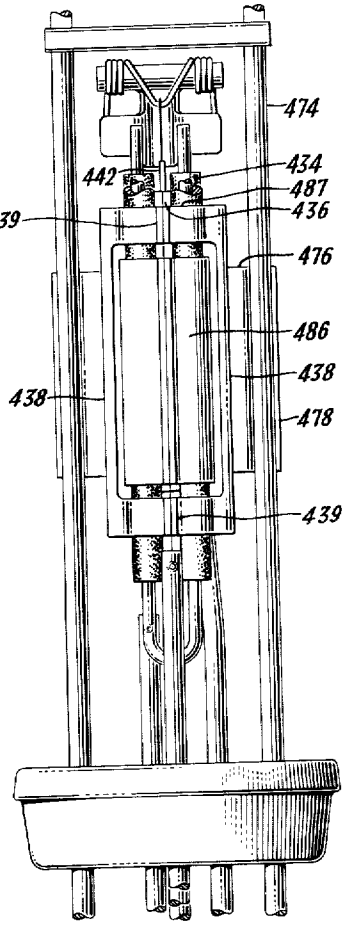


Fig. 17

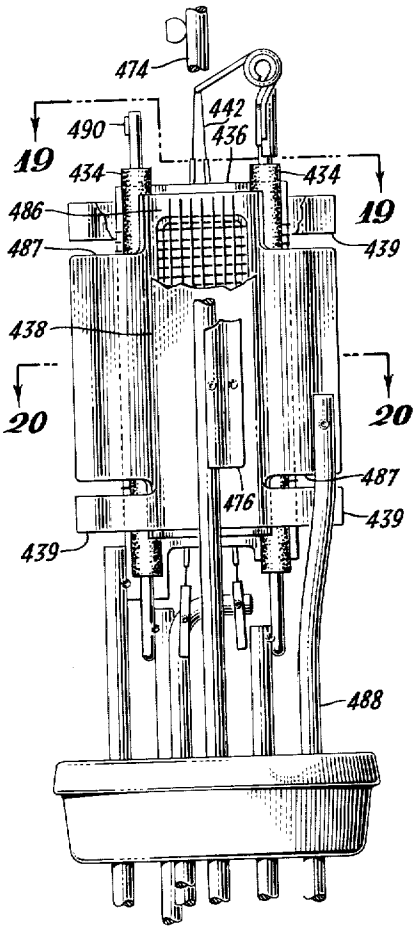


Fig. 18

INVENTORS
CRAIG M. GARRETSON
MORTIMER E. WEISS
BY
Michael Hertz,
ATTORNEY

United States Patent Office 2,976,452 Patented Mar. 21, 1961

2,976,452

CERAMIC ROD SPACERS FOR USE IN MASS PRODUCIBLE ELECTRON TUBES

Mortimer E. Weiss, Flushing, and Craig M. Garretson, East Norwich, N.Y., assignors, by mesne assignments, to Sylvania Electric Products Inc., Wilmington, Del., a corporation of Delaware

Filed Nov. 4, 1954, Ser. No. 466,888

5 Claims. (Cl. 313—257)

This invention relates to the use of ceramic rods, which may be metal cored, in electron tubes to obtain the requisite spacing between elements of the tubes.

In conventional tube manufacture spaced perforated ceramic or thin mica spacers are employed, these being threaded over elements of the tube to align and space them properly. These spacers, particularly if they be of the mica type, are fairly difficult to apply to the tube elements to be spaced apart and in so applying them to the tube elements edges of the holes may break away with consequent poor performance of the finished tube or with loss of time and material in replacing the spacers before further manufacturing operations on the tube takes place. Furthermore, use of these perforated spacers does not lend itself to high uniformity of tube characteristics, nor, due to the character of the material, to such ruggedness as can be attained by the use of the ceramic rod spacers of this invention, as will be described. Moreover, the use of insulating rods as spacers enables compact assembly of closely spaced parts leading to the manufacture of tube mounts of small dimensions and low inertia and to obtain electrical characteristics not possible with conventional structures. The use of metallic rods with insulating coating thereon has the added advantage of affording electrical and heat conducting means for some of the electrodes and of insulated support for others of the electrodes.

It is an object of the invention to provide for ease and cheapness in manufacture of tube mounts.

It is a further object of the invention to provide means whereby uniformity of tube mount manufacture may be attained.

It is a still further object of the invention to provide an electrode package wherein basic spacer elements are insulating rods.

It is yet another object of the invention to make the rods with electroconductive cores so that they function not only as means about which the electrodes may be compacted but also as conductive elements as between electron tube parts and the stem leads of the tube base.

These and other objects of the invention will be apparent after reading the following specification and claims when taken in conjunction with the accompanying drawings in which:

Fig. 1 is a side view of a tube mount with portions broken away to expose hidden parts.

Fig. 2 is a top view of the mount.

Fig. 3 is a side view of the tube mount taken at right angles to Fig. 1.

Fig. 4 is a section through the mount on the line **4—4** of Fig. 3.

Fig. 5 is a view similar to Fig. 1 showing a tube mount with a modified form of assembly.

Fig. 6 is a section through Fig. 5 on the line **6—6** thereof.

Fig. 7 is a side view of the tube mount of Fig. 5 at right angles thereto.

Fig. 8 is a top view of the tube mount at Fig. 7.

Fig. 9 is a side view of another modification of a tube mount manufactured in accordance with this invention, parts being broken away to expose hidden portions.

Fig. 10 is a section of the mount of Fig. 9 on the line **10—10** thereof.

Fig. 11 is a view of the mount at right angles to Fig. 9, with parts broken away.

Fig. 12 is a top plan view of Fig. 11.

Fig. 13 is a side view of still another modification of a tube mount made in accordance with the invention, showing how an electron tube utilizing more than three electrodes may be spaced apart by insulating rods. A filament tensioning spring is removed for simplicity of illustration.

Fig. 14 is a section of the mount of Fig. 13 on the line **14—14** thereof.

Fig. 15 is a view of the mount taken at right angles to the Fig. 13 position.

Fig. 16 is a section of the line **16—16** of Fig. 15.

Fig. 17 is a side view of yet another modification of a tube mount made in accordance with the invention, showing how an electron tube utilizing more than three electrodes may be made in a fashion other than that set forth in the previous species.

Fig. 18 is a view of the mount at right angles to the position shown in Fig. 17.

Fig. 19 is a section on the line **19—19** of Fig. 18, and

Fig. 20 is a section on the line **20—20** of Fig. 18.

Considering the figures in greater detail in Figs. 1 to 4 is disclosed one form of the invention.

In this form there is disclosed a stem **30** to which is welded a stack assembly **32**. The stack assembly comprises pairs of spacer rods **34**, a grid **36**, a pair of anode plates **38**, a pair of straps **40**, a filamentary type cathode **42** and a getter **44**.

The spacer rod of a pair is made up of a metallic rod held to close tolerance as to diameter bent into shape with the arms of the U covered with insulating material **46**, preferably ceramic material such as alumina. The insulating material is also held in close tolerance as to thickness so as to facilitate reproducible spacing and therefore electrical characteristics of the tube. The free ends of the U and the bight or bend of the U is left bare. The grid **36** is a two part frame with wire **50** wound about the parts. Each frame half is generally rectangular in plan, two of the sides **52** of each frame being in contact with the corresponding sides of the other frame and the ends **54** being offset away from each other to provide passage through the grid of the filamentary cathode **42**. The grid wires are wound taut about the two frames and the grid laterals on one frame are spaced apart from the grid laterals on the other grid frame by the thickness of the two frames. The filament **42** passes through the interior of the grid laterals without touching the same. One of the sides of each grid frame is prolonged as at **56** for attachment to a stem lead.

The grid is positioned between the two U-shaped ceramic covered rods with the ceramic material on the rods interposed between the grid and metal of the rods.

On each side of the U-shaped ceramic covered rods is an anode plate **38**. Each plate is generally rectangular in form with channels **58** formed on the long edges of the rectangles. These channels partially embrace the ceramic coating on the rods and serve to position the plates laterally relative to the rods and also position the plates at a fixed distance from the grid.

Girding the assemblage of grid, U-shaped rods and anode plates are the two narrow metallic straps **40**. The straps are each U-shaped members with arms of unequal length and with outturned flanges **60**. The flanges of one strap are welded to the flanges of the other strap,

the straps being of such rigidity as to firmly clamp the grid, side rods and plates together. This provides for a rigidly held together compact electrode assembly.

Welded on two of the rods **34** is the tension spring support **62**, this being a generally H-shaped member, laid on its side, with one leg of the H broad enough to serve as an attaching means to the side rods and as a tacking surface to which may be welded a filament tensioning spring **64**. This spring is coiled about the narrow leg of the H-shaped member and pulls upwardly on the bight of the cathode filament **42**. The lower ends of the filament have tabs **66** welded thereto.

The electrode assembly is mounted on the leads of the stem in any position desired. It is here shown as having the connecting bend of the rods welded to two of the stem leads **68** and **70**. The grid frame is welded to another lead **72** of the stem by means of the grid frame prolongation **56**. The straps **40**, which are in electrical contact with the anode plates, are welded to two long stem leads **74** one on each side of the strap flanges **60**. The filament tabs **66** are pulled down to exert tension on the spring **64** and are welded to an angled portion of stem lead **68**. It will be noted that current is supplied from the stem lead **68** to the parallelly connected filament sections through a spacer rod, the current flowing from stem lead **68** to the two tabs, the filament **42**, the spring **64**, spring support **62**, a spacer rod **34** and stem lead **70**. The unflashed getter is supported between the long stem leads **74** near the upper ends thereof and initially is in circuit with the spacer rods.

It will be noted that with the above described construction, no mica or other fragile spacers are employed and that electrode elements are held rigidly together in properly spaced relation by the insulated rods and straps. Since the rods and the insulation thereon can be held to close tolerances, the electron device can be built with reproducible electrical characteristics with much more exactitude than where perforated spacers are utilized and in which the perforations may in assembly or in tube use become enlarged to vary the spacing between elements. Moreover the package arrangement disclosed lends itself to ease in automatic assembly.

In the species of invention disclosed in Figs. 5 to 8 substantiallly the same form of stem, grid, tension spring support, tension spring and filament are employed. However, in this modification the plate anodes themselves bind parts together. The grid frames, as before, have prolongations **156** secured to a stem lead **172**. The anode plates **138**, **138**, as before, have channels **158** but these are now not at the edges of the plates, but inwardly thereof. The plates beyond the channels are bent toward each other and are provided with flanges **159** parallel to and welded to one another to firmly clamp the grid frames to the ceramically coated rods. The stacked electrode assembly in this modification also includes two metallic angles **176**, each having one leg welded to a plate **138** and another leg provided with a channel **178** running along the edge of the leg.

The stacked electrode assembly is mounted on the stem assembly by welding the channels **178** to stem leads **174** and making suitable electrical connection of the electrode elements to the other stem leads. As before, getter **144** is welded to stem leads **174**. This species of invention simplifies the formation of the stacked assembly since the plates themselves perform the function of both plates and straps in the first described embodiment. Also the plates extend over a longer length of rod than the straps do in the first species and therefore provide for a more rugged structure.

In the species disclosed in Figs. 9 to 12 only a single pair of straight insulated rods **234** is employed. These rods are preferably metallic rods insulated as heretofore described, the ends being bare of insulation. The filamentary cathode **242** is of the same construction as heretofore. The grid **236** is substantially the same as in the previous form, the difference residing in the provision of wings **237**, one at each corner of each grid frame. These wings, when the two frames of the grid are in abutting relation, are divergent from one another and accommodate between them the insulated rods. The grid frames, as before, have prolongations **256** welded to each other and to a stem lead **257** extending up from wafer **230**. The anode in this species comprises two plates **238** and **239**. The plate **238** is generally U-shaped with outwardly turned flanges **241**. The U-shaped plate at its bend snugly engages an insulated rod **234** and then the arms of the plate are offset to provide clearance between them for the grid. The flanges **240** are channeled at the edges, as at **258**, and are welded to stem leads **268** extending upwardly from wafer **230**. The plate **239** has a central channel section **240** embracing a rod **234** and welded at arcuate lateral edges to the stem leads **268**.

The cathode tension spring support **262** is welded to the upper bare end of one of the rods **234**, the lower end of the rod being welded to a stem lead. The lower ends of the cathode filament are welded via the tabs to still another stem lead. The unflashed getter **244** is welded to the two stem leads **268**. All of the above provisions makes the construction of this packet very rugged and with but few parts.

In the species disclosed in Figs. 13 to 16 there is disclosed still another embodiment of the invention. Here there is disclosed a tetrode involving a cathode, two grids, and an anode.

As in the previous species, only two insulated rods **334** are employed. The control grid structure **336** with its wings **337** and its projections **356** and the cathode structure **342** are as described in conjunction with the previous species. Anode plate **338** in this species, has its parallel portions spread apart a greater distance than in the previous species to accommodate a second grid **386**. The connecting or base portion of the U-shaped anode is channeled to partially encompass the insulated rod **334** and the free longitudinal edges of the anode are welded to two stem leads **368**. These leads are held in properly spaced relation by a pair of straps **339**, one above and one below the electrodes, the ends of the straps being welded to the stem leads **368** and the intermediate portion being channeled and snugly embracing an insulated rod **334**. Second grid **386** has two parallel spaced apart rectangular frame sections **387** connected together by bars **388** at the upper and lower end of the grid sections, along one edge of the sections and these connecting bars are provided with channel sections to fit over a rod **334**.

Each of the other edges of the grid frames has, at the upper and lower ends thereof, a right angularly bent ear **389**, each of the lower ears being welded to a stem lead **380**, and both the upper pair of ears and the lower pair of ears being connected by straps **381** welded to the ears and channeled to snugly fit about an insulated rod **334**.

Cathode tensioning spring support **362** is mounted on the bare part of a rod **334**, the lower bare end of this rod being welded to stem lead **382**. The filamentary cathode is tensioned by the spring **364** mounted on the support **362**, the lower end of the cathode being welded via tabs to angled stem lead **383**. Unflashed getter **344** bridges the two stem leads **368** near the upper ends thereof.

In Figs. 17 to 20 there is illustrated a tetrode with four insulated spacers **434**. In these figures there is illustrated a filamentary cathode **442**, a first or control grid **436**, a second grid **486** and an anode **438**. In this form of invention, the four electrodes and rods are in the form of a package held in compacted relation by the welding together of the lateral ends of portions of the second grid **486** and of portions of the plates constituting

the anode 438. The cathode, its support and connections are essentially as described in connection with Figs. 5 to 8. This is likewise true of the first or control grid 436. The frame sections of the second grid 486 are cut away at each of their corners, as at 487 and the shortened-in-height wings of the second grid are channeled and partially bent around the insulated rods 434, the ends of the wings being inclined toward each other and finally arranged in parallel relation and welded together. The anode plates 438 are generally rectangular in shape with ears 439 at each corner of the plates bent in toward the rods 434 and with the oppositely positioned ears welded to one another. The anode plates each have angle brackets 476 welded thereto, the angle brackets also having channeled portions 478 welded to stem leads 474. The second grid 486 is electrically welded to a stem lead 488. The unflashed getter is mounted on the stem leads 474 and a reinforcing bar 490 is welded to the two rods 434 opposite the tension spring support.

It is obvious from the examples given about that the invention is capable of being carried out in still other various forms and therefore the invention should not be limited except as defined by the following claims.

We claim as our invention:

1. A stack comprised of a tightly held assembly including insulating rods, at least one of which has an electro-conductive core, and electrodes including a cathode, a grid, and an anode, the conductive core forming part of the electrical circuit to one of the electrodes, the grid being held against movement and spaced from said anode by said insulating rods, and means supporting the cathode adjacent the grid.

2. A stack comprised of a tightly held assembly including insulating rods, at least one of which has an electro-conductive core, a cathode electrically connected to the core, a grid, and an anode, the grid being held against movement and spaced from said anode by said insulating rods.

3. A stack comprised of a grid having a rectangular frame, a pair of insulated rods engaging the frame above and below the same at each of two parallel edges of the frame, a pair of anode plates parallel to the grid frame and engaging the four rods on sides thereof opposite to the sides engaging the grid frame, said plates being secured together at the edges which are parallel to the rods, and a second two frame grid engaging the insulating rods on the same side as the anode plates engage the rods and having the frame edges parallel to the rods secured together.

4. A structure as defined in claim 1 in which the grid is a rectangular frame, the rods being arranged in pairs, one pair engaging the frame above and the other below the same at each of two parallel edges of the frame, the anode comprising a pair of plates parallel to the grid frame and engaging the four rods on sides thereof opposite to the sides engaging the grid frame, said plates being secured together at the edges which are parallel to the rods.

5. A structure as defined in claim 4 in which a second two frame grid is provided engaging the insulating rods on the same side as the anode plates engage the rods and also having the frame edges parallel to the rods secured together.

References Cited in the file of this patent

UNITED STATES PATENTS

2,064,981	Knoll	Dec. 22, 1936
2,197,526	Kosack	Apr. 16, 1940
2,355,083	Krim	Aug. 8, 1944
2,413,006	Spencer	Dec. 24, 1946
2,463,635	McIntosh	Mar. 8, 1949
2,503,806	Diggle	Apr. 11, 1950
2,660,688	Walsh	Nov. 24, 1953