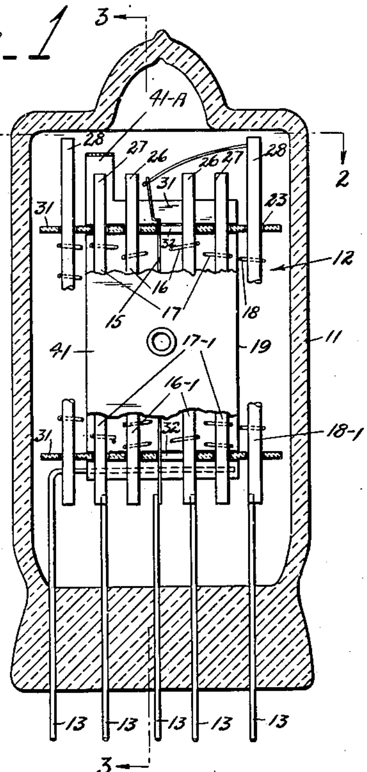
March 15, 1949. H. D. SUESHOLTZ ET AL 2,464,272

ELECTRODE ASSEMBLY FOR ELECTRON SPACE DISCHARGE DEVICES

Filed Dec. 8, 1945 2 Sheets-Sheet 1

FIG-1



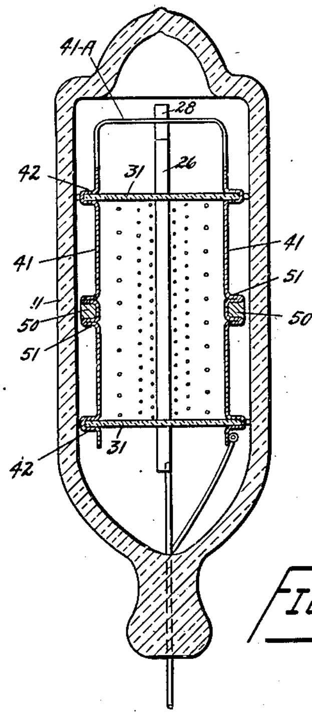


FIG-3

FIG-4

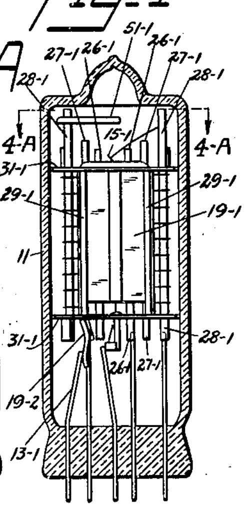
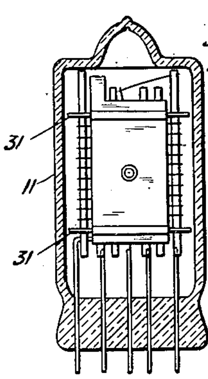


FIG-1-A



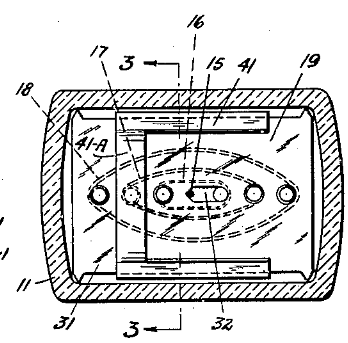


FIG-2

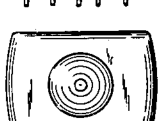


FIG-2-A

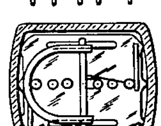


FIG-4-A

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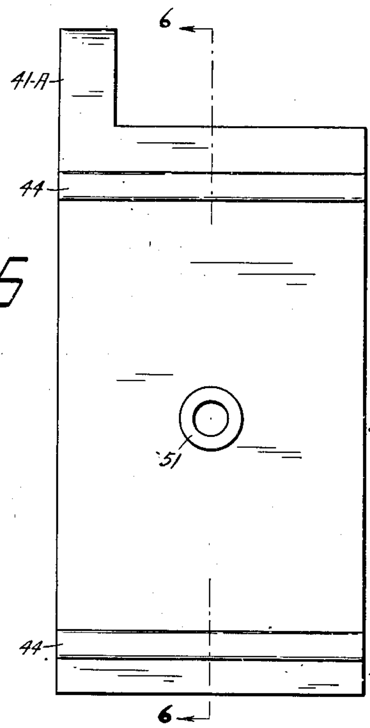


Fig-5

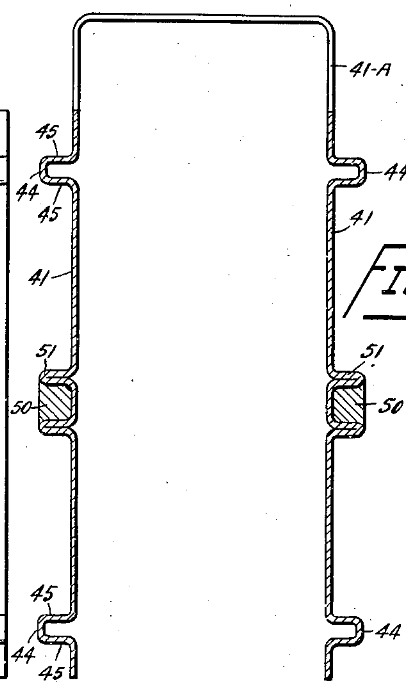
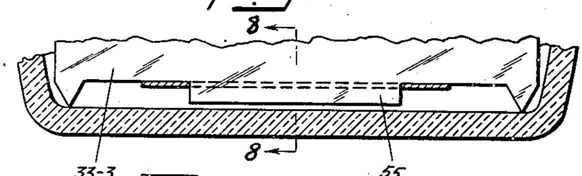
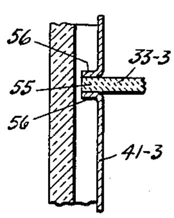


Fig.6

Fig-7





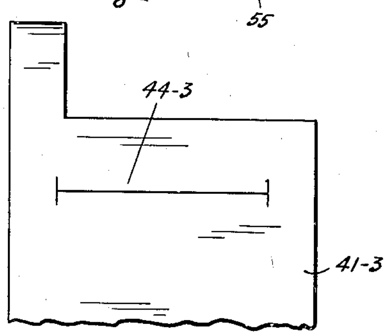


Fig 8 Fig-9

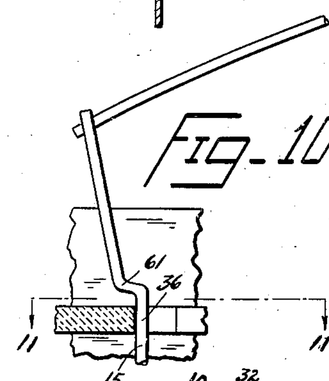


Fig-10

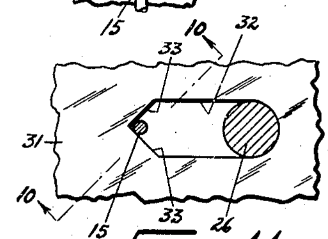


Fig-11

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UNITED STATES PATENT OFFICE

2,464,272

ELECTRODE ASSEMBLY FOR ELECTRON SPACE DISCHARGE DEVICES

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Application December 8, 1945, Serial No. 633,670

8 Claims. (Cl. 250—27.5)

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This invention relates to electron space discharge devices in which an electrode assembly comprising a cathode, an anode and at least one grid electrode interposed between the cathode and anode are enclosed in a hermetically sealed evacuated envelope, and more particularly to such electron discharge devices which are known commercially as "subminiature electron tubes."

Among the objects of the invention are subminiature tubes embodying novel features which make it possible to appreciably reduce their overall volume, to simplify their manufacture, and reduce the cost and the problems connected with their manufacture.

The foregoing and other objects of the invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawings wherein

Fig. 1 is a vertical cross-sectional view of one form of multi-electrode tube of the subminiature type exemplifying the invention, the tube being shown in a scale of about 1 to 6½;

Figs. 2 and 3 are cross-sectional views along lines 2—2 and 3—3 respectively, of Fig. 1 on the same scale; Fig. 3 also being a cross-sectional view along line 3—3 of Fig. 2;

Fig. 1–A is a view generally similar to Fig. 1 of the same tube on a scale of 1 to 3¼;

Fig. 2–A is a top view of the tube shown in Fig. 1–A on a scale of 1 to 3¼;

Figs. 4 and 4–A are views generally similar to Figs. 1–A and 2–A showing in comparison and on the same scale the most compact prior art subminiature tube of the same operating characteristics as the tube of the invention shown in Figs. 1–A and 2–A, Fig. 4–A being a cross-section along line 4–A—4–A of Fig. 4;

Fig. 5 is an elevational view of the flat side of the anode electrode of the tube in Fig. 1;

Fig. 6 is a cross-sectional view along line 6—6 of Fig. 5;

Fig. 7 is a cross-sectional view similar to Fig. 2 illustrating constructional features of a modified type of tube arrangement of the invention;

Fig. 8 is a cross-sectional view along line 8—8 of Fig. 7;

Fig. 9 is an evelational view similar to Fig. 6 of the portion of the anode electrode shown in Fig. 8;

Fig. 10 is a detailed vertical cross-sectional view along line 10—10 of Fig. 11 showing the suspension of the end of a cathode element; and

Fig. 11 is a top view along line 11—11 of Fig. 10.

There are many applications requiring multi-electrode electron amplifier tubes of the subminiature type having extremely small dimensions and able to operate with a high degree of uniformity and efficiency. Among such applications are hearing aid amplifiers and radio broadcast receivers of a size small enough to be worn hidden in a pocket of the user, amplifiers for shortwave applications, such as television signal amplifiers, and other fields such as the field of proximity fuses, in which space is at a premium.

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Although the principles of the invention are applicable to other types of subminiature tubes, their application will be described in connection with a pentode-type tube shown in Figs. 1, 2 which has a very wide field of use. The pentode tube shown comprises a hermetically sealed evacuated tubular envelope 11, of a material such as glass, which encloses an electrode assembly 12 provided with a plurality of leads 13 which are hermetically sealed in a terminal wall portion of the envelope to provide external circuit connections to the enclosed electrodes.

The electrode assembly 12 comprises a cathode shown in the form of a single longitudinally-extending filament 15, a control grid 16, a screen grid 17, a suppressor grid 18 and an anode structure 19. The several electrodes 15, 16, 17, 18, 19 are of the conventional type, and form internested electrode structures which extend longitudinally in directions generally parallel to a common longitudinal axis of the electrode assembly, and the tubular envelope 11. The cathode 15 is the central element of the electrode assembly and may be formed of an oxide coated metal filament. The several grids 16, 17, 18 are made in the form of very fine metal wire about .001″ to .004″ in diameter.

The inner grid 16 has its wire supported on two grid posts 26 likewise of wire, the grid 17 is supported on two grid posts 27 and grid 18 is supported on two grid posts 28. The several grid posts 26, 27, 28 of such miniature tubes are usually formed of metal wires about .012″ to .025″ in diameter.

The electrode assembly also includes two similar generally flat sheet-like insulating spacer elements 31, commonly made of a material having a high dielectric constant, such as mica, which support and hold properly aligned the grid posts 26, 27, 28 of the several grids as well as the cathode structure 15 and the anode structure 19. In the form shown, each of the spacer elements has in its center an elongated hole 32 against the opposite narrow edge portions of which are positioned two spaced facing portions of the cathode filament 15 and of one of the grid posts 26 of the inner grid 16. Two spaced portions of each of the other grid posts 27, 28 are similarly held by additional small holes in the spacer element 31, so that the several supports, posts and spacers form a self supporting electrode assembly.

The several grids 16, 17, 18 are usually made by winding a thin grid wire as a helical spiral around the two grid posts, the individual turns of the helix being swaged to the grid posts. The anode structure 19 is shown formed of two alike flat anode halves 41 of thin metal sheet material which extend along the opposite outer sides of the electrode structure 12.

Figs. 1-A and 1-B show the tube of Figs. 1 to 3 in reduced scale and the similar Figs. 4 and 4-A show for comparison and on the same scale one of the most compact and best prior-art subminiature tubes of the same general type. The tube of Figs. 4 and 4-A has generally analogous tube and electrode elements, including an envelope 11—1, an anode 19—1 and grid posts 26—1, 27—1, 28—1, forming with the spacer elements 31 a generally similar electrode assembly. The anode 19—1 of the tube shown in Figs. 4 and 4-A is formed of two metallic sheet elements, each anode sheet element 19—1 being supported by a pair of wire posts 29—1 held in the spacer elements 31—1 in the same manner as the similar grid posts. This made it necessary to provide thin spacer elements 31 of the electrode assembly with two additional sets of two holes for two pairs of wire posts 19—2 of the two anode halves 19—1.

Since the anode structure of the prior art tube shown in Figs. 4 and 4-A forms the outermost region of the electrode assembly, the spacer elements 31—1 of the electrode assembly must be sufficiently wide to provide firm anchorage for the anode posts 19—1. Special manipulation care is required in order to thread the several sets of grid support posts 26—1, 27—1, 28—1 as well as the additional anode supports posts 29—1 into their proper retaining holes of the supporting plates 31—1. Since in subminiature tubes, the several electrodes must be crowded into a very small space and all parts are delicate and tiny, the assembly of the electrodes on their supporting plates presented a difficult problem.

The problem will appear more clearly when considering the actual dimension data of such prior-art pentode tube, shown in Figs. 4, 4-A, given below:

The overall length of the glass envelope, but without the sealing tip projecting above the top of the envelope, was about $1\frac{1}{16}''$.

The width of the envelope along the wider side was about ⅜''.

The width of the envelope along the narrower side was about $^2/_8''$.

The length of sealing of the tip was about ⅛''.

The distance between the sheet element 19—1 forming the anode halves was about $^7/_{64}''$.

In the gain pentodes each half was about $\frac{3}{16}''$ wide, $^5/_{16}''$ long and .005'' thick.

In the generally similar power pentodes the length of each anode half was increased from $\frac{5}{16}''$ to about ⅝'' and the overall length of the envelope was similarly increased from $1\frac{1}{16}''$ to about 1⅜''.

The distance between the lower spacer element 31—1 to the electrode-lead seal-portion of the envelope was about $\frac{5}{16}''$ in order to provide space for connecting the terminal tail portions 19—2 of the two anode halves 19—1 to each other and to the sealed-in anode lead 13—1.

One of the wire posts 28—1 of the third grid had affixed thereto a resilient supporting wire which served to support and tension the upper end of the cathode filament 15—1, this cathode support extending about ⅛ inch above the upper spacer element 31—1.

The getter holder 51—1 was supported by one of the wire posts 28—1 of the third grid about ¼ inch above the upper spacer disk 31—1. The upper end wall of the glass envelope 11 was spaced about ⅛ inch away from the getter 51—1.

In the most compact prior subminiature electron discharge tubes of the foregoing type, the getter body required in order to secure the desired degree of vacuum in the fiinished tube was, as a rule, supported in a getter holder 51—1 carried on the top of the electrode assembly and this required the additional length of envelope for accommodating the getter holder.

The upper end walls of the envelope of such prior art subminiature tubes was also provided with the usual exhaust tubulation through which the envelope was exhausted, and which was sealed off by heating upon completion of the exhaust process. The tipping-off, or sealing-off, of the envelope tubulation subjects the upper envelope end wall to a permanent strain. Because of the small size of the subminiature tubes, they cannot be subjected to annealing in order to eliminate the permanent strain in the tip-off region of the tube, since the amount of gas freed by the annealing process would permanently impair the operation of the tube. Since, as explained above, in the best and most compact prior subminiature electron tubes of the foregoing type, the getter holder was placed adjacent to the sealed off tubulation region of the envelope, the envelope had to be made high enough to provide a space of approximately ⅛ of an inch between the getter holder 51—1 of such prior tube shown in Fig. 4 and the tip-off and region of the envelope in order to assure that the high temperature of the flashed getter body did not impose an excessive strain on the permanently strained tip-off region of the envelope.

According to the invention, the foregoing difficulties are very materially reduced and the required width of the spacer elements and of the electrode assembly of the most compact prior art tubes is considerably reduced by using the anode sheet elements as the getter holders and by forming the thin sheet material of the anode structure so as to provide therein two spaced retainer regions overlapping and clampingly engaging facing edge regions of the two spacer elements of the electrode assembly.

Furthermore, according to the invention, the foregoing difficulties encountered with the getter structures are eliminated and an envelope structure of shorter length is made possible in such subminiature tubes, by affixing the getter body directly to the outer side of the sheet material forming the anode structure. The getter body is of such composition and of such size and mass in relation to the anode structure to which it is affixed as to make it possible to heat the anode to properly degas it during the exhaust process without materially reducing the quantity of the getter body, and so that upon the completion of the anode degassing procedure, sufficient getter body is retained on the anode structure to effect the required absorption of the remaining gases in the envelope after the getter body is flashed.

Furthermore, the masses of getter body and anode structure are sufficiently small and they are of such configuration, that upon heating the anode structure for the purpose of flashing the getter body after the degassing of the anode structure has been completed—the quantity of gases released within the envelope by the anode structure while it is heated to the higher temperature at which the getter body is flashed—are of the same order of magnitude as the quantity of gases which are given off on flashing the getter by the getter holder usually employed in prior art tube structures of the subminiature type.

One form of such anode structure is shown in detail in Figs. 1 to 3, 5, 6. A continuous body of sheet material is stamped to provide two alike anode halves **41** shaped to overlappingly engage the opposite side edges **42** of the two supporting spacers **31** and establish good clamping engagement therewith so as to be retained firmly in operative position thereon. The anode halves **41** are interconnected by a junction portion **41–A** and they may be stamped out therewith in one operation. In the form shown, the clamping engagement between the retainer regions of the anode halves with the spacer element is secured by shaping the retainer regions of each anode sheet element into a generally-U-shaped channel formation **44** the sides **45** of which are pressed into frictional clamping engagement with the opposite surfaces of the edge region of the spacer element **31**, in the manner shown in Figs. 3, 5, 6.

Figs. 3, 5, 6 show how the anode structure of such subminiature tube of the invention is arranged to serve as a protective support for the getter body. Each of the two anode sheet elements **41** of the anode structure may be formed, as usual, of nickel sheet material having a thickness of approximately .005″. In pentodes which are designed for operation as voltage gain tubes and power tubes, the area of each sheet section of the anode is about $\frac{3}{16}$ x $\frac{5}{16}$ inch and for power tubes about $\frac{3}{16}$ x $\frac{5}{8}$ inch. The total mass of each anode section formed of such sheet element $\frac{3}{16}$ x $\frac{5}{16}$ inch is about .060 to .100 grams. In power tubes the area and mass of such anode sheet section is about twice as great.

This feature of the invention is based upon the discovery that an anode sheet element of the character given above may be utilized as a direct support for a sufficient quantity of a getter body to effect the required absorption of gases remaining in the envelope after the exhaust process has been completed, provided that such getter bodies are formed of compounds which have the property of vaporizing at a temperature appreciably higher than the temperature to which the sheet element of such anode body has to be heated to properly degas it during the exhaust process, so that upon completion of the anode degassing procedure, the getter body on such sheet element may be heated to the temperature required for flashing and effecting the required absorption of the remaining gases in the envelope. Getter compounds meeting these requirements are well known and they have been commercially available for a number of years past. Among such commercially available getter compounds are barium titanate, barium beryliate, barium aluminum alloy and others. In subminiature tubes of the invention, the mass of the anode body, constituting the support of the getter body, which has to be heated when flashing the getter body, is made sufficiently small so that upon heating it to the temperature of flashing the getter, the additional gases given off by the anode body do not impair the required degree of vacuum which has to be secured within the envelope. Furthermore, in subminiature tubes of the invention, the quantity of additional gases given off by the anode body when heated to a temperature at which the getter body is flashed, is of the order of the additional gases which were given off by the getter holder employed in prior art subminiature tubes such as shown in Figs. 4, 4—A.

As shown in Figs. 1 to 3, 4, 5, each of the two separate sheet sections **41** of the anode structure **19** extending on the opposite sides of the electrode assembly is utilized as a support and container for its own getter body. In order to properly hold the getter body **50** on the anode sheet element **41**, a small pocket **51** is formed therein. As indicated in the drawing, the pocket is formed by a stamping operation which folds a generally central portion of the sheet element **41** into an outwardly projecting pocket **51** so that the side of the generally flat sheet element **41** facing the electrode assembly has a flush surface and is without any protrusion so that it may be brought very close to the next adjacent inner electrode element, such as the grid **18**.

It is well known that the greater the amount of getter material available in a tube, the longer the life expectancy of the tube. As indicated in Fig. 6, the outward protrusion formed by the getter pocket **51** is less than the protrusion formed by the retainer crimps or folds **42** which serve to fasten the anode to the supporting spacers **31**. By making the electrode assembly with two anode sheet elements **41**, each having an outwardly facing pocket **51** with the getter body affixed thereto, the tiny electrode assembly of such subminiature tube may be provided with a large excess of getter body compound, thereby assuring a better vacuum during a prolonged life of the tube, a critical factor in such subminiature tubes.

The getter arrangement shown not only reduces the length of the subminiature tubes, but has a number of other advantages. It simplifies the assembly by eliminating a separate getter holder and the procedure of fastening it to the electrode assembly. Furthermore, it enables more efficient degassing by reducing the overall mass of the electrode assembly. In particular, if instead of following the invention, a separate getter holder were affixed to the anode sheet element, it would be necessary—in order to raise such anode supported getter holder to the getter flashing temperature—to raise the anode sheet element to a considerably higher temperature, and at such higher temperature the anode body would release a much larger quantity of gas than with the getter arrangement of the invention. For example, while the anode body of a subminiature tube of the invention has to be heated to approximately 900°–950° C. to flash the getter, the anode body of a subminiature tube having a getter holder affixed to the anode, would have to be heated to a temperature 50° C. higher or more for flashing its getter body.

In Figs. 7 to 9 is shown a modified arrangement for securing clamping engagement between the retainer regions of the anode sheet element with the edge regions of the spacer elements of the electrode assembly. The edge region of the spacer element **31—3** to which the retainer region of the anode sheet element is to be clamped is provided with a tongue-like projection **55** and the retainer region **44—3** of the anode sheet element is cut and bent to provide two outwardly bent tongs 56 so that the tongue 35 of the spacer element may be forced within the slot between the two tongs 36 of the sheet element for establishing frictional clamping engagement therebetween.

As indicated in detail in Figs. 10 and 11, the upper support of the filamentary cathode 15 of the tube shown in Figs. 1 to 3 is formed by a longitudinal portion thereof located adjacent an inwardly facing short edge region of the elongated opening 32 formed by two edge sections 33, extending at an angle of about 450°.

In prior art cathode suspensions of this type, the filamentary cathode support projecting above the upper spacer 31 generally rested only against a knife-like edge of the edge regions 33 of the opening 32. Tubes formed with such cathode support gave a great deal of trouble due to microphonics because this cathode support did not provide the degree of damping required for suppressing vibrations of the cathode when the tube was subjected to external vibratory forces.

The cathode mounting shown in Figs. 10 and 11 eliminates the foregoing difficulties by providing the filamentary cathode support emerging above the opening in the supporting spacer 31 with a sharply bent section 61 forming with the part of the filament support 36 extending inwardly through the hole 32 and angle of the order of 140° down to about 95° so that substantially the entire region of the filament support 36 facing the edge region of the hole is held in positive coupling engagement therewith for effectively suppressing and damping physical vibrations transmitted to the cathode.

In general, by providing subminiature tubes of the invention with the anode and getter arrangement of the type described above, the spacing of the flat anode sheet elements 41 from the facing flat side wall of the envelope may be reduced to a distance of the order of about .01" or even less. Furthermore, the spacing of the upper insulating support from the adjacent upper end of the envelope may be reduced to a distance of the order of about .090" or less. This makes it possible to reduce the overall volume of such tube by 20% or more, a factor of great practical importance in such tubes.

It will be apparent to those skilled in the art that the novel principles of the invention disclosed herein in connection with specific exemplifications thereof will suggest various other modifications and applications of the same. It is accordingly desired that in construing the breadth of the appended claims they shall not be limited to the specific exemplifications of the invention described above.

We claim:

1. In an electron space discharge device: a cathode electrode, an anode electrode and at least one grid electrode interposed between the cathode and anode electrodes; said electrodes extending longitudinally generally parallel to a common axis, a sealed generally-tubular envelope enclosing said electrodes and extending generally co-axial therewith; two generally-flat sheet-like insulating spacer elements extending transverse to said axis and supporting the opposite ends of said electrodes in their operative positions and holding them spaced from the envelope; said anode electrode having a continuous metallic sheet element extending along a wall region of said envelope and constituting a barrier separating the other electrodes from said wall region; and a body of getter material affixed directly to the side of said sheet element facing said wall region for confining vapor of said material to the region of the envelope wall facing said sheet element; said continuous metallic sheet element of the anode electrode having two spaced retainer regions having frictional clamping engagement with facing edge regions of the two spacer elements for securing said anode electrode to said spacer elements.

2. In an electron space discharge device: a cathode electrode, an anode electrode and at least one grid electrode interposed between the cathode and anode electrodes; said electrodes extending longitudinally generally parallel to a common axis; a sealed generally-tubular envelope enclosing said electrodes and extending generally co-axial therewith; two generally-flat sheet-like insulating spacer elements extending transverse to said axis and supporting the opposite ends of said electrodes in their operative positions and holding them spaced from the envelope; said anode electrode having a continuous metallic sheet element extending along a wall region of said envelope and constituting a barrier separating the other electrodes from said wall region; and a body of getter material affixed directly to the side of said sheet element facing said wall region for confining vapor of said material to the region of the envelope wall facing said sheet element; a portion of said sheet element forming a pocket having an open side facing said envelope wall for retaining said getter material; said continuous metallic sheet element of the anode electrode having two spaced retainer regions having frictional clamping engagement with facing edge regions of the two spacer elements for securing said anode electrode to said spacer elements.

3. In an electron space discharge device: a cathode electrode, an anode electrode and at least one grid electrode interposed between the cathode and anode electrodes; said electrodes extending longitudinally generally parallel to a common axis; a sealed generally-tubular envelope of generally oblong cross section enclosing said electrodes and extending generally co-axial therewith; two generally-flat sheet-like insulating spacer elements extending transverse to said axis and supporting the opposite ends of said electrodes in their operative positions and holding them spaced from the envelope; said anode electrode having at least two interconnected opposite anode sections each formed of a generally-flat continuous metallic sheet element extending along opposite generally-flat wall regions of said envelope and constituting a barrier separating the other electrodes from said wall regions; and a body of getter material affixed directly to the side of said sheet element facing said wall region for confining vapor of said material to the region of the envelope wall facing said sheet element; a portion of said sheet element forming a pocket having an open side facing said envelope wall for retaining said getter material; each of said continuous metallic sheet elements of the anode electrode having two spaced retainer regions having frictional clamping engagement with facing edge regions of the two spacer elements for securing said anode electrode to said spacer elements.

4. In an electron space discharge device: a cathode electrode, an anode electrode and at least one grid electrode interposed between the cathode and anode electrodes; said electrodes extending longitudinally generally parallel to a common axis; a sealed generally-tubular envelope enclos-

ing said electrodes and extending generally co-axial therewith; two generally-flat sheet-like insulating spacer elements extending transverse to said axis and supporting the opposite ends of said electrodes in their operative positions and holding them spaced from the envelope; said anode electrode having a continuous metallic sheet element extending along a wall region of said envelope and constituting a barrier separating the other electrodes from said wall region; said continuous metallic sheet element of the anode electrode having two spaced retainer regions having frictional clamping engagement with facing edge regions of the two spacer elements for securing said anode electrode to said spacer elements.

5. In an electron space discharge device: a cathode electrode, an anode electrode and at least one grid electrode interposed between the cathode and anode electrodes; said electrodes extending longitudinally generally parallel to a common axis; a sealed generally-tubular envelope of generally oblong cross section enclosing said electrodes and extending generally co-axial therewith; two generally-flat sheet-like insulating spacer elements extending transverse to said axis and supporting the opposite ends of said electrodes in their operative positions and holding them spaced from the envelope; said anode electrode having at least two interconnected opposite anode sections each formed of a generally flat continuous metallic sheet element extending along opposite generally flat wall regions of said envelope and constituting a barrier separating the other electrodes from said wall regions; each of said continuous metallic sheet elements of the anode electrode having two spaced retainer regions having frictional clamping engagement with facing edge regions of the two spacer elements for securing said anode electrode to said spacer elements.

6. In an electron space discharge device: a cathode electrode, an anode electrode and at least one grid electrode interposed between the cathode and anode electrodes; said anode electrode comprising two generally flat anode sheet elements extending parallel to each other and confining the space occupied by the other electrodes; said electrodes extending longitudinally generally parallel to a common axis; a sealed generally-tubular envelope of generally oblong cross section enclosing said electrodes and extending generally co-axial therewith and having two generally flat wall regions facing said anode sheet elements; two generally-flat sheet-like insulating spacer elements extending transverse to said axis and supporting the opposite ends of said electrodes in their operative positions and holding them spaced from the envelope; said anode sheet elements extending along opposite generally flat wall regions of said envelope and being spaced from the facing flat envelope wall portion from the other flat anode sheet element so as to constitute a barrier separating the other electrodes from said wall regions; each of said continuous metallic sheet elements of the anode electrode having two spaced retainer regions having frictional clamping engagement with facing edge regions of the two spacer elements for securing said anode electrode to said spacer elements; a getter body affixed to at least one of said sheet elements; said getter body being of a material which vaporizes at a temperature appreciably higher than the temperature to which the sheet element has to be heated to properly degas it during the exhaust process and containing sufficient getter material so that upon completion of the anode degassing procedure the getter body on said sheet element is sufficient to effect the required absorption of the remaining gases in the envelope.

7. In an electron space discharge device: a cathode electrode, an anode electrode and at least one grid electrode interposed between the cathode and anode electrodes; said anode electrode comprising two generally flat anode sheet elements extending parallel to each other and confining the space occupied by the other electrodes; said electrodes extending longitudinally generally parallel to a common axis; a sealed generally tubular envelope enclosing said electrodes and extending generally co-axial therewith, and having two generally flat wall regions facing said anode sheet elements; two sheet-like insulating spacer elements extending transverse to said axis and supporting the opposite ends of said electrodes in their operative positions and holding them spaced from the envelope; said anode sheet elements extending along opposite wall regions of said envelope and being spaced from the facing flat envelope wall portion by a distance smaller than the distance separating it from the other flat anode sheet element so as to constitute a barrier separating the other electrodes from said wall region; at least one anode sheet element having an intermediate sheet portion which is deformed to provide by itself an endless pocket wall projecting outwardly toward the facing flat wall region of the envelope; said pocket space having an open side facing a flat envelope wall region; and a body of getter material held in said pocket in such position that upon evaporation, vapor of said getter material shall be confined to the region of the envelope wall facing said sheet element; the mass of the anode which has to be heated for securing desired evaporation of the getter body being sufficiently small so that the additional gases given off by the heated anode do not substantially impair the required degree of vacuum.

8. In an electron space discharge device: a cathode electrode, an anode electrode and at least one grid electrode interposed between the cathode and anode electrodes; said anode electrode comprising two generally flat anode sheet elements extending parallel to each other and confining the space occupied by the other electrodes; said electrodes extending longitudinally generally parallel to a common axis; a sealed, generally tubular envelope of generally oblong cross-section enclosing said electrodes and extending generally co-axial therewith, and having two generally flat wall regions facing said anode sheet elements; two sheet-like insulating spacer elements extending transverse to said axis and supporting the opposite ends of said electrodes in their operative positions and holding them spaced from the envelope; said anode sheet elements extending along opposite generally flat wall regions of said envelope and being spaced from the facing flat envelope wall portion by a distance smaller than the distance separating it from the other flat anode sheet element so as to constitute a barrier separating the other electrodes from said wall regions; each of said anode sheet elements having an intermediate sheet portion which is deformed to provide by itself an endless pocket wall projecting outwardly toward the facing flat wall region of the envelope; said pocket space having an open side facing a flat envelope wall region; and a body of getter material held

in said pocket in such position that upon evaporation, vapor of said getter material shall be confined to the region of the envelope wall facing said sheet element; the mass of the anode which has to be heated for securing desired evaporation of the getter body being sufficiently small so that the additional gases given off by the heated anode do not substantially impair the required degree of vacuum.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,628,987	King	May 17, 1927
2,355,083	Krim	Aug. 8, 1944