Dec. 16, 1952 D. W. POWER 2,621,996

METHOD OF MAKING ULTRAHIGH FREQUENCY ELECTRON DISCHARGE DEVICE

Original Filed Oct. 26, 1946

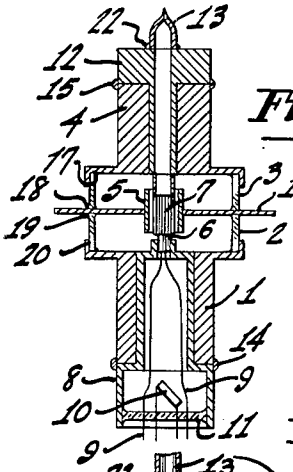


Fig. 1.

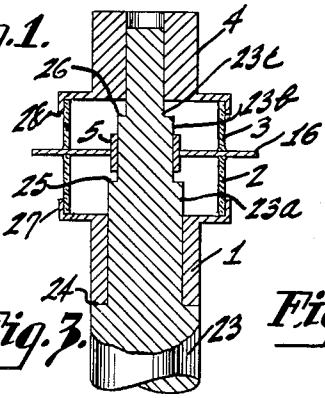


Fig. 3.

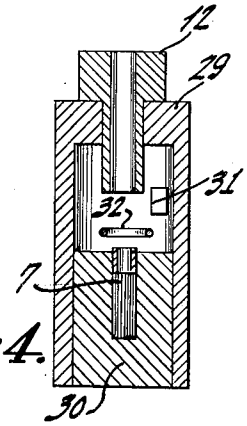


Fig. 4.

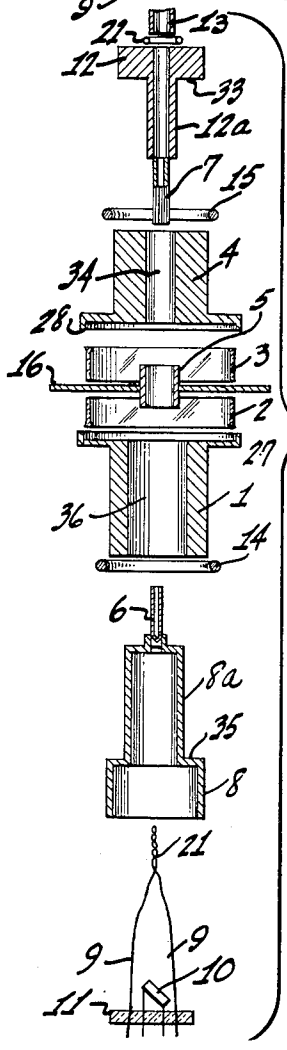


Fig. 2.

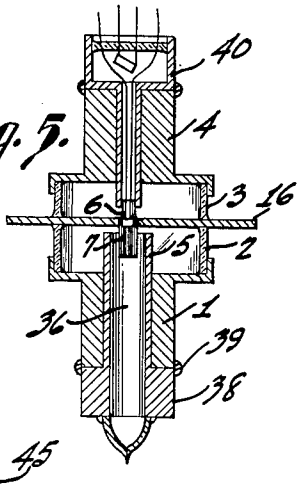


Fig. 5.

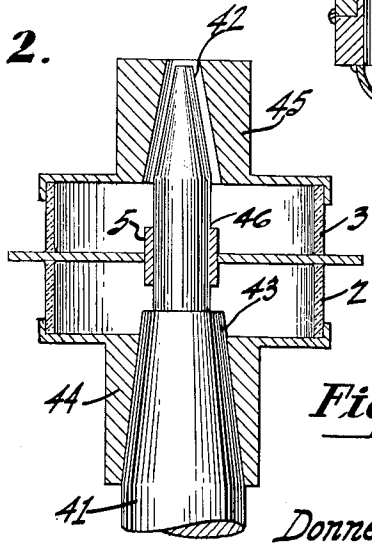


Fig. 6.

Inventor
Donnell W. Power

By
William A. Zalesak
Attorney

Patented Dec. 16, 1952 2,621,996

UNITED STATES PATENT OFFICE

2,621,996

METHOD OF MAKING ULTRAHIGH FREQUENCY ELECTRON DISCHARGE DEVICE

Donnell W. Power, New Providence, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Original application October 26, 1946, Serial No. 705,951. Divided and this application January 20, 1950, Serial No. 139,616

12 Claims. (Cl. 316—19)

1

The present invention relates to electron discharge devices, and more particularly to a method of manufacture and assembly of such devices.

This is a division of my co-pending application, Serial No. 705,951, filed October 26, 1946, and assigned to the same assignee as the present application.

Electron discharge devices designed for ultra high frequency operation are more limited as to structure than devices for use at lower frequencies. For example, the electrode elements in an ultra high frequency electron discharge device must observe closer tolerances in spacings relative to each other and must maintain such critical spacings during operation of the device. In addition the electrode leads for such devices must be characterized by critical dimensions and spacings to avoid undesired capacity effects therebetween. Although these factors require recognition, to a lesser or greater extent, in all types of electron discharge devices they become more critical as the frequency at which the devices operate is increased.

These structural limitations present obvious problems in the manufacture of such devices, particularly by mass production methods. One of the problems concerns the selection of the most desirable type of electrode elements. Thus, in some types of electron discharge devices useful at ultra high frequencies, planar type electrode elements have been utilized; for example, in triodes a flat grid is interposed between a flat surfaced cathode and a flat surfaced anode, both closely spaced from the grid. In other types of such devices, concentric electrode elements have been proposed. In certain respects concentric electrode elements are more advantageous than planar electrodes. For example, less heater power is required for devices using concentric electrodes than for those having planar electrodes, since in the former heat in all radial directions is utilized for producing electron emission whereas in the latter the heat in one plane only is made use of for this purpose. Furthermore, it is possible to more effectively maintain the desired alignment and spacing of concentric electrode elements during operation, once these have been fixed in manufacture, for the reason that heat produced during operation affects concentric elements in a radial sense which does not substantially disturb the spacings therebetween.

Another problem involves the structure of the electrode leads. To reduce undesired capacity effects between leads to the input and uotput electrodes of an ultra high frequency

2

electron discharge device, they should be as short as possible and spaced from each other as far as possible. This has resulted in the practice of taking the leads from spaced apart locations on the device envelope. One expedient has been to make these leads integral with the envelope, one lead being contributed by an end portion of the envelope and the other lead being formed by a disc sealed through the envelope wall. However, this arrangement is accompanied by the danger that unless the disc is sealed to the envelope prior to the fixing of the electrodes therein, the greater quantity of heat required for the larger disc envelope seal will harmfully affect the mounting of the electrodes, and any other seals previously made in assembling the device. It is, therefore, desirable in the manufacture of the device that the steps followed in assembly be characterized by a descending order of heat quantity required therein to safeguard the seals produced by such heat.

Another matter that requires consideration in the manufacture of an electron discharge device is the preservation of the electrodes from oxidation. In methods of assembly which require placement of the electrodes in the envelope of the device prior to effecting the various seals for completing the envelope, there is danger that the heat required for such seals might harmfully oxidize the previously sprayed electrodes. It is obviously desirable therefore, that the manufacturing procedure involve completion of the seal for forming the envelope prior to insertion of the electrodes therein.

It is an object of my invention to provide an improved electron discharge device useful at ultra high frequencies.

Another object of my invention is to provide a structure for and a method of assembling an electron discharge device which will facilitate assembly and insure good seals.

A further object is to provide a method of fabricating electron discharge devices useful at ultra high frequencies in which spacing of the electrode elements is determined in a positive manner by elements previously assembled and sealed.

An additional object is to provide a method of making an electron discharge device useful at ultra high frequencies, having hollow electrodes which follow an order in manufacture assuring good seals and a minimum oxidation of the electrodes thereof.

Another object is to provide a method of making an electron discharge device from previously

prepared parts formed to permit the use of centering means for automatically centering and spacing the parts during assembly and to permit an order to be followed in the use of heat to preserve previously fixed elements of the device and to reduce oxidation of the electrodes of the device.

For a better understanding of my invention reference will now be made to the accompanying drawings which show embodiments of my invention for purposes of illustration only and not by way of limitation, in which:

Figure 1 shows a triode, in section, made according to my novel method wherein the anode is supported in the central aperture of the disc lead-in conductor, the electrodes and envelope being cylindrical;

Figure 2 is an exploded view, partly in section, of the relationship of the parts employed in my novel method of fabricating the ultra high frequency triode shown in Figure 1;

Figure 3 shows in section, a step in my novel method wherein the parts forming the walls of the envelope are assembled on a centering pin prior to the sealing together of the parts; and

Figure 4 is a view in section of the jig used for centering and mounting the grid on its support;

Figure 5 shows in section, a modification wherein the grid is supported on the disc lead-in conductor; and

Figure 6 is a view in section of a further modification wherein the chambers or passageways in the end portions of the envelope are formed by tapered walls and the centering pin is provided with certain longitudinal sections of tapered elevation.

Referring now to the drawing in more detail, there is shown in Figure 1 an ultra high frequency triode made in accordance with the method of my invention which includes an envelope and electrodes mounted therein. The envelope includes a tubular metallic flanged end section **1**, a tubular glass section **2**, a second tubular glass section **3** and a tubular metallic flanged end section **4**. Each of these envelope sections defines an open-ended chamber or passageway. The electrodes, which in this embodiment are cylindrical in shape, comprise an anode **5**, a cathode **6**, and a grid **7**, which are concentrically disposed and have equal lengths. Supports are provided for each of the electrodes.

Cathode support **8** has a hollow interior affording accommodations for cathode heater leads **9** and getter **10**. This support **8** is mounted with a portion thereof in snug engagement with the interior wall of tubular end section **1** and fixed in position thereon by brazing **14**. The open end of cathode support **8** is sealed by a vitreous closure member **11**.

The grid support **12** has a channeled interior affording communication between the interior of the envelope and exhaust tube **13**, shown pinched off after exhaust. A portion of support **12** forms a snug fit with the interior wall of the tubular end section **4** and is fixed in position thereon by being brazed thereto at **15**. Both the cathode support **8** and grid support **12** abut end surfaces of the tubular end portions **1** and **4** of the envelope to fix their longitudinal spacings.

The anode support comprises a disc **16** having a central aperture in which anode **5** is mounted. This disc is sealed across the tubular glass sections **2** and **3** by glass-to-metal seals **17, 18, 19** and **20**.

A feature of the method of my invention resides in first assembling and sealing together the larger side wall sections **1, 2, 3** and **4** of the envelope and disc **16** with opposite ends of the envelope open for subsequent insertion and mounting of the electrodes therein. This completes the larger seals **17, 18, 19** and **20** before the other seals, closing the ends of the envelope and requiring a lesser quantity of heat, are made. This feature permits the use of disc **16** as an electrode support and as a lead-in conductor without danger that the sealing thereof to the envelope might impair other seals of the device. This feature also provides for insertion of the electrodes within the envelope after the larger seals have been completed, thus preventing oxidation of the electrodes by the heat required for such larger seals.

Another feature of the invention is the provision of previously prepared parts for forming the envelope and the electrode assembly, which are correlated in shape and dimensions to a centering and spacing means employed in the manufacture of the device. This feature of the invention requires that the parts for forming the envelope side wall be first assembled and sealed, leaving end portions open for insertion of electrodes and their supports into the envelope in predetermined locations for forming snug fits between the electrode supports and interior wall portions of the envelope.

The open ended chambers or passageways **34, 36** in flared end sections **4** and **1**, shown in Figure 2, have dimensions for receiving in snug fits portion **12***a* of grid support **12** and portion **8***a* of cathode support **8**, respectively. The end chambers **34, 36** are accurately aligned axially by a jig or centering pin to be described. The grid **7** and cathode **6** are also accurately aligned axially with respect to their supports **12** and **8**, which alignment may be accomplished in the manner shown in Figure 4. As will be more fully described, the anode **5** is also accurately aligned axially with respect to chambers **34, 36** by the centering pin referred to. The supports **12***a* and **8***a* for the grid and cathode are of a length to dispose the grid **7** and cathode **6** in concentric relation with respect to each other and with respect to anode **5** when the supports referred to are extended into the end chambers **34, 36**.

In a modification to be described and as shown in Figure 5, the central aperture in disc **16** is provided with walls that define a chamber that is aligned with respect to the end chambers formed in end members **1** and **4**. In this modification therefore three axially aligned chambers are provided for receiving electrode supports for disposing the electrodes in coaxial and concentric relation.

It will be noted that my invention provides for an electrode arrangement wherein the electrodes are of different diameter to permit a first electrode to telescope into a second electrode, and to permit the first and second electrodes to telescope into a third electrode. All the electrodes are therefore coextensive axially of the device and in registering relation around a common axis. The requirement for a common axis for the electrodes and coextensive disposition of the electrodes results in an electrode arrangement wherein the electrodes are spaced from each other radially of said axis and in all directions normal to said axis.

Therefore, the feature of my invention which requires that the side walls of the envelope of the device be first assembled and sealed, is advantageous from the several standpoints of preserv-

ing the seals of the device, avoiding the danger of oxidation of the electrodes, and properly aligning and spacing the electrodes within the envelope.

Figure 2 shows an exploded view of the relationship of the previously prepared parts which when assembled and sealed together form the structure of my novel electron discharge device. In this modification of my invention the previously prepared parts, with the exception of the cathode heater, are cylindrical in form and include cathode 6, mounted on the support 8 and energized by cathode heater 21 having leads 9 sealed through insulating closure member 11, which seals the open end of cathode support 8. The envelope side wall portions include metallic end portions 1 and 4 and cylindrical glass members 2 and 3. The anode structure includes disc 16 supporting anode 5. The grid structure includes grid support 12 and grid 7. Exhaust tube 13 is in position to be sealed over the opening in grid support 12 for communicating with the interior of the envelope. The metallic parts 8, 1, 4, 12 and 13 are sealed together by brazing rings 14, 15 and 22.

The dimensions and shapes of each of these previously prepared parts are determined in relation to dimensions and shapes of predetermined portions of a centering pin 23 shown in Figure 3. This figure shows the parts for forming the envelope assembled on centering pin 23 prior to sealing. The cylindrical interior space of member 1 forms a snug fit with the offset portion 23*a* of pin 23 and rests on a shoulder 24 thereof. The cylindrical anode 5 forms a tight fit around another portion 23*b* of pin 23 and is limited in downward movement by shoulder 25 on this pin. Envelope member 24 forms a snug fit around a still further offset portion 23*c* of pin 23 and is limited in downward movement by shoulder 26 on the pin. Since the offset portions referred to of pin 23 are accurately centered, a snug engagement therewith of envelope members 1 and 4 and anode 5 results in an alignment of these members and anode 5. Since anode 5 is mounted in the center of disc 16, the alignment of anode 5 with members 1 and 4, also results in the alignment of disc 16 with these members, assuming the anode has been amounted on disc 16 prior to this assembly step.

Envelope end members 1 and 4 are each provided with a flange having annular ribs or guides 27 and 28 for engagement with end portions of cylindrical glass members 2 and 3. Such engagement of cylindrical glass members 2 and 3 with the annular ribs or guides 27—28 results in an alignment of these glass cylinders with envelope end portions 1 and 4. The alignment of these cylindrical glass members 2 and 3 with envelope portions 1 and 4 completes the alignment of all the parts entering into the structure of the device envelope.

The next step involves the sealing together of the envelope parts referred to while maintaining their aligned relationship. The desired longitudinal spacing of the parts referred to is accomplished during the sealing operation to be described. The sealing operation involves the application of heat to form glass-to-metal seals between cylindrical glass member 2, the envelope end member 1 and the disc 16. When the seal is effected between these members, anode 5 rests on shoulder 25 of pin 23. Each of the offset portions 23*a*, 23*b* and 23*c* is characterized by a predetermined length. Therefore when anode 5 rests on shoulder 25 of pin 23 there is a predetermined longitudinal spacing between the lower edge of anode 5 and the lower end of envelope end portion 1. The next step is the sealing of the glass member 3 to disc 16 and the envelope end portion 4. When these seals are accomplished the envelope end portion 4 rests on shoulder 26 of pin 23. The longitudinal spacing between the upper edge of anode 5 and the upper end of envelope end portion 4 is, therefore, of a predetermined magnitude.

The steps thus far described have resulted in an accurate alignment of the parts forming the envelope of my device and a proper longitudinal spacing therebetween. The next step involves the mounting of electrodes and electrode supports within the envelope wherein the aligned and appropriately spaced parts referred to automatically align and properly space the electrodes within the device.

In the modification of my invention presently described, the cathode and grid electrodes constitute parts of a previously prepared structure which include these electrodes as well as supports therefor. These electrodes and their supports observe predetermined dimensional values so that the electrode supports have a portion thereof which forms a snug fit with internal chambers or passageways defined by envelope end members 1 and 4. The cathode and grid electrodes are each suitably centered on their supports so that when these supports engage the interior walls of the envelope end members 1 and 4, these electrodes are accurately aligned. The cathode and grid supports are also provided with portions thereof which limit their longitudinal movement within said end portions 1 and 4. This limitation of longitudinal movement of the cathode and grid supports results in an accurate longitudinal spacing of the cathode and grid with respect to each other as well as with respect to the anode 5.

Figure 4 shows a jig which I may employ for centering the grid 7 on its support 12. This jig includes an outer member 29 for holding the grid support 12 and an inner member 30 fitting snugly into the outer member 29 for holding the grid 7 in appropriately aligned and spaced relationship with respect to support 12. Members 29 and 30 may be made of metals having different coefficients of expansion, so that the inner member expands more than the outer member when similarly heated to accomplish a tight fit between these members to more accurately align them. Members 29 and 30 are given longitudinal movement relative to each other until the upper end of grid 7 abuts the lower end of grid support 12 as viewed in Figure 4. Sufficient clearance around grid 7 is provided for brazing ring 32, which is heated through aperture 31 in member 29 to fix grid 7 to its support. Jig members 29 and 30 are so constructed that they hold the grid 7 and the grid support 12 in accurate alignment and longitudinal spacing during the brazing step. A jig employing similar principles may be used to center cathode 6 on its support 8.

After the cathode and grid electrodes are thus accurately mounted on their supports, they are inserted into the envelope. Grid 7 and grid support 12 are inserted in the envelope end section 4 with shoulder 33 of grid support 12 abutting against the upper end of end portion 4 and sealed thereto by brazing ring 15. During this brazing step, a cooling clamp may be employed to absorb the heat required for the braz-

ing. The portion 12a of the grid support fits snugly within the cylindrical space 34 of envelope end portion 4. This results in an accurate alignment and spacing of grid 7 with respect to anode 5.

Cathode 6 and cathode support 8 are next inserted in envelope end portion 1 with the shoulder 35 of the cathode support abutting against the lower end of this portion. The portion 8a of the cathode support fits snugly within the cylindrical space 36 in the envelope end portion 1. This results in an accurate alignment and spacing of cathode 6 with respect to grid 7 and anode 5.

As has been stated before herein, the longitudinal dimensions of the cathode and grid and their supports are predetermined, whereby the cathode and grid each may have a length equal to that of the anode. The cathode and grid supports are each provided with a length from their shoulders 33 and 35 to their electrode supporting ends which accurately positions the cathode and grid within the cylindrical space defined by anode 5. The electrodes, therefore, are accurately aligned and may be characterized by a displacement that extends only in a radial or lateral sense.

Cathode heater 21 is next inserted into the cathode 6 and the open end of the cathode support is sealed by sealing member 11.

The grid 7 and grid support 12 are provided with a channel communicating with the interior of the device envelope. Exhaust tube 13 is next brazed to the upper end of this channel as viewed in Figures 1 and 2 by brazing ring 22 and the envelope is evacuated. The exhaust tube is then closed as by pinching and the device is complete.

It will be seen, therefore, that according to the novel method of my invention electrodes are mounted in critically aligned and spaced relationships within an envelope, the resultant structure being characterized by many advantages. Moreover this method inherently provides a procedure which permits the desired type of leads for ultra high frequency use to be employed while assuring good seals, freedom from oxidation of the electrodes by the heat required for such seals, and unimpaired fixed mounting of the electrodes within the envelope of the device.

Figure 5 shows a modification wherein the grid 7 is suitably mounted in a central aperture of disc 16. Anode 5 is supported at one end of the envelope on a support 38 on which it is suitably centered, as by a jig of the type previously referred to. Anode support 38 is brazed to the envelope end member 1 at 39. The cathode 6 is mounted on support 40, which is brazed to envelope end member 4. In this modification the anode 5 occupies the larger cylindrical space 36 in end member 1 while the cathode support occupies the smaller cylindrical space in end member 4. This modification requires no change in the structure of envelope end members 1 and 4 or of glass cylindrical members 2 and 3. It does, however, require a modification of the structure of cathode support 40 and anode support 38. The exhaust tube is shown brazed to the end of anode support 38, the support and anode having interior channels communicating with the interior of the envelope.

Figure 6 shows a further modification wherein a centering pin 41 has tapered portions 42 and 43 which engage correspondingly tapered interior wall portions of envelope end members 44 and 45. Pin 41 is provided with a cylindrical portion 46 which receives anode 5 in a snug fit. In this modification anode 5 and envelope end portion 44 are accurately centered by engaging cylindrical portion 46 and tapered portion 43, respectively, of the pin. Envelope end portion 45 becomes centered only during the sealing operation when this member is brought into snug engagement with tapered portion 42 of pin 41. The tapered portions of pin 41 accomplish both a centering and accurate longitudinal spacing of envelope end portions 44 and 45 and anode 5. Cylindrical glass members 2 and 3 are centered in a manner previously described. The other electrodes are also suitably aligned and longitudinally spaced with respect to the anode 5 by engagement of their supports with the interior tapered walls of envelope end portons 44 and 45. The remaining steps for the completion of the device are similar to those referred to in connection with previously described modification of Figures 1 and 2.

While the invention has been described by reference to several embodiments thereof it is to be clearly understood it is not limited thereto. While these embodiments involve the use of cylindrical and tapered parts, it is obvious that parts of other configuration may be used without departing from the invention; and although the use of the invention in a triode has been described it can with equal advantage be employed in a diode or in a device having more than three electrodes. It is, therefore, desired to include these and other modifications which may suggest themselves to persons skilled in the art within the scope of the appended claims.

I claim:

1. A method of fabricating an ultra high frequency electron discharge device using a removable centering means provided with longitudinally displaced stops thereon and previously prepared parts including envelope sections having predetermined internal dimensions and electrode structures including hollow electrodes of different cross sectional area and supports therefor, some of said supports having dimensions for forming a snug fit when received in said envelope sections, said electrodes being centered on said supports, comprising the steps of assembling the envelope sections and one of said supports in a predetermined longitudinal order on said removable centering means, joining the envelope sections and said one of said supports by sealing, removing said removable centering means, and mounting the other of said electrode structures in said envelope with the supports of some said structures in snug engagement with said envelope sections for accurately aligning and radially spacing said electrodes.

2. A method of fabricating an ultra high frequency electron discharge device using a removable centering means provided with longitudinally displaced stops thereon and previously prepared parts including envelope sections having predetermined internal dimensions and electrode structures including hollow electrodes of different cross sectional area and supports therefor, some of said supports having dimensions for forming a snug fit when received in said envelope sections, said electrodes being centered on said supports, comprising the steps of assembling the envelope sections and one of said supports in a predetermined longitudinal order on said removable centering means, joining the envelope sections and said one of said supports by sealing, while subjecting said sections and said one of said sup-

ports to longitudinal pressure against said stop means, removing said removable centering means, and mounting the other of said electrode structures in said envelope with the supports of some of said structures in snug engagement with said envelope sections for accurately aligning and radially spacing said electrodes.

3. The method of fabricating an ultra frequency electron discharge device using a fixed centering means having longitudinally displaced stops thereon, and previously prepared parts including envelope parts, hollow electrode parts having ducts therethrough and lead-in conductor parts, said envelope parts including two metallic end portions having passageways therethrough, and an intermediate glass portion, said electrode parts including electrodes and supports therefor, said electrodes being centered on said supports to form electrode structures, one of said lead-in conductor parts comprising a centrally apertured metallic disc, said electrode structures having stops for abutting against surfaces of said end portions to limit their longitudinal displacement, which comprises the steps of assembling said envelope parts and said disc on said centering means in a predetermined longitudinal order, joining said parts by the application of heat which automatically fixes the longitudinal spacing of said end portions of the envelope and said disc by abutment against said stops on said centering means, removing said centering means, mounting said electrode structures in said passageways in said end portions with the supports thereof in snug fit with the walls of said passageways, moving said electrode structures longitudinally toward each other until said stop means thereon abut said surfaces of said end portions to longitudinally space said electrodes, fixing said electrode structures to said end portions, sealing the duct in one of said electrode structures, exhausting the envelope through the duct in the other of said electrode structures and sealing said duct.

4. A method of fabricating an ultra high frequency electron discharge device using a centering and a longitudinal spacing means and previously prepared parts including envelope parts, electrode and electrode support parts, said supports including lead-in conductors for said devices, which comprises the steps of aligning and longitudinally spacing said envelope parts by positioning the same in predetermined order on said centering and longitudinal spacing means, sealing said parts together, and subsequently mounting said electrode and electrode support parts in said envelope with a portion of said support extending exteriorly of the envelope, said electrodes being centered and registered by engagement of the support parts thereof with certain parts of said envelope previously centered and longitudinally spaced.

5. A method of fabricating an ultra high frequency electron discharge device from previously prepared envelope and electrode parts which comprises assembling said envelope parts in aligned relation, sealing and fixing the longitudinally spaced relation of said envelope parts without disturbing the said aligned relation thereof, and mounting said electrode parts in said envelope in aligned and spaced relations determined by certain of said envelope parts.

6. A method of making an ultra high frequency electron discharge device from previously prepared envelope, electrode and electrode support parts, said envelope parts having passageways therethrough which comprise positioning said envelope parts in aligned relation, sealing said parts together, determining the longitudinal spacing of said parts during said sealing operation, mounting said electrodes on said supports in predetermined aligned and longitudinally spaced relation, mounting said supports in previously aligned and longitudinally spaced parts of said envelope whereby said electrodes are aligned and observe a predetermined spacing.

7. A method of manufacturing an ultra high frequency electron discharge device using a centering means having different transverse sections and stop means, and previously prepared parts comprising envelope sections having different internal transverse sections, a plurality of electrodes having supports, the dimensions of which correspond to some of said transverse sections to provide a close fit when received within said sections, comprising the steps of assembling said sections and one of said electrodes together with its support in successive longitudinal positions on said centering means in coaxial alignment, sealing said sections and said support together, removing said centering means, inserting the other of said electrodes and supports in said assembled envelope sections with some of said supports snugly engaging the interior walls of said sections to position said electrodes in predetermined spaced relation within said envelope, and sealing said supports to said envelope.

8. A method of manufacturing an ultra high frequency electron discharge device using a centering means having different transverse sections and stop means, and previously prepared parts comprising envelope sections having different internal transverse sections, a plurality of electrodes having supports, the dimensions of which correspond to some of said transverse sections to provide a close fit when received within said sections, comprising the steps of assembling said sections and one of said electrodes together with its support in successive longitudinal positions on said centering means in coaxial alignment, sealing said sections and said support together while subjecting said sections and said support to longitudinal pressure against said stop means, removing said centering means, inserting the other of said electrodes and supports in said assembled envelope sections with some of said supports snugly engaging the interior walls of said sections to position said electrodes in predetermined spaced relation within said envelope, and sealing said supports to said envelope.

9. A method of manufacturing an ultra high frequency electron discharge device using a centering means having different transverse sections and stop means, and previously prepared parts comprising envelope sections having different internal transverse sections, a plurality of electrodes having supports, the dimensions of which correspond to some of said transverse sections of said envelope sections to provide a close fit when received within said sections, comprising the steps of assembling said sections in successive longitudinal positions on said centering means in coaxial alignment, sealing said sections together, while subjecting said sections to longitudinal pressure against said stop means, removing said centering means, inserting said electrodes and supports in said assembled envelope sections with some of said supports snugly engaging the interior walls of some of said sections to position said electrodes in predetermined spaced relation within said envelope, and sealing said supports to said envelope.

10. A method of manufacturing an ultra high frequency electron discharge device using a centering means having different transverse sections and stop means, and previously prepared parts comprising envelope sections having different internal transverse sections, a plurality of electrodes having supports, the dimensions of which correspond to some of said transverse sections of said envelope sections, to provide a close fit when received within said sections, comprising the steps of assembling said sections in successive longitudinal positions on said centering means in coaxial alignment, sealing said sections together, removing said centering means, inserting said electrodes and supports in said assembled envelope sections with some of said supports snugly engaging the interior walls of some of said sections to position said electrodes in predetermined spaced relation within said envelope, and sealing said supports to said envelope.

11. The method of fabricating an ultra high frequency electron discharge device using a centering means having longitudinally displaced stops and longitudinal portions of different transverse sections, and previously prepared parts including envelope parts and electrode parts, said envelope parts comprising two metallic end portions having passageways therethrough correlated in dimensions with predetermined longitudinal portions of said centering means and an intermediate insulating portion, said electrode parts including electrodes and supports on which said electrodes are centered, said supports having stop means thereon and dimensions correlated to predetermined portions of said centering means, which comprises the steps of assembling said envelope and one of said electrode parts on said centering means in predetermined longitudinal order, joining said parts by the application of heat while automatically fixing the longitudinal spacing of said parts by abutment thereof against said stops on said centering means, removing said centering means, mounting the others of said electrode parts in said passageways in longitudinally spaced relationships determined by said stop means on said supports and fixing said relationships.

12. The method of forming a completed assembly of an electron discharge device using a removable centering means and previously prepared parts, said centering means having stops thereon and longitudinal portions of different cross section, said previously prepared parts including envelope parts some of which have dimensions to engage said longitudinal portions in snug fits and abut against said stops, and electrode assembly parts of predetermined dimensions each comprising an aligned structure including a portion having external dimensions substantially similar to those of one of said longitudinal portions, comprising positioning said envelope parts on said centering means in a predetermined longitudinal order with some of said parts engaging said longitudinal portions of the centering means in a substantially snug fit and abutting against certain of said stops, applying heat to said parts to soften end portions of certain of said parts while forcing them together to cause certain other of said parts to abut against certain others of said stops and to join said parts to form the envelope of the device, removing said centering means, inserting in said envelope through apertures therein formed by removal of said centering means at least two of said electrode assembly parts with said portions thereof received in snug fits in said envelope parts previously engaged in snug fits by said centering means fixing said electrode assembly parts in said envelope, and exhausting the envelope.

DONNELL W. POWER.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,872,344	Robinson	Aug. 16, 1932
2,107,903	Peters	Feb. 8, 1938
2,422,945	Brian	June 24, 1947
2,428,610	Beggs	Oct. 7, 1947
2,473,969	Pryslak et al.	June 21, 1949