Nov. 19, 1946. J. E. BEGGS 2,411,184

FABRICATION OF DISCHARGE DEVICES

Filed July 2, 1942 2 Sheets-Sheet 1

Fig.2.

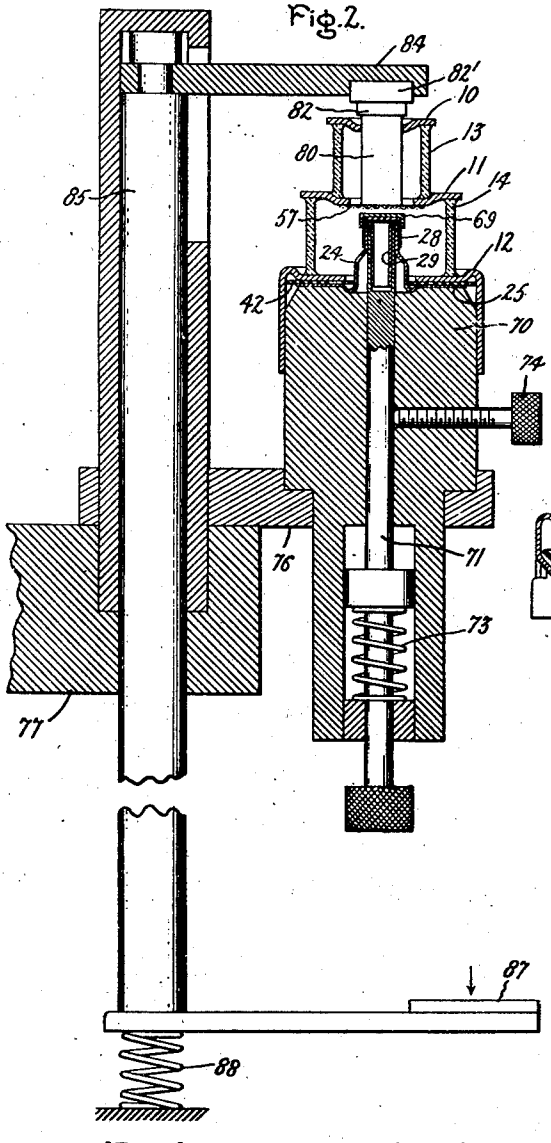


Fig.1.

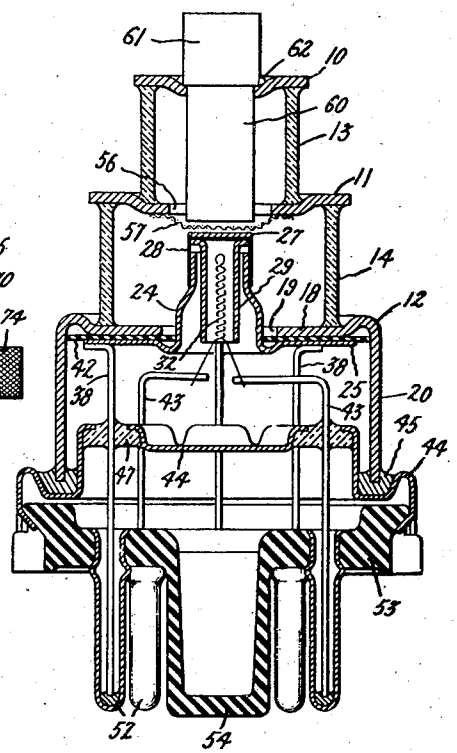


Fig.3.

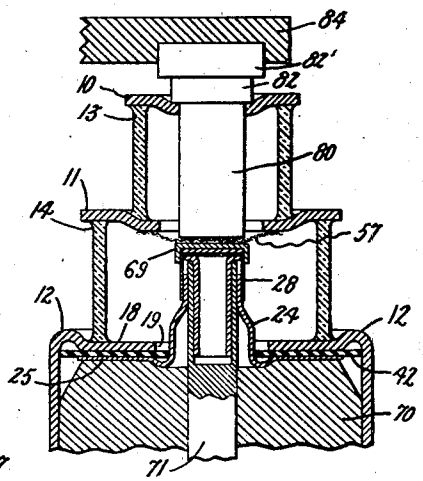


Fig.4.

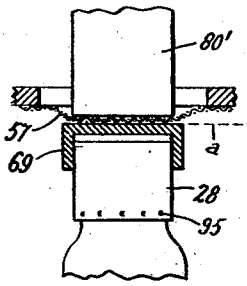
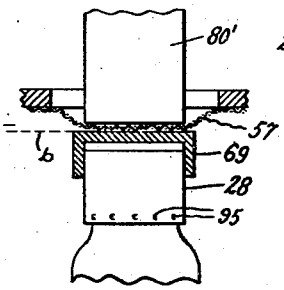


Fig.5.



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FABRICATION OF DISCHARGE DEVICES

Filed July 2, 1942 2 Sheets-Sheet 2

Fig. 6.

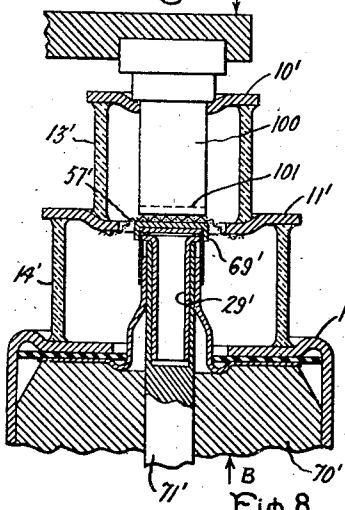


Fig. 7.

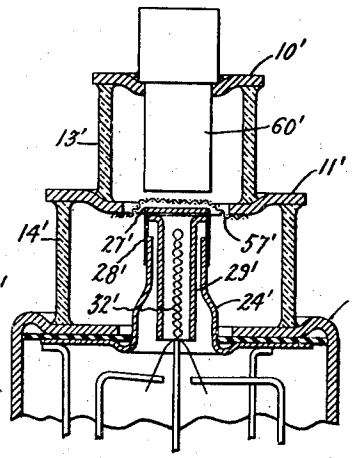


Fig. 9.

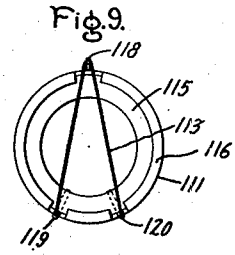


Fig. 10.

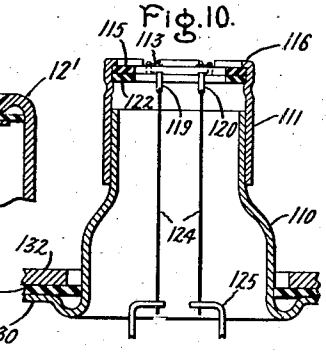


Fig. 8.

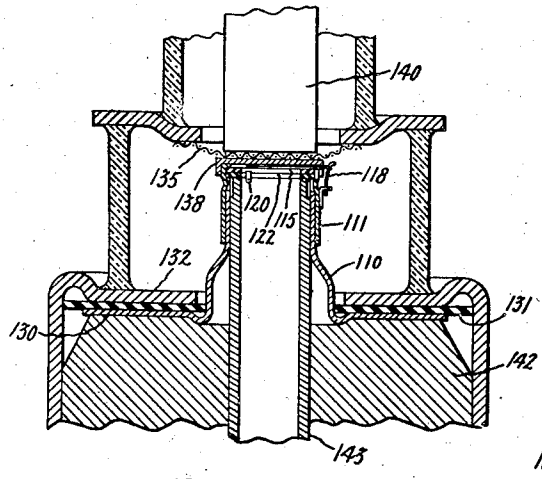


Fig. 11.

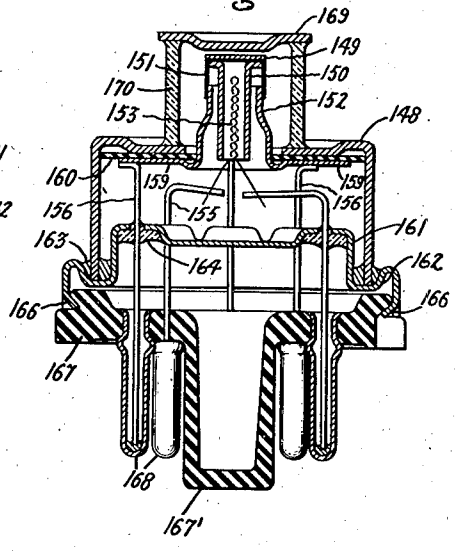
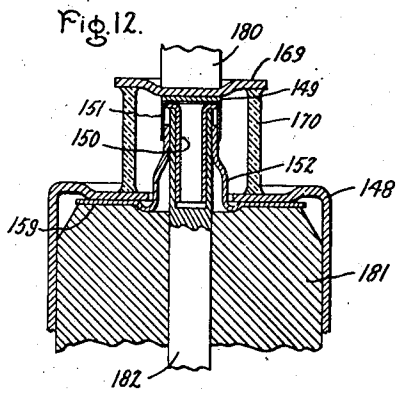


Fig. 12.



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Patented Nov. 19, 1946

2,411,184

UNITED STATES PATENT OFFICE

2,411,184

FABRICATION OF DISCHARGE DEVICES

James E. Beggs, Scotia, N. Y., assignor to General Electric Company, a corporation of New York

Application July 2, 1942, Serial No. 449,391

15 Claims. (Cl. 250—27.5)

1

This is a continuation-in-part of my copending application, Serial No. 436,633, filed March 28, 1941, and assigned to the General Electric Company, a corporation of New York.

The present invention relates to the fabrication of electronic discharge devices and more particularly to a process for obtaining a precise spacing of the electrodes of such devices.

In connection with vacuum tubes for use in the ultra-high frequency range it is important that the interelectrode distances be uniformly maintained from tube to tube with a deviation not materially in excess of a fraction of a mil. Any deviation greater than this, especially with reference to the spacing between the cathode and grid electrodes, results in inconsistent and unpredictable operating characteristics and is, therefore, highly undesirable.

It is an object of the present invention to provide a method of tube fabrication by which tolerances as close as those specified can be readily maintained.

One aspect of the invention which is important in the attainment of the foregoing object involves making at least one of the electrodes employed of deformable construction, installing the electrode in approximately its desired location in the tube structure, and thereafter deforming the electrode in situ to bring its active part more precisely into the desired relationship with the other electrodes of the tube.

Another important feature consists in the use of an arrangement and procedure by which adjustment of the deformable electrode serves concurrently to establish the proper relationship between the remaining electrodes of the tube.

A still further feature, which is ancillary to those specified above, comprises the use of a multipart cathode construction of such nature that relative adjustment of the respective parts affords an effective means for bringing the active component of the cathode into precisely the proper correlation with the other electrodes.

The features which I desire to protect herein are pointed out in the appended claims. The invention itself, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawings in which Fig. 1 represents in section a three-element discharge tube of a type which may suitably be constructed in accordance with the invention; Figs. 2 and 3 represent successive steps in the process of fabricating a tube such as that illustrated in Fig. 1; Figs. 4 and 5 represent optional steps in the process of completing the fabrication of the tube of Fig. 1; Figs. 6 and 7 show an alternative method of procedure according to the invention; Fig. 8 illustrates the application of the invention to a form of device somewhat different from that illustrated in Fig. 1; Figs. 9 and 10 are enlarged detail views which illustrate various aspects of the structure of Fig. 8; Fig. 11 is a sectional view of a diode of a type which may be produced in accordance with the invention, and Fig. 12 shows an intermediate step in the fabrication of the tube of Fig. 11.

2

Referring particularly to Fig. 1 the discharge tube there illustrated includes a series of three circular metal members 10, 11 and 12 which are arranged in spaced relation and which are mutually separated by vitreous (e. g. glass) cylinders 13 and 14 sealed between them. Both the metal members 10 to 12 and the cylinders 13 and 14 are of progressively decreasing diameter from one end of the tube to the other so that the tube as a whole has a step-wise configuration.

The metallic part 12 includes a planar portion 18 having a central opening 19 and a circular rim 20 which extends away from the main body of the discharge enclosure. Within the opening 19 there is provided a cathode structure which includes a supporting part 24 and an active part consisting of a metal disk 27, a cylindrical sleeve 28 secured to the disk 27 and a flanged sleeve 29 which depends from the disk. The disk is preferably coated on its upper surface with an activating coating such as a layer of barium and strontium carbonates, and a filamentary heater 32 arranged within the cathode structure serves to maintain the disk at a temperature of thermionic emission. In the use of the device, the heat developed by the filament 32 is conveyed to the emissive disk 27 both by direct radiation and by conduction through the sleeve 28. The sleeve 29 serves the further function of minimizing radiation of heat to the other parts of the cathode structure.

The part 28, by which the emissive disk 27 is directly supported, is preferably constituted of a thin foil of a metal of low thermal conductivity such, for example, as a nickel-iron-cobalt alloy (Fernico). Because of the relatively limited heat conduction path provided by the foil, which may be on the order of a few tenths of a mil in thickness, the loss of heat from the disk 27 to the other part of the cathode structure is relatively slight, and efficient operation of the cathode is assured. The part 28 is of such dimensions that it may slide over the part 24, being prevented from

moving with respect to that part, however, by a welded connection to it. (The cathode structure just specified, including particularly the combination of the heat shield 29 and the part 28 which provides high resistance to heat flow, is more fully described and is claimed in my copending application Serial No. 453,158, filed August 1, 1942, and assigned to the General Electric Company, a corporation of New York.)

For the purpose of supporting the cathode structure, a series of relatively rigid conductors 38 are attached to the lower surface of a circular flange 25 formed on the part 24. The part 25 is arranged in face to face relation with the lower surface of the part 18 but is maintained at a fixed spacing with respect to this part by the interposition of a sheet or layer of a dielectric substance 42 consisting, for example, of mica or other inorganic insulating material. As a result of this arrangement the cathode structure is insulated from the part 12 with respect to unidirectional currents while being effectively connected to it (e. g. through the capacity between the opposed surfaces of the parts 18 and 25) as far as high frequency currents are concerned. As a consequence, the part 12 is adapted to serve as a high frequency terminal for the cathode structure.

Unidirectional potential may be supplied to the cathode and heating current may be supplied to the filament 32 by means of the conductors 38 and additional conductors 43 connected to the terminals of the filament. In the illustrated arrangement, these various conductors are sealed through a metallic closure member 44 which is hermetically sealed by a soldered joint 45 to the lower edge of the circular rim 20. Individual glass-to-metal seals 47 corresponding in number to the lead-in conductors, serve to maintain the conductors in insulatingly spaced relation with respect to the part 44. The externally extending extremities of the lead-in conductors are soldered into tubular contact prongs 52, and these in turn are supported in an insulating adaptor 53 which is suitably secured in engagement with the closure member 44. A centering pin 54 which depends from the adaptor 53 serves to facilitate the orientation of the tube in a cooperating socket.

The class cylinder 14 is sealed to the upper surface of the planar wall part 18 in a region surrounding the cathode structure, the joint between these parts being vacuum-tight. In order to facilitate the production of a joint of this kind it is expedient to form the part 12 as well as the disks 10 and 11 of iron and to use for the cylinders 13 and 14 a glass which is capable of being sealed to iron, such glasses being described, for example, in Hull and Navias Patent No. 2,272,747, granted February 10, 1942. To make the sealing process easier, the various metallic parts in question are preliminarily coated with copper, which has the further effect of increasing the surface conductivity of these members with respect to high frequency currents. The copper is to some extent oxidized during the sealing procedure and it is desirable to remove this oxide before putting in place the cathode structure and the closure member 44 upon which the cathode structure is mounted. As a further preliminary to evacuation of the device and sealing in of the closure member it has been found helpful in some cases to silver or gold plate the internal and external surfaces of the parts 10, 11 and 12 to assure that these surfaces shall be perfectly clean and resistant to corrosion.

The disk 11 which is sealed to the upper extremity of the cylinder 14 is provided with a central opening 56 and supports a mesh grid 57 covering this opening, the grid being spaced only a few mils from the active surface of the cathode disk 27. Above the grid and in cooperative relation with respect to the grid and cathode, there is supported an anode in the form of a solid cylinder 60. This extends through an opening formed centrally in the disk 12 and connects above the disk with a cylindrical terminal 61 which, as shown, is of smaller diameter than the disk 10, although of larger diameter than the hole formed in the disk. A fused metal joint produced between the terminal 61 and the disk 10, as indicated at 62 renders this end of the tube vacuum-tight and completes the enclosure of the device.

In connection with a tube such as that described, it is extremely important that the spacing established between the various electrodes and especially the spacing between the cathode disk 27 and the grid 57, be maintained within very close tolerances and be substantially invariable from tube to tube. In order to fulfill this condition in a manner which is consistent with the requirements of quantity production methods, the present invention makes use of a procedure such as is illustrated in Figs. 2 and 3.

In the first of these figures there are shown certain tube parts which correspond to various parts illustrated in Fig. 1 and which are similarly numbered. These include particularly the enclosure-forming parts 10 to 14, the grid 57, and the cathode parts 24 to 29.

The parts 10 to 14 and the grid 57 are already assembled in the relationship they are expected to occupy in the finished device. These parts, together with the incompletely assembled cathode structure and a spacing cap 69 interposed between the cathode disk 27 and the grid 57, are mounted upon a fabricating jig having an outer cylinder 70 which bears upon the cathode part 25 and a retractable plunger 71 which engages the lower extremity of the part 29. (At this point no joint exists between the cathode parts 24 and 28, so that relative motion of these parts is possible.) A spring 73 located within the interior of the jig structure tends to press the plunger 71 upwardly while a set screw 74 affords a convenient means for locking the plunger in a particular location with respect to the body of the jig. The jig as a whole, and the parts which it carries are supported upon a fixed arm 76 extending outwardly from a bench 77 or other immovable working surface.

In place of the anode 60 referred to in connection with Fig. 1 the upper part of the tube contains a location-determining agency 80 which is in substantially the same form as the anode 60 but which differs in length from the anode by an amount corresponding to the spacing desired to exist between the active surface of the anode and the active portion of the grid 57. The part 80 is provided at its upper end with an enlarged cap 82 which determines the distance which the part 80 can project into the tube enclosure. The cap 82 has a still larger part 82' which is engaged by a recess formed in a movable arm 84, and at its opposite end the arm 84 is secured to the upper extremity of a plunger 85 which is attached to an operator-controlled pedal or actuator indicated at 87.

The pedal 87 acts against a spring 88 so that the plunger 85 is normally biased in the upward direction, but when pressure is applied to the pedal, the plunger and consequently the part 80 are moved downwardly. Assuming the set screw 74 to be in a retracted position, the part 80 acting on the grid 57 will overcome the action of the spring 73 and will move the discharge enclosure downwardly until the part 18 comes to rest upon the upper surface of the insulator 42. When this condition is attained the supporting part 24 of the cathode structure is in substantially its intended relationship with reference to the tube as a whole. Since further downward motion of the tube is impossible under the circumstances assumed, continued motion of the part 80 can occur only as a result of downward deformation of the grid 57 as indicated in Fig. 3. If the force applied is sufficient to cause such deformation to occur, the part 80 will eventually reach the point at which the cap 82 is seated upon the upper surface of the disk 10. If subsequently the part 80 is replaced by an anode which differs from it only in being x mils shorter, it is clear that a spacing of exactly x mils will exist between the anode and the deformed central portion of the grid 57. This then affords an extremely accurate method of obtaining a desired spacing between the grid and anode in a construction such as that illustrated in Fig. 1. In a particular case a spacing of about 13 mils has been found appropriate.

To obtain an equally accurate spacing between the grid and the active part of the cathode structure, it is only necessary to make the cathode-grid spacer 69 of the proper dimensions. In general, it is found desirable to apply the activating coating to the cathode disk 27 after the cathode assembly is completed so that the spacer 69 should have a thickness equal to the desired cathode to grid spacing (say, 4 mils) plus one or two mils to take into account the expected thickness of the subsequently deposited layer of activating material.

With the spacer 69 in place, the upward pressure of the spring 73 (Fig. 2) serves to maintain the spacer clamped between the grid and cathode surfaces as the grid is deformed downwardly and thus holds a constant spacing between these surfaces. This spacing will be retained even when the part 80 moves to its lowest permitted position (i. e. the position illustrated in Fig. 3). Accordingly, if the cathode structure is frozen in the relationship which it then occupies, the desired relationship between the cathode and the grid and anode elements will have been established. This "freezing" of the cathode parts can be accomplished by adjusting the set screw 74 so that it clamps the parts 70 and 71 in fixed spatial relationship and then removing these elements from the tube assembly together with the cathode parts which they respectively support. Without disturbing this arrangement, the cathode foil 28 may then be welded to the outer surface of the part 24 so that no subsequent displacement between them is possible. The spacer 69 may then be removed and the cathode reinserted into the tube assembly with the certainty that its active surface will occupy the desired relationship with respect to the grid 57. (The fact that the part 42 abuts flatly against the under surface of the part 25 makes it certain that the earlier disposition of the cathode structure in the discharge enclosure can be accurately reestablished.)

It occasionally happens that in welding the

parts of the cathode structure together, some slight displacement of these parts may occur in spite of the fact that they are retained very closely in their proper relationship by the jig elements 70 and 71. If any displacement of this kind happens, it can be readily rectified by replacing the cathode structure in the lining up assembly shown in Figs. 2 and 3. If this is done and the part 80 is again forced downwardly into its lowest possible position, it will reestablish the desired relationship of the various elements. In some cases it may be desirable to substitute for the element 69 a similar element having a length a few mils greater so that it is capable of producing a slight additional deformation of the grid 57. When such a longer element is forced down into the tube assembly it will obviously seat the grid firmly upon the spacer 69 even if some slight shrinking or deformation of the cathode structure has occurred. If no such shrinkage exists, the slight additional displacement of the grid will be taken up by a correspondingly slight deformation or compliance of the foil of which the cathode part 28 is constituted. It is assumed that the cathode parts 24 and 28 are welded in fixed relationship at this point so that relative displacement between them is no longer possible. The details of this realigning step are indicated in Figs. 4 and 5 in which the displacement between the dotted lines a and b represents the difference in length between the location determining agency 80 originally employed and the slightly longer element 80' employed in the realigning process. Spot welds joining the cathode part 28 to the part 24 are indicated at 95 in Fig. 5.

After the assembly of the cathode parts and the rechecking of the cathode to grid spacing has been accomplished, the cathode filament 32 (Fig. 1) is inserted in its proper location and the cathode structure as a whole is mounted upon the closure member 44 (i. e. by means of the conductors 38 and 43). Finally the closure member is soldered to the lower edge of the circular flange 20 by a mass of solder 45 as previously specified. The flange 20 is of such dimensions with relation to the length of the conductors 38 that it does not seat upon the surface of the closure part 44 but remains slightly spaced from it while the soldered joint is being produced. This means that the cathode part 25 can be forced firmly against the insulating disk 42 and that the disk in turn can be seated solidly upon the envelope part 18. Accordingly, assurance is provided that the cathode structure as a whole occupies precisely the relationship which it had during its preliminary adjustment (i. e. during the performance of the procedural steps illustrated in Figs. 2 and 3.)

In some cases it is desirable to omit the insulating disk 42 and to solder the cathode part 25 directly to the envelope part 18. Where this is done, the preliminary line-up procedure will be the same as that described in the foregoing except that the part 25 will be seated against the part 18 during the deformation of the grid 57.

It is not necessary that the means employed to determine the spacing between the anode and the grid 57 shall take the precise form represented in Figs. 2 and 3. Alternatively, one may employ the anode itself in connection with a spacer of appropriate dimensions used in the manner of the spacer 69. Of course, where such a spacer is employed, it must be capable of attachment to the lower extremity of the anode and the opening formed in the disk 10 must be of sufficient diame-

ter to permit the introduction through it of the spacer and its attaching means.

As a further alternative to forming the grid by use of an anode-simulating element, as described in connection with Fig. 2, the same function may be accomplished by appropriate manipulation of the cathode parts as indicated in Fig. 6. (In this figure, parts corresponding to elements previously described bear similar reference numerals differentiated by priming.) In the intended location of the anode there is provided a location determining agency 100 which differs from the anode in by an amount corresponding to the desired spacing between the anode and grid, the intended length of the anode being indicated by the dotted line 101. The grid 57' is pressed upwardly against the lower extremity of the element 100 by pressure suitably applied to the lower extremity of a plunger 71' which acts upon the cathode sleeve 29'. This drives the active part of the cathode structure in an upward direction, carrying with it a spacer 69' which acts against the lower surface of the grid to deform it. Upward pressure is applied to the jig 70' and downward pressure to the part 100, as indicated by the arrows A and B respectively, so that all the elements of the tube structure are placed under compression. A completed discharge device formed in accordance with the procedure illustrated in Fig. 6 is shown in Fig. 7, the lower part of the tube being broken away to conserve space.

The invention may also be applied in connection with the fabrication of a tube in which the cathode takes the form of a directly heated filament rather than an indirectly heated construction as in Fig. 1. This possibility is illustrated for example, in Figs. 8, 9 and 10, the last two figures showing the structural details of a completed cathode structure of the type in question.

As appears most clearly in Fig. 10 the cathode includes a supporting part 110 which is in telescoping relation with a metallic sleeve 111 forming the lower component of the active part of the cathode structure. The emissive portion of the cathode is in the form of a V-shaped filament 113 (Fig. 9) which extends across the upper face of the cathode structure. The filaments which make up the sides of the V rest at their extremities upon the upper surface of a mica washer 115 which is held in place by the fact that the edge of the part 111 is crimped over to provide a retaining means as indicated at 116. (The upper edge of the part 111 is cut away at appropriate regions to avoid interference with the filament 113.) The apex of the filament V is engaged by a spring arm 118, whereas the extremities of the V are attached appropriately formed terminals 119 and 120. These terminals are clamped between the mica washer 115 and a second similarly shaped mica washer 122 positioned below it, the inwardly extending parts of the terminals being shown in Fig. 10. Current is supplied to the filament by wires 124 which connect with lead-in conductors 125 shown only in part. The supporting structure for the cathode is quite similar to that described in connection with Fig. 1 and includes a circular flange 130 which bears against an insulating washer 131, the washer in turn being pressed against the lower surface of a metallic envelope part 132. The upper end of the cathode, specifically the filament 113, is, in the completed form of the tube, desired to be spaced a particular distance from the grid 135 (Fig. 8). In order to produce the desired grid-to-cathode spacing, a spacer cap 138 is placed over the upper end of the cathode so that it lies flat upon the filament 113, being supported through the filament by the underlying mica ring 115. As in the procedure described in connection with Fig. 2, a location-determining agency 140 having a particular dimensional relationship to the anode which is to be used in the tube is forced down against the grid 135 to produce a predetermined deformation of it. After this operation is performed, the cathode parts 110 and 111 are locked in the position which they then occupy by means of a jig having an outer component 142 and an inner, relatively movable component 143, these being adapted to be secured in fixed relation by a set screw or other means, not shown. With the jig in locked relation, the cathode structure (after adjustment) is removed from the tube assembly and its parts welded together in the manner previously described. Thereafter, upon removal of the spacer cap 138 and restoration of the cathode structure to its original position in the tube assembly, the desired fixed spacing between the cathode filament and the grid 135 will have been attained. The desired spacing between the anode and the grid is, of course, produced by substituting for the location-determining element 140 an anode whose length differs from that of the element by the desired amount.

Certain aspects of the invention are also applicable in connection with the fabrication of two element discharge tubes. This is illustrated in Figs. 11 and 12 which show respectively a completed diode of a type described in my copending application S. N. 436,633, and an intermediate step in the manufacture of such a diode.

The tube referred to includes an apertured circular part 148 having an indirectly heated cathode extending through its central opening. As in the construction of Fig. 1, the cathode comprises an active disk 149 to which is secured a depending sleeve 150 and a cylinder of metal foil 151, the cylinder being telescoped over and welded to a correspondingly shaped suporting part 152. A filamentary heater 153 is provided within the interior of the cathode, being supplied with heating current by means of lead-in terminals 155. Additional lead-in conductors 156 are provided for the purpose of supporting the cathode structure and supplying it with unidirectional potential. Close capacitive coupling between the cathode structure and the part 150 is provided by means of a flat metallic member 159 which is connected to the cathode and which is insulatingly spaced from the part 150 by means of a mica spacer 160.

The lower opening of the circular member 148 is closed by means of a generally cup-shaped part 161 which is reversely bent to provide a circumferentially extending trough portion 162. This latter portion is adapted to receive the extreme edge of the member 148 and when filled with solder as indicated at 163 provides a vacuum-tight seal for the tube enclosure. The lead-in wires 155 and 156 are sealed through the part 161 by means of a plurality of glass-to-metal seals shown at 164.

The lower edge of the cup-shaped part 161 is provided with bent-in tabs 166 which serve to engage and retain a socket adapter 167 constituted of a suitable insulating material, such as a synthetic resin. The adapter is provided with a centering lug 167' and supports a number of hollow contact prongs 168 to which the extremities of the conductors 155 and 156 are attached.

The anode of the device comprises a disk 169

which is supported in fixed spaced relation with respect to the active surface of the cathode by being sealed to the end of a glass cylinder 170.

In the fabrication of the tube the anode 169 and the base part 148 are first sealed to the respective extremities of the glass cylinder 170. Thereafter these elements and the loosely assembled cathode parts are positioned in a line-up jig having a fixed part 180 and two concentric movable parts 181 and 182. (See Fig. 12.) At this stage, the insulating disk 160 is omitted for a reason which will shortly appear. By pushing the jig parts 181 and 182 concurrently in the upward direction, the flange of the cathode part 152 is caused to seat flatly against the under surface of the part 148 and the cathode cap 149 is pressed against the anode 169.

Thereafter, the cathode assembly is "frozen" (by locking the jig parts 181 and 182 together) and withdrawn from the tube so that the cathode parts may be welded in fixed relationship Finally, the cathode is mounted on the base 161 and reinserted in the tube in the arrangement shown in Fig. 11, the insulating washer 160 being now included. By comparing Figs. 11 and 12 it will be seen that the resultant spacing of the cathode with respect to the anode 169 corresponds precisely to the thickness of the washer, which may be made as great as is desired for the particular application at hand.

In cases where the cathode structure and the base part 150 of Fig. 11 are desired to be at the same potential, a metal washer may be used as a spacer in place of the insulating disk 160. As a still further variant, in a case where the anode is of the type employed in the construction of Fig. 1, the desired anode-cathode spacing may be obtained by inserting a washer of proper thickness under the anode terminal cap after the anode and cathode have been brought into abutting relation and the cathode parts joined in accordance with a procedure such as that just described.

While the invention has been described by specifying various procedural steps as being taken in a particular order, it will be understood that a considerable variation in the order of procedure is possible, and I aim in the appended claims to cover all such equivalent variations as come within the true spirit and scope of the foregoing disclosure.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A process of fabricating a discharge device having an electrode of deformable construction, which process comprises installing the electrode approximately in its desired location in the device and thereafter deforming the electrode in situ to bring its active part more precisely into the desired location.

2. A process of fabricating a discharge device having a grid constituted of deformable material, which process comprises installing the grid approximately in its desired location in the device, and thereafter deforming the grid in situ to bring its active part more precisely into the desired location.

3. A method of fabricating a discharge device having an electrode of deformable construction, which method comprises installing said electrode in approximately its desired location in the device, positioning location-determining agencies on opposite sides of said electrode, and deforming the electrode by said agencies, thereby to effect a more precise location of a part of said electrode.

4. A method of fabricating an electric discharge device having a first electrode structure and a second electrode structure which includes an active part and a supporting part; which method comprises installing said first electrode structure in its desired location in the device, placing said second structure in approximately its desired location in the device and with its parts in loose assembly, moving said parts relative to one another into precisely their desired relationship with respect to said first structure, and thereafter joining said parts in fixed assembly to assure the subsequent preservation of the said relationship.

5. The method of fabricating a discharge device having a first electrode structure of deformable character and a second electrode structure which includes the assembly of an active part and a supporting part; which method comprises installing said first structure in approximately its desired location in the device, installing said second structure in approximately the desired relationship with the first structure and with its parts in loose assembly, deforming the said first structure to bring it more precisely into the desired location, modifying the assembly of said second structure to bring its active part more precisely into the desired relationship with the first structure, and thereafter fixing the assembly of the second structure to preserve the said desired relationship.

6. The method of fabricating a discharge device having a generally planar grid constituted of deformable material and a cathode which includes a supporting part and an electrically active part; which method comprises installing said grid in approximately its desired location in the device, placing said cathode in approximately its desired relationship with respect to the grid and with its said parts in loose assembly, deforming the said grid to cause its active portion to occupy a plane more nearly at the desired location, modifying the cathode assembly by relative motion of its parts to cause the said active part to assume a desired spacing with respect to the said active grid portion, and thereafter fixing the assembly of said parts to assure the preservation of the said spacing.

7. A method of fabricating a discharge device having an envelope, an anode, a grid of deformable material and a cathode which includes active and supporting parts capable of being assembled in engaging relation; which method comprises installing said grid in said envelope, positioning said active cathode part in substantially its proper relation to said grid, arranging said supporting part of the cathode in its intended location with respect to said envelope and in loosely engaging relation with said active part, deforming said grid to bring it more precisely into its desired location, bringing the active part of said cathode structure more precisely into its proper relation to said grid by adjustment of such part with reference to the said supporting part, securing said cathode parts to one another in the relation which they then occupy, and finally completing the assembly of said device.

8. A method of fabricating a discharge device having an envelope, an anode, a grid of deformable material and a cathode which includes separate active and supporting parts capable of being mutually joined; which method comprises the following steps, installing the grid in said envelope in substantially its intended location, positioning the active cathode part in proximity to said grid with a spacer of predetermined thick-

ness between them, arranging said supporting part in its intended location with respect to said envelope and in proximity to said active part, deforming a portion of said grid to bring it more precisely into its desired location, moving said active cathode part with reference to said supporting part to establish between said active cathode part and the deformed portion of said grid a spacing determined by the thickness of said spacer, joining said cathode parts in the relation which they then occupy, removing said spacer, and completing the assembly of said device.

9. A method of fabricating a discharge device having three electrodes, the intermediate electrode being a grid of deformable material, which method comprises temporarily assembling said grid and a selected one of said remaining electrodes in approximately their desired relationship in the said device, interposing between said electrodes a spacer having a thickness equal to the desired spacing of the electrodes, adding to the assembly an agency having a surface which can be located with certainty in a plane which is a fixed distance from the desired location of the third electrode, moving said surface against the grid to bring the active part of the grid into the said plane while said spacer maintains the grid in fixed relationship with respect to said one electrode, and thereafter withdrawing said spacer and said agency and completing the permanent assembly of the electrodes.

10. A method of fabricating a discharge device having a first electrode which is of deformable character and a second electrode, which method comprises installing said electrodes in approximately the desired location in the device, interposing a spacer of predetermind dimensions between the electrodes, and moving said second electrode to force said spacer against the first electrode with resultant deformation of it, thereby to bring the active parts of both said electrodes more precisely into the desired location in said device while concurrently establishing a desired spatial relationship between them.

11. The method of fabricating a discharge device having three electrodes, the intermediate electrode being constituted of deformable material, which method comprises temporarily assembling said intermediate electrode and a selected one of the remaining electrodes in approximately their desired relationship in the said device, interposing between said electrodes a spacer having a thickness corresponding to the desired spacing of the electrodes, adding to said assembly an agency having a surface which can be located with certainty a fixed distance from the desired location of the active surface of said third electrode, moving said selected electrode toward said intermediate electrode without withdrawing said spacer, thereby by deformation of material to force the active portion of said intermediate electrode against the said surface of said agency while maintaining the desired spacing of said selected and intermediate electrodes, and thereafter withdrawing said spacer and said agency completing the permanent assembly of the electrodes.

12. A method of fabricating a discharge device having three electrodes including a grid and cathode of deformable character and an anode of non-deformable character, which method comprises temporarily assembling said grid and cathode in approximately their desired location in said device with a spacer of predetermined

thickness between them, adding to said assembly on the anode side of said grid an agency having a surface which can be located with certainty in a plane which is a fixed distance from the desired location of the active part of said anode, moving said surface against the grid to bring the active part of the grid into the said plane while concurrently deforming said cathode by the action of said spacer to preserve a fixed spacing between the grid and cathode and thereafter withdrawing said spacer and said agency and completing the permanent assembly of said electrodes.

13. A method of fabricating a discharge device having a first electrode and a second electrode which includes as separable components an active part and a supporting part; said method comprising the steps of disposing said first electrode in its desired location in said device, disposing the supporting part of said second electrode at a fixed distance from the first electrode and in approximately its desired relationship with respect to such electrode, arranging the active part of said second electrode in abutment with said first electrode and in its desired relationship with respect to said supporting part, fixing said active and supporting parts in the relationship which they then occupy, displacing the whole structure of one of said electrodes from its originally assigned location by an amount corresponding to the spacing desired to exist between the said active part and the first electrode, and without subsequnt displacement of the parts completing the fixed assembly of the device.

14. A method of fabricating a discharge device having a cathode which includes an active part and a supporting part adapted to be assembled in telescoping relation, a second electrode adapted to cooperate with said cathode, and an envelope for enclosing said cathode and said second electrode; said method comprising disposing said second electrode in its desired location in said envelope, disposing said cathode in the envelope with its parts in loosely engaging relation and with its supporting part at a fixed distance from said second electrode, moving the active part of the cathode with reference to the supporting part to bring it into abutment with the second electrode, fixing said cathode parts in the relationship which they then occupy, displacing said supporting part from its originally assigned location in the envelope by an amount corresponding to the spacing desired to exist between the anode and cathode, and without subsequent change in the relationship of the parts completing the permanent assembly of the device.

15. A method of fabricating an electric discharge device having a first electrode structure and also having a second electrode structure which includes a cylindrical supporting part and a conformingly cylindrical active part; which method comprises installing said first electrode structure in its desired location in the device, placing said second structure in approximately its desired location in the device with its said cylindrical parts in slidably interfitting relation, relatively sliding said parts to cause the said active part to assume precisely a desired spacing with respect to said first electrode structure, and thereafter fixing the assembly of said parts to assure the preservation of the said spacing.

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