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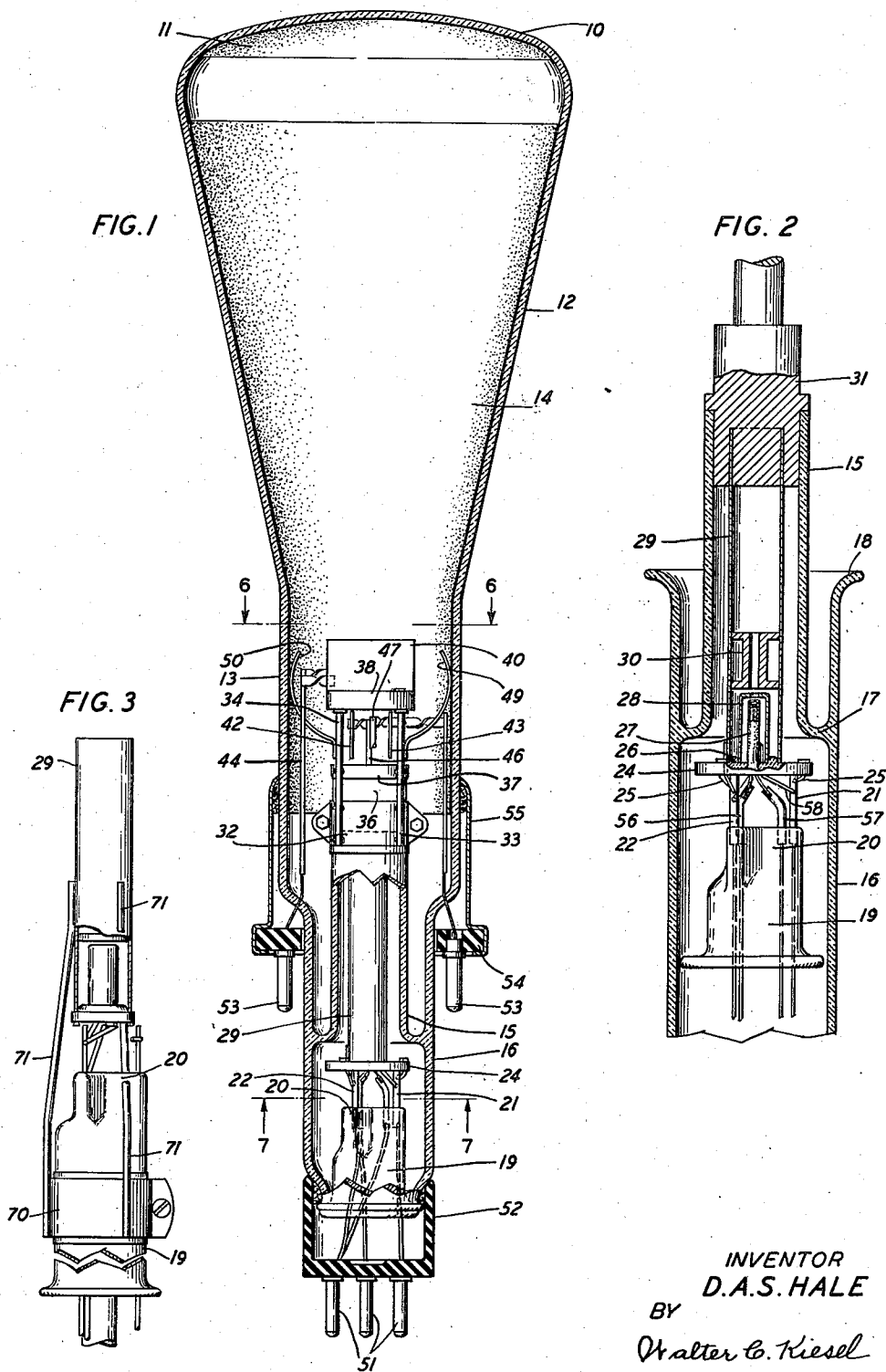
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2,141,387

ELECTRON DISCHARGE DEVICE

Filed Oct. 10, 1936

2 Sheets-Sheet 1



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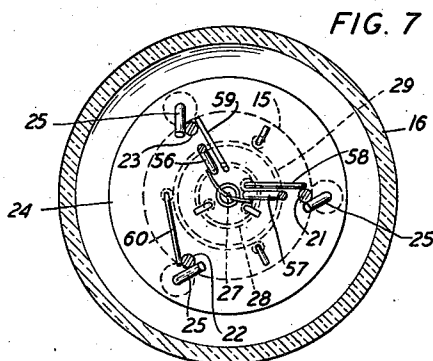
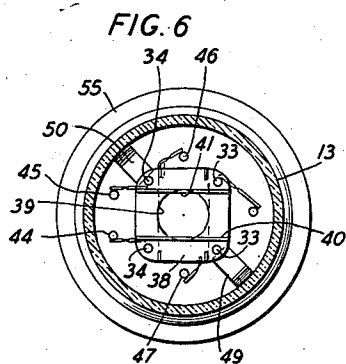
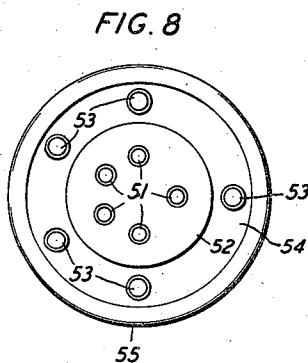
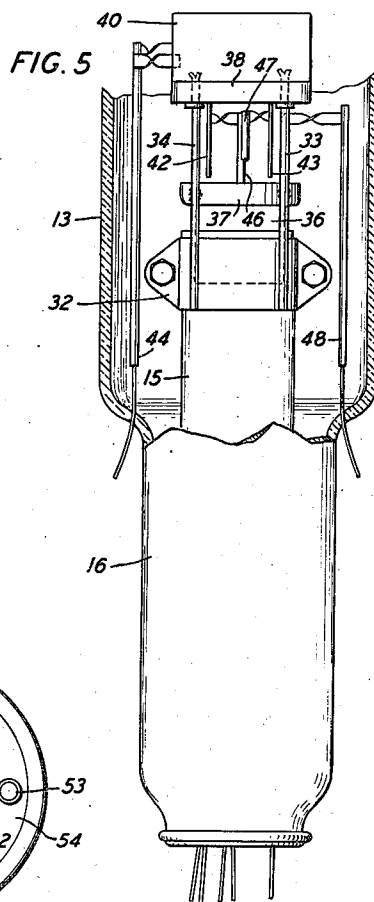
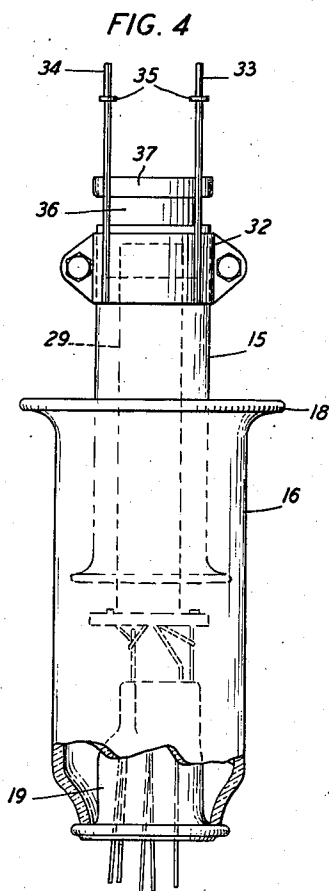
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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ELECTRON DISCHARGE DEVICE

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Application October 10, 1936, Serial No. 104,937

10 Claims. (Cl. 250—141)

This invention relates to electron discharge devices and particularly to such devices of the cathode ray type and to a method of fabricating the assembly.

One object of this invention is to maintain alignment of the elements of an electron gun assembly along the axis of the device.

Another object of the invention is to facilitate production methods in the manufacture of cathode ray discharge devices.

In accordance with this invention a unitary mount for the electron gun elements is formed of concentric tubular members of insulating material, such as glass, the inner member being fused to an intermediate portion of the outer member and the outer member being flared outwardly. The inner member forms a guideway for lining up the accelerating electrode assembly and the electron gun assembly during the sealing of the stem of the gun assembly to one end of the mount. This arrangement insures concentricity between the electron gun assembly and the deflector plate assembly which is mounted on the inner tubular member beyond the end of the gun assembly.

Another feature of the invention relates to a unitary mounting of the elements comprising the electron gun and deflector plate assemblies to facilitate efficient production and insure reproducible devices having the same characteristics in operation. This arrangement comprises a platform having an annular embossment formed thereon concentric with a central aperture and spaced therefrom to form the registering boundaries for the cathode, control electrode and a tubular focusing electrode of the electron gun assembly. The deflector plate assembly comprises a collar embracing the inner member of the mount and carrying a plurality of rods supporting a platform to which the deflector plates are attached. These rods also form a support for an accelerating electrode which is attached to all the rods and extends downwardly into the space between the focusing electrode of the gun assembly and the inner member of the mount. This arrangement accurately centers the deflector plate assembly with respect to the electron gun assembly to insure uniform control of the electron stream projected toward the screen.

A further feature of the invention relates to the sealing of the bulbous portion of the vessel embodying the fluorescent screen of the device to the unitary mount and simultaneously forming a hermetic seal for the leading-in conductors without distorting the axial relationship of the electrode assemblies supported by the mount. This is ac-

complished by sealing the screen bulb to the flared outer member of the mount and fusing the glass around the leading-in conductors to insure a tight hermetic seal. This arrangement avoids the alteration of the position of the deflector plate assembly with respect to the electron gun and the axis of the mount which might be affected by a change in the rigidity of the inner supporting member of the mount. Since the flared end of the outer member is remote from the supporting base of the mount, it is possible to fuse the screen bulb onto the mount without affecting the spacial relationship of the electrode elements of the device.

Another feature of the invention pertains to the manufacturing technique whereby all the glass fusing operation may be performed by glass working machinery instead of employing skilled glass artisans. In accordance with the method of this invention, the units of the complete device may be assembled by straightforward operations in sequence thereby facilitating manufacturing procedure and reducing the cost.

These and other features of the invention may be more clearly understood by reference to the following detail description taken in connection with the accompanying drawings:

Fig. 1 illustrates a complete device in vertical section embodying features of this invention;

Fig. 2 is a sectional view of the unitary mount of this invention and shows the step of sealing the electron gun assembly to the mount;

Fig. 3 shows a modified supporting structure for the electron gun assembly of this invention;

Fig. 4 illustrates in elevation another step in arranging the deflector plate assembly on the unitary mount;

Fig. 5 shows the final sealing operation in which the conductors of the deflector plate assembly are hermetically sealed in the junction of the bulbous portion of the vessel and the unitary mount;

Fig. 6 is a cross-sectional view taken on the line 6—6 of Fig. 1 showing the position of the deflector plates in the device;

Fig. 7 is an enlarged cross-sectional view taken on the line 7—7 of Fig. 1 to illustrate the details of the platform support and the related structure; and

Fig. 8 shows a bottom end view of the device of Fig. 1 to illustrate the arrangement of the terminals on the multiple bases.

Referring to the drawings, the cathode ray discharge device of this invention comprises a bulbous enclosing vessel having a dome portion coated on the interior with a fluorescent material

11 which functions as the screen of the device, a long tapered portion 12 and a terminating cylindrical portion 13 both of which are coated on the interior with a non-reflecting material 14, such as graphite. The bulbous enclosing vessel is joined to a unitary mount which supports the electron gun assembly and the deflector plate assembly so that the axes thereof are coincident with the axis of the enclosing vessel in order that a stream of electrons may be projected toward the screen 11 on the end of the enclosing vessel. The unitary mount is shown more clearly in Fig. 2 and comprises concentric inner and outer cylindrical glass members 15 and 16, respectively, the inner member being joined to the outer member intermediate the ends thereof by fusing the lower end to the inner surface of the outer member at 17. The upper end of the outer member is flared outwardly as shown at 18 to facilitate joining the bulbous enclosing vessel to the mount. The mount may be formed of three parts, namely, the inner member 15, the flared upper portion of the outer member and an extension of the same diameter as the outer member.

The electron gun assembly as shown in Fig. 2 comprises a stem 19 having a press 20 which supports three upright rods 21, 22 and 23 to which is attached a circular insulating platform or disc 24 by headed studs 25 which extend through the platform and are bent toward the adjacent upright rods extending from the stem. The platform 24 is provided with a central aperture and a concentric annular embossment or ridge 26 for readily establishing the space relationship between the various electrodes of the electron gun. This gun assembly comprises a central cathode thimble 27 which is secured in the central aperture of the platform 24. The cathode is surrounded by a cup-shaped control or modulator electrode 28 which is located with respect to the cathode by the inner edge of the embossment 26. An elongated tubular focusing electrode or anode 29 surrounds the cup-shaped electrode and is concentrically arranged with respect to the cup-shaped electrode 28 by being secured to the disc 24 at the outer edge of the embossment 26. The anode carries a spool-shaped collimating member 30 which is arranged close to the cup-shaped electrode 28. Instead of supporting the electron gun assembly solely from the press 20, a supporting structure, as shown in Fig. 3, may be employed. In this arrangement, a clamping collar 70 surrounds the stem 19 and carries a plurality of bracing wires 71 which are welded to the surface of the elongated tubular anode 29 to relieve strains in the press. The particular electron gun assembly pertaining to the electrode elements and their space relationship does not form the subject-matter of this invention since a more detailed description thereof is contained in the copending application of M. S. Glass Serial No. 104,963, filed October 10, 1936, and claimed therein.

In the fabrication of cathode ray discharge devices the skill of an experienced glass worker is necessary in order to line up the electrode assemblies along the axis of the vessel so that the projected stream of electrons will strike the screen at an axial point and the deflector plates can assume equal control over the stream passing between them. This necessarily consumes considerable time and requires the manual skill of highly experienced artisans which increases the cost of manufacture of such devices. These difficulties are materially overcome in accordance

with this invention since the fabrication is carried out principally by glass working machinery and the units are assembled in sequence operation so that mass production may be attained and the individual cost materially reduced.

In accordance with one aspect of this invention, the first step in the fabrication of the device after the formation of the mounting comprising the coaxial portions 15 and 16 consists in positioning the stem 19 and the electron gun assembly in the lower end of the mount as shown in Fig. 2 with the elongated anode 29 extending almost to the end of the inner tubular member 15. In order to center the electron gun assembly in the mount, a gauge 31 is inserted in the end of the inner tubular member 15, the gauge being provided with a centering recess to receive the end of the anode 29. This arrangement is then inserted in a glass sealing machine to fuse the wall of the outer tubular member 16 and the flared end of the stem 19 to a form as shown in Fig. 1.

After removal of the mount from the machine the gauge 31 is removed and the deflector plate assembly is mounted on the end of the inner tubular member 15. This constitutes the second step of the method of fabrication and the preliminary operation of this step consists in placing a clamping collar 32, as shown in Fig. 4, around the end of the inner tubular member 15. This collar carries four vertical rods 33 and 34 arranged in pairs at the corners of a square and each rod is provided with a flange portion 35. The four rods support a short tubular metallic accelerating electrode or second anode 36 having a larger diameter throat portion 37 which makes contact with the four rods and is welded thereto while the smaller diameter portion 36 extends into the inner tubular portion 15 of the mount and coaxially surrounds the projecting end of the elongated tubular anode 29 of the electron gun assembly as shown in Fig. 4.

Another method of accurately lining up the electron gun assembly may be practiced in accordance with another aspect of this invention by delaying the sealing of the stem 19 to the mount, as shown in Fig. 2, until the assembly of the collar 32 and the accelerating anode 36 is positioned on the inner portion 15 as shown in Fig. 4. A suitably formed gauge to fit the accelerating anode is inserted therein and the electron gun assembly is centered by this gauge. The sealing operation of the stem 19 and the mount can then be consummated and the gauge removed.

The deflector plate assembly also includes a rectangular shaped insulating platform 38 having a large central aperture 39 and four deflector plates 40, 41, 42 and 43 which are arranged in transverse pairs on opposite surfaces of the platform 38 so that they form a central box-like passageway for the projected stream of electrons from the electron gun. The platform 38 is mounted on the ends of the rods 33 and 34 and is pressed down until it is seated on the flanges 35 of the rods after which the rods are staked over to prevent the movement of the platform. The upper plates 40 and 41 are provided with straps on the left-hand end thereof which are attached to rigid conductors 44 and 45 while the lower plates 42 and 43 are provided with straps on opposite edges which are attached to rigid conductors 46 and 47. An additional conductor 48 is provided on the right-hand side of the assembly and connected by a strap to one of the

rods 33 of the deflector plate assembly to serve as an electrical connection for the short anode 36 which is attached to the rod. The electrical connection 48 also conveys a suitable potential to the graphite coating 14 on the interior of the bulbous vessel by means of the spring contacts 49 and 50 which are secured to opposed diagonal rods 33 and 34 and have their resilient ends in contact with the graphite coating.

The assembled unitary mount is now in condition for the final step of assembly in which the bulbous vessel is fused to the mount. This is accomplished by arranging the flexible ends of the conductors over the flared edge 18 of the outer tubular member of the mount and slipping the cylindrical portion 13 of the enclosing vessel over the flared portion 18 of the mount in order to simultaneously fuse the juncture of the flare 18 and the end of the tubular portion 13 and seal the flexible ends of the conductors in the formed joint. During this operation, the glass in the vicinity of the joint is rendered plastic in order to provide a good union between the separate sections and also to hermetically seal the leading-in conductors through the glass wall of the vessel. This operation, however, does not affect the alignment of the electron gun assembly or the deflector plate assembly since the flared portion 18 of the mount is remote from the supporting glass portions of these assemblies. After the final step in the fabrication procedure is completed, as shown in Fig. 5, the device may be evacuated in the usual manner through the stem 19 of the mount and the device is then provided with bases which carry the terminals or prongs which may easily be connected to an external circuit.

Fig. 1 shows the general structure of these bases and Fig. 8 shows the relationship of the terminal prongs on both bases. The leading-in conductors of the electron gun assembly extend through the stem 19 and are secured to terminals 51 on a base 52 attached to the end of the mount while the conductors of the deflector plate assembly are attached to terminals 53 carried by an annular disc member 54 supported by a shell base 55 which is cemented to the intermediate portion of the device adjacent the juncture of the bulb and the mount. The various terminals shown in the arrangement of Fig. 8 may be identified in the following manner. The left-hand terminals 51 on the base 52 are connected to the heater element of the cathode through the extensions 56 and 57 in the press 20. The upper and lower central terminals 51 on the base 52 are connected to rods 21 and 23 by flexible wires and these rods are connected to the cathode 27 and the modulator electrode 28 through the wires 58 and 59, respectively. The right-hand terminal 51 on the base 52 is connected to the rod 22 in the press 20 and this rod is connected to the tubular anode or focusing electrode 29 through the wire 60. The left-hand terminals 53 on the annular base are connected to the upper deflector plates through the conductors 44 and 45, respectively, while the upper and lower terminals 53 on the annular base are connected to the lower deflector plates through the conductors 46 and 47, respectively. The right-hand terminal on the annular base is connected to the accelerating anode 35 and the graphite coating 14 through the conductor 48. This symmetrical arrangement of the terminals on both bases insures the proper segregation of the high poten-

tial terminals on both bases, namely: the potential supplied to the anodes of the device, and facilitates the proper connection of the device to an external circuit since the terminal arrangement is easily memorized.

While the invention has been described with respect to a particular assembly and a definite sequence of operations, it is, of course, understood, that various modifications may be made in the detailed assembly and method without departing from the spirit of this invention as defined in the appended claims.

What is claimed is:

1. An electron discharge device comprising an electron producing electrode assembly, a controlling electrode assembly, a unitary mount including a pair of cylindrical portions joined in series relation in a longitudinal direction, said electron producing electrode assembly being mounted in axial relation within one of said portions, said controlling electrode assembly being coaxially supported on the other of said portions in relation to said electron producing electrode assembly, an additional cylindrical portion surrounding and coextensive with one of the mount portions and having one end sealed to the juncture of said portions, and an enclosing vessel fused to the opposite end of said additional portion.

2. A cathode ray discharge device comprising an electron gun assembly, a deflector plate assembly, a vessel having a bulbous portion with a fluorescent screen deposited on its closed end, a unitary mount for supporting the electrode assemblies of said device, said mount having inner and outer cylindrical portions formed in series relation at one end of said device, said outer portion having a flared end intermediate the ends of said inner portion, means for joining said electron gun assembly to one end of said outer portion, and means for supporting said deflector plate assembly on the free end of said inner portion, the flared end of said outer portion being sealed to the bulbous portion of said vessel.

3. A cathode ray discharge device comprising an electron gun assembly, a deflector plate assembly, a vessel having a bulbous portion with a fluorescent screen deposited on its closed end, a unitary mount for supporting the electrode assemblies of said device, said mount comprising an external tubular member at one end of said vessel, an internal tubular member within said vessel having a flared portion fused to the inner surface of said external member intermediate the ends thereof, means for joining said electron gun assembly to one end of said external tubular member, means for supporting said deflector plate assembly on the free end of said internal tubular member, and means for sealing the bulbous portion of said vessel to the opposite end of said external tubular member.

4. A cathode ray discharge device comprising an electron gun assembly, a deflector plate assembly, a vessel having a bulbous portion with a fluorescent screen deposited on its closed end, a unitary mount for supporting the electrode assemblies of said device, said mount having an external tubular member at one end of said vessel provided with a flared end, an internal tubular member within said vessel having a flared portion fused to the inner surface of said external member intermediate the ends thereof and extending beyond the flared end of said external member, means for joining said electron

gun assembly to one end of said external member remote from said flared end, and means for supporting said deflector plate assembly on the free end of said internal member, the flared end of the external member being joined to the bulbous portion of said vessel.

5. A cathode ray discharge device comprising a mount having outer and inner concentric glass portions joined together at one end and arranged intermediate the ends of the device, the free end of said outer portion being flared outwardly, an extension having a reentrant stem sealed to the end of said portions, an electron gun supported by said stem and extending axially through said inner glass portion, a plurality of deflector plates mounted upon said inner glass portion, an elongated vessel having a fluorescent screen at one end and having the other end adjacent the flared free end of said outer glass portion, and conductors for said plates sealed between the junction of the adjacent ends of said vessel and the flared outer portion of said mount.

6. In the fabrication of cathode ray discharge devices including a mount having outer and inner concentric portions arranged at one end of said device, a bulbous vessel, an electron gun unit, and a deflector plate unit, the method of assembling which comprises gauging said electron gun unit in said mount, sealing said unit to one end of the outer portion of said mount, affixing the deflector plate unit to said inner portion in superimposed relation to said gun unit, and fusing said bulbous vessel to the other end of said outer portion adjacent said deflector plate unit.

7. In the fabrication of cathode ray discharge devices including a mount having outer and inner concentric portions arranged at one end of said device, a bulbous vessel, an electron gun unit, and an accelerating anode unit, the method of assembling which comprises securing said anode unit to the inner portion of said mount, centering said gun unit by a gauge in contact with said gun and the surface of said anode, sealing said gun unit to the outer portion of said mount, removing said gauge, and sealing said bulbous vessel to the free end of said outer portion of said mount.

8. In the fabrication of cathode ray discharge devices including a mount having outer and inner concentric portions arranged at one end of said device, a bulbous vessel, an electron gun assembly, and a deflector plate assembly including a plu-

5 rality of conductors, the method of assembling which comprises gauging said electron gun assembly in said mount, sealing said assembly to the outer portion of said mount, affixing the deflector plate assembly to said inner portion in superimposed relation to said gun assembly, and simultaneously fusing said vessel to the end of said outer portion and sealing the conductors of said deflector plate assembly at the junction points of said vessel and said outer portion.

9. In a cathode ray discharge device, a deflector plate assembly comprising a collar, a plurality of upright rods secured to said collar, each of said rods having an abutment near its free end, an apertured platform secured to said rods and resting on the abutments, a pair of deflector plates depending from said platform, a second pair of plates arising from said platform, and a tubular metallic electrode extending within said collar and having an enlarged throat portion in contact with said rods.

10. A cathode ray discharge device comprising a vessel having a bulbous portion with a fluorescent screen deposited on its closed end, a unitary mount sealed to the end of said bulbous portion, said mount having outer and inner cylindrical portions arranged longitudinally at one end of said device, an electron gun assembly coaxially supported by said mount, said assembly comprising a stem sealed to said outer cylindrical portion of said mount, an insulating platform secured to said stem, said platform having an annular embossment on the surface thereof concentric with a central aperture, a cylindrical cathode mounted in said aperture, a cup-shaped modulator electrode surrounding said cathode and spaced therefrom by the inner limit of said annular embossment and an elongated tubular focusing electrode surrounding said modulator electrode and secured to said platform along the outer boundary of said annular embossment, a deflector plate assembly arising from the inner portion of said mount, said assembly comprising a collar clamped to the outer surface of said inner portion of said mount, a plurality of upright rods secured to said collar, an apertured platform secured to said rods, a plurality of deflector plates affixed to said platform, and an accelerating anode having a portion in contact with said rods and another portion interposed between the wall of said inner portion of said mount and the end of said elongated focusing electrode.

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