June 21, 1960 J. H. JOHNSON 2,942,128

ELECTRODES FOR ELECTRON GUN UNIT

Filed May 28, 1958

FIG. 1

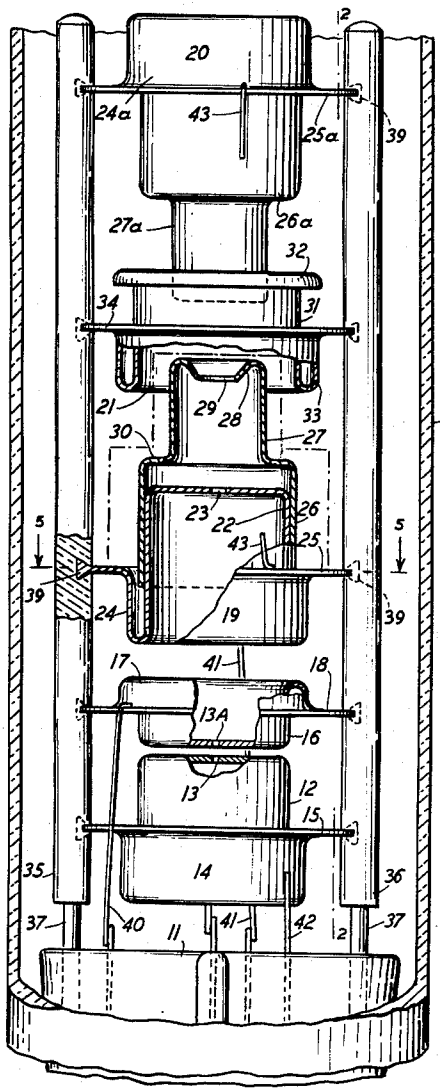


FIG. 2

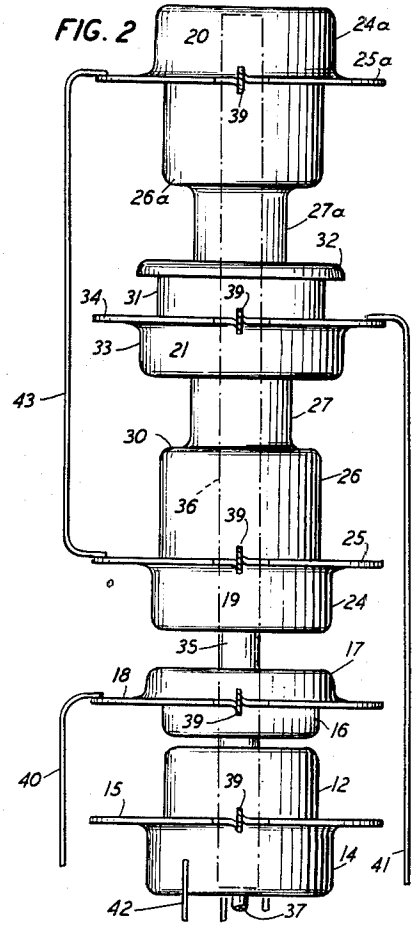


FIG. 3

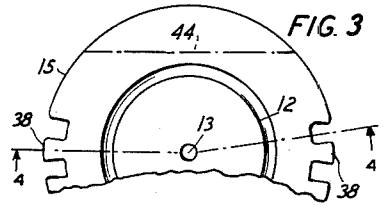


FIG. 6

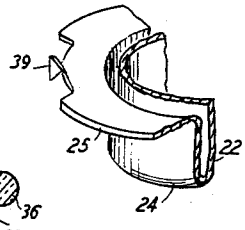


FIG. 5

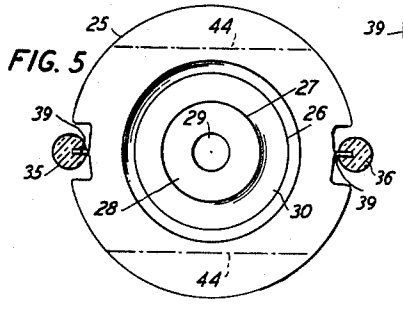
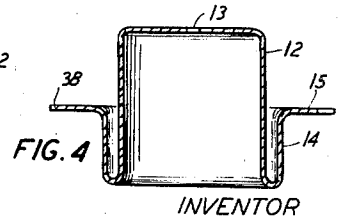


FIG. 4



INVENTOR

JAY H. JOHNSON

BY Frank E Ward

ATTORNEY

United States Patent Office 2,942,128 Patented June 21, 1960

2,942,128

ELECTRODES FOR ELECTRON GUN UNIT

Jay H. Johnson, East Williston, N.Y., assignor to Johnson and Hoffman Manufacturing Corporation, Mineola, N.Y., a corporation of New York

Filed May 28, 1958, Ser. No. 738,389

11 Claims. (Cl. 313—82)

This invention relates to electron discharge devices and particularly to cathode ray tubes including television picture tubes.

In cathode ray tubes, a beam of electrons is produced, focused and directed toward the viewing screen end of the tube by an arrangement of electrodes, known as the "gun." Heretofore, the gun electrodes, which are thin walled metal tubes and certain of which are closed at one end except for a small aperture, have usually had welded to them mounting studs, pins, wires or straps whose free ends were embedded in glass rods or posts while the electrodes were temporarily held in position in an aligning jig.

This prior type of gun construction has many disadvantages including those now specified. The localized pressures and temperatures to which the electrodes were subjected during welding thereto of the mounting elements often distorted the electrodes so that it was difficult or impossible to effect their precise alignment in the assembly jig. Consequently, the electrodes as permanently affixed to the glass supporting rods or posts did not provide a gun having satisfactory beam forming and directing characteristics. Moreover, the welding of the studs was often accompanied by weld-splash, pitting and other irregularities whose sharp points or whiskers resulted in corona discharge between gun electrodes operated at different potentials. Furthermore, in efforts to obtain resistance to displacement under conditions of shock and vibration, individual electrodes were often provided with axially spaced pins with the result that the length of the leakage path through or along the surface of the support posts between the mounting pins of different electrodes enforced wider electrode spacing or lower operating voltages than desired. In some cases, in efforts to reduce inter-electrode leakage, additional supporting posts of glass having unusually low specific conductivity were used for certain of the electrodes. This increased the costs and the complexity of the gun assembly. Another disadvantage of the prior electrode constructions was the poor parallelism of the opposite ends of the electrodes; in assembling the electrodes of a gun, it was often only by chance that their angular orientations would be such that the spacing between the ends of the adjacent electrodes would be uniform when they were axially positioned or moved in the aligning jig in preparation for their permanent attachment to the support posts.

The foregoing disadvantages of the prior constructions are overcome, in accordance with the present invention, by making individual electrodes in the form of a reentrant tube whose shorter outer portion has a radial flange providing an integral mounting element intermediate the ends of the electrodes. Specifically, at peripherally spaced regions, the flange may be notched to provide ears or lugs for sealing into the supporting posts of the assembled electrodes. With this construction, there are absent the sharp points or irregularities due to welding of pins and there is absent the distortion of the cross-sectional shape of the electrodes by welding pressures and temperatures. Thus, as assembled and in use, the electrodes may be operated with high potential differences between them without danger of corona or flash-over between weld whiskers or points. Also during assembly, the undistorted perimeters of the electrodes insure their proper alignment in the assembly jig. Furthermore, the integral flange mount and reverse bend of the individual electrodes provides a rigid mounting, insuring maintenance of proper alignment and by elements whose greatly enhanced spacing along the supporting posts precludes leakage without need for special glasses or extra posts between certain electrodes. Furthermore, the electrodes are shaped and drawn by dies providing precise dimensioning, including parallelism of the opposite ends of individual electrodes; thus, the electrodes may be assembled with their adjacent faces or ends closely uniformly spaced and with their axes in precise alignment by engagement of their undistorted perimeters with the aligning jig.

One of the features of the invention is the provision of a compound focusing electrode in the gun array, to efficiently collimate the beam of electrons in its axial travel to the screen. In this construction a primary hollow or cup form of electrode is provided with a reverse turned wall portion coaxial with the main side wall of the electrode so that the end of said latter wall terminates about the central length of the electrode. This wall flows into a radial flange portion which forms the support of the compound electrode. Superimposed on the closed end of the primary cup electrode is an auxiliary front lens electrode having a reduced neck portion projecting away from the closed end of the focus electrode. The two superimposed electrodes are spot-welded to form an integral collimating lens for focusing the intense beam of electrons generated in the axis of the gun structure.

Another feature relates to the consolidation of all the electrodes in the gun unit into an integral assembly in which the highest degree of insulation resistance is attained without affecting the relatively close spacial relation of the various electrodes in the gun structure.

Another advantage of the ruggedized construction of the invention is concerned with the reinforced double-wall feature of the electrode so that the concentricity of the inner wall of the electrode is insured with respect to the central aperture in the electrode and out-of-round distortion is substantially eliminated.

The new construction also permits reduction in length of the gun stack of electrodes which materially facilitates the achievement of close tolerances in the new 110° type television tubes. These limits may be attained by further reduction in dimensions of the electrodes, since smaller electrodes could easily be fabricated by the proposed double-walled construction without any deleterious effects in the formation of the electrodes. Another advantage of the reduction in length of the gun unit is the physical effect of increasing the efficiency of the structure and at the same time attaining approximately twice the beam current at the same modulating voltage as employed in the same prototype structure.

The rigid flange construction also provides a shielding effect of the gun unit stack of electrodes, particularly in respect to the shielding of the first grid against preignition effects, due to excessive heating caused by the enclosed heater and cathode and the combined effect of getter dust dispersion when the getter is flashed during the final processing of the tube during manufacture.

The unique construction also contributes to the anti-emission characteristics of the tube by the novel radiation features of the electrodes, since the increased metal area in each electrode materially radiates heat, both

physical and electrical, in the normal functions of the gun unit in operation.

Another feature relates to the removal of excess flange material, to reduce the radial dimension of the unit in one diameter, whereby the lead wires to the various control electrodes may be suitably located without increasing the dimensions of the neck of the tube to provide clearance of the wires along the sides of the unit.

A further feature of the invention along the same lines as the preceding idea is the fact that the attenuation of the flange construction provides a self-indexing characteristic to the structure of the electrodes, since the electrodes may be easily stacked in jigs without regard to the location of spaced projections on the flanges which are used in anchoring the electrodes in a unitary assembly.

A still further feature of the ruggedized construction of the electrodes is that when the stack is assembled in the jig unit, the whole assembly may be hydraulically compressed, to insure stable localization of the electrodes when the side posts are fused to embed the flange projections of the electrodes therein.

Another feature of the heat radiating characteristics of the electrodes of this invention relates to the freedom from burning effects at the aperture in the first grid or control electrode where the emission from the cathode is substantially in excess of the required emission provided in the beam of electrons projected from the cathode through the grid aperture. The complete and effective heat radiation characteristics of the proposed construction insures the maintenance of stable operation in the control of the beam, so that burning of the aperture rim is substantially eliminated.

The ruggedized construction also materially improves the operating life of the tube by the elimination of weak supports, fragile lateral connectors and auxiliary straps which tend to reduce the strength of the assembly. The structure also provides accurate alignment so that greater efficiency is obtained in the manufacture and service of the tube.

A further feature of the ruggedized assembly of the gun unit is that greater salvage value may be attained with the present design in view of the fact that when the tube is disabled because of effects in the tube other than the gun structure, it is very easy to reclaim the gun after the tube is opened and then replace the cathode and heater in the first grid and thereby reuse the structure which constitutes a large potential value in the tube reclamation field.

A still further feature relates to efficient production whereby increased benefits and lower costs may be realized. This is accomplished by reason of the fact that the majority of the electrodes in the gun structure may be fabricated by the same set of dies, since all but the shield element surrounding the focus anodes and the reduced neck components may be produced by the same die sets. An auxiliary feature of this same aspect of the invention is the fact that the production process of formation of the cup portion of the electrode from flat strip metal the waste is cut off the bottom of the cup. In the present environment, the reverse bend portion and the flange are formed from the scrap portion and the excess metal which is lost is considerably reduced, thereby materially increasing the value of the raw material in the industrial processes of electronics manufacture.

These and many other features and advantages may be realized more fully by reference to the following detailed description when considered in connection with the accompanying drawings, in which;

Fig. 1 is a view in elevation, partly in cross-section, showing, on a greatly enlarged scale, the neck portion of a typical television tube with the gun mount supported therein and embodying the electrode structure of this invention;

Fig. 2 is a side elevation view of the array or stack of electrodes in the gun mount, taken on the line **2—2** of Fig. 1;

Fig. 3 is a plan view of the electrode assembly of this invention, to show the flange construction and the cutout ears formed at diametrically opposite points across the flange thereof;

Fig. 4 is a view in cross-section, taken on the line **4—4** of Fig. 3, of one form of cup electrode, to show the reverse bend in the wall of the electrode whereby the electrode is physically extended without increasing the effective length of the electrode, so far as its effect on the electron beam is concerned;

Fig. 5 is a plan view, taken on the line **5—5** of Fig. 1, showing the relationship of the electrode support posts and the bent ears of the electrodes embedded in the posts; and,

Fig. 6 shows a partial perspective view of the configuration of the electrode of this invention and the relation of the bent ear on the flange portion.

Referring to the drawings, and particularly to Fig. 1, the invention is embodied in a partial view of a television tube having a neck portion **10**, provided with a stem **11**, which supports a gun unit or electrode mount, for projecting a beam of electrons along the axis of the tube toward the picture screen, not shown, on the opposite end of the tube. The gun unit comprises a plurality of electrodes or cylindrical elements arranged in an array or stack and primarily concerned with projecting and controlling a beam of electrons toward the screen.

The gun unit involves a series of reentrant tubular electrodes, of which the primary electrode is an inverted cup electrode or first grid **12**, shown in cross-section in Fig. 4, having a central aperture **13**, in the closed end, to form the initial control electrode of the gun array. The cylindrical wall of this electrode is extended and reversely bent or turned at **14**, to extend substantially one half the distance back from the lower open end of the electrode. The reverse bend portion **14** terminates in a radial flange portion **15**, which forms the support of the control grid. The electrode **12** is formed of nonmagnetic stainless steel or similar highly refractory material, of light gauge, about .010 inch thickness and is thoroughly degreased and freed from injurious contaminants prior to assembly in the gun unit. Mounted within the first grid **12** is a small tubular cathode and heater, no shown, which serve as the electron source for projecting an electron beam through the array of electrodes constituting the gun unit. The outer wall **14** and the flange **15** enhance the heat radiating surface of the grid and so minimize its temperature changes, despite its proximity to the heater, with consequent improved stability of the close spacing between this grid and the adjacent grid **16**.

The second grid **16** is a short cup-shaped electrode having its closed end facing toward the closed end of the first grid and provided with a central aperture **13A**, which is coaxially aligned with the aperture **13** in the first grid **12**. The spacing between the adjacent faces of grids **12** and **16** is only a few thousands of an inch, of the order of .020 to .040 inch. The cup grid **16** has a reverse bend wall portion **17**, concentric with the cup wall **16** and turned downwardly from the open end to be joined to a flange portion **18**, which forms the support extension of the second grid electrode. As indicated in Figs. 1 and 2, the closed ends of the first and second grids **12** and **16**, respectively, are relatively close together while their support flanges **15** and **18** are widely spaced apart, thereby materially increasing the leakage resistance between these control electrodes.

Beyond the second or #2 grid electrode is a focusing anode assembly composed of a group of cooperating electrodes which influence the beam just in advance of its passage through electrostatic or electromagnetic fields which control its deflection across the area of the fluores-

cent screen on the viewing end of the tube. This group of focusing electrodes include a lower lens **19**, an upper lens **20**, in contraposed relation to lens **19**, and a cylindrical shield anode **21**, encompassing the reduced ends of the cooperating lens electrodes **19** and **20**.

The focus lens electrodes **19** and **20** are identical in construction so that a description of lens **19** will suffice for both. The electrode **19** is formed of a cup portion **22**, similar to the first grid **12**, and having a small central aperture **23**, in the closed end. A reversely turned wall extension **24**, continues from the open end and projects back from the open end to about one half the length of the cup portion **22**. The extension wall **24** is coaxial with the cup walls **22** and is of larger diameter. The rim of the extension **24** terminates in a flange **25**, which extends radially in the same relation as grids **12** and **16**. The inverted cup portion **22** above the reverse bend portion **24** and the flange **25** is enveloped by an auxiliary shell portion **26**, slightly larger in diameter than the cup portion **22**, so that it fits in telescopic relation and is affixed thereto.

The shell **26** is provided with a reduced neck portion **27**, having a recessed closed end **28**, with a central large aperture **29**, coaxial with aperture **23** in the shell portion **22**. A shoulder **30**, couples the neck portion **27** to the shell **26** and is spaced in parallel relation to the closed end of the cup portion **22**, to form an axial passageway between the apertures **23** and **29**, so that these compound electrodes **22** and **26** form an electron focus lens for concentrating the beam of electrons projected through the gun mount or assembly.

The complementary focus lens assembly **20** is mounted in opposed relation to lens electrode **19**. In this relation the reduced neck portions of both lens assemblies are mounted in coaxial relation and the intervening focus area is surrounded by a shield anode electrode **21**, formed of a cylindrical metallic portion **31**, having a curled rim **32**, surrounding the neck portion **27***a* of lens assembly **20**. The opposite end of the cylinder portion **31** has a reversely turned wall portion **33** surrounding and extending approximately to the central portion of the cylinder where it is flared outwardly to form a radial flange **34**. The shield anode establishes a magnetizing field in the vicinity of the focus lens area so that the electrons are concentrated in the axial beam through this portion of the gun assembly. The energizing high potential of the shield anode precludes straying of electrons from the beam in its progress toward the screen.

The multiple focus assembly, which includes the composite individual lens electrodes, is thus comprised of a series of reentrant tubular electrodes which are widely spaced in relation to their support points but are closely spaced in their functional relation with respect to the beam of electrons which passes through them. Furthermore, the high potential anode **21** is widely spaced in relation to the flange portions **25** and **25***a*, of the lens assembly respectively, so that the leakage paths between the various electrodes is materially lengthened and the danger of high potential breakdown is essentially eliminated.

The flanged reverse bend portions on all the electrodes have an extremely beneficial effect on the physical and electrical characteristics of the gun assembly. The reverse bend stiffens the open end of the electrode so that despite the thin wall, the inner cylinder retains its original cross-sectional shape. This is important both in assembling of the electrodes in precise alignment and in production of proper fields from an electrical standpoint during operation of the tube. The flange mount extending radially of the reverse bend in a plane substantially remote from both ends of the individual electrodes provides for their attachment to the supporting posts with wide spacing between the support points of adjacent electrodes. The reverse bend and flange construction thus provides both a rigid mount and long non-conductive path between each electrode and the next adjacent electrode. Since the mounting flange and ears are integral with the electrodes, there are absent the common weld flashes and irregularities which, heretofore, were responsible for internal flash-over and corona between the gun electrodes.

Each of the electrodes of this invention is rigidly mounted in cooperative relation so that the beam of electrons is directly axially through the aligned apertures in the various electrodes and combined into an integral unit or mount in the gun assembly. To achieve this result, each electrode is provided, as above described, with a radial flange portion which forms the support junction with a pair of glass or ceramic posts **35** and **36**, which are mounted in parallel vertical relation from stem **11** in the lower end of the neck portion **10** of the vessel by stub wires or rods **37**.

As shown in Fig. 4, each flange portion is provided with diametrically opposed cut-out portions which form a central ear or tab **38**, which is twisted, at **39**, in Fig. 6, transversely of the plane of the flange, so that ear may be sealed into the posts, as shown in cross-section in Fig. 1. The relation of the electrodes mounted between the posts **35** and **36** is shown clearly in plan view in Fig. 5, in which the twisted ears are perpendicular to the plane of the flange and are sealed into the inner surfaces of the posts in linear alignment, as shown in Fig. 2.

The sealing of the ears of the electrodes into the glass support posts is effected while the electrodes are held temporarily in a jig in axial alignment and with proper inter-electrode spacing. Since the electrodes have not been distorted by welding pressures and temperatures, they properly cooperate with the locating surfaces of the jig in attainment of precise alignment of the beam apertures of the gun electrodes. In production, the shrinkage loss, due to rejection of guns and tubes for faulty alignment or for poor cathode ray spot formation, is practically eliminated.

The manufacture of the individual electrodes from a disc blank involves drawing and extrusion operations, all performed by precision dies, thereby insuring accurate dimensioning of the electrodes, including parallelism of their opposite faces within a tolerance easily held to less than two thousandths of an inch. Thus, in the assembly jig, in readiness for their attachment to the support posts, the electrodes may be precisely positioned for predetermined control in the formation of the cathode beam and with very close spacing of the adjacent faces of the grids **12** and **16**, without danger of internal short-circuits or other malfunction.

The connection of the electrodes **16** and **21** to the terminals or pins in the stem **11** may be effected by lead wires **40** and **41**, welded to the marginal flange area of the electrodes, as indicated in Fig. 2. The first grid **12** may be connected to a pin in the stem by a short wire **42**, welded to the outer tubular section **14** of electrode **12**. The two focusing anode electrodes **19** and **20**, may be connected to each other by wire **43**, welded to their marginal flanges, Fig. 2, and to an interior conductive coating of the tube by spring contacts, not shown, so that the high energizing potential may be applied to the focusing anode assembly. As indicated by dotted lines in Figs. 4 and 5, the mounting flange may be cut away at **44** between the cut-out ears, to provide more clearance between the gun electrodes and the neck portion of the tube for dressing the lead wires in the gun unit. The attenuated electrodes are, therefore, more easily stacked in a jig assembly by the self-indexing parallel edges of the flange portions and provide a biased assembly which materially enhances the production processes of manufacture of the gun unit. The proposed electrode structure also lends itself to automation assembly since it may be fed from a hopper to the assembly jig and then consolidated into a gun unit, to provide a stable and constantly aligned and accurate assembly at low cost.

While the invention has been set forth specifically in a particular embodiment, it is, of course, understood, that various modifications may be made in the detailed structure of the electrodes and their assembly without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. An electrode, comprising a double walled metallic member having the outer wall concentric with the inner wall and extending approximately half the distance beyond one end of said member, said outer wall being spaced away from said inner wall, an integral annular junction connecting said walls together at said one end to form a reverse bend between said inner and outer walls, and an integral outwardly extending flange projecting from the free end of said outer wall and having integral mounting lugs angularly spaced about its periphery and each defined by notches extending inwardly from said periphery.

2. In an electron gun assembly, an electrode comprising a double walled metallic member having the outer wall concentric with the inner wall and extending approximately half the distance beyond one end of said member, said outer wall being spaced away from said inner wall, an integral annular junction connecting said walls together at said one end to form a reverse bend between said inner and outer walls, and an integral outwardly extending flange projecting from the free end of said outer wall, said flange having integral cut-out mounting lugs at dimetrically opposed points on the edge thereof, the outer ends of said mounting lugs being within the outer boundary of said flange.

3. In an electron gun assembly having support posts, an electrode comprising a double walled metallic member having the outer wall concentric with the inner wall and extending approximately half the distance beyond one end of said member, said outer wall being spaced away from said inner wall, an integral annular junction connecting said walls together at said one end to form a reverse bend between said inner and outer walls, and an integral outwardly extending flange projecting from the free end of said outer wall, said flange having cut-out ear portions at diametrically opposed points on the edge thereof, said ear portions being twisted perpendicularly to the plane of said flange for sealing into said support posts.

4. In an electron gun assembly having support posts, an electrode comprising a double walled metallic member having the outer wall concentric with the inner wall and extending approximately half the distance beyond one end of said member, said outer wall being spaced away from said inner wall, an integral annular junction connecting said walls together at said one end to form a reverse bend between said inner and outer walls, and an integral outwardly extending flange projecting from the free end of said outer wall, said flange having cut-out ear portions at diametrically disposed points on the edge thereof, said ear portions being twisted perpendicularly to the plane of said flange for sealing into said support posts, said ear portions being formed within the boundary of the periphery of said flange.

5. An electron gun assembly comprising a series of reentrant tubular electrodes each having an integral flange extending radially outwardly from the outer tubular section of the electrode in a plane parallel to and spaced substantially midway from the opposite ends of the inner reentrant tubular section of the electrode, each of said flanges having integral mounting elements angularly spaced about its periphery, and support posts respectively directly attached to said angularly spaced mounting elements of each electrode flange with each post attached at predetermined points along its length to the corresponding integral mounting elements of the successive flanges rigidly to maintain the electrodes in spaced axial alignment and to provide increased leakage resistance between the successive electrodes of the series.

6. An electron gun assembly as in claim 5 in which said angularly spaced mounting elements of the electrode flanges are ears defined by peripheral notches and each twisted perpendicularly to the plane of the associated flange.

7. An electron gun assembly including a tube stem, support posts attached at one end to said stem and extending therefrom parallel to each other, and a stack of reentrant tubular electrodes each having an integral flange extending radially from the outer tubular section of the electrode in a plane parallel to and spaced substantially equally from the opposite ends of the inner reentrant tubular section of the electrode, the periphery of said flanges having integral angularly spaced mounting elements directly attached to said support posts rigidly to maintain the alignment and axial spacing of the electrodes of the stack.

8. An electron gun assembly including two reentrant tubular grid electrodes each having an integral mounting flange extending radially outwardly from the outer tubular section of the electrode in a plane parallel to and spaced substantially equally from the open reentrant end of the inner tubular section of the electrode and from the closed apertured end of said inner tubular section, said flanges each having integral mounting elements angularly spaced about its periphery, said reentrant grid electrodes being in mutually inverted relation with their closed apertured ends in close proximity, and support posts respectively directly attached to said angularly spaced mounting elements of each of said flanges and individually attached at axially spaced regions to the corresponding mounting elements of the flanges of the two grid electrodes rigidly to maintain the aperture alignment and spacing of the closed ends of said grid electrodes and by a mounting arrangement providing increased leakage resistance between said grid electrodes.

9. An electron gun assembly including two lens electrodes and an intervening shield electrode, each of said three electrodes being reentrant tubular electrodes each having an integral mounting flange extending radially outwardly from the outer tubular section of the electrode in a plane parallel to and substantially equally spaced from the opposite ends of the inner reentrant tubular section of the electrode, the three flanges each having integral mounting elements angularly spaced about its periphery, said reentrant lens electrodes being in mutually inverted relation with their closed apertured ends faced toward one another and each having a tubular shell fitting over its inner reentrant tubular section, said shells of the lens electrode extending into the space defined by the inner reentrant tubular section of the shield electrode with their closed apertured ends in spaced relation, and support posts respectively directly attached to the angularly spaced mounting elements of each of said three flanges and individually attached at axially spaced regions to the corresponding mounting elements of the lens electrodes and the intervening shield electrode rigidly to maintain the aperture alignment and spacing of said electrodes and by a mounting arrangement providing increased leakage resistance between said shield electrode and each of said lens electrodes.

10. An electron gun assembly including in sequence a first grid electrode, a second grid electrode, a focusing electrode, a shield electrode and a second focusing electrode, each of said electrodes comprising a reentrant tubular structure having an integral flange extending radially outwardly from its outer tubular section in a plane parallel to and spaced substantially equally from the opposite ends of the inner reentrant tubular section, said flanges of all electrodes having the same radius and having similarly angularly spaced mounting ears defined by peripheral notches, and support posts in each of which are embedded the corresponding axially aligned ears of

said electrodes to provide a mounting arrangement rigidly maintaining said electrodes in spaced axial alignment and having increased leakage resistance between the successive electrodes.

11. An electron gun assembly including a tube stem, support posts attached at one end to said stem and extending therefrom parallel to each other, and a series of electrodes including in spaced axial sequence a first grid electrode, a second grid electrode, a focusing electrode, a shield electrode and a second focusing electrode, each of said electrodes comprising a reentrant tubular structure having an integral flange extending radially from the outer tubular section of the electrode in a plan parallel to and spaced substantially from the opposite ends of the inner reentrant tubular section of the electrode, each of said flanges having angularly

spaced integral peripheral ears embedded in said support posts rigidly to maintain the alignment and axial spacing of said electrodes and by a mounting arrangement providing increased leakage resistance between said electrodes.

References Cited in the file of this patent

UNITED STATES PATENTS

2,233,795	Pensak	Mar. 4, 1941
2,567,893	Pohle et al.	Sept. 11, 1951
2,627,585	Van Ornum	Feb. 3, 1953
2,690,517	Nicoll et al.	Sept. 28, 1954
2,732,511	Dichter	Jan. 24, 1956
2,792,515	Broderick et al.	May 14, 1957
2,847,599	Kaseman	Aug. 12, 1958
2,853,639	Knochel et al.	Sept. 23, 1958

UNITED STATES PATENT OFFICE

CERTIFICATION OF CORRECTION

Patent No. 2,942,128 June 21, 1960

Jay H. Johnson

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 47, for "no" read -- not --; column 5, line 14, for "walls" read -- wall --; column 9, line 14, for "plan" read -- plane --.

Signed and sealed this 18th day of July 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents