Nov. 26, 1957 C. E. MURDOCK ET AL 2,814,751

STEM STRUCTURE FOR BEAM TYPE TUBES

Filed March 16, 1955 2 Sheets-Sheet 1

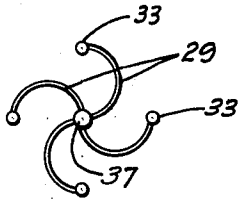


Fig. 2

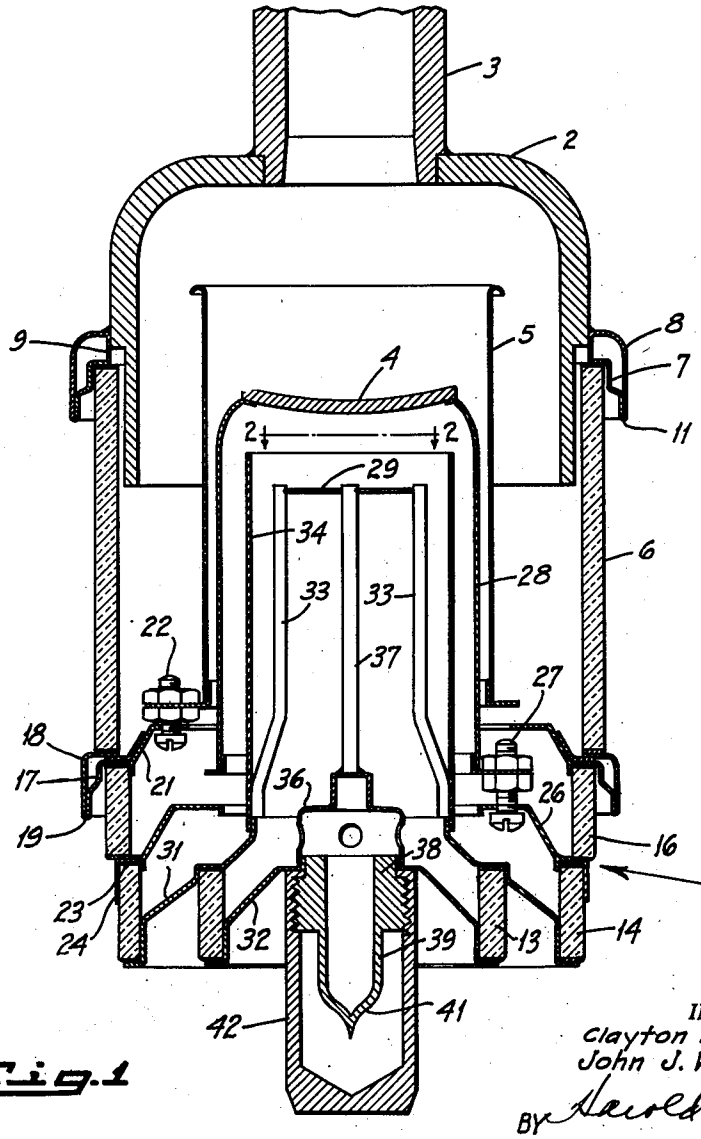


Fig. 1

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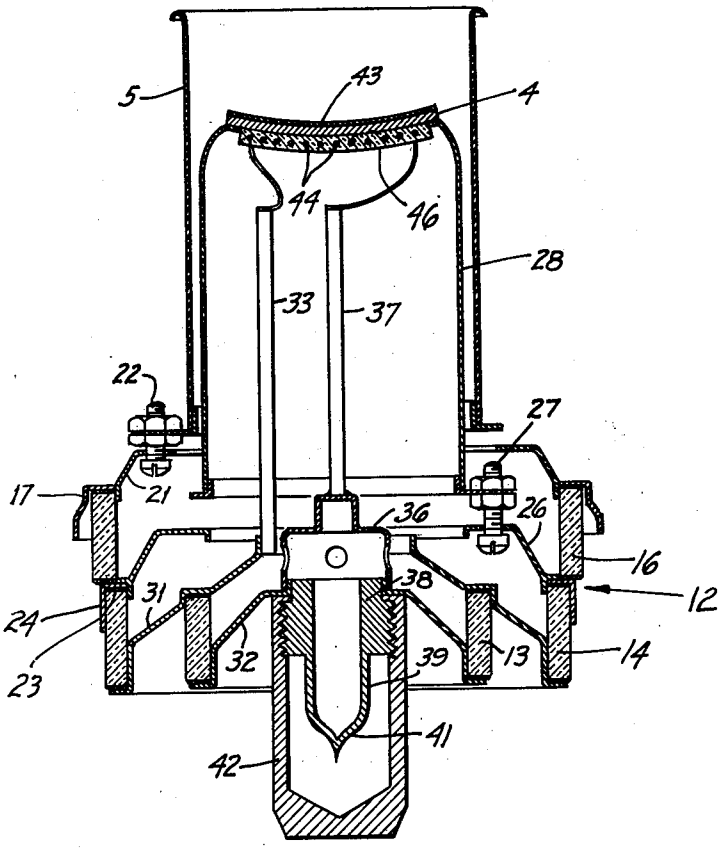


Fig. 3

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STEM STRUCTURE FOR BEAM TYPE TUBES

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9 Claims. (Cl. 313—247)

Our invention relates to a stem structure incorporating an electron gun for beam type tubes such as klystrons and the like.

An object of our invention is to provide an evacuated envelope having a stem structure carrying the gun electrodes, which stem has coaxial terminals axially aligned with the electrodes.

Another object is to provide a separately fabricated header on the stem, upon which the gun electrodes may be mounted prior to fixing the header on the stem structure.

Another object is to provide a stem structure which enables the gun electrodes to be accurately aligned with the tube axis.

A further object is to provide an improved stem of ceramic construction.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of our invention. It is to be understood that we do not limit ourselves to this disclosure of species of our invention, as we may adopt variant embodiments thereof within the scope of the claims.

Referring to the drawings:

Figure 1 is an axial sectional view of our improved stem structure; and

Figure 2 is a detail view looking at the top of the cathode heater, taken in a plane indicated by line 2—2 of Figure 1.

Figure 3 is a view similar to Figure 1 but showing the header only and illustrating a modified cathode and heater construction.

Referring first to Figures 1 and 2, our stem structure for beam type tubes, say a klystron, comprises an envelope having a metal anode 2 with an aperture opening into a drift tube 3, the electron beam from a disk-shaped cathode 4 being directed into the drift tube by a coaxial focusing electrode 5. Anode 2 is preferably cup-shaped and extends down about the cathode of the electron gun.

A cylindrical wall 6 of insulating material, preferably ceramic, extends axially from the anode. A joint between the anode and ceramic cylinder is formed by a pair of cup-shaped metal sealing flanges 7 and 8, inner flange 7 being brazed to a metalized upper end of ceramic cylinder 6 and outer flange 8 being brazed to anode 2. An abutting lip 9 takes up the end thrust. The nested cylindrical sides of the sealing flanges are coaxial with the anode and wall cylinder 6 so that the latter parts are automatically aligned when the sealing flanges are engaged. A vacuum-tight joint is made by a metallic bond 11 formed by welding together the registering edges of the sealing flanges.

A header 12 is provided across the outer or lower end of wall cylinder 6, upon which header the electron gun is mounted. This header also carries the electrode terminals, the latter being coaxially arranged and axially aligned with the gun electrodes. Header 12 comprises a series of metalized ceramic cylinders including inner and

outer cylinders 13 and 14 and a third cylinder 16 above the outer cylinder 14. These cylinders are connected together by suitable metallic members making up a unitary header structure upon which the electrodes are mounted and providing the desired coaxial terminal arrangement.

Header 12 is designed for attachment to wall cylinder 6 after the electrodes have been mounted. For this purpose a joint is formed by a pair of complementary cup-shaped metal sealing flanges 17 and 18, inner flange 17 being brazed to the metalized upper end of ceramic header cylinder 16 and outer flange 18 being brazed to the metalized lower end of ceramic wall cylinder 6. A vacuum-tight joint is made by metallic bond 19 formed by welding together the registering edges of the sealing flanges. The nested cylindrical sides of these sealing flanges are coaxial with header 12 and with wall cylinder 6 so that the gun electrodes are automatically aligned with the anode and drift tube.

The above joint between the header and wall cylinder also functions as a terminal for focusing electrode 5, which electrode is tubular and coaxially surrounds cathode 4. An inwardly extending supporting ring 21, preferably of conical shape, is fastened to lower sealing flange 17 and carries mounting screws 22 which are secured to focusing electrode 5. This arrangement permits the electrode to be mounted on the header prior to making the final seal at weld 19.

Ceramic cylinders 14 and 16 of the header are joined together along abutting ends, preferably by brazing the two metalized ends of the ceramic to an interposed metal ring 23 having a down-turned flange portion 24 to provide a terminal. An inwardly extending conical supporting ring 26 is connected to terminal 23 at the joint and carries mounting screws 27 secured to tubular cathode support 28. In the electron gun illustrated, the cathode 4 is disk-shaped, preferably of a metal such as tantalum, and is maintained at electron emitting temperature by electron bombardment from a suitable filament or heater 29 below the cathode button.

Inner ceramic cylinder 13 of the header functions as a spacer between two conical metal wall members 31 and 32 forming the bottom of the header structure. Member 31 is brazed at its outer periphery to the lower metalized end of outer ceramic 14 and is brazed along an intermediate portion to the upper metalized end of inner ceramic ring 13. The upper circular end of member 31 provides a mount for four filament supporting side rods 33 which are arranged in a circle about the axes of the stem structure. It also serves as a support for a tubular heat shield 34 surrounding the filament.

Central wall member 32 is brazed at its outer periphery to the lower metalized end of ceramic cylinder 13 and carries a cap 36 which supports center rod 37 of the filament assembly. This center wall also carries a stud 38 having a metal exhaust tubulation 39 which is pinched off at 41 after evacuation of the tube envelope. A threaded cap 42 covering the tubulation is applied after the pinch-off.

Filament 29 is located in a plane below cathode 4 and preferably comprises a group of four filament wires, each connected at one end to center rod 37 and at the outer end to one of the spaced side rods 33. These filament wires extend in curves spiraling outwardly from the center rod as shown in Figure 2, providing a rigid filament structure.

In disk-shaped cathodes of this kind which are heated by electron bombardment there is normally a tendency for the center of the disk to be overheated, causing the center to warp or bulge downwardly during tube life. This is overcome with our filament structure because of the center rod support at the central region of the cathode

disk. There is appreciable end cooling of the filament wires at the central region on account of heat conduction down the center rod, which cooler region of the filament array means that there is less electron emission and consequently less electron bombardment at the center of the cathode disk. The filament may take shapes other than that shown in Figure 2, such as a zigzag formation or the like, but in any case we preferably provide a center rod support to give the desired cooling at the central region of the filament, for the reasons above described.

Figure 3 is a view of the header with the electrodes mounted in place and also illustrates our improved stem structure adapted for an oxide coated type of cathode. In this case the cathode disk is of nickel and is coated with the conventional oxide layer **43**. The cathode is preferably heated by a heater coil **44** embedded in an insulating layer **46** on the under surface of the cathode disk. Only one of the side rod conductors **33** is needed in this instance.

Figure 3, which shows the header only, also illustrates how the gun electrodes are mounted prior to fixing the header in final position. Here it is clearly shown that electrodes are out in the open for easy assembly and alignment. It can also be appreciated that the mounted electrodes will be automatically brought into axial alignment with the anode aperture when header flange **17** is brought into engagement with sealing flange **18** on the cylindrical wall of the anode section.

We claim:

1. A stem structure for beam type tubes comprising an envelope having coaxial terminals, a disk-shaped cathode in the envelope, a tubular support for the cathode connected to one of said terminals and directly supporting said cathode transverse to the axis of said terminals, a tubular focusing electrode surrounding the cathode and at least a substantial part of said tubular cathode support and connected to another of the terminals, a generally cup-shaped anode having a central aperture and partially surrounding said focusing electrode, a heater for the cathode within the cathode support and connected to still another of said terminals, an exhaust tubulation on the envelope, said tubulation comprising part of the centermost of said coaxial terminals, and a center rod axially disposed within said envelope in alignment with said exhaust tubulation and establishing an electrical connection to said heater.

2. A stem structure for beam type tubes comprising an envelope having a cup-shaped anode having a central aperture, an insulating wall cylinder extending axially from the anode cup walls, a header across the outer end of said cylinder opposite said anode, a disk-shaped cathode facing the anode and partially surrounded thereby and supported centrally on the header, a cathode terminal on the header, complementary metal sealing flanges with registering edges on the header and said outer end of the wall cylinder, and a metallic bond uniting the registering edges of said last mentioned flanges.

3. A stem structure for beam type tubes comprising an envelope having a cup-shaped anode having a central aperture, an insulating wall cylinder extending axially from the anode cup walls, a header across the outer end of said cylinder opposite said anode, a disk-shaped cathode facing the anode and partially surrounded thereby and supported centrally on the header, a cathode terminal on the header, complementary metal sealing flanges with registering edges on the header and said outer end of the wall cylinder, and a metallic bond uniting the registering edges of said last mentioned flanges, said flanges being cup-shaped and having nested cylindrical sides coaxial with the header and said wall cylinder to center the cathode with respect to said cylinder.

4. A stem structure for beam type tubes comprising an envelope having a cup-shaped anode having a central aperture, an insulating wall cylinder extending axially from the anode cup wall, complementary metal sealing flanges with registering edges on the anode and on the adjacent end of the wall cylinder, a metallic bond uniting said registering edges, a header across the outer end of said cylinder opposite said anode, a disk-shaped cathode facing the anode and supported centrally on the header, a cathode terminal on the header, complementary metal sealing flanges with registering edges on the header and said outer end of the wall cylinder, and a metallic bond uniting the registering edges of said last mentioned flanges.

5. A stem structure for beam tubes comprising a generally cylindrical envelope, a disk-shaped cathode in the envelope lying transversely of the envelope axis, a heater for the cathode comprising a filament lying in a plane substantially parallel with the cathode disk, a heat conductive center support extending axially of the envelope and connected to the central portion of said filament, means coaxial with said envelope and center support for exhausting said envelope, said means supporting the terminal end of said support remote from said filament, and a conical wall member supporting said exhaust means on the envelope and thermally coupling said center support to said envelope.

6. A stem structure for beam type tubes comprising an envelope, a disk-shaped cathode in the envelope, a heater for the cathode comprising a plurality of supporting rods projecting toward the cathode disk, one of said rods being centrally located along the cathode axis and conducting heat away from the center of the heater and others of said rods being spaced about the center rod, an array of filament wires lying in a plane substantially parallel with the cathode disk, each wire being connected at one end to the center rod and at the other end to one of said spaced rods, and means for exhausting said envelope axially aligned with said center rod and supporting the terminal end of said rod away from said heater.

7. A stem structure for beam type tubes comprising an envelope, a disk-shaped cathode in the envelope, a heater for the cathode comprising a plurality of supporting rods projecting toward the cathode disk, one of said rods being centrally located along the cathode axis and conducting heat away from the center of the heater and others of said rods being spaced about the center rod, an array of filament wires lying in a plane substantially parallel with the cathode disk, each wire being connected at one end to the center rod and at the other end to one of said spaced rods, said filament wires extending in curves spiraling outwardly from the center rod and means for exhausting said envelope axially aligned with said center rod and supporting the terminal end of said rod away from the heater, a tubular heat shield enveloping said heater and heater rods, a pair of conical wall members axially aligned with said center rod, one of said conical wall members supporting said heat shield and one or more of said spaced rods and the other supporting said exhausting means and center rod, and an insulating cylindrical ring extending between said conical wall members and fixing said wall members one to the other.

8. A stem structure for beam type tubes comprising an envelope having coaxial terminals, a disk-shaped cathode in the envelope connected to one of said terminals, an anode facing said cathode and having an aperture therethrough forming a passageway for electrons emanating from the cathode, a focusing electrode surrounding said cathode and connected to another of said terminals, said envelope having a header end comprising an inner cylinder of insulating material and an outer cylinder of insulating material surrounding and spaced from said inner cylinder, a first metal wall secured across said inner cylinder, a second metal wall secured between said cylinders and insulated from said first metal wall by said inner cylinder, a heater for said cathode, a first heater lead connected to said first metal wall, a second heater lead connected to said second metal wall, and an exhaust tubulation connected to said first metal wall.

9. A stem structure for electron tubes having a metal

member forming part of the tube envelope, said stem structure comprising a plurality of annular ceramic members forming additional parts of the envelope and being coaxial with said metal envelope member, said ceramic members having flat ends and being of consecutively decreasing diameters with the largest diameter ceramic member being attached to said metal envelope member, electrodes and annular metallic supports therefor in the envelope, metallic means electrically extending said supports radially through the envelope between adjacent ones of said ceramic members and forming terminals for said electrodes externally of the envelope, said metallic means being bonded to said flat ends of the ceramic members between which they pass, said metallic means between two of said ceramic members comprising complementary sealing flanges having cylindrical portions received one within the other and inwardly extending flange portions bonded respectively to the flat ends of two adjacent ceramic members, and a metallic bond joining said cylindrical portions at their ends opposite said flange portions, one of said electrodes being a cathode, a heater for said

cathode, and metallic means located axially of the stem at the end remote from said metal envelope member and forming an end closure and heater terminal, said metallic closure means being bonded to the flat end of the smallest diameter ceramic member, and a heater lead attached to said closure means.

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