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(54) Electron gun assembly

(57) An electron gun assembly includes a cathode 1, control grid 5 located in front of it and a focus electrode 6. The control electrode 5 is integral with a cylindrical support 11 and formed of pyrolytic graphite. Similarly, the focus electrode 6 is integral with a cylindrical support 16 and is formed of molybdenum. The control grid 5 and focus electrode 6 are mounted on a common mount 15 located behind the front face of the cathode 1, giving a simple structure having low thermally capacity and being mechanically robust.

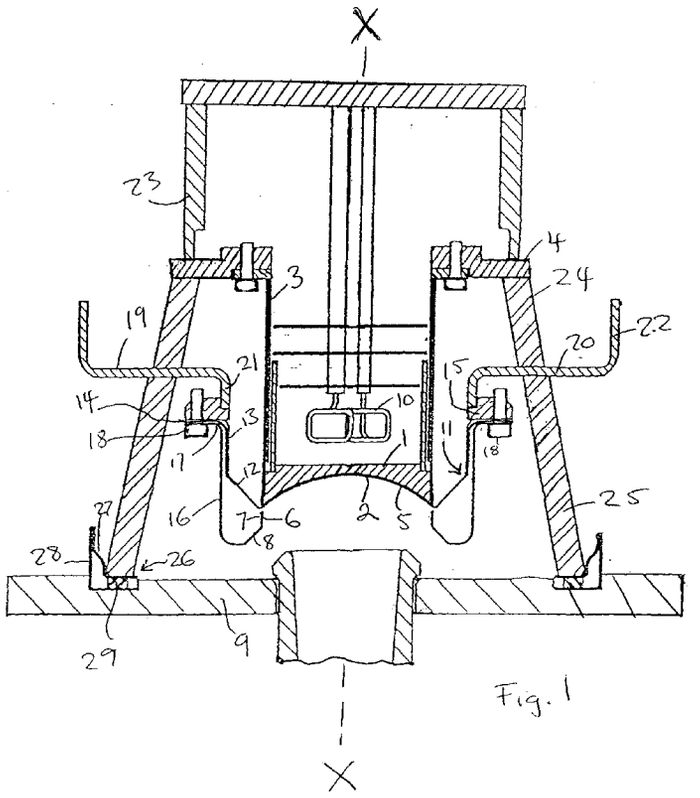

Fig. 1

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Description

[0001] This invention relates to an electron gun assembly and more particularly, but not exclusively, to an electron gun assembly suitable for use in inductive output tubes (IOTs).

[0002] An electron gun assembly includes a cathode from which an electron beam is generated at its front surface and usually also includes one or more control electrodes to govern the profile of the electron beam so produced and to control its electron density. The present invention is concerned with an electron gun assembly in which both a control grid and focus electrode are included in front of the cathode.

[0003] According to the invention, there is provided an electron gun assembly comprising: a cathode, a control grid having a substantially cylindrical support and a focus electrode having a substantially cylindrical support, the control grid and focus electrode being in electrical contact with one another and being mounted on a common mount.

[0004] By providing a common mount for the control grid and focus electrode, instead of separate structures to support these two components, the amount of material used in the mounting arrangement is reduced, hence presenting a reduced thermal capacity. This permits thermal equilibrium to be reached more quickly than would be case with a separately mounted control grid and focus electrode. Thus, the electron gun assembly reaches an operational state more quickly. Furthermore, the invention provides a simple, mechanical robust construction which also occupies a smaller volume within the vacuum envelope surrounding an electron gun. The common mount may consist of a single component or could be made up of several separate components which are joined together. The common mount is preferably a complete annulus, but it could be interrupted at one or more places around its circumference. In one embodiment, the common mount is annular, having an axially extensive cylindrical part and a flange part extensive normal to the axis, the axis being parallel to the direction of the electron beam. The cylindrical supports may be fixed to the axially extensive part and/or the flange part of the common mount.

[0005] The substantially cylindrical supports of the control grid and focus electrode also may be made as thin walled shells, the cylindrical configuration being mechanically strong. Hence, the supports also present a small thermal capacity such that the whole assembly reaches an operating condition quickly. The control grid and its support may be a single integral component, and similarly so may the focus electrode and its support.

[0006] In a preferred embodiment of the invention, the cylindrical supports for the control grid and for the focus electrode have sides which are parallel to one another but in other arrangements they may diverge. The cylindrical supports extend rearwardly behind the front face of the cathode such that in a preferred embodiment, the common mount is located behind the front face of the cathode. This arrangement is advantageous as it removes the influence of the mount structure from a region where it might affect the profile of the electron beam generated at the front face of the cathode.

[0007] As the control grid and focus electrode are in electrical contact with one another at the common mount, they may be mounted directly one on the other, minimising the number of components required and simplifying the assembly. Spacer means may be included between at least two of the common mount, the grid support and the focus electrode support to achieve the required spacing between these components. For example, the spacer means may comprise one or more packing washers, or separate spacers located around the periphery of one of the components.

[0008] The cylindrical supports may advantageously have ends which are substantially normal to the cylindrical walls of the supports although they could be configured so as to lie somewhere between the generally axially extensive direction of the main part of the cylindrical support and the preferred configuration lying in a plane transverse to the axial direction. The ends may then be the parts of the cylindrical supports which are fixed to the common mount. In an alternative embodiment, the cylindrical supports may be fixed to the common mount via their cylindrical walls.

[0009] In a preferred arrangement, fixing means pass through both cylindrical supports to fix them to the common mount. This may reduce assembly time and improve accuracy in the relative positioning of the control grid and focus electrode. However, in other arrangements, they may be separately fixed to the common mount. In a preferred embodiment, a plurality of fixing members are distributed spatially around the cylindrical supports, for example, these could be screws passing through the supports, to fix them firmly against a receiving face on the common mount. Washers or some compliant member could be interposed between the cylindrical supports and mount or fixing members. In other arrangements, a single fixing means may be provided, for example, as an annular clamp arrangement.

[0010] According to a feature of the invention, an electron beam tube arrangement includes an electron gun assembly in accordance with the invention.

[0011] Some ways in which the invention may be performed are now described by way of example with reference to the accompanying drawings in which:

Figure 1 schematically illustrates an electron gun assembly in accordance with the invention;

Figure 2 schematically illustrates an electron beam tube arrangement which includes the electron gun assembly of Figure 1; and

Figure 3 schematically illustrates part of another electron gun assembly in accordance with the in-

vention.

[0012] With reference to Figure 1, an electron gun assembly comprises a cathode 1 having a curved front surface 2 from which, during operation, an electron beam is generated along the longitudinal axis X-X. The cathode 1 is supported by a cylindrical tube 3 which in turn is mounted on an annular support plate 4. A control grid 5 of pyrolytic graphite is located in the front of the cathode 1 having a configuration which conforms to the shape of the front surface 2 of the cathode and being closely spaced therefrom. A focus electrode 6 is located adjacent the control grid 5 on the other side to the cathode 1 and comprises a cylindrical part 7 which is substantially parallel to the axis X-X and a portion 8 flaring outwardly away from the axial direction X-X. A plate 9 located in front of the focus electrode 6 is maintained at a higher potential than the cathode 1 and acts as an anode. A cathode heater 10, which may be potted, is located behind the cathode 1.

[0013] The control grid 5 is supported by a substantially cylindrical support 11 which is integral with it, the components being manufactured as a shell of the correct profile in which the apertures in the control grid 5 are then cut. The cylindrical support 11 has a conical rearwardly extending portion 12 immediately adjacent the control grid 5 and continues as a substantially straight sided, axially parallel portion 13, giving a relatively rigid structure. The end of the cylindrical support 11 is turned outwardly to form as a transversely extensive part 14 which is substantially normal to the axial part 13. The end 14 is mounted on a face of an annular mount 15 of Kovar, a material of low thermal expansivity.

[0014] The focus electrode 6 is of molybdenum and is a thin walled shell which is produced by spinning or pressing. It is integral with a substantially cylindrical support 16. The support 16 has a substantially straight-sided section arranged parallel to the axis X-X. The end of the cylindrical support 16 is turned outwardly as a transverse flange 17 which is located adjacent to the end 14 of the pyrolytic graphite shell 11. The focus electrode support 16 is also mounted on the mount 15. A plurality of screws 18, only two of which are shown, are distributed around the circumference of the annular mount 15 and pass through both the molybdenum support 16 of the focus electrode 6 at flange 17 and the pyrolytic graphite support 11 of the control grid 5 at end 14.

[0015] The annular mount 15 is supported by an annular member 19 which is a Kovar spinning or pressing and includes a generally transverse portion 20 and axially extensive parts 21 and 22, the annular mount 15 being attached to the inner part 21 of the annular member 19.

[0016] The electron gun assembly is included within a vacuum envelope which comprises a rearward portion 23 which is connected via vacuum seal to the annular support plate 4 of the cathode support tube 3. A conical ceramic cylinder 24 is brazed to the other side of the annular support plate 4 and to one surface of the cylindrical member 19. A second conical ceramic cylinder 25 is brazed to the other surface of the cylindrical member 19 at one end and at its other end to a vacuum tight seal arrangement 26 which includes annular flanges 27 and 28 and a ceramic balance ring 29 located adjacent the anode plate 9.

[0017] Figure 2 schematically shows an IOT having an electron gun assembly as shown in Figure 1 and further includes an input resonant cavity 30 which is annular and generally surrounds the electron gun assembly, drift tube 31 and an output cavity 32 from which an amplified output signal is extracted via coupling means 33.

[0018] With reference to Figure 3, in part of another electron gun assembly, a common mount 34 comprises an annular Kovar member having a cylindrical axially extensive part 35 and a flange part 36 normal to the axis. The cylindrical walls 37 and 38 of the grid support and focus electrode support respectively are fixed by a plurality of screws, one of which 39 is shown, to the axially extensive part 35. Packing washers 40 and 41 are located between the common mount 34 and walls 37 and 38, the latter being in electrical contact with one another.

Claims

1. An electron gun assembly comprising: a cathode, a control grid having a substantially cylindrical support and a focus electrode having a substantially cylindrical support, the control grid and focus electrode being in electrical contact with one another and being mounted on a common mount.

2. An electron gun assembly as claimed in claim 1 wherein the common mount is located behind the front face of the cathode.

3. An electron gun as claimed in claim 1 or 2 wherein the common mount is substantially annular.

4. An electron gun as claimed in claim 1, 2 or 3 wherein the cylindrical supports of the control grid and the focus electrode include end parts which are substantially normal to the cylindrical parts of the supports.

5. An electron gun assembly as claimed in claim 4 wherein the end parts of the cylindrical supports are fixed to the common mount.

6. An electron gun assembly as claimed in any preceding claim wherein fixing means pass through both the cylindrical supports to fix them on the common mount.

7. An electron gun assembly as claimed in claim 6

wherein the fixing means comprises a plurality of fixing members distributed spatially around the cylindrical supports.

8. An electron gun assembly as claimed in claim 6 or 7 wherein the fixing means pass through the cylindrical walls of the supports.

9. An electron gun assembly as claimed in any preceeding claim wherein the common mount is supported by a mount support which is extensive through a vacuum envelope within which the electron gun assembly is contained.

10. An electron gun assembly as claimed in claim 9 wherein the mount support is substantially cylindrical and comprises an axially extensive portion and a transversely extensive portion, the transversely extensive portion being extensive through the vacuum envelope.

11. An electron gun assembly as claimed in claim 9 or 10 wherein the mount support comprises a Kovar spinning or pressing.

12. An electron gun assembly as claimed in any of claims 9 to 11 wherein the vacuum envelope comprises a ceramic wall through which the mount support is extensive.

13. An electron gun assembly as claimed in any preceding claim wherein a voltage is applied to the mount support to maintain the potentials of the focus electrode and the control grid.

14. An electron gun assembly as claimed in any preceding claim wherein the control grid is of pyrolytic graphite.

15. An electron gun assembly as claimed in any preceding claim wherein the focus electrode is of molybdenum.

16. An electron gun assembly as claimed in any preceding claim wherein the control grid is integral with its cylindrical support.

17. An electron gun assembly as claimed in any preceding claim wherein the focus electrode is integral with its cylindrical support.

18. An electron gun assembly as claimed in any preceding claim and including spacer means between at least two of the common mount, the grid support and the focus electrode support.

19. An electron gun assembly as claimed in any preceding claim wherein the common mount is annular, having an axially extensive cylindrical part and a flange part extensive normal to the axis.

20. An electron beam tube arrangement including an electron gun assembly as claimed in any preceding claim.

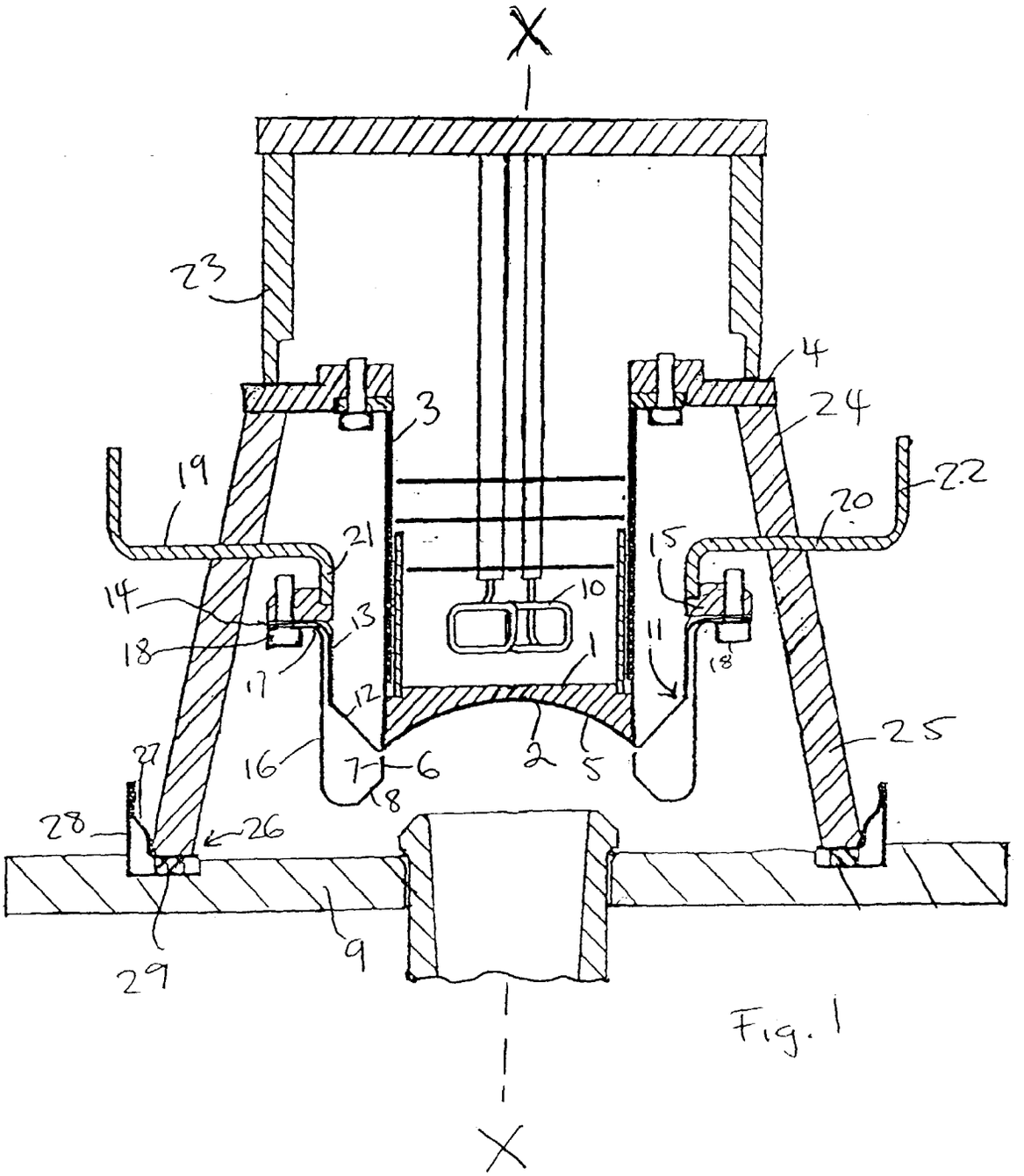
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Fig. 1

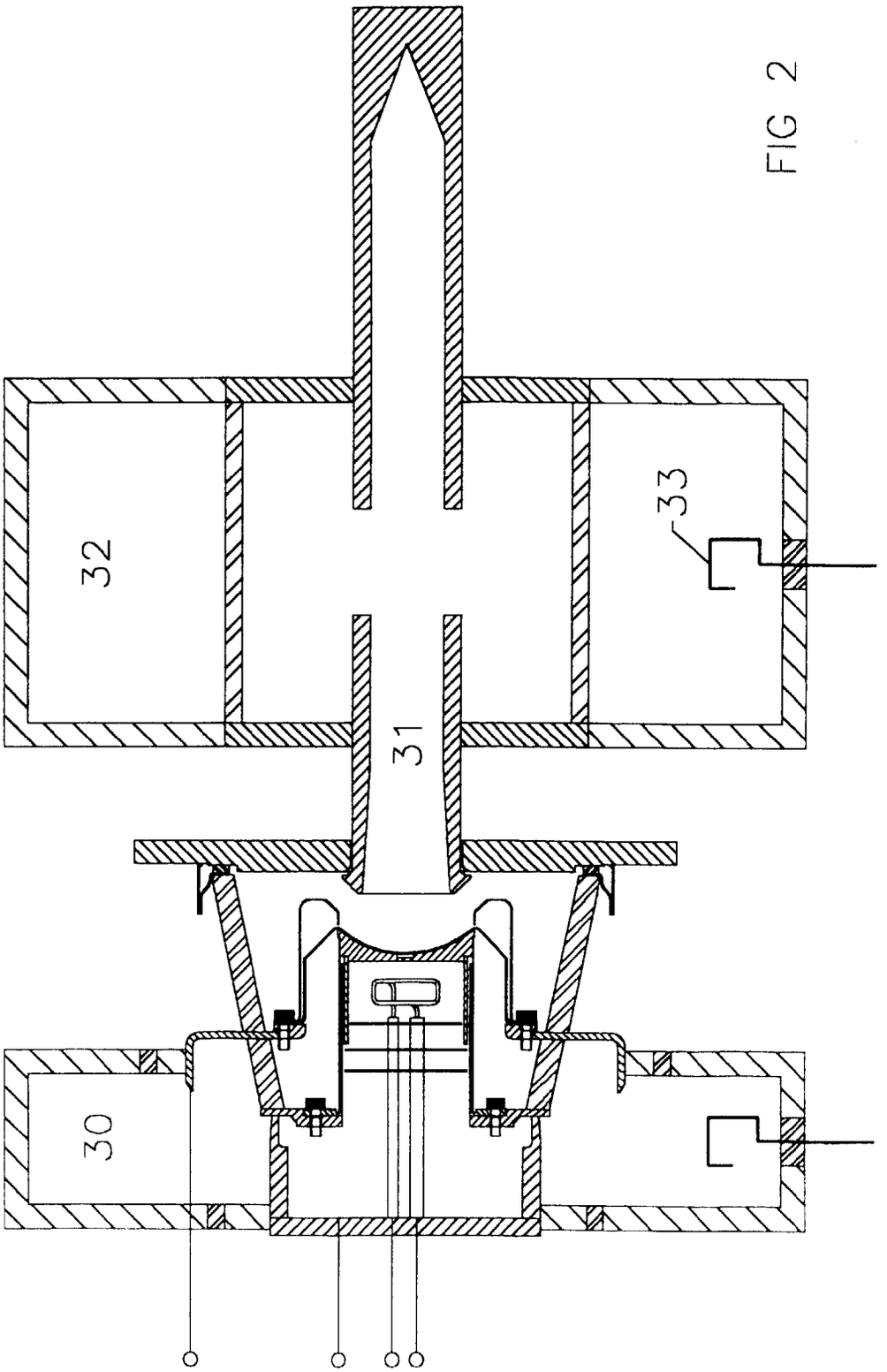

FIG 2

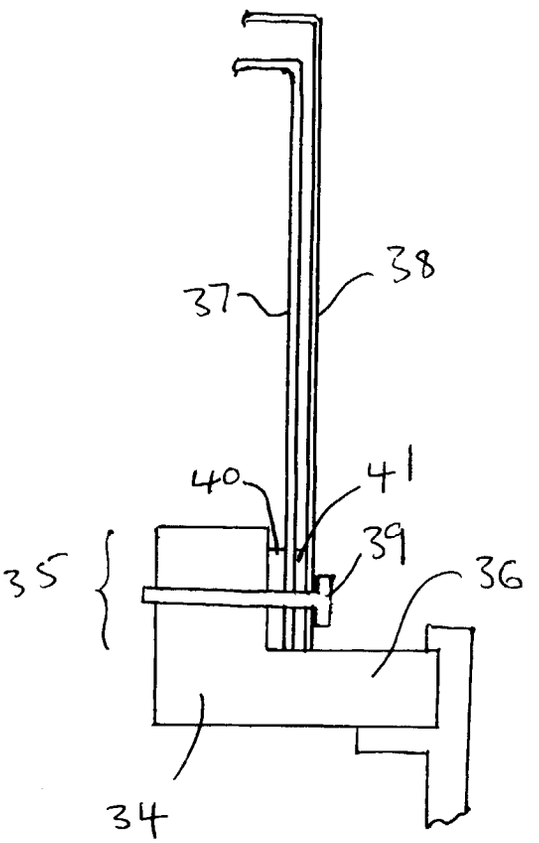

Fig. 3