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ELECTRON DISCHARGE DEVICE WITH A SINGLE PIECE CATHODE SUPPORT

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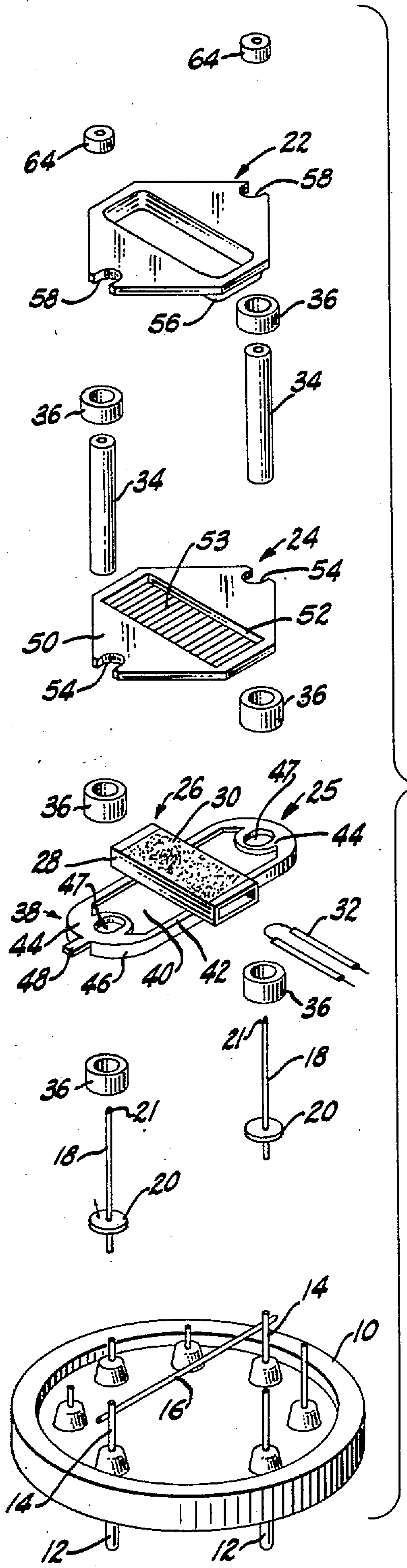

Fig. 1

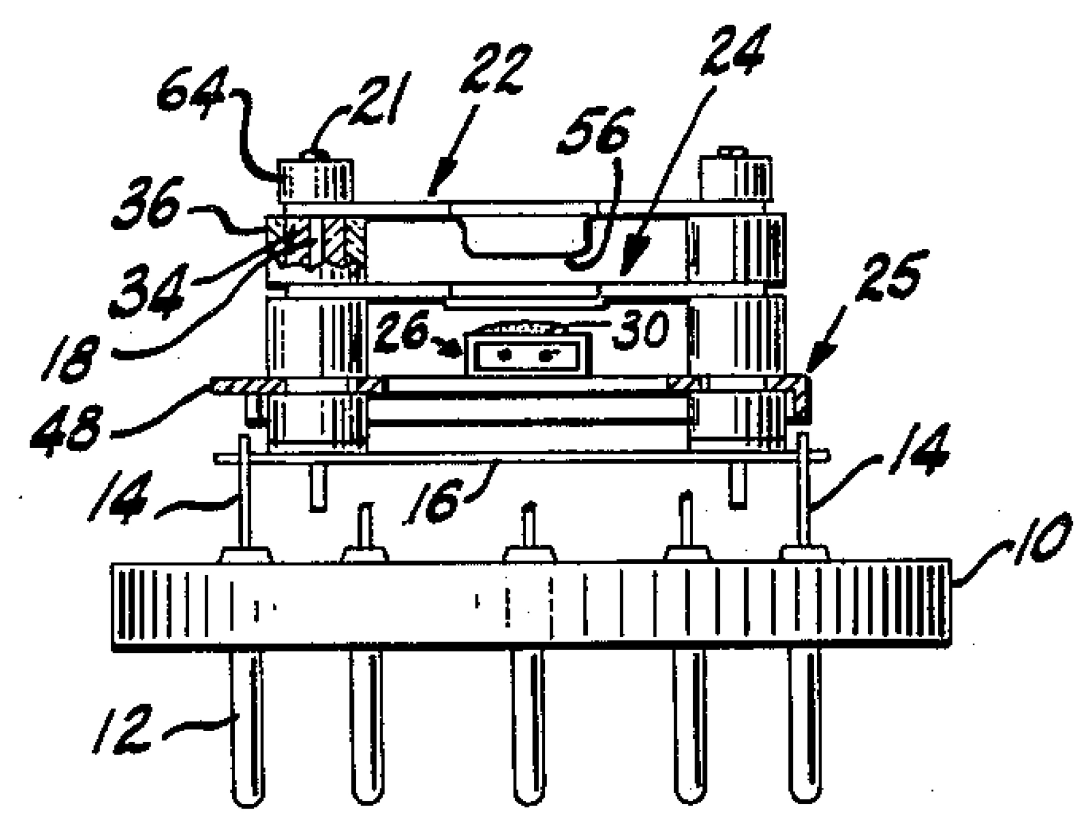

Fig. 2

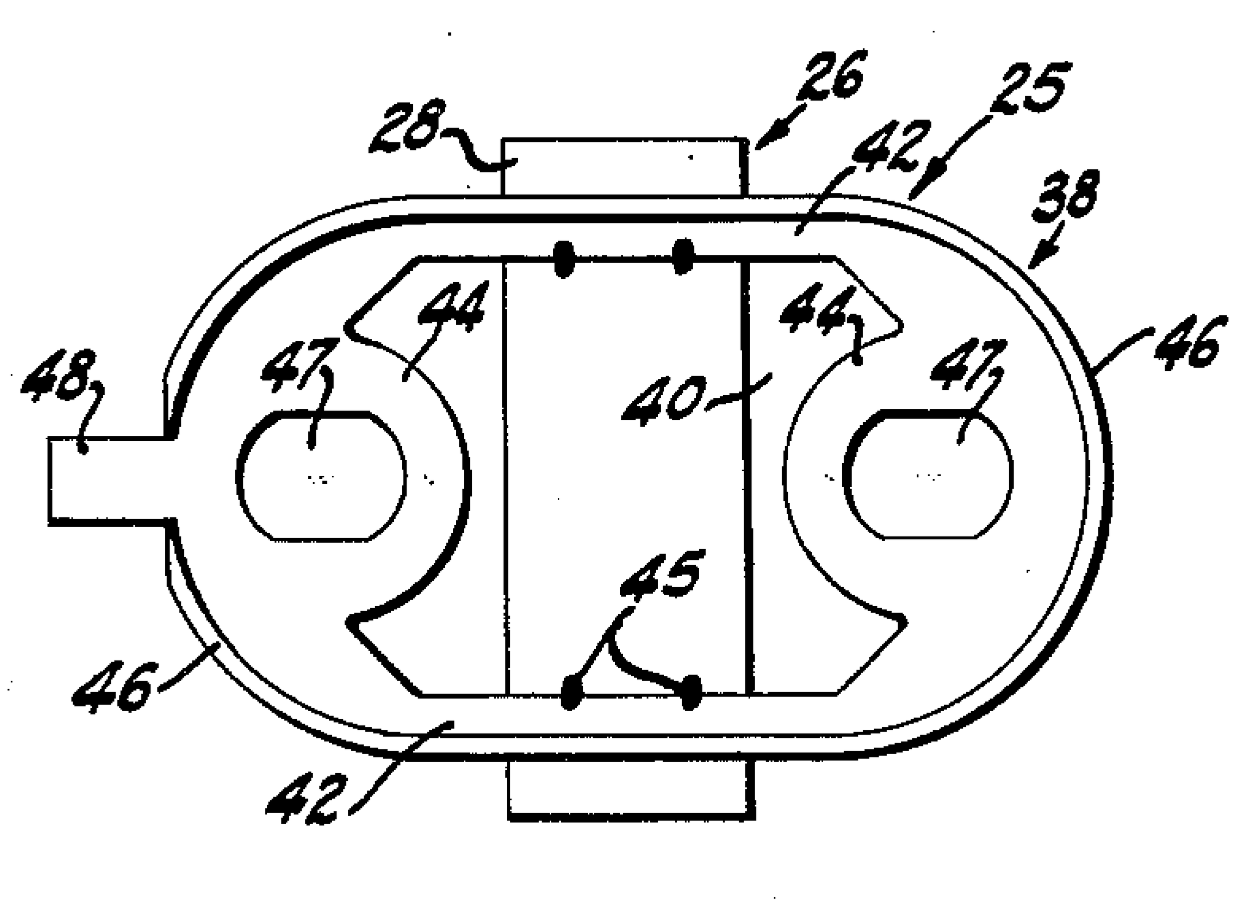

Fig. 3

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ELECTRON DISCHARGE DEVICE WITH A SINGLE PIECE CATHODE SUPPORT

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This invention generally relates to electron discharge devices and more particularly to a cathode support for use in a planar electrode mount structure.

Electron discharge devices such as radio tubes utilize a variety of mount structures. The miniature or subminiature types which are increasingly more in demand due to their small size and long life capabilities utilize a type of internal electrode construction known in the art as a planar electrode mount. In a planar electrode mount structure a plurality of electrodes and insulated spacers are alternately arranged upon insulated support rods. Because of the small size of the electrodes and the close spacing tolerances required, means for supporting them in a spaced relationship with one another must of necessity be of small size and considerable rigidity. This requirement of rigidity seldom presents a difficult problem with the anode or grid since these elements are usually blanked and formed from a single piece of self supporting metal. However, this rigidity requirement does present an acute problem when fabricating an appropriate support for an indirectly heated cathode, which requires auxiliary support means since it is conventionally not self supporting. A rigid cathode support is desirable to afford easy cathode handling during assembly operations and also to avoid distortion of the supports with resulting mis-alignment of the cathode during heated operation of the tube. While providing this rigidity, however, it is also necessary to keep the cross-sectional area of the support at a minimum in order to reduce heat conduction and radiation losses from the cathode and thereby achieve maximum electron emission for a given heater power input.

In the prior art it has been suggested that the cathode be supported by means of fine wires welded to opposed sides of the cathode. While this support meets the requirements of low heat conduction losses, it is costly to fabricate and assemble and too delicate to be handled without some distortion occuring either during assembly of the mount or during operation of the tube. Since the spacing and alignment of the electrodes is very critical, imperfect lateral suspension caused by distortion of the support will result in improper operation of the tube.

It is, therefore, an object of the invention to provide a cathode support that may be blanked or otherwise formed in one operation.

It is another object of the invention to provide rigidity for a cathode assembly which will be concomitant with the rigidity of other electrodes in the mount without detracting from the requirement of maintaining heat losses from the cathode at a minimum.

It is still another object of the invention to minimize cathode distortion due to handling and to accelerate cathode assembly operations.

Still another object of the invention is to provide means which allow for expansion of the cathode during operation of the tube without causing binding and distortion which in turn affects the spacing between the cathode and adjacent electrodes.

The foregoing objects are achieved in one aspect of the invention by the provision of a cathode assembly for an electron discharge device which utilizes a metal frame having rigid side straps and end plates defining a relatively large central aperture. The cathode bridges

the aperture and is welded or otherwise connected to the side straps.

For a better understanding of the invention, reference is made to the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is an exploded perspective view of a planar type electron tube mount;

FIG. 2 is a side elevation of the mount of FIG. 1; and

FIG. 3 is a plan view of the underside of the cathode support shown in FIG. 1 with the cathode fixed thereon.

Referring to the drawings, an insulating stem or base 10 for an electron tube is shown with a plurality of connector pins 12 extending therethrough. The pins provide an electrical connection between the internal tube electrodes described below and the exterior circuitry. In addition, pins 12 also provide support at their upper ends 14 for the electrode mount.

In the embodiment illustrated in FIG. 1, the planar electrode mount represents a triode comprising an anode 22, grid 24, and an indirectly heated cathode assembly 25 utilizing heater 32. A pair of insulating support rods 34 provide lateral alignment of the electrodes while insulating spacers 36 provide longitudinal spacing between the electrodes. Support pins 18 threadably receive rods 34 to provide the stacking means for the various mount elements in addition to holding them in a rigid stacked array as shown in FIG. 2 by virtue of the compacting pressure provided by discs 20 and end swages 21.

The cathode assembly 25 includes a cathode 26 and a cathode support 38. Indirectly heated cathode 26 consists of a tubular sleeve 28, substantially rectangular in cross section, having opposed planar surfaces with an electron emissive layer 30 deposited on the surface thereof facing grid 24 and anode 22.

Cathode support 38 comprises a substantially planar elongated single piece metal frame having a relatively large central aperture 40 defined by opposed rigid side straps 42 and opposed end plates 44. A substantially continuous peripheral flange 46 projects from the side straps and end plates, thereby forming substantially L-shaped side strap configurations which are small in cross section and yet rigid. The end plates 44 have elongated apertures 47 for receiving rods 34. These apertures are larger than the diameter of support rods 34 in order to allow the cathode support 38 to expand along its major axis without distortion and binding and thereby prevent disruption of the critical spacing between the electrodes along the longitudinal axis of the mount. A tab 48 is provided on the cathode support 38 so that an electrical connection with one of the leads 14 may be made thereto. This tab interrupts the continuous flange 46.

The grid 24 consists of a planar metal base 50 with a substantially rectangular aperture 52 formed therein and a plurality of lateral wires 53 spaced across the aperture on the side facing coating 30. Opposed notches 54 in grid base 50 are made to partially encompass support rods 34, thereby fixing the lateral alignment and spacing of the grid with regard to the cathode while still allowing grid movement and expansion in a lateral direction.

The anode 22 is fabricated from metal and has a substantially planar raised center plate portion 56 and opposed notches 58 on both sides to partially encompass support rods 34. The plate portion 56 is of substantially the same planar configuration as the cathode 26 and the grid aperture 52 and is mounted in alignment therewith.

Spacers 36 are fabricated from ceramic insulating materials such as aluminum oxide and steatite. These spacers are circular in shape and of a length determined by the amount of separation desired between electrodes.

Centrally located support rod receiving apertures **62** are formed therein.

Referring to FIG. 3, cathode **26** is shown attached to side straps **42** by means of spaced welds **45** to the cathode sleeve surface opposite the emissive coating surface so that the cathode bridges central aperture **40** in support **38**.

During assembly of the electrode mount, support rods **34** are threaded onto pins **18** and rest on shoulders **20**. A pair of spacers **36** are then placed over the rods **34** and these also rest on shoulders **20**. Cathode assembly **25**, with the heater filament **32** in place within cathode sleeve **30**, is then threaded upon the support rods with the emissive surface facing upwardly. Two more spacers are threaded over the support rods and these rest on end plates **44** of the cathode support. Grid **24** is next placed upon these spacers, with the planar surface having lateral wires **53** facing the emissive surface of the cathode. Another pair of spacers **26** are then threaded on the support rods and the anode **22** is subsequently placed thereon. Finally cup shaped clamps **64** are placed on the support rods **34** and the ends **21** of pins **18** projecting therethrough are swaged or bent over and welded to the clamps, thus completing assembly of the mount. After this mount has been affixed by welding or some other conventional means to the cross bar **16** of wafer stem **10**, the electrodes are then in position for connections with leads **14**.

The invention described above provides a unique cathode support and an improved planar type electron discharge device. Such a device may be a diode type or it may utilize several grids. Support **38** is formed to provide rigid side straps **42** which have a small cross sectional area and a relatively large opening **40**. The rigid straps minimize the possibility of distortion during heated operation of the cathode as well as minimizing the heat conduction losses from the cathode. This latter feature is important since it provides maximum electron emission for a given heater power input. Additionally, openings **47** in support **38** assure a loose coupling between the support and rods **34** so that lateral binding of the support will not occur during heat expansion of the support which may occur during operation of the tube. The single piece support structure is economical to fabricate and is conducive to efficient assembly.

Although one embodiment of the invention has been shown and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. In an electron discharge device, a cathode assembly comprising an indirectly heated cathode sleeve having opposed planar surfaces with an electron emissive layer on one of said surfaces, and a substantially planar cathode support comprising an elongated single piece metal frame having a relatively large central aperture defined by opposed rigid side straps and opposed end plates and provided with a substantially continuous peripheral flange projecting from said straps and end plates, the cathode sleeve being attached on the surface thereof opposite said emissive surface to said straps and oriented to bridge the central aperture in the support.

2. In an electron discharge device employing electrodes including an anode and an indirectly heated cathode having opposed planar surfaces with an electron emissive layer on one of said surfaces spaced from said anode, a plurality of insulating support rods formed to provide lateral alignment of said electrodes relative to one another, insulating spacers disposed intermediate the electrodes, and a substantially planar cathode support comprising a metal frame having a relatively large central aperture defined by opposed rigid side straps and opposed end plates, the cathode being attached on the surface thereof opposite said emissive surface to said straps and oriented to bridge the central aperture in the support.

3. In an electron discharge device employing electrodes including an anode, at least one planar grid, and an indirectly heated cathode having opposed planar surfaces with an electron emissive layer on one of said surfaces closely spaced from said grid, a plurality of insulating cylindrical support rods having a given diameter formed to provide lateral alignment of said electrodes relative to one another, insulating spacers disposed intermediate the electrodes, and a substantially planar cathode support comprising an elongated metal frame having a relatively large central aperture defined by opposed rigid substantially L-shaped side straps providing a relatively small heat conduction path and opposed end plates formed to provide openings larger than said given diameter for loose lateral coupling of the end plates with said support rods, the cathode being attached on the surface thereof opposite said emissive surface to said straps and oriented to bridge the central aperture in the support.

4. In an electron discharge device, a cathode assembly comprising an indirectly heated cathode sleeve having opposed planar surfaces with an electron emissive layer on one of said surfaces, and a substantially planar cathode support and integral connector comprising an elongated single piece metal frame having a relatively large central aperture defined by opposed rigid side straps and opposed end plates and provided with a substantially continuous peripheral flange projecting from said straps and end plates, the cathode sleeve being attached on the surface thereof opposite said emissive surface to said straps and oriented to bridge the central aperture in the support.

5. In an electron discharge device employing electrodes including an anode and an indirectly heated cathode having opposed planar surfaces with an electron emissive layer on one of said surfaces spaced from said anode, a plurality of insulating support rods formed to provide lateral alignment of said electrodes relative to one another, insulating spacers disposed intermediate the electrodes, and a substantially planar cathode support and integral connector comprising a metal frame having a relatively large central aperture defined by opposed rigid side straps and opposed end plates, the cathode being attached on the surface thereof opposite said emissive surface to said straps and oriented to bridge the central aperture in the support.

6. In an electron discharge device employing electrodes including an anode, at least one planar grid, and an indirectly heated cathode having opposed planar surfaces with an electron emissive layer on one of said surfaces closely spaced from said grid, a plurality of insulating cylindrical support rods having a given diameter formed to provide lateral alignment of said electrodes relative to one another, insulating spacers disposed intermediate the electrodes, and a substantially planar cathode support and integral connector comprising an elongated metal frame having a relatively large central aperture defined by opposed rigid substantially L-shaped side straps providing a relatively small heat conduction path and opposed end plates formed to provide openings larger than said given diameter for loose lateral coupling of the end plates with said support rods, the cathode being attached on the surface thereof opposite said emissive surface to said straps and oriented to bridge the central aperture in the support.

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