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G. DIEMER ET AL

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ELECTRON DISCHARGE DEVICE HAVING DISK-SHAPED ELECTRODE SUPPORTS

Filed March 7, 1950

2 Sheets-Sheet 1

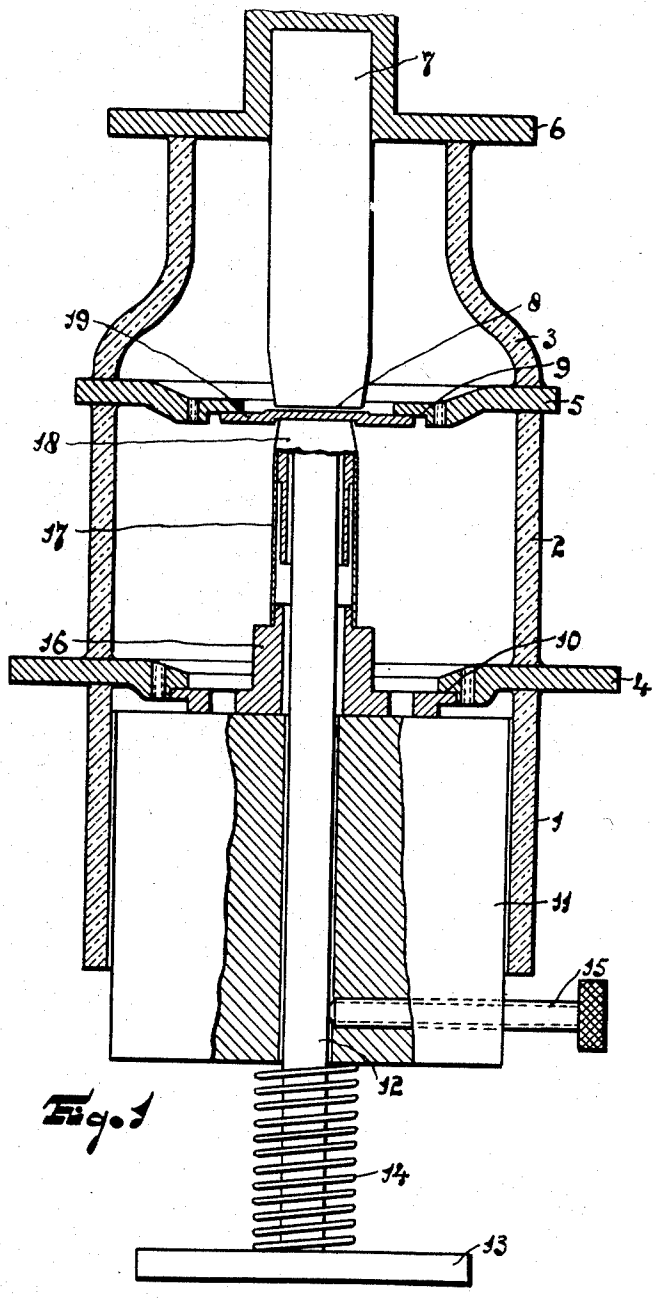


Fig. 1

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Fig. 2



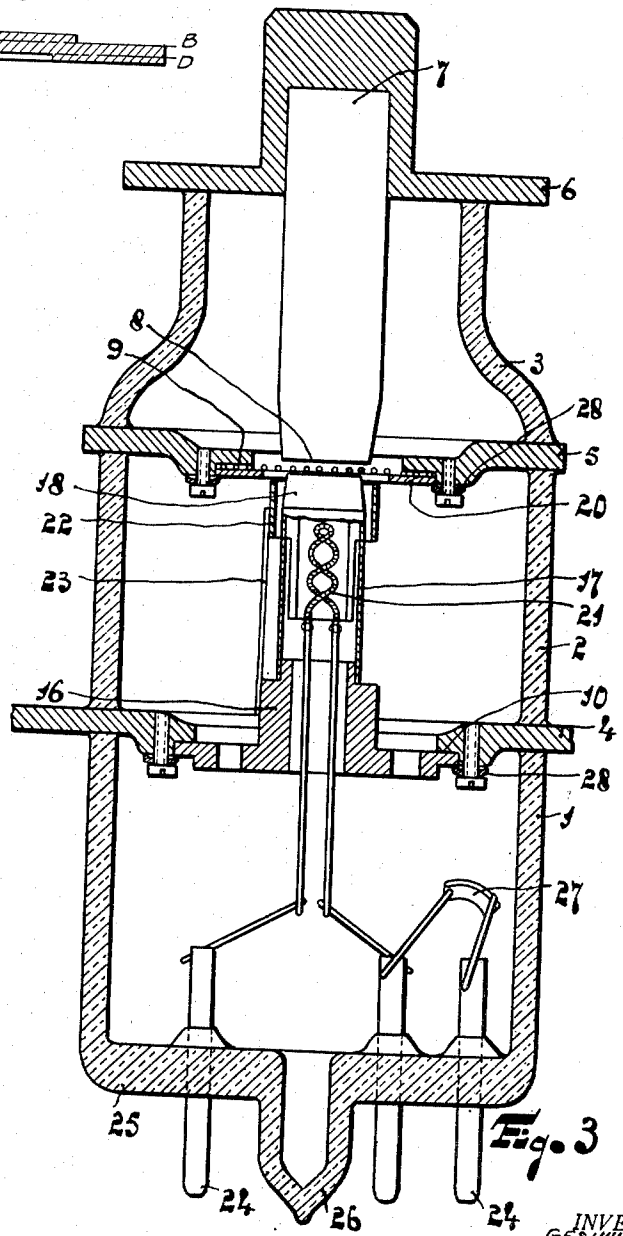


Fig. 3

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ELECTRON DISCHARGE DEVICE HAVING DISK-SHAPED ELECTRODE SUPPORTS

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6 Claims. (Cl. 313—249)

This invention relates to electric discharge tubes in which the cathode and the grid are constituted by a flat ring provided on one side with the grid wires and are supported each from a flat disc sealed in the glass wall of the tube. The invention furthermore relates to a method of manufacturing such a tube.

With tubes in which only the grid is supported from a flat disc sealed in the tube wall, it is known to build up the grid from a flat ring, on one side of which the grid wires are stretched, said ring having its blank side secured to the cathode side of the grid disc, after which the cathode structure is fitted in the tube. The spacing between cathode and grid must then be adjusted by shifting the parts of the cathode structure in relation to one another and checking the spacing with the use of optical or electrical expedients. However, for cathode-grid spacings of less than 100/mu the accuracy of this method is generally insufficient.

With tubes in which the cathode, the grid and the anode are supported from flat discs sealed in the tube wall and in which the emissive front surface of the cathode is secured to the remainder of the cathode structure by way of a foil, it is also known to adjust the spacings between cathode, grid and anode as hereinafter described. The central one of the apertured discs has welded to it the woven grid, after which the anode disc has inserted through it a jig member a shoulder of which abuts against the anode disc and the length of which is equal to that of the anode plus the desired anode-grid spacing. Against the disc on which it will be caused to bear the cathode structure is forced by means of a cylindrical jig member in which a central stud is adapted to move and which urges against the rear of the emissive member of the cathode. This emissive member is not yet stabilized in relation to the cathode structure by means of the foil. The anode jig member is then forced against the grid whereby the latter is deformed, while on the other side the grid is held in engagement with a small hood which is arranged over the emissive member of the cathode and the thickness of which is equal to the desired cathode-grid spacing. The central stud in the pressure jig member of the cathode structure is rigidly secured by means of a set screw, after which the assembly of the cathode structure and adjustable jig member are removed from the tube and the emissive member is fixed in relation to the cathode structure. The latter is thus adapted to be secured in the tube and to be provided with a heating element.

The method described above is generally insufficiently accurate for cathode-grid spacings of less than some few tenths of a millimetre, since the grid surface of woven grids is not accurately defined. Moreover such grids require to be mounted as that they are kept taut in order to retain their exact shape when heated by cathode radiation and grid current.

According to the invention, with an electric discharge tube in which at least the grid and the cathode are secured each to a flat disc sealed in the glass wall of the tube, the grid is constituted by a flat ring on which the grid wires are stretched on one side, is in engagement with the cathode side of the grid disc.

This construction permits of improving the accuracy of adjustment of the cathode-grid spacing so as to be even sufficient for spacings of less than 25/mu.

The following method may be adopted. The grid

disc and the cathode disc are worked so as to be flat, for example by simultaneously turning off the two surfaces to be machined so that the worked surfaces are parallel. At the same time the front surface of the anode is worked on so as to be spaced from the cathode side of the grid disc by the desired distance and to be parallel thereto. In contact with the cathode side of the grid disc is then placed a circular plate, of which on one side the centre and on the other side the edge is ground away so that the spacing between the two worked surfaces is equal to the diameter of the grid wires plus the desired spacing between the cathode and the said grid wires, while allowing for the expansion of the cathode support when heated from room temperature to operating temperature. The plate is placed so that its turned-off edge is in engagement with the grid disc. Next, in the manner described above, the cathode structure is introduced into the tube with the use of an adjustable jig member until the emissive member of the cathode engages with the said plate. The cathode structure is then finished; the aforesaid plate is replaced by the grid ring and its wires, which is secured to the grid disc. The cathode-grid spacing is thus equal to the thickness of the auxiliary plate between the two worked surfaces minus the thickness of the grid wires and since this plate may be the same for all tubes, the tolerance in the thickness of the grid ring is not important; in contradistinction, the tolerance in the thickness of the very thin grid wires, which thickness is minute, is important.

It has been found that, if the grid disc is worked so as to be satisfactorily flat and the grid wires are gilt, the contact between grid and disc does not introduce high-frequency losses, even if the grid ring is not secured by soldering but is resiliently compressed instead. The avoidance of soldering has the advantage of causing less heat transfer from the ring, so that a higher load on the grid is permissible without the grid wires being subjected to stress.

The method of component mounting indicated above is most accurate, if use is made of a so-called "stock-cathode" having a smooth metal front surface, so as to prevent the emissive layer from being damaged by reason of compression.

In order that the invention may be readily carried into effect, an example will now be described in detail with reference to the accompanying drawings in which:

Fig. 1 shows a partly completed tube with the auxiliary plate and the adjustable jig member in the cathode structure arranged therein;

Fig. 2 is a cross-sectional view of the auxiliary plate and

Fig. 3 shows the completed tube.

The linear dimensions of the tube are shown increased five times. Referring to the figures, the reference numerals 1, 2 and 3 designate glass rings between which silvered ferro-chromium discs 4, 5 and 6 are sealed. The ring 6 has a head to which a copper anode block 7 is soldered. The front surface of anode 8 and the front surface of grid disc 9 are accurately worked to ensure the desired anode-grid spacing. The front surface 10 of the cathode disc 4 is also worked so as to be flat. The cylindrical jig member 11 comprises a central stud 12, which is provided with a base plate 13 which locks up a helical spring 14, the relative positions of 11 and 12 being stabilised by means of a screw 15. The cathode structure comprises a bushing 16, on top of which is loosely arranged a foil 17 of thickness 15/mu which is made of tantalum. Secured to the top of the foil 17 is the emissive member 18 of the cathode, which is constituted by a slightly tapered block having a cylindrical extension inside the foil. The block constitutes a cathode of the kind having an internal supply of emissive material which is not described further. The surface 9 is engaged by a plate 19, in which the spacing between the planes AB and CD (shown in Fig. 2) is equal to the distance of the cathode from the grid plus the thickness of the grid wires. The form indicated is chosen to avoid sagging as far as possible. While the screw 15 is loose, 12 is forced against 18 and thus 18 against 19, 19 against 9, 11 against 16 and 16 against

10. The screw 15 is then tightened and the cathode structure with the jig members is removed from the tube. The foil 17 is then welded to the ring 16, whilst the cathode body is rigidly pressed on to the stud 12. Referring now to Fig. 3, next a volatilization-retaining ring 22 is secured to the ring 16 with the use of three stay rods 23. In the cathode body 18 is placed a filament-heating helix 21, which is connected to two lead-in studs 24 sealed in the tube base 25. Fitted between the two studs 24 is a current-heated getter 27 and an exhaust tube 26 is secured in the base of the tube. The cathode bushing 16 is screwed against the cathode disc 4 with the use of resilient washers 28 and the grid ring 20 is secured to the grid disc 5 in a similar manner. This resilient compression ensures a satisfactory high-frequency contact. It will be noted in the completed tube shown in Fig. 3 that the grid wires are secured between and abut the opposing surfaces of the grid disc 5 sealed in the envelope and the grid ring 20.

What we claim is:

1. An electric discharge tube comprising a tubular envelope, a cathode mounting disc member secured to said envelope at one portion thereof, anode supporting means spaced from said disc member and secured to said envelope at another portion thereof, cathode and anode electrodes secured to said disc member and supporting means respectively, a grid mounting disc member secured to and sealed in said envelope and spaced between said cathode disc member and said anode supporting means, said grid mounting disc member having a flat surface facing said cathode mounting member, and a grid electrode secured to said grid mounting member, said grid electrode comprising a ring member having a flat surface arranged in opposing relationship to the said flat surface of said disc member and a plurality of parallel grid wire elements secured between and directly abutting the said opposing surfaces of said grid disc member and grid ring member.

2. An electric discharge tube comprising a tubular envelope, a cathode mounting disc member secured to said envelope at one portion thereof, anode supporting means spaced from said disc member and secured to said envelope at another portion thereof, an anode electrode secured to said supporting means, a cathode electrode having a planar base portion, said cathode mounting disc member having a planar mounting surface and said base portion engaging said mounting surface, a grid mounting disc member secured to and sealed in said envelope and spaced between said cathode disc member and said anode supporting means, said grid mounting disc member having a flat surface facing said cathode mounting member, and a grid electrode secured to said grid mounting member, said grid electrode comprising a ring member having a flat surface arranged in opposing relationship to the said flat surface of said disc member and a plurality of parallel grid wire elements secured between and directly abutting the said opposing surfaces of said grid disc member and grid ring member.

3. An electric discharge tube comprising a tublular envelope, a cathode mounting disc member secured to said envelope at one portion thereof, anode supporting means spaced from said disc member and secured to said envelope at another portion thereof, cathode and anode electrodes secured to said disc member and supporting means respectively, a grid mounting disc member secured to and sealed in said envelope and spaced between said cathode disc member and said anode supporting means, said grid mounting disc member having a flat surface facing said cathode mounting member, a grid electrode comprising a ring member having a flat surface arranged in opposing relationship to the said flat surface of said disc member and a plurality of parallel gold plated grid wire elements, and means to resiliently secure said ring member to said grid mounting member to thereby compress said grid wire elements between and directly abutting the said opposing surfaces of said grid disc and grid ring member.

4. An electric discharge tube comprising a tubular envelope, a cathode mounting disc member secured to said envelope at one portion thereof, anode supporting means spaced from said disc member and secured to said envelope at another portion thereof, a cathode electrode comprising a formed body having an internal supply of emissive material secured to said disc member, an anode electrode secured to said supporting means, a grid mounting disc member secured to and sealed in said envelope and spaced between said cathode disc member and said anode supporting means, said grid mounting disc member having a flat surface facing said cathode mounting member, and a grid electrode secured to said grid mounting member, said grid electrode comprising a ring member having a flat surface arranged in opposing relationship to the said flat surface of said disc member and a plurality of parallel grid wire elements secured between and directly abutting the said opposing surfaces of said grid disc member and grid ring member.

5. An electric discharge tube comprising a tubular envelope, a cathode mounting disc member secured to said envelope at one portion thereof and having a planar mounting surface, anode supporting means spaced from said disc member and secured to said envelope at another portion thereof, an anode electrode secured to said supporting means, a cathode electrode having an emitting portion and planar base portion spaced from said emitting portion and engaging said planar mounting surface, a tantalum foil member securing said emitting portion and said base portion in fixed relationship, a grid mounting disc member secured to and sealed in said envelope and spaced between said cathode disc member and said anode supporting means, said grid mounting disc member having a flat surface facing said cathode mounting member, and a grid electrode secured to said grid mounting member, said grid electrode comprising a ring member having a flat surface arranged in opposing relationship to the said flat surface of said disc member and a plurality of parallel grid wire elements secured between and directly abutting the said opposing surfaces of said grid disc and grid ring member.

6. An electric discharge tube comprising a tubular envelope, a cathode mounting disc member secured to said envelope at one portion thereof and having a planar mounting surface, anode supporting means spaced from said disc member and secured to said envelope at another portion thereof, a grid mounting disc member secured to and sealed in said envelope and spaced between said cathode disc member and said anode supporting means, said grid mounting disc member having a flat surface facing said cathode member, an anode electrode secured to said supporting means and having an active surface arranged parallel to and in the vicinity of said flat surface of said grid mounting disc member, a grid electrode comprising a ring member having a flat surface arranged in opposing relationship to said disc member and a plurality of parallel grid wire elements arranged between and directly abutting the said opposing surfaces of the said grid disc member and the said grid ring member, means to resiliently press said grid ring and grid wire elements into contact with said grid disc member, and a cathode electrode having an emitting portion and a planar base portion spaced from said emitting portion and engaging said planar mounting surface.

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