Sept. 23, 1947. W. H. WARREN 2,427,888

BEAM TYPE ELECTRON DISCHARGE DEVICE

Filed May 30, 1945 2 Sheets-Sheet 1

Fig. 1.

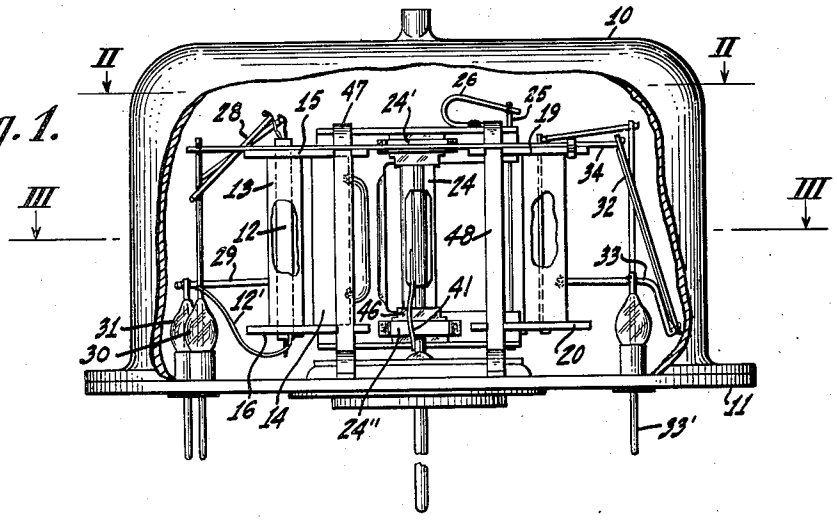



Fig. 2.

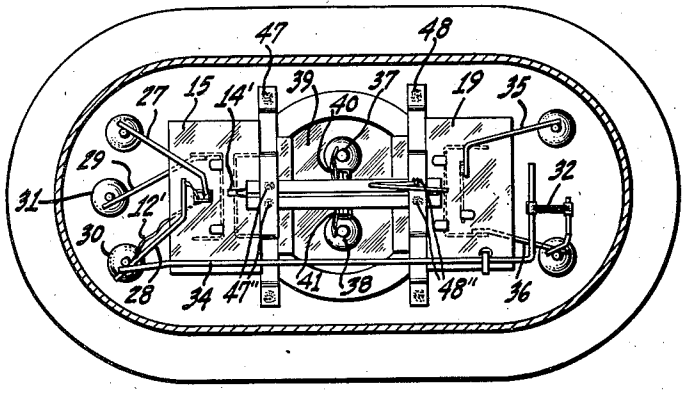



Fig. 3.

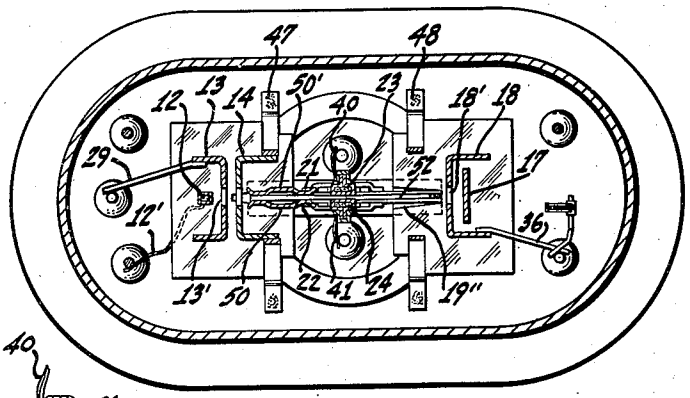
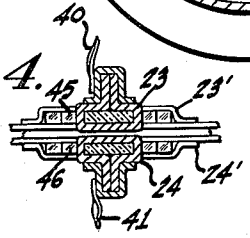



Fig. 4.




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BEAM TYPE ELECTRON DISCHARGE DEVICE

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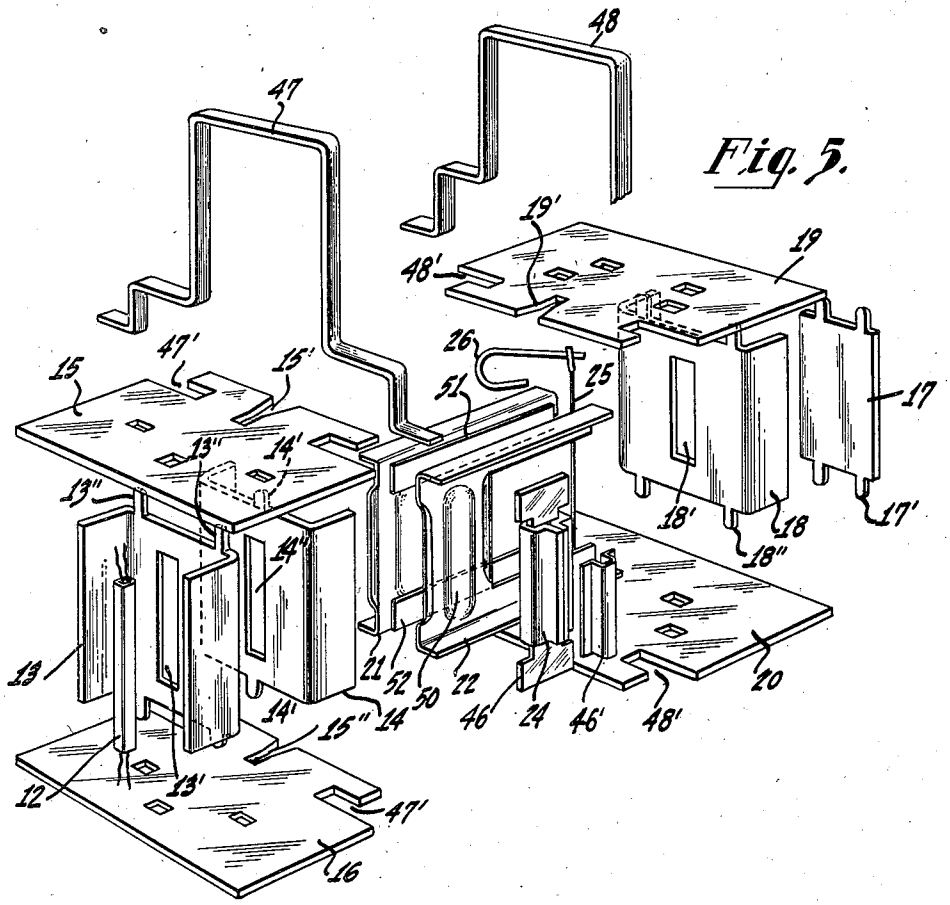



Fig. 5.

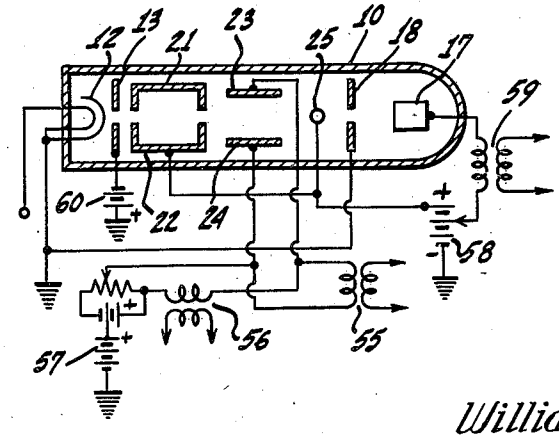



Fig. 6.

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2,427,888

# UNITED STATES PATENT OFFICE

2,427,888

## BEAM TYPE ELECTRON DISCHARGE DEVICE

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Application May 30, 1945, Serial No. 596,622

6 Claims. (Cl. 250—141)

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My invention relates to electron discharge devices, more particularly to such devices employing an electron beam which is subjected to a varying transverse electric field.

In one form of tube of the type described and disclosed in a copending application of Charles W. Mueller, Serial No. 561,339, filed November 1, 1944, and assigned to the same assignee as the present application, there is provided at one end of an elongated metal envelope a cathode assembly comprising a cathode and a shield both mounted between a pair of spaced insulators, preferably mica, and at the other end an anode for receiving the electrons, and between the cathode and the anode a beam defining and deflecting electrode assembly comprising a pair of spaced flat plate members having aperture defining portions and a pair of oppositely disposed deflecting electrodes, the beam path passing between the plates and the deflecting electrodes and being directed onto an intercepting electrode comprising a wire. Electrons from the cathode are deflected across the intercepting electrode to produce an output current in the anode having an output frequency twice that of the voltage applied to the deflecting electrodes. The entire electrode assembly is supported from a flat closure member sealing the metal envelope and having an insulating insert through which leads from the deflecting electrodes extend. Other apertures are provided in the closure member or header for other leads connected to the various electrodes.

In the manufacture of this type of tube the critical part of manufacture is in the alignment of the cathode, cathode shield, beam forming apertures, deflecting plates, intercepting wire, and collector electrode. Other problems are involved in the assembly and in supporting the electrode assembly from the closure member or header.

It is therefore an object of my invention to provide an electron discharge device of the type described in which alignment of the various elements is assured. Another object of my invention is to provide a simplified mount assembly which can be quickly and accurately assembled. A still further object of my invention is to provide an improved supporting means for the mount assembly.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, but the invention will best be understood by reference to the following description taken in connection with the accompanying drawing in which Figure

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1 is a side elevation with part of the envelope removed to show details of the mount construction; Figure 2 is a section taken along the line 2—2 of Figure 1; Figure 3 is a transverse section taken along the line 3—3 of Figure 1; Figure 4 is a transverse section showing details of the deflecting electrode assembly; Figure 5 is an exploded perspective of the mount assembly showing the method of assembly; Figure 6 is a diagrammatic longitudinal section of an electron discharge device made according to my invention and its associated circuit.

In the construction to be described the cathode assembly and the anode assembly are quite similar and are assembled as units. The aperture plate and deflecting electrode assembly is assembled as a third unit. The cathode and anode assemblies are so constructed that they must be fitted together with the aperture plate and deflecting electrode assembly in only one way. Supporting straps lock the assemblies together and support the assemblies from the closure member or header. The details of this construction are disclosed in the various figures.

Referring to Figures 1 and 5, the cathode assembly includes the indirectly heated cathode 12, the cathode shield, a beam forming member 13 having the aperture 13' and provided with positioning lugs 13''. The second shield 14 having the positioning tabs or lugs 14' and the aperture 14'' is also a part of the assembly. These elements are spaced by and supported between a pair of insulating members 15 and 16, preferably of mica, and having appropriate apertures for receiving the ends of the cathode and the positioning lugs on shields 13 and 14. The micas 15 and 16 are provided with slots 15' and 15'' and the slots 47' for purposes to be described.

The anode assembly comprises the flat plate anode 17 provided with the positioning lugs 17' and the anode shield or secondary electron suppressor 18 having the aperture 18' and the positioning lugs 18''. These elements are spaced by and supported between a pair of insulating members 19 and 20 preferably of mica and also provided with slots 19' and 48' for purposes to be described. The cathode and anode assemblies are quite similar.

The beam defining and deflecting electrode assembly comprises the aperture plates 21 and 22 of elongated U-shape, the legs of which extend parallel to the beam path. These aperture plates are separated by a pair of elongated conducting elements 51 and 52. The closed ends of these members 21 and 22 are provided with outwardly

directed deformations 50 and 50' to produce in effect a pair of apertures on either side of the deformed portions. The deflecting electrodes 23 and 24 are supported between the legs of the elements 21 and 22 as is the intercepting wire 25 maintained in tension by means of the spring 26. Each deflecting electrode assembly includes for example an insulating member 46 preferably of mica around which may be folded a gold foil providing the deflecting electrode 24. A tab such as 46' receives the ends of the electrode 24 for retaining the electrode in position and for providing means to which the leads such as 40 and 41 may be attached. Deflecting electrode assemblies are secured to the legs of the U-shaped members 21 and 22 by straps such as 24', 24'' and 23'. (See Figures 1 and 4.)

The cathode assembly and the anode assembly are then assembled with the beam forming and deflecting electrode assembly which last assembly may be referred to as the aperture frame by inserting the ends of the frame into the slots 15' and 15'' in the cathode assembly and the slots 19' and 19'' in the anode assembly. This automatically aligns all of the elements, that is, the cathode, the apertured elements, the apertures formed in the beam forming assembly, the deflecting electrodes, intercepting wire, and the anode, since the elements in each assembly are positively fixed in definite spaced relation, and the slots automatically align the elements of the various assemblies. The assemblies are then locked together by means of the inverted U-shaped strap elements 47 and 48 which are weldeld to the top of the aperture frame as shown at 47'' and 48'' in Figure 2, the legs of the U-shaped members passing down through the slots 47' in micas 15 and 16 and legs of the U-shaped member 48 passing down through the slots 48' of the mica spacer members 19 and 20. The legs of the U-shaped members are welded to the header 11 of the envelope 10 thereby fixing the relative height of the mount assembly with respect to the header and the longitudinal position of the assembly with respect to the leads extending through the header 11.

The cathode heater (not shown) is provided with a pair of leads 27 and 28, the cathode with lead 12', the cathode shield with the lead 29, the leads passing through the header and sealed as shown by internal glass beads at 30 and 31. The shield 14 is welded to the strap 47 and thus electrically connected with the aperture frame. A conductor 34 is connected to one end of the getter trough 32, the other end being connected to the lead 33 electrically connected to the lead 36 of the suppressor shield 18, through the lead 33' extending through and sealed through the header. The anode or collector 17 is provided with lead 35.

In Figure 6 is shown a conventional circuit connected to an electron discharge device made according to my invention. The input signal may be introduced between the deflecting plates by means of the input transformer 55 and the local oscillator voltage by means of the transformer 56. The output is taken by means of the intermediate frequency transformer 59. The various voltage sources are shown at 57, 58, and 60. In the arrangement shown, the aperture plates 21 and 28 and the deflecting electrodes 23 and 24 provide an electron lens system for focusing the beam on the intercepting wire 25.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variatious may be made in the particular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.



What I claim as new is:

1. An electron discharge device having an electrode assembly comprising two oppositely positioned pairs of oppositely disposed spaced members of insulating material, electrodes supported by each pair of said members of insulating material, said members of insulating material having registering slots in the edges thereof, the slots in each of said members of insulating material registering with the slots in the oppositely disposed member, and an electrode assembly comprising substantially flat elongated elements, one end of said electrode assembly being received within one pair of registering slots in one pair of members of insulating material and the other end of said assembly being received within another pair of slots in the other pair of members of insulating material.

2. An electron discharge device having an electrode asssembly comprising two oppositely positioned pairs of oppositely disposed spaced members of insulating material, said members having a plurality of registering apertures therein, and electrodes supported by each pair of said insulating members, the ends of said electrodes extending within said apertures, said members of insulating material having registering slots in the edges thereof, the slots in each of said members of insulating material registering with the slots in the oppositely disposed member, and an electrode assembly comprising substantially flat elongated elements having a U-shape, the legs of said elements being received within one pair of registering slots in one pair of members of insulating material and the closed ends of said U-shaped elements being received within another pair of slots in the other pair of members of insulating material.

3. An electron discharge device having a cathode assembly comprising a pair of spaced oppositely disposed plate members of insulating material, a cathode and a cathode shield having an aperture registering with said cathode both mounted between said plate members, said plate members being provided with registering slots in the edges thereof in line with said cathode and aperture, and an anode assembly comprising a pair of oppositely disposed spaced insulating plate members and an anode and an anode shield spaced by and supported between said last insulating plate members, said last insulating plate members being provided with a pair of registering slots, and a beam forming and deflecting electrode assembly including a pair of spaced substantially flat conducting members insulatingly supporting a pair of deflecting electrodes, the ends of said conducting members being received within the slots in said insulating plate members whereby said cathode, anode, shields and deflecting electrodes are automatically aligned.

4. An electron discharge device having a cathode assembly comprising a pair of spaced oppositely disposed plate members of insulating material, a cathode and a cathode shield having an aperture registering with said cathode both mounted between said plate members, said plate members being provided with registering slots in

the edges thereof in line with said cathode and aperture, and an anode assembly comprising a pair of oppositely disposed spaced insulating plate members and an anode and an anode shield spaced by and supported between said last insulating plate members, said last insulating plate members being provided with a pair of registering slots, and a beam forming and deflecting electrode assembly including a pair of spaced substantially flat conducting members insulatingly supporting a pair of deflecting electrodes, the ends of said conducting members being received within the slots in said insulating plate members whereby said cathode, anode, shields and deflecting electrodes are automatically aligned, said insulating plate members having other slots in other edges thereof lying in planes normal to said first slots and inverted U-shaped strap members received within said other slots and secured to said spaced substantially flat conducting members, a header member supporting said U-shaped members and said assembly, and an envelope secured to said header member and enclosing said cathode, anode, and beam forming and deflecting electrode assemblies.

5. An electron discharge device including a mount assembly, said mount assembly comprising a cathode unit assembly including a pair of spaced parallel insulating plates having registering apertures therein, an elongated cathode and a shield having an aperture and lugs at its ends received between and supported by said insulating plates, the ends of said cathode and said lugs being received within said apertures, a second member positioned adjacent said shield and having an aperture registering with the aperture in said shield and an anode assembly including a pair of spaced parallel insulating members having registering apertures therein, an anode electrode received between said insulating members and having lugs extending within apertures in said insulating members, and a suppressor electrode received between said insulating members and comprising an elongated sheet-like member of U-shaped transverse section and having an aperture therein and lugs received within apertures in said insulating members, and a beam forming and deflecting electrode assembly comprising a pair of substantially flat elongated U-shaped members and deflecting electrodes supported in spaced relationship by the legs of said U-shaped members, said insulating plates having registering slots in the edges thereof for receiving the closed ends of said U-shaped members, said insulating members having other slots in the edges thereof receiving the ends of the legs of said U-shaped members, and inverted U-shaped strap members having legs engaging said insulating plates and said insulating members and secured to said U-shaped members.



6. An electron discharge device including a mount assembly, said mount assembly comprising a cathode unit assembly including a pair of spaced parallel insulating plates having registering apertures therein, an elongated cathode and a shield having an aperture and lugs at its ends received between and supported by said insulating plates, the ends of said cathodes and said lugs being received within said apertures, a second member positioned adjacent said shield and having an aperture registering with the aperture in said shield and an anode assembly including a pair of spaced parallel insulating members having registering apertures therein, an anode electrode received between said insulating members and having lugs extending within apertures in said insulating members, and a suppressor electrode received between said insulating members and comprising an elongated sheet-like member of U-shaped transverse section and having an aperture therein and lugs received within apertures in said insulating members, and a beam forming and deflecting electrode assembly comprising a pair of substantially flat elongated U-shaped members and deflecting electrodes supported in spaced relationship by the legs of said U-shaped members, said insulating plates having registering slots in the edges thereof for receiving the closed ends of said U-shaped members, said insulating members having other slots in the edges thereof receiving the ends of the legs of said U-shaped members, said insulating plates and said insulating members having other slots in the edges thereof, and inverted U-shaped strap members having legs received within said other slots and engaging said insulating plates and said insulating members and secured to said U-shaped members, a header member in which said mount assembly is mounted and to which said inverted U-shaped strap members are secured, and an envelope enclosing said mount assembly and secured to said header member.

WILLIAM H. WARREN.