Oct. 21, 1952 A. C. GRIMM 2,615,138

BEAM TYPE ELECTRON TUBE

Filed Oct. 30, 1948

Fig. 1

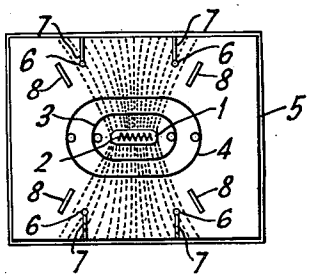


Fig. 7

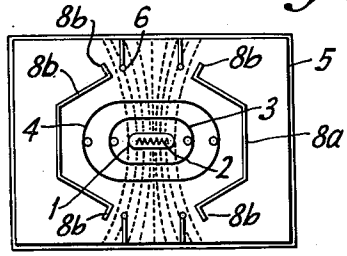


Fig. 2

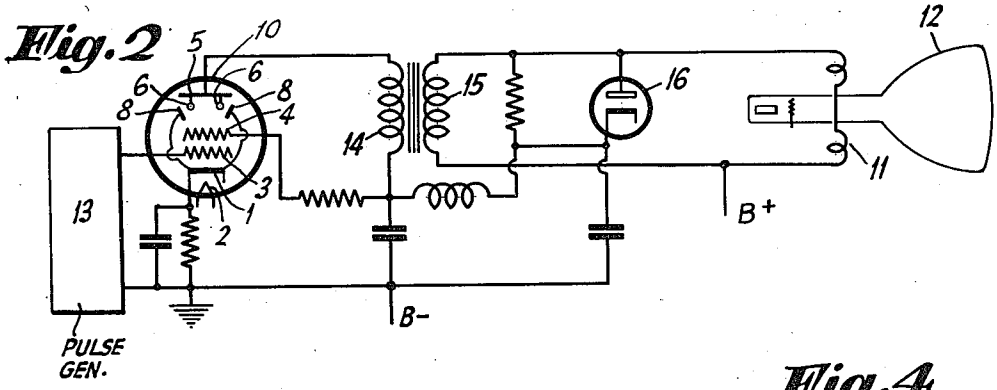


Fig. 3

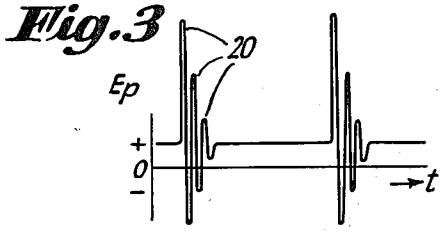


Fig. 4

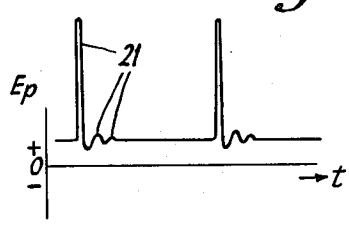


Fig. 6

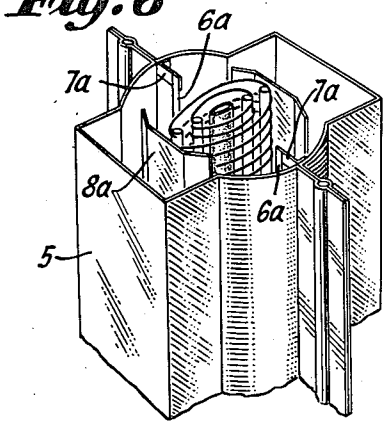
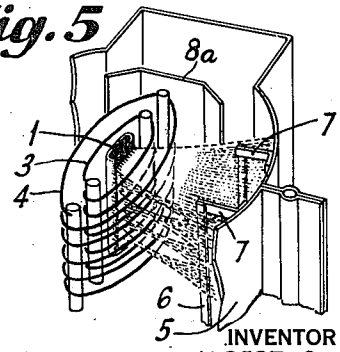


Fig. 5



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BEAM TYPE ELECTRON TUBE

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11 Claims. (Cl. 313—71)

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This invention relates to electron tubes, and particularly to electron tubes of the type used as deflection tubes in the deflection circuits of cathode ray tubes as employed, for example, in television systems, radar systems and the like. However, the invention may be used in any circuit wherein a tube works into a reactive load.

The deflection circuits of cathode ray tubes used in television and similar systems comprise an electron tube upon whose control grid is impressed a succession of pulses. The resulting pulses of anode current traverse the primary of a transformer whose secondary supplies the deflection coil or plates of the cathode ray tube. In such deflecting circuits, the sudden interruptions of current in the transformer and deflecting yoke windings set up undesirable oscillations in these components due to shock excitation, necessitating some form of unidirectional damping to suppress these oscillations. Conventionally this damping is accomplished by an electron tube connected in parallel with the secondary of the transformer. In deflection circuits so damped, inadequate damping of the primary circuit of the transformer, due to imperfect coupling between the primary and secondary circuits of the transformer, allows the primary circuit to oscillate during the re-trace time and that portion of the scansion period when the deflection circuit tube is cut off. The oscillations may be of such magnitude that on their negative peaks the anode potential of the deflection tube falls sufficiently far below the potential of the screen grid of the tube that the proper relations exist for generation of electronic oscillations within the tube, presumably of the Barkhausen-Kurtz type. The oscillations are undesirably produced within the conventional deflection tube and by the associated circuit cause very objectionable interference evidenced in television systems by severe impairment of the quality of the received picture.

Various arrangements and methods have heretofore been proposed to suppress or reduce such undesired oscillations, but in general they have required additional circuit components including expensive transformers whose windings must have low capacity to ground and be insulated from each other to withstand differences of potential of the order of several thousand volts.

In accordance with the present invention, such external circuit components, with their attendant cost and problems, are unnecessary and the damping of the undesired oscillations is effected within the deflection circuit tube itself.

In accordance with the present invention, such undesired oscillations are prevented by providing

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within the deflection circuit tube itself a damping path or circuit avoiding need for external circuit components such as high-voltage diodes and transformers with the attendant problems of low capacity and high-voltage insulation as well as additional cost. More specifically, in addition to its usual electrodes, the tube of the present invention is provided with an auxiliary cathode heated to emission temperature by bombardment of electrons moving toward the anode of the tube. The electrons emitted by this auxiliary cathode are collected by an auxiliary anode within the tube, or, in the case of a beam tetrode, by the beam-focusing electrode which also serves as the auxiliary anode. The auxiliary cathode and anode are connected to the main anode and cathode, respectively, of the tube so to provide a unidirectional damping path effective to suppress the undesired oscillations.

This invention corrects two important types of interference, namely, high frequency electronic oscillations generated within the tube and low frequency oscillations generated by oscillation of the transformer windings. Complete suppression of the low frequency oscillation removes the negative potential from the tube anode and thus prevents high frequency oscillations within the tube.

The object of this invention is to provide an improved electron tube structure.

More specifically, the principal object of the invention is to provide means within an electron tube for effectively suppressing oscillations which could otherwise be produced in the tube due to oscillations originating in the external anode circuit thereof.

Another object of the invention is to provide an electron tube having as elements at least an anode and a cathode with means for producing an auxiliary unidirectional conducting path within the tube in shunt with these elements.

A further object is to provide an electron tube having electrodes determining a main electron path with auxiliary cathode structure disposed in this path for heating by electron bombardment and auxiliary anode structure to collect electrons emitted by auxiliary cathode structure.

The invention further resides in features of construction, combination and arrangement hereinafter described and claimed.

For a more detailed understanding of the invention, reference is made to the accompanying drawings in which:

Fig. 1 is a plan view of the electrode arrangement of a tube embodying my invention;

Fig. 2 is a schematic diagram of a cathode ray

tube deflection circuit in which my improved tube may be used;

Figs. 3 and 4 are explanatory figures referred to in the explanation of the operation of my improved tube;

Figs. 5 and 6 are perspective views of the electrode arrangements of two beam tetrodes embodying my invention; and

Fig. 7 is a plan view of a modification of the structure shown in Fig. 5.

Referring to Fig. 1, the tube comprises a cathode 1, control grid 3, screen grid 4 and anode 5. Each of these electrodes has substantial length normal to the plane of Fig. 1. The cathode 1 may be of the directly heated type, or, as shown, there may be provided an internal heater 2 for raising the temperature of the cathode to electron-emissive temperature. The cathode, grids and grid supports are so constructed and arranged that during operation of the tube the stream of electrons, generally indicated by the dotted lines, passing through the mesh of the control grid 3 and the screen grid 4 in its movement to the anode 5 is focused into a divergent beam, as shown in dotted lines. It will be understood that the electrode structure will be enclosed and mounted within an evacuable envelope (see Fig. 2). The tube construction as thus far described is conventional and tubes so constructed are productive of undesired oscillations when used in cathode ray tube deflection circuits, and analogous applications wherein the tube works into an inductive load, for reasons above discussed.

In accordance with my invention, in order to suppress such oscillations, the tube is provided with one or more auxiliary cathodes 6 disposed in the path of electrons moving from the main cathode 1 to the anode 5. These auxiliary cathodes, which may be in the form of filaments, are preferably disposed in the region adjacent the plate or anode 5 and are directly electrically connected thereto as by the supporting bars or wires 7. Each of the auxiliary cathodes 6, shown in end view in Fig. 1, is of substantial length as measured transversely of the electron stream and is rigidly supported as by one or more supports 7. One of the supports may be spring loaded to tension the filament.

Because of their location, the auxiliary cathodes 6 are bombarded by electrons moving toward the anode 5 and are heated by such bombardment to electron-emissive temperature so that each becomes a source of electrons distinct from the main cathode 1.

In the particular form of tube shown in Fig. 1, the electrons emitted by the auxiliary cathodes 6 are collected by one or more auxiliary anodes 8 which are disposed outside of the path of electrons moving from the main cathode 1 to the main anode 5. The auxiliary anodes 8 may be connected to the main cathode 1 within the tube itself, or may be connected to separate terminal structure for external connection to portions of the circuit at other than cathode potential. Each of the cathodes 6 with its associated auxiliary anode 8 forms a diode providing a unidirectional damping path in shunt with the main anode 5 and cathode 1 within the tube itself. As the auxiliary cathode 6 is heated by electron bombardment, there does not arise the problem of providing insulation between a heating circuit for the auxiliary cathode and the high voltage applied to the anode 5.

Referring to Fig. 2, the tube 10, generically representative of the tubes shown in Figs. 1, 5, 6, and 7, is included in a deflection circuit or system for supplying sawtooth current impulses to the deflection coil 11 of a cathode ray tube 12. Appropriately shaped voltage impulses produced by a pulse generator 13 are impressed upon the control grid 3 of tube 10. In the anode circuit of the tube 10 is included the primary winding 14 of a coupling transformer whose secondary winding 15 is connected to the deflection coil 11. A diode 16 is provided for damping oscillations in the secondary winding 15. As appears from Fig. 2 and from the foregoing description of Fig. 1, the auxiliary cathodes 6 and auxiliary anodes 8 form within the tube envelope a unidirectional conductive path or paths in shunt to the primary winding 14 of the coupling transformer The path or paths so provided within the tube 10 damp out oscillations otherwise produced when the primary circuit is unloaded during part of each scanning pulse applied to the control grid 3.

Fig. 3 illustrates the plate voltage wave form of a conventional tube used in a deflection circuit similar to that shown in Fig. 2. The loops 20 represent the undamped oscillations in the plate voltage caused by oscillations in the primary winding 14 of the coupling transformer.

Fig. 4 illustrates the plate voltage wave form of my improved tube in the circuit of Fig. 2. The diode incorporated in the deflection tube 10 quickly damps out the oscillations, as shown by the loops 21.

When, as shown in Fig. 5, the tube is of the beam tetrode type using beam-forming or beam-focusing electrodes 8a at cathode potential, these electrodes, in addition to their normal beam-focusing function, may also serve as the auxiliary anodes for collection of electrons emitted by the bombarded auxiliary cathodes 6. The auxiliary cathodes 6 may be of ribbon form supported at each end by plates 7, as shown. In other respects the electrode arrangement shown in Fig. 5 is similar to that of Fig. 1 and accordingly further description thereof is unnecessary. In both figures, corresponding elements have been identified by like reference characters. In brief, in Fig. 5 the auxiliary cathode structure 6 is disposed within the main beam of electrons and connected to the main anode 5, and the electrons emitted by the auxiliary cathode structure 6 are collected by auxiliary anode structure formed by the edges of the beam forming electrodes 8a which are outside of the main beam of electrons and connected to the main cathode 1.

The tube shown in Fig. 6 is similar to that of Fig. 5 with the exception that only one auxiliary cathode 6a is provided in the beam path on each side of the elliptical cathode and grid structure. However, each auxiliary cathode 6a and the two adjacent edges of the two beam forming electrodes 8a form two damping diodes in shunt with the main anode and main cathode.

Fig. 7 shows a modification of the tube of Fig. 5 wherein the edges of the beam forming electrodes 8a are provided with flanges or similar projections 8b to serve as the auxiliary anodes of the shunt diodes.

It is not necessary that the auxiliary anodes be located outside the beam path, as illustrated and described in the specific examples given, although that is the preferred arrangement. If the auxiliary anodes were in the beam path, the beam would be slightly deflected, but otherwise the tube would function normally.

It will be understood that the invention is not limited to the particular tubes described and il-

lustrated, and that changes and modifications may be made within the scope of the appended claims.

What is claimed is:

1. An electron tube comprising a main anode, a main cathode spaced from said main anode to define a path for electrons from said main cathode to said main anode, auxiliary cathode structure disposed within said path for heating by electron bombardment, and auxiliary anode structure disposed outside of said path to collect electrons emitted by said auxiliary cathode.

2. An electron tube comprising a main anode, a main cathode spaced from said main anode to define a path for electrons from said main cathode to said main anode, auxiliary cathode structure disposed within said path for heating by electron bombardment and directly connected internally of the tube to said main anode, and auxiliary anode structure disposed outside of said path for collection of electrons emitted by said auxiliary cathode.

3. An electron tube comprising a main anode, a main cathode spaced from said main anode to define a path for electrons from said main cathode to said main anode, auxiliary cathode structure disposed within said path for heating by electron bombardment, auxiliary anode structure disposed outside of said path for collection of electrons emitted by said auxiliary cathode, and connections within the tube connecting said auxiliary anode and cathode to said main cathode and anode, respectively.

4. An electron tube comprising a main anode, a main cathode spaced from said main anode to define a path for electrons from said main cathode to said main anode, auxiliary cathode structure disposed adjacent said anode and in said path for heating by electron bombardment, and auxiliary anode structure disposed outside of said path for collection of electrons emitted by said auxiliary cathode.

5. An electron tube comprising a cathode, control and screen grids and an anode determining an electron path for electrons from said cathode to said anode, and means within said tube for preventing the anode potential from falling to substantial negative values relative to said cathode during operation of said tube comprising auxiliary cathode structure disposed in said electron path for heating by electrons moving toward said anode, and auxiliary anode structure disposed outside of said path for collection of electrons emitted by said auxiliary cathode.

6. A beam tube comprising a cathode, a grid, beam-focusing electrode structure and an anode determining a beam path for electrons from said cathode to said anode, and means within said tube for suppressing conditions which bring about oscillations comprising auxiliary cathode structure disposed within said beam path and adjacent said beam-focusing electrode structure for heating by electron bombardment, said beam-focusing electrode structure additionally serving as auxiliary anode structure for collection of electrons emitted by said auxiliary cathode.

7. A beam tube comprising a cathode, a grid, beam-focusing electrode structure and an anode determining a beam path for electrons from said cathode to said anode, and means within said tube for suppressing conditions which bring about oscillations comprising auxiliary cathode structure disposed within said beam path and adjacent said beam-focusing electrode structure for heating by electron bombardment, said beam-focusing electrode structure additionally serving as auxiliary anode structure for collection of electrons emitted by said auxiliary cathode, said auxiliary cathode structure being mounted on and electrically connected to said anode, and said beam-focusing electrode structure being electrically connected to said cathode.

8. An electron tube comprising a cathode, an anode spaced from said cathode in position to receive electrons therefrom, and means for preventing the anode potential from falling to substantial negative values relative to said cathode during operation of said tube comprising auxiliary cathode structure disposed in the path of electrons from said cathode to said anode for heating by electron bombardment and auxiliary anode structure spaced from said auxiliary cathode structure in position to collect electrons emitted thereby, said auxiliary anode structure being directly connected to said cathode.

9. An electron tube comprising a cathode, an anode spaced from said cathode in position to receive electrons therefrom, and means for preventing the anode potential from falling to substantial negative values relative to said cathode during operation of said tube comprising auxiliary cathode structure disposed in the path of electrons from said cathode to said anode for heating by electron bombardment and means for collecting electrons emitted by said auxiliary cathode structure.

10. An electron tube comprising a main anode, a main cathode spaced from said main anode to define a path for electrons from said cathode to said main anode, auxiliary cathode structure disposed within said path for heating by electron bombardment and directly connected to said main anode, and auxiliary anode structure spaced from said auxiliary cathode structure in position to collect electrons emitted thereby.

11. An electron tube comprising a main anode, a main cathode spaced from said main anode to define a path for electrons from said main cathode to said main anode, auxiliary cathode structure disposed within said path for heating by electron bombardment, auxiliary anode structure spaced from said auxiliary cathode structure in position to collect electrons emitted thereby, and connections within the tube connecting said auxiliary anode and cathode to said main cathode and anode, respectively.

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