

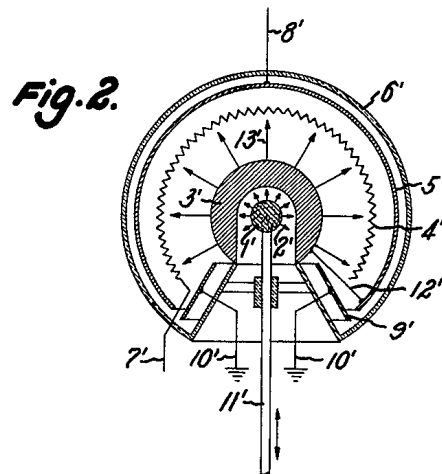
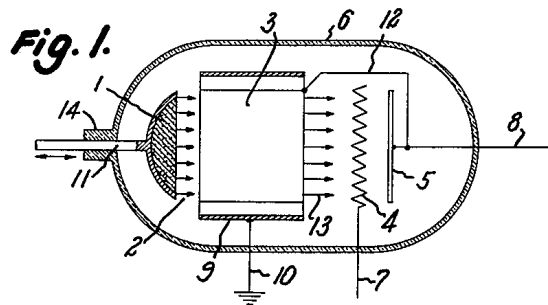
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R. D. REYMOND

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SELF-POWERED ELECTRON DISCHARGE TUBE DEVICES

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INVENTOR

*Ralph D. Raymond*

BY *Edwin C. Greigg*  
ATTORNEY

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**SELF-POWERED ELECTRON DISCHARGE  
TUBE DEVICES**

Ralph Daniel Reymond, Arlington, Va.

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7 Claims. (Cl. 313—54)

This invention relates to electron discharge tube devices and more particularly to a multi-element tube which has incorporated therewith an internal source of power.

Heretofore a triode type of tube, for example, has consisted, in its basic form, of a heater filament, emitter cathode, control grid and collector plate, the cathode, gride and plate or anode making up the base elements. In an infinite variety of circuits such tubes have been connected to external power supplies to derive their source of energy for heating the filament and thereby drive the cathode. In some tubes the cathode has been heated directly instead of indirectly. In their various environments such tubes have been very successful, yet they have had the shortcoming of having to have associated with them an expensive and heavy power supply. Furthermore, they have been of relatively short life.

This invention overcomes the disadvantages inherent in these prior externally powered tubes. Indeed, it is an object of this invention to provide a tube in which the power source is an integral element of the tube itself.

It is a further object of this invention to provide a tube in which the cathode source of electrons is replaced by a radioactive source providing charged particle emission.

Still another object of this invention is to provide a tube in which little or no heat is developed.

In general the objects of this invention are accomplished by substituting a radioactive source of charged particle emission, and an associated secondary electron emitting material, for the filament and cathode of a multi-element tube. The electrons driven off from the secondary emitting element, when radiation particles strike the emitting element, will flow toward a collector plate or anode. Intermediate the plate and emitter is the necessary control grid and/or suppression grid or grids.

The above and other objects of the claimed invention will become clear through a study of the description when read in conjunction with the accompanying drawings. Throughout the description and drawings like parts are represented by like numerals.

Fig. 1 is a sectional side view of a preferred embodiment of the tube made in accordance with the invention, and

Fig. 2 is a sectional side view of another preferred embodiment of tube made in accordance with the teachings of the invention.

Referring now to Fig. 1, a source 1 of radioactive radiation designated by arrows 2 is positioned close to a semi-conducting material 3. On the side of the semi-conducting material away from the radioactive hard particles radiation source is positioned a grid 4, and beyond the grid from the semi-conducting material is positioned a plate 5.

The above described elements are enclosed within a sealed tube 6. Leads 7 and 8 extend through the tube envelope so that effective utilization may be made of the tube through the grid 4 and plate 5. Around the

semi-conductor 3 is positioned a collector 9 having an external lead 10.

To effectively position the radioactive source of charged particles emission with respect to the semi-conductor the source may be held by an insulating rod 11 having a section extending through the envelope. A vacuum type seal shown schematically at 14 may be used so that suitable adjustment of the axial position of the radioactive source of emission may be made without affecting the gaseous state of the tube. One example of a seal which might be used is shown and described in Hotine Patent No. 2,416,318, of February 25, 1947. This is not intended to be limiting, however, since it is obvious that many ways may be devised for positioning the source.

In the operation of the tube, a radioactive source 1 of atomic material, such as strontium 90, a waste material of the atomic fission of uranium emits hard radiation rays 2 which are primarily high energy beta particles. These are directed by the proper shaping of the source to a semi-conductive wafer 3 which is in close proximity to the radiation source. Possible semi-conductive materials are silicon, lead sulfite, selenium and other similar materials. The semi-conducting material serves as the source of emitted electrons shown as arrows 13. The initial linear velocity of the high energy particles emitted by the radioactive source is used to knock electrons out of the secondary emitting wafer, and the electrons move as a stream out of the wafer toward the collector plate. Multiple secondary emission within the secondary emitter takes place and increases the density of the stream. Since silicon has electrons whose bonds are not so great as those of the other materials, it would seem to be a preferred material to use.

As the high energy radiation particle 2 strikes and passes through the silicon, it drives off an estimated 200,000 electrons 13. Since the strontium 90 emits several billion particles per second a great number of electrons are driven from the semi-conductor or wafer 3. The output from this source is in the nature of one-millionth watt. The electrons which are driven from the wafer 3 are directed through the control grid which is connected to a modulating source of signals to a plate where they may be received and utilized as a rectified, amplified, or oscillating signal. This wafer 3 may serve as a lens to guide the electrons to the plate and to this end may be suitably shaped.

Since electrons are continuously being driven from the wafer, it will be positively charged and therefore can be used to polarize the plate through connection 12 which may be made on the edge of said wafer. To eliminate any spurious electron flow from the secondary source 3, a collector 9 is provided which will pick up any stray electrons and conduct them through a lead 10 to ground.

Referring now to Fig. 2 the radioactive radiation source 1' is positioned at the center of a spherical arrangement of parts. These include the emitter materials 3' which is in close proximity to the source. Surrounding the emitter 3' as a concentric sphere is the grid 4' and lying still further from the source is the collector plate 5' as a concentric sphere.

All of these elements, excluding the source which may or may not be, are maintained in spaced relationship with one another within a sealed envelope 6' which is also spherical in shape.

To provide access to the radioactive radiation source, which is movable toward and away from the geometrical center of the spherical elements by means of insulating rod 11', a conical shaped section is provided which forms a cavity in the assembly into which the source may be inserted.

Within the sealed envelope but about the conical cut-out cavity is positioned a truncated conical element 9'

which serves as a collector. The elements 4', 5', and 9' have leads 7', 8', and 10' extending to the exterior of the tube permitting the tube to be connected in the desired circuit.

As in the embodiment shown in Fig. 1, connector 12' serves to polarize the plate 5'.

The tube of this embodiment operates just as the tube of Fig. 1 and for this reason a description of operation will not be repeated.

Suffice it to say that since the radiation of the source is in all directions this spherical arrangement permits greater utilization of the available atomic material which results in increased efficiency.

It is thus seen that I have provided an electron tube which is self powered; that is, it has no external power source. Furthermore, by the nature of the half life of the atomic radiator strontium 90, it may be seen that such a tube will have a life, barring accidents, of about twenty years. In its various environments this tube could be used as any multi-element tube is now used. While the embodiments described are of particular utility as vacuum type of tubes, this invention is not intended to be limited thereto.

Various changes and modifications are considered to be within the principle of the invention and the scope of the following claims.

Having thus described the invention, what is claimed is:

1. An electron discharge device comprising a sealed envelope elements in axial longitudinal spaced relationship, said elements including, a radioactive source of high energy emitting material, a secondary emitting wafer juxtaposed to said radioactive source and presenting an imperforate surface thereto, a control grid having control leads extending transversely through said envelope, said grid being positioned adjacent said secondary emitter and on the opposite side of said emitter from said source and a collector plate positioned adjacent said grid on the opposite side of said grid from said emitter and having a lead extending axially through said envelope.

2. An electron discharge device according to claim 1 in which said radioactive source is movable with respect to said secondary emitting material.

3. An electron discharge device according to claim 1 including a stray electron collector plate positioned with respect to said wafer so that spurious electron flow is prevented.

4. An electron discharge device according to claim 1 having a connection between the collector plate and wafer whereby said plate may be positively polarized with respect to said wafer.

5. An electron discharge device comprising a sealed envelope, a radioactive source of high energy emitting

material movably positioned with respect to said envelope, a secondary emitting wafer stationarily positioned within said envelope, said wafer maintained in spaced relationship with respect to said source and presenting an imperforate surface thereto, a collector fixedly positioned within said envelope about said wafer, said collector having a lead extending through said envelope, grids positioned in said envelope and maintained in fixed spaced relation with said wafer on the side of said wafer away from said source, said grids having leads extending through said envelope, a collector plate positioned within said envelope and on the opposite side of said wafer and grids from said source, said plate having a lead extending through said envelope, and having a connection from said plate to said wafer.

6. An electron discharge device comprising a sealed envelope of substantially spherical shape and at the center thereof, a radioactive source of high energy emitting material, a secondary emitting wafer of substantially spherical shape in concentric relationship to said source and of greater circumference and presenting an imperforate surface thereto, a control grid of substantial spherical configuration having control leads extending transversely through said envelope and being of concentric relationship and greater circumference with respect to said secondary emitting wafer, and a collector plate of substantially spherical configuration positioned in concentric relationship to said control grid and being of greater circumference and having a lead extending transversely through said envelope.

7. An electron discharge device comprising a sealed envelope, a radioactive source of high energy emitting material positioned with respect to said envelope, a secondary emitting wafer stationarily positioned within said envelope, said wafer maintained in spaced relationship with respect to said source and presenting an imperforate surface thereto, a collector fixedly positioned within said envelope about said wafer, said collector having a lead extending through said envelope, grids positioned in said envelope and maintained in fixed spaced relation with said wafer on the side of said wafer away from said source, said grids having leads extending through said envelope, a collector plate positioned within said envelope and on the opposite side of said wafer and grids from said source, said plate having a lead extending through said envelope, and having a connection from said plate to said wafer.

References Cited in the file of this patent

UNITED STATES PATENTS

2,264,851	Linder	Dec. 2, 1941
2,520,603	Linder	Aug. 29 1950
2,709,229	Linder	Mar