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P. T. FARNSWORTH

2,141,837

MULTISTAGE MULTIPACTOR

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Fig. 1.

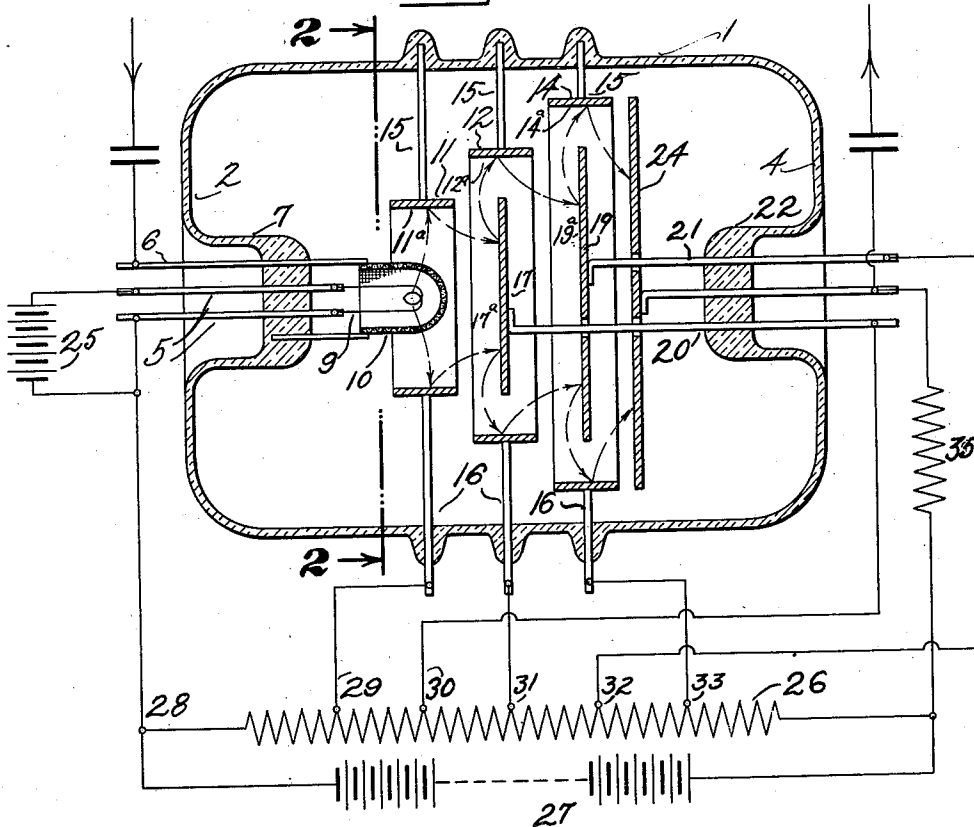
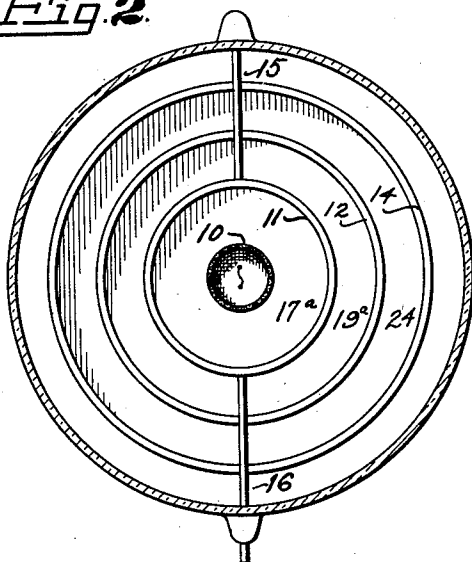


Fig. 2.



INVENTOR,

PHILO T. FARNSWORTH.

BY

Lippincott & Metcalf
ATTORNEYS.

UNITED STATES PATENT OFFICE

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MULTISTAGE MULTIPACTOR

Philo T. Farnsworth, San Francisco, Calif., assignor to Farnsworth Television Incorporated, San Francisco, Calif., a corporation of California

Application June 1, 1936, Serial No. 82,888

3 Claims. (Cl. 250—175)

My invention relates to electron multipliers, and more particularly to that type wherein electrons are directed to successively impact a series of surfaces to produce a current augmented by secondary emission at each impact.

Among the objects of my invention are: To provide an electron multiplier embodying simplicity in construction; to provide an electron multiplier in which space charge limitations are a minimum; and to provide an electron multiplier the arrangement of which is such as to facilitate the movement of electrons.

Other objects of my invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but I do not limit myself to the embodiment of the invention herein described, as various forms may be adopted within the scope of the claims.

In the drawing:

Figure 1 is a sectional view through a preferred embodiment of my electron multiplier.

Figure 2 is a sectional view taken in the line 2—2 of Figure 1.

In the preferred embodiment of my invention, an evacuated cylindrical envelope 1 closed by end walls 2 and 4 has supported axially therein, as by leads 5 and 6 sealed through stem 7, a filamentary cathode 9 and a grid 10. A series of short cylinders 11, 12 and 14 are supported in spaced co-axial relation longitudinally of the envelope axis by means of anchor pins 15 and leads 16 respectively fused in and sealed through the envelope 1. The endmost cylinder 11 of the series is disposed adjacent the cathode 9 and the cylinders of the series are of progressively increasing diameters as shown. The interior surface elements 11a, 12a, and 14a of these cylinders are treated to provide a surface capable of readily emitting secondary electrons at a ratio greater than unity when impacted by a primary electron traveling at the proper velocity.

Disposed within the cylinders 12 and 14 in spaced relation thereto are disks 17 and 19 supported by leads 20 and 21 sealed through stem 22 of the envelope end wall 4. The surfaces 17a and 19a are likewise sensitized for secondary emission and I have found that the surface elements 11a, 12a, 14a, 17a, and 19a may be sensitized by the deposition thereon in any well known manner of thin film of thorium, caesium, potassium, or calcium. However, any material capable of emitting secondaries on impact is satisfactory.

A final disk 24 similar in structure to disks 17 and 19 is provided as a collector, no sensitized

surface being necessary for this disk. It will be noted that the disks are of progressively increased diameter and arranged opposite the ends of the cylinders.

The multiplier is rendered active by activating the filament 9 from a source 25 and attaching a resistor 26 across a source of potential 27, taps 28 to 33 being taken from the resistor and leading to the filament and alternately to the cylinders and plates 11, 17, 12, 19, and 14, respectively, to produce progressively increasing potentials thereon, the end of the resistor being connected through output impedance 35 to the anode plate 24, the impedance being arranged for utilization in any well known manner.

Energized in the manner above indicated, electrons leaving the filament 9 are accelerated through the grid 10, and attracted to the surface 11a of higher potential, impact the same to cause secondary electrons to be emitted. The secondary electrons so emitted are attracted to the disk surface 17a in a similar manner with secondary emission resulting at surface 17a. Surface 17a acting as a source, the electrons emitted are attracted to surface 12a.

In this manner the flow of electrons between successive surfaces is augmented and the electrons emitted from surface 14a are collected on the anode 24. It will be observed that the successive emitting surfaces are so relatively arranged that the electrons take a zig-zag course, cascading from surface to surface in the manner indicated generally by the arrows in Figure 1, and that the path continues to increase in cross-sectional area as the multiplication increases, thus holding electron concentrations within desirable limits.

While I have shown the first emitting surface to be cylindrical, it is apparent that the electrons from the cathode may be first impacted upon the disk surface 17a, the surrounding cylinder 11 being omitted. It is furthermore apparent that any desired number of multiplications may be obtained by varying the number of surfaces, and that either a disk or a cylinder may be utilized for an anode collector.

While the construction of an electron multiplier herein described is well adapted for carrying out the objects of the present invention, it is understood that various modifications and changes may be made without departing from the invention which is considered to include all such modifications as lie within the scope of the following claims:

I claim:

1. An electron multiplier comprising a series of alternately cylindrical and plane secondary electron-emitting surfaces mounted in cascade, each of said cylindrical surfaces and each of said plane surfaces being progressively increased in size from one end to the other in the series, and means for liberating secondaries from the smallest surface.
2. An electron multiplier comprising an envelope, a series of axially spaced cylindrical secondary electron-emitting elements mounted therein, and plane secondary-electron emitting elements, each mounted axially adjacent one of said cylinders and within the succeeding cylinder.
3. An electron multiplier comprising an envelope containing a source of electrons, a cylindrical surface capable of producing secondary electrons at a ratio greater than unity upon electron impact therewith surrounding said source to receive electrons from said source, a planar surface opposite one end of said cylindrical surface and collecting means surrounding said planar surface to attract secondary electrons.

PHILO T. FARNSWORTH.