June 27, 1939. M. PLOKE ET AL 2,163,700

SECONDARY ELECTRON MULTIPLIER

Filed Dec. 2, 1938

Fig. 1

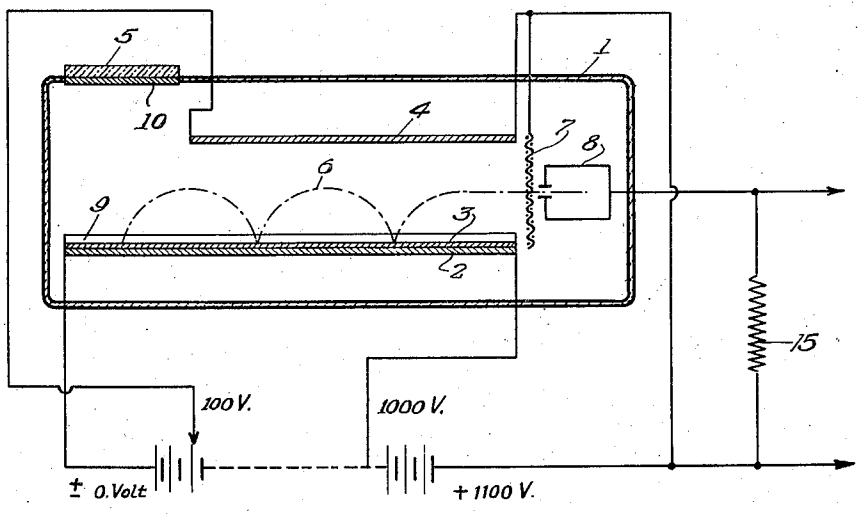


Fig. 2

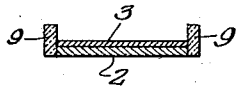


Fig. 3

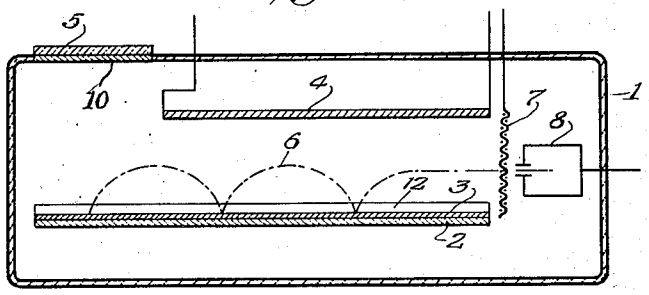
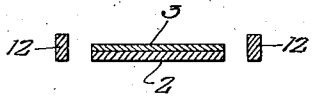


Fig. 4



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SECONDARY ELECTRON MULTIPLIER

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Application December 2, 1938, Serial No. 243,516
In Germany July 4, 1936

3 Claims. (Cl. 250—166)

(Granted under the provisions of sec. 14, act of March 2, 1927; 357 O. G. 5)

The present invention is a continuation in part of our application for Letters Patent filed in the United States Patent Office on the 6th day of July 1937, Serial No. 152,279, relating to improvements in secondary electron multipliers adapted particularly for sound film reproduction and also for television purposes.

Heretofore it was customary to provide secondary electron multipliers operating according to the electrostatic principle with a plurality of spaced electrodes, each provided with a suitable layer so as to emit progressively multiplied secondary electrons when struck by the electron beam to be amplified. Similarly, the companion electrodes arranged opposite said first mentioned emitting electrodes and which were positioned to accelerate the released secondary electrons, heretofore consisted of a plurality of spaced individual electrodes. Obviously, the employment of a relatively great number of electrodes makes the construction of the secondary electron multiplier very complicated.

It is now an object of the present invention to simplify the construction of the secondary electron multiplier by combining all the spaced photo sensitive electrodes to a single photo sensitive electrode.

Another object of the invention is to combine all the previously used spaced accelerating electrodes to a single accelerating electrode.

In particular, the invention has as its object a secondary electron multiplier in which a plurality of photo sensitive layers, is arranged upon a single carrier the electron beam being successively conducted to these layers to be amplified by multiplication of the emitted secondary electrons.

The invention also has the object of providing a secondary electron multiplier in which a single accelerating electrode is used, and in which accelerating fields are arranged between the multiple photo sensitive electrode and the accelerating electrode, which accelerating fields are produced by a drop of potential lengthwise of said electrodes.

The drawing illustrates by way of example a few embodiments of the new secondary electron multiplier.

In the drawing:

Fig. 1 is a diagrammatic view of one embodiment of the secondary electron multiplier of the present invention.

Fig. 2 is a cross sectional view of the secondary electron emitting electrode and its associated concentrating means.

Fig. 3 is a diagrammatic view of a modified embodiment of the secondary electron multiplier of the invention, and

Fig. 4 is a cross-sectional view of the secondary electron emitting electrode of the modification.

The secondary electron multiplier of the invention preferably is provided with a hermetically-sealed envelope 1 of ceramic material. According to the embodiment illustrated in Fig. 1, there are arranged within the envelope 1 an electode 2 provided with a photo sensitive layer 3, an accelerating electrode 4, a projecting grid 7 and the collector or output electrode 8. The wall of the envelope 1 is provided with a transparent window 5 on which is mounted the photo cathode 10.

According to the invention the electrode 2 which is adapted to emit secondary electrons consists of a semi-conductor as carbon, slate or the like, which serves as a carrier for a photo sensitive layer 3 adapted to emit secondary electrons when struck by an electron beam. Such a photo sensitive layer 3 may consist of a caesium-silver oxide coating. The electrode 4 arranged opposite the electrode 2 and adapted to accelerate the secondary electrons emitted by the layer 3 consists also of a semi-conductor, as carbon, slate or the like. The ends of the electrodes 2 and 4 are connected with a source of potential the positive value of which increases lengthwise of the electrodes in direction toward the collector 8. The potential applied to the electrode 4 is of such size that there will exist between opposite points of the electrodes 2 and 4 a difference of potential with the positive value toward the electrode 4. Under the influence of the accelerating field and a magnetic field the electrons may be guided along a path as approximately indicated by dotted line 6, according to which the electrons strike the photo sensitive layer 3 a number of times, are multiplied thereby and finally reach the collector 8. In order to prevent a divergence of the electron beam along the path 6, it is advisable to arrange along each side of the electrode 2 a strip-like plate 9 for concentrating the electron beam. Fig. 2 illustrates diagrammatically in cross section such an arrangement of concentrating plates. The plates 9 are made preferably of glass, mica or similar materials, which due to their negative charge prevent a divergence of the electrons.

Fig. 3 shows a secondary electron multiplier which is distinguished from the embodiment of Figs. 1 and 2 by the fact that the plates 9 have been substituted by concentrating electrodes 12, which similar to the electrodes 2 and 4 are made

of a material known as a semi-conductor. The ends of these concentrating electrodes 12 are connected with a source of potential. The potentials selected are of such magnitude that in any transverse plane, for instance in the plane of Fig. 4 the concentrating electrodes 12 are negative with respect to the secondary electron emitting cathode 2, while the electrode 4 is positive with respect to the secondary electron emitting cathode 2.

What we claim is:

1. A secondary electron multiplier comprising an envelope provided with a transparent photo cathode and containing a plate-like longitudinal secondary electron emitting electrode adapted to be struck repeatedly at different places by the electron beam to be amplified, narrow strip-like members extending along the longitudinal edges of said secondary electron emitting electrode and projecting above the electron emitting face thereof, a longitudinal accelerating electrode mounted parallel to said secondary electron emitting electrode and a collecting electrode:

2. A secondary electron multiplier comprising an envelope provided with a transparent photo cathode and containing a plate-like longitudinal secondary electron emitting electrode adapted to be struck repeatedly at different places by the electron beam to be amplified, narrow strip like members of insulating material extending along the longitudinal edges of said secondary electron emitting electrode and projecting above the electron emitting face thereof, a longitudinal accelerating electrode mounted parallel to said secondary electron emitting electrode and a collecting electrode.

3. A secondary electron multiplier comprising an envelope provided with a transparent photo cathode and containing a plate-like longitudinal secondary electron emitting electrode adapted to be struck repeatedly at different places by the electron beam to be amplified, narrow strip-like concentrating electrodes extending each in spaced relation parallel to and along the longitudinal edges of said secondary electron emitting electrode and projecting above the electron emitting face thereof, a longitudinal accelerating electrode mounted parallel to said secondary electron emitting electrode and a collecting electrode.

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