Dec. 31, 1940. R. ORTHUBER ET AL 2,227,103

ELECTRON MULTIPLIER

Filed June 26, 1937

Fig. 1

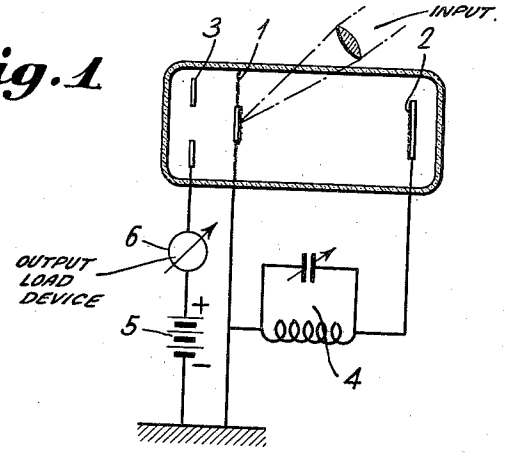


Fig. 2

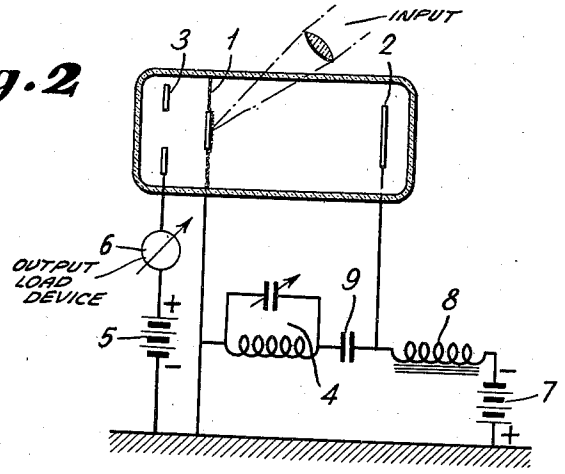
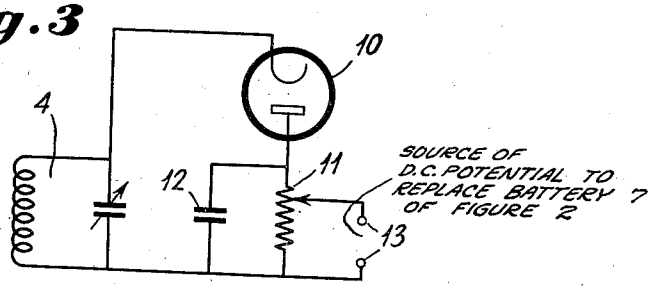


Fig. 3



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ELECTRON MULTIPLIER

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1 Claim. (Cl. 250—27)

An electron multiplier has been proposed by prior art in which the electrons are accelerated to and fro between two opposite electrodes on which they release secondary electrons. The amplified current is derived by means of an anode of ring shape or cylindrical shape inserted between the plates. A magnetic field extending at right angles to the electrodes and parallel to the axis of the arrangement prevents the electrons from impinging prematurely on the anode. For the proper operation of this arrangement three quantities, namely, the amplitude and the frequency of the alternating potential as well as the value of the plate potential must have a definite relationship to each other and to the distance between the electrodes. This signifies that the three electrical values are to be maintained constant during the operation of the multiplier. Furthermore, also the value of the magnetic field has an effect on the value of the amplification, so that in fact four values are to be maintained constant. Thus again a substantial requirement of technical means presents itself whose avoidance would be desirable.

The invention provides an improvement in the known arrangement. In accordance with the invention for the collection of the electrons in a multiplier with two electrodes between which the electrons are accelerated to and fro, collector electrodes are provided and are positioned on the side of one or both electrodes which is remote from the side of the other electrode.

The invention can best be explained by referring to the drawing wherein like reference characters represent like parts, and wherein:

Figure 1 shows one form of an electron multiplier tube constructed in accordance with the present invention;

Figure 2 shows a modified form of an electron multiplier tube, and

Figure 3 shows a circuit for deriving a direct current biasing potential from an oscillator.

Referring now to the drawing, and particularly to Figure 1, reference characters 1 and 2 represent two electrodes, both of which are to furnish a favorable yield of secondary electrons, and of which at least the plate 1 is to have furthermore an outer photo-effect, if the multiplier is to respond at luminous excitation. The plate 1 may wholly or in part be formed as a mesh or grid. In accordance with the invention, the plate 3 herein formed as annular anode member serves for collecting the electrons, but a further collector anode (not shown in the drawing) may be arranged on the side of the electrode 2 remote from the side of the electrode 1. By the provision of the collector electrodes or anodes in accordance with the invention the field existing between the plates 1 and 2 is but unappreciably disturbed by the bias potential of the collector plate anode. The circuit is arranged in the known manner; the high frequency alternating potential is furnished by the oscillatory circuit 4, the plate 1 may for instance be grounded. From battery 5 the absorption electrode 3 receives a bias potential which is positive relative to 1 and eventually also relative to 2, and the amplified current is passed to the output load device or instrument 6.

The multiplier functions in a manner similar to that of the prior art in that the electrons between the plates 1 and 2 perform a pendulum movement until they are forced beyond the border of the plate by the radial component of their exist velocity and by the influence of the space charge, and then impinge on the collector 3. The conditions under which multiplication takes place are more distinct as compared with the known method since owing to the plate potential necessary in the known method, an uncertain variation of the potential course between the electrodes 1 and 2 takes place. Furthermore, the arrangement according to the invention has the additional advantage that when the amplitude and frequency of the alternating potential are fixedly maintained, the distance carried out by the electrons during a half cycle is shorter so that the new arrangement requires less space.

Another mode of construction of the arrangement according to the invention resides in that the plate 2 does not emit secondary electrons but serves only for the production of an electric alternating field between 1 and 2. The circuit suitable in this case is shown in Fig. 2. The reference numbers 1 to 6 refer to the same elements as in Fig. 1. Furthermore, between the plates 1 and 2 a direct potential exists derived from the battery 7 for instance, and whose negative pole is connected to the plate 2 across a high frequency choke 8. The condenser 9 prevents a short circuit of the direct potential source 7. In this figure, an electron leaving 1 is accelerated by the alternating field which has become unsymmetrical due to the superimposed direct potential, then this electron is being deccelerated and accelerated back to 1 again, before reaching the electrode 2. In order to attain a periodical condition, it is only necessary to adjust to a definite relationship between the amplitude of the alternating potential and the direct potential,

while the frequency of the alternating potential and the distance of the plates 1 and 2 are only subject to the limitation that the electrons must not impinge on the plate 2, while otherwise said frequency and distance may be chosen as desired.

The constant ratio of the amplitudes may, for instance, be maintained in that instead of obtaining the direct potential from a battery 7 it is produced in a known manner from the alternating potential. An example of a circuit is shown in Fig. 3. In this figure, the alternating potential derived from the oscillatory circuit 4 is applied to a potentiometer 11 across a valve 10, the potentiometer having a condenser 12 connected in parallel thereto, and the direct potential is derived at the contacts 13. Through such an arrangement at a fluctuation of the alternating potential, the direct potential is simultaneously varied in the correct proportion. The arrangement according to the invention has the advantage that the amplitudes and frequencies can be varied within wide limits without the multiplier being disturbed thereby.

What we claim is:

An electron multiplier comprising an envelope, a pair of parallel spaced electrodes positioned in the envelope with their surfaces opposed, means for maintaining one of the electrodes positive with respect to the other, said one electrode being adapted to produce secondary electrons upon electronic bombardment at a ratio greater than unity, and said one electrode having an electron permeable portion and a radiant energy responsive portion, means for impressing an alternating potential upon said electrodes to produce electronic oscillation therebetween for electron multiplication at said one electrode, a collector anode positioned at the side of said one electrode remote from the other electrode and adapted to collect electrons which pass through the electron permeable portion thereof, and means for maintaining said collector anode positive with respect to said one electrode.

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