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DEVICE FOR AMPLIFYING VOLTAGE AND CURRENT

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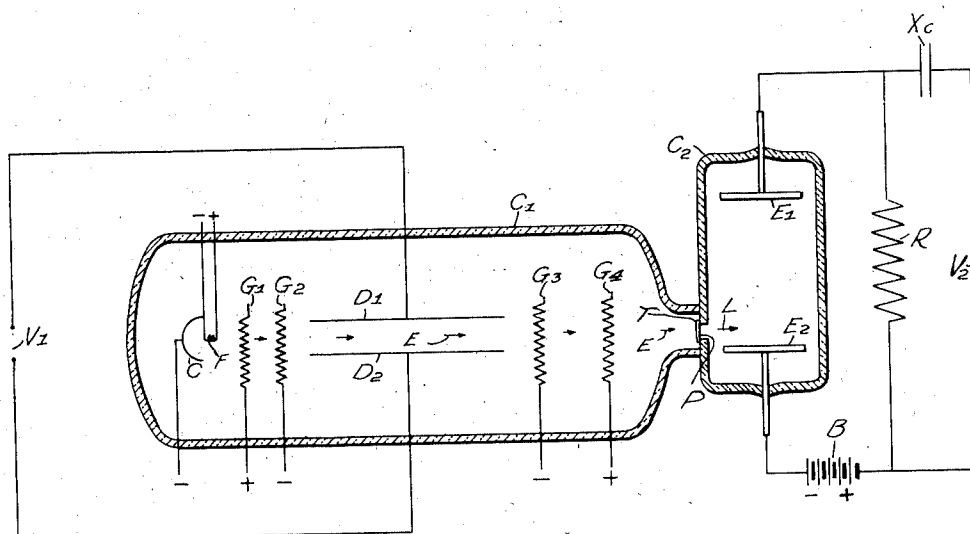


FIG 1

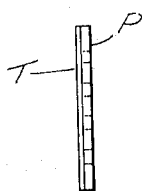


FIG 2

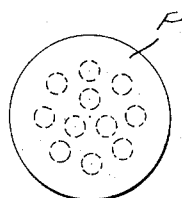


FIG 3

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DEVICE FOR AMPLIFYING VOLTAGE AND CURRENT.

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My invention relates to a device for amplifying voltage and current, and it consists in the combinations, constructions and arrangements herein described and claimed.

5 An object of my invention is to provide a device, by means of which a very high degree of distortionless voltage and current amplification may be obtained by utilizing given voltage to deflect a retarded cathode ray for the subsequent production of Leonard rays, by means of which the amplification is effected.

10 A further object of the invention is to provide an apparatus which is composed of relatively few parts, and by means of which the amplification is effected.

Other objects and advantages will appear in the following specification, and the novel features of the invention will be particularly pointed out in the appended claims.

20 My invention is illustrated in the accompanying drawings, forming part of this application, in which

Figure 1 is a diagrammatic view of the apparatus, and

Figures 2 and 3 are detailed views showing a perforated plate which forms a part of the apparatus.

In carrying out my invention I provide 30 an envelope C_1 , forming a chamber which is preferably made of glass. The air is exhausted from the chamber so as to produce a good vacuum. At one end of the chamber is an electrostatic focusing mirror C . In front of this mirror is disposed a thoriated tungsten filament F , which forms the source of the cathode rays. At G_1 I have shown a grid for the acceleration of a cathode beam and at G_2 is a retarding grid 40 for decreasing the velocity of the beam. The beam, itself, I have indicated at E . At D_1 and D_2 are electrostatic deflecting plates which are connected to the source V_1 of the voltage to be amplified. At G_3 is a neutral grid which is at the same potential as the retarding grid G_2 on the opposite side of the deflecting plates. At G_4 I have shown an accelerating grid, by means of which the electron beam is speeded up for the 50 production of Leonard rays.

The envelope C_1 has associated with it an envelope C_2 in which a secondary discharge takes place. Between these chambers, and in alignment with the central axis of the electron beam, is a window in which there

is a perforated metal plate P covered over with thin metal foil T , which is brazed to the surface of the plate so as to render the plate gas-tight, but to permit the production of Leonard rays in the auxiliary chamber C_2 .

In the latter chamber are second discharge electrodes E_1 and E_2 , respectively. The latter is connected to one side of a secondary discharge battery B , the opposite 65 terminal of which is connected with one terminal where the amplified voltage V_2 is to be impressed. The electrode E_1 is connected to the other terminal, a blocking condenser X_c being provided in the circuit. At 70 R I have shown a D. C. shunt.

From the foregoing description of the various parts of the device, the operation may be more clearly understood. In order that a large deflection of the beam may be produced by very small electrostatic deflecting fields, the cathode beam is produced in a good vacuum so as to prevent the shielding of the beam from the deflecting field by space charge. To this end the thoriated 80 tungsten filament F is used as the electron source. The electrostatic focusing mirror C is for the purpose of concentrating the rays to form a beam with a cross-section of uniform current density. Since the deflection 85 of an electron stream by an electrostatic field is inversely proportional to its velocity, great sensitivity can be obtained by passing the electron stream through a retarding field so as to greatly reduce its velocity before passing into the deflecting field. To this end I 90 make use of the grid G_2 through which the beam is passed.

Since the lateral acceleration produced by the deflecting field between the plates D_1 and 95

D_2 is $\frac{Xe}{m}$ where X is the electric field, e is

the charge, and m the mass of the electron, 100 and $\frac{e}{m}$ is 1.77×10^7 electromagnetic units per

gram, it is evident that a very small field will produce a great acceleration and will produce large deflections if the velocity of 105 the electron beam is reduced so that the accelerating force has an appreciable time to act. After the deflected beam passes out of the deflecting field, it is accelerated by another electric field G_4 so as to strike the metal 110

foil window of the ionization chamber with sufficient velocity to produce Leonard rays. In the position of zero deflection of the beam, part of the cross-section of the focused beam strikes the wall of the ionization chamber and has no useful effect, while the other part strikes the thin metal foil window in the wall of the ionization chamber for the production of Leonard rays. Thus the variation in the magnitude of the Leonard rays produced is directly proportional to the deflection of the cathode beam.

The ionization chamber contains gas under pressure. As an example, I may use carbon dioxide gas under pressure of 3.95 mm., although the kind of gas, gas pressure, and potential drop between the electrodes E_1 and E_2 may vary without departing from the spirit of the invention. Each negative ion produced by the Leonard rays produces several thousand more by ionization, by collision, in each cm. of its path to the anode, and every new negative ion produced, itself produces several thousand electrons for each cm. of its path, so that the effect is very greatly multiplied and a relatively large current may be produced. The discharge is still stable and directly proportional to the num-

ber of ions initially produced by the Leonard rays.

I claim:

1. In an apparatus for amplifying current or voltage, the combination of a vacuum tube, a source of cathode rays in said tube, means for directing the rays to form a beam of substantially uniform current density, means for retarding the velocity of the beam, means for deflecting the beam after retardation, means for accelerating the deflected beam, and means for producing Leonard rays by the accelerated portion of the beam.

2. In an apparatus for amplifying current or voltage, the combination of a vacuum tube, a source of cathode rays in said tube, means for directing the rays to form a beam of substantially uniform current density, means for retarding the velocity of the beam, means for deflecting the beam after retardation, means for accelerating the deflected beam, means for producing Leonard rays by the accelerated portion of the beam, a second discharge chamber associated with the said first-named tube for receiving the Leonard rays, and electrodes in said second discharge tube.

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