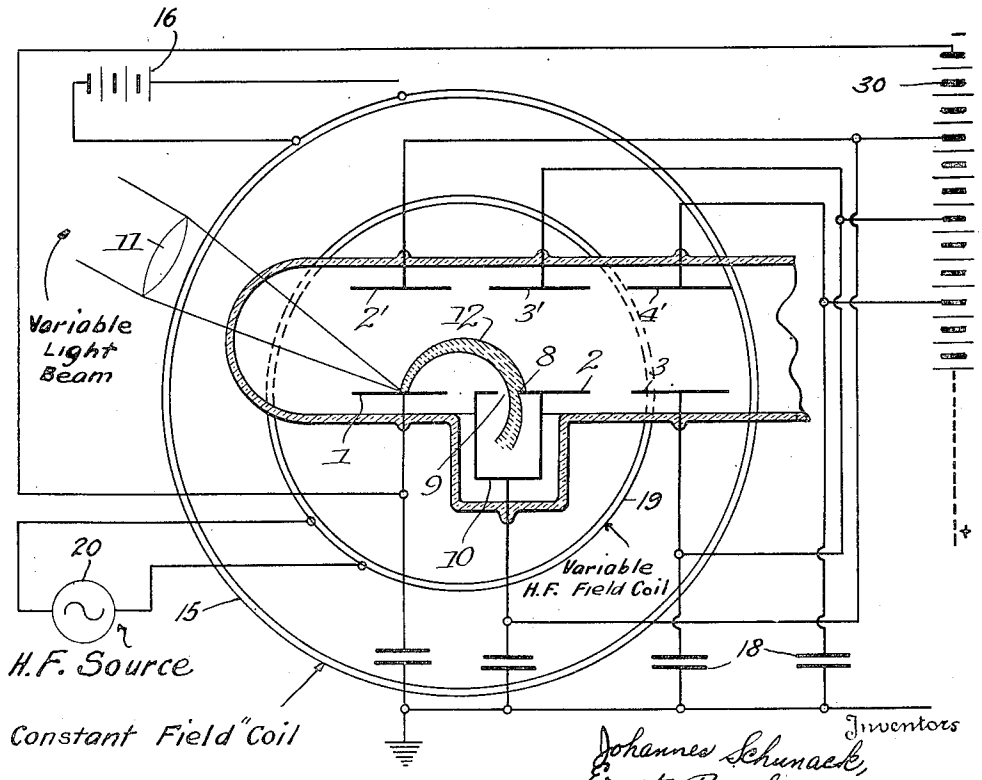
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ELECTRON MULTIPLIER

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ELECTRON MULTIPLIER

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This invention relates to an electron multiplier and particularly to a method of introducing a carrier frequency in such a multiplier. If light impulses, for instance, the picture impulses of a television transmission are to be modulated upon a carrier, this may be done in the known manner that an accelerating voltage of carrier frequency is applied to the photosensitive part, that is, usually the photocell. Instead of simple photocells for television transmission, cells are often used at present in which an amplification by secondary emission is produced. The photoelectrons liberated by the first electrode are guided upon an emitting electrode from which an enlarged number of electrons are liberated. These electrons are then guided upon a further emitting electrode, and so on.

If such a tube is to be operated in at least one stage with high frequency the disadvantage exists that not all emitting electrodes may be held at ground with respect to high frequency, that is, connected to ground by means of a condenser. In this case the high-frequency source would be short-circuited by the capacitances. In multistage electron multipliers it is, however, desirable to hold all electrodes at ground in regard to high-frequency in order to eliminate high frequency interferences and to prevent the latter from passing through further stages and thereby being amplified.

This invention shows a method for introducing the carrier frequency in which it is possible to connect all emitting electrodes to ground by means of a condenser. First a known arrangement will be considered in which the electrons in each stage travel through a homogeneous magnetic field and are guided upon following emitting electrodes by means of this magnetic field. According to the invention the electrons travel in at least one stage through a variable magnetic field, the frequency of the variations being identical with the carrier frequency. Thereby the electron beam experiences a variation in deflection and can be controlled in this manner by deflecting the beam across an aperture. Preferably the variable magnetic field is disposed in one of the first stages of the electron multiplier where the electron beam possesses a small diameter and may be completely modulated with slight variations of the magnetic field.

The invention may now be explained with the aid of the drawing, in which the single figure shows an embodiment of the invention.

Referring to the single figure, of the drawing, the electrodes 1, 2, 3, 4 and 5 are emitting electrodes or secondary electron emissive cathodes, opposite which the accelerating electrodes 2', 3', 4', 5' and 6' are disposed. The electrode 2' may be held at the potential of the emitting electrode 2, the electrode 3' at the potential of the emitting electrode 3, and so on. A homogeneous magnetic field is applied in the direction vertical to the plane of the drawing by a solenoid 15 energized by a source 16.

According to the invention the electrons from electrode 1, for instance, in the first stage, are guided through a magnetic field which varies with the carrier frequency. The emitting electrode 2 is somewhat shorter than the other electrodes. The variable magnetic field is chosen in such a way that the electron beam 12 emitted by the emitting electrode 1 completely impacts emitting electrode 2 in one extreme case, whereas it completely enters through the slit 9 in the other extreme case. Thus, a modulation takes place corresponding to the amount of the electron beam impacting the emitting electrode 2. A Faraday cage 10 is connected with the electrode 2, in which that part of the electron beam is received which enters through the slit 9. Preferably only that part of the emitting electrode 2 will be made secondary-emitting which lies on the right side of the slit 9. The intensity of the beam emitted from the electrode 2 then varies with carrier frequency. If light impulses are given upon the emitting electrode 1 by means of the optical system 11 a carrier frequency modulated by these light impulses can be taken from the output of the electron multiplier. The electrodes 2 and 2' are energized positively relative to the first electrode 1 by a source 30. Electrodes 3 and 3', etc., are similarly energized to higher potentials relative to electrode 1. All the electrodes are grounded at high frequency through the condensers 18.

In this embodiment of the invention it is preferable to use a magnetic field of constant direction but varying intensity. This is accomplished, for example, by supplying a constant homogeneous field throughout the multiplier by a solenoid 15 energized by source 16, and positioning an additional solenoid 19 energized by a carrier frequency source 20, to create a variable field between electrodes 1 and 2 in a direction normal to the plane of the drawing or in other words parallel to the planes of the secondary emissive cathodes. Thus, an alternating magnetic field is superimposed upon a constant magnetic field of such intensity that the direction of the resulting field remains the same at all times. How-

ever, other arrangements are also possible in which the magnetic field varies its direction. Furthermore, it may seem preferable to use the magnetic field of which the variations are not sinusoidal but contain harmonics. In this case approximately 30% larger amplitude can be taken from the fundamental frequency.

We claim:

1. In an electron multiplier tube having a plurality of secondarily emissive cathodes having plane surfaces arranged to be serially impacted by an electron stream, a plurality of accelerating electrodes positioned opposite and energized to attract electrons emitted from said cathodes, means for setting up a constant magnetic field parallel to the planes of said cathode surfaces, means for controlling the intensity of an electron stream from the initial one of said cathodes, means for creating an additional cyclically varying magnetic field parallel to the plane of said cathodes, and means including an equipotential space associated with the second of said serially arranged cathodes for collecting a portion of said electron stream in accordance with said varying magnetic field to render said collected portion of said electron stream ineffective in further electron multiplication.

2. In an electron multiplier tube having a plurality of secondary electron emissive cathodes arranged to be serially impacted by an electron stream, means forming with at least one of said secondary electron emissive cathodes an equipotential space, and means for diverting variable portions of said electron stream into said equipotential space to render said variable portions ineffective in further electron multiplication thereby to produce a variable output from said electron multiplier in accordance with such diversions.

3. In an electron multiplier tube having a plurality of secondarily emissive cathodes having plane surfaces arranged to be serially impacted by an electron stream, a plurality of accelerating electrodes positioned opposite and energized to attract electrons emitted from said cathodes, means for setting up a constant magnetic field parallel to the planes of said cathode surfaces and normal to the plane of the electron path between the initial and second of said cathodes, a Faraday cage associated with said second cathode and opening on the surface of said second cathode, and means for setting up an additional magnetic field parallel to the planes of said cathode surfaces and varying cyclically at carrier frequency to direct electrons from said first cathode across said opening.

4. In an electron multiplier tube having a plurality of secondary electron emissive cathodes arranged to be serially impacted by an electron stream, the combination of means forming with at least one of said secondary electron emissive cathodes an equipotential space, said space being so arranged that electrons falling into said space impact said one cathode at a point where they are ineffective in producing secondary electrons which may pass to a subsequent one of said cathodes, and means for diverting variable portions of said electron stream into said equipotential space thereby to produce a variable output from said electron multiplier in accordance with such diversions.

5. In an electron multiplier tube, the combination of a plurality of secondary electron emissive cathodes arranged to be serially impacted by an electron stream initiated by one of said cathodes, means for controlling the intensity of the electron stream initiated by said one cathode, means forming with a second of said secondary emissive cathodes an equipotential space, and means for diverting variable portions of said electron stream into said equipotential space to render said variable portions ineffective in further electron multiplication thereby to produce a variable output from said electron multiplier in accordance with such diversions.

6. The combination, in an electron multiplier tube, of a plurality of secondary electron emissive cathodes arranged to be serially impacted by an electron stream initiated by one of said cathodes, means for attracting from each of said cathodes electrons emitted thereby, means forming with at least one of said secondary electron emissive cathodes an equipotential space, said space being so arranged that electrons falling into said space impact said one cathode at a point where they are ineffective in producing secondary electrons which may pass to a subsequent one of said cathodes, and means for diverting variable portions of said electron stream into said equipotential space to produce a variable output from said electron multiplier in accordance with such diversions.

7. The combination, in an electron multiplier tube, of a plurality of secondary electron emissive cathodes arranged to be serially impacted by an electron stream initiated by one of said cathodes, means for controlling the intensity of the electron stream initiated by said one cathode, means for attracting from each of said cathodes electrons emitted thereby, means for constraining said electrons to move from one cathode to another in said serial arrangement, means forming with a second of said secondary electron emissive cathodes an equipotential space, and means for diverting variable portions of said electron stream into said equipotential space to produce a variable output from said electron multiplier in accordance with such diversions.

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