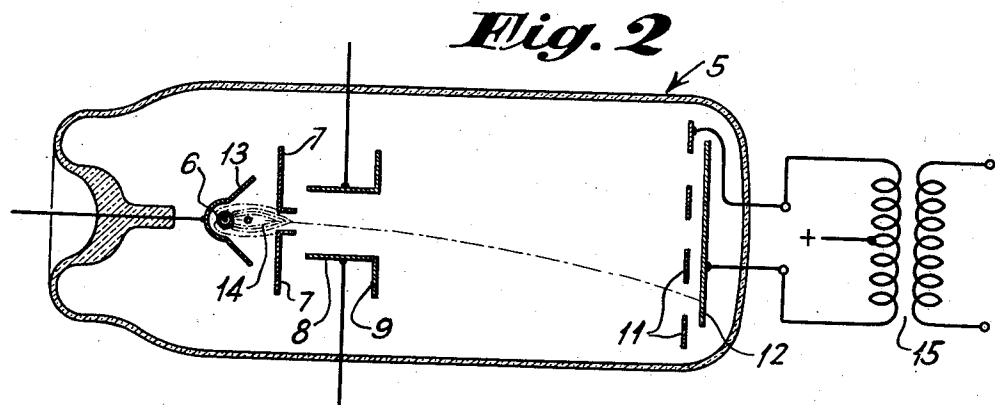
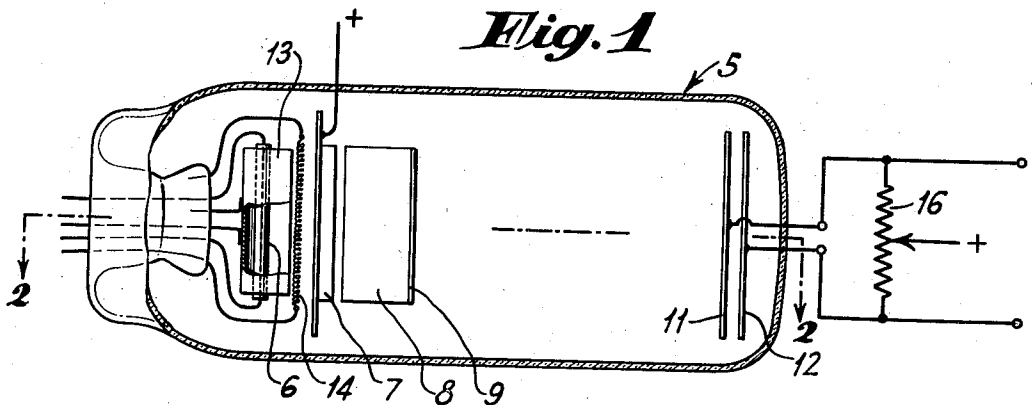


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ELECTRON DISCHARGE TUBE
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ELECTRON DISCHARGE TUBE

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2 Claims. (Cl. 250—163)

This invention relates to an improvement in electron discharge tubes particularly of the cathode ray type as used for frequency multipliers.

Cathode ray tubes when used as frequency multipliers ordinarily have a relatively small output current and in most cases it is necessary to use at least one or more stages of amplification in order to increase the magnitude of the current of the output frequency to the desired amount. The use of these amplifying tubes is of course objectionable in that it entails considerably more electrical apparatus together with the fact that some wave form distortion may occur in the amplifying tubes.

It is the purpose of the present invention, therefore, to produce a frequency amplifier tube which will produce sufficient current output to obviate or minimize the necessity of amplifying such output.

A further purpose of the invention is to produce a frequency multiplier tube with a cathode shield for deflecting substantially all of the electrons in a direction toward the focusing and deflecting plates of the tube.

A still further purpose of the invention is to produce a multiplier tube having an electrode positioned between the electron emitter and the focusing electrodes for accelerating the electrons produced by the emitter and for directing the electrons in a particular predetermined path.

A still further purpose of the present invention is to provide means in a frequency multiplier tube for collecting and focusing substantially all of the electrons produced by the emitter into a beam of electrons which may be later deflected by suitable deflecting plates.

Another purpose of the present invention is to provide deflecting plates which will be efficient in operation and which will produce maximum deflection of the beam through a minimum of voltage applied to the deflecting plates.

A still further purpose of the invention is to provide a frequency multiplier tube which will produce a stream of electrons which is rectangular in cross-section in order that the current output of the tube may be increased.

Still further purposes and objects of the present invention will become apparent to those skilled in the art from the following specification and claims, particularly when considered in connection with the drawing, in which:

Figure 1 represents the improved cathode ray frequency multiplier tube and

Figure 2 represents a section through the improved tube.

Referring to the drawing an envelope 5 is shown for housing the elements of the cathode ray tube and it is to be understood that this envelope may be made of any desirable material such as glass, metal, a vitreous substance, etc. Within the tube is positioned an electron emitter 6 which may be directly or indirectly heated by an electrical heating element or which may be supplied with heat from any desirable source. This electron emitter is preferably elongated in shape and is constructed in a manner, for instance, as shown and described in the patent to Nicolson #1,459,412 of June 19, 1923.

Positioned near the emitter is a focusing shield or electrode 7, the purpose of which is to concentrate the electrons produced by the emitter into a narrow beam. This focusing shield may be circular in form with a rectangular opening therein, the edges of the opening being provided with extensions which project in the direction of the beam. The focusing shield may, however, take the form of two separate plates mounted adjacent each other so as to produce the desired results.

A pair of deflecting plates are also provided for causing the electron beam to be deflected in a particular manner in order that it may be swept across the anode structure which is provided in the end of the tube. These deflecting plates comprise a portion 8 which extends parallel to the direction in which the developed beam travels, and a portion 9 which extends at right angles to the direction of travel of the beam. The purpose of the right angle extension 9 is to assist in deflecting the beam and to produce a concentrated electrostatic field at this region in order that an increased movement or deflection of the beam will result whereby smaller deflecting voltages may be applied to produce the desired beam deflection.

In the end of the tube is positioned the anode structure which comprises two plates or electrodes, one of which consists of a plurality of parallel conducting portions 11 which are electrically connected together and the other of which is a flat plate 12 which is positioned on the side of the first anode plate 11 opposite which the electron gun structure is positioned. The anode may be of any desired construction for instance, as shown in the patent to Ferry #2,011,920 or the patent to H. J. van der Bijl #1,614,626.

The anodes may be connected to any desired electric circuit so that as the beam is caused to sweep across the anode structure, it will contact

alternately the plates 11 and 12 of the structure, thereby producing a frequency multiplication over that applied to the deflecting plates of the tube.

In order to utilize a maximum of the electrons which are produced by the emitter, an emitter or cathode shield 13 is provided which is generally of semi-cylindrical shape and which may be provided with a pair of plane fins as shown in cross-section in Figure 2.

This shield is normally maintained at a potential negative with respect to the electron emitter in order that the electrons which are produced by the emitter will be repelled from the shield and projected in the direction of the focusing plates. Since the focusing plate is positive with respect to the emitter, it is obvious that some percentage of the electrons would be absorbed by the focusing plate and would not be projected through the tube as a useful cathode beam. In order to prevent this situation from arising, a grid or electrode member 14 is provided which is maintained at a potential positive with respect to the emitter. This electrode is positioned opposite the rectangular opening of the focusing shield and between the focusing shield and the emitter as shown in Fig. 2. Due to the positive potential of this electrode, the electrons as produced by the emitter and as reflected by the shield 13 are attracted toward this electrode 14, but, because of their acceleration, the velocity of the electrons is sufficient to permit them to be projected beyond the electrode 14 and into the field of the focusing plate 7. From this point the electrons are further accelerated and attracted to the anodes 11 and 12 because of the positive potential applied to the anodes.

It has been found desirable to utilize a coiled wire for the electrode 14. However, a single wire or combination of wires can readily be substituted for this structure. When a coiled wire is used, the coil may be of .001 inch tungsten wire with approximately 75 turns per inch, having a wound diameter of .005 inch; an electrode so constructed is effectively electron pervious. It is to be understood, however, that these dimensions are merely suggested and that other forms or dimensions which will produce the desired results may well be used.

In the operation of the device, the electrons emitted from the cathode surface or the emitter are repelled from the shield 13 and are attracted by and accelerated toward the wire grid or electrode 14, that surface being at a positive potential with respect to the cathode. A small portion are attracted to the surface of the electrode 14, but the majority of the electrons continue past the coiled wire structure toward the slit in the focusing shield 7. This shield also being at a positive potential attracts the electrons in the general direction of the slit which is in line with the grid wire and the cathode or emitter. The resulting electrostatic field produced by the potentials of the focusing shield 7 and the electrode 14 is of such a nature that the electrons entering this field are directed toward the slit and simultaneously focused into a narrow beam. Some few electrons may be taken from the stream as it passes through the slit but the percentage is relatively low, the majority of the electrons, because of focusing action, being permitted to be projected in a direction of the anodes.

When a deflecting voltage is applied to the deflecting plates, the beam, as produced by the electron gun, is therefore deflected so as to contact alternately the anodes 11 and 12 and thereby

produce a frequency voltage variation in the output circuit of the tube.

So far as the output circuit of the tube is concerned, any circuit may be used and by way of example a transformer 15 is shown in Fig. 2 and a resistance 16 is shown in Fig. 1. The positive potential for the anodes is connected to the midpoint of the resistance 16 or to a center tap of the primary winding of transformer 15 as shown in the drawing.

In certain instances the electrode 14 may be electrically connected to the focusing shield 7 while in other instances the connection to the electrode 14 may be entirely separate in order that the potential applied to this electrode may be varied as desired. In such an instance it is possible to modulate the beam as produced by the electron gun by applying appropriate modulating voltages to the electrode 14.

The elements of the tube may be supported in any desired manner and, as shown in the drawing, for example, the emitter, the emitter shield 13 and the electrode 14 may be supported by the stem press of the tube. The focusing shield and the deflecting plates, as well as the anodes, may be supported in any desired manner as long as they occupy the desired positions with reference to the other elements of the tube. Since the invention is not concerned primarily with the specific manner in which the elements are mounted it is to be understood that any appropriate and desirable mounting means may be employed.

The complete circuit in which the tube may be used has not been shown, since it is obvious that such a tube is applicable in many different circuit arrangements. Furthermore, the use of cathode ray frequency multiplier tubes is well known to those skilled in the art.

Various modifications and alterations may be made in the device without departing from the spirit of the invention and it is desired that all such modifications be considered as within the purview of the invention except as limited by the hereinafter appended claims.

I claim as my invention:

1. A cathode ray tube comprising apparatus for producing a flat electron beam including an elongated electron emitter, means provided with an elongated aperture positioned at one side of the emitter with the aperture parallel to the emitter and adapted to be maintained at a potential positive with respect to the emitter for attracting and focusing the electrons produced by the emitter, elongated shield means positioned on the other side of the emitter adapted to be maintained at a potential negative with respect to the emitter for repelling the electrons produced thereby, said last named means being substantially semi-cylindrical in form, and an elongated rod-like electrode positioned parallel to the emitter and between and in alignment with said emitter and said aperture of said first named means whereby substantially all of the electrons may be directed through the aperture.

2. A cathode ray tube comprising apparatus for producing a flat electron beam including an elongated electron emitter, an accelerating electrode provided with an elongated aperture positioned adjacent the emitter with the aperture parallel thereto, said electrode being adapted to be maintained at a potential positive with respect to the emitter for accelerating and focusing the electrons produced by the emitter, elongated shield means positioned on the side of the emit-

5 ter opposite said accelerating electrode and adapted to be maintained at a potential negative with respect to the emitter for directing the electrons produced by the emitter in the direction of the accelerating electrode, and an elongated electron pervious rod-like electrode positioned

parallel to the emitter between the emitter and the accelerating electrode and in alignment with the aperture of said accelerating electrode whereby substantially all of the electrons may be directed through the aperture.

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