June 4, 1957 G. MOURIER ET AL 2,794,935

MODULATING DEVICES FOR TUBES HAVING CROSSED ELECTRIC AND MAGNETIC FIELDS

Filed May 18 1954 2 Sheets-Sheet 1

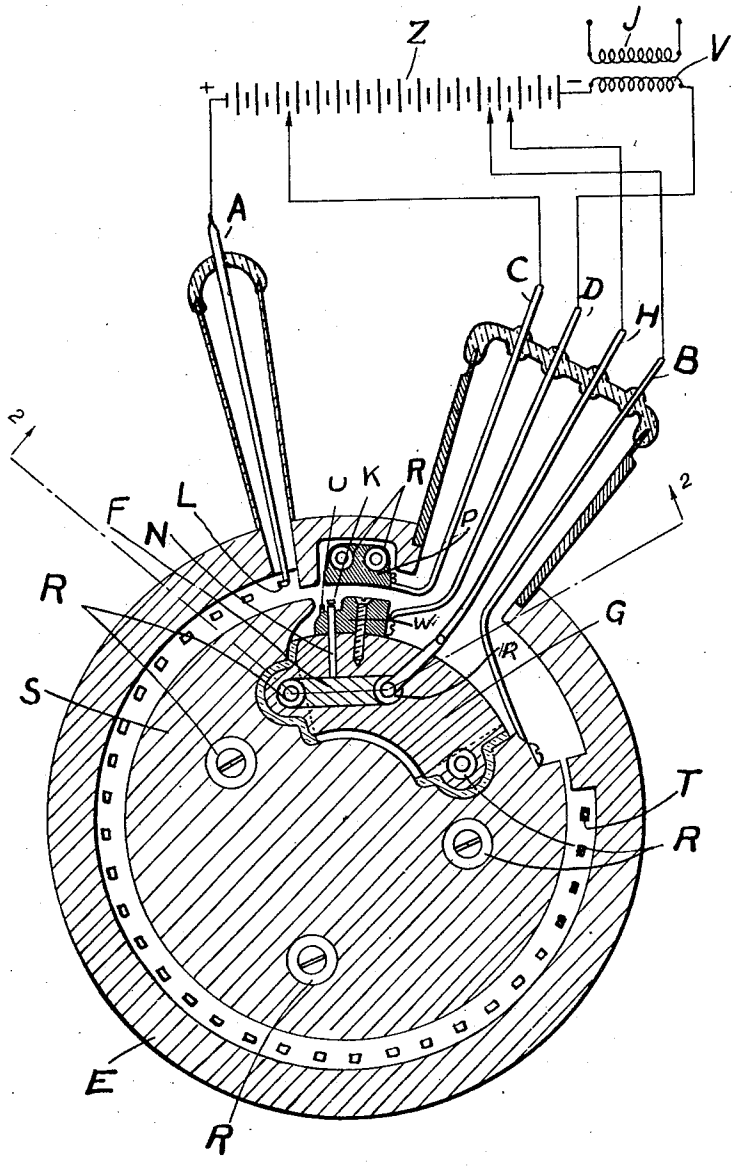


Fig. 1

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MODULATING DEVICES FOR TUBES HAVING CROSSED ELECTRIC AND MAGNETIC FIELDS

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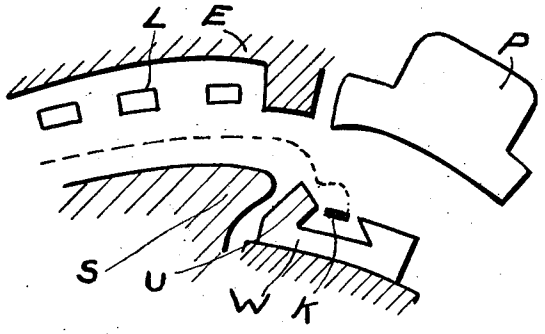


FIG. 3

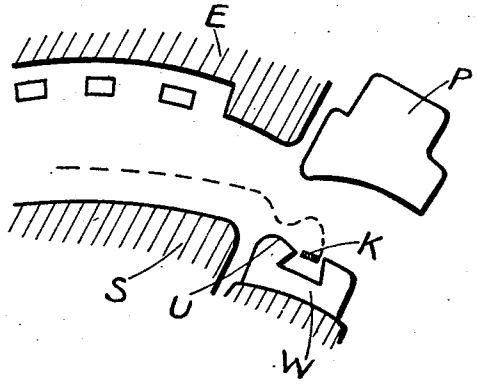


FIG. 4

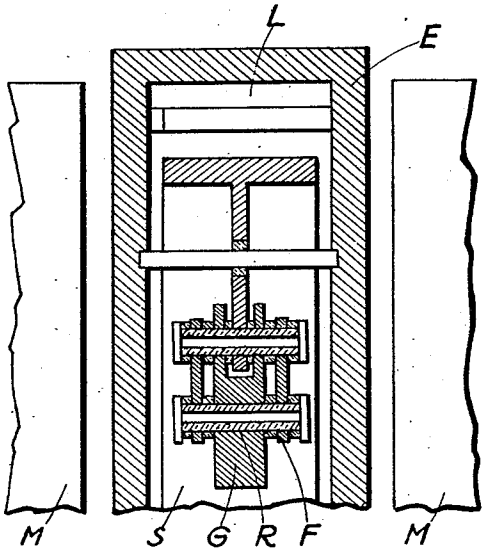


FIG. 2

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MODULATING DEVICES FOR TUBES HAVING CROSSED ELECTRIC AND MAGNETIC FIELDS

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Application May 18, 1954, Serial No. 430,684

Claims priority, application France May 19, 1953

3 Claims. (Cl. 315—3.5)

The present invention relates to amplitude modulation of signals provided by amplifier or oscillator traveling wave tubes having crossed electric and magnetic fields. It is known that such tubes comprise a pair of parallel electrodes between which an electric field is established. These electrodes limit an interaction space into which an electron beam is fed by an appropriate electron gun, and directed in a direction parallel to the electrodes by means of an electron optical system. The positive electrode constitutes a delay line in which an ultrahigh-frequency traveling wave is propagated and the space between the electrodes is subjected to a magnetic field which is perpendicular to the electric field and the electron beam.

It is also known that for modulating the output signal of such a tube, it is convenient to modulate the electron beam.

The modulating devices heretofore used in such tubes usually comprised an auxiliary modulating electrode situated at a certain distance from the cathode. Hence the modulation voltage had to be relatively high.

The present invention eliminates this disadvantage. According to the invention, the cathode is located in the modulating electrode itself, the latter being insulated from the above mentioned parallel electrodes.

In order to prevent the electrons emitted by the cathode from settling on this electrode, the latter is brought to a sufficiently negative potential that in the course of modulating it is always more negative than the cathode.

The modulating electrode occupies a certain amount of space and this necessitates increasing the distance between the cathode and the entrance of the interaction space. This distance, which in known electron optical systems is equal to a half-arch of the cycloidal trajectory of the electrons of the beam, must be equal to an odd number of these half-arches i. e. to at least one and a half arches.

The invention will be better understood from the ensuing description with reference to the accompanying drawing in which,

Fig. 1 is a cross-sectional view of one embodiment of the tube incorporating the improvement according to the invention;

Fig. 2 is a sectional view on line 2—2 of Fig. 1;

Figs. 3 and 4 are views of two modifications of the modulating device of the tube according to the invention.

The tube shown in Figs. 1 and 2 is an oscillator tube of circular shape. It comprises, within a metallic envelope E, a delay line L brought to a positive potential by means of a connection A, and a cylindrical electrode S, brought to a negative potential by means of a connection B. At the entrance of the interaction space is mounted an auxiliary electrode P, brought through a connection C to a positive potential, which is preferably equal to half the potential existing between the line L and the electrode S.

Further, according to the invention, a modulating electrode W, insulated from the electrode S and negatively biased through a connection D, is mounted substantially opposite the electrode P. The electrode W is mounted on a piece G, housed in a recess formed in the electrode S. The piece G is insulated from the electrode S. The modulation voltage is provided by a source J through a transformer V. The piece G supports on its lateral face a pair of terminals F which are insulated therefrom and to which are fixed the connections N of the heating filament of the cathode K, housed in a recess formed in the electrode W. The filament is fed through a connection H. At R are shown insulating spacer elements which serve to fix the various elements to and insulate them from, the envelope E. A magnet M (Fig. 2) creates a magnetic field perpendicular to the plane of Fig. 1. As the illustrated tube is an oscillator tube, it comprises a single output A, situated adjacent the entrance of the interaction space. The delay line L comprises an attenuation T at its end opposite to the cathode, as described in the co-pending United States application Serial No. 281,347 filed by B. Epsztein on April 9, 1952. Of course, it is to be understood, that the invention is just as applicable to amplifiers as to oscillators.

The various bias voltages are furnished by a source Z.

Fig. 3 shows at an enlarged scale the modulating portion of the tube of Fig. 1.

As mentioned hereinbefore and clearly shown in Fig. 3, it is necessary to dispose the cathode K a certain distance from the entrance of the interaction space so as to provide ample space for housing the electrode W. The distance passed through by the electrons between the cathode K and the entrance of the interaction space must be equal to an odd numbr of half-arches of the cycloid passed through by the electrons of the beam, for example one and a half cycloid arches. It is advantageous that the electrode W have in front a part U in the form of an inclined plane connecting the edge of the cathode K to the entrance of the interaction space. As shown in Fig. 4, it is preferable that the edges of the electrodes W, P, E and S be rounded in the region where these edges define the entrance of the interaction space.

What we claim is:

1. In a travelling wave tube of the type comprising two spaced parallel electrodes, and terminal connections for applying different potentials to said electrodes: a cathode positioned for feeding an electron beam in the space bounded between said two electrodes, a modulating electrode insulated from said parallel electrodes, said cathode being located in a recess provided in said electrode and insulated therefrom, terminal connections for varying the potential of said modulating electrode for modulating said electron beam and terminal connections for negatively biassing said electrode with respect to said cathode for preventing the electrons emitted by the cathode from reaching said modulating electrode.

2. A tube according to claim 1 wherein said terminal connections for negatively biassing said electrode are adapted for bringing said modulating electrode to such a potential that this electrode remains negative with respect

to the cathode even when positive crest modulating voltage is applied thereto.

3. A travelling wave tube, of the type including two spaced parallel electrodes, and terminal connections for applying different potentials to said electrodes, comprising: a cathode positioned for feeding an electron beam in the space bounded between said two electrodes, a modulating electrode insulated from said parallel electrodes, said cathode being located in a recess provided in said electrode and insulated therefrom, means for varying the potential of said modulating electrode for modulating said electron beam and means for negatively biassing said electrode with respect to said cathode.

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