June 12, 1934.

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1,962,582

MODULATING SYSTEM FOR ULTRA-SHORT WAVE SIGNALING

Filed Nov. 24, 1931

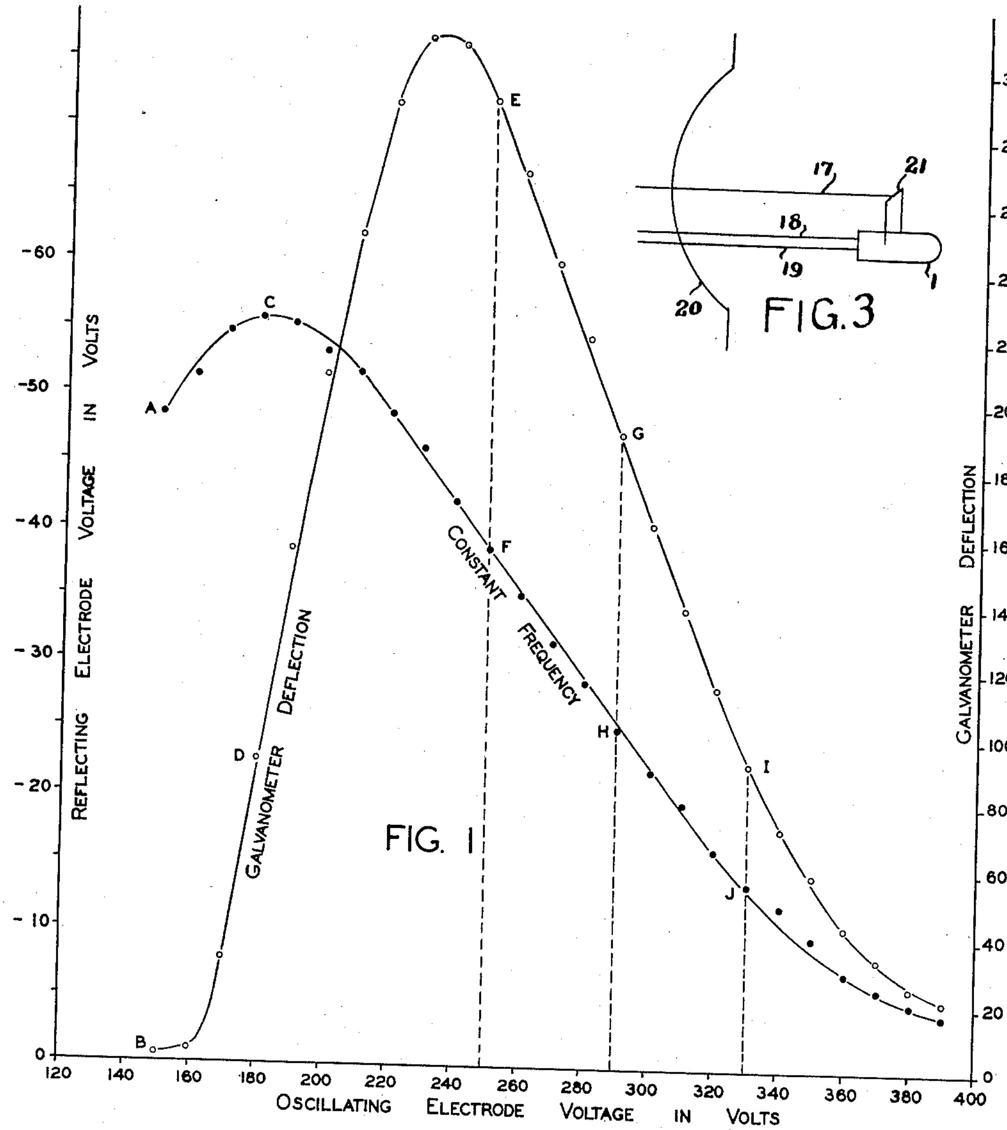

FIG. 1

FIG. 3

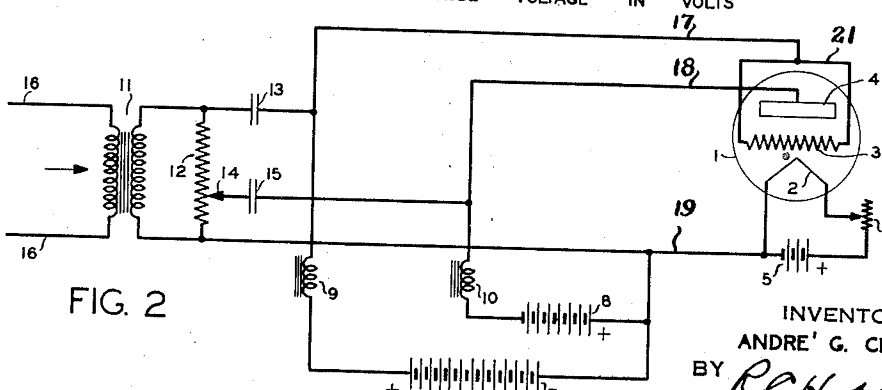

FIG. 2

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Patented June 12, 1934 **1,962,582**

UNITED STATES PATENT OFFICE

1,962,582

MODULATING SYSTEM FOR ULTRA-SHORT WAVE SIGNALING

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Application November 24, 1931, Serial No. 576,973

1 Claim. (Cl. 179—171)

This invention relates to micro-ray modulation systems, that is, to means for modulating waves in signaling systems in which micro-rays are used. The term micro-ray will be used herein to denote any electromagnetic wave having a wave length lying between the limits of approximately 100 centimeters and 1 centimeter, although the wave length may exceed these limits in either direction.

In my U. S. Patent No. 1,928,408, I have described suitable apparatus for the efficient production, radiation, reception and detection of waves of this length. That apparatus consists, substantially, of a vacuum tube of special construction in which there is a filament or cathode consisting of a straight wire of tungsten or other refractory material, an oscillating or grid electrode wound in a helix so that the filament lies along its axis, and a reflecting electrode consisting of a metallic cylinder surrounding the oscillating electrode and concentric therewith.

The object of this invention is to provide improved means for modulating the oscillations generated in such a tube.

It has been discovered that in a tube constructed according to the above description, if the positive voltage applied to the oscillating electrode is increased from approximately plus 250 volts to approximately plus 330 volts, it is necessary to change the negative bias applied to the reflecting electrode from a value of approximately minus 38.5 volts to approximately minus 13.5 volts, in order to maintain oscillations at constant frequency. The curve for the values of voltage applied to the reflecting electrode to the values of voltage applied to the oscillating electrode for constant frequency lies on a substantially straight line in this range.

In a specific tube with which experiments were conducted, the optimum wavelength, for a given external circuit constituted by a parallel wire transmission line leading to a radiating doublet, was found to be 18.42±.01. When the voltages applied to the oscillating and reflecting electrodes were varied, as described above, with the tube oscillating at 18.42 centimeters, it was found that the galvanometer deflection, as measured, for example, by the apparatus described in U. S. Patent No. 1,923,916 to Rene H. Darbord, corresponding to the power output of the tube, varied in a substantially straight line from a value of approximately 290 to approximately 60. The curve corresponding to the amplitude of the current in the radiator would also, of course, depart very little from a straight line. It will thus be observed that if the voltages applied to the electrodes in the range mentioned can be maintained at the proper ratio, it will be possible to utilize the corresponding variations in power output to obtain distortionless amplitude modulation.

A feature of this invention is the provision of means for impressing a signal wave on a tube in such a manner that distortionless amplitude modulation can be obtained.

In the drawing,

Fig. 1 is a graph showing the relation between the voltages applied to the oscillating electrode and to the reflecting electrode for constant frequency, and the corresponding power output of the tube for each set of values; and

Fig. 2 is a circuit diagram showing how amplitude modulation may be obtained.

Fig. 3 shows a conventional output device for the oscillations generated by the tube.

In tabulating the data shown on Fig. 1, the constants of the line connecting the tube to the radiator were adjusted for oscillations at a wave length of 18.42 centimeters. At point A it will be observed that the voltage applied to the oscillating electrode of approximately plus 150 volts and the negative voltage applied to the reflecting electrode of approximately minus 48 volts maintained oscillations at this frequency. With these values it will be noted from point B on the curve for galvanometer deflection that the deflection was almost unnoticeable. At point C an oscillating electrode voltage of plus 180 volts with a reflecting electrode voltage of approximately minus 55 volts gave a galvanometer deflection, as noted at point D, of 90 units.

Moving over now to that portion of the curve where amplitude modulation may be performed, that is, from point F to point J on the constant frequency curve, the curve lies on a substantially straight line with a reduction of about 1 volt in the negative voltage applied to the reflecting electrode for an increase of about 3 volts in the positive voltage applied to the oscillating electrode. In the same range on the curve for galvanometer deflection between corresponding points E and I, this curve also lies on a substantially straight line.

In Fig. 2 a micro-ray tube 1, such as that described above, has a cathode or electron emitting electrode 2, an oscillating or grid electrode 3 and a reflecting electrode or anode 4. It is to be understood that by micro-ray tube is meant a tube which generates oscillations having a wavelength between 1 and 100 centimeters. The cathode is heated by means of a battery 5 in series with a resistance 6. A battery 7 applies a positive potential to the oscillating electrode, and a battery 8 applies a negative potential to the reflecting electrode. Since it is desired to use the tube for amplitude modulation, these voltages will be adjusted to approximately the center of that portion of the curve on which the amplitude modulation may be performed, that is, to point H where it will be seen, by reference to Fig. 1, that the voltage applied to the oscillating electrode is approximately plus 290 and the voltage applied to the reflecting electrode is approximately minus 25. The point common to the three batteries may be grounded if desired, but this is not necessary.

In series with the battery 7 an inductance 9 is provided, and in series with the battery 8 an inductance 10 is provided. These inductances serve the same function in this circuit that they would in ordinary circuits with radio frequency apparatus, that is, they serve as choke coils to keep the modulating frequency currents out of the batteries.

A signal frequency is applied to the device across leads 16. This signal may be voice waves for a telephone conversation, it may be a tone wave for telegraphy, or it may consist of any wave of single or mixed frequencies in any portion of the frequency spectrum from below audibility up to and including waves of radio frequency. The signal wave is impressed on the circuit through a transformer 11. This transformer is shown in the drawing as a low frequency transformer. In case radio waves are impressed on the circuit this transformer would not, of course, have an iron core such as that indicated in the drawing. Correspondingly, the choke coils 9 and 10 would be designed to keep the modulating radio frequency currents out of the battery circuits. Across the secondary of transformer 11 a potentiometer 12 is connected. One end of this potentiometer is connected through condenser 13 to the oscillating electrode. The other end of the potentiometer is connected to the common point joining the batteries. A tap 14 on the potentiometer is connected through a condenser 15 to the reflecting electrode. The condensers 13 and 15 act as stopping condensers for the direct current from the batteries.

Consider now a single frequency wave applied to the input with a maximum voltage of 20 volts. At a maximum peak of input voltage the voltage on the oscillating electrode will have a positive value of 310 volts. The tap on the potentiometer which leads to the reflecting electrode is adjusted to impress approximately ⅓ of this voltage on the reflecting electrode. Consequently, the voltage applied to this electrode will be increased from the adjusted value of minus 25 before the input wave was applied to approximately minus 18 volts. By reference to Fig. 1 it will be seen that this shift in the voltage applied to the electrodes corresponds to a constant frequency for the oscillating frequency of the tube, so that no distortion is introduced in the wave of ultra high frequency generated by the tube. It will also be noted, by reference to Fig. 1, that this shift in the voltage on these electrodes changes the power output of the tube from a point corresponding to a galvanometer deflection of 190 to approximately 140. Consequently, the amplitude of the output will be modulated by the signal wave. At a negative peak of constant frequency the voltage on the oscillating electrode will be plus 270, the voltage on the reflecting electrode will be approximately minus 32, and the power output will correspond to the galvanometer deflection of approximately 240. It will also be observed that distortionless amplitude modulation may likewise be accomplished even though the signal input wave is a complex wave such, for example, as a speech wave.

Referring to Fig. 3, which shows a conventional output device for the modulated waves generated by the tube 1, the tube 1 is shown placed in front of a reflector 20 which may be of any desired construction, as, for example, a metallic surfaced reflector, parabolic in cross-section. It will be understood, by reference to Fig. 2, that the conductor 17 is connected to the opposite ends of the oscillating electrode 3, the conductor 18 is connected to the reflecting electrode 4, and the conductor 19 is connected to the filament 2 of the tube 1. It is to be further understood that in actual practice the battery 5 and the potentiometer 6, as shown in Fig. 2, are placed behind the reflector 20. The doublet 21, connected by leads to the opposite ends of the oscillating electrode 3, serves as a radiating element. The greater portion of the modulated oscillations radiated by the doublet 21, as is well understood in the art, are refracted from the surface of the reflector 20 in a direction substantially parallel to the axis of the reflector.

What is claimed is:

Means for modulating ultra short waves comprising an ultra short wave vacuum tube consisting of a cathode, an oscillating electrode, and a reflecting electrode, a battery for applying potential to said reflecting electrode, a choke coil in series with said battery, a battery for applying potential to said oscillating electrode, a choke coil in series with said battery, a battery for supplying current to said cathode, a potentiometer, a connection between one end of said potentiometer and said cathode, a connection between the other end of said potentiometer and said oscillating electrode, a condenser in said last-mentioned connection, a tap for said potentiometer, a connection between said tap and said reflecting electrode, a condenser in said last-mentioned connection, an input circuit, a transformer the primary of which is connected across said input circuit and the secondary of which is connected across said potentiometer.

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