April 6, 1937. H. O. ROOSENSTEIN 2,076,351

MODULATION

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Fig. 1

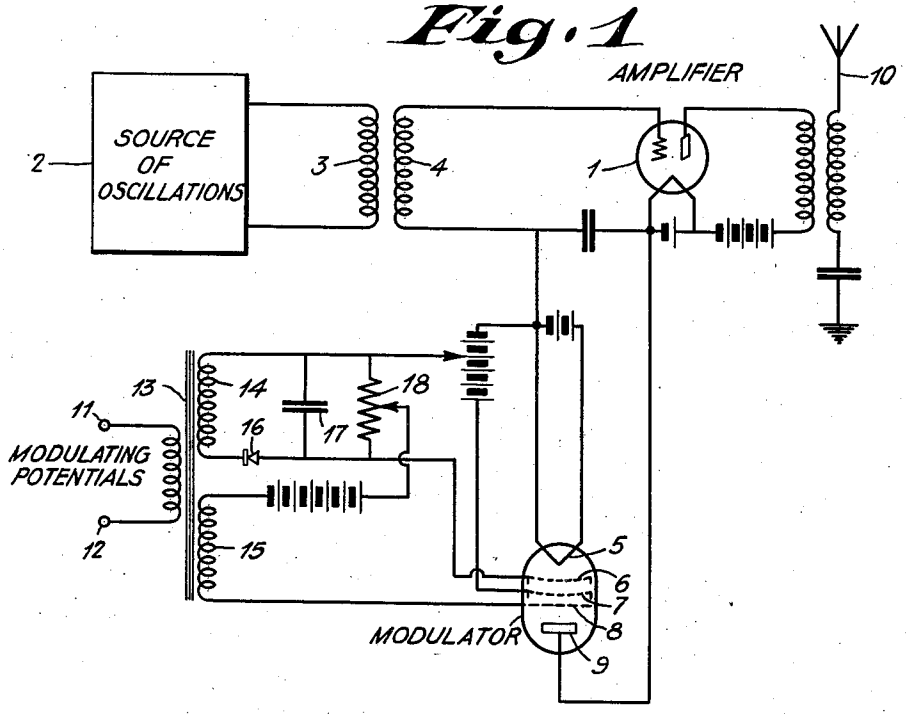
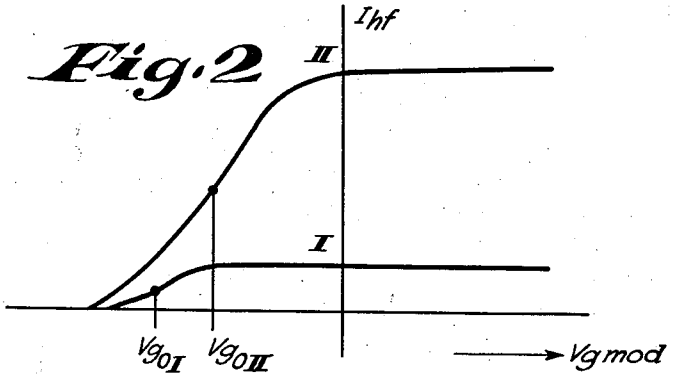


Fig. 2



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MODULATION

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8 Claims. (Cl. 179—171)

The present invention relates to a novel method of and means for modulating carrier waves.

To save energy and for other purposes it is known in the art to adapt the momentary intensity of the carrier wave of a modulated transmitter to the intensity of the modulation currents at any given instant. This is accomplished by always shifting the static value of the current to a point on the modulation characteristic such that the amplitude of the carrier wave will always lie above the fluctuations due to the modulation. This method involves the drawback that, in the presence of low modulation amplitudes operation of necessity takes place in the lower knee or bend of the modulation characteristic, in other words, in the markedly curved portion of the same. This occasions distortions which the arrangement hereinafter to be disclosed purposes to obviate.

According to the invention, a portion of the modulation current is shunted from the modulation current source of the transmitter and rectified. The intensity of the currents shunted and rectified is a function of the intensity of the modulation current. This direct current resulting from rectification is, in accordance with this invention utilized to distort the modulation characteristic, such deformation being preferably always produced in such a manner that the static point is always maintained upon the rectilinear portion of the characteristic.

Application of the basic idea of the invention is feasible in a great many manners which will differ according to the particular modulation system that happens to be employed.

For better explanation of the scheme a special embodiment is shown in Figure 1. In the arrangement of Figure 1 my modulation scheme is used in connection with the well known method of grid (direct current) modulation. The curves in Figure 2 illustrate the manner in which the amplitude of the carrier and the modulating potentials are correlated in accordance with the present invention.

Referring to Figure 1, 1 denotes a transmitter amplifier tube which is fed from the oscillation generator 2 by way of the coupling established between coils 3 and 4 with radio frequency grid excitation voltage. The distortion of the modulation characteristic is accomplished in the main by the shortening or lengthening of the linear portion of the characteristic curve. The slope of the curve is but little affected by this method. In the drawing, 5, 6, 7, 8, 9, denote the modulation frequency amplifier tube represented to be of the heated cathode type comprising the density grid 6, control grid 8 and the velocity grid 7. By adjusting the charging potentials at 6 and 7 a state is created where only a very definite portion of the electrons (apparent saturation current) of the emission of the actual cathode will be able to reach regions outside the grid 7, i. e., in the control grid anode space between 8 and 9. This apparent saturation current is capable of variation under conditions free from inertia chiefly by variation of the biasing voltage acting at the density grid 6. If the apparent saturation current is very small, then the flowing plate current of the tube and thus also the maximum radio frequency current fed into the input circuit of 1 and consequently in the antenna 10 will be comparatively small.

The modulation characteristic, in other words, the relation between the audio frequency voltages across the input terminals 11 and 12 of the apparatus and the radio frequency current in the aerial can therefore be represented by curve I of Figure 2. If, on the contrary, the emission of the modulation tube 5, 6, 7, 8, 9, as adjusted by the voltages at the density grid 6 and the velocity grid 7 is large, then the antenna currents are able to attain great values and as a result the modulation characteristic assumes a shape such as shown by curve II of Figure 2.

Now, in an arrangement as shown in Figure 1, the distortion of the modulation curve by variation of the saturation of the modulation tube is automatically occasioned by the intensity of the modulation currents prevailing at a given time. For this purpose, direct current is derived from the modulation currents by way of the secondary winding 14 of the input transformer 13, 14, 15, and the rectifier 16, the said direct current being caused to charge the condenser 17, and in this manner with a slight lag an additional charging voltage is applied to the density grid 6. Now, the polarity of the rectifier 16 is such that, in the presence of a large amplitude of the modulation potential applied to 11 and 12, an increase in the voltage at 6 and thus an increase in the apparent emission of the modulation tube 5, 6, 7, 8, 9, is brought about. In this case, with corresponding voltage at the control grid 8, large plate currents in this tube, that is to say, large grid currents of the master tube 1 can be passed.

Inasmuch as it is desirable that, in the presence of variable values of the modulation currents,

the working point should always come to lie upon the rectilinear parts of the characteristic, a potentiometer, e. g., may be provided as indicated at 18 whence part of the voltage for the density grid 6 is tapped. When the voltages at the density grid 6 are comparatively higher, this will cause as a consequence a simultaneous rise of the biasing voltage of the control grid 8 so that, if the voltage division is properly chosen, the said effect will be realized.

Having thus described my invention and the operation thereof, what I claim is:

1. A device for impressing modulating potentials on a carrier wave including a first electron discharge tube having input electrodes energized by carrier waves and output electrodes, a second discharge tube having a cathode from which electron emission takes place, an anode to which said electrons are attracted when said anode is energized, a control grid, and a density grid which varies the density of the electron stream reaching said anode in accordance with the potential on said density grid, a source of modulating potentials, a circuit coupling said modulating potential source between said control grid and cathode of said second-named tube, a circuit connecting said modulating potential source between the density grid and cathode in said second-named tube, said last named circuits having a common portion, and a circuit connecting the anode to cathode impedance of said second-named tube in series with the impedance between a pair of electrodes in said first-named tube.

2. A device as recited in claim 1 in which said circuit connecting said modulating potential source between the density grid and cathode in said second-named tube includes, a rectifier which rectifies said modulating potentials to derive therefrom a direct current component, the intensity of which varies in accordance with the amplitude of the modulating potentials.

3. A device as recited in claim 1 in which said circuit connecting said modulating potential source between the density grid and cathode in said second-named tube includes, a rectifier in series with said density grid and cathode and a condenser and resistance in parallel with said density grid and cathode, and in which said resistance is in said common portion.

4. Means for relaying oscillations linearly irrespective of variations in the mean amplitude thereof including, an electron discharge tube having an electron emission element, and a control grid, a circuit for applying oscillations to be relayed between the control grid and the electron emission element, means for biasing said control grid negative with respect to said emission element, and means for insuring operation of said tube on the rectilinear portion of its characteristic curve irrespective of variations in the mean amplitude of the oscillations to be relayed including, an electron density limiting electrode located between said control grid and electron emission element, an additional circuit including a rectifier coupling said first-named circuit to said density limiting electrode and to said electron emission element, and means connecting said control grid to said rectifier to impress a supplemental potential from said rectifier on said control grid.

5. Means for relaying oscillations linearly irrespective of variations in the mean amplitude thereof including, an electron discharge tube having an electron emission element and a control grid, a transformer having a primary winding coupled to a source of oscillations, a circuit including the secondary winding of said transformer for applying oscillations from said source to the control grid and the electron emission element of said tube, means for biasing said control grid negative with respect to said emission element, and means for insuring operation of said tube on the rectilinear portion of its characteristic curve irrespective of variations in the mean amplitude of the oscillations to be relayed including, an electron density limiting electrode located between said control grid and electron emission element, an additional secondary winding on said transformer, an additional circuit including said additional secondary winding and a rectifier in series between the density grid and electron emission element of said tube, a capacity and a resistance connected in parallel with the impedance between the density grid and electron emission element of said tube and a connection between said control grid and a point on said resistance for supplying a supplemental potential produced by said rectifier to said control grid.

6. In a signalling system, an electron discharge tube having an anode, a cathode from which electron emission takes place, a control grid electrode and an auxiliary electrode which controls the density of the emission reaching said anode, means for controlling the conductivity of said tube including a source of varying potentials coupled between the control grid and cathode of said tube, means for maintaining said control grid at a fixed negative potential with respect to said cathode and means for distorting the effect of said varying potentials on the conductivity of said tube including a circuit connected to said control grid and coupled to said source of varying potentials and to said auxiliary electrode and cathode for applying a biasing potential which is characteristic of the amplitude of the varying potentials of said source of varying potentials between said auxiliary electrode and said cathode to control the density of the electron emission reaching said anode and for applying a supplemental direct current potential which is characteristic of said first named varying potential to the control grid of said tube.

7. A device as recited in claim 1 wherein said tube has an additional electrode and said additional electrode is maintained positive relative to said cathode.

8. A system as recited in claim 6 wherein said tube has an additional electrode and said additional electrode is maintained positive relative to said cathode.

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