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MODULATING MEANS

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Fig. 1

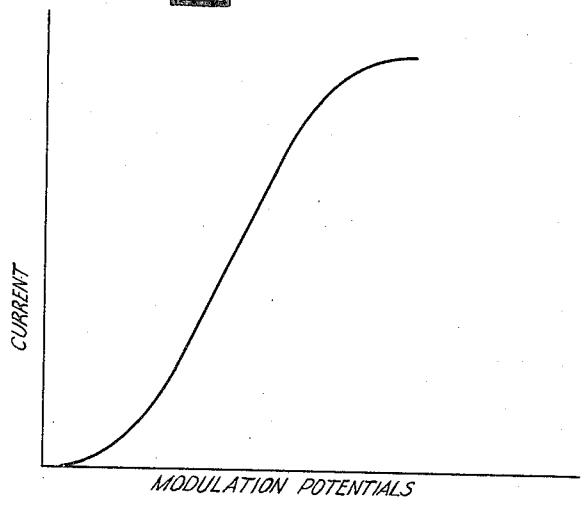
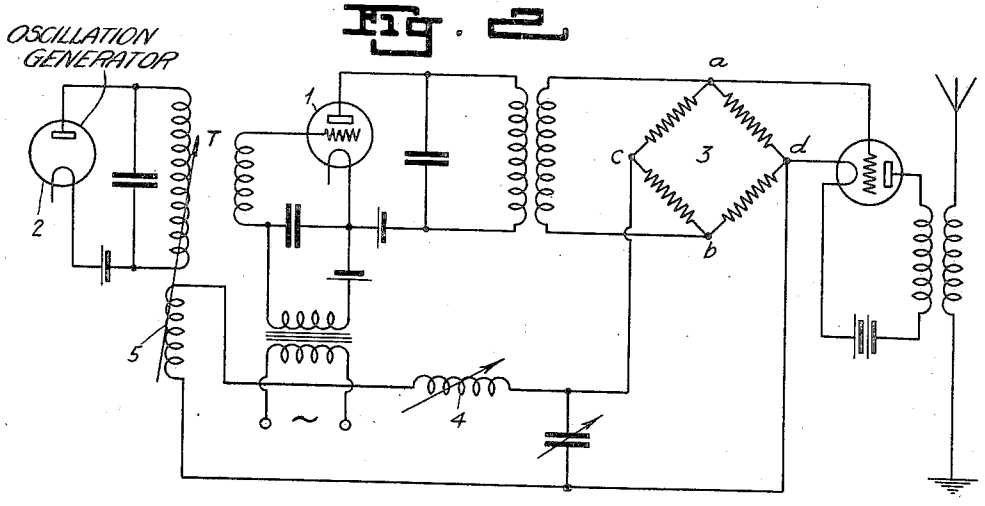



Fig. 2




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## MODULATING MEANS

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5 Claims. (Cl. 179—171)

This invention relates to a method of and arrangement for selective amplitude or phase modulation with variable modulation.

The object of the present invention is to provide a new and improved method of and means for producing phase or amplitude modulated oscillations, or both.

The manner in which this object is accomplished will be understood by reading of the following description, and therefrom when read with the drawing, in which:

Figure 1 is a curve illustrating the invention; while,

Figure 2 is an embodiment of the modulator.

In the use and operation of a transmitter or generator valve the demand frequently arises to be able to vary the degree of modulation after modulation has been effected, or else to be able to generate phase-modulated oscillations rather than amplitude-modulated waves.

Figure 1, by way of example, shows a modulation curve of a generator valve which presents a rectilinear portion only in its middle. In the presence of high modulations undesirable distortions are bound to arise owing to the curvature or knees of the curve. Now, in order that a high modulation may be secured also in the presence of a modulation curve of a kind as here shown, a more or less large part of the carrier wave, according to the present invention, is to be taken away (removed), whereas the size of the side-bands remains unaltered. What is essential in this connection is that the phase of the added wave should be in exact phase coincidence with the phase of the carrier wave. But if an oscillation is added to the carrier wave having a different phase position then the ensuing oscillation results in a component at right angles to the original carrier wave which, together with the side-bands, causes phase modulation. In other words, if energy including a side band resulting from amplitude modulation is combined with a new carrier of the same frequency as the original carrier or the original carrier and the phase of the new carrier or the original carrier is advanced or retarded with respect to the side band, a resultant will be obtained which lies between the side band and new carrier. Now, if the signal varies the amplitude of the carrier the combined side band will vary and the position of the resultant relative to the side band and the carrier will shift. This is phase modulation. For the production of pure phase modulation care must be taken so that the original carrier wave will be entirely extinguished and that only a component at right angles thereto remains.

One embodiment of this basic idea of the present invention is shown as incorporated in the circuit scheme Figure 2. Referring to the same, 1 denotes a separately controlled thermionic oscillation amplifier excited by generator 2 through windings T, or a generator valve whose oscillations, as well known in the art, are modulated in amplitude, e. g., by acting upon the grid biasing potential, it being understood that recourse could be had also to some other mode of modulation such as by acting upon the plate potential. The modulated oscillations are fed, for instance, to the points *a, b,* of a balanced bridge 3, whereas at the points *c, d,* of the said bridge, there is suitably applied an unmodulated oscillation derived from the pilot generator 2. By convenient tuning of the circuit 4 and proper coupling of the coil 5 to the pilot generator 2, the amplitude and phase of the added oscillation may be adjusted at will. Due to the combining of the carrier and side band energy there results, as pointed out hereinbefore, an oscillation, varied in degree of modulation, or phase-modulated. This resultant modulation is derivable at each of the four arms of the bridge, for instance, in arm *a, d,* from whence it may be utilized as shown.

In the rectification of a modulated oscillation of higher degree of modulation it is known to be difficult to suppress non-linear distortion of the audio frequency. In this instance, it is possible to diminish the degree of modulation by the addition of a carrier oscillation under proper phase conditions, whereby the rectifier effect is improved both in linear detectors, as well as in detectors operating on the basis of a square law.

Having thus described our invention and the operation thereof, what we claim is:

1. In a system for producing signal modulated waves of substantially constant amplitude, a thermionic tube having input and output electrodes, a source of high frequency oscillations connected with the input electrodes thereof, a source of signal potentials connected with said input electrodes, a bridge circuit, a circuit coupling opposed points on said bridge circuit to the output electrodes of said tube, a separate circuit including amplitude and phase regulating elements coupled between said high frequency source and another pair of opposed points on said bridge circuit, and a load circuit connected to said bridge circuit.

2. An arrangement for the selective use of amplitude modulation and phase modulation with

a variable degree of amplitude modulation and phase modulation comprising, a thermionic generator, a thermionic amplitude modulator coupled to said generator, an output circuit coupled to said modulator, said output circuit comprising a bridge having four arms, each arm of which comprises impedance, a coupling between one diagonal of said bridge and the output of said modulator, a circuit including phase shifting means coupled between said generator and the other diagonal of said bridge circuit, and a work circuit coupled with one arm of said bridge.

3. In a signalling system, a thermionic modulator tube having a source of high frequency oscillations and a source of modulating potentials coupled to its input electrodes to amplitude modulate said high frequency oscillations in said tube, a bridge circuit having one diagonal inductively coupled with the output electrodes of said modulator tube, a circuit for impressing oscillations of a frequency equal to the frequency of the oscillations from said source of high frequency oscillations on the other diagonal of said bridge circuit, means in said last named circuit for adjusting the phase and amplitude of the impressed oscillations to oppose and diminish the carrier frequency component in the energy of said bridge circuit resulting from said modulation to thereby increase the degree of modulation and to reduce distortion in the signal modulated wave, and a load circuit coupled to one arm of said bridge circuit.

4. Means for impressing amplitude and phase modulations on a carrier wave and for varying the amount of either of said types of modulation from substantially zero to maximum while varying the other of said types of modulation in the opposite direction comprising, a thermionic tube having anode, cathode and grid electrode, a circuit for applying carrier waves to be modulated and signal waves for such modulation to the grid and cathode of said tube, an output circuit connected between the anode and cathode of said tube, a bridge circuit including four arms each having an impedance, a circuit coupling opposed nodal points on said bridge to said output circuit, a circuit including tunable reactances connected to another pair of opposed nodal points on said bridge, said last named circuit including means on which said carrier wave may be impressed in varying amounts, and a utilization circuit connected with the impedance in one of the arms of said bridge.

5. Means as set forth in claim 4 in which said utilization circuit comprises a thermionic tube having its input electrode connected to the impedance of one of said arms.

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