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MODULATOR SYSTEM

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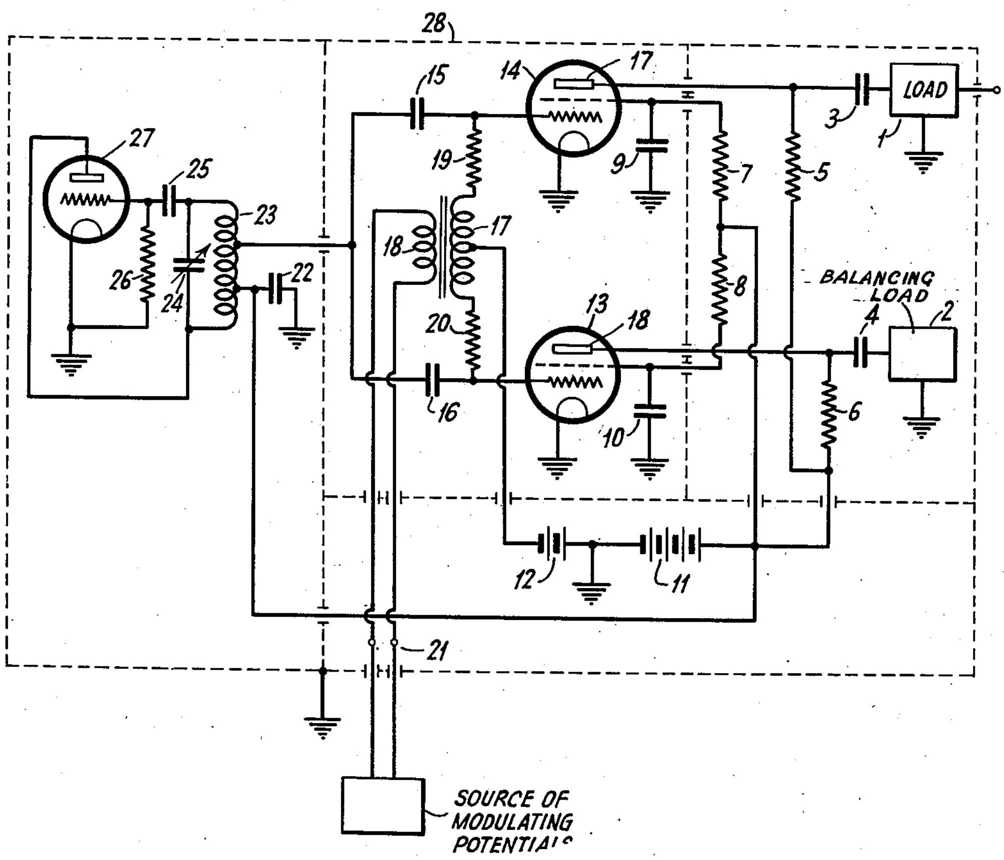

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MODULATOR SYSTEM

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6 Claims. (Cl. 250—17)

The object of this disclosure is to describe a method for producing amplitude modulation of the carrier output of an oscillator without simultaneously introducing a frequency modulation of said carrier.

In the past various circuits have been used to modulate the amplitude of the carrier output of a generator of high frequency oscillations but in a number of the devices used the amplitude modulation has been accompanied by modulation of the carrier frequency. This has been specially true of most of the standard signal generators produced for testing purposes. The device herein described makes it possible to modulate the amplitude of a high frequency carrier without such inherent reaction effects as would simultaneously affect the instantaneous frequency of the carrier.

In describing my invention more in detail reference will be made to the attached drawing wherein the single figure illustrates an amplitude modulator arranged in accordance with my invention and including means for maintaining frequency of the wave modulated constant during the modulation process.

Referring to the drawing, I have shown for sake of illustration a conventional type of vacuum tube oscillator consisting of parts 22, 23, 24, 25, 26 and 27. The output of this oscillator is applied by coupling condensers 16 and 15 in equal magnitude to the control grids of two vacuum tubes 13 and 14. Thus, the high frequency voltage on the control grids of 13 and 14 will be equal and in phase. The modulating voltage is introduced to the control grids of 13 and 14 in a differential manner through a transformer having a primary winding 17 and secondary winding 18. Thus the modulation frequency voltage applied to the control grid of tube 14 is equal to that applied to the control grid of 13 in amplitude but opposite in phase.

Two loads 1 and 2 are provided and are coupled by condensers 3 and 4, respectively, to the anodes 17 and 18 of tubes 14 and 13. One load may be used in or in connection with signaling and the other load may be artificial in that it is used merely for balancing purposes as will appear more in detail hereinafter or both loads may be used in signaling. For example, the load 1 may comprise an antenna coupling system or a line or an amplifier or repeater coupled with any load. Load 2 may be the same as 1 or a network electrically equivalent to 1. The constants of these two loads are electrically equivalent within close approximation. There will consequently appear in each load circuit high frequency voltage substantially modulated in amplitude only by the modulation voltage applied through terminals 21.

When the grid of vacuum tube 14 is modulated by the modulation frequency there occurs simultaneously a slight modulation of the effective grid impedance of this tube. This is a property inherent to the operation of the vacuum tube. This slight change of impedance tends to shift the carrier frequency of the oscillator. By providing tube 13 as shown and applying modulation frequency to it in phase opposition to that applied to tube 14 I produce a condition in which the impedance of the grid of vacuum tube 13 will be variable in phase opposition to the variations of grid impedance of tube 14 and by equal amounts. By this process the effective impedance presented to the oscillator is substantially constant and there will consequently be substantially no frequency modulation of the oscillator.

Tubes 13 and 14 may be of the screen grid type in which case it may be desirable to by-pass the screen grids through by-pass condensers 9 and 10. The type 89 tube was found to function nicely in positions 13 and 14 in a circuit on which experiments were conducted.

Resistors 19 and 20 are provided to present a high impedance at radio frequencies between the modulated grids and the transformer.

In a signal generator the load circuit may include the calibrated attenuator circuit. There would also be provided instruments for measuring the amount of voltage generated across the load circuit. There may also be included instruments for measuring the modulation frequency voltage applied to the modulated grids, thereby standardizing the percentage modulation.

Batteries are indicated as plate supply and bias supply. Obviously these voltages may be derived from other sources such as an alternating current rectifier or a generator.

In a signal generator the circuits would generally be enclosed in metallic shielding indicated at 28 in the drawing, for purposes of confining undesired radiations.

I claim:

1. In a system for modulating wave energy and for maintaining the frequency of the wave energy constant during such modulation, a source of wave energy of substantially constant frequency, a modulator system comprising a pair of electron discharge tubes having control electrodes connected in phase to said source of wave energy, means connecting corresponding electrodes of

said tubes in phase opposition to a source of modulating potentials, a signaling circuit connected to the output electrodes of one of said tubes and a circuit having characteristics similar to said signaling circuit connected to the output electrode of the other of said tubes, said tubes and circuits presenting a substantially constant total impedance to said source of wave energy during operation of said system.

2. In a system for modulating wave energy and for maintaining the frequency of the wave energy constant during such modulation, a source of wave energy of substantially constant frequency, a modulator comprising an electron discharge tube having an output electrode and having a control electrode coupled to said source of wave energy, and an electrode connected to a source of modulating potentials which varies the impedance of said tube and consequently the amplitude of said wave energy, an output circuit coupled to said output electrode to be energized solely by energy supplied from said output electrode, and means for compensating the effect of said variation in impedance on said source of wave energy comprising a second electron discharge tube having a control electrode coupled to said source of wave energy, an output electrode coupled with a circuit electrically equivalent to said output circuit, and having its impedance controlled in an opposite sense by said modulating potentials, whereby the total impedance presented by said tubes and circuits to said source of wave energy is substantially constant.

3. In a modulation system including means to modulate wave energy and to maintain the frequency of the modulated wave energy substantially constant, a source of oscillatory energy of substantially constant frequency, a signaling circuit, a separate balancing load circuit substantially electrically equivalent to said signaling circuit, a pair of electron discharge devices each having a control grid, an anode, and a cathode, a connection between the anode of one of said devices and said signaling circuit, a connection between the anode of said other devices and said balancing load circuit, a modulation frequency reactor connected between corresponding electrodes in said devices, means for applying modulating potentials to said reactor and a connection between the control grids of said devices and said source of oscillatory energy.

4. In a modulation system including means to modulate wave energy and to maintain the frequency of the modulated wave energy substantially constant, a source of oscillatory energy of substantially constant frequency, a signaling circuit, a separate balancing load circuit substantially electrically equivalent to said signaling circuit, a pair of electron discharge devices each having a control grid, an anode, and a cathode, a connection between the anode of one of said devices and said signaling circuit, a connection between the anode of said other devices and said balancing load circuit, a modulation frequency reactor connected by high resistances between corresponding electrodes in said devices, means for applying modulating potentials to said reactor, and means for applying oscillatory energy from said source in phase to the control grids of said devices.

5. In a modulation sytem including means to modulate wave energy and to maintain the frequency of the modulated wave energy substantially constant, a source of oscillatory energy of substantially constant frequency, a load circuit in which currents to be used for signaling are to be caused to flow, an artificial load circuit substantially electrically equivalent to said first load circuit, a pair of electron discharge devices each having a control grid, an anode, and a cathode, a connection between the anode of one of said devices and said first load circuit, a connection between the anode of the other of said devices and said artificial load circuit, a modulation frequency reactor connected by high resistances between corresponding electrodes in said devices, means for applying modulating potentials to said reactor, means for applying oscillatory energy from said source in phase to the control grids of said devices, and a shielding electrode between the control grid and anode of each device.

6. In a system for modulating wave energy and for maintaining the frequency of the wave energy constant during such modulation, a source of wave energy of substantially constant frequency, a source of modulating potentials a modulation system comprising an electron discharge tube having an output electrode, said tube having a control electrode connected to said source of wave energy, and an electrode connected to said source of modulating potentials which varies the impedance of said tube to thereby vary the amplitude of the wave energy appearing on said output electrode, an output circuit coupled to said output electrode to be energized by modulated wave energy supplied from said output electrode, and a second impedance connected with said source of wave energy of substantially constant frequency to present thereto an impedance effect which supplements the impedance effect presented to said source of wave energy by said discharge tube, and means for varying the impedance of said second impedance in a sense opposite to the variations of the impedance presented by said electron dicharge device to said source of wave energy to thereby present a total substantially constant impedance to said wave energy source and consequently maintain its frequency substantially constant.

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