Aug. 29, 1939. R. URTEL 2,171,151

CIRCUIT FOR AMPLITUDE MODULATION CARRIER WAVE

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Fig. 1

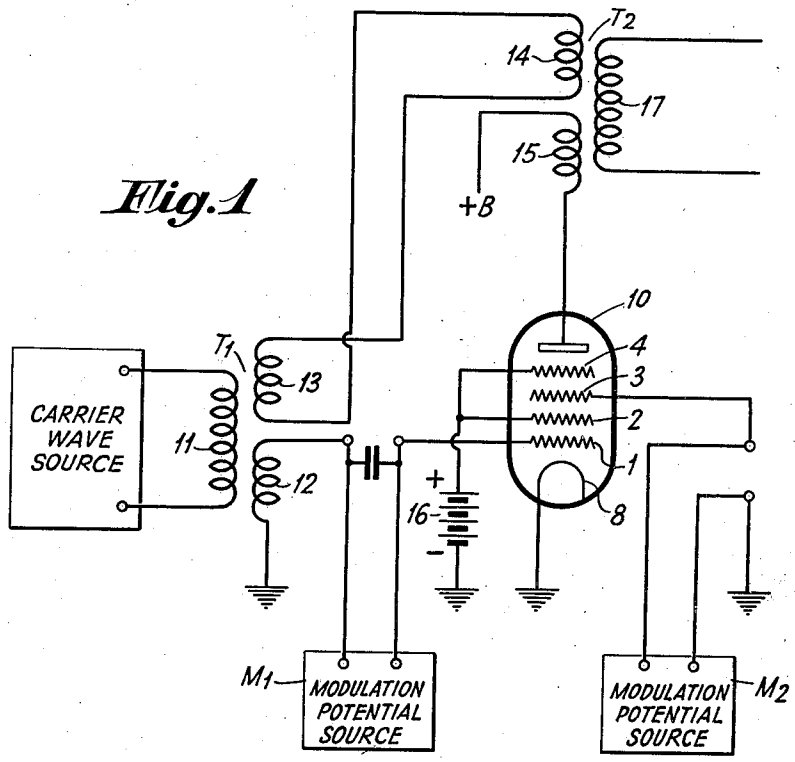
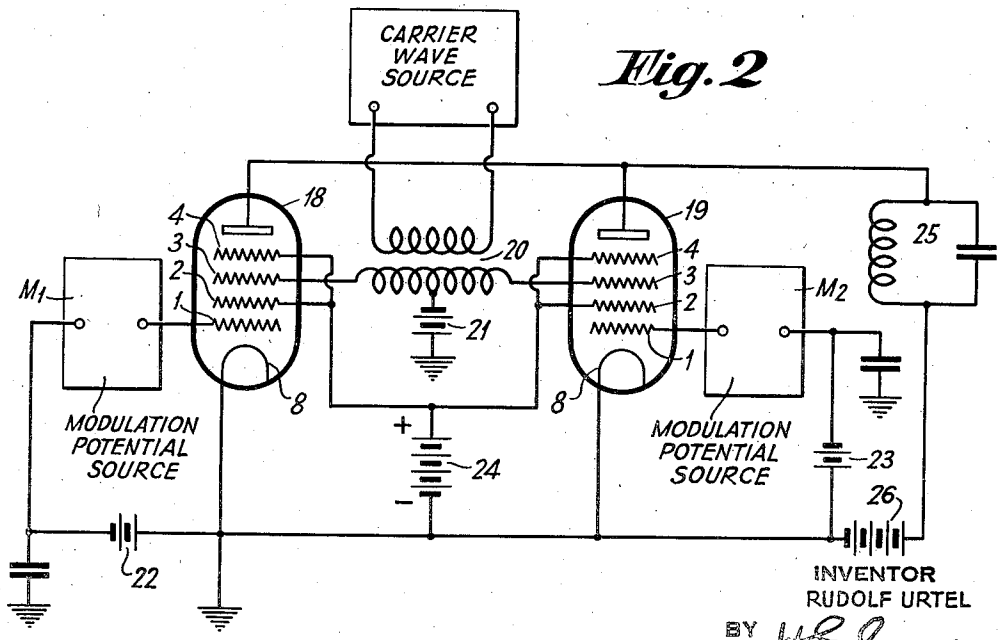


Fig. 2



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CIRCUIT FOR AMPLITUDE MODULATION CARRIER WAVE

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In Germany November 22, 1935

5 Claims. (Cl. 250—9)

The invention concerns a circuit arrangement for modulating the amplitude of a carrier wave and particularly an arrangement for television purposes of the type wherein appear alternating currents of the carrier frequency in phase opposition in two current branches disposed parallel to one another. The invention has further particular reference to the manner whereby several modulation potentials each occupying different bands of frequencies such as picture signals and background signals in television, may be impressed on a modulation arrangement of this type. The invention pertains to systems as disclosed in my United States application #95,519 filed August 12, 1936.

In accordance with the invention the modulation of the carrier wave with several potentials is to be accomplished in the manner that these potentials are fed to separate electrodes of discharge tubes disposed in one or both branches. In what follows two embodiments of the invention will be described as illustrated in Figures 1 and 2 of the drawing. In Figure 1 modulating potentials from two sources are impressed on wave energy by means of a single tube of the multielectrode type. In Figure 2 two tubes are arranged to modulate a wave by two controlling potentials.

10 in Figure 1 represents a hexode and T_1 and T_2 two transformers, the first being provided with one primary and two secondaries, the second with two primaries and one secondary. Primary 11 of transformer T_1 is fed by energy from a carrier frequency generator and the secondary 12 of this transformer is connected in series with a modulation potential source M_1 in the circuit between the cathode 8 and grid 1 of the hexode 10. The secondary 13 of the same transformer feeds the primary 14 of transformer T_2 whose primary 15 is connected in the plate circuit of hexode 10. The circuit of grid 3 of hexode 10 contains a second modulation potential source M_2 while grids 2 and 4 are connected to a suitable positive potential source 16.

The arrangement according to Figure 1 operates in the manner that the plate alternating current of tube 10 having carrier frequency is modulated with the frequencies of potential source M_1 and M_2 and that the fields of windings 14 and 15 have opposite action with respect to each other. Thus in the absence of modulating potentials the carrier portions in 15 and 14 oppose but are related and adjusted to produce a finite carrier with no modulation. In the presence of modulation potentials from say source M_1 the above condition no longer holds and modulated carrier energy modulated in accordance with potentials from M_1 goes out. Now if modulating potentials from M_2 are impressed on grid 3 the carrier in 17 is also modulated in accordance with said potentials. A potential of carrier frequency may therefore be taken from secondary 17, modulated to a higher degree from the plate alternating current of tube 10.

In contrast to the arrangement illustrated in Figure 1, the scheme shown in Figure 2 provides controllable discharge tubes, again hexodes 18 and 19, in both branches connected in parallel. The carrier frequency potential is fed in phase opposition to grids 3 through a transformer 20 whose secondary midpoint is grounded by way of a negative biasing potential source 21. The two modulation potential sources M_1 and M_2 are disposed in the circuits of grids 1 of both tubes and are connected in series with a negative biasing potential sources 22 and 23. Grids 2 and 4 of both tubes are impressed with a suitable positive potential by potential source 24. In the joint plate current branch is connected a current resonance circuit 25, tuned to carrier frequency, and a plate potential source 26.

This arrangement operates in the manner that a plate alternating current appears in each of the two tubes modulated with the frequency of M_1 and M_2, the two plate alternating currents being in phase opposition.

If sources 22 and 23 are equal and the tubes are of like characteristics in the absence of modulating potentials the carrier wave is substantially suppressed in the circuit 25. However, if as pointed out in my United States application #95,519 filed August 12, 1936, the sources 22 and 23 are made unequal then in the absence of modulating potentials one tube amplifies more than the other and a finite carrier frequency potential arises across the parallel resonant circuit 25 even in the absence of modulating potentials from M_1 and M_2. If then modulating potentials are set up on grid 1 by M_1 but not by M_2 the plate alternating current of tube 19 will not be modulated while that of 18 will be modulated. In the presence of modulating potentials at M_1 and M_2 an alternating potential of carrier frequency will appear in current resonance circuit 25, resulting from the difference of the plate alternating currents of the two individual tubes and this alternating potential will be modulated in accordance with the modulating potentials of M_1 as well as of M_2.

The connection proposed in accordance with

invention of the modulation potential sources to separate electrodes is worthy of notice for the reason that the possibility is thereby insured to ground each modulation potential generator one-sided so that all interferences are completely avoided that occur if several modulation potential sources must be connected in series to each other in the circuit of a control grid.

I claim:

1. In a signalling system, a pair of electron discharge tubes each having an anode and a plurality of auxiliary electrodes, means for applying wave energy in phase opposition to like auxiliary electrodes in said tubes, means for applying a plurality of sources of different modulating potentials each of said modulating potentials occupying a different frequency band to corresponding auxiliary electrodes in said tubes, and an output circuit connected to the anodes of said tubes.

2. In a modulation system, a pair of electron discharge tubes each having a cathode, an anode and a controlling electrode, means for applying wave energy to be modulated in phase opposition to said controlling electrodes, an alternating current circuit connecting the anode to cathode impedances of said tubes in parallel whereby the wave energies impressed on the controlling electrodes of said tubes oppose in said alternating current circuit, means for impressing separate operating potentials on corresponding electrodes of said tubes to control amplifying characteristics of said tubes so that the resultant wave energy appears in said alternating current circuit, and means for impressing plurality of sources of different modulating potentials each of said modulating potentials occupying a different frequency band on the controlling electrodes of said tubes.

3. In a modulation system, a pair of electron discharge tubes each having a cathode, an anode and a plurality of grid electrodes, means for applying wave energy to be modulated in phase opposition to like grid electrodes in said tubes, means tying the anodes of said tubes together, means tying the cathodes of said tubes together, an alternating current circuit connected between the anodes of said tubes and the cathodes of said tubes whereby the wave energy impressed on the grids of said tubes oppose in said alternating current circuit, means for impressing separate operating potentials on corresponding grid electrodes of said tubes to control amplifying characteristics of said tube so that resultant wave energy appears in said alternating current circuit, a source of modulating potentials of a predetermined frequency band connected with a grid of one of said tubes, and a second source of modulating potentials occupying a frequency band different from said predetermined frequency band connected with a grid of the other of said tubes.

4. A system as recited in claim 2 wherein the modulating potential sources are each grounded at one terminal.

5. A system as recited in claim 3 wherein the modulating potential sources are each grounded at one terminal.

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