Aug. 20, 1940. K. STEIMEL ET AL 2,211,939

MODULATION SYSTEM

Filed June 24, 1938

Fig. 1

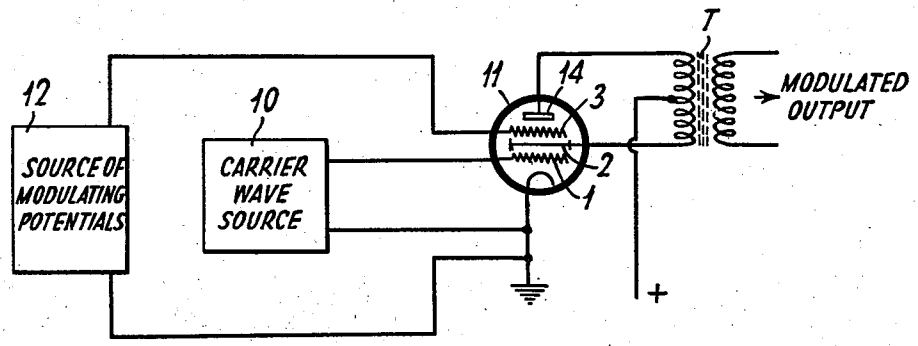
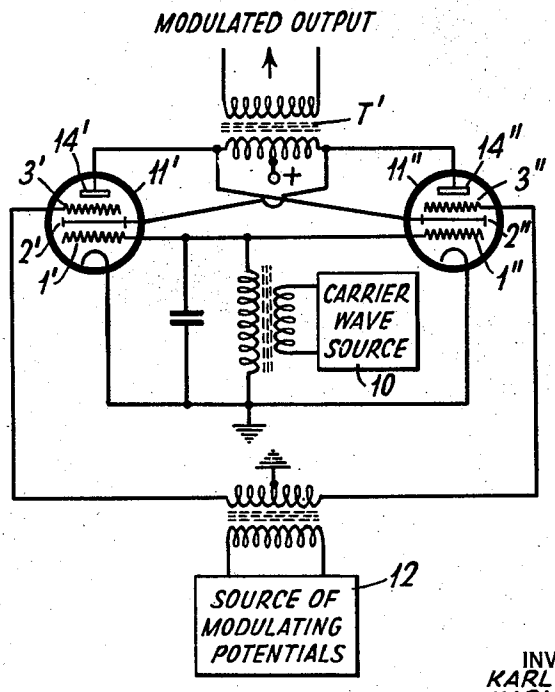


Fig. 2



INVENTORS
KARL STEIMEL
KARL WILHELM
BY H. S. Glover
ATTORNEY

Patented Aug. 20, 1940 2,211,939

UNITED STATES PATENT OFFICE

2,211,939

MODULATION SYSTEM

Karl Steimel and Karl Wilhelm, Berlin, Germany, assignors to Telefunken Gesellschaft für Drahtlose Telegraphie m. b. H., Berlin, Germany, a corporation of Germany

Application June 24, 1938, Serial No. 215,573
In Germany July 3, 1937

3 Claims. (Cl. 179—171.5)

This application concerns a circuit arrangement for distortion-free modulation.

At modulation with ordinary tube modulation circuits distortions appear at a high degree of modulation in view of the fact that the modulation characteristic has a bend at its lower end. It is known as such to eliminate this disadvantage in that instead of varying from zero onwards the steepness of a tube by means of the modulation frequency, the difference of the steepnesses of a tube arrangement is influenced. In this known circuit (German Patents #550,512 and #620,922) the high-frequency is impressed in push-pull upon the control grids of two double grid tubes and is modulated only at the space charge grid of the one tube. The modulated frequency is derived in parallel from both tubes. The biasing potentials of the two space charge grids are chosen such that in the state of rest the desired carrier amplitude appears in the output.

The invention shows the way of attaining the same end with a single tube and the manner of obtaining a completely symmetrical circuit by means of two tubes.

In accordance with the invention a tube having at least three grids serves as modulation tube in utilizing the mentioned principle and in such a manner that the carrier frequency is applied to the control grid and the modulation frequency is applied to the distribution grid, and that the modulation product is derived in push-pull from the anode and from the positively biased grid situated between the control grid and the distribution grid and adjacent the latter.

The invention will now be described in greater detail on hand of the figures. Figure 1 shows the circuit in its simplest form, and Figure 2 shows the improved circuit for attaining complete symmetry.

In describing my invention reference will be made to the attached drawing wherein:

Figure 1 shows a single tube; and

Figure 2 shows a two tube modification of my novel modulating means including the distortion reduction features described briefly above.

In Figure 1 high frequency energy from source 10 is impressed upon the control grid 1 of tube 11 and the audio frequency from source 12 upon the distribution grid 3, while the modulation product is derived by means of the push-pull transformer T which is connected at the primary winding side between the anode 14 and the screen grid 2. The lower end of this transformer may instead, be connected to another positively biased grid placed between the grids 2 and 3, since it is desirable that the distribution grid 3 distributes the high frequency current between the anode and a preceding grid. Since in relation to the secondary winding the two halves of the primary winding of the transformer act in opposition, the secondary potential corresponds to the difference of the high frequency currents passing to the grid 2 and to the anode. The difference of the high frequency potentials at the primary winding depends on the biasing grid potential of the distribution grid 3 and upon the location of the tap point at the transformer T. Ordinarily, the grid biasing potential of the distribution grid will be set such that there appears at the secondary side the desired mean amplitude of the carrier frequency from which amplitude the modulation is carried out upwards and downwards. However, the grid biasing potential may also be so chosen that in the state of rest no carrier frequency appears in the output. Then a modulation with suppressed carrier wave appears which is carried out normally through a push-pull circuit by means of two tubes.

The circuit according to Figure 1 has the further advantage that as viewed from the anode and from the screen grid, the inner resistances are different and therefore the halves of the primary winding have different loads. This difference between the inner resistances furthermore depends on the potential of the distribution grid 3, so that the damping of an oscillatory circuit connected to the output side is not constant. For this reason in Figure 2 the push-pull outputs of both tubes are placed cross-wise in parallel so that each half of the primary winding is loaded with both inner resistances, namely always with one of the two tubes. In order that the control still takes place in the proper sense, the distribution grids 3' and 3'' are controlled in push-pull and the control grids 1' and 1'' in synchronism.

The two circuits were found to give favorable results when utilized for instance in measuring transmitters.

We claim:

1. In a modulation system, a source of wave energy to be modulated, a source of modulating potentials, a tube having a cathode, an output electrode, a control grid, an additional grid electrode and an auxiliary electrode, said additional grid being located between said output electrode and said auxiliary electrode, means for applying wave energy to be modulated to said control grid, means for deriving wave energy output from said

output electrode and said auxiliary electrode, and means for applying modulating potentials to said additional electrode located between said output electrode and said auxiliary electrode to control the respective portions of output wave energy derived from said output electrode and said auxiliary electrode in accordance with said modulating potentials.

2. In a system for combining two alternating currents of different frequency to produce other currents of a third frequency, an electrode discharge device having a cathode, a control grid, an auxiliary grid and an output electrode on each side of said auxiliary grid, an output circuit responsive to said third frequency connecting said output electrodes in push-pull relation, means for impressing one of said alternating currents between said control grid and cathode and means for impressing the other of said alternating currents between said auxiliary grid and cathode.

3. In a system for combining two alternating currents of different frequency to produce other currents of a third frequency, the amplitude of which is linearly related to the amplitude of one of said alternating currents, a pair of electron discharge devices each having a cathode, a control grid, an auxiliary grid and two output electrodes one on each side of said auxiliary grid, an output impedance responsive to said third frequency, means including said impedance connecting the output electrodes of each of said devices in push-pull relation, means for impressing one of said alternating currents in push-pull relation between said auxiliary grids, and means for impressing the other of said alternating currents between said control grids and cathodes, said last named alternating current being impressed in phase on said control grids.

KARL STEIMEL.
KARL WILHELM.