Dec. 10, 1935. A. COTTET 2,023,780

MODULATION

Filed April 30, 1932

Fig. 1

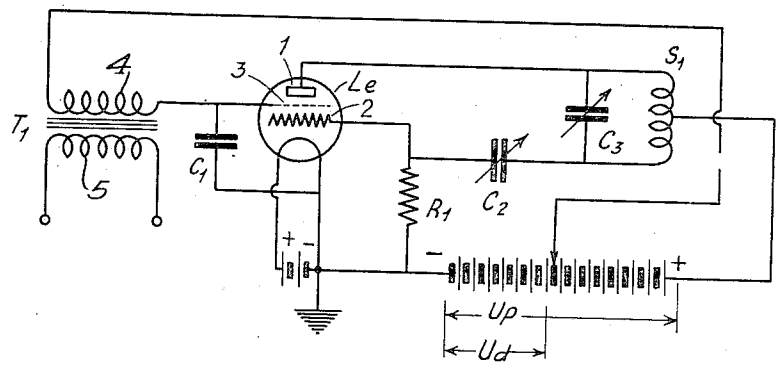


Fig. 2

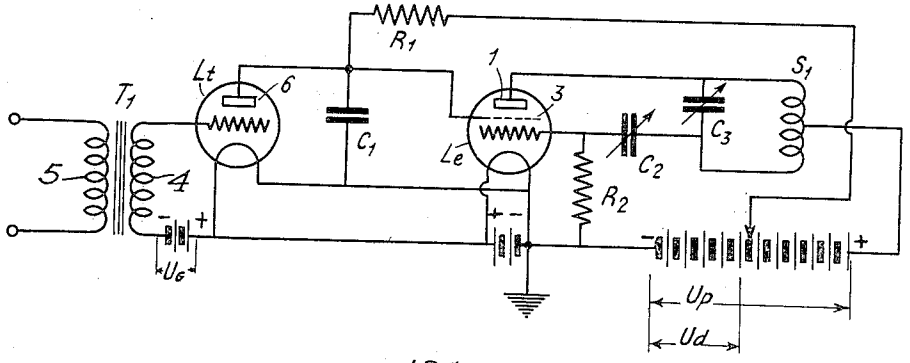
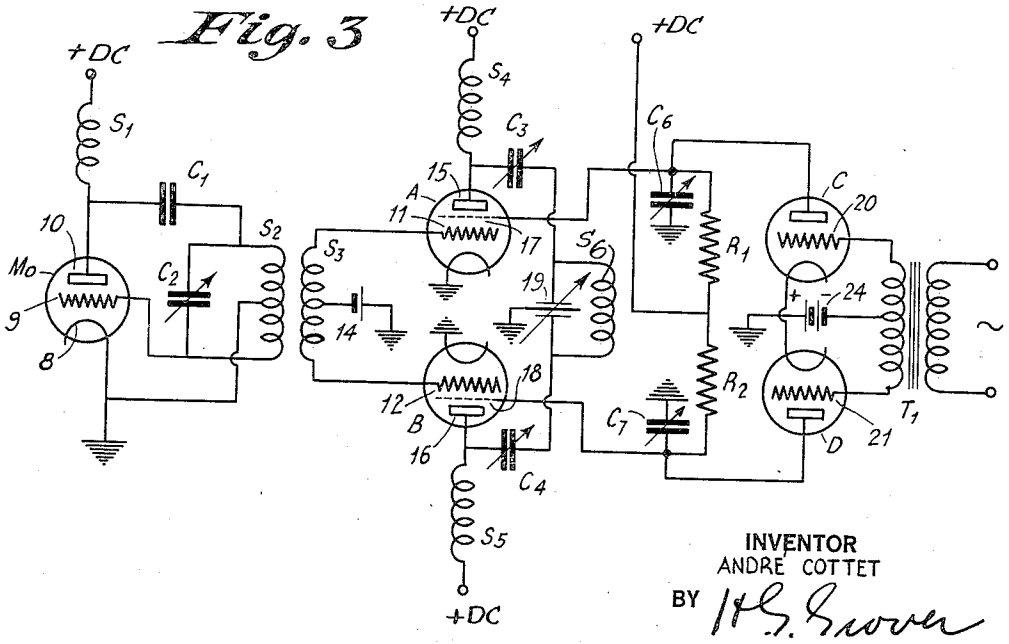


Fig. 3



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MODULATION

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2 Claims. (Cl. 179—171)

The present invention is concerned with ways and means for modulating oscillations generated or amplified, or relayed, by the aid of screen-grid tubes.

It is known that what is meant by screen-grid tubes, as used herein, are tubes comprising a plurality of electrodes, one of which is supplementary in nature and known as the "screen grid electrode". In general this electrode is maintained at a positive potential of a value substantially equal to the potential of the anode, though generally lower, which is interposed between the control electrode and the anode.

The invention consists essentially in superposing by any well known means a potential produced by current of microphonic frequency upon the direct current potential supplied to the screen grid electrode.

The invention will be more readily understood by reference to the accompanying drawing and the detailed description thereof which follows.

In the drawing Figure 1 shows an oscillation generating circuit including means for applying signal modulations to the generated oscillations. In this figure a single tube of the screen grid type is connected in a novel manner to develop oscillations and modulate the same; while,

Figures 2 and 3 show modifications of the arrangement of Figure 1. In Figure 2 means is added for amplifying the modulating potentials, while in Figure 3 separate means is provided for producing the oscillations which are amplified and modulated by amplified modulating potentials. These embodiments of the basic idea are shown by way of illustration and are not intended to limit the invention, except as otherwise indicated in the claims appended hereto.

When screen grid tubes are employed in a radio frequency oscillator scheme, whether it be of the self-exciting type or comprising radio frequency amplification, it will be noted that the efficiency of the arrangement depends essentially:

(1) upon the potential fed to the screen grid;

(2) the discharge capacity of this screen grid electrode relative to the neutral point of the arrangement;

(3) upon the value of the resistance interposed between the negative pole of the screen grid potential and the said screen grid electrode.

Now, this property is utilized by this invention. In fact the screen grid of the tube is employed for the purpose of modulating the radio frequency oscillation generated by the said tube or imparted to the grid thereof by an oscillator arrangement associated with this tube.

Figure 1 indicates, by way of example, one embodiment of the arrangement according to the invention.

The screen grid tube L_e is disposed oscillator fashion in accordance with a scheme known in the prior art of triodes by the interposition between the anode 1 and the control grid 2 of an oscillation circuit comprising the inductance coil S_1 and condenser C_3, with blocking condenser C_2 and leak resistance R_1. The direct current plate potential U_p, being the aggregate potential of the anode source, is applied to the anode 1. A potential U_d, which is a fraction of the total potential, is fed to the screen grid 3 by way of the secondary winding 4 of the transformer T_1, which winding is disposed between the positive pole of the screen grid potential and the screen grid while condenser C_1 discharges the screen grid to ground. Modulating frequencies are impressed on the primary winding 5 of the transformer T.

In the scheme shown in Figure 2 the screen grid potential lead from source U_d serves at the same time for the positive polarization of the anode 6 of a triode tube L_t fed with audio frequency oscillations from the transformer T_1. The source U_g denoting the grid polarizing battery of the triode. The audio frequency potentials are then fed to the screen grid of the oscillator tube by means of a resistance R_1 interposed between the positive pole of the screen grid potential and the leak (discharge) condenser C_1 of the screen grid to the neutral point.

In this arrangement the value (size) of the capacity C_1 is of high importance looked at from the viewpoint of the amplitude curve, the frequency of the arrangement, as well as the rate of modulation.

The carrier frequency oscillations modulated at signal frequency appear in the circuit S_1, C_3 of Figures 1 and 2, from which circuit they may be utilized in any manner.

The arrangement last described and shown in Figure 2 is very broadly similar to the invention disclosed in Gunn's application No. 330,579, filed January 5, 1929, and in Peterson's application No. 360,631, filed May 6, 1929.

Where more stable operation at greater powers is desired, applicant provides a novel circuit including an oscillation generator and a balanced relay stage utilizing auxiliary electrode tubes through the screen grid electrodes of which the signals relayed in the stage are modulated. This stage in turn supplies energy to a second symmetrical stage wherein the modulated signals are amplified. A more complete understanding

of this modification of applicant's invention will be had by reference to Figure 3.

In Figure 3 MO is a thermionic oscillator having a heated filament 8, a control grid 9, and an anode 10. Oscillations are produced by means of an oscillation circuit C_1, S_2 and C_2 connected between the anode and control electrodes and completed by means of a lead connecting a point on the inductance S_2 to the filament. Charging potential for the anode 10 is supplied by a choking inductance S_1 from any source of potential not shown. The output inductance S_2 is coupled with a symmetrical inductance S_3 having its terminals connected to the grids 11 and 12 of thermionic tubes A and B respectively. Biasing potential is supplied for this input circuit by means of a source 14 connecting the electrical center of inductance S_3 to ground, the grid circuits being completed by way of the filaments which are also grounded. Potential for the anodes 15 and 16 of tubes A and B respectively is supplied through inductances S_4 and S_5 respectively from any source of potential not shown. The output electrodes 15 and 16 are connected through series capacities C_3, C_4 and inductance S_6. Symmetry of the output circuits is insured by means of a balancing condenser 19 having three electrodes, one of which is grounded and the other two of which are connected to the anodes 15 and 16. The high frequency oscillations relayed in the tubes A and B respectively are modulated by means of modulating frequency oscillations impressed on the screen grid electrodes 17 and 18 of tubes A and B respectively, from the output circuits of tubes C and D respectively. This is accomplished by connecting the control electrodes 20 and 21 of tubes C and D respectively with the secondary winding of a transformer T_1, the primary winding of which is supplied with modulating frequencies. These modulating frequencies are amplified in the tubes C and D respectively and appear in the anode cathode circuits thereof. The modulating frequencies flowing through the resistances R_1, R_2 produce potential variations therein at the modulating frequency. These potential variations are applied from the terminals of resistances R_1, R_2 to the screen grid electrodes 17 and 18 of tubes A and B respectively. Biasing potential for the input circuits of tubes C and D is supplied by means of a biasing battery 24. In order to balance the output circuit of the tubes C and D and the screen grid circuits of tubes A and B with respect to ground, applicant provides variable capacity C_6 and C_7 connected between the anodes of tubes C and D respectively and ground.

In operation of the arrangement shown in Figure 3, high frequency oscillations are generated in MO, impressed on the tubes A and B, and amplified or relayed therein. Voice frequencies set up in the secondary winding of T_1 from any source are impressed on tubes C and D wherein they are amplified and the current repeated in the output circuits of tubes C and D, which is representative of the modulating frequencies, is utilized to produce potentials which are applied to the screen grids of the relay tubes A and B. Varying of the potential on the screen grids varies the anode cathode impedance of the tubes. This variation is at signal modulating frequency and therefore the carrier wave relayed in tubes A and B is modulated at signal frequency and appears in the circuit C_3, C_4, S_6, from whence it may be utilized in any manner.

It will be understood that the invention is susceptible to a great number of modifications in addition to those herein disclosed. It is especially adapted to various oscillator, amplifier, or relay schemes used in screen grid tubes.

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

1. A push-pull thermionic relay comprising, a pair of four-electrode tubes symmetrically arranged, a symmetrical input circuit connecting the control electrodes of said tubes, an output circuit including series capacities and an inductance connected between the output electrodes of said tubes, means for balancing said output circuit with respect to ground comprising a three-electrode condenser having one terminal connected to ground and the other terminals connected to the ends of said inductance, a source of modulating potentials, a pair of thermionic tubes in push-pull relation having their input circuits symmetrically connected with said source of modulating potentials, series resistances connected between the output electrodes of said last named pair of tubes, and a connection between the screen grid electrode in each of said first named tubes and a different point on said resistances.

2. A modulation system comprising, a pair of thermionic tubes each having an anode, a cathode, a control grid and an auxiliary grid-like electrode, a circuit which may be energized by carrier frequency waves connected between the control grids and cathodes of said tubes, an output circuit including variable capacitive reactances and an inductance in series between the anodes of said tubes, means for balancing said output circuit with respect to ground comprising a capacity having one armature connected to the anode of one of said tubes and the other armature connected to the anode of the other of said tubes, and an additional plate located in the potential gradient between said armatures connected to the cathodes of said tubes, and means for modulating the carrier frequency waves which may be applied to the input electrodes of said tubes comprising, a pair of resistive impedances connected in series between the auxiliary grid-like electrodes of said tubes, a source of modulating potentials connected in parallel with said resistive impedances, and means for balancing said modulating circuit and said auxiliary grid-like electrodes with respect to each other and to the cathodes of said tubes comprising a variable capacity connecting each of said auxiliary grid-like electrodes to the cathodes of said tubes.

ANDRÉ COTTET.