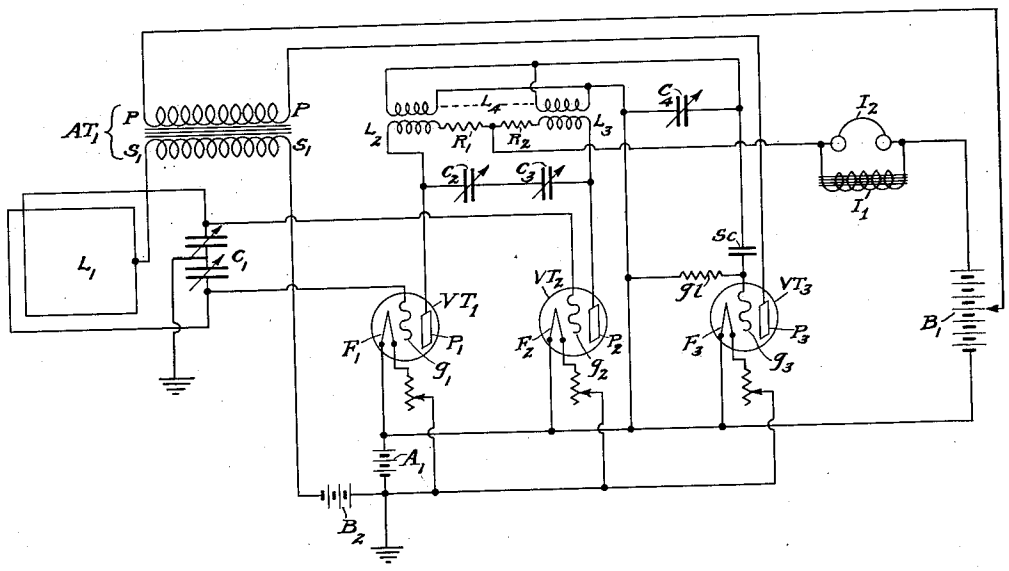
June 5, 1928. 1,672,037

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METHOD OF AND APPARATUS FOR AMPLIFYING ELECTRICAL CURRENTS

Filed March 12, 1924



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REISSUED

Patented June 5, 1928. 1,672,037

UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR AMPLIFYING ELECTRICAL CURRENTS.

Application filed March 12, 1924. Serial No. 698,680.

While my invention relates generally to the amplification of electrical currents it has for a particular object the amplification of high frequency electrical currents modulated at low or audible frequency.

A particular object of the invention is the efficient amplification of the currents at high frequency and having so amplified the currents to reduce them to low frequencies and further amplifying the low frequency currents in the presence of the high frequency currents, using the same amplifying devices for the dual function.

My invention will be best understood by reference to the accompanying drawing in which it is illustrated in the figure employed as an amplifier in a receiving system for radio.

L_1 represents a coil or loop receiver having a capacity tuning arrangement illustrated by C_1. As the capacity C_1 I preferably employ an air condenser having two sets of fixed plates and one set of movable plates. The movable plates are controlled by one shaft and since these plates are of a low potential at all times, I have grounded them as shown in order to eliminate any stray capacity effects in the manipulation of the tuning of the resonant circuit. Two three-electrode vacuum tubes VT_1 and VT_2 have their grids g_1 and g_2 connected to opposite sides of the capacity C_1. The grounded filament lead to these tubes is connected to approximately the mid point of the coil L_1 through the secondary S_1 of audio frequency transformer AT_1. This lead also includes a biasing battery B_2 to apply a negative potential to the leads of the vacuum tubes of a chosen value to obtain efficient amplification. The plate circuits of tubes VT_1 and VT_2 are supplied with a source of energy B_1 which causes currents to flow through choke coil I_1 and telephone receiver I_2, resistances R_1 and R_2, tuned circuit consisting of inductances L_2 and L_3 with condensers C_2 and C_3, and through plates P_1 and P_2 back to filaments F_1 and F_2 to battery B_1. Inductively coupled to tuned circuit L_2, L_3, C_2 and C_3 is another tuned circuit containing inductances L_4 and condenser C_4. One side of this tuned circuit is connected to filament F_3 of a vacuum tube VT_3 and the other side to the grid g_3. The vacuum tube VT_3 is connected for rectification, having stopping condenser SC and grid leak gL, and not including a biasing potential on the grid. The plate P_3 of this tube is connected to the source of energy B_1 through the primary p of audio frequency transformer AT_1, and the circuit is completed through the filament F_3. The plate circuit connection to the battery B_1 is shown as variable as the detector or rectifying tube does not require as much plate potential as do the amplifying tubes VT_1 and VT_2. The filaments of the tubes are supplied with heating current from the battery A_1 in the usual manner. The condensers C_2 and C_3 are preferably arranged as described in connection with capacity C_1. The choke coil I_1 is not essential but I find it preferable to permit a larger current flow in the plate circuit of the vacuum tubes VT_1 and VT_2 than is ordinarily obtainable through the impedance of telephones or loud speaking devices I_2. It is not essential to employ a tuned coupling between the plate circuits of vacuum VT_1 and VT_2 and the grid circuit of the vacuum tube VT_3 the tuned coupling I have shown being replaceable by an ordinary radio frequency transformer or other suitable transfer device, but such devices are not as selective as the tuned coupling I have shown. The resistances R_1 and R_2 are for the purpose of restricting the tendency of the vacuum tubes to create oscillations in tuned circuits, and these resistances should be chosen of such value to just overcome this tendency so as not to destroy the amplitude of the amplified currents.

The operation of the system is as follows:

Signals are received on tune circuits L_1C_1 acting as a collector. The signal currents being of an oscillatory nature charge grids g_1 and g_2 of the amplifier tubes VT_1 and VT_2 alternately with equal and opposite potentials. By means of the biasing battery B_2 the grids are worked at a most efficient potential for amplification. The highly amplified currents are joined in the common plate circuit through the connection between the inductances L_2 and L_3. This amplified current is in its high frequency form and is transferred to the detector tube VT_3 by inductive coupling between coils L_2 and L_3 and resonant circuits L_4C_4. In the vacuum tube VT_3 the amplified currents are converted into low frequency currents through the rectifying action of the tube and its connections, these low frequency currents being characteristic of the modulations in the high frequency currents. The low frequency cur-

rents flowing through the plate circuit of the detector tube VT_3 also flow through the primary or low frequency transformer AT_1 and induce current in the secondary S_1 of this transformer. This induced current then acts upon the grids g_1 and g_2 of the amplifier tubes VT_1 and VT_2, causing these tubes to act as audio frequency amplifiers to actuate the telephones I_2 with amplified low frequency currents.

Having described my invention I claim:

1. The method of amplifying high frequency electrical currents modulated at audible frequencies which consists of converting the high frequency currents into a plurality of high frequency currents out of phase with each other, amplifying these high frequency currents in two parallel vacuum tube circuits, combining the amplified currents, reducing the combined currents to audible frequency currents corresponding to the modulations of the high frequency currents transferring the audible frequency currents to the radio frequency circuits and amplifying said audible frequency currents through the high frequency amplifying circuits.

2. The method of reducing high frequency electrical currents modulated at low frequencies to amplified low frequency currents characteristic of said modulations which consists of converting the said high frequency currents into opposite currents differing 180 degrees in phase with each other, employing the alternating high frequency potentials of said converted currents to produce amplified high frequency currents, combining the amplified currents, reducing the resultant amplified currents to low frequency currents corresponding to the modulations thereof, and amplifying said low frequency currents simultaneously with the amplication of subsequent high frequency currents.

3. In a system for receiving and amplifying electrical currents a pair of three electrode vacuum tubes, means for receiving high frequency electrical currents, means for converting the said high frequency currents into opposite currents differing in phase with each other, means for applying the varying potentials of said opposite currents to the grids of said tubes, means for combining the resultant plate currents of said tubes, means for rectifying said combined currents to produce low frequency currents, and means for returning said low frequency currents to said vacuum tubes for further amplification in low frequency form.

4. In a system for receiving and amplifying electrical currents a pair of three electrode vacuum tubes, means for receiving high frequency electrical currents, means for converting the said high frequency currents into opposite currents differing 180 degrees in phase with each other, means for applying the varying potentials of said opposite currents to the grids of said tubes, means for combining the resultant plate currents of said tubes, means for rectifying said combined currents to produce low frequency currents and means for returning said low frequency currents to said vacuum tubes for further amplification in low frequency form.

5. In a receiving and amplifying system including a plurality of vacuum tubes having filaments, grids and plates and sources of power therefor, the combination of an input coil having a central tap, one terminal of the input coil connected to the grid of one vacuum tube, the other terminal of the input coil connected to the grid of a second vacuum tube, a tuning condenser in parallel with the input coil, a connection between the central tap of the input coil and the filaments of the vacuum tubes including the secondary of an audio transformer, the plates of the first and second vacuum tube connected together through an inductance, a tuning condenser in parallel with the inductance, a tap centrally located with respect to the terminals of the inductance, a connection from the tap through an indicating device and a source of plate power to the filaments of the vacuum tubes, an inductance coupled to the inductance in the plate circuits of the first and second vacuum tubes, a tuning condenser for this inductance, one terminal of this inductance coupled to the grid of a third vacuum tube functioning as a detector, the other terminal of this inductance connected to the filaments of the vacuum tubes and the plate of the detector tube connected through the primary of the audio frequency transformer and the source of plate power to the filaments of the vacuum tube.

6. In a receiving and amplifying system including a plurality of vacuum tubes having filaments, grids and plates and sources of power therefor, the combination of an input coil having a central tap, one terminal of the input coil connected to the grid of one vacuum tube, the other terminal of the input coil connected to the grid of a second vacuum tube, a plurality of tuning condensers in parallel with the input coil, a connection between the central tap of the input coil and the filaments of the vacuum tubes including the secondary of an audio transformer, the plates of the first and second vacuum tube connected together through a plurality of inductances, a plurality of tuning condensers in parallel with the inductances, a tap between the inductances, a connection from the tap through an indicating device and a source of plate current to the filaments of the vacuum tubes, a plurality of inductances coupled to the induc-

tances in the plate circuits of the first and second vacuum tubes, a tuning condenser for these inductances, one terminal of these inductances coupled to the grid of a third vacuum tube functioning as a detector, the other terminal of these inductances connected to the filaments of the vacuum tubes and the plate of the detector tube connected through the primary of the audio frequency transformer and the source of plate power to the filaments of the vacuum tubes.

7. In a receiving and amplifying system including a plurality of vacuum tubes having filaments, grids and plates and sources of power therefor, the combination of an input coil having a central tap, one terminal of the input coil connected to the grid of one vacuum tube, the other terminal of the input coil connected to the grid of a second vacuum tube, a plurality of tuning condensers in parallel with the input coil, the central element of the tuning condensers being grounded, a connection between the central tap of the input coil and the grounded filaments of the vacuum tubes including the secondary of an audio transformer, the plates of the first and second vacuum tubes being connected together through an inductance, a tuning condenser in parallel with the inductance, a tap centrally located with respect to the terminals of the inductance, a connection from the tap through an indicating device and a source of plate current to the filaments of the vacuum tubes, an inductance coupled to the inductance in the plate circuits of the first and second vacuum tubes, a tuning condenser for this inductance, one terminal of this inductance coupled to the grid of a third vacuum tube functioning as a detector, the other terminal of this inductance connected to the filaments of the vacuum tubes and the plate of the detector tube connected through the primary of the audio frequency transformer and the source of plate power to the filaments of the vacuum tubes.

8. In a receiving and amplifying system including a plurality of vacuum tubes having filaments, grids and plates and source of power therefor, the combination of an input coil having a central tap, one terminal of the input coil connected to the grid of one vacuum tube, the other terminal of the input coil connected to the grid of a second vacuum tube, a tuning condenser in parallel with the input coil, a connection between the central tap of the input coil and the filaments of the vaccum tubes including the secondary of an audio transformer, the plates of the first and second vacuum tubes being connected together through an inductance, two resistances and a second inductance, a plurality of tuning condensers in parallel with the inductances and resistances, a tap between the resistances, a connection from the tap through an indicating device and a source of plate current to the filaments of the vacuum tubes, a plurality of inductances coupled to the inductances in the plate circuits of the first and second vacuum tubes, a tuning condenser for these inductances, one terminal of these inductances coupled to the grid of a third vacuum tube functioning as a detector, the other terminal of these inductances connected to the filaments of the vacuum tubes and the plate of the detector tube connected through the primary of the audio frequency transformer and the source of plate power to the filaments of the vacuum tubes.

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