

Aug. 24, 1926.

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1,597,398

OSCILLATION CIRCUIT

Filed May 1, 1920

2 Sheets-Sheet 1

Fig. 1

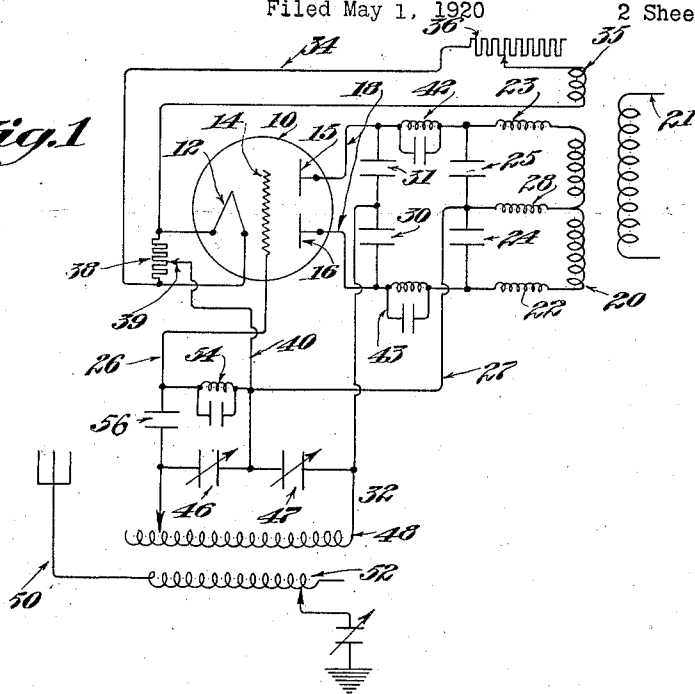
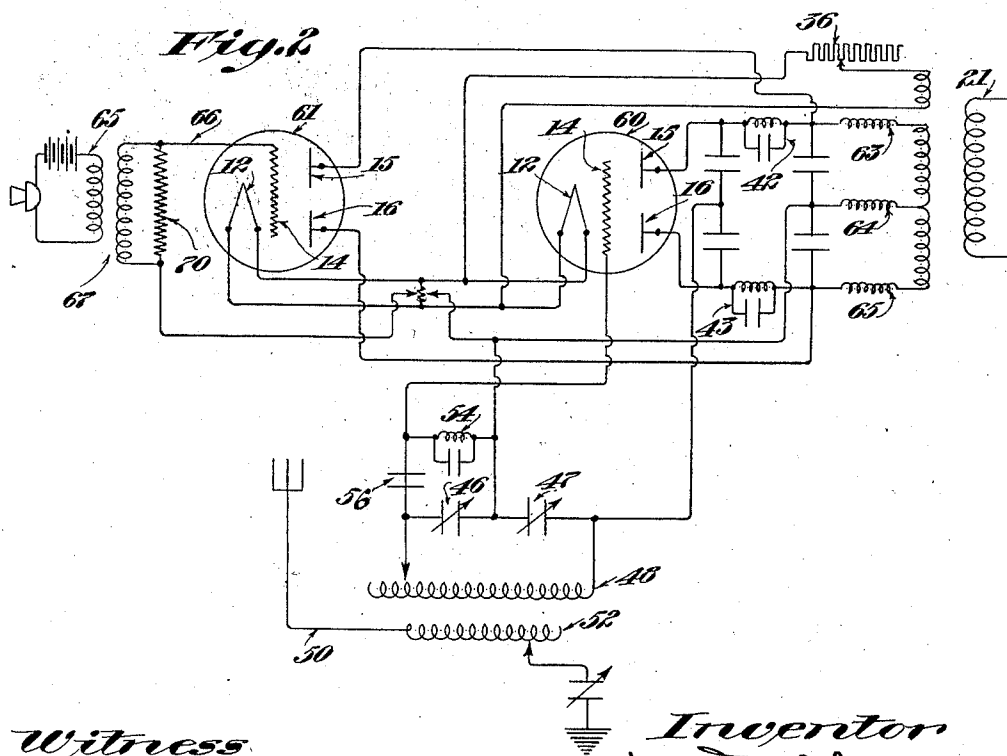


Fig. 2



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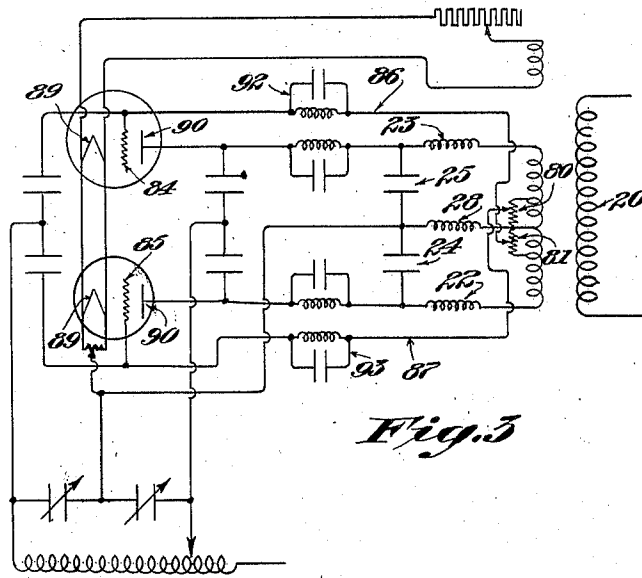


Fig. 3

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UNITED STATES PATENT OFFICE.

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OSCILLATION CIRCUIT.

Application filed May 1, 1920. Serial No. 378,269.

The present invention relates to oscillation circuits for radio transmitting apparatus and more particularly to such circuits employing thermionic tubes for generating or amplifying high frequency currents. It is usual in this type of circuit to employ a direct current source for supplying energy to the plate and filament circuits. There are certain advantages, however, in utilizing an alternating current source for this purpose and it has been proposed to employ a multiphase source of alternating current for supplying energy to the plate and filament circuits, the fluctuations of energy in the circuits being modulated as desired.

It is the object of the present invention to provide a new form of oscillating circuit and thermionic tube connected therein which shall permit the employment of a single phase alternating current source of supply for both the plate and filament circuits.

The present invention is not only adapted for use in connection with commercial sources of supply employing a sixty cycle single phase alternating current source of supply, but, in addition, is particularly adapted for the changing over of spark sets having a motor generator set to transmitting apparatus employing a thermionic tube in which the motor generator set may be used as the source of supply.

In the drawings, Fig. 1 illustrates an oscillation circuit for radio telegraphy, Fig. 2 illustrates the embodiment of the invention in an existing type of transmitting circuit for radio telephony and Fig. 3 illustrates a modification for smoothing out the plate current to a greater degree.

As shown in Fig. 1, the usual thermionic tube is indicated at 10, this tube being provided with a filament 12, a grid 14, and two plates 15 and 16. The two plates are connected into opposite sides of a plate circuit indicated at 18 which is inductively coupled through a transformer 20 with an alternating current source of supply 21. This A. C. source of supply is single phase and may have any desired frequency according to its mode of generation. Connected in series with each of the plates 15 and 16 and opposite ends of the transformer secondary 20 are inductances 22 and 23. In addition, condensers 24 and 25 are connected across the plate circuit, as indicated, these condensers thus being in shunt with the plates

15 and 16. The grid or control electrode 14 connects with a grid circuit indicated at 26, upon which high frequency oscillations may be impressed in the usual manner to control the flow of current in the plate circuit. The plate circuit connects with the filament circuit of the tube in a manner to be presently explained through a connection 27 having an inductance 28 connected to the mid point of the secondary of the transformer 20. With this construction the alternating current in the supply circuit 21 causes the flow of a pulsating current through the plate circuit 18 having double the frequency of the supply current, but owing to the inductance and capacity in the plate circuit, the pulsations of current are smoothed out materially, producing a slightly fluctuating flow of current which is suitable for undamped wave transmission. It will be obvious to those skilled in the art that in this manner both halves of the single phase alternating wave in the source of supply will be utilized, as during one half of the cycle the plate 15 will be positive and during the next half of the cycle the plate 16 will be positive, the inductance 28 in either case being traversed by the plate current. If it were attempted to apply the alternating source of supply directly to the usual plate circuit the resulting plate current would be so highly modulated that it would be unsuitable for transmitting purposes.

It has been found that in some instances the inductances 22 and 23 and condensers 24 and 25 which serve to smooth out the pulsations of current in the plate circuit may be omitted. In this case the current in the plate circuit is modulated in accordance with the modulation of the supply and the inductance 28 connected to the middle point of the secondary serves to further smooth out the fluctuations in the current and also insure the continuance of oscillation.

In order to insulate the plates from one another and aid in the insulation of the grid from the high voltage of the plate the illustrated embodiment of the invention is provided with condensers 30 and 31, which may, if so desired, be designed to fulfill the function of the condensers 24 and 25, enabling these condensers to be omitted from the circuit. The condensers 30 and 31, as shown, are connected to the usual oscillating circuit 32 and thus serve to conduct the high fre-

quency currents from the plate to this circuit. The grid circuit 26 is also connected with the oscillating circuit 32 in a manner to be presently described, thereby forming
 5 a coupling between the plate and grid circuits, by which the oscillations in the plate circuit may be fed back to the grid circuit in the usual manner to set up oscillations in the circuit 32, the frequency of the
 10 oscillations depending upon the electrical characteristics of the circuit.

As shown, the filament 12 also receives its energy from the source of supply 21 through a circuit 34 inductively coupled with the
 15 transformer primary through a secondary 35. This filament current is controlled through a variable resistance indicated at 36. In order to render the filament current more uniform and reduce the modulation,
 20 due to the A. C. drop along the filament, an additional resistance 38 is connected across the filament and is tapped at approximately its electrical center 39, this tap being connected with the oscillation circuit 32 and the
 25 circuit 27 through a connection indicated at 40.

The choke circuits indicated at 42 and 43 are for the purpose of preventing the flow of radio frequency currents through the
 30 condensers 24 and 25 or the secondary of the transformer 20 supplying the plate current. In other words, the choke circuits are for the purpose of preventing the short circuiting of the high frequency currents
 35 flowing through the oscillation circuit 32 and the included condensers 46 and 47. The oscillation circuit, as usual, contains the variable condensers 46 and 47 and inductance 48 supplying energy to an antenna circuit
 40 50 through a second inductance 52 embodied in the antenna circuit. The choke circuit 54 serves to convey to the filament the charge which collects on the grid during the oscillation of the circuit and prevents the short
 45 circuiting of the condenser 46. In addition, a condenser 56 is provided to aid in insulating the grid from the high voltage applied to the plates. This condenser, for some reason at present not known, also
 50 aids in reducing the undesirable modulation of the output.

It will be obvious to those skilled in the art that although for reasons of simplicity and because of certain inherent advantages
 55 the present invention is shown as applied to a single tube having two plates cooperating with the usual filament and grid, if so desired the same results may be obtained by the use of two bulbs properly
 60 connected in the circuit and each having a single filament, grid and plate.

Fig. 2 illustrates the application of the present invention to a transmitter circuit for radio telephony. As shown, this circuit
 65 is provided with an oscillator tube 60

and a modulator tube 61, each having the filament 12, grid 14, and two plates 15 and 16, the plates in both tubes receiving their energy from the A. C. source of supply 21. Connected in series with the plates are
 70 the inductances 63, 64 and 65, corresponding to the inductances 22, 23 and 28 in the circuit shown in Fig. 1. In addition, the inductances 63, 64 and 65 are designed as audio frequency chokes which prevent
 75 the flow of current in the plate circuit at audio frequency and therefore maintain a substantially constant plate current to both tubes. It will be seen that inductance 64
 80 in common with inductance 28 of Fig. 1 is traversed by all the plate currents. With this arrangement, the plate current of the modulator tube is increased and decreased
 85 in the usual manner according to the speech frequency or voltage impressed upon the grid of the modulator tube through a telephone circuit 65, inductively coupled with the modulator grid circuit 66 through a transformer 67. This causes the plate current
 90 of the modulator tube to vary in accordance with the speech frequency voltage impressed on its grid and as the total plate current is constant the plate current of the oscillator or generator tube must correspondingly vary to modulate the output
 95 in accordance with the speech. As this circuit operates upon a differential principle, any undesirable modulation, due to the A. C. supply is substantially eliminated. The usual resistance 70 is connected across the secondary of the transformer 67 to stabilize the action of the transformer and improve the modulation.

The employment of a vacuum tube as an oscillator or amplifier having a modulated plate current has certain distinct advantages
 105 for purposes of radio telegraphy as the modulated wave emitted by such a transmitter gives a steady note with excellent tone qualities which is well adapted for reception to the receiving circuits. This note, due to the above characteristics, lends itself to high amplification at the receiving end by the use of the usual regenerative circuits, thus
 110 enabling the tube set to transmit a greater distance, due in part to the use of the regenerative receiving circuit and the reduced interference from other stations and static disturbances.

For purposes of radio telephony it may be desirable, however, to smooth out the plate current to a greater degree than is possible with the circuit shown in Fig. 2. To this end the circuit shown in Fig. 3 of the drawings may be employed. As indicated therein, resistances 80 and 81 are tapped off of the secondary of the transformer 20 at points near its electrical center, these resistances being connected with separate
 125 grids 84 and 85 through additional circuits,
 130

indicated at 86 and 87, respectively. The grids 84 and 85 are embodied in two separate thermionic tubes and each cooperates with a filament 89 and plate 90. The connection with the grids is so arranged that the voltage applied to each grid is opposite to the voltage applied to the corresponding plate, tending to smooth out the plate current to a certain extent. In addition to the modulation of the plate current afforded by the usual inductances 22, 23 and 28 and the condensers 24 and 25, as shown in Fig. 1, located in each of the circuits 86 and 87 is inductance and capacity indicated at 92 and 93, respectively. This inductance and capacity is designed to change the phase of voltage applied on the grid so that it may be made opposite to the pulsations of plate current. By properly varying the phase and amplitude of the voltage applied to the grids, the pulsations of plate current may be entirely smoothed out and a steady flow obtained.

I claim:

1. An oscillation circuit comprising a plate circuit including two plates, a cathode circuit having provision for electron emission toward the plates, a grid circuit for controlling the flow of electrons between the cathode circuit and the plates, means for energizing the plate circuit from an alternating current source, and means for impressing on the grid circuit variations in voltage opposite to and of smaller magnitude than those impressed on the plate circuit.

2. An oscillation circuit comprising a

plate circuit including two plates, a cathode circuit having provision for electron emission toward the plates, a grid circuit for controlling the flow of electrons between the cathode circuit and the plates, and connections to the plate circuit energizing means for impressing on the grid circuit variations in voltage opposite to and of smaller magnitude than those impressed on the plate circuit.

3. An oscillation circuit comprising a plate circuit including two plates, a cathode circuit for controlling the flow of electrons between the cathode circuit and the plates, a transformer adapted to have its primary connected to a source of alternating current and having its secondary connected to the plate circuit to cause each plate to carry alternate halves of the induced wave, and grid circuit connections for impressing upon the grid circuit a voltage which is opposite to the voltage applied to the plate circuit to smooth out pulsations in the plate circuit.

4. An oscillation circuit comprising a plate circuit including two plates, a cathode circuit, a grid circuit, a transformer adapted to have its primary connected to an alternating source and having the ends of its secondary connected with the plates, and means for tapping the grid circuit into the secondary of the transformer in such a manner that the voltage in the grid circuit is opposite to the voltage applied to the plate circuit.

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