

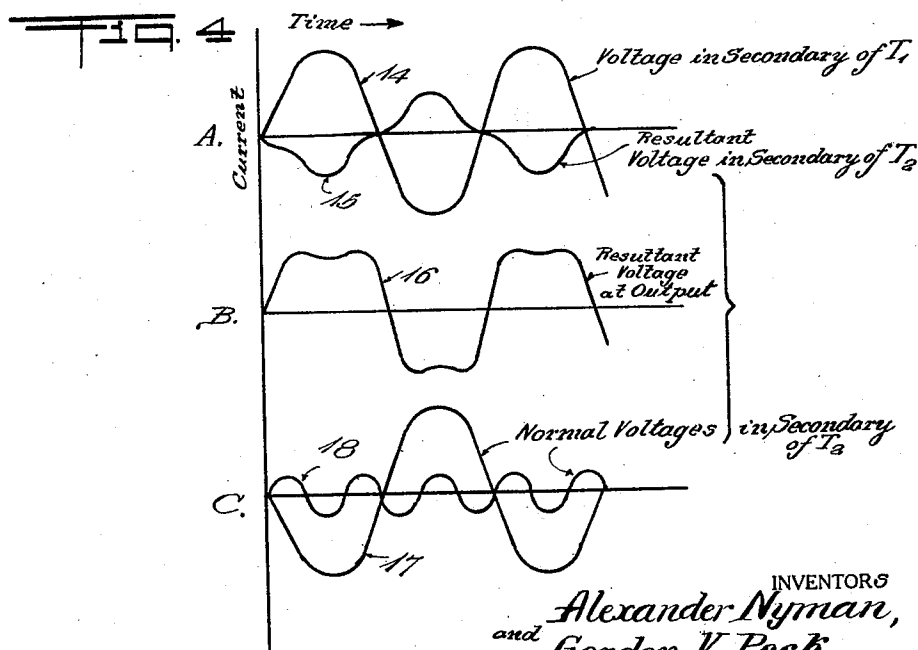
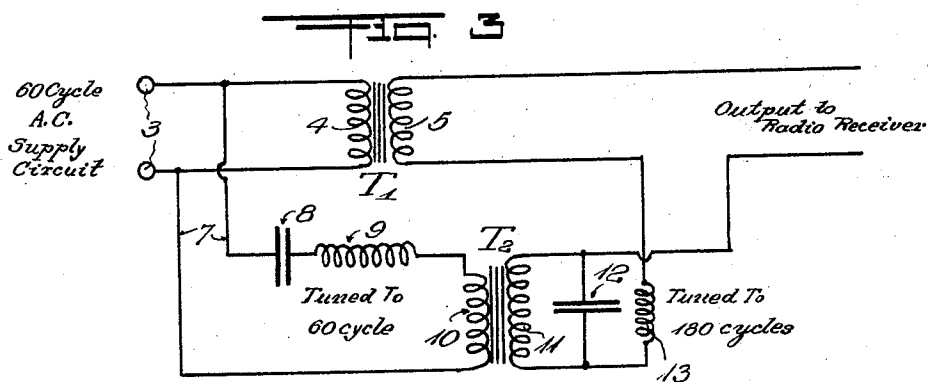
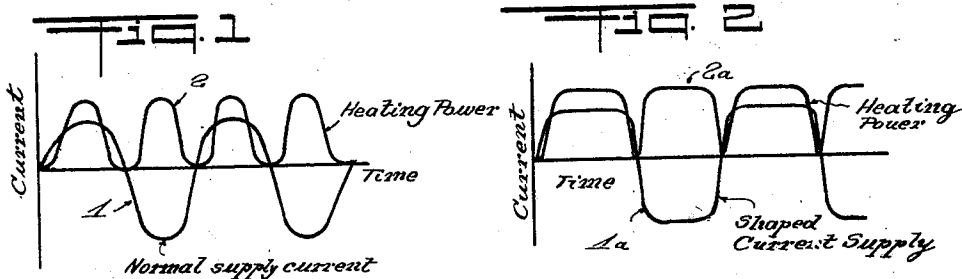
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A. NYMAN ET AL

1,870,960

METHOD OF ENERGIZING FILAMENTS

Filed March 18, 1926 2 Sheets-Sheet 1



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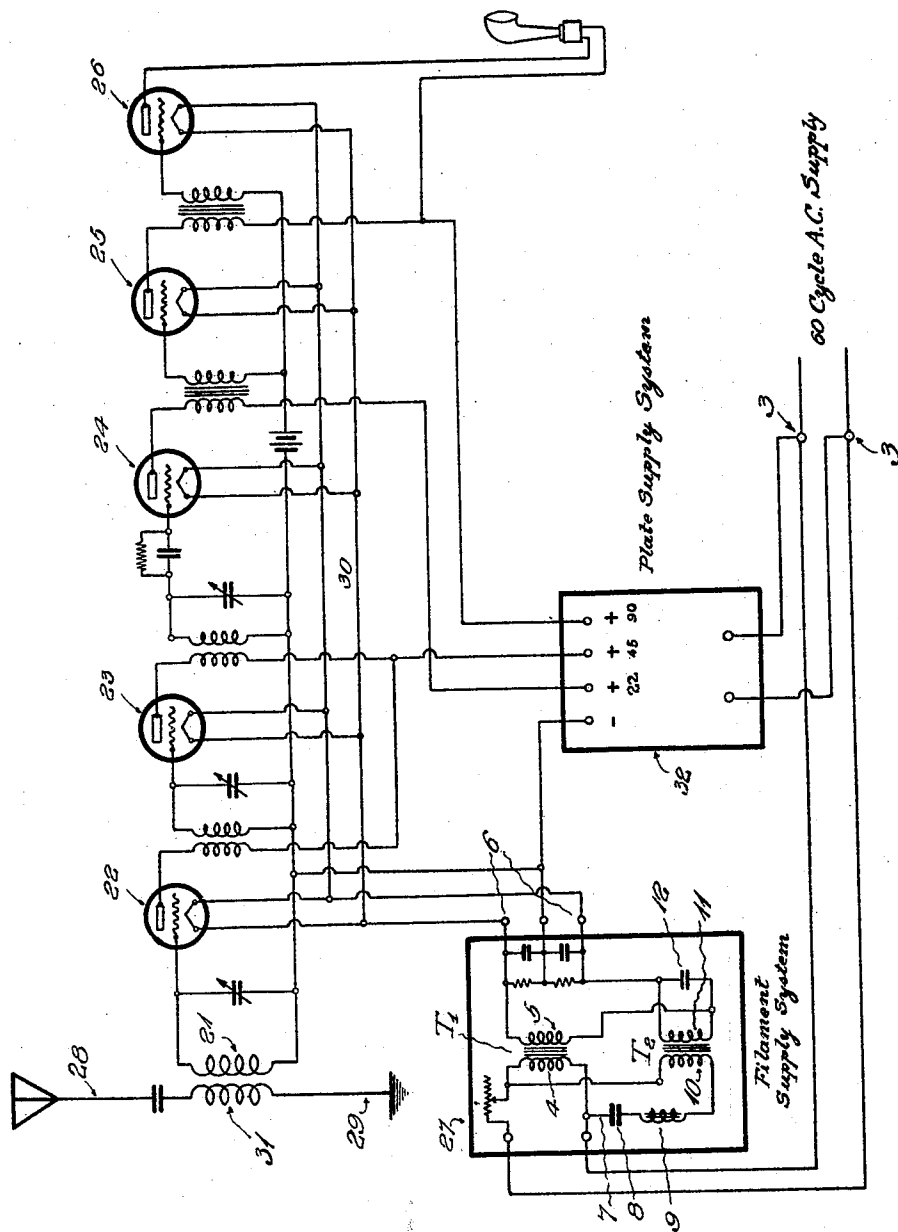
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METHOD OF ENERGIZING FILAMENTS

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2 Sheets-Sheet 2



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METHOD OF ENERGIZING FILAMENTS

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Our invention relates broadly to the operation of electron tubes from a source of alternating current and more particularly to a system of supplying the filament electrodes of a plurality of electron tubes from an alternating current power source without the setting up of undesired disturbances in the electron tube circuits which normally interfere with the operation of such tubes in a signal receiving circuit.

One of the objects of our invention is to provide a system for delivering alternating current to the filament circuits of electron tubes having means for reducing the tendency of the filament electrodes of the several electron tubes from periodically varying in temperature upon the reversal of current of the alternating current power source thereby reducing the tendency of the electron tube circuits to responding to disturbances in the power supply system.

Another object of our invention is to provide a power supply system for the circuits of electron tubes having means for smoothing out the alternating current supplied to the tube circuits independently of filter systems heretofore employed.

Another object of our invention is to provide a current supply set for a filament electrode of a signal receiving electron tube apparatus having means for maintaining the filament electrodes at a substantially constant temperature when the energy is supplied from the alternating current power source.

Still another object of our invention is to provide an alternating current power supply system for the filament electrodes of a plurality of electron tubes wherein the electron emission from the filament electrodes is maintained substantially constant independent of reversals in current of the alternating current power supply system whereby quiet operation of the electron tube circuits in a signal receiving system may be obtained.

A further object of our invention is to provide a current supply system for operating the filament electrodes of a plurality of electron tubes from an alternating current power supply source with means for deriving a

heating power from the alternating current which is substantially constant independent of the normal reversals in current of the alternating current source for eliminating the disturbances arising in the sensitive electron tube circuits due to the periodic changes in direction of the current of the source.

Other and further objects of our invention will be understood from the specification hereinafter following by reference to the accompanying drawings, wherein:

Figure 1 is a theoretical view showing the normal heating power obtained in the filament circuit of a plurality of electron tubes when current is supplied from an alternating current power source; Fig. 2 is a theoretical view showing the more constant heating power which is obtainable with the shaping of the characteristic curve of the current supply in accordance with our invention; Fig. 3 is a diagrammatic view illustrating a circuit arrangement embodying the principles of our invention; Fig. 4 is a view of a number of characteristic curves showing the several currents existing in the current supply set of our invention; and Fig. 5 illustrates a complete receiving system including a plurality of electron tubes having the filament circuits thereof supplied from the current supply set of our invention.

Heretofore in the art one of the difficulties in operating electron tube amplifying systems with power derived from an alternating current source has been the amplification of the hum of the alternating current in the receiving apparatus to a greater degree than the amplification of the signaling energy. The disturbances which are set up in the electron tube circuits arise from the periodic reversal in the current in the power supply system. Where the filament electrodes of a plurality of tubes are heated from an alternating current source the filaments tend to periodically change in temperature due to reversal in the direction of current. The variation in filament temperature results in the production of a hum in the reproducing means which connect with the electron tube circuits. By our invention we provide a current supply set having means for securing an alternating cur-

rent which is so shaped in its characteristic curve as to secure a substantially constant heating power. A circuit arrangement is provided whereby the current which is supplied to the filament circuits substantially approaches a rectangular wave form which tends to produce a substantially uniform heating power eliminating the periodic variation in electron emission. The current supply set is provided with circuits tuned to the fundamental frequency of the available alternating current supply and tuned to a multiple of the fundamental frequency for combining the effects of the currents of the separated frequencies for producing a substantially rectangular wave form for developing uniform heating power in the filament circuits of the electron tubes which are operated from the alternating current source.

Referring to the drawings in more detail, reference character 1 designates the sine wave characteristic curve of the commercial alternating current. Reference character 2 shows the normal heating power for the filament electrode of an electron tube which is energized from the alternating current designated by curve 1. It will be observed that the heating power passes through periodic and sudden increases and decreases resulting in changes in the electron emission of the filament. By our invention we so shape the characteristic curve of the alternating current supply as shown in Fig. 2 at 1a, that a heating power in accordance with curve 2a is obtained which does not have the abrupt increase and decrease in amplitude as is true in the case of curve 2 of Fig. 1.

In Fig. 3 we have illustrated one embodiment of our invention where the current supply terminals are designated at 3 for delivering alternating current to the primary winding 4 of transformer T_1 having secondary winding 5 for connection to the filament circuits of the electron tubes of the signal receiving apparatus. Shunted across the current supply circuits at 3, we provide connections 7 which connect through a tuned system including condenser 8 and inductance 9 with the primary winding 10 of transformer T_2 . The system 8-9-10 is tuned to the frequency of the commercial alternating current supply which for the purpose of describing the invention may be considered as 60 cycles. The transformer T_2 has its secondary 11 connected in series with the load circuit and is tuned by means of condenser 12 and inductance 13 to a multiple of the supply frequency and for the purpose of describing the invention we have indicated this frequency to be 180 cycles.

As represented in Fig. 4 the characteristic of the voltage across the secondary winding 5 of transformer T_1 is designated by curve 14. By reason of the tuning of the several circuits in the current supply set the normal voltages existent across the secondary winding 11 of

transformer T_2 are shown by curves 17 and 18 which result in a voltage having a characteristic wave form 15. The combined resultant of the voltage delivered to the output circuit is substantially rectangular in shape as designated at 16.

In illustrating the connections of the current supply set with the electron tube circuits of a radio receiver, I have shown in Fig. 5 the complete alternating current power supply set at 27 for supplying the filament heating current to electron tubes 22, 23, 24, 25 and 26 of the signal receiving circuit. The output of the current supply set is connected across terminals 6 to the filament circuit 30 of the receiving apparatus.

We have illustrated the signal receiving apparatus as constituted by a radio receiving system having an antenna 28 with ground connection 29 and including a primary winding 31 of a coupling transformer having secondary 21 connected to the signal receiving apparatus, but it will be understood that any electron tube system may be operated with the apparatus of our invention and that the circuit arrangement illustrated is merely for the purpose of explaining one of the numerous applications of our invention. The plate potential for the several electron tubes 22, 23, 24, 25 and 26 is supplied through a rectifier 32.

The shaping of the alternating current before it is impressed upon the filament circuit 30 avoids the periodic changes in temperature of the filament electrodes, thereby decreasing the tendency of the electron tube circuits to amplify the hum of the alternating current. While we have shown the current supply set as having a portion of its circuit tuned to the third harmonic of the supply frequency we desire that it be understood that the circuits may be tuned to other frequencies and that the purpose of our invention is to broadly set forth the principles of shaping the alternating current wave form for supplying a substantially uniform heating power to the filament circuits of an electron tube system.

We desire that it be understood that other modifications may be made and that no limitations upon the invention are intended other than those imposed by the scope of the appended claims.

What we claim and desire to secure by Letters Patent of the United States is as follows:

1. In a current supply set for heating the filament of a plurality of electron tubes, the combination of a source of alternating current, means for supplying said alternating current to the filament electrodes of a plurality of electron tubes, and means for imparting a substantially rectangular shape to the wave form of the alternating current thus supplied to said filament electrodes for securing a substantially constant heating power for said filament electrodes.

2. Means for energizing the cathode of an

electron tube from a source of alternating current, comprising in combination with a source of alternating current, an electron tube, a cathode circuit for said electron tube, a transformer for delivering alternating current from said source to said cathode circuit, and means supplementing said transformer for shaping the wave form of the alternating current supplied to said cathode circuit for reducing the tendency of abrupt variation in the energizing power of the cathode circuit.

3. A system for heating the filament electrodes of electron tubes comprising in combination a source of alternating current, a circuit including the filament electrodes of electron tubes, means for delivering alternating current from said source to said circuit, and means supplementing the connections of said first mentioned means for imparting a substantially rectangular wave form to the alternating current delivered to said filament electrodes for deriving a substantially constant heating power for said filament electrodes from said source of alternating current.

4. In a system for heating the filament electrodes of a plurality of electron tubes, the combination of a source of alternating current, a plurality of electron tubes having filament electrodes disposed in a common supply circuit, a transformer for delivering alternating current from said source to said common supply circuit, and means supplementing said transformer for imparting a substantially rectangular shape to the alternating current delivered to said common supply circuit for reducing the tendency of the filament electrodes of said electron tubes to vary in their electronic emission.

5. A system for heating the filament electrodes of a plurality of electron tubes comprising in combination a source of alternating current, a plurality of electron tubes having filament electrodes disposed in a common supply circuit, a transformer for delivering alternating current from said source to said common supply circuit, an auxiliary transformer electrically connected with said first mentioned transformer and providing means for imparting a substantially rectangular shape to the wave form of the current delivered to said common supply circuit for maintaining a substantially constant condition of electronic emission of said filament electrodes.

6. A system for heating the filament electrodes of a plurality of electron tubes comprising in combination a source of alternating current, electron tubes having filament electrodes connected to a supply circuit, a transformer having coupled primary and secondary circuits for delivering alternating current from said source to said supply circuit, a second transformer having coupled primary and secondary circuits connected with said first mentioned transformer for im-

parting a substantially rectangular shape to the wave form of the alternating current delivered to said supply circuit for obtaining a substantially constant heating power for the filament electrodes.

7. A system for heating the filament electrodes of electron tubes comprising in combination a source of alternating current, electron tubes having filament electrodes connected to a supply circuit, a transformer having coupled primary and secondary circuits, for delivering alternating current from said source to said supply circuit, an auxiliary transformer having coupled primary and secondary circuits with the primary circuit thereof tuned to the frequency of said source and connected with the primary circuit of said first mentioned transformer and the secondary circuit thereof tuned to a multiple of the frequency of said source and connected with the secondary circuit of said first mentioned transformer for imparting a substantially rectangular wave shape to the alternating current delivered to said supply circuit for maintaining a substantially constant heating power for said filament electrodes.

8. A system for heating the filament electrodes of a plurality of electron tubes comprising in combination a source of alternating current, a plurality of electron tubes having filament electrodes disposed in a common supply circuit, a transformer having coupled primary and secondary circuits, for delivering alternating current from said source to said common supply circuit, an auxiliary transformer having coupled primary and secondary circuits with the primary circuit thereof tuned to the frequency of said source and connected with the primary circuit of said first mentioned transformer and the secondary circuit thereof tuned to three times the frequency of said source for imparting a substantially rectangular shape to the wave form of the alternating current delivered to said common supply circuit for maintaining a substantially constant heating power for the filament electrodes of said plurality of electron tubes.

9. The method of heating the filament of a vacuum tube which consists in utilizing an alternating current, altering the wave form thereof to become substantially rectangular and applying the resultant to said filament.

In testimony whereof we affix our signatures.

ALEXANDER NYMAN.
GORDON V. PECK.