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H. W. HOUCK

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ELECTRON TUBE APPARATUS

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Fig. 1

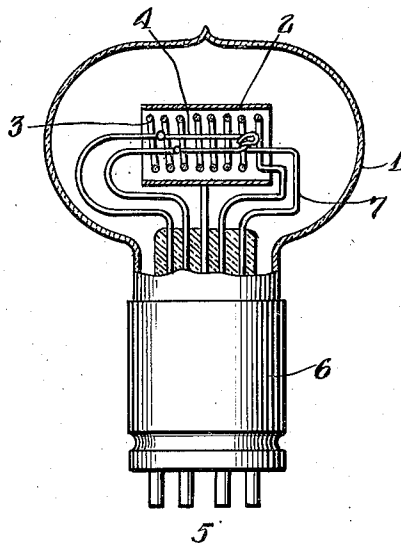


Fig. 2

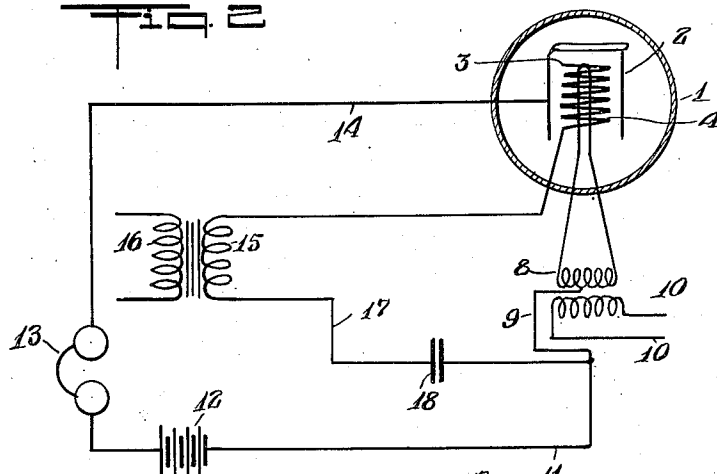
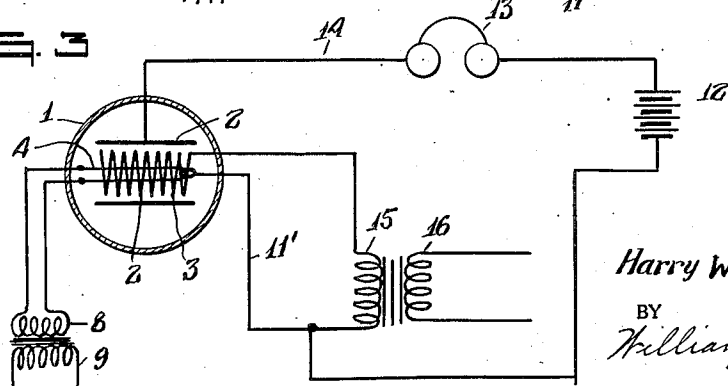


Fig. 3



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ELECTRON TUBE APPARATUS

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This invention relates to a method and apparatus for utilizing alternating current to heat the filament or cathode of a vacuum tube, particularly a vacuum tube designed for circuits requiring electronic emission.

Heretofore, the filaments of vacuum tubes have been heated mostly by current from a battery, and attempts to utilize alternating current for the same purpose have generally resulted in failure because for one thing the filament experienced a change of temperature during each cycle. Hence a steady flow of electrons could not be maintained. To overcome this drawback I make the filament short and thick in the practice of my invention, and otherwise reduce its compass or the amount of space which it occupies so that no loss of heat during the alternations of current passing through it can take place. I also operate the filament with current at relatively low voltage and impart to the filament a non-inductive arrangement and shape. A tube with such filament has superior operating characteristics.

The nature and scope of the invention is set forth in the following description taken with the drawings, and the novel features of the invention are pointed out in the appended claims; but I of course reserve the right to make any slight changes in detail which do not depart from the principle which the invention embodies.

On the drawings:—

Figure 1 is a side view of a tube partly broken away at the top to indicate a construction embodying my invention; and

Figures 2 and 3 are views showing circuits in which such a tube can be connected.

The same numerals identify the same parts throughout.

In the particular description of the drawings, the numeral 1 indicates the usual bulb or container made of glass or some other insulating material and evacuated to remove the air. It contains an anode 2 in the form of a cylindrical tube within which is a grille 3, spiral in shape, and a filament 4; the grid being between the filament and the anode 2. The base of the tube has a number of contact studs 5, one of which is connected to the

anode 2, another to the grid 3, and the remaining two, one to each end of the filament or cathode 4. The glass container 1 is mounted in the usual metallic base 6, and if desired a conductor 7 may be connected to the middle of the filament and let out through the base of the tube 6, and there connected to an additional contact stud, similar to the studs 5, which may be provided for the purpose.

The filament 2 is made short and thick, and the two parts thereof are as close together as possible. A filament of this type will develop enough heat and retain a sufficient amount of such heat during each alternation of current to prevent any appreciable diminution in the amount of electrons therefrom, and the tube will therefore operate in a satisfactory manner.

In Figure 2, two ends of such filament are shown connected to a secondary winding 8, energized by a primary winding 9 which may be connected by conductors 10 to a suitable source of alternating current. The numeral 11 indicates a conductor joined to the mid point of the winding 8 and running to a battery 12 connected to a pair of telephones or a loud speaker 13, also united by a conductor 14 to the anode 2. The numeral 15 indicates the secondary winding of an amplifying transformer joined to the grid 3 and energized by a primary 16 which may be connected to another tube of a wireless receiving set in the usual manner. The other terminal of the secondary 15 is joined by a conductor 17 and condenser 18 to the conductor 11. In operation, the filament 4 will be heated by alternating current generated in the winding 8 and the mid point of this winding being connected to the battery 12, is also joined to the conductor 14 and anode 2 so that a bridge of electrons can be maintained between the filament and the anode 2 in the usual way. The transformer 15—16 can be one of the usual transformers used between the successive tubes of a wireless radio set to produce amplification.

In Figure 3, the filament 4 is energized as before by alternating current produced in the secondary winding 8, but the mid point of the filament is connected by a wire 11' to the bat-

tery 12 from the opposite side of which the circuit leads through the phone 13 and conductor 14 to the anode 2. The grid is energized as before by a secondary 15 and primary 16, but one terminal of the secondary is joined to the wire 11' which leads to the battery 12.

The practical operation of my invention also requires that the filament should be worked with relatively low voltage and to reduce variation by having it doubled upon itself as indicated in the drawings, so that the magnetic field caused by the current in one side of the filament opposes the effect of the current in the other half, thus making the filament non-inductive in effect and avoiding interference with the continuous flow of electrons from the filament to the plate.

Having described my invention, what I believe to be new and desire to secure and protect by Letters Patent of the United States is:—

1. In a three electrode vacuum tube, a filamentary cathode for emitting a flow of electrons therefrom to the plate, and heated directly by a source of alternating current connected thereto, the filament having a low voltage drop with a relatively large cross-sectional area and adapted to carry a heavy heating current, the filament also being doubled upon itself so that its opposite leg portions react upon each other to reduce the electromagnetic effect of the heating current to such value that the voltage, temperature and electromagnetic effects on the said flow of electrons to the plate due to the cyclic changes in the heating current are neutralized.

2. In a three electrode vacuum tube, a filamentary cathode for emitting a flow of electrons to the plate, and heated directly by a source of alternating current connected thereto, the filament being thick and having a low voltage drop and adapted to carry a heavy heating current, the filament also being doubled upon itself and having its leg portions lying in such spaced relation with respect to each other as to cause interaction between them and enable the magnetic field caused by the current in one leg to oppose the magnetic effect of the current in the other leg to such extent that the voltage, temperature and magnetic effects due to the cyclic changes in said alternating current will be neutralized with respect to their influence on said flow of electrons to the plate.

In testimony whereof I affix my signature.

HARRY W. HOUCK.