May 10, 1932. W. L. KRAHL 1,857,645

VACUUM TUBE CONSTRUCTION

Filed March 11, 1927

Fig. 1

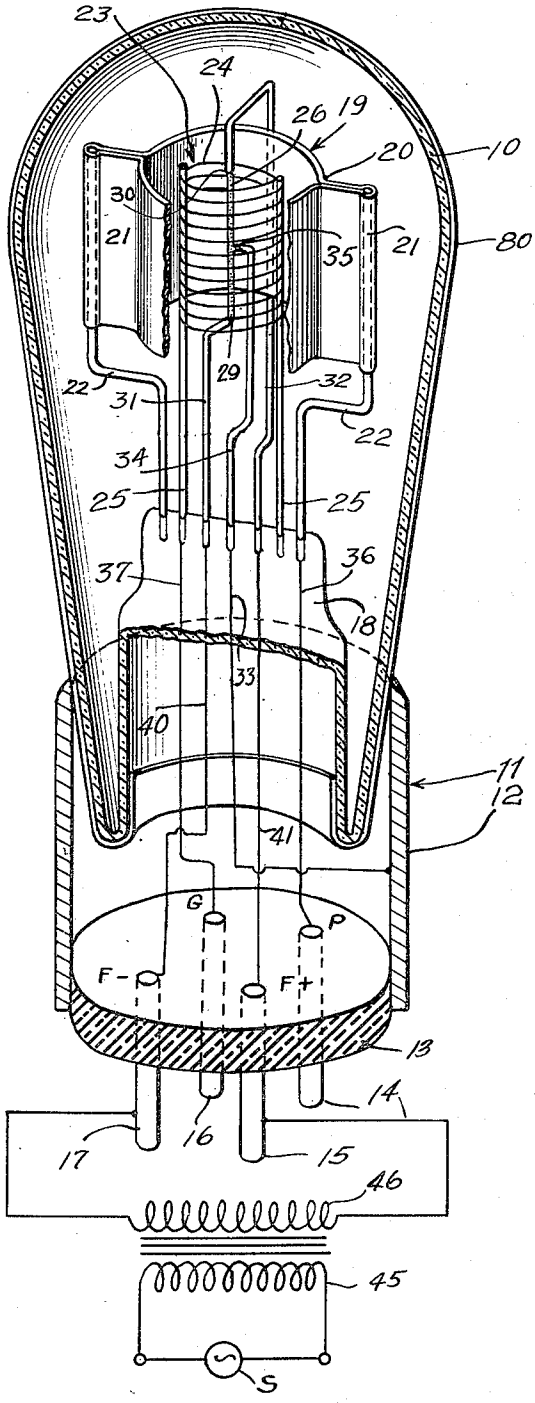


Fig. 2.

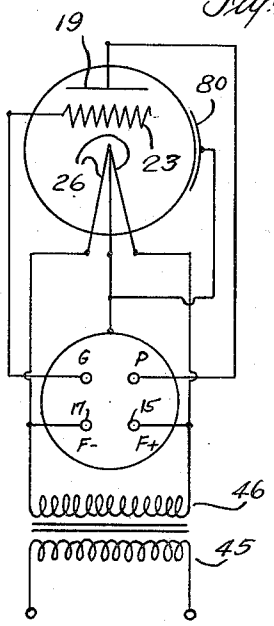
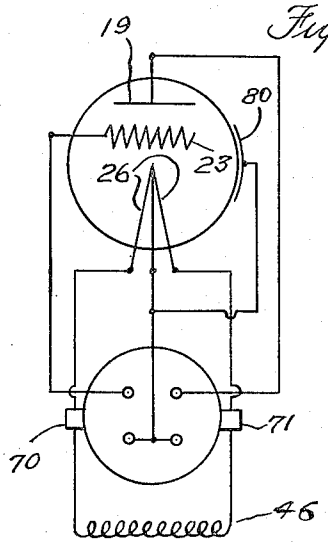


Fig. 3.



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UNITED STATES PATENT OFFICE

WALTER LOUIS KRAHL, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO ARCTURUS RADIO TUBE COMPANY, OF HARRISON, NEW JERSEY, A CORPORATION OF DELAWARE

VACUUM TUBE CONSTRUCTION

Application filed March 11, 1927. Serial No. 174,511.

This invention relates to a thermionic device and to a method of operating the same for the amplification, detection, rectification and the like, of alternating or fluctuating currents, and more particularly, to a method and apparatus for energizing the cathode of a thermionic vacuum tube by means of alternating or fluctuating current in such manner that the output is independent of fluctuations of the energizing current.

It is an object of this invention to provide a thermionic relay or thermionic vacuum tube which may be energized by alternating or fluctuating currents without the production of noise or hum incidental to the use of such alternating or fluctuating currents.

It is a further object of this invention to provide a tube having a filamentary cathode and connections associated therewith, and circuits adapted to function therewith, such that the potential between the grid and filament and the potential between the filament and plate is substantially independent of changes or fluctuations in filament heating current.

It is still another object of this invention to provide such a device having terminals thereon so positioned and arranged that the device may be inserted in a standard socket, and also having an additional terminal and internal connections whereby the device may be utilized in existing apparatus.

It is still a further object of my invention to provide a method of operating a thermionic relay by energizing the filament of such relay by means of alternating or fluctuating currents while impressing the various control voltages in such manner that undesired voltages or voltage changes do not appear in the output circuit.

Still other objects of my invention will be apparent from the specification.

The features of novelty which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its fundamental principles and as to its practical applications, will best be understood by reference to the specification and accompanying drawings, in which

Fig. 1 is a perspective view of a tube according to my invention, partially broken away to show the construction thereof;

Fig. 2 is a diagrammatic view of a tube according to my invention, showing the connections between the internal elements of the tube and the terminals; and

Fig. 3 is a similar view of a modified form thereof.

In accordance with my invention, I provide among others, certain of the elements usually found in thermionic relays, for example: an evacuated envelope having therein an anode, a control electrode and a cathode, the control electrode preferably being in the form of a grid surrounding the cathode, and the anode in the form of a plate surrounding both.

In accordance with my invention, I utilize a special form of filamentary cathode consisting of a pair of branches or legs, and connections upon the base of the device in such a manner that alternating or fluctuating currents are supplied to the filamentary cathode and flow through the two legs or branches in series, whereas the control voltage applied between the grid and filament and the voltage applied between the filament and plate are impressed between the respective electrodes and the common point of the two filament branches.

It will be understood that if the input and output circuits are connected to the filamentary cathode at a common point, the potential between the anode and cathode and that between the input electrode and cathode will not be appreciably affected by the voltage drop in the cathode. It will also be seen that if this common point of contact of output and input circuits in the filament is the mid-point, it will be at the mean alternating current potential of the filament. It is also obvious that if a filament having sufficient thermal capacity be utilized, the thermionic emission of said filament will not vary appreciably with current pulsations when heated with alternating or fluctuating currents of the frequencies normally utilized for house-lighting. It will be understood that disturbances due to electrostatic and electromagnetic fields aris-

ing from an alternating or fluctuating source of heating current, will vary with the power consumption of the filament. It is therefore desirable to utilize oxides which emit at low temperatures, so that a low-resistance filament may be operated with the least current. Oxides of aluminum have been found particularly effective at low operating temperatures, but oxides of barium, strontium, and others known to the art may also be utilized. Copper or nickel may be used advantageously as a resistance material, but other metals, such as platinum, tungsten, molybdenum and thorium might also be used.

Referring now more particularly to Fig. 1, I have illustrated an embodiment of my invention as applied in a thermionic tube comprising an evacuated container or envelope 10, having a base 11 secured to one end thereof. The base 11 is preferably in the form of a cylindrical shell 12 of conducting material, having an end plate 13 of insulating material which is provided with axially extending terminals 14, 15, 16 and 17 projecting therefrom. Within the tube envelope there is provided a single stem or press 18, through which are passed all of the leads and supports for the various elements of the tube.

In the particular arrangement shown, there is provided an anode 19 of tubular formation and approximately circular cross-section comprising plane portions 20, laterally extended and bent on themselves to form supporting tubes 21, adapted to receive the supporting rods 22 mounted on the press 18. Within the anode 19, there may be positioned a control electrode or grid 23 in the form of a helical coil of wire 24 mounted on support rods 25 extending into press 18. Within the space defined by grid 23, there may be placed cathode 26.

It will be noted that the cathode 26 is a cylindrical rod or wire, and the ends 29 and 30 are connected to conducting support rods 31 and 32 embedded in the press. A conductor 33 is provided, connected to conductor 34 which in turn, is connected to the mid point 35 of the filament. It will therefore be seen that all of the electrodes are supported and the leads thereto passed through the single press 18.

Within the stem of the tube, the base connections are made from the tube elements as follows: from anode 19 through support 22 and lead 36 to terminal 14; from control electrode 23 through support 25 and lead 37 to terminal 16; from the mid point of the filament through conductor 34, conductor 33, to the metallic shell 12 of the base 11. The ends of the filament, 29 and 30, are connected through leads 40 and 41 respectively to terminals 17 and 15.

In addition, the envelope or container may be coated with a layer of conducting material such as metal in the form of foil 80 glued thereon or applied by deposition, which coating may be connected through the metallic shell 12 to a suitable source of potential, either ground or a point positive or negative with respect thereto.

Referring now to Fig. 2, it will be seen that the filament may be energized by connecting a suitable source to the terminals 15 and 17. Any suitable source may be utilized, for example: a commercial alternating current power outlet of approximately 110 volts, the current from which may be passed through the primary 45 of a suitable transformer having a secondary 46, the terminals of which are connected to terminals 15 and 17.

It will now be seen that a signal voltage may be applied between the grid or control electrode and the cathode which will be substantially independent of the cathode alternating current potential providing that this signal potential be impressed between the grid and the cathode mid-point: and similarly, a plate voltage may be applied to the tube, which is independent of the heating current if applied between the anode and the cathode mid-point, which permits the use of the tube as an amplifier, detector, rectifier, or the like, utilizing commercial alternating current as a source of filament supply.

If it is desired to utilize tubes of a construction herein described in connection with a standard radio receiving circuit without alteration of the internal wiring of said receiver, additional external terminals, such as described in co-pending application Serial No. 140,245, filed October 8th, 1926, and diagrammatically illustrated in Fig. 3 of the present case by references 70 and 71 may be used. Connections from the internal elements of the tube may be made as illustrated in Fig. 3.

While I have shown and described certain preferred embodiments of my invention, it will be understood that modifications and changes may be made as will be understood by those skilled in the art without departing from the spirit and scope of my invention as covered by the appended claims.

I desire to claim as my invention:

1. A thermionic relay comprising an evacuated container having therein an anode; a control electrode; and a filamentary cathode adapted to be heated by fluctuating currents to cause electron emission; a base secured to said container; four terminals positioned on said base; a fifth terminal; a conducting surface film on the container; a connection between the anode and one of said terminals; a connection between control electrode and another of said terminals; a connection between the mid-point of said cathode and said fifth terminal; a connection between the surface film and the fifth terminal; and connections between opposite ends of said cathode and the remaining two base terminals.

2. A thermionic relay comprising an evacuated container having therein an anode, a control electrode and a filamentary cathode adapted to be heated by fluctuating currents to cause electron emission; a base secured to said container; said base having a conducting shell; four terminals positioned in said base according to standard practice, said base shell forming a fifth terminal; a metallic film on said container; a connection between said anode and one of said terminals; a connection between said control electrode and another of said terminals; a connection between the mid-point of said cathode and the base shell; a connection between the container film and base shell; and a connection between opposite ends of said cathode and the remaining two base terminals.

In testimony whereof, I affix my signature.

WALTER L. KRAHL.