

Nov. 16, 1926.

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M. LATOUR

HIGH POWER THERMIONIC VALVE

Filed Dec. 5, 1923

2 Sheets-Sheet 1

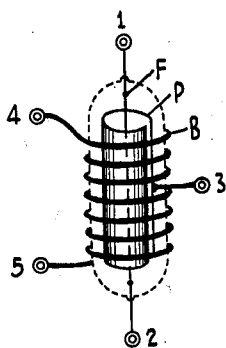


Fig. 1



Fig. 2



Fig. 3



Fig. 4



Fig. 5

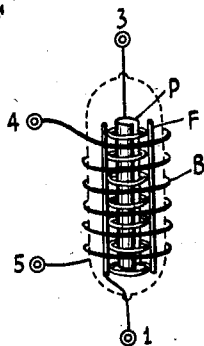


Fig. 6

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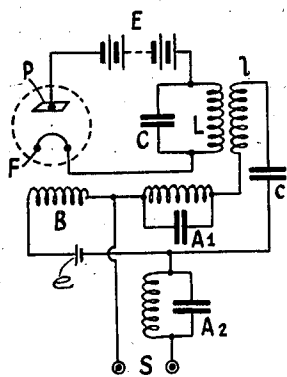


Fig. 7

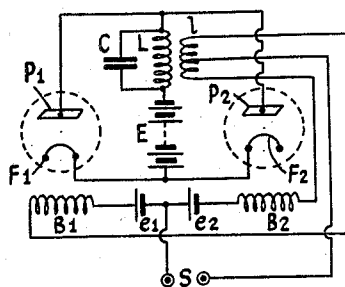


Fig. 8

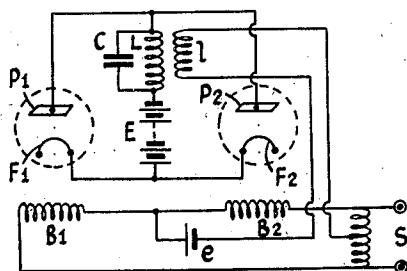


Fig. 9

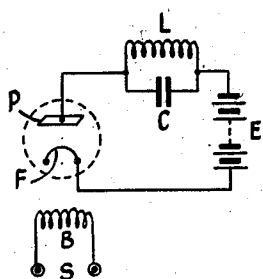


Fig. 11

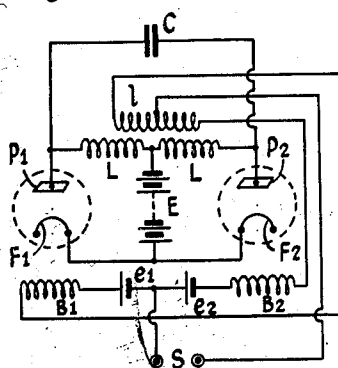


Fig. 10

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HIGH-POWER THERMIONIC VALVE.

Application filed December 5, 1923, Serial No. 678,575, and in France December 21, 1922.

The invention relates to improvements in the so-called "magnetron" valves of high power (see A. W. Hull, Proceedings of the American Institute of Electrical Engineers, for September, 1921, and Latour, Radio Review of London, November, 1921).

In the drawings, Fig. 1 represents a thermionic device or valve for use in applicant's systems.

Figs. 2, 3, 4 and 5 show various modified forms of the cathode structure for use in said thermionic device or valve.

Fig. 6 shows a modified arrangement of the electrodes of Fig. 1.

While Figs. 4 to 11, inclusive, diagrammatically represent various circuit arrangements or systems in which the mentioned valves or thermionic devices are employed.

According to Fig. 1 of the drawing herewith, these valves comprise a filament or cathode F with terminals 1 and 2, a plate or anode P with terminal 3, and an exterior coil B with terminals 4 and 5 designed to be passed by the current producing a magnetic control field in the space comprised between the anode and the cathode.

In practice, in large power magnetrons, the filament has a rather great thickness, and it can be said that, as a consequence of coincidence between the axis of the filament and that of the magnetic controlling field produced by coil B, the currents induced in this filament by the high frequency control field contribute, in a certain measure, to the heating of the filament.

Now, according to the present invention, this phenomenon is developed and applied in a systematic manner by making the cathode of an appropriate shape in a manner so as to reduce appreciably the electric force to be furnished by way of conduction from the outside for heating purposes of the cathode, to such a point, indeed, that all outside supply of current can be done away with.

With this end in view, the cathode constituted generally of tungsten or tungsten coated with thorium, is made either in the shape of a hollow cylinder (see Fig. 2), or in the shape of a series of spires or turns interconnected by generatrices (see Fig. 3), or in the shape of a closed helix (see Fig. 4), or else in the shape of a series of generatrices of one and the same cylinder (see Fig. 5), etc. In these different cases, the

geometrical cylinder enveloping the cathode may have the same axis as coil B. But if besides a supplementary electric supply of energy from the outside for heating is needed, the same could, for instance, feed a filament having this axis, or the conductors serving as a support for the spires in Fig. 3.

When the cathode is disposed in the interior of the anode as in Fig. 1 the resultant controlling field in the space comprised between anode and cathode may then be greater than the one produced by coil B alone, seeing that the induced current which flows through the cathode may be used to contribute a certain magnetic action. But one may arrange the cathode outside the anode as illustrated in Fig. 6, where the cathode, by way of example, is given a shape as already shown in Fig. 3. Under these conditions the magnetic field between anode and cathode may be appreciably smaller than the one normally generated by the coil B. In this way, it is feasible to a certain extent, by adopting a relative disposition of anode and cathode, to cause the resultant value of the high frequency field (allowing of auto-supply of the cathode) to coincide with that of the usual controlling field in magnetrons.

But if these values cannot be brought to coincide, it is possible to resort to the feeding of the coil by two currents of different frequencies of which one creates the controlling field, and the other one the field for the self-feeding of the filament.

Such double-feeding scheme of coil B is illustrated diagrammatically in Fig. 7.

The magnetron comprising plate P and cathode F is fed by the source E through oscillation circuit L—C. A reaction coil Z, through condenser c, feeds coil B. The source S which is to set up the field necessary for the heating of the filament feeds likewise coil B. A "stopper" A¹ stops the flow of the current from the source S towards coil Z the same as "stopper" A² stops the current of coil Z towards source S. The frequency of source S will have to be chosen so much higher the weaker the desired stray field shall be. In the operation of the arrangement of Fig. 7 current induced in the filament F from the control winding B heats the filament and causes plate current to flow in the plate circuit including plate P, plate battery E, oscil-

lation circuit LC, and the filament F, induces a voltage in the control circuit of the magnetron. This circuit includes control winding B of the magnetron, stopper A¹, winding L, condenser c to the other terminal of the winding B. The voltage induced in this circuit causes the controlling winding B to effect a larger plate current determined by the plate battery and the constants of the circuits.

By a combination of two magnetrons, it is possible to realize still more readily the separation of the two currents possessing different frequencies. Serviceable modes of connection are shown in Figs. 8, 9, and 10.

In Fig. 8 the two magnetrons P¹F¹ and P²F² work in parallel. Merely for the sake of indication, there have been added the direct current voltages e¹ e² which act in conformity with a well-known principle. Whereas reaction coil L feeds the coils B¹ and B² in series, source S feeds the same coils B¹ and B² in parallel, by using the middle point of coil L.

In Fig. 9 the relations are reversed, for the reaction coil L feeds coils B¹ and B² in parallel by using the middle of the source S, while source S feeds coils B¹ and B² in series.

In Fig. 10 there are shown the two magnetrons in such a way that, whereas the anode current diminishes in the one, it grows in the other, and vice versa. Coil L is then disposed in a different way, in fact, in a manner as indicated in the figure.

In Figs. 7, 8, 9 and 10 auto-excitation of the magnetron has been shown; but it could also be made to operate as an amplifier with or without addition of direct current voltage in coil B, as shown in Fig. 11.

From a view-point of construction, the cylindrical anode disposed inside or outside the cathode, could constitute a wall part of the magnetron. The opening possibly necessary in the plate or in the metallic wall of the magnetron could be filled with an insulation material, or else could simply be made less conducting, with the sealing being carried out in an up-to-date manner.

The starting of the magnetron could be effected, in all of these cases, by the aid of an auxiliary source of high frequency current.

Having described my invention, what I claim is:

1. A thermionic device comprising an anode, and a cathode and an electromagnetic controlling winding surrounding said elements, said cathode being constructed and arranged to be heated solely by currents induced therein by said controlling winding.

2. In a thermionic device, an anode, a cathode, and a winding surrounding said

anode and cathode adapted to produce a magnetic field therebetween, said cathode being constructed and arranged to be heated solely by currents induced therein by said controlling winding.

3. In a thermionic device, the combination of an anode, a cathode and a controlling winding located in proximity to said anode and cathode, means for supplying heating currents of predetermined frequency to said controlling winding, and means for supplying currents of different frequencies to said controlling winding.

4. In a thermionic device, the combination of an anode, a cathode and a controlling winding adapted to produce a magnetic field between said anode and cathode, means for supplying heating currents of a predetermined frequency to said controlling winding, means for supplying controlling currents of different frequencies to said controlling winding, and means inserted in the circuit of said controlling winding for maintaining separation between heating currents and controlling currents in their respective sources.

5. In a system of the class described, a thermionic device including a cathode, an anode, and an electromagnetic control element for controlling space current between said cathode and said anode, a source of potential for said anode, and means for heating said cathode by currents induced therein by said electromagnetic control element.

6. In a system of the class described, an electron discharge device having a cathode and an anode, input and output circuits connected to said electron discharge device, electromagnetic controlling means in said input circuit, means for heating said cathode by currents induced therein from said electromagnetic controlling means, and means for reactively coupling said output circuit to said input circuit.

7. In a system of the class described comprising divided input and divided output circuits, devices for interlinking said circuits including means for producing two electron streams, said electron streams being oppositely included in said output circuits, means for electromagnetically controlling said electron streams, and means including said controlling means for heating said first means by currents induced therein.

8. In a system of the class described, two thermionic devices each having elements including a cathode, an anode and a controlling winding, circuits in which said elements are connected in opposition, and means including said controlling windings for heating said cathodes by currents induced therein.

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