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G. R. KILGORE

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MAGNETRON

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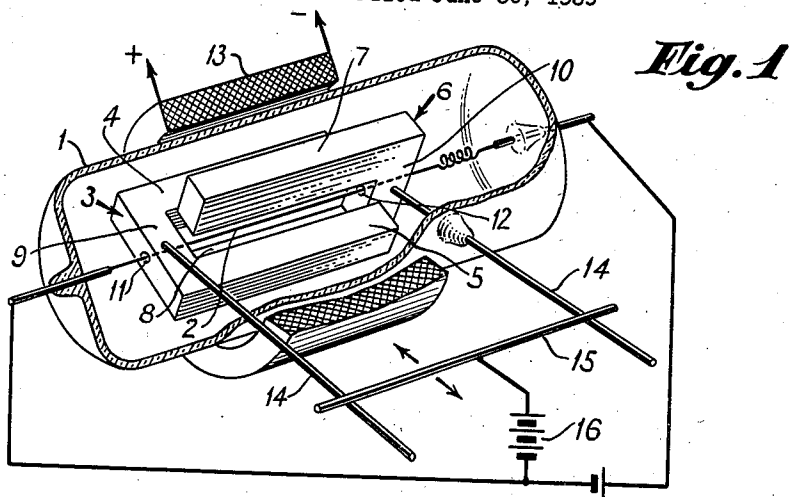
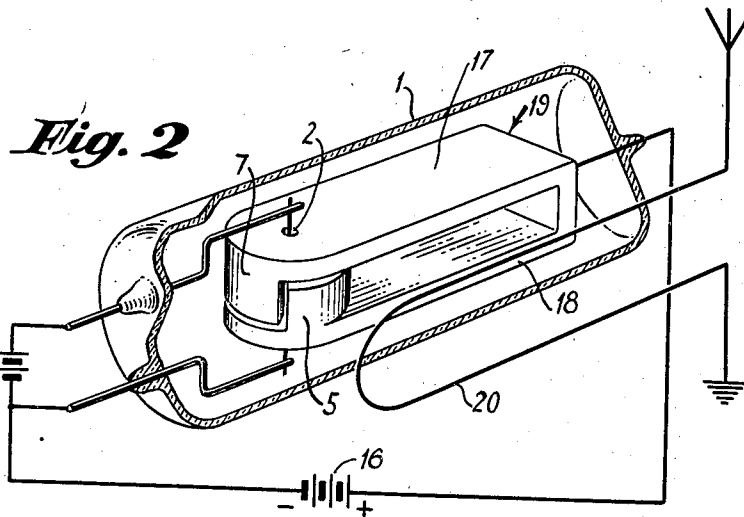


Fig. 3

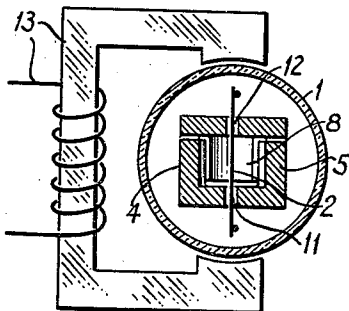
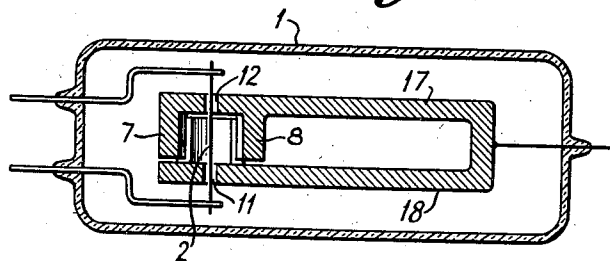


Fig. 4



INVENTOR.
GEORGE R. KILGORE
BY *Charles McClair*
ATTORNEY.

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MAGNETRON

George R. Kilgore, Verona, N. J., assignor to
Radio Corporation of America, a corporation
of Delaware

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5 Claims. (Cl. 250—27.5)

My invention relates to electron discharge devices of the magnetron type, particularly to the anodes for such devices.

It is common in the construction of magnetrons to symmetrically arrange two or more pairs of anode segments around a straight filamentary cathode and to connect alternate segments in parallel through conductors inside or outside the envelope to form a group connected to one side of an output circuit and to connect the remaining segments to form a second group connected to the other side of the output circuit. For efficient operation of such a tube at ultra high frequencies in a single phase circuit, the pulsations in each group of connected segments should be in phase. It is difficult in such magnetrons of conventional construction to prevent standing waves and out-of-phase pulsations on the segments. Further, the small anode-cathode spacings necessary for short waves limit the size of anodes and their power dissipating capacity.

An object of my invention is an improved high power magnetron in which standing waves are prevented, out-of-phase pulsations in an anode having plates or sections are eliminated, and the heat dissipating power of the anodes is great.

Characteristic features of my invention are specifically defined in the appended claims and preferred embodiments are described in the following specification and shown in the accompanying drawing in which Figure 1 is a perspective view of one form of magnetron device embodying my invention, and Figures 2, 3 and 4 are sectioned perspective, end and side views of another form of my improved magnetron.

The magnetron shown as an illustration of one form of embodiment of my invention and shown in Figure 1 comprises a tubular envelope 1 preferably of glass enclosing a straight filamentary cathode 2 extending lengthwise of the envelope. Each anode of my magnetron comprises, in the specific tube shown in Figure 1, a relatively heavy U-shaped yoke or piece of metal 3 supported with the two legs 4 and 5 of the anode parallel to and on opposite sides of the cathode. The other anode 6 is similar in size and shape to the first anode with its two legs 7 and 8 parallel to and on opposite sides of the cathode. The blocks, shanks or transverse portions 9 and 10 of the yokes are preferably of the same cross section as the tines or legs of the yoke and are at opposite ends of the envelope, and to clear the centrally disposed cathode may be bored with aligned holes 11 and 12 as shown in Figures 1, 3 or 4 concentric with the cathode or may have offsets. The anodes

may be of carbon, or of solid metal with their surfaces blackened for better heat dissipation, or the anodes may be fabricated from sheet metal to provide each anode with an extended current carrying and heat radiating area outward from the electron collecting surfaces on the inner sides of the legs of the anodes.

In operation, according to one accepted theory, the electrons leaving the cathode follow curved paths between the cathode and the positively charged anodes under the biasing force of a strong magnetic field parallel to the cathode produced by an electromagnet or a magnetic coil such as coil 13, the path of the electrons being nearly circular and slightly less in diameter than the radial distance between the cathode and anodes. Each time an electron passes the gap between adjacent anodes a positive impulse is given to one anode and a corresponding negative impulse to the other. The spaced legs of my U-shaped anode are connected through an integral transverse section of the anode and because of their extended surface area present practically zero impedance to ultra high frequency currents even of the frequency of 600 or more megacycles, hence the impulses to the parallel connected sections of the anode are in phase. Anodes constructed according to my invention have the advantages in magnetrons of multi-plate operation without the disadvantage of phase displacement in impulses between parallel connected segments. Transmission lines such as Lecher wires 14 may be sealed into the envelope and attached to the anodes at any convenient point, the connections in Figure 1 being on the transverse portions of the anodes intermediate the two legs of the anodes. Its transmission line is adjusted in length and tuned by a conventional short circuit bar 15, the center point of which is connected to the positive end of a direct current voltage source 16. For three or more phase operation there of course may be three or more anodes. Each anode, further, may have three or more legs with as many electron collecting surfaces. I have made and operated tubes of the type shown in Figure 1 with the legs of the anode about 1.4 cm. long and spaced .25 cm. from a pure tungsten cathode with an anode voltage of 1600 volts and a magnetic field of 4000 gauss at frequencies corresponding to wavelengths of about 6.1 centimeters.

The two U-shaped anodes may conveniently be made integral with the tuned transmission line for the tube and incorporated within the envelope as shown in Figure 2. The two leg portions of each anode are joined integrally with

each arm 17 and 18 of a horseshoe-shaped transmission line 19 disposed along the inside of the cylindrical envelope. The filament 2 is parallel to the legs of the anode, transverse to the axis of the envelope, and held between lead-in conductors sealed in one end of the envelope. The frequency of operation is determined by the length of the horseshoe transmission line and ultra high frequency output is conveniently coupled inductively to a load circuit by a loop of wire 20 parallel to the sides of the horseshoe, thus obviating a lead-in conductor for ultra high frequencies.

The low impedance connections between opposite legs of the anodes and the high power dissipating capacity of the anodes adapt my improved magnetron for efficient and high powered operation for transmission purposes. Although the inter-electrode spacings are limited, the anodes constructed according to my invention have considerable mass and power dissipating capacity.

I claim:

1. An electron discharge device comprising an elongated straight cathode, a first U-shaped anode with its two parallel legs disposed parallel to and on opposite sides of said cathode, a second U-shaped anode with its legs parallel to and on opposite sides of said cathode, the planes through the legs of the two mentioned anodes intersecting on a line axial with said cathode, an envelope enclosing the mentioned electrodes, lead-in conductors for the electrodes, and means for producing a magnetic line of force parallel with said cathode.

2. An electron discharge device comprising a straight filamentary cathode, means for producing magnetic lines of force parallel with said cathode, and a unitary anode structure comprising two elongated spaced anode segments parallel to said cathode, each segment being integral at one end with a connecting block of substantially the cross sectional area of said segments and substantially the same length as the distance

between said segments, said block being apertured and the cathode passing centrally through the aperture.

3. An electron discharge device comprising a straight cathode, a unitary anode structure comprising a U-shaped yoke with a substantially straight shank portion, the legs of the yoke disposed parallel to said cathode, the shank portion of said yoke being integral with said legs and substantially equal in length to the distance between said legs, said shank portion being near one end of the cathode and insulated from said cathode at the point where the cathode passes through the shank.

4. An electron discharge device comprising a straight cathode, a first U-shaped anode with its two legs disposed parallel to and on opposite sides of said cathode, a second U-shaped anode with its legs parallel to and on opposite sides of said cathode, the electron collecting portions of said legs lying in a cylindrical surface coaxial with said cathode, a tuning element comprising two parallel arms joined at one end to form a U-shaped transmission line, the free end of each of said arms being integral with two legs of the mentioned anodes.

5. A magnetron having an envelope containing an elongated U-shaped member, the arms of which have a comparatively large transverse cross section and are of comparatively large mass, the arms being flat and parallel, a pair of anode segments at the free end of each of said arms on the inside surface thereof and extending toward the opposite arm, the anode segments on one arm being interleaved with the anode segments on the other arm and having electron collecting areas in a cylindrical surface providing a cylindrical chamber, the axis of which is normal to the flat sides of the arms of said U-shaped member, a straight thermionic cathode positioned axially of said cylindrical chamber and means for inducing a magnetic field longitudinally of said cathode.

GEORGE R. KILGORE.