Nov. 8, 1938. K. FRITZ 2,136,101

MAGNETRON

Filed March 18, 1937

Fig. 1

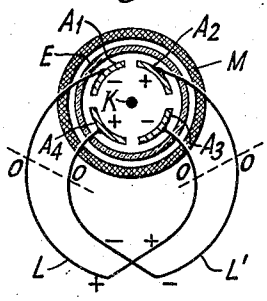


Fig. 2

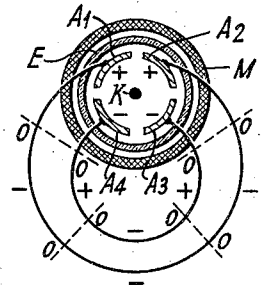
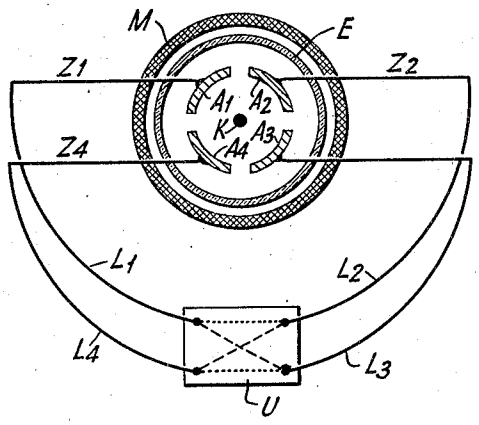


Fig. 3



INVENTOR
KARL FRITZ

BY Charles McClair
ATTORNEY

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MAGNETRON

Karl Fritz, Berlin, Germany, assignor to Telefunken Gesellschaft für Drahtlose Telegraphie m. b. H., Berlin, Germany, a corporation of Germany

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5 Claims. (Cl. 250—27.5)

The present invention relates to magnetrons having an even number of anode segments and in which each anode lead is brought out separately through the envelope of the tube.

Tubes of this type are shown in U. S. Patent 1,901,112. In this patent the tube has four anode segments arranged parallel to the tube axis. The two opposite segments are connected with each other across a special oscillatory circuit. In this arrangement each anode segment is adjacent a segment oscillating in phase and a segment oscillating in opposite phase.

In other magnetron arrangements having four anode segments, two oppositely arranged segments are connected to each other by short bends or connections within the tube. These connections have a common oscillatory circuit connected thereto. In such an arrangement each anode segment has on both sides of it a segment oscillating in opposite phase.

The object of the present invention is to provide improved and novel connections for a multi-anode segment magnetron.

The present invention differs from the known arrangements not only in the kind of connections used, but also from an electrical point of view in that it affords a selective excitation of different waves without change in the operating conditions and data of the oscillatory circuit connected thereto.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the accompanying drawing in which Figures 1, 2 and 3 are diagrammatic representations of modifications of a multi-segment magnetron and associated circuit connections made in accordance with my invention.

The magnetron arrangement according to the invention utilizes a tube having an even number of anode parts, in which each anode part or segment is provided with a separate lead brought out through the envelope and is characterized in that each anode segment is connected to a point of a common structure capable of resonance and having distributed inductance and capacity.

Preferably a tube having four anode segments arranged parallel to the axis is used and in accordance with the invention to two directly adjacent anode segments a double wire system is connected which is connected outside the tube to the other oppositely disposed segments.

It was found that the segments can oscillate in push-pull with A_1 and A_3 connected together and A_2 and A_4 connected together as well as in a kind of equal sense with A_1 and A_2 connected and A_3 and A_4 connected. In the last mentioned case the four part magnetron operates in the manner of a two part magnetron. In the gaps between the segments A_1 and A_2 or A_3 and A_4 respectively, practically no alternating potentials appear. This mode of oscillation therefore is possible for oscillations of the first, fourth and higher orders. Experiments have verified these principles.

Figure 1 shows a cross section through a magnetron tube having four anode segments A_1—A_4 disposed parallel to the axis for instance, and which are arranged concentrically to a cathode K. The envelope E containing the electrodes may be surrounded by a coil M for producing the magnetic field. Two opposite segments are connected to each other across a common conductor outside the tube. The conductors L and L' are laid out mainly parallel to each other and cross each other in the center of the parallel wire system which they form. Now by adjusting the operating conditions, the magnetron tube can be made to oscillate and the entire arrangement will be excited so that n waves having a length λ are produced on the arrangement where n represents the numbers 1, 3, 5, etc. Each anode segment is bounded by two other segments oscillating in opposite phase. Hence the segments oscillate in push-pull.

Figure 2 shows a similar arrangement with the exception that the conductors are not crossed. The entire arrangement oscillates so that $2n$ waves having a length λ are produced where $2n$ represents the numbers 2, 4, 6, etc. Each anode segment is bounded by a segment oscillating in opposite phase and by one oscillating in the same phase. Hence the segments oscillate in a kind of equal sense.

The arrangement according to Figure 2 may also be excited so that $n/2$ waves having a length λ are produced. In this case, on the double wire system i. e. in the center thereof a single voltage node (0—0) appears. The segments then oscillate in phase opposition for instance as shown in Figure 1.

Figure 3 shows an arrangement as used in practice. The anode segments A_1—A_4 have leads Z_1—Z_4. Two connections brought out at different sides are connected to each other by circular conductors L_1 and L_2 and L_3 and L_4. In the center of the parallel wire line the conductors are interrupted and connected to a switch U. By means of

this switch there can be connected at will L_1 with L_2, and L_3 with L_4 (dotted line) or L_1 with L_3 and L_2 with L_4 (dash lines).

In the schematic Figures 1 and 2, two examples of the potential distribution are shown which can be obtained on the parallel wire system.

The signs (+) indicate voltage maxima, and the signs (—) represent voltage minima. The voltage nodes are symbolically shown by **0—0**. The lengths (wave lengths λ) in conjunction with the order numbers relate generally to the electrically effective lengths, and only in part to the geometrical lengths.

Now in order to stabilize the shortest wave to be produced in a tube with for instance four anode segments, the two oppositely situated segments are connected with each other by means of short bends or conductors. The natural frequencies of these small circuits whose capacity is formed by the mutual capacity of the segments, and whose induction is formed by the bends or conductors approximately conform with the frequency of the shortest oscillations to be produced.

The arrangement according to the invention is suited especially for test transmitters which can be rapidly switched, and for purposes of reception. Without the necessity of changing the electrical and magnetic data and simply by operating the switch U, the type of oscillation can be changed for instance from 50 cm. to 25 cm., from 50 cm. to 100 cm. etc.

The idea of the present invention is not confined to the use of magnetron tubes whose segments are arranged parallel to the axis, or to the use of four segments. The anode parts may also be formed of hollow cylinders or annular rings of equal diameter, arranged coaxially to the cathode.

I claim:

1. An electron discharge device having an envelope containing a straight thermionic cathode, a plurality of pairs of anode segments surrounding said cathode, means for producing a magnetic field parallel to and surrounding said cathode and conductors forming loops each electrically connected between two different anode segments, said conductors lying parallel to each other throughout the greater portion of their length and constituting with the anode segments an oscillating circuit.

2. An electron discharge device having an envelope containing a straight thermionic cathode, a plurality of pairs of anode segments surrounding said cathode, means for producing a magnetic field parallel to and surrounding said cathode and conductors forming loops each electrically connected between two different anode segments, said conductors lying parallel to each other throughout the greater portion of their length and constituting with the anode segments an oscillating circuit, said conductors having approximately the same length.

3. An electron discharge device having an envelope containing a straight thermionic cathode and a plurality of pairs of oppositely disposed anode segments surrounding said cathode, means for producing a magnetic field parallel to and surrounding said cathode and separate conductors each forming a loop electrically connected between each pair of oppositely disposed anode segments, said conductors lying parallel to each other throughout the greater portion of their length and of approximately the same length, and providing with the anode segments an oscillating circuit.

4. An electron discharge device having an envelope containing a straight thermionic cathode and a plurality of pairs of oppositely disposed anode segments surrounding said cathode, means for producing a magnetic field parallel to and surrounding said cathode and separate conductors, each conductor forming a loop and being electrically connected between one of each pair of opposite disposed anode segments, said conductors being approximately the same length and parallel to each other throughout the greater portion of their lengths, and providing with the anode segments an oscillating circuit.

5. An electron discharge device having an envelope containing a straight thermionic cathode, a plurality of pairs of anode segments surrounding said cathode, means for producing a magnetic field parallel to and surrounding said cathode and conductors forming loops and each electrically connected between two different anode segments, said conductors lying parallel to each other throughout the greater portion of their length to provide with the anode segments an oscillating circuit, said conductors being about the same length and arcuate in shape.

KARL FRITZ.