

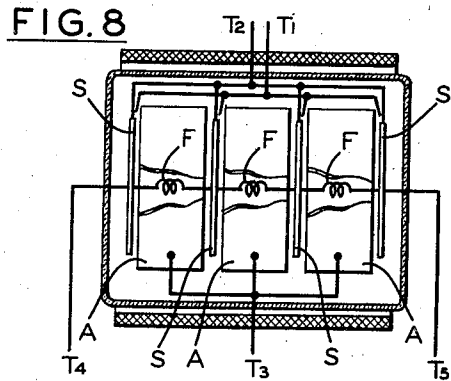
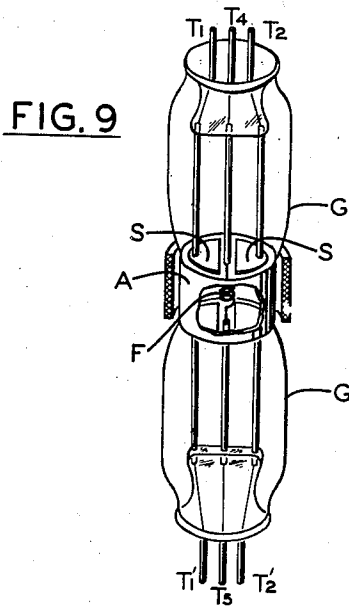
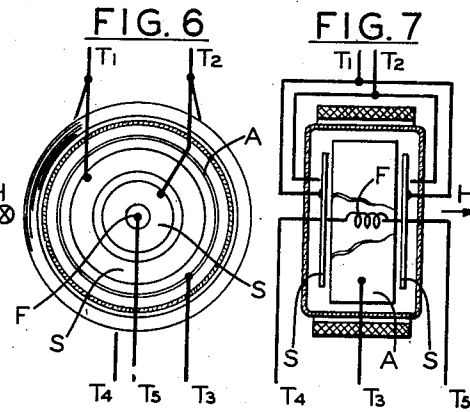
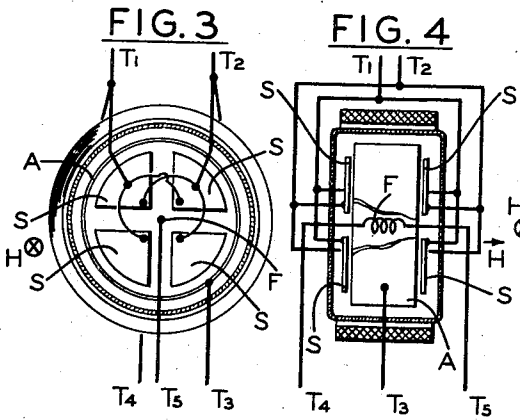
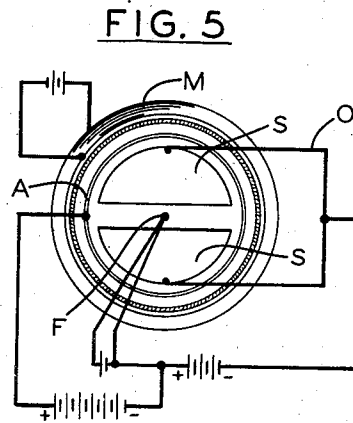
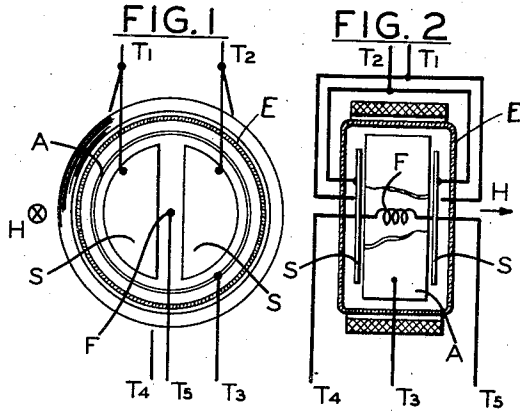
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K. OKABE

2,187,172

VACUUM TUBE

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INVENTOR.  
KINJIRO OKABE

BY  
*Charles McClair*  
ATTORNEY

## UNITED STATES PATENT OFFICE

2,187,172

## VACUUM TUBE

Kinjiro Okabe, Ashiya, Japan, assignor to Radio Corporation of America, New York, N. Y., a corporation of Delaware

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9 Claims. (Cl. 250—27)

My invention relates to vacuum tubes having a particular structure to which a magnetic field is applied.

The main object of my invention is to provide vacuum tubes of higher efficiency and greater output, producing ultra short wave or micro wave oscillations.

The invention may be understood more readily from the following detailed description when considered in connection with the accompanying drawing and those features of the invention which are believed to be novel and patentable will be pointed out in the claims appended hereto. In the drawing Figure 1 shows an end view of an electron discharge device made according to my invention; Figure 2 is a side view of Figure 1; Figures 3 and 4 are end and side views of a modification of my invention; Figure 5 is a schematic diagram of an electron discharge device made according to my invention and its associated circuit; Figures 6 and 7 are views of further modifications of an electron discharge device made according to my invention; and Figures 8 and 9 show still further modifications of an electron discharge device made according to my invention.

Referring now more in detail to the drawing, it will be seen that the like reference characters are being utilized throughout the drawing to designate the like parts, that is to say, A, F and S designate respectively anodes on which higher voltages are to be impressed, thermionic cathodes to emit electrons, and oscillating electrodes kept at zero or negative potentials and to be connected to oscillation circuits. The electrodes are positioned within an exhausted envelope E. T<sub>1</sub> to T<sub>5</sub> designate terminals of all electrodes while H designates the directions toward which magnetic fields to be applied are directed. The magnetic field coil M produces a magnetic field parallel to the cathode and between the cathode and anode.

Referring now to Figs. 1 to 4 inclusive, the anode A serves mainly to accelerate electrons while oscillations are caused by electrodes S which are disposed about both ends of said anode and are divided into two or more parts, thereby producing oscillations of a high efficiency.

In Fig. 5 a typical connection for these electrodes is shown. O and M are respectively an oscillation circuit and a magnetic field coil. In the state of non-oscillation, if an intensity in the magnetic field exceeds a critical value there may flow substantially no current in A. When the length of the oscillation circuit, voltages, and hot cathode current are adjusted, there may arise oscillations the wave lengths of which are mostly

determined by O only and at the same time the current may flow both in S and A. The oscillators having such characteristics operate with high efficiency.

Figures 6 and 7 show an instance in which the electrode S is divided into rings, while Fig. 8 shows an instance in which three groups of such electrodes as shown in Fig. 1, are arranged side by side in the axial direction for the purpose of increasing the output. Fig. 9 shows a vacuum tube of water cooling type arranged according to my invention. G are the glass walls. By connecting the wall directly to the anode A the said anode may be cooled directly from without thereby affording a great output. The oscillation circuits may be formed by connecting between T<sub>1</sub> and T<sub>2</sub>, and between T'<sub>1</sub> and T'<sub>2</sub>.

Summing up, vacuum tubes according to my invention have such features that they will operate with a high efficiency, generating ultra-short waves or micro waves of great output. It will be readily understood that vacuum tubes of my invention may also be employed for super-regenerative receiving tubes of ultra-short waves or micro waves.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electron discharge device including a thermionic cathode, a cylindrical anode surrounding and coaxial with said cathode, a pair of output electrodes positioned adjacent one end of said cylindrical anode and closing the end of said anode and lying in a plane transverse to the axis of said cathode and anode and means for producing only a single magnetic field parallel to and between said cathode and cylindrical anode.

2. An electron discharge device including a thermionic cathode, a cylindrical anode surrounding and coaxial with said cathode, a plurality of segmental output electrodes positioned adjacent each end of said cylindrical anode and lying in planes transverse to the cathode and said anode, and means for producing only a single magnetic field parallel to and between said cathode and cylindrical anode.

3. An electron discharge device including a thermionic cathode, a cylindrical anode surrounding and coaxial with said cathode, a plurality of segmental output electrodes positioned adjacent each end of said cylindrical anode and closing the end of the anode and lying in planes transverse to the cathode and said anode, and means for producing only a single magnetic field parallel to and between said cathode and cylindrical anode.

4. An electron discharge device having a ther-

thermionic cathode and a cylindrical anode surrounding and coaxial with said cathode, a pair of ring-like output electrodes positioned adjacent and closing the end of said cylindrical anode and lying in a common plane transverse to the cathode and said anode, and an electromagnetic field producing coil surrounding and coaxial with said cathode and cylindrical anode, for producing a single magnetic field parallel to and between said cathode and cylindrical anode.

5. An electron discharge device having a thermionic cathode and a cylindrical anode surrounding and coaxial with said cathode, a pair of ring-like output electrodes positioned adjacent each end of said cylindrical anode and closing the ends of said cylindrical anode and lying in planes transverse to the cathode and said anode, and an electromagnetic field producing coil surrounding and coaxial with said cathode and cylindrical anode, for producing a single magnetic field parallel to and between the cathode and the anode.

6. An electron discharge device having an elongated thermionic cathode, a plurality of cylindrical anodes surrounding and coaxial with said cathode and disposed longitudinally along said cathode, and a plurality of output electrodes positioned adjacent the ends and between said cylindrical anodes, said output electrodes lying in planes transverse to the axis of the cathode and circular anodes, and means for producing a magnetic field parallel to and between said cathode and cylindrical anodes.

7. An electron discharge device having an elongated thermionic cathode, a plurality of cylindrical anodes surrounding and coaxial with said

cathode and displaced longitudinally along said cathode, and a plurality of output electrodes positioned adjacent the ends and between said cylindrical anodes, said output electrodes lying in planes transverse to the axis of the cathode and circular anodes, and means for connecting said output electrodes in parallel and other means for connecting said circular anodes in parallel, and means for producing a magnetic field parallel to and between said cathode and cylindrical anode.

8. An electron discharge device including a thermionic cathode, a cylindrical anode surrounding and coaxial with said cathode, a pair of output electrodes positioned adjacent each end of said cylindrical anode and closing the ends of said anode and lying in planes transverse to the axis of said cathode and anode, and means for producing only a single magnetic field parallel to and between said cathode and cylindrical anode, and an oscillating output circuit connected between said output electrodes.

9. An electron discharge device comprising a thermionic cathode, a cylindrical anode surrounding and coaxial with said cathode, a plurality of segmental output electrodes positioned adjacent the end of said cylindrical anode and lying in a plane transverse to the cathode and said anode, an output circuit connected between said output electrodes, and a connection between said output circuit and said cathode, and means for biasing said output electrodes negatively with respect to said cathode and said circular anode positively with respect to said cathode.

KINJIRO OKABE. 35