Jan. 16, 1940. K. OKABE 2,187,171

VACUUM TUBE FOR MICROWAVES OR ULTRA-SHORT WAVES

Filed May 1, 1937

Fig. 1

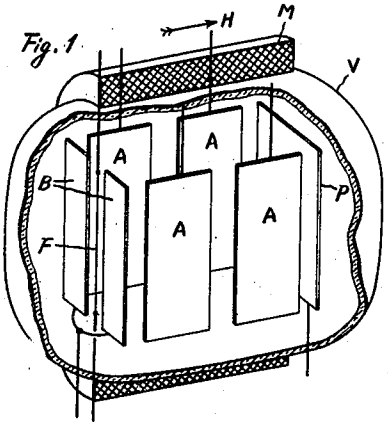


Fig. 2

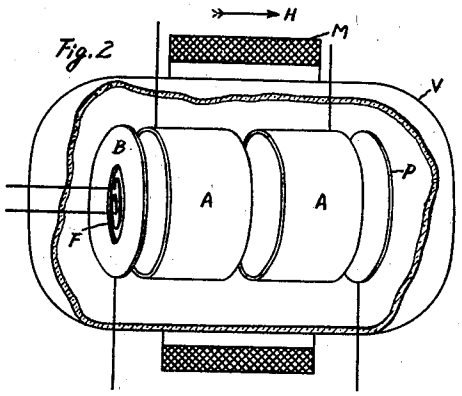


Fig. 3

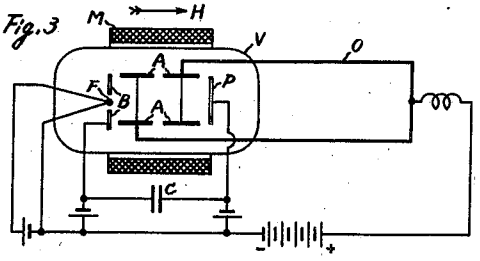


Fig. 4

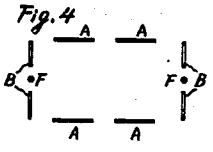


Fig. 5

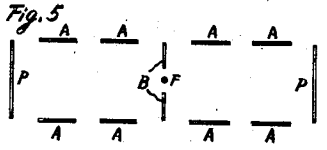


Fig. 6

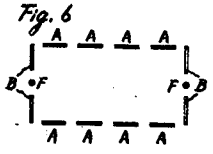
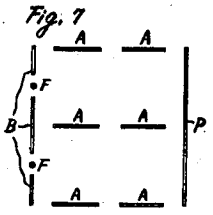


Fig. 7



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UNITED STATES PATENT OFFICE

2,187,171

VACUUM TUBE FOR MICROWAVES OR ULTRA-SHORT WAVES

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Application May 1, 1937, Serial No. 140,130
In Japan June 4, 1936

4 Claims. (Cl. 250—27.5)

My invention relates to vacuum tubes useful in generating oscillations of extremely high frequencies and in amplifying or detecting the same. More particularly my invention relates to vacuum tubes which function under the influence of magnetic fields.

The main object of my invention is to provide a vacuum tube which generates efficiently intensive oscillations of extremely high frequency as, for example, micro waves or ultra short waves and which makes it possible to amplify or detect the same with high stability.

Further objects and advantages of my invention will be understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 represents an arrangement of electrodes illustrating one embodiment of my invention, while Fig. 2 represents an other embodiment thereof; Fig. 3 is a circuit diagram therefor; Figs. 4 to 7 inclusive show other modifications of the electrode arrangement.

In all figures V are the walls of vacuum tubes, F are heating filaments, A are anodes, P and B are electrodes to be impressed with negative or low voltage, that is, P being allotted to that far from F, while B to that near F, M designates electromagnetic means for producing the magnetic field and H shows the direction of the applied magnetic field. In case of a cylindric structure as is shown in Fig. 2 the said magnetic field is to be applied in the axial direction of said cylinder or the direction proximate thereto. O is a principal oscillation circuit, C is a condenser for forming an auxiliary oscillation circuit between B and P. I have found, however, that the tube could be put into oscillation satisfactorily, in some cases, even if this auxiliary oscillation circuit were omitted. Consequently it may require no auxiliary electrode in such cases.

The electrode arrangements shown in Figs. 4–7 may be inferable directly from the like arrangement given in Fig. 1. Figs. 4 and 6 are plan views showing cases where each heating filament is arranged at right and left ends. Fig. 5 is a like view showing the case where the said filament is centrally disposed. Fig. 7 is also a like view showing the case where two sets of electrode arrangements shown in Fig. 1 are arranged in juxtaposition.

If P or B are used as modulating electrodes they require extremely small modulating energy. It is apparent that micro-waves or ultra short waves may be amplified and detected with a high stability by employing the oscillator embodying the present invention as a super-regenerative receiver.

In short, my invention resides in providing a unique vacuum tube for extremely high frequency as, for example, micro-waves or ultra short waves, by utilizing a magnetic field, that is, by causing thermoelectrons from heating filaments to take a reciprocating movement, taking a long spiral passage.

I have chosen the particular embodiments described above as illustrative of my invention and it will be apparent that various other modifications may be made without departing from the spirit and scope of my invention which modifications I am to cover by the appended claims.

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

1. An electron discharge device for use at high frequencies, having an envelope provided with a major axis, oppositely disposed electrodes within said envelope and spaced apart along said axis, a cathode adjacent one of said electrodes for supplying electrons to the space between said electrodes, additional electrodes positioned about said major axis and spaced along said axis between the first mentioned oppositely disposed electrodes, and means for providing a magnetic field parallel and around said axis and transverse to the first mentioned oppositely disposed electrodes.

2. An electron discharge device having an envelope provided with a major axis, a plurality of oppositely disposed electrodes spaced apart along said axis, a cathode for supplying electrons to the space between said electrodes and lying in a plane passing through one of said electrodes, a plurality of additional electrodes positioned between the oppositely disposed electrodes and spaced along said major axis, and means for inducing a magnetic field parallel to and around said major axis between said additional electrodes and transversely to said oppositely disposed electrodes.

3. An electron discharge device having an envelope provided with a major axis, a cathode and an electrode positioned along said axis and spaced apart, additional electrodes adjacent said cathode and lying in a common plane with said cathode, a plurality of electrodes positioned about said major axis and spaced along said axis between the cathode and said first electrode, and means for inducing a magnetic field parallel to and around said major axis between said additional

electrodes and transverse to said first mentioned electrode and said cathode.

4. An electron discharge device having an envelope provided with a major axis, a cathode and an electrode positioned along said axis and spaced apart, electrodes adjacent said cathode and lying in a plane passing through said cathode, a pair of cylindrical electrodes coaxial with said major axis and spaced along said axis between said cathode and first mentioned electrode, and means for inducing a magnetic field parallel to said major axis within said cylindrical electrodes and transverse to said cathode and said first mentioned electrode.

KINJIRO OKABE.