July 20, 1943. W. T. GIBSON 2,324,772

ELECTRON DISCHARGE APPARATUS

Filed May 8, 1940

FIG.1.

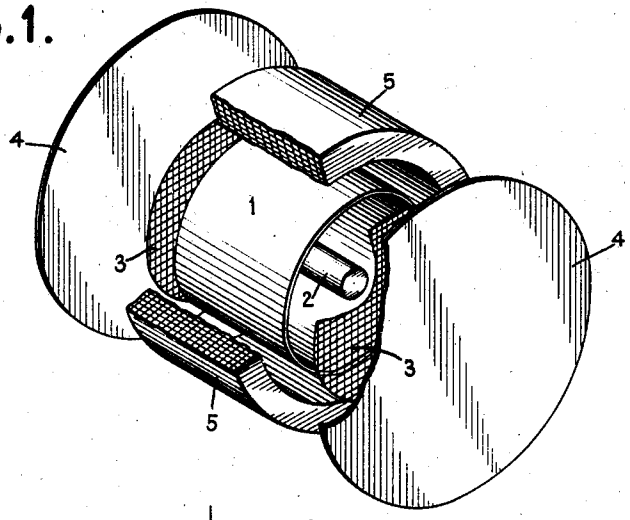


FIG.2.

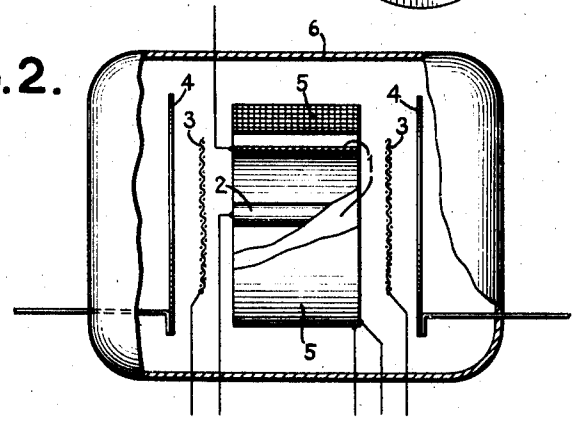
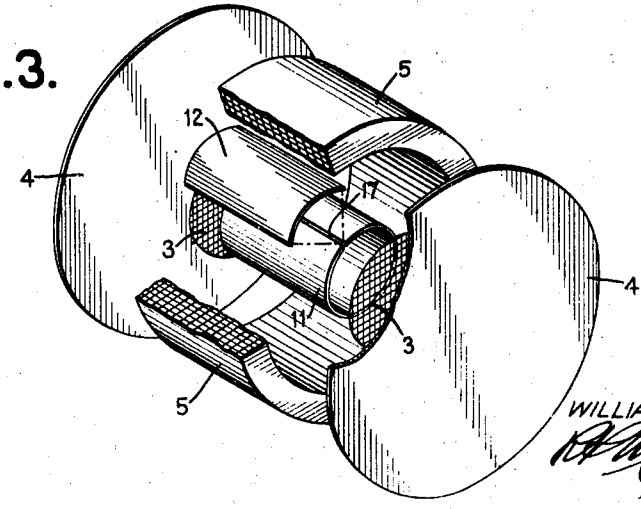


FIG.3.



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ELECTRON DISCHARGE APPARATUS

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3 Claims. (Cl. 250—27.5)

In electron discharge apparatus and particularly in oscillators and amplifier valves for use at very high frequencies a limit is often set by the total emission available from the cathode being inadequate. The cathode current may only flow for a relatively short portion of the cycle, but the cathode watts and area must be adequate to provide the peak emission required at this moment. The watts and area have perhaps to be five or six times as large as would be necessary to provide an emission current continuously equal to the average value of the current required. This involves a general increase in dimensions and capacity, which again set limits in operation.

It has been proposed (French patent specification No. 838,404) to overcome this difficulty by providing a space around a cathode in which electron oscillations may occur so that electrons continuously withdrawn from the cathode are stored up as oscillating space charge and extracted as required by the main oscillating grid.

In the electron discharge apparatus of the invention a rotating space charge is arranged to serve as a reservoir from which electrons can be abstracted under the control of an oscillating electrode. The rotating space charge may be set up within a hollow cylinder by means of an axial magnetic field acting upon transversely moving electrons.

The electron discharge apparatus may comprise within an evacuated envelope a cathode, an electrode adapted when suitably polarised to draw or direct electrons from the cathode into a space in which a transverse magnetic field can be set up to deflect the electrons into a circular path and an electrode system so disposed with respect to said space that the electrons stored therein can serve as an electron source for said system.

In the drawing,

Figs. 1 and 2 are perspective and side views respectively, illustrating one example of the invention, showing an electron discharge device, partly broken away to indicate the relation of electrodes.

Fig. 3 is a perspective view showing a modification of the device of Figs. 1 and 2.

In the form of the invention illustrated in Figs. 1 and 2, an electron discharge device or valve includes a hollow cylindrical electrode or drum 1 containing an axial electron emitting cathode 2. At one or both ends is a perforated grid 3, and outside this an anode 4. The electrodes 3 and 4 may be circular discs.

The drum is normally maintained at a high positive potential with respect to the cathode, and grid 3 is negative to the cathode. Anode 4 is at a high positive potential. Electrodes 3 and 4 may be connected to an oscillatory circuit, or grid 3 may be driven from a separate oscillator. The whole device is placed in a magnetic field parallel to the axis of the drum, the field being produced by the magnet coil 5, and the elements 1 to 5, being enclosed in an evacuated envelope 6, Fig. 2.

In operation, electrons are emitted from the cathode 2 and are accelerated towards drum 1 but the magnetic field is adjusted to such a value that the electrons are unable to reach the drum but circulate in the space as a space charge. At the moment of the cycle that grid 3 is driven positive this space charge is withdrawn from the drum and passes to anode 4.

As the space charge will be largely concentrated in a revolving circular orbit, it is possible to make the grid and anode as circular rings or annular discs with consequent reduction of capacity.

In the form of the invention shown in Fig. 3, the cathode 12 is located outside the drum 11, which is provided with a slot 17 along one side parallel to its axis, the other elements 3, 4 and 5 corresponding with those in Figs. 1 and 2. Electrons from the cathode 12 are focussed into the interior of drum 11 through the slot 17 and are then caused to rotate in circles in the drum in the magnetic field produced by coil 5.

What is claimed is:

1. In an evacuated vessel, a generally cylindrical electrode having a generally longitudinally extending aperture, a cathode outside said cylindrical electrode, means for passing electrons emitted from said cathode thru said aperture, and means for producing a magnetic field within said electrode and substantially coaxial therewith.

2. An electron discharge device including a cathode, a hollow cylindrical electrode coaxially disposed about said cathode for operation with a positive potential with respect to said cathode, means for setting up an axial magnetic field within said cylindrical electrode, a grid electrode disposed over an open end of said cylindrical electrode, and a plate electrode on the side of said grid electrode remote from said cylindrical electrode.

3. An electron discharge device including a cathode, a hollow cylindrical electrode having an opening in the side thereof, means for directing electrons from said cathode into the interior of said hollow cylindrical electrode through said opening, means for setting up an axial magnetic field within said cylindrical electrode, a grid electrode disposed over an end of said cylindrical electrode, and a plate electrode on the side of said grid electrode remote from said cylindrical electrode.

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