May 11, 1937. K. STEIMEL 2,080,098

ELECTRON DISCHARGE TUBE

Filed Dec. 20, 1933

Fig. 1

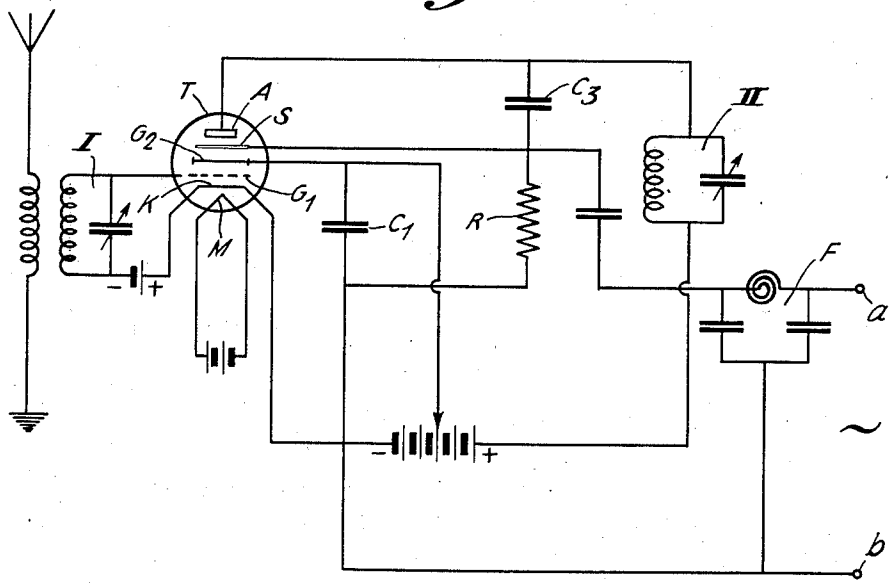


Fig. 2

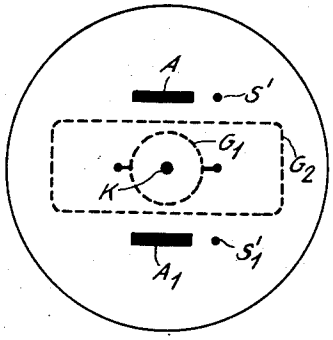
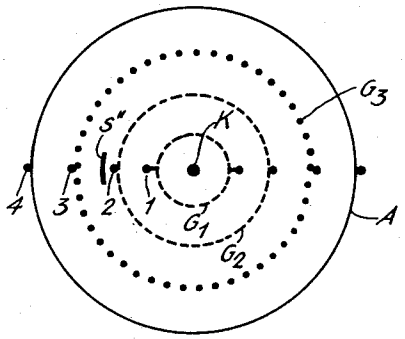


Fig. 3



INVENTOR
KARL STEIMEL

BY

ATTORNEY

Patented May 11, 1937 2,080,098

UNITED STATES PATENT OFFICE

2,080,098

ELECTRON DISCHARGE TUBE

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

Application December 20, 1933, Serial No. 703,239
In Germany January 9, 1933

6 Claims. (Cl. 250—27.5)

The present invention relates to electron tubes and circuits therefor, and more particularly is concerned with a tube of the screen-grid type which is supplementarily equipped with a rectifier path.

Apparatus used for reception and demodulation of electrical oscillations, especially with the use of circuit arrangements designed to insure volume control, can be built far more favorably if the demodulation or rectification is effected in a distinct rectifier without amplification, such as a two-electrode or diode tube. It has been suggested to combine such rectifier together with an amplifier system in one and the same vacuum vessel so that both systems to be sure, constitute a constructional unit, while yet remaining separate as regards their electrical effects. The amplifying and the rectifying systems must then be disposed adjacent to each other over a sufficiently long cathode. The audio frequency derived from the rectifier, after being smoothed out or filtered to eliminate the radio frequency components, is fed to the control grid of the amplifier portion. A marked disadvantage of this arrangement consists in that the length of the cathode must be greater than that for the amplifying system alone, and that, basically speaking, what is involved is a twin-system confined inside one and the same glass bulb and comprising two distinct and independent discharge paths or gaps, a construction which is complicated.

Now, this and other disadvantages are readily obviated by the present invention. The rectifying path is no longer accommodated in the tube which is to amplify the audio frequency formed thereby, but rather in the preceding tube which amplifies the radio frequency energy. The rectifier anode is no longer disposed directly adjacent the cathode, but consists of a probe electrode formed by a piece of wire or a strip of sheet material, and which, in a tube of the screen-grid type is located at the plate side or end of the screen-grid.

The fundamental application of the basic idea of the invention is as follows: In a screen-grid tube comprising at least a cathode, a control grid, a screen grid and a plate, there is mounted a further electrode at the plate side of the screen grid which serves for the rectification of the radio frequency current. Preferably said auxiliary electrode has no direct current biasing potential at all, or at most only one of small value. Now, this electrode should, if possible, be arranged so that it will not disturb the potential conditions in the tube. Furthermore, since it receives the radio frequency potential from the plate, it must be capacitively shielded from the control grid just as thoroughly as the plate.

The present invention will best be understood by reference to the following description taken in connection with the accompanying drawing in which,

Fig. 1 shows schematically an electron tube and its associated circuits in accordance with the invention,

Fig. 2 is a diagrammatic showing in cross section of another form of electron tube that may be used in the circuit of Fig. 1, and

Fig. 3 is a further modification.

Referring now more specifically to Figure 1 which shows the fundamental principle of the arrangement, the electron tube T is shown to comprise a heater M, cathode K, control grid G_1, screen grid G_2, probe electrode S and anode or plate A. The grid G_1 which is closest to the cathode K is fed with the incoming alternating voltage from the tuned circuit I. The second or screen grid G_2 receives a constant positive potential and is in short-circuited relation with the cathode by the condenser C_1. The plate circuit includes an oscillation circuit II which is also tuned to the input frequency. The radio frequency potential set up in this oscillation circuit is fed to the probe electrode S in a suitable manner, say, by a resistance-condenser coupling, R, C_3. By virtue of the rectifier action there will then be occasioned across the low frequency impedance, resistance R, an audio frequency voltage which may thereafter be impressed upon the next stage, say, by way of a radio frequency filter network, such as F. The audio frequency output terminals are indicated by the letters *a* and *b*.

The embodiment hereinbefore disclosed may be varied in various way whenever electron tubes containing a greater number of grids are used. For instance, there could be used a screen-grid tube furnished with a retarder or suppressor grid. What is here meant by a retarder or suppressor grid is an electrode whose potential is negative in reference to the electrodes previously passed by the current of electrons. Such a retarding grid is mounted, for example, posteriorly of the screen grid, and by regulation of its potential it allows of regulating and influencing the slope of the plate-current characteristic, referred to the potential of the control grid. In this instance, it would be preferable to mount the probe electrode between the screen grid and the retarding grid.

In Figures 2 and 3 are shown certain constructional ways of disposing the probe electrode so that its reaction upon the amplifying system will be as small as possible.

In Figure 2 is shown a tube having a cathode K, a cylindrical control grid G_1 and a box-shaped screen-grid G_2 as well as two plate anodes A and A_1. The probe electrodes S' and S_1' are disposed laterally in reference to the plate anodes; the electronic current needed for rectification is so small that the plate current is not appreciably weakened thereby.

In Figure 3 is shown the arrangement of a probe electrode inside a screen-grid tube provided with a retarding or suppressor grid. In this case the probe electrode S'' is disposed between the screen-grid G_2 and the suppressor grid G_3, the probe electrode simply consisting of a strip of sheet material positioned parallel to the cathode K and in the plane of the electrode supporting stays, 1, 2, 3, 4. The control action of the various electrodes in the plane of the stays is disturbed anyway, so that the disposition therein of a probe electrode will not produce any appreciable influence.

What is claimed is:

1. An electron discharge tube comprising a cathode, substantially coextensive grid and anode electrodes cooperating therewith and constituting an amplifier of radio frequency oscillations, and a linear probe electrode interposed in the space between cathode and anode, and arranged in parallel relation to and substantially coextensive with the cathode, said probe electrode adapted to cooperate with the cathode and anode to rectify the amplified radio frequency oscillations.

2. An electron discharge tube comprising a cathode, a signal control grid and a screen grid substantially coextensive with and surrounding the cathode, and amplifier and rectifier anodes substantially coextensive with the aforesaid electrodes disposed one within the other outside the screen grid.

3. An electron discharge tube comprising a cathode, a signal control grid and a screen grid substantially coextensive with and surrounding the cathode, an amplifier anode in the form of a plate disposed outside the screen grid and a rectifier anode in the form of a rod also disposed outside the screen grid but adjacent the amplifier anode and in the electron path between the cathode and said amplifier anode.

4. An electron discharge tube comprising a cathode, a signal control grid and a screen grid surrounding the cathode, an amplifier anode in the form of a cylinder surrounding the screen grid, and a rectifier anode in the form of a narrow metal strip interposed between the screen grid and the amplifier anode.

5. An electron discharge tube comprising a cathode, a signal control grid and a screen grid surrounding the cathode, an amplifier anode in the form of a cylinder surrounding the screen grid, and a rectifier anode in the form of a narrow metal strip interposed between the screen grid and the amplifier anode, support rods for the grids and the amplifier anode all arranged in a common plane, and said rectifier anode being disposed in substantially the plane of electrode support rods.

6. An electron discharge tube for the simultaneous amplification and rectification of high frequency currents comprising a cathode, an anode and a plurality of control electrodes interposed therebetween, said mentioned electrodes being substantially coextensive with said cathode and adapted to amplify high frequency currents, and a probe electrode in the form of a metal strip disposed immediately adjacent said anode, coextensive with and parallel thereto, and cooperating therewith and with the cathode to rectify the amplified high frequency currents.

KARL STEIMEL.