June 15, 1926. 1,588,813

W. SCHEPPMANN

OSCILLATION CIRCUITS

Filed August 31, 1921

Fig.1.

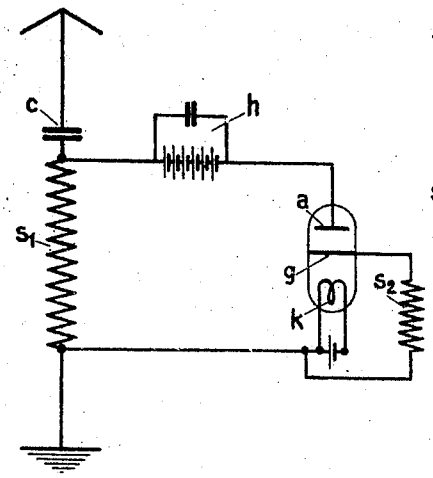



Fig.2.

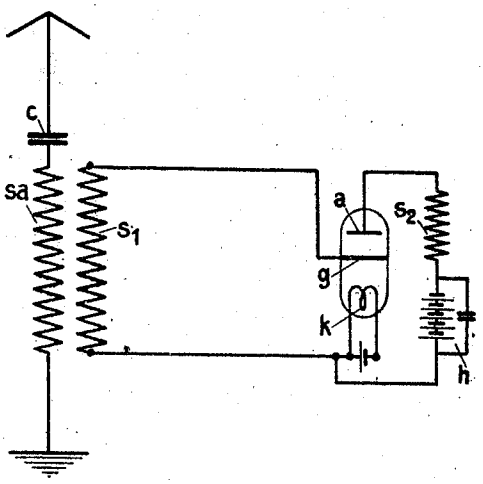



Fig.3.

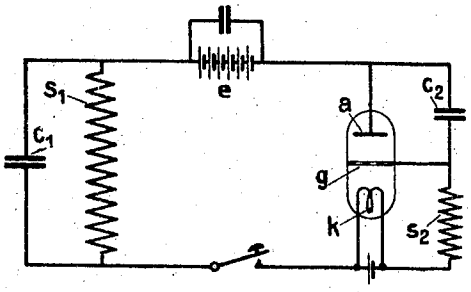
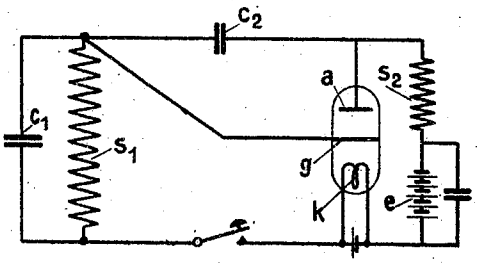



Fig.4.




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# UNITED STATES PATENT OFFICE.

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## OSCILLATION CIRCUITS.

Application filed August 31, 1921, Serial No. 497,316, and in Germany November 29, 1917.

It has become known in the use of ray tubes with an auxiliary electrode as generators for the production of undamped electric oscillations, that the auxiliary electrode as well as the anode must be coupled with an oscillation circuit in order on the one hand, to transmit to the oscillation circuit the energy produced by the tube and, on the other hand to conduct again to the tube, part of the oscillating energy which exists in the oscillation circuit to excite the tube for producing undamped oscillations. Generally in this practice the two self inductances for the connection of the auxiliary electrode and of the anode with the filament are both inserted in one oscillation circuit. These methods suffer from the inconvenience that the energy which is returned to the tube for the purpose of control must not exceed certain limits if the best efficiency has to be ensured. These arrangements can therefore not be used for a great wave range and for different degrees of energy without an alteration of the return coupling of the tube with the oscillation circuit. This is particularly disturbing as, amongst others, the alteration has to be made by relatively moving coupled coils whose position is determined by the condition that they couple themselves in a degree determined by their relative positions.

A further inconvenience is caused by the coupled coils as comparatively a large amount of material is thus introduced into the field of self-induction of the oscillation circuit so that an unnecessary damping of this oscillation circuit and unnecessary losses in the same are caused which is noxious specially when the tube is used for receiving purposes.

These inconveniencies are avoided, according to this invention, by the arrangement that of the two self-inductances, of which one connects the auxiliary electrode and the other the anode with the cathode, only one is coupled with the primary oscillation circuit or forms a part of this oscillation circuit. Consequently the two self-inductances are connected only through the intermediary of the anode and of the auxiliary electrode (grid) in contradistinction to the arrangement mentioned above in which the two self-inductances are enclosed in one closed common circuit. The following result is obtained from the insertion of only one of the two self-inductances in the primary oscillation circuit or from the coupling of this one self-inductance with said primary oscillation circuit.

In order to excite the tube for the production of oscillations it is necessary that between cathode and anode or auxiliary electrode a periodic pressure difference be produced which determines the rhythm in which the oscillations are produced. The rhythm itself is determined by the electric value of the circuits between the cathode and anode and between the cathode and grid. To produce this necessary pressure difference it is sufficient to insert a self-inductance between the cathode and one of the other electrodes, the energy produced being taken from the cathode and from the electrode which is still free.

The arrangement can be used not only for the sending of energy but also as receiver in which case relay-action occurs in the well known manner.

Figures 1 and 2 of the accompanying drawing show by way of example two connections for the execution of the method, while Figs. 3 and 4 correspond with the modes of connection shown in Figs. 1 and 2 with the exception that between the anode and grid a fixed condenser is inserted.

In the connection shown by Fig. 1 the cathode $k$ and the anode $a$ are coupled with the oscillable primary system (antenna), the cathode $k$ and the anode $a$ being connected with the antenna self-inductance $s_1$ across the high-tension battery $h$ provided with the parallel condenser. The primary oscillation system is completed by the tuning condenser $c$. A self-inductance is inserted between cathode and grid whereby the grid $g$ obtains a pressure difference with regard to $k$.

In this connection the self-inductance which is coupled with the primary circuit (antenna) forms therefore a part of the same.

According to Fig. 2 the connection can be arranged so that grid $g$ and cathode $k$ are coupled with the oscillable primary system $s_a c$ by a self-inductance $s_1$, whilst the anode is connected with the cathode by the coil $s_2$ across the battery $h$.

The value of the self-inductance which does not form part of the oscillation system depends within certain limits on the wave

length but it is not critical. Under certain conditions the value of self-induction resulting from the connecting conduits between the electrodes will be sufficient.

The hereinbefore described connections can be utilized, according to a further object of the invention, by bridging the anode and the grid over by a condenser, whilst only one of the self-inductances situated between the auxiliary electrode and cathode or between the anode and cathode is coupled with the oscillation circuit or forms part of the same.

By the bridging over of anode and auxiliary electrode by means of a capacity a mode of connection is obtained in which a circuit anode-cathode self-inductance is produced which is not coupled with the primary oscillation circuit and which serves exclusively for the control of the electron tube.

Herefrom result the forms of construction of the invention which are shown by way of example on Figs. 3 and 4. They correspond with the modes of connection shown on Figs. 1 and 2 with the exception that between anode $a$ and auxiliary electrode $g$ a fixed condenser $c^2$ is inserted. The coil $s^2$, not coupled with the self-inductance $s^1$ of the primary oscillation circuit ($c_1$ $s_1$) is situated according to Fig. 3 between the cathode $k$ and the auxiliary electrode $g$, and according to Fig. 4 between the cathode $k$ and the anode $a$, $c'$ is the tuning capacity of the oscillation circuit, and $e$ is a source of high-tension with parallel-condenser.

The following operation results from this connection:

When the key indicated in the connection arrangements (Figs. 3 and 4) is depressed the condenser $c^2$ is recharged from the high tension battery $e$ across the coil $s^2$, whereupon the condenser discharges over the electron tube and coil $s^2$. In this manner a tension is produced at the auxiliary electrode $g$ which can be utilized for the control of the electron tube.

A special advantage of the mode of connection shown by Figs. 2 and 4 consists in this that the damping influence of a special return coupling coil is avoided in the oscillation circuit $c^1$ $s^1$. This arrangement permits further to connect, at the production of auxiliary oscillations, the auxiliary electrode $g$ which is generally constructed as a grid with the total tension of the coil $s^1$ of the oscillation circuit whereby under receiving conditions the maximum intensity of sound is realized. The mode of connection shown by Fig. 4 can be utilized obviously as a connection for heterodyne reception.

I claim:—

1. In an electron tube system for the generation of electrical oscillations, the combination of an electron tube having grid, filament and plate electrodes, an oscillation circuit, an inductance connected across said plate and filament electrodes and connected with said oscillation circuit, a fixed condenser connected between said grid and plate electrodes, and an inductance element connected between said grid and filament electrodes and substantially independent of said aforementioned inductance, said last mentioned inductance having such value that damping losses in said oscillation circuit are balanced and an alternating current resistance is established between said grid and filament electrodes for securing a potential difference between said grid and filament electrodes for setting up oscillations in said oscillation circuit.

2. In a system for the production of electrical oscillations the combination of an electron tube having grid, filament and plate electrodes, a plurality of inductance elements, one of said inductance elements being connected between the plate and filament electrodes of said electron tube, and the other inductance element being connected between the grid and filament electrodes of said electron tube, an oscillation circuit connected with said first mentioned inductance element, a fixed condenser connected in series with said second mentioned inductance element and shunted across said grid and plate electrodes, the values of said second mentioned inductance and said fixed condenser being so chosen that the damping losses in said oscillation circuit are balanced and a potential difference is normally established between said grid and filament electrodes for setting up an alternating current resistance therebetween for the generation of oscillations in said oscillation circuit.

3. In a system for the generation of electrical oscillations the combination of an electron tube having grid, filament and plate electrodes, a pair of inductance elements, one of said inductance elements being connected across said plate and filament electrodes and the other of said inductance elements being connected across said grid and filament electrodes, an oscillation circuit, and a connection between said oscillation circuit and said first mentioned inductance element only, a fixed capacity connected across said grid and plate electrodes, the values of said capacity and said second mentioned inductance each being selected to balance the losses existent in said oscillation circuit and to establish a phase displacement of 180 degrees between the currents in said first and second mentioned inductances for the generation of oscillations in said oscillation circuit.

In testimony whereof I have signed this specification.

WILHELM SCHEPPMANN.