April 28, 1925. 1,535,674

D. G. McCAA

APPARATUS FOR PRODUCING OSCILLATIONS

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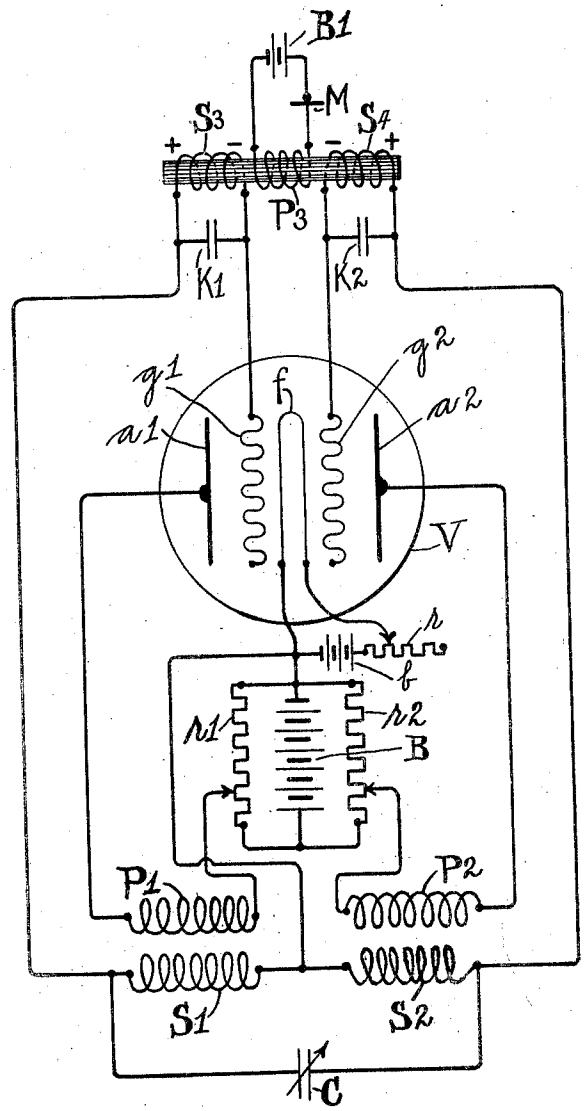

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR PRODUCING OSCILLATIONS.

Application filed January 12, 1921. Serial No. 436,668.

To all whom it may concern:

Be it known that I, DAVID G. McCAA, a citizen of the United States, residing in the city of Lancaster, county of Lancaster, State of Pennsylvania, have invented a new and useful Apparatus for Producing Oscillations, of which the following is a specification.

My invention relates to apparatus for producing and controlling the production of fluctuating or alternating current, and particularly high frequency oscillations such as may be employed in radio signaling, including telephony and telegraphy, or in systems employing a conductor extending between transmitting and receiving stations.

It is a characteristic of my invention that oscillations are produced only when a signaling instrument, or equivalent, is actuated or in operation.

In accordance with my invention, thermionic means are so related with coupling and signaling circuits that oscillations are produced when the signaling circuit is operative, and no oscillations are produced at other times during which the coupling for oscillation production is ineffective.

For an understanding of my invention, and for an illustration of one of the various forms my apparatus may take, reference may be had to the accompanying drawing, which is a diagram of circuits embodying my invention.

Referring to the drawing, V represents a thermionic device, as an audion or the like, comprising an evacuated chamber within which are disposed the filament or cathode f, grids g^1, g^2 and anodes a^1 and a^2, the filament f being brought to suitable temperature by current from the battery b, the current strength being adjustable by the resistance r. In the respective anode circuits are the transformer primaries P^1 and P^2, the currents in the anode circuits being brought to equality by adjustment of the resistances r^1 and r^2 traversed by current from the battery B. Coupled to the primaries P^1 and P^2 are the secondaries S^1 and S^2, which may be considered a single winding with a connection to the cathode f from the mid-point thereof. Shunting the secondaries S^1 and S^2 is the variable condenser C. The secondaries S^1 and S^2 are connected, respectively, in the circuits of the grids g^1 and g^2, in which are connected also the secondaries S^3 and S^4 coupled to the primary P^3, in circuit with which is the source of current B^1 and the microphone M, or any other suitable signaling instrument, or other device. Shunting the secondaries S^3 and S^4 are the condensers K^1 and K^2, respectively.

With no current through the primary P^3, or with a nonvarying current in the primary P^3, as when the microphone M is at rest, and with the currents in the anode circuits adjusted to equality, no oscillations are produced notwithstanding the fact that the anode and grid circuits are coupled. This is due to the fact that the coupling effect is zero, since the primaries P^1 and P^2 are so wound or connected that they act equally and oppositely upon the secondary circuit including the secondaries S^1 and S^2. In other words, when the microphone M is at rest, the relations of the primaries P^1, P^2 with the secondary circuit is such, due to the equal and opposite actions of the primaries P^1 and P^2, that no oscillations are produced.

However, when the microphone is actuated by sound waves, there will be in the primary P^3 a current fluctuating in accordance with sound waves, inducing in the secondaries S^3 and S^4 voltages also varying in accordance with sound waves. The secondaries S^3 and S^4 are so wound or connected, however, that they affect the potentials of the grids g^1 and g^2 in opposite senses, that is, at a given instant the potential of one grid has been increased by its associated secondary coupled with primary P^3, while the potential of the other grid has been decreased. The result is, that the current in one anode circuit is increased and the current in the other anode circuit is simultaneously decreased, with the result that the effects of the primaries P^1 and P^2 upon the secondary circuit including the coils S^1 and S^2 are no longer equal and opposite, but are unequal, with the result that there is now an effective coupling suitable for oscillation production between the anode and grid circuits, oscillations being set up in the well known manner in the secondary circuit including the condenser C, the capacity of the condenser C and the inductance of the secondaries S^1 and S^2 largely determining the frequency of the oscillations, which frequency may accordingly be adjusted or varied by adjusting the condenser C, or by adjusting the amount of inductance in its

circuit, or both. At a given instant during actuation of the microphone M the polarities of the neighboring or adjacent ends of the primaries P^1 and P^2 are similar, that is, the plate and grid circuits are symmetrically coupled or coupled in the same sense or direction.

By the condensers K^1 and K^2 the oscillations produced are shunted past the secondaries S^3 and S^4, these condensers being in effect oscillation by-passes.

The oscillatory or high frequency energy may be taken off from the secondary circuit S^1, S^2, C for any suitable purpose. For example, the antenna or any radiating structure of a radio system may receive oscillatory energy from said circuit, or energy from said circuit may be impressed upon a wire or conductor extending between transmitting and receiving stations, as in a carrier wave system. The oscillatory energy may be suitably amplified, if suitable or desirable, by well known means, and then delivered to the radiating structure or carrier wave system.

While the different pairs of anodes and grids are shown within the same vacuum tube, it will be understood that two separate vacuum tubes may be similarly employed, their plate and grid circuits being connected as described.

From the foregoing description, it is accordingly apparent that by employment of a pair of thermionic devices, oscillations will be produced only when the signaling instrument is in operation, for then only is there an effective coupling essential to oscillation production between the grid and anode circuits.

What I claim is:

1. The combination with a plurality of thermionic devices having anode and grid circuits, a pair of primary coils subjected respectively to the different anode circuits, a pair of secondary coils subjected respectively to the different grid circuits and inductively related to said primary coils, capacity shunting one of said pairs of coils and cooperating in the production of oscillations, said coils being so related that normally no oscillations are produced, and means for simultaneously varying the potentials of the grids of said devices in such senses as to cause production of oscillations.

2. The combination with a plurality of thermionic devices having anode and grid circuits, a coil in each grid circuit, a connection from one terminal of each of said coils to the cathode structure of said devices, a coil inductively related to each of said coils, a terminal of each of said last named coils connected to said cathode structure and the remaining terminals connected to the anodes of said devices, said pairs of inductively related coils being so related that normally none of said thermionic devices produces oscillations, a capacity associated with said coils and serving as a frequency determining element in the production of oscillations and means for simultaneously varying in opposite senses the potentials of the grids of said devices to cause production of oscillations.

3. The combination with a plurality of thermionic devices having anode and grid circuits, a coil in each grid circuit, a connection from one terminal of each of said coils to the cathode structure of said devices, a coil inductively related to each of said coils, a terminal of each of said last named coils connected to said cathode structure and the remaining terminals connected to the anodes of said devices, said pairs of inductively related coils being so related that normally none of said thermionic devices produces oscillations, a capacity associated with said coils and serving as a frequency determining element in the production of oscillations, and means for simultaneously varying in opposite senses and in accordance with sound waves the potentials of the grids of said devices to cause production of oscillations.

4. The combination with a plurality of thermionic devices having anode and grid circuits, a coil in each grid circuit, a connection from one terminal of each of said coils to the cathode structure of said devices, a coil inductively related to each of said coils, a terminal of each of said last named coils connected to said cathode structure and the remaining terminals connected to the anodes of said devices, said pairs of inductively related coils being so related that normally none of said thermionic devices produces oscillations, a capacity associated with said coils and serving as a frequency determining element in the production of oscillations, means for simultaneously varying in opposite senses the potentials of the grids of said devices to cause production of oscillations, said means comprising secondary coils, a primary coil coupled therewith, and signaling means in the circuit of said primary coil.

5. The combination with a plurality of thermionic devices having anode and grid circuits, of coupling means between the anode and grid circuits of a character tending to produce oscillations, means effecting a balance normally to prevent production of oscillations, means for effecting adjustment of the anode circuit currents with respect to each other, and means for disturbing said balance to cause production of oscillations.

6. The combination with a plurality of thermionic devices having anode and grid circuits, of coupling means between the anode and grid circuits of a character tending to produce oscillations, means effecting a

balance normally to prevent production of oscillations, means associated with the anode circuits for adjusting the currents therein relatively to each other, and means for disturbing said balance to cause production of oscillations.

7. The combination with a plurality of thermionic devices having anode and grid circuits, of coupling means between the anode and grid circuits of a character tending to produce oscillations, means effecting a balance to prevent production of oscillations, a source of energy common to said anode circuits, means for deriving from said source different potentials for adjusting relatively to each other the currents in said anode circuits, and means for disturbing said balance to produce oscillations.

8. The combination with a plurality of thermionic devices having anode and grid circuits, of means for coupling said anode and grid circuits for the production of oscillations, said means comprising inductive windings so related to each other as normally to effect a balance to prevent production of oscillations, capacity connected in shunt with a part of said windings and cooperating in the production of oscillations, and means for disturbing said balance to cause production of oscillations.

9. The combination with a plurality of thermionic devices having anode and grid circuits, of primary coils subjected, respectively, to the different anode circuits, a secondary winding inductively related to said primary coils and having a connection intermediate its terminals to the cathode structure of said thermionic devices and having its terminals connected, respectively to said grid circuits, capacity connected across the terminals of said secondary winding, and means for simultaneously varying the potentials of the grids of said devices in such senses as to cause production of oscillations.

In testimony whereof I have hereunto affixed my signature this 6th day of January, 1921.

DAVID G. McCAA.