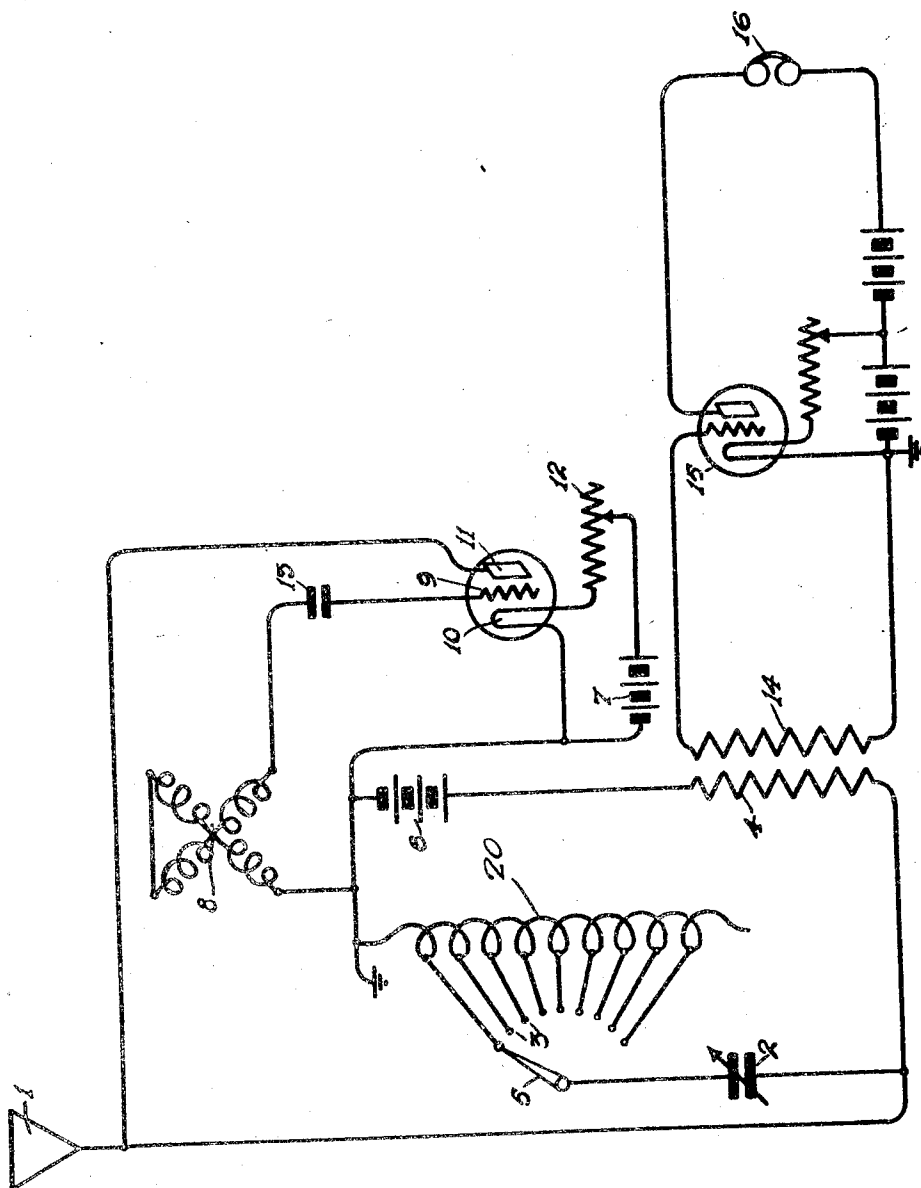


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L. D. KELLOGG
RADIO RECEIVING SYSTEM

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UNITED STATES PATENT OFFICE.

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RADIO RECEIVING SYSTEM.

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The invention has to do with wireless receiving systems although not limited to such systems, and its objects are to provide a novel and improved organization of the elements comprising such a system and provide an arrangement affording sharpness of tuning, power, and clearness in respect of the signals received.

A further object of my invention is the provision of a receiving circuit in which the antenna oscillations are received upon the anode or plate of the audion and are effective through the tube coupling to operate the grid of the audion.

A still further object of my invention is the provision of a receiving circuit provided with an audion having a grid circuit and a plate circuit that may be resonated so that oscillations in the plate circuit are effective upon the grid circuit to cause the grid to function to sustain the oscillations in the plate circuit.

Referring particularly to the drawing which diagrammatically illustrates a preferred organization involving my invention it will be noticed that the antenna 1 is connected to the anode or plate 11 of an audion tube having the usual elements including the cathode 10, grid 9 and anode 11. The grid circuit of the audion tube includes a grid condenser 13 which may have associated with it a grid leak, and a continuously variable inductance 8. Connected between the antenna 1 and ground is a continuously variable capacity 2 and a variable inductance 20 which I prefer to arrange so that the same may be varied by steps through means of a rotary switch 5 cooperating with contacts 3 connected to taps on the inductance. One pole of the plate battery 6 is connected to ground and the other pole is connected through the primary 4 of the transformer to the plate 11 of the audion. If the circuit arrangement is used without a stage of audio frequency amplification then the primary winding 4 of the transformer would be replaced by a pair of receivers or the winding of the loud speaking device. The cathode 10 of the audion tube is provided with heater current from a battery 7. To regulate the amount of heater current supplied to the cathode I use a rheostat 12 and for my system I prefer that this element should be one affording the most micrometric variations of filament or heater current.

The secondary 14 of the amplifying transformer is connected to the grid of the audio amplifier tube 15. The audio amplifier tube 15 has connected in its plate circuit a pair of receivers 16 and a separate plate battery. As the circuit of the audio amplifier and the apparatus associated therewith is of the customary type further description is thought unnecessary.

Considering the system as a whole, the incoming oscillations become active on the audion tube by way of the plate 11 (instead of in the usual manner by way of the grid element) so that the potential changes energizing the grid element will, in the organization herein shown, have come under the rectifying influence of the tube before they become effective upon the grid and its connections. The grid circuit is connected about the filament element and has the usual condenser 13, and the grid circuit, as a whole, is capable of having its inductance varied by means of variometer 8 while its capacity can be adjusted by means of rheostat 12; the capacity of the audion tube varying with increase and decrease of filament current.

The main circuit in any such system is, of course, the receiving circuit which is the one containing the receiving device 4, and this circuit in the present case, may be traced from ground through the plate battery 6, receiving device 4 to plate 11, thence to filament 10 and back to ground. About the elements 4 and 6 I connect a circuit containing the elements 2—3 and 5 and this circuit has its capacity and inductance variable by means of said elements. In view of the foregoing it is evident that, the incoming oscillation groups being rectified at the tube the potential changes in the resulting undulatory current will be effective across the terminals of receiver 4 included in the circuit of battery 6 and of the plate 11 and the audio frequency variations will manifest themselves in the receivers to reproduce the sounds that they represent. The grid of the tube is energized responsive to the rectified oscillations by the coupling of the tube and I find it acts in the usual way upon the plate circuit to amplify the impressed potential variations. Thus the grid may be said to operate initially by energy derived from the plate and builds up the plate circuit current from which circuit it again

derives energy and still further builds up the plate current.

Considering again the plate circuit as a whole, it will be noted that there are provided two oscillatory circuits each including a portion of this circuit. The first is found in the grid circuit in conjunction with the filament and the other includes the elements 2—3—4 and 6. Each of these circuits may be adjusted in respect to their oscillations with a resulting increased output of energy to the plate circuit and by adjusting them, the one against the other, to the most favorable relation an enormous increase in the strength of the received signals is obtained. I have operated the organization chiefly for telephonic reception from stations transmitting on a 360 or 400 meter wave using the inductances and capacities ordinarily employed in other systems, using a like wave.

In tuning I start without being very particular as to the adjustment of element 3 and tune chiefly, by the inductance 8 and the capacity of the tube. The signals can be brought in fairly well, in fact with a good sharpness of tuning, if the elements 2—3—5 are removed from the circuit entirely. With the tube in an oscillatory condition and properly tuned, due to the grid circuit adjustment, I manipulate the element 5 to different points each time varying the condenser 2. With certain inductive adjustments at 3—5 condenser 2 may be varied over a good range without very greatly affecting the signals being received but when the favorable relation between 2 and 3—5 is found the additional oscillatory effect will be immediately recognized, the signals will increase in power and the most minute variations at 2 will have profound effects as will minute variations at 8 and 12. By carefully adjusting at this time 2, 8 and 12 the oscillations can be controlled to steady the tube and I find, for this purpose, a device that will give the greatest control of filament current very essential. With the two oscillatory circuits effective and adjusted as indicated the signals are received with great strength and excellent purity of reproduction.

The plate circuit may of course be coupled to the antenna by the usual vario-coupler device and the antenna circuit carried to ground with the usual tuning devices, a variable condenser and a variable inductance connected in it. The results I have obtained, however, from a circuit thus connected, have not been as satisfactory on the whole as those obtained from the arrangement disclosed herein.

On account of the very high frequency of the oscillatory currents involved in systems of this character and their tenuity together with the sensitively balanced effects that exist when such systems are operating, it is,

as is well known, always difficult to ascertain the precise actions and reactions involved as applications of tests often put out of action the very matters that it is sought to investigate. The preceding description and explanations will enable anyone interested to practice the invention and the analysis given is believed to indicate the principal effects involved in the results obtained.

Having described my invention what I claim as new and desire to secure by Letters Patent is:

1. A receiving circuit including a three-electrode thermionic vacuum tube, a tuned input circuit for said tube, a tuned output circuit for said tube, an oscillation receiver directly connected to said output circuit whereby the oscillations received by said oscillation receiver are effective upon the tuned input circuit entirely through the tube electrodes, and means for resonating said circuits so that the received oscillations are sustained in the output circuit by the actions of the input circuit.

2. In an audion wireless receiving system the combination of a multi-electrode thermionic vacuum tube with a plate circuit upon which the impressed oscillations are directly received from an antenna, an audio frequency translating device in said plate circuit, an oscillation circuit including the grid of said audion, said grid receiving its initial actuating energy from the impressed oscillations through the tube coupling only, and tuning means in the output circuit including said audio frequency translating device.

3. The combination in a three-electrode tube receiving circuit for radio frequency oscillations of an antenna, a plate circuit upon which the impressed oscillations are directly received from the antenna, a grid operatively disassociated from the oscillations in the form received by the antenna, a pair of oscillatory circuits, one of said oscillatory circuits including said grid and the other of said oscillatory circuits including said plate, and means for tuning said oscillatory circuits to render effective upon the grid through the tube coupling the energy received by the plate directly from the antenna.

4. The combination of a receiving arrangement including a three-electrode tube, a plate circuit for said tube directly connected to an antenna for receiving the antenna oscillations, means for tuning said plate circuit, a tuned grid circuit for said tube, said tuned grid circuit being initially energized through the tube coupling by the oscillations received on the plate from the antenna and operative to sustain the oscillations received in the plate circuit from the antenna.

5. In a wireless receiving system provided

with an audion, the combination with a plate
circuit upon which the impressed oscillations
are received directly from an antenna, of a
grid for said audion energized solely by po-
5 tential changes upon the plate of the audion,
a tuned circuit connection for said grid for
making effective in the plate circuit the

changes in the grid circuit, and tuning means
for the plate circuit.

Signed by me at Chicago, in the county of 10
Cook and State of Illinois, this 30 day of
March, 1923.

LEROY D. KELLOGG.