

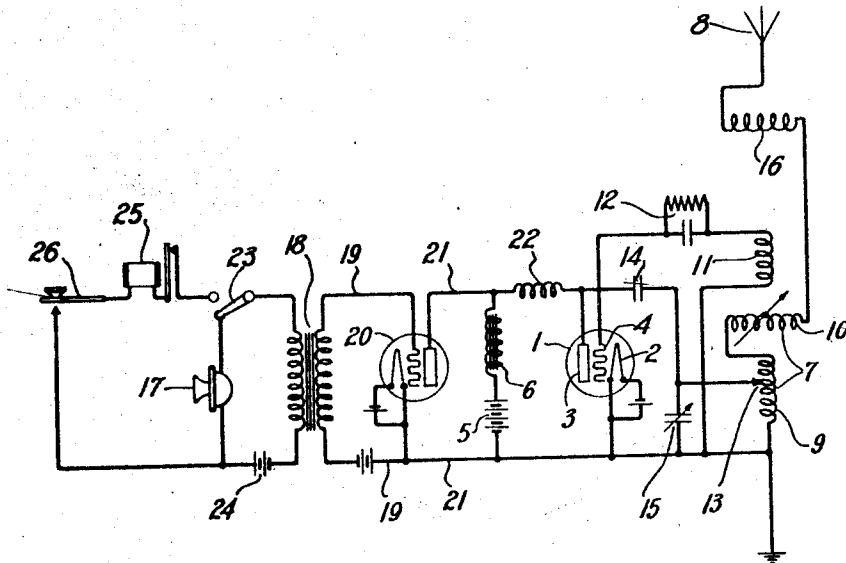
Sept. 1, 1925.

1,551,624

J. C. SCHELLENG

CIRCUITS FOR WAVE TRANSMISSION

Filed June 30, 1924



Inventor:
John C. Schelleng.

by E. W. Adams Att'y

UNITED STATES PATENT OFFICE.

JOHN C. SCHELLENG, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

CIRCUITS FOR WAVE TRANSMISSION.

Application filed June 30, 1924. Serial No. 723,138.

To all whom it may concern:

Be it known that I, JOHN C. SCHELLENG, a citizen of the United States of America, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Circuits for Wave Transmission, of which the following is a full, clear, concise, and exact description.

10 This invention relates to the production, modulation and transmission of electrical oscillations, and more particularly to the production of oscillations by devices of the space current type.

15 One object of the invention is to provide an oscillator of simple construction conveniently adjustable to generate oscillations of any one frequency within a given range, and to maintain the power output close to the maximum value at any one frequency.

20 Other objects of the invention are to prevent the production of spurious oscillations; to improve the efficiency and the power factor of the space current from the oscillator device; to connect the anode of an oscillator of the space current type through a stopping condenser to a grounded variometer in an antenna circuit in such a manner that the antenna is insulated from the voltage of the space current source; and to provide a simple circuit in which the frequency is varied by means of one variable element and the power adjustment is accomplished by means of another variable element.

35 Certain features of the present invention are improvements upon the methods and apparatus disclosed in British Patent No. 156,159, and a theoretical consideration of problems encountered in apparatus of the kind referred to will be understood more clearly upon reference to this patent.

40 In accordance with the present invention, an oscillator utilizing a space current device is arranged for adjustment to produce any desired frequency within a given range, and is so constructed that the power generated at any frequency is close to the maximum value. A variometer for changing the frequency of the generated oscillations automatically adjusts the coupling controlling the production of the oscillations. By connecting a variable capacity between the anode and cathode of the space current device, provision is made for improving the

phase relation of the oscillator circuits and for preventing the production of spurious oscillations. The variometer is employed as an auto-transformer for coupling the oscillator to an antenna and simplifies the apparatus otherwise needed, the arrangement being such that the auto-transformer and cathode are both grounded and the antenna is insulated from the voltage of the space current source.

Other features and objects of the invention will be more clearly understood from the following detailed description in connection with the appended drawing.

50 In the drawing, the space current device 1, of well known form, contains the electron emitting cathode 2, the anode 3, and the grid or control element 4. Source 5 supplies space current to device 1 through the low frequency choke coil 6 and radio frequency choke 22. Variometer 7, having one terminal grounded and the other terminal connected to antenna 8, is provided with a stationary portion 9 adjacent to the grounded terminal, and a rotary portion 10, variably coupled to portion 9 and connected in series therewith remote from the grounded terminal. Inductance winding 11 is inductively coupled to variometer 7, and is thus variably coupled to movable inductance 10. Connections from the two terminals of winding 11 lead, respectively, to cathode 2 and grid 4, the grid connection including the condenser and grid leak resistance 12 of well known construction.

60 Cathode 2 is connected directly to the grounded terminal of variometer 7, and is thus grounded. Anode 3 is directly connected to any desired point in inductance 9 by adjustment of the variable connection 13 to adjust the ratio of the step-up auto-transformer formed by the anode-cathode connections to variometer 7 and the antenna-ground connections thereto. Blocking condenser 14 connects anode 3 to inductance 9 and prevents the application to inductance 9 and to antenna 8 of the voltage from space current source 5.

70 The capacity between antenna 8 and ground, together with the inductance of variometer 7 and reactance in the associated circuits, form a tuned circuit which is predominant in determining the frequency of oscillations regeneratively produced by virtue of the coupling between variometer 7

and winding 11. Oscillations transmitted through variometer 7 induce similar oscillations in winding 11, the induced oscillations being transmitted to grid 4 in a manner well known in the art. The frequency of the generated oscillations is adjusted to any desired value within a considerable range of frequencies by rotation of inductance 10 to vary the inductance of variometer 7 and the tuning of the antenna. It will be noted that variation of the inductance of variometer 7 varies the coupling between variometer 7 in the anode-cathode circuit and winding 11 in the grid-cathode circuit. The relation between the position of inductance 10 and the position of inductance 11 is so designed that, when the frequency is changed, the coupling between winding 11 and variometer 7 is adjusted to a value giving close to maximum power output from the oscillator and giving suitable stability to the operation of the oscillator.

A small variable capacity 15, connected between anode 3 and cathode 2, that is, between variable contact 13 and the grounded terminal of variometer 7, provides a path having capacity reactance in shunt to the lower portion of inductance 9. This capacity is readjusted after changing the frequency of the oscillations so that a stable adjustment is obtained at proper power and efficiency without the production of spurious oscillations. These spurious oscillations are ordinarily of considerably higher frequency than those intended to be generated for transmission to the antenna. Capacity 15, apparently because of its low impedance to oscillations of parasitic frequency and its high impedance to waves intended to be generated, and possibly for other reasons, provides an easy means for suppressing the parasitic oscillations.

The frequency of the oscillation occurring does not ordinarily differ very much from one of the two resonant frequencies of the coupled circuits formed by antenna 8, coil 16, and the variometer 7 on the one hand, and by capacity 15 and the section of coil 9 between 13 and ground on the other. Ordinarily the coupling between 11 and 7 is made to be of such phase as to produce the lower of these two frequencies, which is somewhat less than that of the antenna circuit alone. Condenser 15, by virtue of its capacity reactance, may be adjusted so that the phase angle of the load into which the tube is delivering power is substantially zero while at the same time all the other conditions necessary for the production of stable oscillations are satisfied by the circuit. In this way both the power output and efficiency of device 1 are maintained at satisfactory values throughout the entire frequency range.

Inductance 16 is a loading coil in the an-

tenna circuit which ordinarily has a fixed value, being altered only when a general shift in the frequency range is required or when the antenna is changed.

For the purpose of modulating oscillations in accordance with telephone signals, telephone transmitter 17 is coupled by transformer 18 to the input circuit 19 of amplifier 20, of the well known space current type, the anode circuit 21 of which is supplied with space current by source 5 through choke coil 6, which functions to maintain a substantially constant current from source 5. Space current through tube 20 is varied in well known manner in accordance with speech or sound waves from transmitter 17, and, inasmuch as the space current through coil 6 is substantially constant, complementary changes are produced in the space current supplied to device 1, thus causing modulation of the generated oscillations in accordance with the speech or sound waves acting on transmitter 17, the modulated waves being radiated by antenna 8. High frequency choke coil 22 prevents the transmission of high frequency oscillations from device 1 to device 20 and 6. It will be noted that the modulating system described utilizes the well known principle of the Heising constant current modulating system.

When telegraph signals are to be transmitted, switch 23 is connected to its upper position, establishing connection between battery 24 and buzzer 25. Intermittent operation of telegraph key 26 causes intermittent transmission to tube 20 of waves of the frequency of buzzer 25 and produces a corresponding modulation of the oscillations generated by device 1.

What is claimed is:

1. In an oscillator, a space current device having an anode, a cathode and a control element, an antenna circuit having an inductance connected at one of its terminals to ground and to said cathode, a portion of said inductance being variably coupled to another portion of the inductance, means for capacitatively coupling said anode to a variable point in said other portion of the inductance, an inductance connected between said control element and said cathode and coupled to said other portion of the inductance, and a variable capacity connected between said anode and cathode.

2. In an oscillator, a space current device having an anode, a cathode and a control element, an antenna circuit having an inductance connected at one of its terminals to ground and to said cathode, a portion of said inductance remote from the grounded terminal thereof being variably coupled to a portion of the inductance adjacent the grounded terminal, means for capacitatively coupling said anode to a variable point in the portion of said inductance adjacent

said grounded terminal, an inductance connected between said control element and said cathode and coupled to the portion of said antenna inductance remote from the grounded terminal, and a variable capacity connected between said anode and cathode.

3. In an oscillator, a space current device having an anode, a cathode and a control element, an antenna circuit having an inductance connected at one of its terminals to ground and to said cathode, a portion of said inductance remote from the grounded terminal thereof being variably coupled to a portion of the inductance adjacent the grounded terminal, means for capacitatively coupling said anode to a variable point in the grounded portion of said inductance, an inductance connected between said control element and said cathode and coupled to the portion of said antenna inductance remote from the grounded terminal, and means connected between one terminal of said antenna inductance and the variable point therein for reducing the tendency for the oscillator to generator parasitic oscillations and for increasing the power output after change of frequency.

4. In an oscillator, a space current device having an anode, a cathode and a control element, an antenna circuit having an inductance connected at one of its terminals to ground and to said cathode, a portion of said inductance remote from the grounded terminal being coupled to a portion of the inductance adjacent to the grounded terminal, one of said portions being movable with respect to the other to vary the coupling therebetween, means for connecting said anode to said inductance and for varying the value of the inductance between said anode and cathode, a winding coupled to the movable portion of said antenna inductance, connections from said winding

for impressing oscillations on said control member, and means associated with said oscillator for varying the phase relation between currents in said antenna inductance and said winding.

5. In a signaling system, a space current device having an anode, a cathode and a control element, an antenna circuit having an inductance connected at one of its terminals to ground and to said cathode, a portion of said inductance remote from the grounded terminal being variably coupled to a portion of the inductance adjacent the grounded terminal, means for capacitatively coupling said anode to a variable point in the grounded portion of said inductance, an inductance connected between said control element and said cathode and coupled to the portion of said antenna inductance remote from the grounded terminal whereby oscillations are generated in accordance with the tuning of said antenna circuit, and means whereby the generated oscillations are modulated in accordance with signal waves.

6. In an oscillator, a space current device having an anode, a cathode and a control element, a variometer having one of its terminals connected to an antenna and its other terminal connected to ground and to said cathode, an inductance coupled to the movable portion of said variometer and having connections for impressing oscillations on said control member, means connecting said anode to a variable point between the terminals of said variometer, and a variable capacity connected between said point and one of the terminals of said variometer.

In witness whereof, I hereunto subscribe my name this 25th day of June, A. D., 1924.

JOHN C. SCHELLENG.