

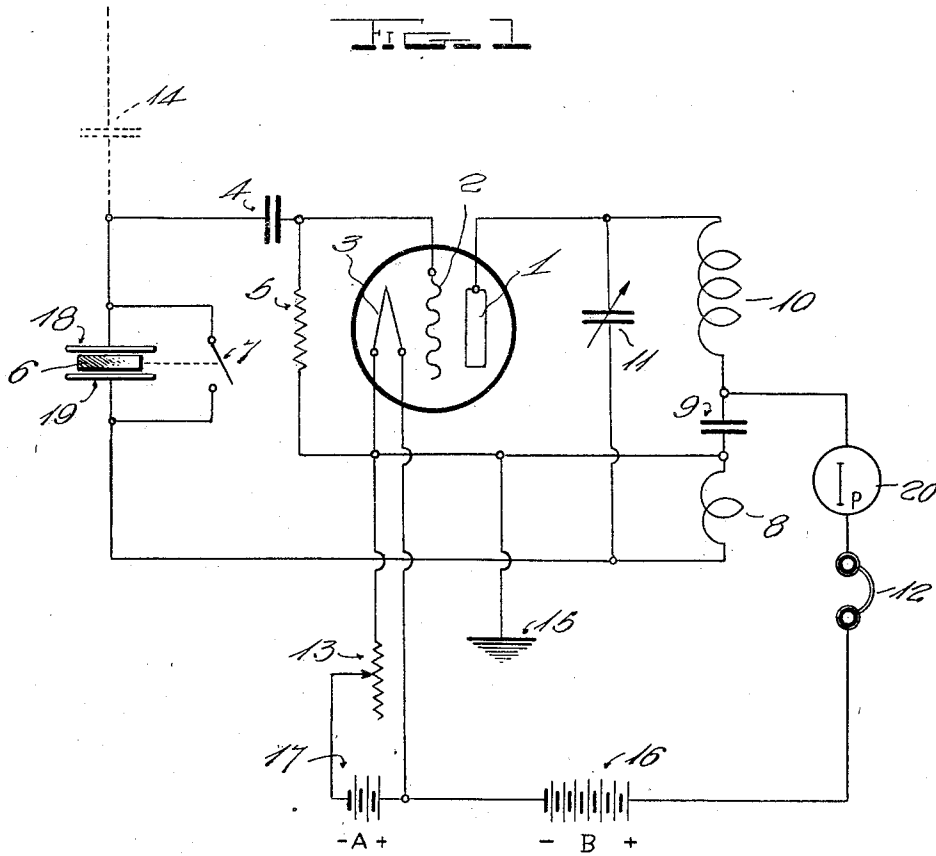
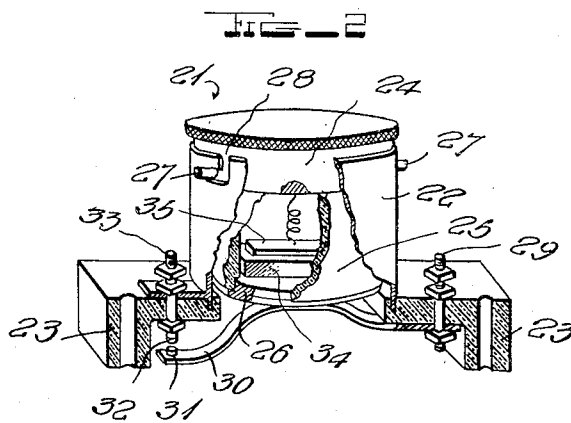
Nov. 10, 1931.

E. R. HENTSCHEL

1,830,837

SIGNALING APPARATUS

Filed April 18, 1929



INVENTOR.

Ernest R. Hentschel,

BY *Harold J. Dodd*

ATTORNEY

UNITED STATES PATENT OFFICE

ERNEST R. HENTSCHEL, OF WASHINGTON, DISTRICT OF COLUMBIA; JOHN OLSON, ADMINISTRATOR OF SAID ERNEST R. HENTSCHEL, DECEASED, ASSIGNOR TO WIRED RADIO, INC., OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

SIGNALING APPARATUS

Application filed April 18, 1929. Serial No. 356,174.

My invention relates to signaling apparatus generally and more particularly to high frequency signaling systems and the apparatus employed therewith.

5 An object of my invention is to provide an oscillator arrangement adapted for many uses in signaling systems.

Another object of my invention is to provide a wave meter having great flexibility of operation.

10 Still another object of my invention is to provide a universal oscillator and wave meter.

Other and further objects of my invention are to provide certain structural features, a better understanding of which can be had from the specification following and from the accompanying drawings, wherein:

15 Figure 1 is a schematic circuit diagram of my invention and Fig. 2 illustrates certain structural features employed in the signaling apparatus of my invention.

20 In high frequency systems it is necessary that the frequency of the generated energy be substantially constant. Mechanically vibratile elements are usually employed for this purpose, which elements are connected in the input circuit of a thermionic tube. The output circuit comprising inductance and capacity is adjusted so that the frequency characteristics of this circuit approach the frequency characteristics of the mechanically vibratile element. The mechanically vibratile element may be a slab of quartz having piezo electric properties, magnetostriction rods or any suitable vibratile element having a defined period of mechanical vibration. The circuit in its entirety is termed an oscillator, having many different applications in signaling systems. One of the more common uses of the oscillator is that of an exciter for a plurality of succeeding thermionic tube amplifiers. The amplified energy from such an amplifier is of substantially constant frequency. Another common use of such an oscillator is that of an oscillating wave meter. In either use, that of an exciter for succeeding thermionic amplifiers, or as a wave meter, it is necessary that the frequency of the generated energy be ac-

curately known and that such accuracy of frequency be maintained for the use intended. It is frequently desirable however, to operate the oscillator at some frequency other than the frequency corresponding to the frequency characteristics of the mechanically vibratile element. To accomplish this it has heretofore been necessary to substitute other mechanically vibratile elements having the desired frequency characteristics.

60 My invention provides a constant frequency oscillator having sufficient flexibility without the necessity of employing an excessive number of mechanically vibratile elements.

65 Fig. 1 of the accompanying drawings is a schematic circuit diagram showing certain embodiments of my invention. A thermionic tube of any suitable design is employed such as that illustrated having an anode, control electrode 2 and cathode 3. A thermionic tube having a shielding anode electrode may be employed if so desired. The input circuit comprises resistance element 5, condenser 4, mechanically vibratile element 6, electrodes 18, 19, switch 7 and coil 8. The output circuit comprises coil 10, adjustable condenser 11, condenser 9, meter 20, phones 12 and battery 16. Cathode 3 is energized by source 17 through rheostat 13. Ground 15 is associated with the connection to cathode 3. In the schematic circuit diagram as shown, such a circuit arrangement is essentially an oscillator. The frequency of the generated energy is governed by the frequency characteristics of element 6. Coil 8 has a relatively low inductance value as compared to the inductance of coil 10 but serves to produce a coupling between the input and output circuits in addition to that normally provided by the interelectrode capacity of the thermionic tube. Condenser 11 is adjusted to cause the frequency characteristics of the output circuit to be approximately equal to the frequency characteristics of mechanically vibratile element 6. Oscillations are sustained in the circuit by virtue of element 6 in a manner well known to those skilled in the art.

Any circuit such as the tank circuit of a 100

transmitter may be associated with the generated energy of the oscillator by coupling through a small capacity 14 to the input circuit of the oscillator. When the frequency characteristics of the auxiliary tank circuit are adjusted to correspond with the frequency of the generated energy from the oscillator, the familiar zero beat will be observed in telephones 12. The adjustment of condenser 11 may be noted which adjustment corresponds to approximately the frequency characteristics of element 6. The oscillator is capable of generating energy having frequency values corresponding to the frequency characteristics of the mechanically vibratile element employed. High frequency energy may be generated however without employing the mechanically vibratile element. Element 6 may be removed from the input circuit without interrupting operation of the oscillator circuit. The dotted line shown in Fig. 1 of the accompanying drawings, represents a mechanical connection between element 6 and the movable arm of switch 7. When the element 6 is removed, switch 7 is closed thereby providing a completed input circuit. The circuit is then a self-oscillatory circuit without the mechanically vibratile element. The supply of potential to anode 1 may be simultaneously increased or decreased with this adjustment thereby regulating the generated energy thereby. Should such an oscillatory arrangement be employed as an exciter for larger amplifying tubes, telephones 12 would of course be removed from the circuit.

The frequency characteristics of the circuit in its entirety will remain substantially the same as when the element 6 is employed. When the element 6 is employed the impedance given by electrodes 18 and 19 is high enough to prevent self-oscillation, that is at a frequency other than the frequency of the crystal or other element employed. The portion of the tuned circuit, namely coil 8, now merely aids in building up a potential difference across the crystal and causes the crystal to oscillate more readily. Condenser 11 is connected across both inductances 8 and 10, inductance 8 remaining in the circuit in either adjustment. This provides a more uniform feed back to the input circuit in both the self-oscillatory adjustment and the adjustment employing element 6. The inductance employed in the input circuit is very small as compared to the inductance in the output circuit, the value of inductance employed in the input circuit merely being of sufficient value to insure oscillation when the circuit is employed in the self-oscillating adjustment. With the circuit as shown and the parameters chosen as aforementioned, the resonant frequency of the tuned circuit remains unchanged except by a very small amount caused by the minute changes in the

input circuit. The same calibration curve may be employed in adjustments of the self-oscillatory state and when the mechanically vibratile element is employed. The width of the line or marking constituting the actual calibration curve would serve to indicate this change. Thus the lower portion of the line indicating one adjustment and the upper portion of the line, the other adjustment. It is seldom that such accuracy is necessary and for most practical purposes the calibration curve is interpreted in like manner for either adjustment.

Fig. 2 of the accompanying drawings shows certain structural features embodying my invention. A plug shaped member 21 is adapted to fit into a receptacle 22, 23. The upper portion of member 21 is of metal, the intermediate portion 25 of suitable insulating material and the bottom 26 of metal. Pins 27 carried by the metal portion 24 of member 21, engage with slots 28 cut in metal shell 22. Metal shell 22 is electrically connected to terminal 33 which extends through insulating base 23. One end of a metallic spring member 30 is positioned to the under side of terminal 29. The free end of member 30 carries a contact member 31 positioned adjacent to stationary contact member 32. Stationary contact 32 is positioned to one end of terminal 33. The mechanically vibratile element is herein represented as a quartz crystal 34 having piezo-electric properties. Crystal 34 rests upon and contacts with metallic base 26 of member 21, establishing one connection from the crystal to terminal 29 by member 30. A metallic plate 35 rests upon the upper surface of crystal 34 constituting the other electrode. Plate 35 is electrically connected to portion 24 and through shell 22 to terminal 33. The two connections from crystal 34 are in this manner brought to contact members 31 and 32. When the crystal is to be removed plug member 21 is turned a small amount and lifted out of shell 22. The crystal element completes the electrical circuit between terminals 29 and 33 until contact members 31 and 32 are closed. When members 31 and 32 are closed, the circuit is completed between terminals 29 and 33 by member 30.

When plug 21 is inserted in shell 22 the electrical circuit by members 30, 31 and 32 is completed until plug 21 has pressed against spring member 30 sufficiently to interrupt the circuit between contacts 31 and 32. At this same instant crystal 34 is connected in the circuit. There is therefore no lapse of time in changing from the self-oscillating circuit arrangement to the arrangement employing the mechanically vibratile element, the change is instantaneous and the circuit between terminals 29 and 33 is never open.

By referring to the schematic circuit diagram shown in Fig. 1 of the accompanying

drawings many advantages of the apparatus of my invention will be learned. When such an oscillatory circuit is employed in a wave meter it may be desirable to employ an audio frequency amplifier. Any type of audio frequency amplifier may be employed, the input circuit of which substituted for the telephones 12. When element 6 is removed and the circuit is operating as a self-oscillatory circuit the frequency characteristics as shown by the adjustment of condenser 11 may be checked as to accuracy of calibration. This may be accomplished in many different ways. One of the most satisfactory methods is to employ a small number of elements 6 having different frequency characteristics. By employing only a few piezoelectric elements and by utilizing the harmonic frequencies it is possible to check the calibration of the circuit as a self-oscillator. An element of known frequency characteristics is inserted and the adjustment of condenser 11 is set to this frequency.

Other elements of known frequency characteristics are next inserted and the adjustment of condenser 11 is set to this frequency. A check on the frequency calibration above and below the frequency to be determined is sufficient. Mechanically vibratile elements having unknown frequency characteristics may be inserted in the circuit and by adjusting condenser 11 to the proper value for zero beat indication the frequency is determined.

I realize that many modifications of my invention are possible and it is to be understood that I do not intend to restrict the embodiments of my invention by the foregoing specification or by the accompanying drawings but only by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. In an oscillatory circuit arrangement employing a thermionic tube having an input circuit and an output circuit associated therewith, terminals extending from one of said circuits, a mechanically vibratile element for controlling the frequency of the generated energy, mounting means for said element having means adapted to contact with the aforesaid terminals when said element is inserted in said mounting means and having means for shunting the aforesaid terminals when said element is removed from said mounting means, whereby said oscillatory circuit continues without interruption to oscillate at approximately the same frequency independent of the connection of said element with said circuits.

2. An oscillatory circuit comprising a thermionic tube having coupled input and output circuits, a mechanically vibratile element removably connectible with said circuits and adapted to actuate a switch when inserted in and when removed from said cir-

cuits, and an inductance disposed in said input circuit for sustaining oscillations whereby said oscillatory circuit continues without interruption to generate energy when said element is removed from said circuits.

3. In an oscillatory circuit arrangement employing a thermionic tube having coupled input and output circuits, mechanically vibratile means adapted to be inserted in or removed from said oscillatory circuit and means connected with said circuits for sustaining oscillations irrespective of the connection of said mechanically vibratile means in said oscillatory circuit, whereby the generation of energy continues independently of the connection of said vibratile means with said circuits.

4. In an oscillatory circuit arrangement, a thermionic tube, an oscillation circuit connected thereto, a mechanically vibratile element for controlling the frequency of the generated energy and circuit connections for disconnecting said element from said circuit without interrupting the generation of said energy.

5. An oscillatory circuit comprising a thermionic tube having input and output circuits, a mechanically vibratile element removably connected with the input circuit of said thermionic tube and means automatically operative upon the removal of said element, said input circuit for sustaining the operation of said oscillatory circuit as a generator of high frequency electrical energy.

6. An oscillatory circuit arrangement comprising in combination a thermionic tube having coupled input and output circuits, terminals connected with said input circuit, a mechanically vibratile element removably included in said input circuit and a switch member controllable by the removal of said element from said input circuit for automatically closing said switch member with respect to said terminals.

7. An oscillatory circuit comprising in combination a thermionic tube having coupled input circuit and output circuits, terminals connected with said input circuit, mechanically vibratile means removably connected with the terminals of said input circuit switching means disposed in shunt with said terminals, and means whereby the electrical connections to said mechanically vibratile means in said input circuit are automatically short circuited by said switching means when said mechanically vibratile element is removed from said input circuit.

8. In an oscillatory circuit, a thermionic tube having coupled input and output circuits, terminals connected with said input circuit, a mechanically vibratile element removably connected with the terminals of the input circuit of said thermionic tube, switching means connected with said terminals, and means for shunting the connections to said

element whereby the electrical circuit is automatically completed in said input circuit when said element is removed from said input circuit.

- 5 9. An oscillatory circuit arrangement comprising in combination, a thermionic tube having coupled input and output circuits, a switching member in the input circuit of said thermionic tube, a mechanically vibratile
10 means insertable into and removable from said input circuit, and means for actuating said switching member simultaneously with the insertion or removal of said mechanically vibratile means from or into said input
15 circuit.

10. In a high frequency oscillatory circuit, a mechanically vibratile element, an electron tube oscillator circuit, means for sustaining oscillations independently of said mechanically vibratile element, switching means connected with said element whereby the electrical connections of said circuit to said element are short circuited when said element is disconnected from said circuit.

- 25 11. In an oscillatory circuit arrangement, a thermionic tube having input and output circuits connected therewith, a mechanically vibratile element insertable in series with said input circuit, means for automatically completing said input circuit by the removal of said element and an inductance in said input circuit for sustaining oscillations independently of said mechanically vibratile element.

- 30 12. An oscillatory circuit arrangement comprising a high frequency electron tube circuit, a mechanically vibratile element connectible in said circuit, means for sustaining oscillations when said element is removed from said circuit and switching means adapted to automatically complete said circuit when said element is removed therefrom while maintaining the connection of said first mentioned means in said circuit.

- 35 13. In an oscillator system, an oscillatory circuit, a mechanically vibratile element adapted to be inserted in series with said circuit, an impedance element permanently connected in said circuit for sustaining oscillations and a switching member for completing said electrical circuit when said mechanically vibratile element is removed therefrom for sustaining oscillations in said circuit without interruption.

- 40 14. In an electrical circuit an electron tube having circuit terminals connected thereto, a mechanically vibratile element connectible in series with said circuit terminals and switching means whereby the circuit across said circuit terminals is completed by said element when said element is inserted in series therewith and whereby the circuit is automatically completed when said element is removed from connection with said circuit terminals.

- 45 ERNEST R. HENTSCHEL.