

July 31, 1934.

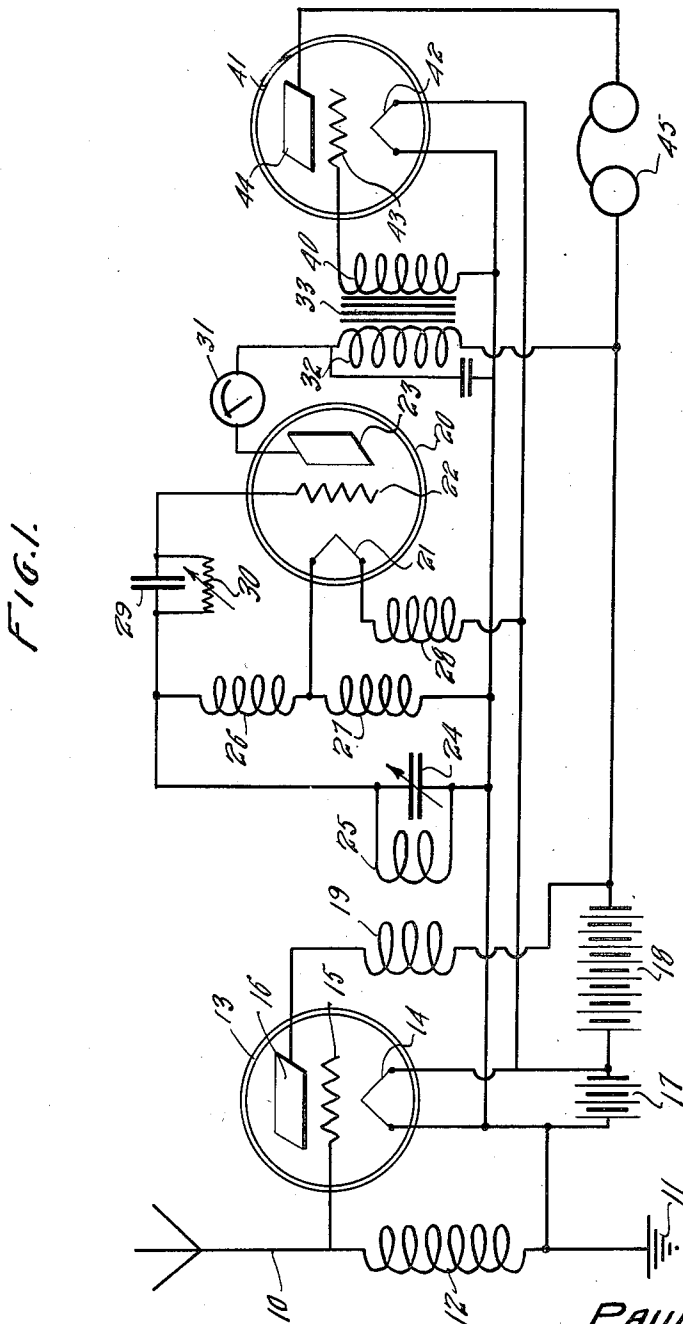
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1,968,750

RADIO RECEIVING SYSTEM

Filed Nov. 1, 1929

3 Sheets-Sheet 1



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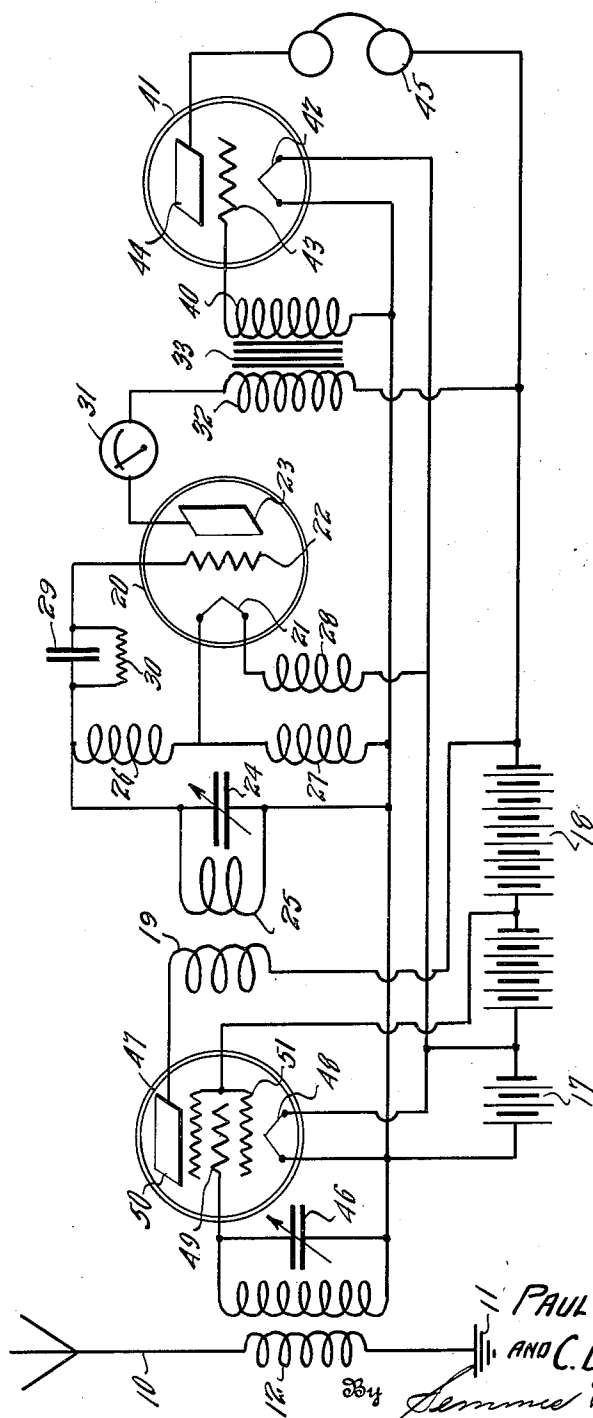
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FIG. 2.



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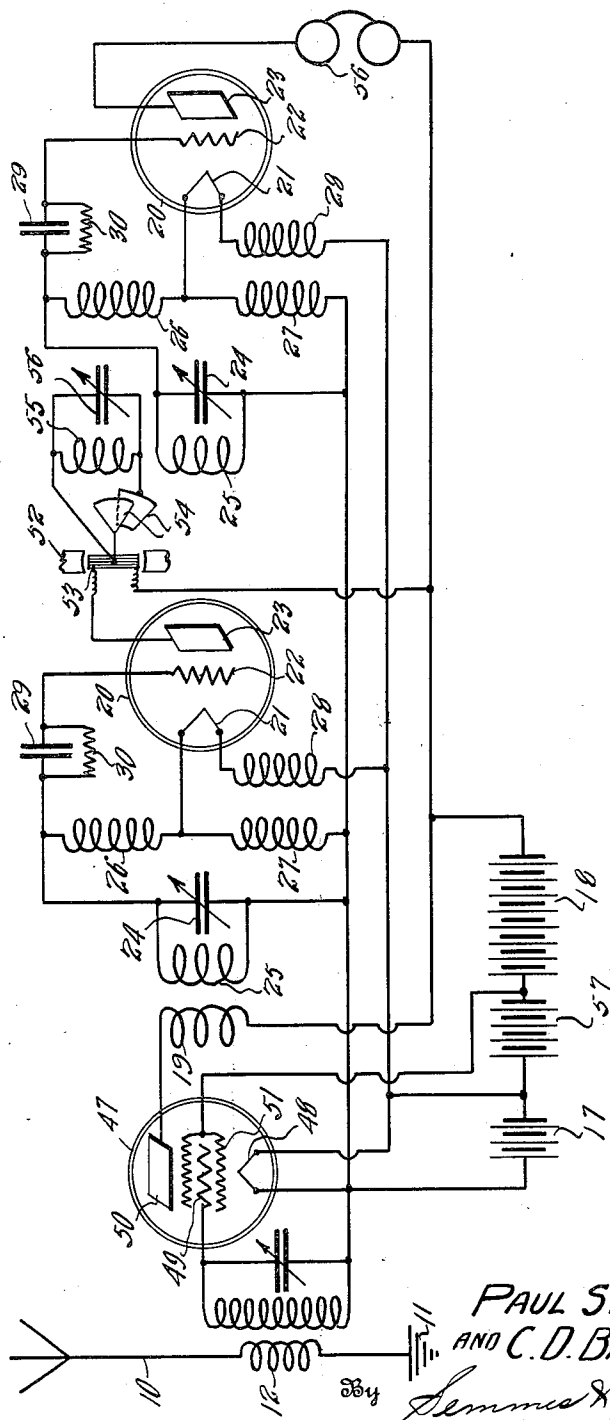
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FIG. 3.



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RADIO RECEIVING SYSTEM

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Application November 1, 1929, Serial No. 404,174

13 Claims. (Cl. 250—8)

This invention relates to radio receiving systems and more particularly to radio receiving systems and remote control.

An object of the invention is to receive signals sent from a distant source of radiant energy which are free from interference due to statics produced by man or nature.

Another object is to remotely control mechanical devices by radiant energy, so that the control is absolute and unaffected by static or other interference.

Yet another object of the invention is to provide a means of communication which is not affected by undesirable causes such as sparks produced by ignition systems or electrical discharges between clouds, etc.

Other objects of the invention will appear from the following description taken in connection with the drawings which form part of this specification, and in which:

Figure 1 is a schematic view illustrating one embodiment of the invention,

Figure 2 is a schematic view illustrating another embodiment of the invention, and

Figure 3 illustrates a slightly modified system.

Referring by numerals to the drawings, 10 represents an antenna of any preferred type grounded as indicated at 11 and provided with the conventional input coil 12. The high frequency voltage across the input coil 12 is amplified by one stage radio frequency amplifier comprising a vacuum tube 13, having a filament 14, a grid 15 and a plate 16 all enclosed within the tube.

The power supply for the tube may comprise a filament battery 17 and a plate battery 18. Connected in the plate circuit of the tube is an output coil 19. The amplification of the high frequency voltage by the vacuum tube 13 provides a strong current in the output coil 19 and this coil is coupled to the coil 25 in the tank circuit of the self-modulated high frequency oscillator.

As shown, the self-modulated high frequency oscillator comprises a vacuum tube 20 having a filament 21, a grid 22 and a plate 23 all enclosed within the tube. Connected to the input and output circuits of the tube is a low loss tank circuit comprising a large variable capacitance 24 and a small inductance coil 25. This coil is magnetically coupled to the output coil 19 of the untuned radio frequency stage.

Connected to the filament 21 are high frequency choke coils 26 and 27. These are composed of a relatively large number of turns of wire and are connected respectively in the plate and grid

circuits of the tube. These coils introduce or generate two driving electromotive forces substantially 180° out of phase as described in detail in application Serial No. 305,753, filed Sept. 13, 1928, Patent 1,874,222, and in application Serial No. 305,754, filed Sept. 24, 1928 Patent 1,905,332, April 25, 1933.

The geometric sum of these separate electromotive forces maintained a heavy oscillating current in the tank circuit and a third coil 28 connected to the filament serves to maintain it at high potential with respect to the ground. The tube 20 receives its electrical supply from the filament battery 17 and the plate battery 18 both of which are maintained at ground potential.

The frequency at which the tube operates is controlled mainly by the value of the condenser 24 and the inductance coil 25. The condenser 24 is of large value and hence the interelectrode capacity of the tube becomes substantially negligible in effect.

Connected in the grid circuit of the tube 20 is a grid condenser 29 and a leak resistance 30. The value of this condenser and resistance is so chosen that the high frequency oscillations generated in the tank circuit will periodically charge the condenser up to a certain value and then discharge through the leak resistance to the ground. Therefore, the condenser 29 and the resistance 30 produced a periodic interruption or chopping of the high frequency oscillations. By selecting proper values for the grid leak and the grid condenser, the circuit becomes a very sensitive detector for radiant energy under the form of electromagnetic waves.

It has been noticed that if the coil in the tank circuit is subjected to the influence of radio waves emitted by a small oscillator placed in the vicinity, or a powerful radio station situated hundreds of miles away, unusually large variations occur in the mean value of the plate current. This change is always accompanied by a change in the pitch of the modulated frequency. The signals transmitted by the radio station under the form of dots and dashes can therefore be read by the difference in pitch.

Connected in the plate circuit or the output circuit of the tube 20 is a meter 31 and the primary 32 of an audio frequency transformer 33. The meter 31 may be employed to indicate the total value of the plate current and the transformer 33 has its secondary 34 connected across the input of a power tube.

As shown, the audiotage comprises a vacuum tube 41 having a filament 42, a grid 43 and a plate

44, all enclosed within the tube. This tube receives its electrical supply from the filament battery 17 and the plate battery 18. Connected in the plate circuit of the tube is a telephone receiver 45 of any preferred type.

The signals are received in the conventional way by the antenna 10 which may be tuned or not to the frequency of the incoming signals. As shown, in Figure 1, an untuned or aperiodic installation is employed using only one stage or radio frequency amplification. It is, of course, to be understood that additional stages of amplification may be used if found desirable.

The high frequency voltage across the input coil 12 is amplified by the vacuum tube 13 and provides a strong current in the output coil 19. The output coil 19 is coupled magnetically to the coil 25 in the tank circuit of the self-modulated high frequency oscillator.

The field produced by the coil 19 changes the reactance of the tank circuit and this produces a sudden change in the pitch of the modulated frequency controlled by the value of the grid condenser 29 and the grid leak 30.

The audiofrequency transformer 33 is resonant to a definite frequency, say 1000 cycles. If the pitch of the initial modulating frequency is 600 cycles, the response in the telephone receiver 44 will be small. When the signal comes and reacts upon the tank circuit, the pitch of the modulated frequency is boosted from 600 to 1000 cycles and the audiotransformer transfers the 1000 cycles very efficiently into the telephone receiver.

Figure 2 illustrates a slightly modified form wherein the input coil 12 is inductively coupled to a radio frequency stage provided with a variable capacitance 46 for tuning to the frequency of the incoming signals. In this modification the conventional three element vacuum tube has been replaced by a screen grid tube 47 having a filament 48, a grid 49, a plate 50 and a screen 51. This tube receives its electrical supply from the filament battery 17 and the plate battery 18 and the screen is connected to the battery 18.

Figure 3 illustrates another modification of the invention wherein the radio frequency stage corresponds to the radio frequency stage shown in Figure 2 and the self-modulated oscillator is the same as the oscillator shown in Figures 1 and 2 except that in the plate circuit the meter 31 and the audiotransformer are replaced by a capacity relay 52, fully described in co-pending applications Serial Number 363,019, filed May 14, 1929; Serial Number 392,466, filed September 13, 1929; and Serial Number 392,811 filed September 19, 1929.

As shown, the capacitance relay comprises a movable coil 53 positioned in the magnetic field of a magnet and a variable capacitance 54, the movable plate of which is displaced by the movement of the coil. The fixed and the movable plates of the capacitance are connected in an oscillatory circuit comprising a coil 55 and a variable capacitance 56.

The coil 55 is coupled to the tank circuit of a second self-modulated oscillator and in close resonance to it. This self-modulated oscillator is a duplication of the self-modulated oscillator used as the detector. Each of the parts corresponds in every particular except that the relay 52 is replaced by a receiver 57. It is, of course, to be understood that the receiver may be replaced by a recording instrument or an electromagnet for controlling a mechanical device.

The incoming signal modifies the reactance of

the tank circuit and provides variations in the plate current. The moving coil displaces the movable plate or rotor of the capacitance 54 changing slightly the tuning of the oscillatory circuit comprising the coil 55 and the capacitance 56. This circuit is coupled to the tank circuit of the second self-modulated oscillator and in close resonance to it, hence, this will produce great changes in the reactance of the tank circuit, and consequently great variations in the pitch of the modulated frequency and in the main value of the plate current. It is, therefore, apparent that the telephone receiver may be replaced by a recording instrument or an electromagnet for controlling a mechanical device.

It is to be noted that this arrangement has remarkably anti-static properties especially for some definite values of the modulated frequency. This property can be well established by adjusting the value of the grid leak until the background noise heard in the receiver is very strong. Upon tuning to a station sending continuous wave signals, the background noise ceases instantly and the receiver remains extremely quiet, so long as there is a carrier wave reacting upon the reactance of the tank circuit.

If the pitch of the modulating frequency is very high and the carrier is modulated at low frequency, it is possible to receive dots and dashes quite free from static. It is, however, necessary that the carrier be maintained all the time and the dots and dashes provided by the modulating frequency. It is clear that the dots and dashes are somewhat mixed with static, but they detach on a background of silence and this greatly facilitates the reception.

It is obvious that the system has enormous possibilities for remote control of mechanical devices, such as torpedoes, crewless boats, tanks, etc. Accordingly it is not our intention to limit the scope of the invention to the particular embodiments illustrated and described or otherwise than by the terms of the appended claims.

Having thus described the various features of the invention, what we claim as new and desire to secure by Letters Patent, is:

1. A radio receiving system comprising a self-modulated radio frequency oscillator, a second self-modulated high frequency oscillator and means in the plate circuit of the first oscillator to change the reactance of the tank circuit of the second oscillator.

2. A radio receiving system comprising a stage of radio frequency amplification, a self-modulated radio frequency oscillator coupled thereto, a second self-modulated high frequency oscillator having a low loss tank circuit connected in its grid circuit and means in the plate circuit of the first oscillator to change the reactance of the tank circuit of the second oscillator.

3. A radio receiving system comprising an antenna system, a stage of radio frequency amplification coupled thereto, a self-modulated radio frequency oscillator having a low loss tank circuit connected in its grid circuit coupled to the radio frequency amplifier by said tank circuit, a second self-modulated high frequency oscillator having a low loss tank circuit connected in its grid circuit and means in the plate circuit of the first oscillator to change the reactance of the tank circuit of the second oscillator.

4. A radio receiving system comprising a stage of radio frequency amplification, a self-modulated radio frequency oscillator having a low loss tank circuit connected in its grid circuit coupled to

said radio frequency stage by said tank circuit, a second modulated high frequency oscillator having a low loss tank circuit connected in its grid circuit and means in the plate circuit of the first oscillator to change the reactance of the tank circuit of the second oscillator by the changes in the mean value of the plate current in the first oscillator produced by the effect of the incoming signals.

5 5. A radio receiving system comprising an antenna system, a self-modulated high frequency oscillator coupled thereto, said oscillator consisting of a tube having a filament, grid and plate, a low loss oscillating circuit of small inductance and large capacitance connected across said grid and plate, a plurality of radio frequency choke coils connected between the filament and the grid on one side and coupled between the filament and plate on the other side producing across said oscillating circuit, a driving electromotive force, and means in the plate circuit of said oscillator for indicating the changes in the pitch of modulation, and other means for indicating the changes in the mean value of the plate current.

6. A radio receiving system comprising an antenna system, a self-modulated high frequency oscillator coupled thereto, said oscillator system comprising a circuit including a vacuum tube having a filament, grid and plate, a tank circuit comprising a low inductance, large capacitance, and low losses connected across the grid and plate, a coil between the filament and grid, and a second coil coupled between the filament and plate of the tube, and means in the plate circuit of the oscillator for indicating the changes in the pitch of modulation, and other means for indicating the changes in the mean value of the plate current.

7. A radio receiving system comprising an antenna system, a self-modulated high frequency oscillator coupled thereto, said oscillator consisting of a vacuum tube including a filament, grid and plate, a tank circuit connected between the plate and grid of the tube, means to induce high frequency oscillations in the tank circuit by two electromotive forces substantially 180° out of phase comprising two coils connecting respectively the filament and grid on one side, and coupled between the filament and plate on the other side, and means in the plate circuit of the oscillator for indicating the changes in the pitch of modulation, and other means for indicating the changes in the mean value of the plate current.

8. A radio receiving system comprising an antenna system, a self-modulated high frequency oscillator including a vacuum tube having a filament, grid and plate, a low loss oscillating circuit of small inductance and large capacitance connected across said grid and plate, and a plurality of radio frequency choke coils connected between the filament and the grid on one side and coupled between the filament and plate on the other, producing across said oscillating circuit a driving electromotive force, said oscillator being coupled to said antenna system by a coupling between the antenna system and the low loss oscillating circuit of small inductance and large capacitance, and an audiofrequency stage of amplification coupled to the output of said oscillator.

9. A radio receiving system comprising an antenna system, a self-modulated high frequency oscillator including a vacuum tube having a filament, grid and plate, a tank circuit comprising a low inductance, large capacitance and low losses connected across the grid and plate, a coil between the filament and grid, and a second coil coupled between the filament and plate of the tube, said oscillator being coupled to the antenna system by a coupling between the antenna system and said tank circuit, and an audiofrequency stage of amplification coupled to the output of the oscillator.

10. A radio frequency system comprising an antenna system, a self-modulated high frequency oscillator including a vacuum tube having a filament, grid and plate, a tank circuit connected between the plate and grid of the tube, means to induce high frequency oscillations in the tank circuit by two electromotive forces substantially 180° out of phase comprising two coils connecting respectively the filament and grid on one side, and coupling the filament and plate on the other side, and an audiofrequency stage of amplification coupled to the output of the oscillator.

11. A radio receiving system comprising an antenna system, a self-modulated high frequency oscillator comprising a tube having a grid circuit, a plate circuit and a tank circuit having a fixed inductance and a variable capacity connected between the grid and plate circuits, the characteristics of the tank circuit being such as to render the stray capacities in the associated circuits substantially negligible, said antenna system being coupled to the oscillator by means of a coupling between the antenna system and the tank circuit of the oscillator, and means for amplifying the output from the oscillator.

12. A radio receiving system comprising a self-modulated radio frequency oscillator including a vacuum tube having a filament, grid and plate, a grid circuit and a plate circuit associated with said vacuum tube, and a tank circuit having a fixed inductance and a variable capacity connected between the grid and plate circuits, the characteristics of the tank circuit being such as to render the stray capacities in the associated circuits substantially negligible, a second self-modulated high frequency oscillator including plate, grid and tank circuits, and means in the plate circuit of the first oscillator to change the reactance of the tank circuit in the second oscillator.

13. A radio receiving system comprising a self-modulated radio frequency oscillator including a vacuum tube having a filament, grid and plate, and having grid and plate circuits, a low loss oscillating circuit of small inductance and large capacitance connected across said grid and plate, a plurality of radio frequency choke coils connected between the filament and grid on one side and coupled between the filament and plate on the other side, producing across said oscillating circuit a driving electromotive force, a second self-modulated high frequency oscillator constructed similarly to the first mentioned oscillator, and means in the plate circuit of the first oscillator to change the reactance of the low loss oscillating circuit of small inductance and large capacitance of the second oscillator.

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