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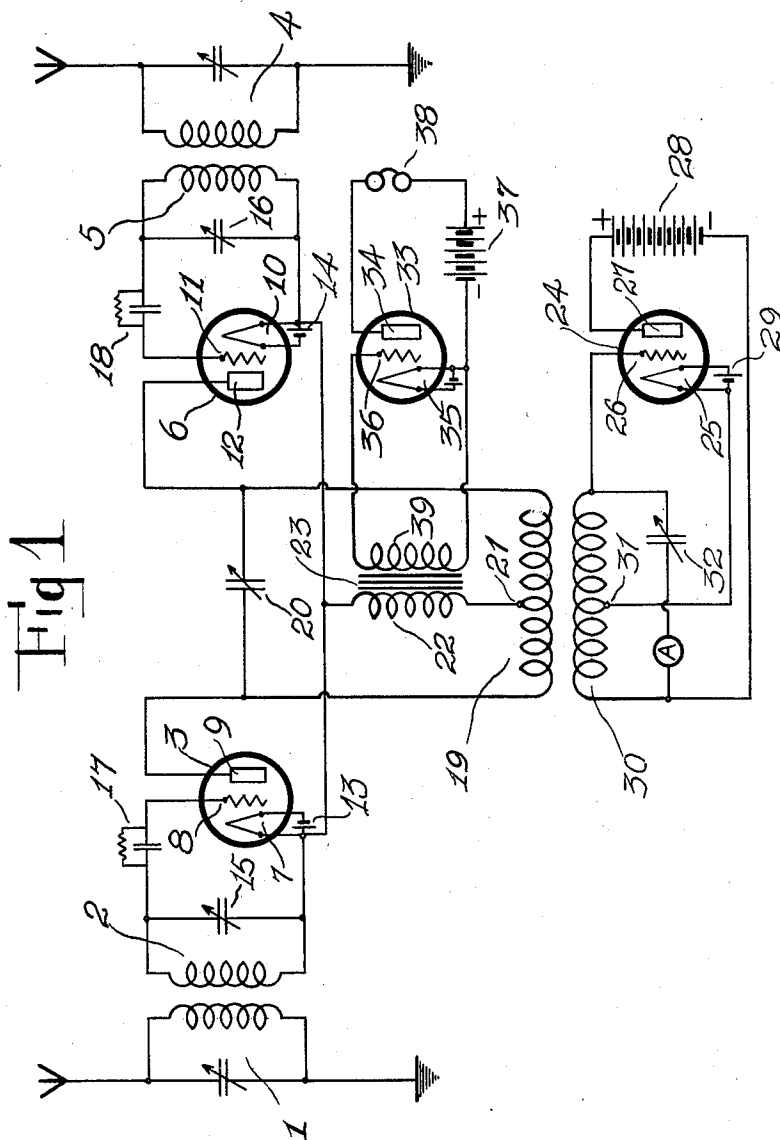
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1,959,281

RADIO RECEIVING SYSTEM

Filed Dec. 22, 1928

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

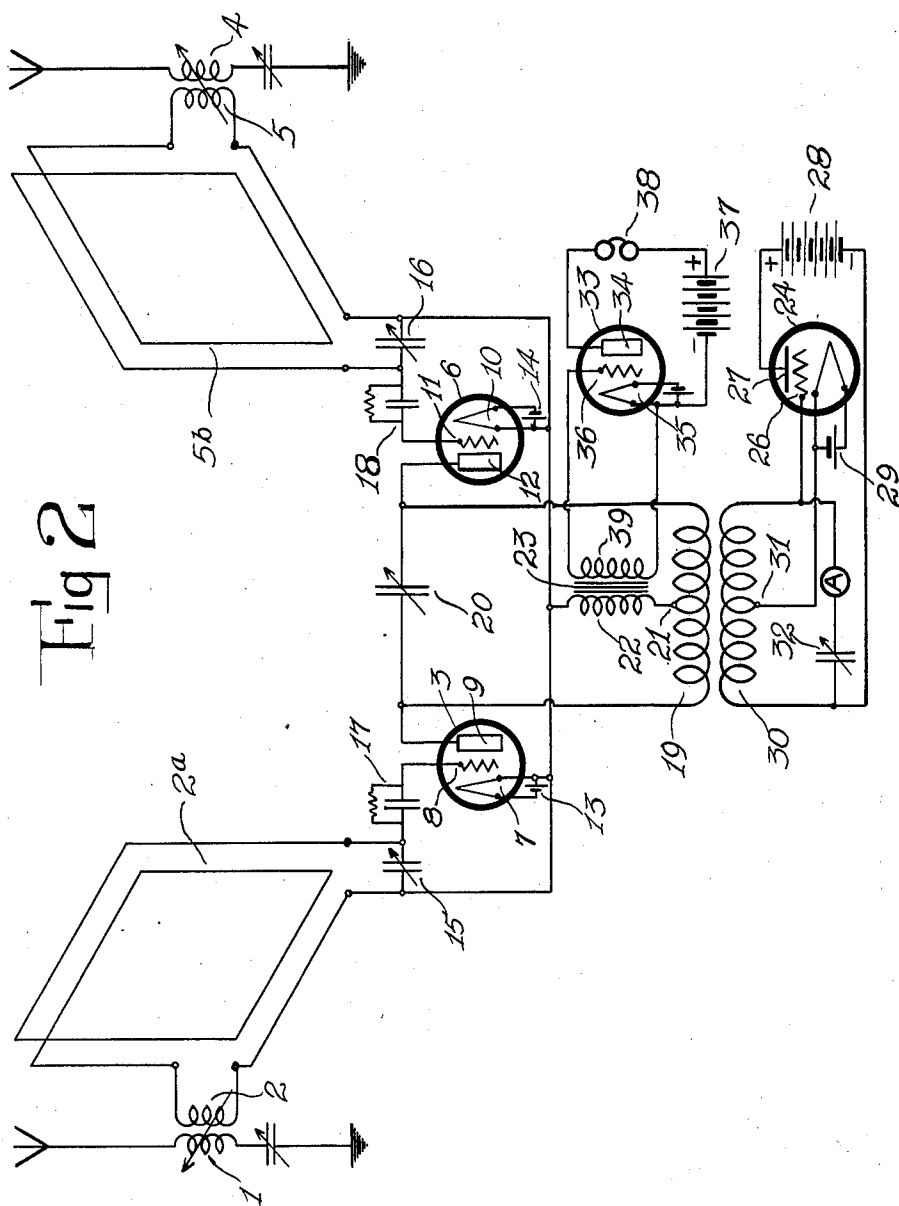


Fig 2

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UNITED STATES PATENT OFFICE

1,959,281

RADIO RECEIVING SYSTEM

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10 Claims. (Cl. 250—20)

My invention relates to radio receiving systems in general and more specifically to radio receiving systems employing thermionic tubes and adapted to receive high frequency signaling energy.

An object of my invention is to receive high frequency signaling energy, without the objectionable fading of the signal.

Another object of my invention is to provide a receiving system employing a multiphase principle to assure reliability of received signaling energy at all times.

Still another object of my invention is to provide a multiphase radio receiving system adapted to receive differently polarized high frequency waves.

Other and further objects of my invention reside in the circuit arrangements I employ of which a better understanding can be had by referring to the specification following and to the accompanying drawings, wherein:

Figures 1 and 2 are schematic circuit diagrams showing the radio receiving system of my invention.

The well known phenomenon of fading is a most serious handicap to the realization of reliable communication by high frequency space radio communicating systems employed at the present time. The phenomenon appears and disappears causing great unreliability and nonuniformity of operation. Many circuit arrangements at both transmitter and receiver may be employed to effectively reduce the effect of fading. These have their disadvantages either from their high cost, intricate circuit arrangements necessitating great precision in operation and care, or for other reasons well known to those skilled in the art. The radio receiving system of my invention does not necessitate intricate workmanship in the construction or operation and has many advantages over systems heretofore employed.

Figure 1 of the accompanying drawings is a schematic circuit diagram showing one form of the radio receiving system of my invention. An energy collecting system 1, comprising an antenna, ground connection, inductance and capacity, is associated with an inductance 2. Inductance 2 is associated with the input circuit of thermionic tube 3. A second energy collecting system 4, comprising an antenna, ground connection, inductance and capacity, is associated with an inductance 5. Inductance 5 is associated with the input circuit of thermionic tube 6. Thermionic tubes 3 and 6 have cathodes 7, 10, control electrodes 8, 11, and anodes 9, 12 respec-

tively. Cathodes 7 and 10 of thermionic tubes 3 and 6 are energized by sources 13 and 14 respectively. A variable capacity 15 is associated with inductance 2 which controls the frequency characteristics of the input circuit of thermionic tube 3. Capacity 16 is associated with inductance 5 which controls the frequency characteristics of the input circuit of thermionic tube 6. Grid leaks and condensers 17 and 18 are connected in the input circuits of thermionic tubes 3 and 6, respectively, the function of which is to maintain control electrodes 8 and 11 at the proper operational potentials.

The output circuits of thermionic tubes 3 and 6 include inductance 19, a connection from the electrical center 21 returning to the common cathode connection. One winding 22 of transformer 23 is connected in series with the common return from center connection 21 to the cathode circuit. Thermionic tube 24 is connected in an oscillatory circuit arrangement comprising inductance 30, center connection 31 and capacity 32. Thermionic tube 24 comprises cathode 25, control electrode 26 and anode 27. Anode 27 is supplied with the proper positive potential in respect to its cathode circuit by source 28. Source 29 supplies the energizing potential for cathode 25. The values of inductance 30 and capacity 32 determine the frequency characteristics of the oscillatory circuit and the frequency of the generated oscillatory energy. Inductance 30 is associated inductively with inductance 19 and is adapted to transfer the generated oscillatory energy thereto. Thermionic tube 33 is of the triode type having an anode 34, cathode 35 and control electrode 36. The input circuit of thermionic tube 33 includes winding 39 of transformer 23. The output circuit of thermionic tube 33 includes reproducing unit 38. Anode 34 of thermionic tube 33 is supplied with the proper potential from source 37. Reproducing unit 38 may be replaced by the input circuit of subsequent amplifiers if so desired. Thermionic tubes 3, 6, 24 and 33 may be of the type employing four or more electrodes instead of the triode type illustrated in the accompanying drawings.

The operation of the radio receiving system of my invention can best be understood by referring to the accompanying drawings. In Fig. 1, assume that collecting systems 1 and 4 are positioned in different planes or otherwise arranged to receive differently polarized waves. Collecting system 1 could be vertically polarized and collector system 4 horizontally polarized for the purpose of illustration. It seldom happens that the

two waves are subjected to the effects of fading at the same time. Circuit 2, 15 and circuit 5, 16 are both adjusted to the frequency of the signal to be received. Thermionic tubes 3 and 6 with their associated circuits are adapted to rectify the incoming signaling energy. The operation of either of these tubes depends, however, upon the proper supply of anode potential to the respective tubes. The supply of anode potential is derived from thermionic tube 24 which is connected in a suitable circuit arrangement to generate oscillatory energy. The energy thus generated, oscillatory in character, provides the necessary anode supply potential to tubes 3 and 6. The electrical center connection 21 is always neutral while the extreme ends of inductance 19 alternate through the positive and negative values in respect to center connection 21. This supplies alternately a potential of positive polarity to anodes 9 and 12 of thermionic tubes 3 and 6, respectively.

The instant that the potential of anode 9 is positive in respect to the cathode 7, anode 12 is negative in respect to the cathode 10. As is well known in the art, a thermionic tube requires a positive anode potential in respect to the cathode if the same is to operate efficiently as an amplifier or detector of electrical energy. Thus thermionic tubes 3 and 6 alternately operate to rectify and amplify the electrical energy received by collectors 1 and 4, respectively. The negative polarity of either anode, during alternate half cycles of the energy from the tube 24, causes a greater degree of inoperativeness during this interval. The following half cycle however, reverses the conditions with the tubes and that tube having a negative polarity on the anode now is supplied with a potential of positive polarity and hence functions to amplify and rectify the energy received by the collector system immediately associated therewith. Thermionic tube 33 is adapted to amplify the incoming energy which is then reproduced by reproducing means 38 or further amplified if so desired. The energy received by collector system 1 may be subjected to a fading condition and hence thermionic tube 3 would transfer little of the energy to inductance 19 or transformer 23. The ultimate result is that a signal of sufficient intensity is present in transformer 23 and hence in the output circuit of thermionic tube 33 irrespective of the above mentioned weak signal received by collector 1. The operation is similar when collecting system 4 receives signaling energy of a value less than normal. Either collecting system 1 or collecting system 4 may contribute a signal of small intensity, yet, the possibilities are that the one not subject to fading at this instant will supply energy of sufficient intensity to insure reliable reception.

Fig. 2 of the accompanying drawings is a schematic circuit diagram showing a modification of the radio receiving system of my invention. Reference characters shown herein correspond to those employed in Fig. 1. The primary distinction between this arrangement and the arrangement shown in Fig. 1 lies in the coil antenna employed in this arrangement. Capacities 15 and 16 operate to control the frequency characteristics of the input circuits of thermionic tubes 3 and 6 respectively. Coil antennae 2a and 5b are connected in series with inductances 2 and 5 respectively. Collecting systems 1 and 4 may be associated with inductances 2 and 5 respectively. Coil antennae

2a and 5b may be placed at right angles to each other so as to make collecting systems 1 and 4 substantially unidirectional. Coil antennae 2a and 5b may, however, be placed in positions in respect to collecting systems 1 and 4, whereby any desired directional characteristics may be obtained. The familiar figure eight characteristic may be changed to such characteristics as exclusively admits reception from a given direction only and not reception from the direction geographically opposite thereto.

The radio receiving system of my invention affords many advantages over types heretofore employed. This invention overcomes fading effects or reduces the same to a negligible amount. Since both receivers are not in operation at the same instant, phase relation between the receivers and the received signal can not neutralize the signals as when both receivers are in operation simultaneously.

I realize that many modifications of the receiving system of my invention are possible without departing from the spirit of my invention and it is to be understood that the embodiments of my invention shall not be limited by the foregoing specification or by the accompanying drawings but only as defined in 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. A radio receiving system comprising in combination a plurality of thermionic tubes connected with individual energy collecting means, a common output circuit connected with said tubes and a thermionic tube oscillator coupled to said output circuit and adapted to supply the anode potential to said tubes whereby said tubes operate in alternate order.

2. A radio receiving system comprising in combination a plurality of thermionic tubes connected with individual energy collecting means, said individual energy collecting means adapted to receive signaling energy from a given direction, a common output circuit connected with said tubes and a thermionic tube oscillator coupled to said output circuit and adapted to supply the anode potential to said tubes whereby said tubes operate in alternate order.

3. A radio receiving system comprising in combination a plurality of thermionic tubes connected with individual energy collecting means, said energy collecting means comprising differently polarized antennae, a common output circuit connected with said tubes and a thermionic tube oscillator coupled to said output circuit and adapted to supply the anode potential to said tubes whereby said tubes operate in alternate order.

4. A radio receiving system comprising in combination a plurality of thermionic tubes connected with individual energy collecting means, said energy collecting means comprising antennae positioned in horizontal and vertical planes in respect to the earth's surface, a common output circuit connected with said tubes and a thermionic tube oscillator coupled to said output circuit and adapted to supply the anode potential to said tubes whereby said tubes operate in alternate order.

5. A radio receiving system comprising in combination a plurality of thermionic tubes connected with individual energy collecting means, said collecting means comprising coil antennae, a common output circuit connected with said tubes and a thermionic tube oscillator coupled

to said output circuit and adapted to supply the anode potential to said tubes whereby said tubes operate in alternate order.

5 6. A radio receiving system comprising in combination a plurality of thermionic tubes connected with individual energy collecting means, some of said means adapted to receive horizontally polarized waves of signaling energy, other
10 of said means adapted to receive vertically polarized waves of signaling energy, a common output circuit connected with said tubes and a thermionic tube oscillator coupled to said output circuit and adapted to supply the anode potential to said tubes whereby said tubes operate in
15 alternate order.

7. In a radio receiving system, the combination of a plurality of separate radio frequency energy collecting means, a plurality of separate receiving circuits each respectively connected
20 with one of said energy collecting means, a common output circuit for said receiving circuits and means for alternately actuating said receiving circuits.

8. In a radio receiving system, the combination

tion of a plurality of separate radio frequency energy collecting means, each of said means adapted to receive radio frequency energy from a different direction in respect to the other, a plurality of separate receiving circuits each respectively connected with one of said energy collecting means, a common output circuit for said receiving circuits and means for alternately energizing said common output circuit from said
85 receiving circuits.

9. The method of reducing the effects of fading which comprises receiving radio frequency energy at geographically separate points and in detecting said received energy in cyclic order.

10. A radio receiving system comprising in combination a plurality of thermionic tubes, individual energy collecting means respectively connected thereto, a common output circuit connected with said tubes, a source of alternating current and means comprising said source of
95 alternating current for causing each of said energy collecting means to alternately affect said output circuit.

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