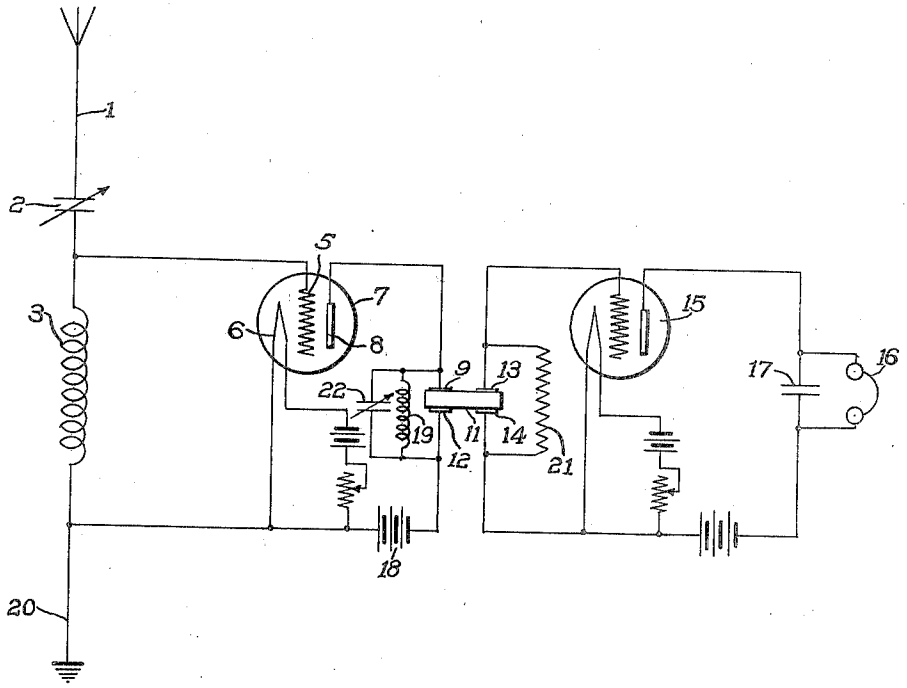
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WIRELESS RECEIVING SYSTEM

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WITNESSES:

A. G. Schiefelbein.

H. A. Thilton Jr.

INVENTOR

Max C. Batsel.

BY

Wesley G. Carr

ATTORNEY

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UNITED STATES PATENT OFFICE

MAX C. BATSEL, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

WIRELESS RECEIVING SYSTEM

Application filed September 20, 1923. Serial No. 663,734.

This invention relates to systems for receiving radio signals and particularly to the coupling means used for connecting successive circuits in such systems.

It is an object of this invention to make use of the characteristics of a piezo electric crystal to secure a sharply tuned coupling between such circuits.

It is a further object of this invention to provide a signalling system having a coupling possessing very great selectivity, whereby the tuning of the system is greatly simplified. In accordance with this object, a receiving system is produced which will be very sensitive to one frequency only, and very insensitive to other frequencies, even when they are fairly close to the particular frequency to which the system is sensitive, so that the operator tuning the system may obtain signals free from interference without employing a multiplicity of delicate tuning adjustments.

It is a further object of this invention to largely reduce the effect of static disturbances upon a signal receiving system.

These and other objects will be made apparent through the further description of my invention, and reference to the accompanying drawings wherein the single figure is a diagrammatic illustration of a receiving system embodying my invention.

In the figure, 1 represents an antenna which is provided with the usual adjustable condenser 2 for tuning, an inductance 3, both for determining the approximate period and for coupling, and a ground connection 20. The terminals of the inductance 3 are respectively connected to the grid 5 and the filament 6 of a thermionic device 7. In the circuit illustrated in the drawing, this device is an amplifier but the invention is equally applicable to systems in which other connections are used, so that the thermionic device may act as a detector, as an auto-heterodyne or for any known or suitable purpose.

The anode 8 of the tube 7 is connected to a plate 9 that is cemented or otherwise secured to one side face of a piezo-electric crystal 11. The opposite side face of the crystal has a plate 12 similarly secured thereto. The plate 12 is connected to a battery 18, whereby the crystal 11 is inserted in the usual plate circuit of the vacuum tube 7.

An inductance coil 19 is connected around the crystal 11 to afford a conductive path for the current from battery 18. If desired, a condenser 22 is provided in parallel with the inductance coil 19 so that the two together form a tuned circuit. The potentials impressed on the plates 9 and 12 will then be increased by the resonant action of this circuit.

Two plates 13 and 14 are connected to the two side faces of the crystal but are separated from the plates 11 and 12. These plates are in the grid circuit of a thermionic device 15 and, to furnish a grid leak for this tube, a high resistance element 21 is connected around the crystal 11. This vacuum device 15 may be connected in any of the usual circuits employed in a receiving system. As illustrated it is a detector, but the invention is equally applicable to amplifying systems of several stages and the crystal 11 may be used as a coupling device between the several stages of such an amplifying system. The plate circuit of the thermionic device 15, as illustrated, includes the usual telephone receivers 16 bridged by a fixed condenser 17, but it is obvious that the telephone receivers with their condenser may be separated from the plate circuit of the vacuum tube 15 by intervening apparatus if desired.

In the operation of the device, the energy received upon the antenna 1 sets up currents in the circuit of the vacuum tube 7 which cause periodic changes in the potentials of the plates 9 and 12, and so of the field between these plates. These changes in the field cause corresponding changes in the length of crystal 11 and these changes in length are accompanied by a changing electrostatic field which produces potential changes upon the plates 13 and 14. The currents set up in the circuit of the tube 7 are thus transferred into the circuit of the vacuum device 15, but this transfer takes place to a very slight extent only, except in the case of currents whose frequency corresponds to the natural period of

the crystal 11 which is determined almost wholly by the length of the crystal.

When the apparatus is built, the length of the crystal 11 is so selected that the system is sensitive to energy of the frequency of the signals which the apparatus is intended to receive. The receiving system will be markedly insensitive to signals of any other period. The selectivity obtained by this means greatly exceeds that which can be obtained either by tuning a transformer or by tuning the circuits associated with a transformer. If the operator tunes the antenna circuit by means of the adjustable condenser 2 so that it is approximately correct for the frequency of the expected signals, that approximately correct tuning will cause the circuit of the tube 7 to respond to some extent to the signals, and, in many instances, to interfering signals as well. The energy transferred by the crystal to the circuit of the vacuum tube 15 is, however, wholly of the intended frequency, because of the sharply selective coupling action of the piezo-electric device 11. The detecting action of the thermionic device 15 will enable the operator to hear the signals in the telephone receivers 16 and he will then re-adjust the condenser 2 until the signals are of maximum strength.

The statement, hereinbefore made, that the plates 9, 12, 13 and 14 are cemented or otherwise secured to the faces of the crystal, is to be understood, by those skilled in the art, to specify that the plates are in fixed relation to the said crystal. It should, accordingly, be clearly apparent that my invention is not limited by the term "cemented" but it is to be broadly construed as covering systems wherein the plates are either cemented to, or disposed adjacent to, the crystal. In this connection see lines 9 to 27 on page 2 of the specification of the Cady Patent 1,472,583.

Various other changes and modifications may be made in the apparatus illustrated without departing from the spirit and scope of my invention. My invention, therefore, is not to be limited except in so far as is necessitated by the prior art or by the spirit of the appended claims.

What I claim as my invention:

1. A signal-receiving system comprising a circuit, a second circuit including an indicating device, and a coupling between said circuits, said coupling consisting solely of a piezo-electric crystal having a greater selectivity than either of said circuits, whereby the frequency to which the receiving system will respond is determined by said coupling.

2. In a radio receiving system, an antenna structure, a thermionic device having input and output circuits, the input circuit being associated with said antenna structure, a piezo-electric crystal capacitively included in said output circuit, a thermionic detector device having an untuned input circuit capacitively including said crystal and a leakage path therearound, whereby the frequency to which the system will respond is determined substantially by the natural period of said crystal section.

3. In a radio receiving system, a thermionic amplifier device having a tunable output circuit capacitively including a piezo-electric crystal, and a thermionic detector device having an untuned input circuit capacitively including said crystal and being free from concentrated inductance, whereby oscillations at the natural period of the said crystal only will be impressed on said detector device and be rectified thereby.

4. In a signal-receiving system, a thermionic device having an output circuit capacitively including a piezo-electric crystal, a second thermionic device having an untuned input circuit also capacitively including said crystal, and a resistance device substantially non-inductive in character connected in shunt to said crystal and comprised in said second circuit, said crystal serving as the entire coupling between said circuits, whereby the frequency to which said system will respond is determined by an oscillation frequency of said crystal.

In testimony whereof, I have hereunto subscribed my name this 11th day of September, 1923.

MAX C. BATSEL.