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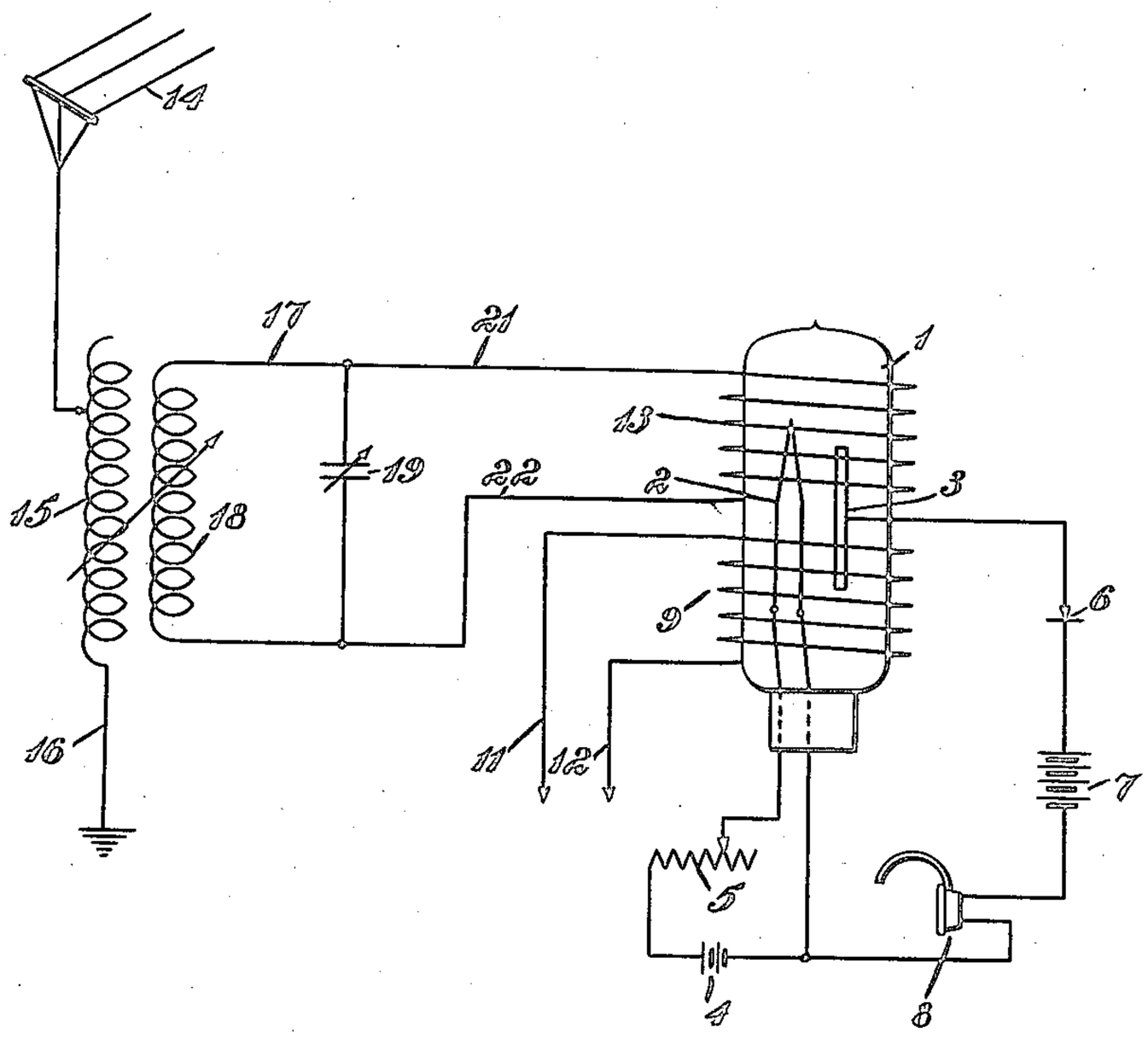
C. T. ALLCUTT.
WIRELESS RECEIVING SYSTEM.
FILED JUNE 25, 1921.

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# UNITED STATES PATENT OFFICE.

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## WIRELESS RECEIVING SYSTEM.

Application filed June 25, 1921. Serial No. 480,366.

*To all whom it may concern:*

Be it known that I, CHESTER T. ALLCUTT, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Wireless Receiving Systems, of which the following is a specification.

My invention relates to wireless receiving systems and more especially, to such receiving systems as are adapted to respond to undamped signal impulses.

The object of my invention is to provide a receiving system for undamped signal impulses which embodies the heterodyne or "beat" principle of operation.

Other objects of my invention will be apparent from the following description, taken in connection with the accompanying drawing and claims.

In a well-known type of receiving system for undamped signal impulses, reception is effected by heterodyning the received signal currents with those from a local source to cause the formation of beat currents.

I have found, however, that similar results may be obtained by combining the magnetic fields of the signal and local currents to form a resulting magnetic field of beat frequency and then causing the resultant magnetic field to control the impedance of a vacuum-tube device.

The desired result may be obtained by employing a two-electrode vacuum tube, of well-known form, and surrounding the tube with magnetizing windings which are associated with wave-responsive apparatus and with a local source of high-frequency currents.

My invention, however, may best be understood by reference to the accompanying drawing, in which;

The single figure is a diagrammatic view of circuits and apparatus embodying my invention.

Referring to the drawing, I have shown a two-electrode tube 1, of well known form, having a hot cathode or filament 2 and an anode 3 suitably disposed therein. The hot cathode 2 may be energized by means of a source of energy 4 through a resistor 5. A plate-filament circuit comprises a rectifier 6, such, for example, as a crystal detector, a source of energy 7 and an indicating device 8. A varying magnetic field of predetermined intensity and frequency may be produced by means of a magnetizing coil 9 which is wound around the vacuum tube and is connected, by conductors 11 and 12, to a local source of high-frequency currents (not shown).

An interacting varying magnetic field, of a frequency determined by that of the received signal impulses, may be obtained by means of a magnetizing coil 13 which is also wound around the vacuum tube 1 and is energized by wave-responsive apparatus of well known form.

The wave-responsive apparatus comprises an antenna circuit, which may include an antenna 14, a coupling coil 15 and a ground lead 16, and a local oscillation circuit 17 which is operatively coupled thereto by a coil 18. The local oscillatory circuit just mentioned comprises the coil 18 and a condenser 19, opposite terminals of which are connected to the magnetizing winding 13 by conductors 21 and 22.

In the operation of my invention, I utilize the well known effect of a transverse magnetic field upon the path of an electron stream.

In a vacuum-tube device comprising a heated filament 2 and an anode 3 disposed symmetrically with respect thereto, the electrons are emitted from the heated filament and travel in substantially straight lines to the surface of the anode. Upon impressing a transverse magnetic field, however, upon the electron path, the paths of the electrons become curved. the degree of curvature depending upon the intensity of the transverse magnetic field. Thus, for example, upon increasing the intensity of the magnetic field to a sufficiently high value, the electron path may be curved to such extent that the electrons fail to reach the anode.

In view of the phenomena just described, upon impressing an alternating current of sufficient intensity upon the terminals of the magnetizing winding 9, the effect of the varying magnetic field produced is to periodically vary the number of electrons reaching the anode 3, or, in other words, the ap-

parent impedance of the tube at a frequency depending upon that of the impressed currents.

In the operation of my invention, however, I cause the magnetic field, which is produced by the coil 13 upon the receipt of signal impulses, to interact with that produced by the coil 9, which is energized by locally generated high-frequency currents of slightly different frequency, to produce a resultant magnetic field having a beat frequency corresponding to the difference between the frequencies of the currents just mentioned.

Since the coils 9 and 13 have been so disposed that the resultant beat magnetic field is transverse to the space-current path within the evacuated electric device 1, the number of electrons reaching the anode 3 are varied at the beat frequency of the resultant magnetic field, thereby causing pulsating direct currents to traverse the plate-filament circuit which may be detected in the indicating device 8. In this instance, it will be noted that the detector device 6 may be omitted from the circuit. However, the detector device becomes effective when it is found necessary to superimpose upon the alternating magnetic fields a direct-current magnetic field in order to adjust the tube 1 to maximum sensitivity.

In order to increase the intensity of the field produced by the coil 13 and thereby render the receiving system more sensitive to weak signals, it may be desirable to employ amplifying devices, of any well known form, in the supply circuits of the magnetizing winding 13. In order to simplify my invention in so far as possible, I have not shown such amplifying devices. Furthermore, as will be readily understood by those versed in the art, amplifying devices may also be employed in the plate-filament circuit for amplifying the audio-frequency currents therein, though I have not shown such devices, for reasons just mentioned.

The radio-frequency circuits have been shown as including means for adjusting them to resonance with the incoming signal impulses, though aperiodic or non-resonant circuits are also applicable to my invention.

From the foregoing description, it will be seen that the operation of the vacuum tube is that of a relay rather than that of a rectifier; since the operation depends upon the variations in the conductivity of the vacuum tube that are effected by a transverse magnetic field and not upon the rectifying action of the tube.

The advantage of my invention is in the provision of a simple and efficient receiving system for undamped signal impulses which embodies the heterodyne method of reception with its attending advantages.

While I have shown only one embodiment of my invention, in the appended drawings, I do not wish to be limited thereby, but I desire that only such limitations shall be imposed upon my inventions as are set forth in the appended claims.

I claim as my invention:

1. In a wireless receiving system, means for producing a high-frequency magnetic field the amplitude of which is modulated at a low-frequency rate upon the receipt of signal impulses and an evacuated electric device having a space-current path therein, said space-current path being substantially transverse to the direction of said magnetic field, whereby the apparent resistance of said space-current path may be varied at said low-frequency rate.

2. In a wireless receiving system, means for producing a periodically varying magnetic field upon the receipt of signal impulses, means for producing a periodically varying magnetic field of slightly different frequency from said first-named magnetic field to cause the formation of beats in the intensity of the resultant magnetic field and an evacuated electric device having a space-current path therein disposed transverse to said resultant magnetic field, whereby the impedance of said space-current path may be varied at frequencies according to said beat-frequency.

3. A wireless receiving system comprising means for producing a periodically varying field of force upon the receipt of signal impulses, means for producing an interacting periodically varying field of force of a frequency slightly different from said first-named field of force, an evacuated electric device having a space-current path therein, said space-current path being so disposed as to be affected by the field of force resulting from the interaction of said fields of force, and means associated with said evacuated electric device for detecting said effects upon said space-current path.

4. A wireless receiving system comprising an evacuated electric device having a space-current path therein, an indicating device adapted to respond to variations in the impedance of said space-current path, wave-responsive apparatus associated with said evacuated electric device for producing a periodically varying filed of force substantially transverse to the space-current path therein upon the receipt of signal impulses and means also associated with said evacuated electric device for producing an interacting periodically varying field of force of slightly different frequency to cause the formation of beats in the magnetic fields, whereby the impedance of said space-current path may be varied at a corresponding beat-frequency.

5. In an intelligence-transmission system of the type employing carrier currents of

relatively high frequency, a local receiving circuit including a translating device and a space-current path, a circuit adapted to carry incoming signal currents, means for heterodyning said signal currents with a local source of high-frequency current and means for subjecting said space-current path to a transverse magnetic field corresponding to the resultant of said signal currents and said heterodyning currents.

6. In an intelligence-transmission system of the type employing carrier currents of relatively high frequency, a local receiving circuit including a translating device and a space-current path, a circuit adapted to carry incoming signal currents, means for heterodyning said signal currents with a local source of high-frequency current and means for subjecting said space-current path to the modulating action of a magnetic field corresponding to the resultant of said signal currents and said heterodyning currents.

In testimony whereof, I have hereunto subscribed my name this 20th day of June 1921.

CHESTER T. ALLCUTT.