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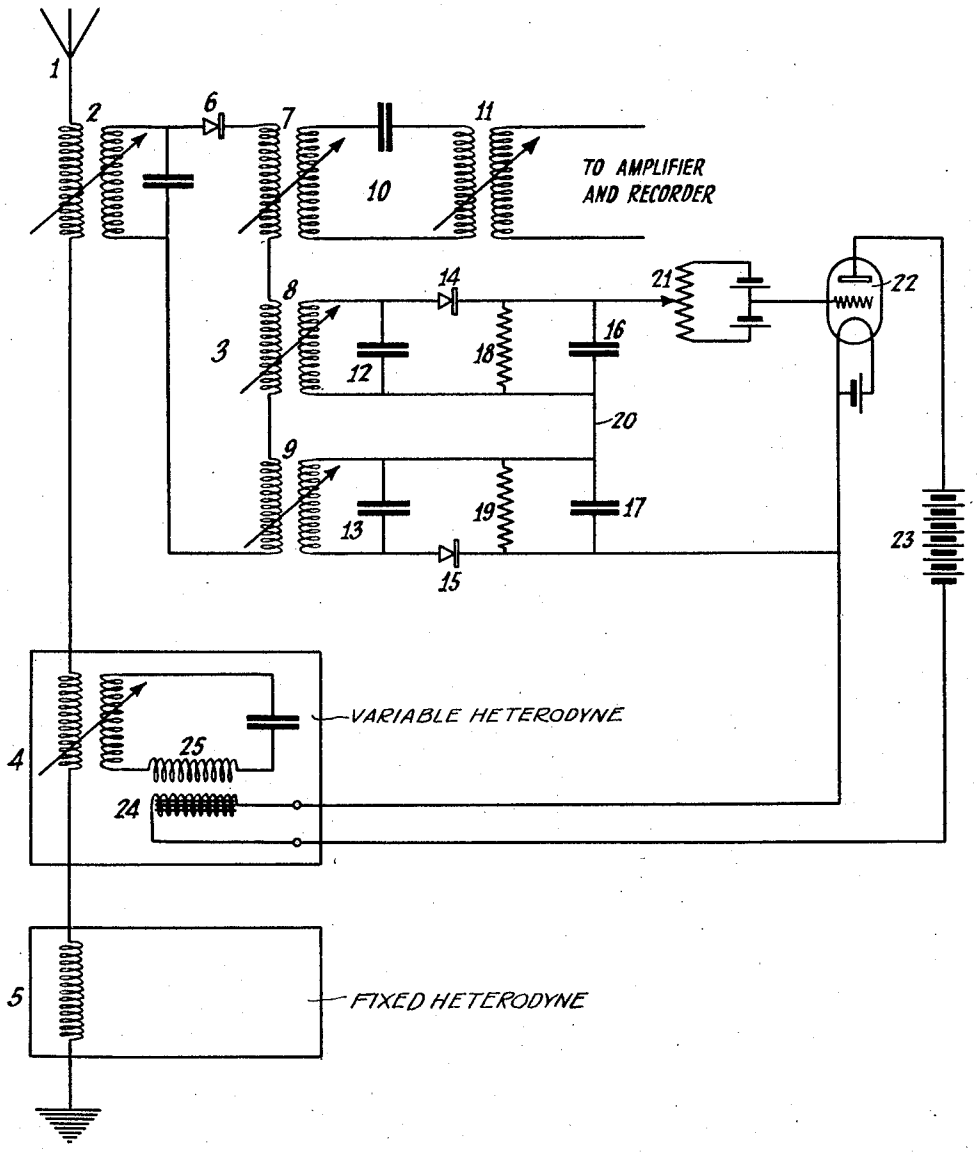
RADIO SIGNALING SYSTEM

Original Filed March 2, 1922



INVENTOR
HENRY J. ROUND
BY Ira J. Adams
ATTORNEY

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HENRY JOSEPH ROUND, OF LONDON, ENGLAND, ASSIGNOR TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE.

RADIO SIGNALING SYSTEM.

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This application is a division of my copending application, Serial No. 540.451 for radio signaling systems filed March 2, 1922, patented September 13, 1927, as Patent No. 1,642,173.

This invention relates to improvements in the reception of continuous wave wireless signals.

In some methods now in use in the beat reception of signals it is customary to employ circuits very accurately tuned to the beat note which of course requires great constancy in the length of the transmitted waves. It is however, very difficult to maintain absolute constancy.

The object of this invention is to provide a method of and means for receiving continuous waves in which even with very accurately tuned circuits reception shall not be impaired by slight variations in the length of the incoming waves.

According to this invention I so arrange the receiving apparatus that when a variation occurs in the length of the incoming waves a corresponding variation is made in the frequency of the heterodyne.

With this object I preferably provide two subsidiary oscillatory circuits, one tuned to a frequency slightly greater than the normal beat frequency, and the other to a frequency slightly less than the normal beat frequency, and I apply beat currents to these two circuits which are connected through rectifiers to condensers shunted with resistances. The latter are arranged in series but in such a manner that normally there is no potential difference between the free terminals which are connected to the grid and filament of a valve preferably through an adjusting potentiometer. The alteration of the resistance of this valve when the beat frequency changes is caused to affect the frequency of the heterodyne. In some cases, however, I may employ only one subsidiary circuit to alter the resistance of the valve.

In cases where the heterodyne is to be varied so as to give a constant beat note with the signals in spite of variations of frequency of the latter, I preferably employ two heterodynes one of which is constant and the other variable and of different frequency from the first.

Beat currents due to the constant heterodyne and the signals are conveyed to the two oscillatory circuits so that when the length of the signal wave varies a differential effect is produced by these circuits and the valve alters the frequency of the variable heterodyne and so is arranged to keep constant the beat note which is due to it and the signals and which is conveyed to the receiving circuit.

Although I have illustrated and described my invention in connection with the usual radio receiving antenna system, it is obvious that it can be used equally well in so-called "wired wireless" systems or in connection with any other devices which depend for their operation on the transmission of signals by high frequency waves. The word "wireless" as herein used is therefore to be construed as including these analogous systems as well as the more usual type of radio signal systems.

For a complete understanding of my invention, reference is had to the accompanying drawing in which the single figure illustrates a diagrammatic circuit arrangement conforming thereto.

In the drawing, 1 represents an antenna circuit coupled to the circuit 3 by the inductive coupling device 2 and likewise coupled to a variable heterodyne 4 and a fixed heterodyne 5. The circuit 3 includes a detector 6 and is coupled to a circuit 10 through the coupling device 7 and to circuits 12 and 13 through the coupling devices 8 and 9 respectively. The circuit 10 is accurately tuned to the frequency of the beat note produced between an incoming signal of predetermined frequency and the normal frequency of the variable heterodyne 4. This circuit is coupled through the device 11 to an amplifier and recorder and other signal responsive device.

The circuit 12 is connected through the detector 14 to a condenser 16 shunted by a resistance 18 while circuit 13 is connected through the detector 15 to a condenser 17 shunted by the resistance 19. The resistances 18 and 19, shunting the condensers 16 and 17, are connected in series by the lead 20. This series connection is connected through a potentiometer 21 to the grid filament circuit of the thermionic relay valve 22, the purpose of which is to convert the alterations in potential in the grid circuit thereof into cor-

responding changes in current in the plate circuit of the valve. The plate circuit of this valve including the battery 23 is connected to the iron core inductance coil 24 which is in inductive relationship to the coil 25 included in the variable heterodyne circuit.

The circuit 10 is accurately tuned to the beat note produced between the incoming wave of predetermined frequency and the normal frequency of the variable heterodyne 4. The circuit 12 is tuned to a frequency slightly above the beat frequency produced by the predetermined frequency of the incoming wave and the frequency of the fixed heterodyne 5, while the circuit 13 is tuned to a frequency slightly below this value.

As long as the incoming wave does not vary from its predetermined frequency, the circuits 12 and 13 will have induced in them equal voltages due to the beat frequency between the incoming waves and the fixed heterodyne 5 which voltages, owing to the detectors 14 and 15 and condensers 16 and 17, will cause equal and opposite voltage drops in the resistances 18 and 19. Under these circumstances the incoming signal waves will have no effect on the potential of the grid of the valve 22. If the frequency of the incoming wave changes, however, the frequency of the beat note between it and the fixed heterodyne will approach the frequency to which one of the circuits 12 or 13 is tuned, the drops across the resistances 18 and 19 will no longer be equal and the grid of valve 22 will have its potential changed due to the change of the incoming wave frequency.

This change in potential of the grid will cause a variation of resistance in the plate circuit of the valve which will change the inductive effect of the coil 24 on the coil 25 of the variable heterodyne circuit thereby changing its frequency. The constants are so chosen that this change in the frequency of the variable heterodyne will exactly compensate for the change in frequency of the incoming wave, thereby maintaining the frequency of the beat note constant. From this it results that the circuit 10 will always have a constant beat frequency induced in it and it can be tuned as closely as desired to this frequency.

Although I have described my invention in connection with a particular circuit arrangement it will be obvious to those skilled in the art that it is adapted to various modifications. The illustration and description should be therefore taken in an exemplary sense and not in a limiting one. I intend to limit my invention only as indicated by the scope of the claims hereto attached.

Having described my invention, what I claim is:

1. In a wireless receiving system, a local heterodyne, a receiving circuit unresponsive to the normal signaling frequency and responsive to deviations from said frequency and means for causing the receiving circuit to vary the local heterodyne frequency.

2. In a wireless receiving system, a local heterodyne, a receiving circuit including a pair of portions balanced for the normal signaling frequency and unbalanced for nearby frequencies and a relay operatively associated with said receiving circuit responsive to alterations of potential therein to change the local heterodyne frequency.

3. In a wireless receiving system, a local heterodyne, a receiving circuit which includes a pair of portions oppositely detuned with respect to the signaling frequency and a relay cooperating with said receiving circuit and responsive to alterations of potential therein to change the local heterodyne frequency.

4. In a wireless receiving system, a local heterodyne, a receiving circuit comprising a pair of oppositely detuned portions balanced for the normal signaling frequency and a relay having its input circuit cooperating with said portions and its output circuit so coupled to the heterodyne as to change the frequency thereof in accordance with deviations in the signaling frequency.

5. In a wireless receiving system, a local heterodyne, a receiving circuit comprising a pair of oppositely detuned portions balanced for the normal signaling frequency and unbalanced for nearby frequencies, a thermionic valve having its input circuit connected to said portions so as to respond alterations of potential in said receiving circuit when unbalanced and its output circuit coupled to the heterodyne and adapted to change the frequency thereof in accordance with the alterations of potential in said circuit.

6. In a wireless receiving system, a local heterodyne, a receiving circuit comprising a pair of oppositely detuned oscillation circuits, a rectifier and a resistance connected to each of the last mentioned circuits, a valve having its input circuit responsive to the relative potential drops across said resistances and having its output circuit coupled to an inductance of the heterodyne for varying the frequency thereof.

7. In a wireless receiving system, a local heterodyne, a receiving circuit comprising a pair of oppositely detuned oscillation circuits, means for rectifying the currents of the last mentioned circuits, a resistance and a capacity in parallel to each of the last mentioned circuits, a valve having its input circuit connected to said resistances and adapted to respond to their relative potential drops and having its output circuit coupled to an inductance of the heterodyne for varying the tuning thereof.

8. In a wireless receiving system, a local heterodyne, a receiving circuit comprising a pair of oppositely detuned oscillation cir-

cuits, means for rectifying the currents of the last mentioned circuits, a resistance and a capacity in parallel to each of the last mentioned circuits, a valve having its input circuit connected to said resistances and adapted to respond to their relative potential drops and having its output circuit coupled to an inductance of the heterodyne for varying the tuning thereof.

9. In a wireless receiving system, the combination of a local heterodyne, a receiving circuit tuned to the normal beat frequency, a second receiving circuit unresponsive to signals giving the normal beat frequency and responsive to alterations in frequency and means for causing the second circuit to vary the heterodyne frequency.

10. In a wireless receiving system, the combination of a local heterodyne, a receiving circuit tuned to the normal beat frequency, a second receiving circuit comprising a pair of circuits oppositely detuned with respect to the normal signal frequency, said second circuit being balanced for said normal frequency and unresponsive to nearby frequencies and means for causing the second circuit to vary the frequency of the heterodyne in response to alterations of the normal signal frequency.

11. In a wireless receiving system, the combination of a tuned circuit, two subsidiary oscillatory circuits, means for applying beat currents to these three circuits, a valve having a grid and a filament, resistances connected to the two subsidiary circuits and between the grid and filament of the valve, and means whereby an alteration in the potential of the grid alters the frequency of the heterodyne.

12. The method of receiving continuous waves which consists in applying a heterodyne thereto and causing a variation in the beat currents so produced due to a change in the frequency of the incoming waves to alter the frequency of the heterodyne.

13. The method of receiving continuous wave signals with a three electrode valve and a beat frequency circuit which consists in heterodyning the signals to produce a beat frequency, causing changes in the frequency of the incoming signals to alter the potential of the grid of the valve, and utilizing the variation in plate current of the valve caused by said grid potential alterations to change the frequency of the heterodyne.

14. In a wireless receiving system a receiving circuit, a local heterodyne associated therewith and with a second receiving circuit which includes a pair of portions oppositely detuned with respect to the signaling frequency and a relay cooperating with said second named circuit and responsive to alterations of potential therein to change the local heterodyne frequency.

15. In a wireless receiving system, a local heterodyne, means including a vacuum tube relay for controlling the frequency of said heterodyne and means whereby a change in the frequency of the incoming signals is caused to vary the potential of a grid of said vacuum tube.

16. In a wireless receiving system, a local heterodyne, means affected by a deviation from constant frequency of the incoming signals and a vacuum tube relay the input circuit of which is operatively associated with said means, and the output circuit of which is operatively associated with said heterodyne.

17. In a wireless receiving system, a circuit responsive to the incoming signals, a local heterodyne associated with said circuit, a receiving circuit associated with said first named circuit and tuned to the normal beat frequency, a second heterodyne associated with said first named circuit, a second receiving circuit comprising a pair of circuits oppositely detuned with respect to normal beat frequency obtained from the incoming signals and said second named heterodyne, a relay including a vacuum tube the input circuit of which is operatively associated with said second named receiving circuit, and means coupling the output circuit of said vacuum tube with said local heterodyne.

18. In a wireless receiving system, a circuit responsive to the incoming signals, a local heterodyne associated with said circuit, a receiving circuit associated with said first named circuit and tuned to the normal beat frequency, a second receiving circuit comprising a pair of circuits oppositely detuned with respect to the normal signal frequency, a relay including a vacuum tube, the input circuit of which is operatively associated with said second named receiving circuit and means coupling the output circuit of said vacuum tube with said local heterodyne.

HENRY JOSEPH ROUND.