June 17, 1930. R. BOWN 1,763,751

RADIO RECEIVING SYSTEM

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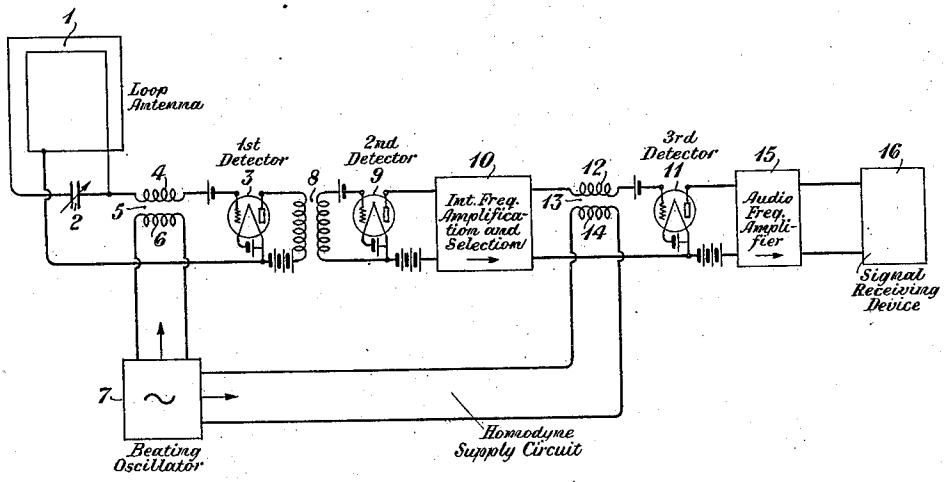


Fig. 1

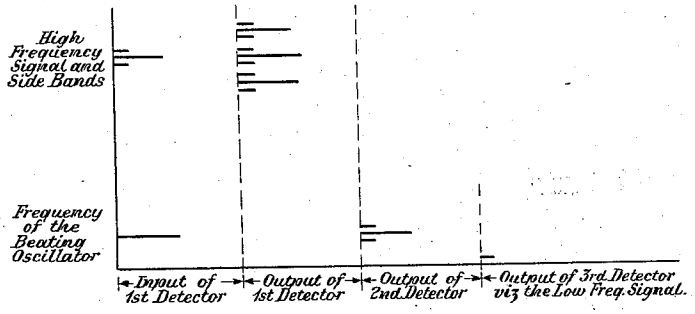


Fig. 2

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UNITED STATES PATENT OFFICE

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RADIO RECEIVING SYSTEM

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This invention relates to radio signaling systems and particularly to a system characterized by triple detection of the incoming signal, the detecting method employing a system of homodyning in which positive synchronism between the incoming carrier frequency and the local homodyning frequency is automatically obtained.

In radio receiving systems, employing double detection and intermediate frequency amplification and selection, the incoming carrier frequency upon which the signal is superimposed is beaten with a locally generated carrier frequency in order to step down the incoming frequency to an intermediate frequency at which it can be efficiently amplified. This beating down constitutes the first detecting operation. The intermediate frequency upon which the signal is superimposed is then beaten with a homodyning frequency equal to the said intermediate frequency, and subsequently detected, thereby producing the audible signal. The operation of such a system is relatively difficult inasmuch as it requires accurate adjustment of the first beating frequency in order to bring the intermediate frequency within the range of frequencies that will pass through the filter associated with the intermediate frequency amplifier; and, furthermore, it requires very accurate adjustment of the second beating frequency, that is, the homodyning frequency, in order to clearly detect the signal superimposed upon the intermediate frequency.

This invention resides in a radio receiving system involving triple detection which may be tuned by a single frequency control source, and in which positive synchronism between the incoming carrier frequency and the local homodyning frequency is automatically obtained.

This invention will be clearly understood from the following description when read in connection with the attached drawing in which Figure 1 shows schematically a form of the invention, and Fig. 2 shows graphically the frequencies present in various parts of the circuit of Fig. 1.

In Fig. 1, the loop antenna 1 is tuned by the variable condenser 2. The outer terminals of the antenna are connected with the grid of the first detector tube 3, the connection including the winding 4 of the transformer 5 by which a beating frequency is applied to the grid circuit. The midpoint of the antenna 1 is connected with the filament of the said tube. Another winding 6 of the transformer 5 is connected with a source of beating oscillations 7, which may be of any well known type, although the vacuum tube oscillator is probably most desirable. The output circuit of the first detector tube 3 is connected by the transformer 8 with the input circuit of the second detector tube 9. The output circuit of this detector tube is connected with an intermediate frequency amplifier and a selective network, represented diagrammatically by the rectangle 10. The output side of the said amplifier and selective network 10 is connected with the input side of the third detector tube 11, the connection including the winding 12 of the transformer 13. The other winding 14 of this transformer is connected with the source of beating oscillations 7, which, as stated, is also connected by the transformer 5 with the input side of the first detector tube. The output side of the detector 11 is connected with an audio frequency circuit, which may include an amplifier 15, and a signal receiving device 16.

The manner in which the system operates for the reception and detection of signals which is illustrated graphically by Fig. 2, may, perhaps, be best described by assuming specific frequencies for such illustration. It is to be understood, however, that the invention is not limited to such frequencies but may be as readily used with other frequencies. Let it be assumed that an incoming wave of 700 kilocycles, having a signal frequency superimposed thereon, is impressed upon the antenna 1. Let it further be assumed that the local source of beating frequency 7 is adjusted to produce 50 kilocycles. Accordingly, the incoming wave of 700 kilocycles plus the signal is impressed upon the first detector tube together with the beating frequency of 50 kilocycles. Owing to the modulating action of this tube there will be pres-

ent in the output circuit thereof three frequencies, i. e., 700 kilocycles, 750 kilocycles and 650 kilocycles, each of which would have the signal superimposed thereon. These three frequencies are impressed by the transformer 8 upon the second detector tube 9 and as the result of the modulating action of this tube there appears in the output side thereof the sum and difference frequencies resulting from the modulation of each of the said basic frequencies with each other. The sum frequencies are relatively so high as not to cause any concern, but the difference frequencies, i. e., 50 kilocycles and 100 kilocycles are within the limits requiring further attention. By setting the filters of the device 10 to pass 50 kilocycles and to suppress all frequencies above that, any tendency on the part of the 100 kilocycle frequency to interfere is eliminated. It will be seen, therefore, that the remaining frequency, which is amplified and impressed upon the third detector tube 11 is the same frequency produced by the oscillator 7, i. e., 50 kilocycles plus the signal. This signal will be detected by homodyning the carrier frequency with the same frequency, viz, 50 kilocycles produced by the oscillator 7. The signal, when amplified by the amplifier 15, will be impressed upon the signal receiving device 16.

The important feature, inherent in this invention, is that the frequency resulting from the second detecting operation is always equal to the frequency of the beating oscillator 7. This is true irrespective of the frequency of the incoming signal. Accordingly, the frequency of the beating oscillator need not be varied in order to effect detection of the signal superimposed upon a carrier frequency differing from that assumed hereinbefore. The only tuning adjustment necessary is that of the high frequency selective networks associated with the antenna, which, in the case of a loop antenna, as illustrated, means simply the adjustment of the variable condenser 2. Since the frequency resulting from the second detecting operation is exactly the same frequency as the beating oscillator it is possible to use the beating oscillator to homodyne the signal at such intermediate frequency, thereby building up the carrier amplitude and thus improving the efficiency of detection in a manner well understood by those skilled in the art.

While this invention has been disclosed in a particular form it is apparent that such form is purely schematic, and that it is capable of embodiment in other and different forms within the spirit and scope of the appended claims.

What is claimed is:

1. In a high frequency signaling system, the combination with a receiving circuit having impressed thereon a carrier frequency modulated by a signal frequency of a detector connected therewith, a source of beating oscillations of a frequency differing from the said carrier frequency connected with the said detector, a second detector having its input connected with the output of the said first detector to beat together the products of the first step of detection, means to select the band of signal frequencies based upon the carrier having the same frequency as the beating oscillations, a third detector upon which the selected band is impressed, means coupling the latter detector with the said source of beating oscillations so as to homodyne the signaling frequency superimposed upon the selected carrier and means connected with the output side of the third detector to indicate the signal.

2. A receiving system comprising a local source of oscillations of a single frequency differing from incoming waves, means to combine incoming waves with oscillations from said source, means to beat together the resultant composite waves from the said first combining means, means to select from the composite waves resulting from the said beating means a wave having present therein the same frequency as that of the local source, and means for combining oscillations from said source with the said selected frequency.

3. The combination with a plurality of frequency changing devices, of means for impressing thereon incoming waves to be changed to a lower frequency through an intermediate stage, a local source of generated oscillations, means to impress oscillations of the same frequency from the said source upon the first and last of said frequency changing devices to change the frequency of the waves impressed thereon, the intermediate frequency changing device being arranged to beat together only those frequencies present in the output of the first frequency changing device, filtering means connected with the output of the said intermediate frequency device to pass the band of frequencies based upon a carrier having the same frequency as the oscillations from the local source, and means connected with the output of the last frequency changing device to observe the waves of changed frequency.

4. The method of automatically homodyning, which consists in beating a received radio signal comprising a modulated carrier frequency with oscillations differing in frequency form the carrier, then beating together the frequencies resulting from the first beating operation to produce a plurality of bands thereby and selecting one of the bands resulting from the said beating operation, beating the selected band with oscillations of the same frequency and from the same source as the first beating operation, and transmitting the resultant signal.

5. A method of receiving signals which comprises producing locally generated oscil-

lations of a single frequency different from that of incoming waves, combining incoming waves with a portion of the locally generated oscillations to produce composite waves, beating together the composite waves produced by the said combining step, and selecting therefrom the wave based upon the same frequency as that produced locally, then combining the selected wave with another portion of the locally generated oscillations.

6. A method of receiving signals which comprises combining incoming waves with locally generated oscillations of frequency differing from the said waves, beating together the resultant waves of the first combining step, selecting from the product of the said beating operation the wave based upon that carrier having the same frequency as that locally generated, combining other locally generated oscillations of the same frequency as the first mentioned locally generated oscillation with the selected wave, and producing an indication of the resultant combination.

7. A method of receiving signals which comprises combining incoming waves with oscillations supplied by a local source of frequency different from said waves, beating together the waves resulting from the said first combining step, selecting that wave based upon a carrier having the same frequency as the locally generated oscillations, combining the selected wave with other locally generated oscillations of the same frequency as those employed in the first combining step, and producing an indication of the resultant wave.

8. The method of detecting radio signals in a system comprising three steps of detection and intermediate amplification, which consists in receiving a signal modulated carrier frequency, beating the said signal modulated carrier with a locally generated frequency to produce a plurality of frequencies thereby, beating together the frequencies resulting from the first beating operation, selecting from the products of the second beating operation that frequency corresponding to the modulation of the locally generated frequency by the said signal, amplifying the selected frequency, beating the selected and amplified frequency by the locally generated frequency and detecting the signal resulting therefrom.

In testimony whereof, I have signed my name to this specification this 16th day of November, 1925.

RALPH BOWN.