June 26, 1928. 1,674,696

R. S. OHL

RADIO RECEIVING SYSTEM

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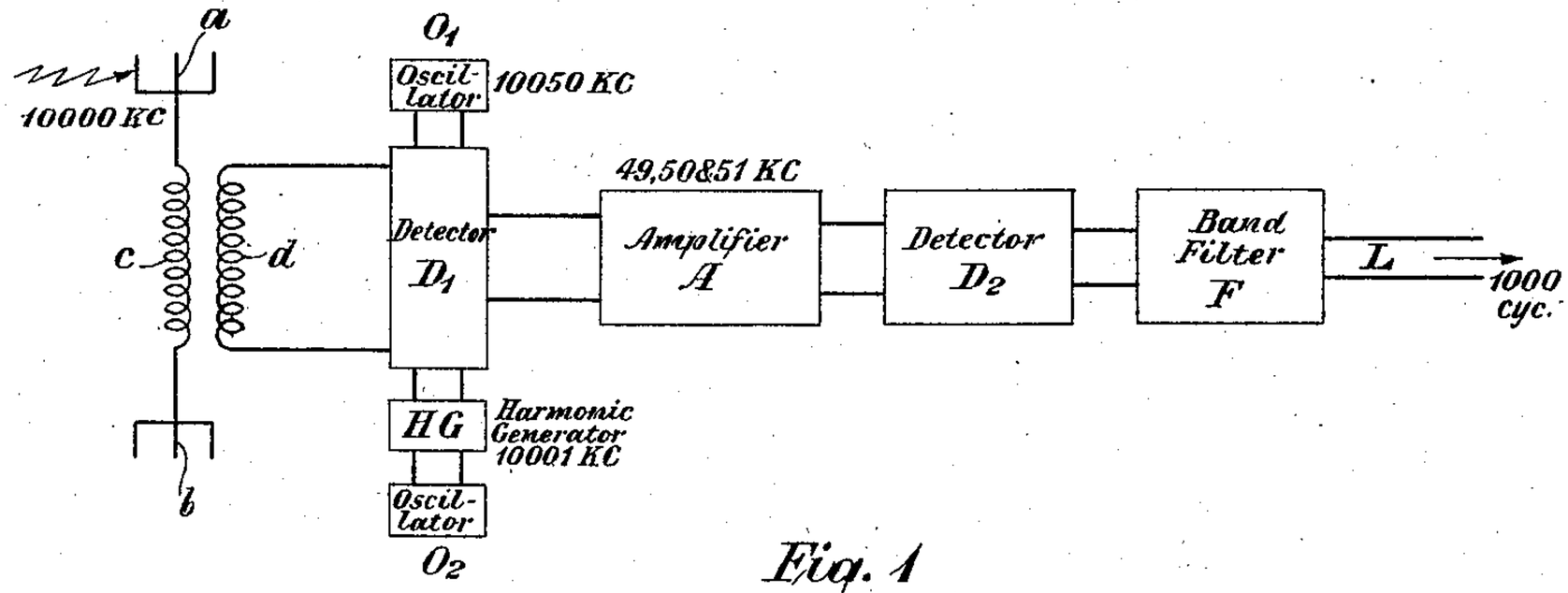

Fig. 1

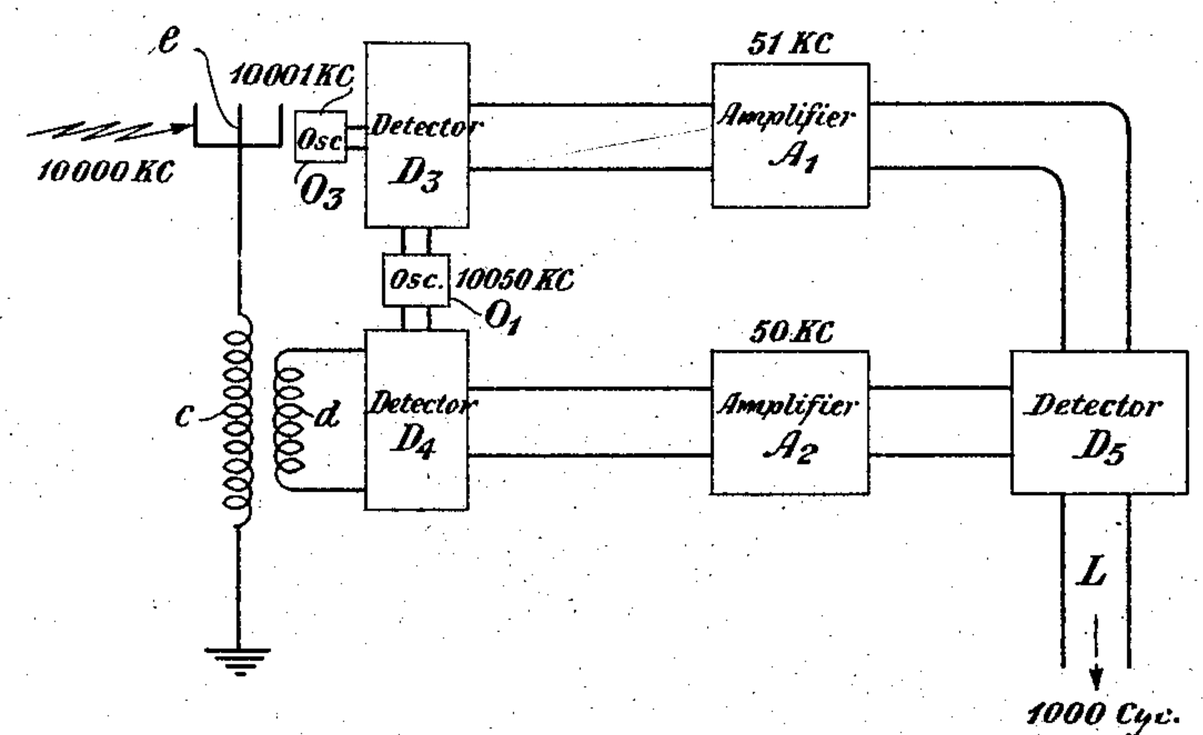

Fig. 2

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RADIO RECEIVING SYSTEM.

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This invention relates to signaling systems, and particularly to a system for detecting a signal which is superposed on a high frequency current.

One of the objects of this invention is to so relate a pair of high frequency oscillators to a circuit carrying a high frequency current modulated in accordance with signals that the signals may be derived therefrom.

Another object of the invention is to beat three high frequency currents together, one of said high frequency currents being modulated in accordance with signals, so that a band of intermediate frequencies results, from which the signals may be selected.

While the novel features of this invention will be pointed out with particularity in the appended claims, the invention itself, both as to its objects and features, will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing in which Figure 1 represents one embodiment of the invention, and Fig. 2 represents a modification of the arrangements of Fig. 1.

Referring to Fig. 1, the reference character *a* represents an antenna which is connected to a counterpoise *b* by means of an inductance *c*. The antenna *a*, counterpoise *b* and the inductance *c* together form a circuit which is adaptable for receiving high frequency currents of the order of 10,000 kilocycles upon which are superposed low frequency signals. An inductance *d* is loosely coupled to the inductance *c* and impresses the frequency of the receiving circuit upon the input circuit of a detector D_1.

An oscillator is represented by the reference character O_1. This oscillator, which is capable of setting up oscillations of high frequency, for example, 10,050 kilocycles, is also connected to the input circuit of the detector D_1. This oscillator may be of any well known type, but is preferably a vacuum tube oscillator. Another oscillator is represented by the reference character O_2, which oscillator may be a piezo-electric oscillator, or any other oscillator capable of setting up high frequency oscillations which are constant in frequency within very narrow limits. This oscillator O_2 is connected to a harmonic generator HG, or frequency multiplier, so that the frequency of oscillations of the oscillator O_2 may be increased to, for example, 10,001 kilocycles. It will be understood that a single oscillator may be employed to replace the oscillator O_2 and the harmonic generator HG, said oscillator being capable of setting up high frequency oscillations of similar order, for example, 10,001 kilocycles. The harmonic generator HG is also connected to the input circuit of the detector D_1. The detector D_1 may be a vacuum tube detector, or any other device capable of beating together a plurality of high frequencies so as to obtain a band of frequencies which is lower in the frequency spectrum than the high frequencies beaten therein.

An amplifier A is connected to the output circuit of the detector D_1. This amplifier may be a vacuum tube amplifier of any well known type, or any amplifier which can conveniently amplify a plurality of frequencies, such as 49, 50 and 51 kilocycles, which are all located in a single band, without intermodulation between the frequencies of the band. A detector D_2 represents a device which is capable of detecting a signal when a plurality of high frequencies are impressed thereon, one of said high frequencies being modulated in accordance with the signal. This detector D_2 may be of any well known type, but is preferable a vacuum tube detector. A band filter F is connected to the output circuit of the detector D_2 and is employed for transmitting a low frequency signal of the order of, for example, 1,000 cycles, as derived from the detector D_2, while substantially suppressing all other frequencies. This band filter may be of any well known type, but is preferably of the type disclosed in the patent to G. A. Campbell No. 1,227,113, dated May 22, 1917. The low frequency signal is then impressed on the channel L.

The arrangements of Fig. 1 operate in the following manner for the detection of signals:

A high frequency current is impressed on the receiving circuit comprising the antenna *a*, the counterpoise *b* and the inductance *c*, and, by virtue of the coupling existing between the inductances *c* and *d*, is also impressed on the input circuit of the detector D_1. At the same time the oscillator O_1 also transmits a high frequency current to the input circuit of the detector D_1. Further-

more, the oscillator O_2 transmits a high frequency current to the harmonic generator HG, which multiplies the frequency of the oscillator O_2, and impresses the frequency as thus multiplied upon the input circuit of the detector D_1.

Thus the high frequency current upon which the signal is superposed, having a frequency of 10,000 kilocycles, and the frequency of the oscillator O_1, having a frequency of 10,050 kilocycles, and the frequency of the harmonic generator HG, having a frequency of 10,001 kilocycles, are all impressed on the detector D_1 and are there beaten together. As is well known in the art, a band of frequencies, known as the difference band, results therefrom, among other frequencies. The amplifier A amplifies this band of frequencies, which includes the frequencies of 49, 50 and 51 kilocycles, without any intermodulation between these frequencies. The amplifier A may have filtering means included therein for substantially suppressing all frequencies except the frequencies within the band to be amplified thereby. This band of frequencies is then impressed on the detector D_2 from which the low frequency signal is derived. All of the products resulting from detection are then impressed upon the filter F which transmits the low frequency signal through substantially suppressing all other frequencies. The low frequency signal, which may be of the order of 1,000 cycles, then appears in the channel L.

Referring to Fig. 2, there is shown a modification of the arrangements of Fig. 1. The antenna *e* is connected to the inductance *c*, and these together form a receiving circuit which is capable of receiving high frequency oscillations of the order of 10,000 kilocycles upon which low frequency signals are superposed. An inductance *d* is coupled to the inductance *c* and impresses the received currents on the detector D_4. An oscillator is represented by the reference character O_3, which may be a piezo-electric oscillator, capable of setting up oscillations of the order of 10,001 kilocycles. These oscillations are impressed upon a detector D_3. Connected to the input circuits of the detectors D_3 and D_4 is an oscillator O_1 which is similar in all respects to the oscillator O_1 described hereinabove in connection with Fig. 1. This oscillator O_1 is also capable of setting up oscillations of the order of 10,050 kilocycles.

The detector D_4 is employed for beating together the frequency of the oscillator O_1 and the frequency of the current impressed on the receiving circuit which includes the antenna *e* and the inductance *c*. The detector D_3 is employed for beating together the frequency of the oscillator O_1 and the frequency of the oscillator O_3. An amplifier A_2 is employed for amplifying a frequency, known in the art as the difference frequency, for example, 50 kilocycles, resulting from the beating of the frequency of oscillator O_1 and the frequency of the receiving circuit. An amplifier A_1 is employed for amplifying the difference frequency, for example, 51 kilocycles, resulting from the beating of the frequency of the oscillator O_1 and the frequency of the oscillator O_3. These frequencies, as amplified by amplifiers A_1 and A_2, are impressed on the detector D_5, which derives the low frequency signal by beating these difference frequencies together. The low frequency signal, for example, 1,000 cycles, is then transmitted to the channel L. The detectors D_3, D_4 and D_5 may be similar to the detectors D_1 and D_2 described hereinabove in connection with Fig. 1.

The arrangements of Fig. 2 operate in the following manner:

The frequency of the oscillator O_3, 10,001 kilocycles, beats with the frequency of the oscillator O_1, 10,050 kilocycles in the detector D_3. The frequency of the received currents upon which the signal is superposed, 10,000 kilocycles, also beats with the frequency of the oscillator O_1 in the detector D_4. It will be noted that the frequency of the oscillator O_3 is very close to the frequency to which the receiving circuit is tuned, and it will also be noted that the oscillator O_1 is common to the input circuits of detectors D_3 and D_4. There results from beating these frequencies currents having frequencies of 51 and 50 kilocycles, respectively. The current of 51 kilocycles is impressed on the amplifier A_1 to be amplified thereby, and the current of frequency 50 kilocycles is impressed on the amplifier A_2 to be similarly amplified. These frequencies, as thus amplified, beat together in the detector D_5 from which the low frequency signal of 1,000 cycles is derived. This low frequency signal is then impressed upon the channel L.

It will be understood that the frequencies employed herein are merely illustrative and that other frequencies may be substituted in practice as conditions necessitate.

While this invention has been disclosed in certain particular embodiments which are deemed desirable, it is to be understood that it is capable of embodiment in other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A system for detecting a signal which is superposed on a high frequency current which comprises two high frequency oscillators having frequencies differing from each other and from the frequency of a current on which the signal is superposed, means for beating all of said frequencies together to obtain an intermediate band of frequencies,

and means for detecting the signal from the intermediate band of frequencies.

2. In combination, means to receive a current of high frequency on which a low frequency signal is superposed, a piezo-electric oscillator, a vacuum tube oscillator, means for beating the high frequency current on which the low frequency signal is superposed and the currents of said piezo-electric oscillator and said vacuum tube oscillator, means for substantially suppressing all frequencies except a band of intermediate frequencies, and means for deriving the low frequency signal from said band of intermediate frequencies.

3. In combination, means for receiving a current of high frequency modulated by a low frequency signal, means for generating two high frequencies the frequencies of which differ from each other and from the modulated high frequency current, means for beating together all of said frequencies, and means to transmit to the exclusion of all other frequencies a band of frequencies lower in the frequency spectrum than said high frequencies, means for amplifying said band of frequencies, and means for detecting a low frequency signal from said band of frequencies.

4. A radio receiving system comprising means for generating within one frequency band three high frequency currents, one of said high frequency currents being modulated in accordance with signals, means for beating said frequencies together to produce another band of frequencies, and means for deriving the signal from said latter band of frequencies.

5. A radio receiving system comprising means for receiving a high frequency current on which signals are superposed, means for generating two high frequencies which are within the same region of the frequency spectrum as the reecived high frequency current though differing in frequency from each other, means for putting these frequencies together so as to form a resultant band which is in a different region of the frequency spectrum, and means for detecting the signals from said resultant band.

6. The method of receiving signals superposed on a high frequency carrier current which consists in beating with said high frequency carrier current the currents of two other high frequencies, the frequencies of said latter currents differing from the frequency of the carrier current by a small amount, filtering the products of beating so as to obtain therefrom a band of frequencies lower in the frequency spectrum than the frequencies of said carrier currents, and detecting the signals from said band of frequencies.

7. In a short wave signaling system, the combination with an antenna for the reception of a signaling frequency of a receiving circuit comprising a vacuum tube oscilaltor, a piezo-electric oscillator, means for beating the signaling frequency with the frequencies of said vacuum tube oscillator and said piezo-electric oscillator to obtain a band of intermediate frequencies, the frequencies of said vacuum tube oscillator and of said piezo-electric oscillator differing from each other and from the signaling frequency, and means for deriving the signal from said band of intermediate frequencies.

8. In a short wave signaling system, the combination with an antenna for the reception of a signaling frequency of a receiving circuit comprising a piezo-electric oscillator having a periodicity differing from the periodicity of said signaling frequency, a vacuum tube oscillator having a periodicity differing from the periodicities of said signaling frequency and said piezo-electric oscillator, means for beating the frequencies of said piezo-electric oscillator with the signaling frequency, means for beating the frequency of said vacuum tube oscillator with the signaling frequency, and means for deriving the signal from beating the resultant frequencies.

9. In a system for deriving a signal from a high frequency current upon which an audio frequency signal is superposed, the combination of two oscillation generators which have frequencies differing from each other and from the frequency of said received current, means for beating said frequencies together so as to produce a band of frequencies lower in the frequency spectrum than the frequency of said received current, and means for deriving the audio signal from the lower band of frequencies.

10. The method of signaling which consists in receiving a high frequency current modulated by a low frequency signaling current, beating therewith the oscillations of two high frequency generators which have frequencies differing from the frequency of the received current by a small amount, filtering the products resulting from beating so as to obtain a band which has frequency limits lower than the frequency of said received current, and demodulating the frequencies of said band so as to obtain the low frequency signaling currents.

In testimony whereof, I have signed my name to this specification this 24th day of August, 1925.

RUSSELL S. OHL.