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SIGNALING SYSTEM

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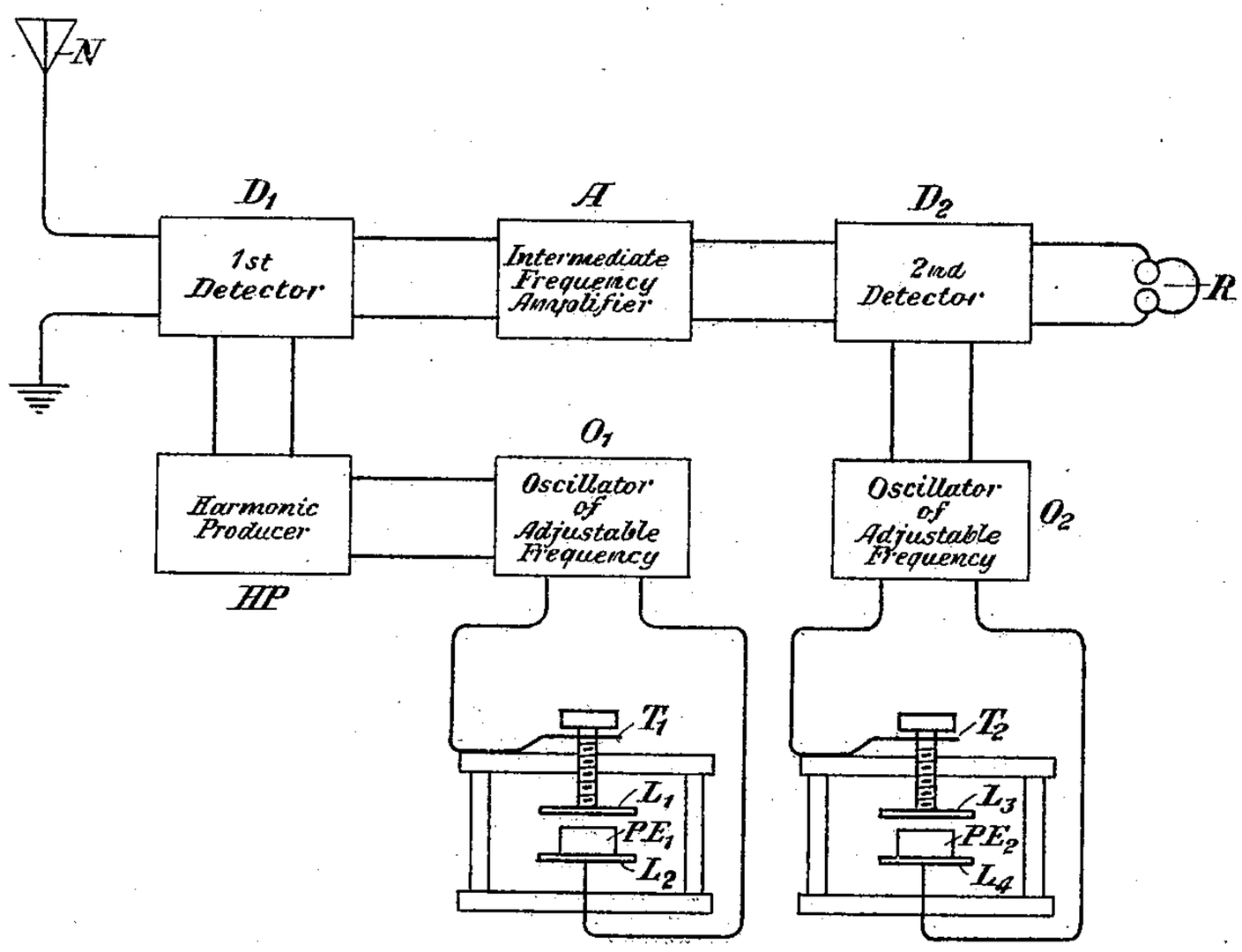

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SIGNALING SYSTEM

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This invention relates to signaling systems, and particularly to arrangements in such systems for faithfully reproducing original low frequency signals from corresponding bands of signals of high frequency.

It is well known that in order to attain good voice quality in voice frequency signaling systems when transmitting voice frequency signals in the form of high frequency energy over a considerable distance, it is necessary to maintain the high frequency or carrier wave very constant in frequency. In order to receive and detect the energy present in, for example, a single side band of such high frequency energy, it is necessary to introduce some local frequency which may be employed to beat with the side band in order that the low frequency signals may be faithfully reproduced.

A common practice for receiving a high frequency modulated signal is first, to change the frequency of the signal to another frequency lowered in the frequency spectrum, which may be amplified more easily than the first high frequency originally received, and second, to detect the signal from the intermediate frequency. This is done by the well-known means of beating the received high frequency signal with the unmodulated, sinusoidal wave of a local oscillator to produce an intermediate frequency which can then easily be amplified. One can readily see that the intermediate frequency should vary no more than the higher frequency originally received, if it is essential to maintain high quality standards throughout the system.

In this invention there will be shown, merely for the sake of illustration, two local oscillators one of which will be connected to a harmonic producer to produce a harmonic of the frequency of that oscillator to be used as a local beating frequency to beat with an incoming side band of high frequency energy. In order to maintain each of the local frequencies constant with very narrow limits, a piezo-electric device will be connected to each oscillator. Means are associated with each piezo-electric device for carefully adjusting its characteristic frequency with considerable accuracy. Accordingly, the frequency of the oscillator to which the piezo-electric device is connected will similarly be varied in frequency in accordance with the variation in the characteristic frequency of the piezo-electric device. The first local oscillator transmits a frequency which, when beaten with the incoming side band of high frequency energy, produces an intermediate band of frequencies which is well defined in the frequency spectrum. The second oscillator, which is controlled and varied as to its frequency by means of a similar piezo-electric device, is employed to beat with the intermediate band of frequencies so that the low frequency signals originally received by the system in the form of high frequency energy are faithfully detected and reproduced.

Accordingly, it is an object of this invention to associate the output of an oscillator with a band of high frequency energy so that by controlling and varying the frequency of the oscillator as conditions necessitate, the band of signals will be accurately detected and reproduced.

Another of the objects of this invention is to so relate a first oscillator and a harmonic producer to means for receiving a band of high frequency energy that the harmonic producer will produce a harmonic of the frequency of the first oscillator, which is piezo-electrically controlled and varied as to its frequency, in order that an intermediate band of signals, corresponding to the original signals, will be produced which may be further beaten with the frequency of the second oscillator, similarly piezo-electrically controlled and varied as to its frequency, to reproduce the original signals, with greater accuracy than has heretofore been possible.

While the invention will be pointed out with particularity in the appended claims, the invention itself, both as to its further objects and features, will be better understood from the detailed description hereinafter following, when read in connection with the accompanying drawing, showing one embodiment of the invention, merely for the purpose of illustration.

Referring to the drawing, an antenna sys-

tem comprising an antenna N and ground is employed to receive a side band of very high frequency energy. This side band of high frequency energy is impressed upon the first detector D_1. The reference characters O_1 and O_2 designate two oscillators, each sustaining oscillations of high frequency. These oscillators may be of any well-known type, but they are preferably of the vacuum tube type. Each oscillator may, of course, be of the untuned type and may of itself vary in frequency considerably from its characteristic frequency. In order to maintain the frequency of the oscillations sustained by the oscillators O_1 and O_2 constant within very narrow limits and in order to render the frequency characteristics of these oscillators adjustable as conditions necessitate, two piezo-electric devices are associated with these oscillators, one of which is connected to the oscillator O_1 and the other of which is connected to the oscillator O_2. These piezo-electric devices comprise piezo-electric crystals PE_1 and PE_2 which are placed between conductive electrodes L_1 and L_2, and L_3 and L_4, respectively. The conductive electrodes L_1 and L_3 are rigidly fixed to corresponding adjustable thumb screws T_1 and T_2, so that as these thumb screws are moved inwardly or outwardly a corresponding change will take place in the distance between the respective piezo-electric crystal and the corresponding conductive electrode L_1 or L_3. Obviously the width of the dielectric, such, for example, as air between the conductive electrodes L_1 and L_3 and the corresponding piezo-electric crystals PE_1 and PE_2, may be changed by manipulation of the thumb screws T_1 and T_2, respectively. Each piezo-electric device may be located in a box or other container, which may preferably be made of hard rubber, bakelite, or other insulating material. Means may also be provided with each piezo-electric device for accurately determining the displacement of its thumb screw. It is to be understood, however, that it is within the scope of this invention to provide any means whatsoever for rendering a fine adjustment of the space between any piezo-electric crystal and one or both of its conductive electrodes so that in effect the frequency characteristic of that piezo-electric crystal may be adjusted and varied with considerable accuracy.

In an oscillator with which a piezo-electric device is associated, which comprises a piezo-electric crystal vibrating between conductive electrodes, it has been found that the frequency of oscillations sustained by the oscillator may be controlled and varied as to frequency by adjusting the size of the gap existing between the piezo-electric crystal and its conductive electrodes. Generally, as the space between the crystal and its conductive electrodes changes, a corresponding change is produced in the frequency of the oscillations sustained by the oscillator. More particularly, as the distance between the piezo-electric crystal and its conductive electrodes is increased, the frequency of the oscillations sustained by the oscillator will, under normal conditions, also be increased, and vice versa. This is exactly what takes place when the piezo-electric devices comprising the piezo-electric crystals PE_1 and PE_2 and the conductive electrodes L_1 and L_2 and L_3 and L_4, respectively, are associated with the oscillators O_1 and O_2. Briefly, the frequency of the oscillations sustained by the oscillators O_1 and O_2 may be controlled and varied by these piezo-electric devices with precision.

Oscillations sustained by the oscillator O_1, controlled and varied as to frequency by the associated piezo-electric device, are transmitted to a harmonic producer HP which is employed to produce a harmonic of the frequency of wave sustained by the oscillator O_1. This harmonic producer may be of any well-known type, but is preferably of the well-known vacuum tube type. It may produce any desired harmonic of the oscillations sustained by the oscillator O_1. This harmonic is transmitted to the detector D_1 and is employed to beat with the incoming side band of high frequency energy. This detector D_1 may be of any well-known type, but it is also preferably of a vacuum tube type. By beating the frequency of the harmonic with the incoming side band of high frequency energy, another band of signals is produced which lies in a different position in the frequency spectrum. The output of the detector D_1 is then transmitted to an intermediate frequency amplifier A which is employed to amplify the band of signals transmitted by the detector D_1. This intermediate frequency amplifier may, of course, be of any well-known type, but it is also preferably of the vacuum tube type. After amplification by the amplifier A, the intermediate band of signals is impressed upon a second detector D_2.

The frequency sustained by the oscillator O_2, which is controlled and varied as to frequency by means of the piezo-electric device connected thereto, is transmitted to the second detector D_2 which may also be of any well-known type but which is preferably of the vacuum tube type. The second detector D_2 beats the frequency of the oscillator O_2 with the band of signals transmitted by the amplifier A. Accordingly, the original signals which are received by the antenna N in the form of a side band of high frequency energy are faithfully received by a head set R. It will be fairly obvious that if the oscillations of the oscillators O_1 and O_2 were not each controllable and variable as to their frequencies by some such device as is shown herein, i. e., a piezo-electric device, the original signals would not be faithfully re-

produced. By associating piezo-electric devices with these oscillators it is possible to maintain a higher quality in transmission than has heretofore been possible.

It will be understood that while only two oscillators have been shown herein, each beating with a band of signals, any number of oscillators may be similarly associated with a signaling system, the characteristic frequencies of these oscillators additively approximating the frequency of the wave which may be considered adjacent to the received band of signals. It will be understood that piezo-electric means may be associated with each of these oscillators for bringing their additive effects into exact synchronism with the high frequency wave assumed to be adjacent to the received band of signals.

It will also be understood that while this system has been shown herein, for the purpose of illustration, as a double detection system, the principles of this invention may be applied to numerous other systems and to various embodiments of such systems without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a signaling system, the combination of means for receiving a band of signals of high frequency, two local oscillators, piezo-electric means for controlling and varying the frequency of said oscillators, means for producing a harmonic of the frequency of the first oscillator which will be similarly controlled and varied as to frequency by said piezo-electric means, means for beating said piezo-electrically controlled and varied harmonic of the first oscillator with the band of signals to produce a corresponding band of signals lowered in the frequency spectrum, and means for beating the piezo-electrically controlled and varied frequency of the second oscillator with the band of signals lowered in the frequency spectrum in order to accurately reproduce the original signals.

2. In a signaling system, the combination of means for receiving a band of signals of high frequency representing speech, first and second oscillators, piezo-electric means coupled to each oscillator for controlling the frequency of sustained oscillations, means for varying the vibratory period of the piezo-electric means coupled to each oscillator to produce a corresponding variation in the frequency of the oscillations sustained thereby, means for beating the piezo-electrically controlled and varied frequency of the first oscillator with the received band of signals so as to produce a corresponding band of signals changed in the frequency spectrum, and means for beating the piezo-electrically controlled and varied frequency of the second oscillator with the latter band of signals changed in the frequency spectrum to faithfully reproduce the speech signals.

3. In a signaling system, the combination of means for receiving a side band of high frequency energy characteristic of voice frequency signals, means for generating two waves whose frequencies additively approximate the frequency of the carrier wave corresponding to the received side band, piezo-electric means connected with each oscillator for controlling the frequency of the generated wave, said piezo-electric means including a screw-threaded member for varying its effective period of vibration in order to maintain the additive effect of both of the generated waves in synchronism with the carrier wave corresponding to the received side band, means for beating one of the piezo-electrically controlled and varied waves with the received side band to produce another band of signals changed in the frequency spectrum and characteristic of the same voice frequency signals, and means for beating the other of the piezo-electrically controlled and varied waves with the latter band of signals in order that the voice frequency signals may be faithfullly derived and reproduced.

In testimony wherof, I have signed my name to this specification this 6th day of October, 1926.

RUSSELL S. OHL.