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SIGNALING SYSTEM

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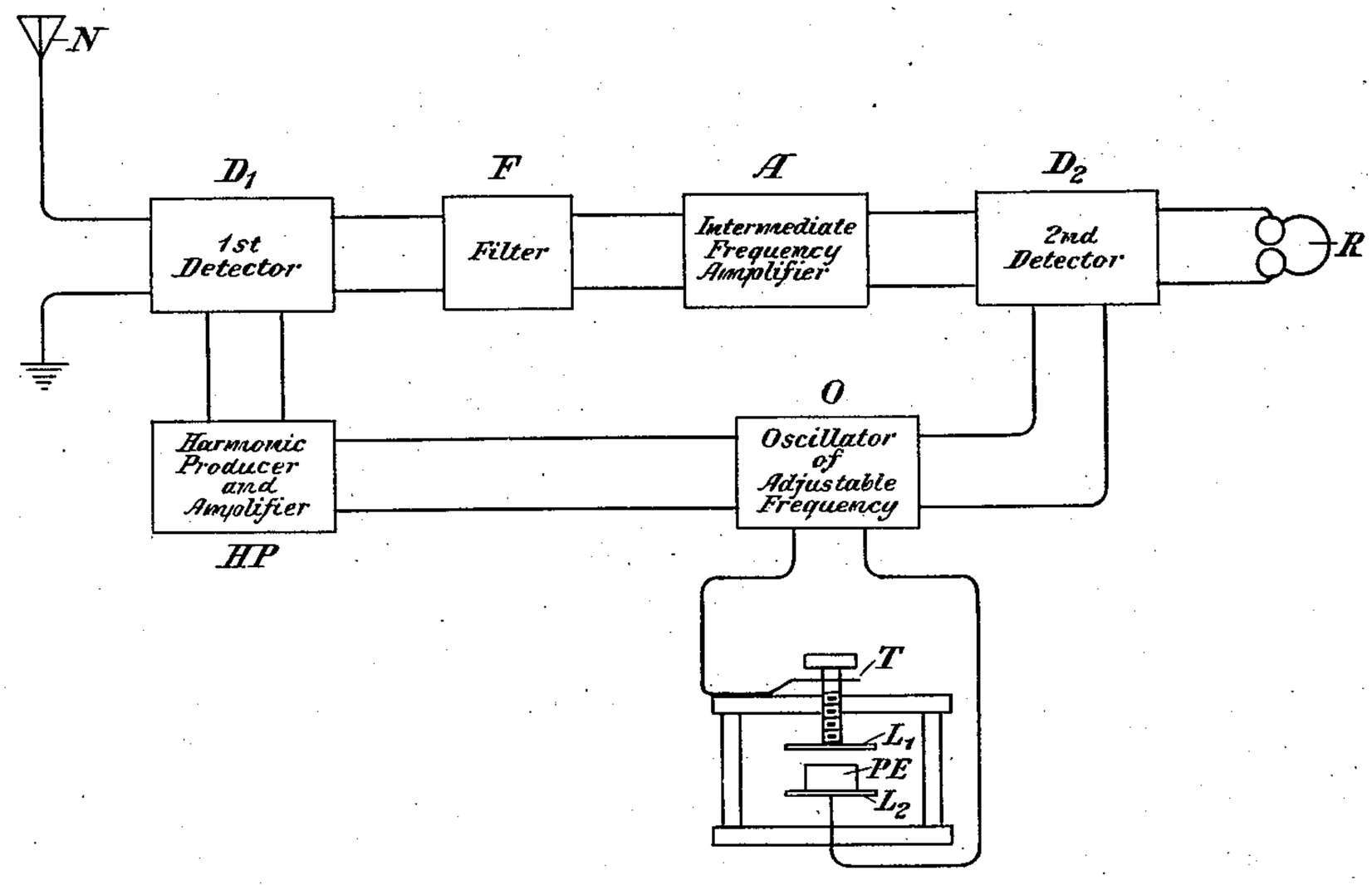

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SIGNALING SYSTEM

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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 high frequency energy, it is often necessary to introduce some local frequency which may be employed to beat with the side band, the local frequency being maintained constant within very narrow limits, 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 higher 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 frequency 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, a local oscillator which is connected to a harmonic producer to produce a harmonic of the frequency of the oscillator to be used as a local beating frequency to beat with a side band of high frequency energy. In order to maintain the local beating frequency constant within very narrow limits, a piezo-electric device is connected to the oscillator. In order to vary the frequency sustained by the local oscillator, means are associated with the piezo-electric device for carefully adjusting its characteristic frequency with considerable accuracy. Accordingly, the intermediate band of frequencies resulting from beating process to be described hereinafter, will be well defined in the frequency spectrum. The same oscillator, controlled and varied as to its frequency by means of the piezo-electric device, is employed to beat with the intermediate band of frequencies, so that the low frequency signals originally present 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 faithfully detected and reproduced.

Another of the objects of this invention is to so relate an 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 oscillator, which may be carefully controlled and varied as to its frequency, in order that an intermediate band of signals corresponding to the original signals can be effected, which may again be beaten with the frequency of the oscillator similarly 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 system 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 a first detector D_1. The reference character O designates an oscillator which sustains os-

cillations of a very high frequency, such, for example, as 2,500,000 cycles. This oscillator may be of any well-known type, but it is preferably of the vacuum tube type familiar to the art. This oscillator may also 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 oscillator O constant in frequency within very narrow limits, and in order to render the frequency characteristic of this oscillator O adjustable as conditions necessitate, a piezo-electric device is connected thereto, which comprises a piezo-electric crystal PE which is placed between two conductive electrodes L_1 and L_2. The conductive electrode L_1 is rigidly fixed to an adjustable thumb screw T so that as the thumb screw is moved inwardly or outwardly, a corresponding change will take place in the distance between the piezo-electric crystal PE and the conductive electrode L_1. Obviously, the width of the dielectric, such, for example, as air, between the conductive electrode L_1 and the piezo-electric crystal PE may be changed by manipulation of the thumb screw T. The piezo-electric device may preferably be located in a box or other container which may, for example, be made of hard rubber, bakelite, or other insulating material. Means may also be provided for accurately determining the displacement of the 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 the piezo-electric crystal PE and one or both of its conductive electrodes, so that in effect the frequency characteristic of the piezo-electric crystal may be adjusted and varied with precision.

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 certain conditions, also be increased, and vice versa. This is exactly what takes place when the piezo-electric device, comprising the piezo-electric crystal and the conductive electrodes L_1 and L_2, is associated with the oscillator O. Briefly, the frequency of oscillations sustained by the oscillator O may be controlled and varied by the piezo-electric device with considerable accuracy.

Oscillations sustained by the oscillator O are transmitted to a harmonic producer and amplifier HP, which is employed to produce a harmonic of the frequency of the oscillator O. This harmonic producer and amplifier HP may be of any well-known type, but it is preferably of a well-known vacuum tube type. It may produce any required harmonic of the oscillations sustained by the oscillator O, as, for example, the ninth harmonic of 22,500,000 cycles. This harmonic is transmitted to the first detector D_1, and is employed to beat with the incoming side band of high frequency energy, which may, for example, be a band of signals between 20,000,000 and 20,005,000 cycles. This detector D_1 may also be of any well-known type, but it is 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 is displaced in the frequency spectrum. In the particular case given for the purpose of illustration, this intermediate band of frequencies may have the limits of, for example, 2,495,000 and 2,500,000 cycles. The output of the detector D_1 is impressed upon a filter F which may be of any well-known type, but preferably of the type disclosed in the patent to G. A. Campbell, No. 1,227,113, dated May 22, 1917. This filter freely transmits the band of signals resulting from beating the harmonic of the oscillator O with the incoming side band of high frequency energy, and substantially suppresses all frequencies above and below the limits of said band. The filter F is connected to an intermediate frequency amplifier A which is employed to amplify the band of signals transmitted by the first detector D_1 and the filter F. This intermediate frequency amplifier A 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, which is controlled and varied as to frequency by means of the piezo-electric device, is now 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 with the intermediate band of signals transmitted by the filter F and the amplifier A. Accordingly, the original signals, which were received by the antenna N in the form of a side band of high frequency energy, are faithfully detected and received by a headset R. It will be fairly obvious that if the oscillator O were not controllable and variable as to its frequency by a device such as is shown herein, i. e., a piezo-

electric device, the original signals would not be faithfully reproduced. By associating the piezo-electric device with the oscillator O, it is possible to maintain such a high quality in transmission as has not heretofore been possible.

It will be obvious that while a single oscillator has been shown herein, which is controllable and adjustable as to its frequency by means of a piezo-electric device, two oscillators may equally well be employed, each equally controllable and adjustable as to its frequency by a common piezo-electric device, or by separate piezo-electric devices, within the scope of this invention.

It will also be understood that while this invention has been shown herein, for the purpose of illustration, embodying 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, an oscillator, piezo-electric means for controlling the frequency of said oscillator, said piezo-electric means including means to vary its vibratory characteristic in order to correspondingly vary the frequency of said oscillator, means for heating said piezo-electrically controlled and varied frequency with the band of signals of high frequency to produce a corresponding band of signals displaced in the frequency spectrum, and means for again beating the piezo-electrically controlled and varied frequency with the band of signals displaced in the frequency spectrum to derive and detect the original signals.

2. In a signaling system, the combination of means for receiving a band of signals of high frequency, a local oscillator, piezo-electric means for controlling and varying the frequency of the local oscillator, means for producing a harmonic of the frequency of said oscillator similarly controlled and varied as to frequency by said piezo-electric means, means for beating said piezo-electrically controlled and varied harmonic 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 said oscillator with the band of signals lowered in the frequency spectrum to derive and detect the original signals.

3. In a signaling system, the combination of means for receiving a band of signals of high frequency corresponding to voice frequency signals, an oscillator, means for beating the frequency of said oscillator with the band of signals of high frequency to produce another band of signals changed in the frequency spectrum, a piezo-electric device associated with said oscillator including means for controlling and varying the frequency of said oscillator, the latter device including a piezo-electric crystal placed between two electrodes and a screw-threaded member for varying the spacing of said electrodes, and means for beating the controlled and varied frequency of said oscillator with said band of signals changed in the frequency spectrum so that the original voice frequency signals will be accurately derived.

4. The combination of means for receiving a band of signals of high frequency corresponding to voice frequency signals, an oscillator, means for beating the frequency of said oscillator with the band of signals so as to produce another band of signals changed in the frequency spectrum, a piezo-electric structure associated with said oscillator including means which may be manipulated for controlling and varying the frequency of said oscillator, and means for beating the piezo-electrically controlled and varied frequency of said oscillator with said band of signals changed in the frequency spectrum so that the original voice frequency signals may be accurately derived and reproduced.

5. In a signaling system, the combination of means for receiving a band of signals of high frequency corresponding to voice frequency signals, an oscillator, means for producing a harmonic of the frequency of said oscillator, means for beating the harmonic of the frequency of said oscillator with the band of signals to produce another band of signals changed in the frequency spectrum, piezo-electric means for controlling and varying the frequency of said oscillator, and means for beating the piezo-electrically controlled and varied frequency of said oscillator with said band of signals changed in the frequency spectrum so that the original voice frequency signals may be accurately detected, derived and reproduced.

6. In a signaling system, the combination of means for receiving a side band of high frequency energy characteristic of signals, means for generating a high frequency wave, piezo-electric means which may be manipulated for adjusting the frequency of said latter wave, said piezo-electric means including a piezo-electric crystal, two electrodes and means for varying the spacing of said electrodes, means for beating the adjusted high frequency wave with the received side band of high frequency energy characteristic of signals to produce another band of energy changed in the frequency spectrum and characteristic of the same signals, and means for beating the latter band of energy with the adjusted high frequency wave so as to accurately derive and detect said signals.

7. In a signaling system, the combination

of means for receiving a side band of high frequency energy characteristic of voice frequency signals, means for locally generating a high frequency wave, means for producing a harmonic of said high frequency wave, piezo-electric means for controlling the frequency of said harmonic, said piezo-electric means including means for varying its vibratory period in order to correspondingly vary the frequency of the harmonic derived from said high frequency wave, means for beating the controlled and varied frequency of the harmonic with the received side band of high frequency energy characteristic of voice frequency signals to produce another band of energy changed in the frequency spectrum and characteristic of the same voice frequency signals, and means for beating the latter side band of energy with the high frequency wave locally generated so as to derive and detect the original voice frequency signals.

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

RUSSELL S. OHL.