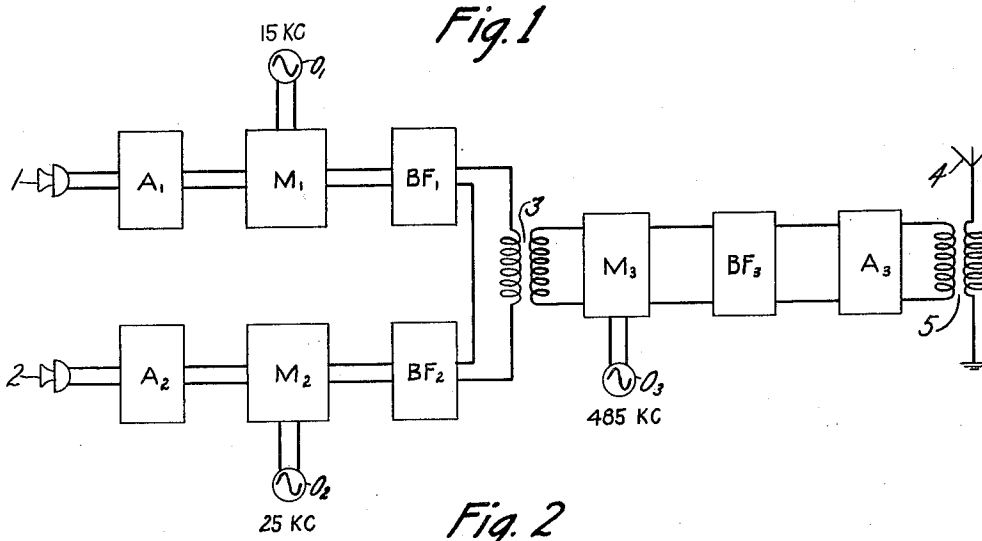
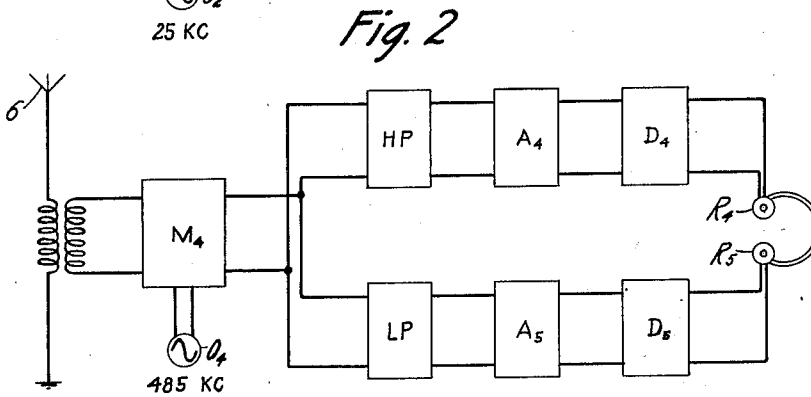
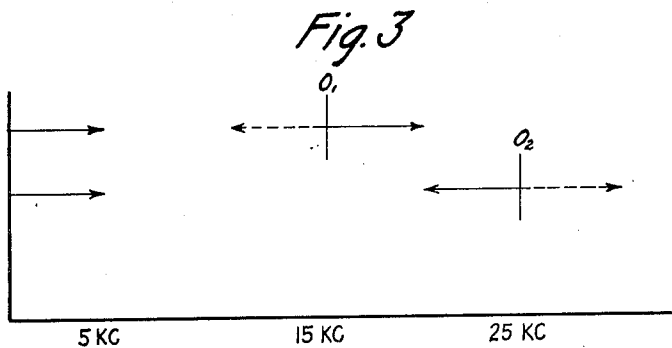


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COMMUNICATION SYSTEM

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COMMUNICATION SYSTEM.

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This invention relates to communication systems and more particularly to binaural signaling systems.

In binaural signaling systems in which two separate signal currents corresponding to sounds heard by the left ear and right ear respectively, are transmitted as modulations of carrier waves; it is desirable to confine the transmission channel to a frequency range not greater than that occupied by the two side bands, which are produced when a carrier wave is modulated by a single signal current.

It has heretofore been proposed to accomplish this by separately modulating a single carrier wave with two versions of a signal and selecting for transmission the upper side band of one modulation and the lower side band of the other modulation.

In accordance with the present invention two different frequency carrier waves respectively, are modulated by two versions of a signal and one side band selected from each modulation. For radio transmission, the selected side bands are then used to modulate a high frequency carrier wave and one side band of this last modulation is selected for transmission.

It is, therefore, an object of this invention to provide a binaural carrier communication system in which a minimum frequency range of the transmission channel is maintained by respectively modulating carrier waves of different frequencies by two versions of a signal.

This object and others which will be apparent as the nature of the invention is disclosed, are accomplished by modulating two carrier waves of comparatively low but different frequencies by separate versions of the same signal and selecting one side band from each modulation.

When the transmission is to be effected over a radio channel the selected side bands are used to modulate a radio frequency carrier wave. One of the side bands resulting from the last mentioned modulation is selected and used for transmission purposes. At the receiving station the transmitted wave is combined with current of the frequency of the radio carrier supplied by a local oscillator to produce currents corresponding to the original low frequency side bands which are then selected and separately

detected in suitable apparatus to yield the two versions, which are used to actuate a signal responsive means.

Although the novel features which are believed to be characteristic of this invention will be pointed out with particularity in the claims appended hereto, the invention itself, its objects and advantages, the manner of its organization and the mode of its operation will be better understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof in which:

Fig. 1 illustrates diagrammatically a radio transmission system operating in accordance with this invention:

Fig. 2 represents suitable receiving apparatus adapted to be operated in connection with the transmitter of Fig. 1; and

Fig. 3 is a chart to be used in explanation of the operation of this system.

Referring more particularly to Fig. 1, the amplitudes of signals received by the two microphones, 1 and 2, are raised to the desired value by suitable amplifiers, A_1 and A_2 , respectively, which may consist of any number of stages resired, to increase the amplitude of the impressed currents to the value necessary for modulation.

The amplified signals are then impressed upon modulators M_1 and M_2 , respectively, in which they are combined with oscillations from oscillators O_1 and O_2 to produce modulation products comprising an unmodulated carrier component and corresponding side band components. The frequency of the oscillations generated by oscillators O_1 and O_2 , for the purpose of illustration and to completely and clearly disclose a preferred embodiment of this invention, will be assumed to be 15 kc. for oscillator O_1 and 25 kc. for oscillator O_2 .

Assuming speech frequency currents to be impressed upon the modulators M_1 and M_2 from the microphones, the frequency range of the impressed currents will lie, for example, between 0 and 5 kc. This is indicated in Fig. 3 by the two solid lines at the left of the figure extending from the zero axis to the 5 kc. point. The modulation products in the output circuit of modulators M_1 and M_2 , respectively, will comprise an unmodulated component of 15 kc. and side band components based thereon, and an unmodulated

component of 25 kc. and side bands based thereon. The two modulated products will have frequency ranges such as that illustrated in Fig. 3, namely between 10 kc. and 20 kc., and between 20 kc. and 30 kc., respectively.

The above mentioned modulation products are passed through band pass filters, BF_1 and BF_2 , which are respectively adapted to pass the unmodulated carrier component and the upper side band based on the 15 kc. oscillations, and the unmodulated carrier component and the lower side band based on the 25 kc. oscillations. The side bands and carrier components transmitted through filters BF_1 and BF_2 , are represented by the full lines in Fig. 3. These products are impressed upon modulator M_3 by means of transformer 3, wherein they are combined with carrier frequency oscillations from oscillator O_2 , which are herein assumed to be of the order of 485 kc., although any other carrier frequency suitable for transmission can be used.

A single side band, of the modulation products in the output circuit of modulator M_3 , is selected by band pass filter BF_3 and impressed upon amplifier A_3 , wherein it is amplified to the intensity desired for transmission.

Current in the output circuit of amplifier A_3 is impressed by means of transformer 5 upon a communication channel, which is herein shown as antenna system 4.

Any other type of communication channel, such as that of a transmission line, may be employed, however, without departing from the spirit of this invention.

The transmitted wave is received in a receiving apparatus by means of energy receiving means, shown as antenna system 6 in Fig. 2, and impressed upon demodulator M_4 , wherein it is combined with oscillations produced by oscillator O_4 . The frequency of the oscillations generated by oscillator O_4 is preferably the same or similar to that of the oscillations generated by oscillator O_2 , although the operation of the system would not be impaired were other frequencies chosen. Assuming, for purposes of illustration, that the oscillator O_4 is generating current at 485 kc., that is, identical with the frequency of oscillator O_2 , the products of demodulation in the output circuit of demodulator M_4 will be represented by the full lines in Fig. 3, that is, they will be identical with the currents impressed upon modulator M_3 at the transmitting station.

The output of transformer 3 may be employed for line transmission if desired, in which case modulation and demodulation by a radio frequency carrier will not be required.

The two carrier currents of 15 and 25 kc., respectively, and their associated side bands are separated by low pass and high pass

filters, HP and LP, and passed through amplifiers A_4 and A_5 , respectively, wherein they are amplified to the desired intensity. The resulting signals are then detected in detectors D_4 and D_5 and impressed upon a signal responsive means herein shown as telephone receivers R_4 and R_5 , respectively.

Should filters HP and LP not have a sufficiently sharp cut-off to effectively separate the respective side bands associated with the two channels any undesired components appearing in the output circuits of detectors D_4 and D_5 may be suppressed by low pass filters having a cut-off at 5000 cycles.

In the operation of this system, by selecting the upper side band produced by the lower frequency, i. e., 15 kc., carrier current, and the lower side band produced by the higher frequency, i. e., 25 kc. carrier current, the resultant wave which is used for modulating the high frequency carrier is confined to a 10 kc. range.

Inasmuch as two side bands of the high frequency carrier, i. e., 485 kc., are separated by a frequency range of about 30 kc., one of these side bands may be readily selected by band pass filters from both the carrier and the other side band and used for transmission. This wave will have a frequency range of 10 kc., which is the same as that required in a carrier current system in which both side bands are transmitted. This is a desirable requirement for transmission systems in general in order that the maximum number of communication channels may be employed within a given frequency band.

In a similar manner, when the components selected by the filters BF_1 and BF_2 are used for transmission over a line the band width of the wave transmitted would be 10 kc.

In order to facilitate the selection at the receiving station of the lower frequency signal modulated waves, the carrier oscillations, supplied by the oscillators O_1 and O_2 , may be chosen to provide the desired frequency interval between the upper limiting frequency of one wave, and the lower limiting frequency of the other wave.

Although a particular system has been disclosed and a particular manner of operation set forth in connection with this invention, it is not to be limited thereto but only in accordance with the scope of the invention as defined by the following claims.

What is claimed is:

1. In a binaural transmission system having a pair of sound pick-up elements situated so as to register different versions of the sounds to be transmitted, sources of continuous waves of different frequency, means to modulate separately each of said waves in accordance with the sounds from a different one of said two pick-up elements, means associated with each modulating means for

selectively transmitting one of the resulting side bands while suppressing the opposite side band, the frequencies of said continuous waves being separated in the frequency spectrum by a proper interval depending on the frequency range of the sounds from said pick-up elements, and the proper side bands being selected, to cause said two selected side bands to occupy substantially the same total frequency range as the range from one of said pick-up elements added to that from the other, and means for transmitting over the same path to a distant point for separate reception thereat the frequency components contained in the two selected side bands.

2. A system as defined in claim 1 in which the means for transmitting to a distant point the frequency components contained in the two side bands comprises means for modulating a radio wave by said two side bands and for suppressing one of the resulting radio frequency side bands while transmitting the other, the frequencies of said two continuous waves which the two sound versions modulate being sufficiently high with respect to the radio wave frequency to enable one radio frequency side band to be effectively separated from the other by filtering only.

3. A system as defined in claim 1 in which the means for selecting the side bands for transmission comprises means for selecting the upper side band resulting from the modulation of the lower frequency one of the two continuous waves and means for selecting the lower side band resulting from the modulation of the higher frequency one of the two continuous waves.

4. A receiving system for the system defined in claim 1, comprising a pair of selec-

tive circuits for separating the two side bands, a detector for each side band, and a receiver element individually associated with the output of each detector.

5. A binaural transmission system comprising two sound pick-up elements operatively related to a source of sound, means to generate two continuous waves of different frequency each high in comparison with any sound frequency to be transmitted, means to modulate the lower frequency continuous wave in accordance with sounds from one pick-up element, filter means to suppress the resulting lower side band but transmit the continuous wave frequency and the upper side band, means to modulate the other continuous wave in accordance with sound from the other pick-up element, filter means to suppress the resulting upper side band but to transmit the continuous wave and the lower side band, the frequencies of said continuous waves being separated such a distance in the frequency spectrum that the two selected side bands form practically a continuous range of frequency components, means to transmit such frequency components and reproduce them at a distant point, filter means thereat for selecting to different circuits the two continuous wave frequencies and the respective side bands based thereon, detector means in each circuit for reproducing in separate circuits components corresponding to the sounds from the respective pick-up elements, and a separate receiver element associated with each of said latter circuits.

In witness whereof, I hereunto subscribe my name this 10th day of December, A. D. 1925.

JOSEPH W. HORTON.