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SINGLE SIDE BAND TRANSMITTER

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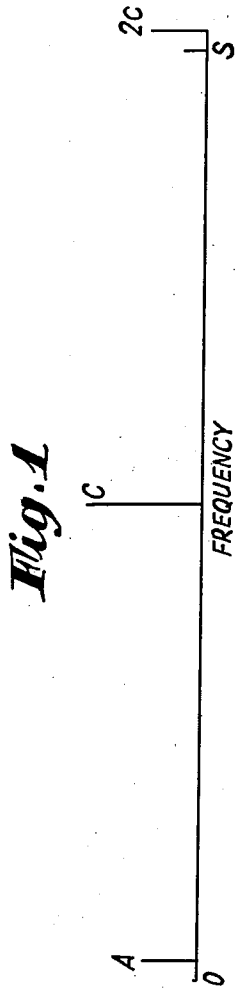

Fig. 1

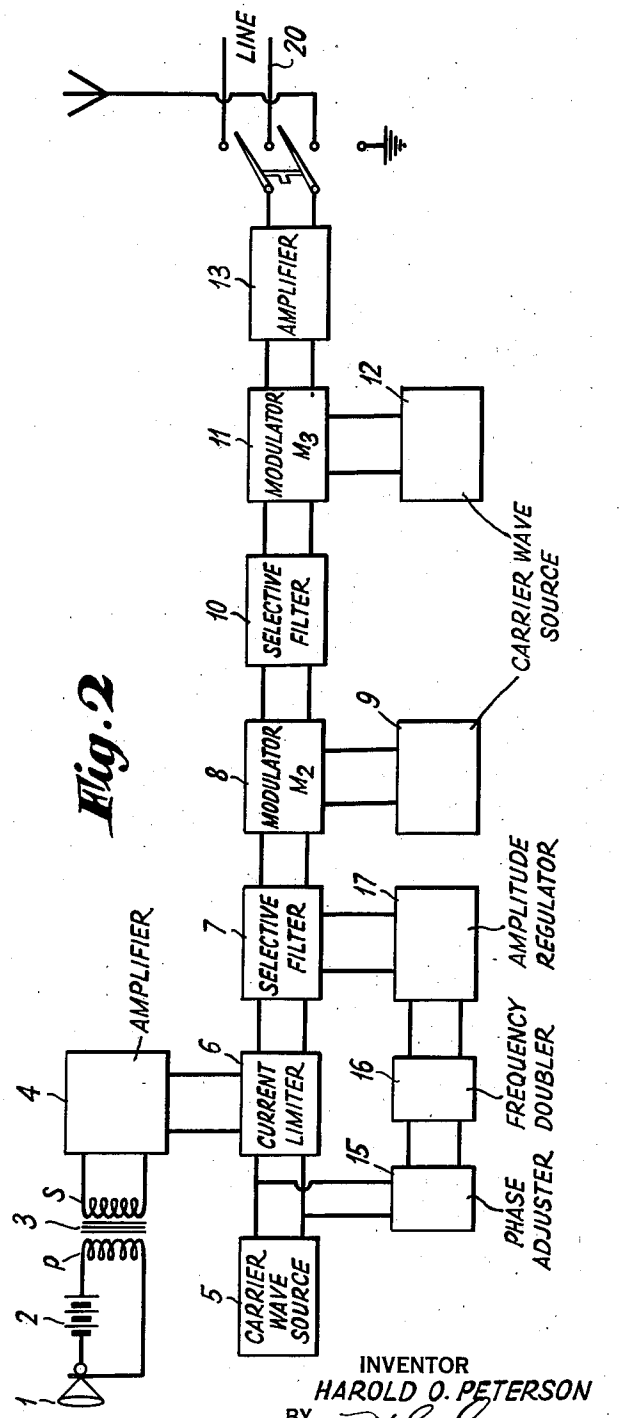

Fig. 2

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SINGLE SIDE BAND TRANSMITTER

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6 Claims. (Cl. 179—171.5)

In the past single side band systems have been used to advantage, especially in the transmission of telephony. In order to produce the single side band type of modulation it has been customary to use a modulator which inherently produces two sets of side bands and then filter off one set of side bands. This is more or less difficult because the two sets of side bands are so close together in the frequency spectrum. It is the object of this invention to make this process of signal side band signaling easier. This is accomplished by producing in a novel manner a carrier and side band widely separated in frequency from the voltages used in producing the same and other produced components thereby eliminating or simplifying the means necessary for separating a carrier and one side band from the other side band.

In describing my invention, reference will be made to the drawing, wherein:

Figure 1 is a graphic representation of the alternating voltages, signal voltages, and so forth in my novel method of and means for producing single side band modulation;

Figure 2 is a schematic showing of a signalling system arranged in accordance with my invention.

Referring now to Figure 1, at C I have shown a voltage wave of carrier wave frequency, and at A a modulation frequency, both being in a frequency spectrum which starts at zero frequency. The frequency of C may be any desired frequency above the highest modulating potential frequency. The two frequencies A and C are now assumed to be supplied to a current limiter with the amplitude of the voltage of frequency C greater than the amplitude of the modulating potentials at frequency A. In the output of the limiter an additional new frequency S will appear at a frequency which is equal to C plus the difference between frequencies C and A. Frequency S is a new frequency and is proportional in amplitude to the amplitude of the modulating potential of frequency A. The limiter will also generate a frequency equal to 2C. These new frequencies C and S are generated in the limiter because the limiter output is held constant and there is a modulating action therein. Although there can be no variation in amplitude of the output, there are in this constant output a series of frequencies including C, 2C, C+(C—A), and so forth. C+(C—A) is S in the graphic representation of Figure 1. The variations in amplitude of S, it is believed, are accompanied by opposite variations in a component not considered here, in order that the total output remains constant. The phase relations of S and C and 2C have been disregarded in the graphic representation of Figure 1 and to some extent in the description that follows, because here we are primarily interested in the positions in the frequency spectrum of C, 2C, and S.

This carrier 2C and single side band S are readily selected from the other frequencies, because they are so far removed from the other components of material amplitude. These frequencies as they stand, provided the carrier is of sufficient amplitude and properly related in phase to the side band S for the use to which it is put, may be used for transmission or may be impressed on additional carrier waves to produce outputs wherein new carriers and side bands are widely separated from other output frequencies so that they may be readily selected by economical filter systems.

In Figure 2 I have shown by block diagram a single side band transmitter in which the principle involved in this invention is utilized. In Figure 2, 1 is a microphone having its output connected with the primary winding P of a transformer 3 and a source of potential 2. The secondary winding S of 3 supplies modulating potentials to an amplifier 4, in turn connected with a current limiter 6. These elements supply the voltages represented by A in Figure 1. Wave energy from a source 5 is also supplied to the limiter 6. This voltage is represented by C in Figure 1, and in practice is made considerably stronger than the amplitude of the modulating potentials supplied to 6 from amplifier 4. In the output of 6 the components described above, C, S, 2C, 3C, and so forth, are present and the filter connected with the output of limiter 6 selects from said output the frequencies 2C and S. These frequencies may be used directly from the output of 7 for signalling purposes, if desired.

If the carrier 2C is not of proper amplitude, a new carrier may be supplied, or 2C may be augmented. Voltages for this purpose are derived from source 5 by a phase adjuster 15, a voltage doubler 16, and an amplitude regulator 17, these voltages being supplied to the selective circuit 7 or the output thereof. The side band S and augmented carrier 2C may now be used for signalling purposes, if desired.

If the frequency of 2C is not as high as desired, an additional modulator 8 may be supplied by voltages S and 2C, and also by a new carrier from a generator or carrier wave source 9. The output of modulator 8 will include the

new carrier and also the sum and difference of the new carrier supplied by 9 and the side band S and preceding carrier 2C. These components again are widely separated from the carrier frequency supplied by 9, and are easily isolated in the filter of selector 10. The new carrier and side bands may be used from the output of 10 or the process can be repeated in the modulator M3 at 11, to obtain a higher frequency carrier by modulating the new carrier and side band from the output of 10 on oscillations from a source 12. In each of these modulator outputs the carrier and side bands to be selected are widely separated from other components and are readily filtered out. The final output may be amplified, if necessary, in amplifier 13 and supplied to a radiation system 14 or a line 20.

What is claimed is:

1. The method of producing a carrier and side band energy widely separated in the frequency spectrum from the said carrier and other components of the combination which includes the steps of, combining voltage of carrier frequency with modulating voltages, said carrier frequency voltage being considerably greater in amplitude than the modulating voltages, limiting the amplitude of the voltages as combined to a constant value, to thereby produce a first component having twice the frequency of the carrier voltage and a second component having a frequency equal to, the frequency of the carrier voltage, plus the carrier voltage minus the modulating voltage, and of an amplitude which varies in accordance with variations in the amplitude of the modulating voltages, and doubling the frequency of the voltage of carrier frequency and adding the voltages of double frequency to said first component to increase the amplitude thereof.

2. The method of producing a carrier and side band energy widely separated in the frequency spectrum from the said carrier and other components of the combination which includes the steps of, combining voltage of carrier frequency with voltage of signal frequency, said carrier frequency voltage being considerably greater in amplitude than the signal voltage, limiting the amplitude of the voltages as combined to a constant value to thereby produce a first component having twice the frequency of the carrier voltage and a second component having a frequency equal to, the frequency of the carrier voltage, plus the carrier voltage minus the signal voltage, and of an amplitude which varies in accordance with variations in the amplitude of the signal voltages, augmenting the amplitude of said first component and modulating a new carrier in accordance with said augmented first component and said second component.

3. In a single side band signalling system, the combination of a source of voltages of a frequency greater than the highest signal frequency, a source of modulating voltages of lesser amplitude than said first voltages, a limiter coupled to both sources, a filter circuit, tuned to pass a band of frequencies including twice the frequency of the first voltage minus the frequency of the second voltage, coupled to said limiter, and a frequency doubler coupling said first source to said filter circuit.

4. In a single side band signalling system, the combination of, a source of signal voltages, a source of voltage of a frequency greater than the frequency of the highest signal voltage, and of greater amplitude than the amplitude of the peak signal voltage, a limiter coupled to both of said sources, a filter circuit tuned to pass a band of frequencies including twice the frequency of the second voltage minus the frequency of the signal voltages coupled to said limiter, a utilization circuit coupled with said filter circuit, and means for impressing on said utilization circuit voltages of a frequency equal to twice the frequency of the second voltage.

5. In a single side band signalling system, the combination of, a source of signalling voltages, a source of voltage of a frequency greater than the highest signal frequency, and of greater amplitude than the amplitude of the signalling voltages, a limiter coupled to both of said sources, a filter circuit tuned to pass a band of frequencies including twice the frequency of the second voltage minus the frequency of the signalling voltages, a modulator coupled with said filter circuit, a source of oscillations of carrier wave frequency coupled to said modulator, and phase adusting means for impressing on said modulator voltages of a frequency equal to twice the frequency of the second voltage and of a phase to augment the amplitudes of said voltages of twice the frequency of said second voltage.

6. In a single side band signalling system the combination of, a source of voltage of a frequency greater than the highest signal frequency, a source of signal voltages of lesser amplitude than said first voltage, a current limiter coupled to both sources, a filter circuit tuned to pass a band of frequencies including twice the frequency of the first voltage minus the frequency of the signal voltages, a modulator, a source of carrier frequency waves coupled with said modulator, means for impressing the output of said filter on said modulator and a phase adjuster, a frequency doubler and an amplitude regulator in cascade coupling said first source of voltage to said modulator to impress thereon voltages of double the frequency of the voltages of said first source and of a phase to aid the voltages of twice the frequency of the voltages of the final source supplied by said filter to said modulator.

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