

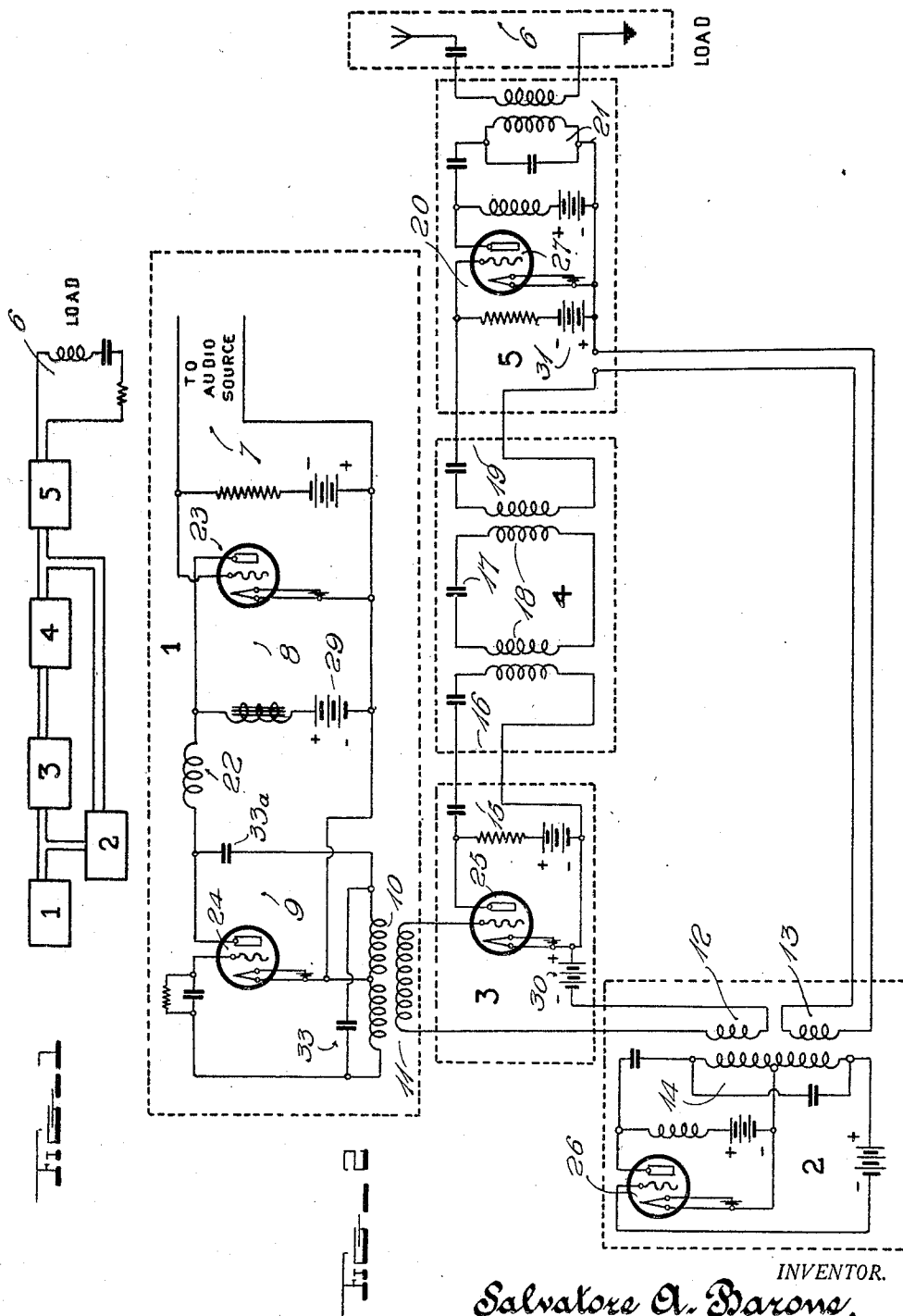
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TRANSMISSION SYSTEM

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TRANSMISSION SYSTEM

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My invention relates to radio transmission systems and more specifically to transmission systems wherein high frequency energy is modulated at a low frequency.

An object of my invention is to provide a system for transmission of signaling energy of a modulated character.

Another object of my invention is to provide a broadcasting system whereby low frequency currents are caused to modulate a source of high frequency energy without causing distortion of the low frequency currents.

Another object of my invention is to space the side bands in the frequency spectrum apart from the carrier.

Another object of my invention is to shift a band of frequencies to a lower part of the frequency spectrum whereby a portion of said band may be readily selected and to shift the selected band to a higher part of the frequency spectrum and spaced apart from the carrier.

Still another object of my invention is to provide a transmission system wherein the carrier frequency may be eliminated.

A further object of my invention is to provide means for eliminating one set of the side band frequencies produced by modulation.

A still further object of my invention is to provide a means for controlling the relative amplitudes of the carrier and side band frequencies.

Other and further objects of my invention will appear from the specification to follow and by reference to the accompanying drawings in which:

Figure 1 is a diagrammatic illustration of the respective embodiments of my invention and is illustrative of the positioning of the various units comprising the transmission system of my invention;

Fig. 2 is a diagrammatic illustration of the schematic circuit arrangement and electrical connections in the transmission system of my invention.

In Fig. 1 a source of modulated high frequency energy 1 is connected to a local oscillator 2 and a combining device 3. Local oscillator 2 is connected to combining device 3 and modulator 5. Combining device 3 is con-

nected to filter system 4. Filter system 4 is connected to modulator 5. Modulator 5 is connected to load circuit 6. A general understanding of the system I employ can be had by reference to Fig. 1. The source of modulated high frequency energy 1 impresses voltages in the input circuit of 3. Local oscillator 2 is coupled likewise to the input circuit of 3. The two frequencies beat together and produce a third frequency in the output circuit of combining device 3. The output circuit of 3 is coupled to the input circuit of filter system 4. The energy is properly filtered and comprises one set of side bands produced by modulation and no carrier, a carrier with the one set of side bands or the carrier alone, as elected by the design of aforementioned circuits and the filter system 4. The signal energy from filter 4 is coupled to the input circuit of a modulator 5, as is also the unmodulated energy of oscillator 2, producing a beat frequency in the output circuit of modulator 5. The output of modulator 5 is coupled to the load circuit 6 which may be a space radio radiating system or the input circuit of a wired radio system.

By referring to Fig. 2 the units comprising the transmission system and their electrical connections are shown. A source of audio frequency 7 is coupled to the input circuit of a thermionic vacuum tube 23. The plate circuits of thermionic vacuum tubes 23 and 24 are connected in multiple in respect to the direct current plate potential source 29. Oscillator circuit 9 includes thermionic vacuum tube 24, inductance 10 and condensers 33 and 33a. Oscillator circuit 9 is coupled to input circuit of thermionic vacuum tube combining device 3 through inductance 11. Oscillator circuit 2 comprises thermionic vacuum tube 26 and grid and plate circuits 14. Oscillatory current from oscillator circuit 2 distributes to inductance coils 12 and 13. Inductance coil 12 is in series with inductance 11 and constitutes a part of the grid circuit of vacuum tube 25. Thermionic vacuum tube 25 is caused to function as a combining tube determined by the value and polarity of supply 30. Modulated high frequency energy from the modulator oscillator circuit 1 beats with

the energy from oscillator 2 and produces resultant frequencies in the output circuit of combining device 3. The output circuit 15 of combining device 3 is coupled to the input circuit 16 of filter system 4. Filter system 4 includes inductances 18 and capacity 17 in addition to the input circuit 16 and output circuit 19. The values of the inductances 18, the capacity 17 and the input and output circuits 16 and 19 respectively, largely determine the function of the filter and the suppression of the upper or lower set of side bands, produced by modulation, or one set of side bands and the carrier. The output 19 of filter system 4 is coupled to the input circuit 20 of modulator 5. Modulator 5 includes thermionic vacuum tube 27, input circuit 20 and output circuit 21. The grid electrode of thermionic vacuum tube 27 is supplied with a predetermined potential with respect to its cathode by means of a source of direct current 31. The output energy from filter 4 and energy from oscillator 2 cause beat frequencies in the output circuit 21 of modulator 5. The output circuit 21 of modulator 5 is coupled to a load circuit 6 which may be a space radio radiating system, the input of a wired radio system, or further means for amplification.

As an example of the operation of my broadcasting system we may assume that the output energy from 1 has a carrier frequency of 600 kilocycles modulated by 1 to 10 kilocycles. This produces one set of side bands 590 to 599 kilocycles and a second set of side bands 601 to 610 kilocycles. The output energy from oscillator 2 has a carrier frequency of 660 kilocycles and unmodulated energy from 2 produce a plurality of resultant frequencies and in the example cited some of these frequencies will be of the order of 60 kilocycles corresponding to the carrier frequency, 50 to 59 kilocycles corresponding to the frequencies of one set of side bands, 61 to 70 kilocycles corresponding to the frequencies of the other set of side bands. In the output circuit of combining device 3 the above mentioned frequencies will be present together with other frequencies outside the range of 50 to 70 kilocycles. The relative amplitude and wave form of such currents will depend on the characteristics of the circuits of 1, 2 and 3. The current in the output circuit of 3 is transferred to the filter circuit 4. Suppose that the filter is one of uniform attenuation for frequencies of 50 to 59 kilocycles and having a very high attenuation for all others. It is evident that by properly designing the filter, all or part of the 60 kilocycle energy may be passed through the filter 4 in which event, all or whatever desired portion of the 60 kilocycle carrier will be in the final output circuit of the filter. The oscillator 2 supplies energy, having a frequency of 660 kilocycles, to the input circuit

of modulator 5. By virtue of the intercombination of the 660 kilocycle frequency from 2 and the bands of frequency from filter 4, the output of modulator 5 will contain frequencies of 710 to 719 kilocycles, 601 to 610 kilocycles and also the frequency 660 kilocycles from oscillator 2. The load circuit may have a uniform frequency characteristic for frequencies of 601 to 610 kilocycles and exclude all other frequencies.

As another example of the operation of my broadcasting system, suppose the filter 4 is one of uniform attenuation for frequencies of 61 to 70 kilocycles and having a very high attenuation for all others. The output of modulator 5 will contain frequencies of 721 to 730, 590 to 599 and also the frequency 660 kilocycles from oscillator 2. The load circuit 6 may be designed to have a uniform frequency characteristic for the frequency band 590 to 599 kilocycles and exclude all other frequencies.

The foregoing examples show that, in accordance with my invention, filter 4 may be designed to suppress either side band and reduce the carrier any desired amount in the band of frequencies received from combining device 3 and corresponding to the original frequencies of source 1. After modulation in 5, the output of filter 4 is stepped up in the frequency spectrum and comprises two side bands of the carrier from source 2. These side bands are spaced from the carrier by a band width in the frequency spectrum equal to the lowest frequency in the output of filter 4. By proper design of the output circuit of modulator 5 and load circuit 6, and in accordance with my invention, either of the spaced side bands, or either side band and the carrier, or the carrier alone, may be suppressed. The selection of the desired band for transmission is made relatively easy because of the separation of the side bands from the carrier.

In either of the examples cited, instead of designing load circuit 6 to transmit 601 to 610, or 590 to 599 kilocycles, the 710 to 719, or 721 to 730 kilocycles may be transmitted by the proper design of the load circuit.

One of the advantages of my broadcasting system, as should be obvious from the foregoing specification, is that with the system I employ it is possible to operate a greater number of transmitters in a given frequency band without interference.

It is evident that the suppression of the carrier and one set of side bands could be accomplished by a filter inserted between the source of modulated high frequency energy and the load. A band pass filter for high frequencies is considerably more difficult to make than would be a filter for the same band width and cut-off characteristics at lower frequencies. This invention makes it possible to use a lower frequency filter in

spite of the fact that the transmitted energy is at higher frequencies. I do not intend to have my invention limited to the foregoing specifications nor to the accompanying drawings, and I realize that many arrangements may be employed without departing from the spirit of my invention as defined in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. In a radio broadcasting system the combination of a modulated source of high frequency energy, an unmodulated source of high frequency energy, means for combining said modulated and unmodulated energy, a filter system and means for impressing said combined energy on the input circuit of said filter system, a modulator and means for coupling said modulator to the output circuit of said filter system and to said unmodulated source of energy and means for coupling the output of said modulator to a load circuit.

2. In a broadcasting system comprising in combination means for producing modulated high frequency energy, means for producing unmodulated high frequency energy, means for causing said modulated and said unmodulated signaling energy to produce resultant sources of signaling energy, filter means for eliminating one of said sources of energy, means associated with said source of unmodulated high frequency and said filter means for producing a beat frequency and a load circuit associated with said last mentioned means for the transmission of signaling energy having frequency characteristics as determined by said aforementioned means and said load circuit.

3. In a signaling system, a source of modulated signaling energy, a source of unmodulated signaling energy, means for causing said modulated and said unmodulated energy to produce resultant sources of signaling energy, means associated with the first mentioned means for selecting a plurality of said sources of signaling energy, modulating means associated with said selecting means and said source of unmodulated signaling energy, and a load circuit associated with said modulating means for the transmission of the desired signaling energy.

4. In a signaling system the combination of a source of modulated energy, a source of unmodulated energy, means for causing said sources of energy to produce a resultant source of energy, filter means associated with said means, modulating means associated with said filter means and said source of unmodulated energy for producing a second resultant comprising a carrier and two side bands and a load circuit associated with said modulating means whereby said carrier and

one set of side bands are transferred to said load circuit.

5. In a signaling system the combination of a source of modulated energy, a source of unmodulated energy, means for causing said sources of energy to produce resultant sources of energy, filter means associated with said means and having such frequency characteristics as to offer a uniform and low impedance to desired energy of desired frequencies and having a high impedance to other energy of other frequencies, modulating means associated with said filter means and said source of unmodulated energy and a load circuit having a uniform and low impedance to desired frequencies and having a high impedance to all other frequencies and means for transferring said energy from said modulating means to said load circuit.

6. A high frequency transmission system comprising a source of unmodulated high frequency oscillations, a source of modulated high frequency oscillations, means for combining the oscillations from said sources, and obtaining the beat frequencies resulting from said combination, means for selectively filtering said beat frequencies, means for modulating high frequency oscillations from the first mentioned source with oscillations in the output circuit of said filter, and means for transmitting a selected portion of the last named modulated high frequency oscillations.

7. A high frequency transmission system comprising a generator of high frequency oscillations, means for modulating the output of said generator, a second generator of high frequency oscillations having a different frequency from the first mentioned generator, means for combining the outputs of both said generators and obtaining a band of frequencies of a lower order, means for filtering said band, means for modulating oscillations in the output circuit of said filter and high frequency oscillations from said second generator, and a tuned circuit associated with the second mentioned modulating means for selecting a portion of said last named modulated high frequency oscillations.

8. The method for transmitting a selected portion of a band of modulated high frequency oscillations which comprises, modulating a source of high frequency oscillations to produce a carrier and two side bands, spacing said side bands in the frequency spectrum apart from said carrier, and transmitting a selected portion of said carrier and said bands.

9. The method for generating modulated high frequency oscillations which comprises beating unmodulated high frequency oscillations with high frequency oscillations modulated with a band of audible frequencies, obtaining therefrom an intermediate band of super-audible frequencies, selectively filter-

ing said intermediate band, and causing said intermediate band to modulate additional high frequency oscillations whereby the last mentioned high frequency oscillations comprise a carrier and two side bands each separated in the frequency spectrum from said carrier.

In testimony whereof I affix my signature.
SALVATORE A. BARONE.

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