

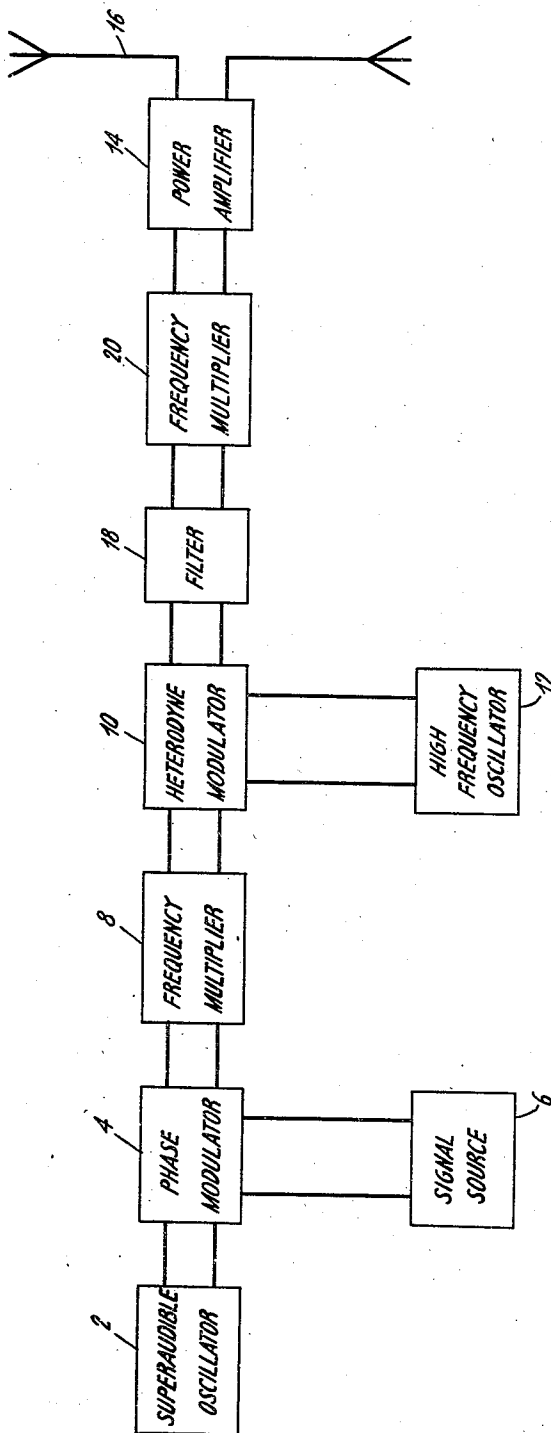
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PHASE MODULATION

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PHASE MODULATION

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This invention relates to a method of producing phase modulation and particularly to a method of producing phase modulation on low frequencies.

5 The most reliable method of producing phase modulation known at present consists of modulating the phase of the output of a constant frequency oscillator source, such as a piezo-electric oscillator. The modulating is accomplished at
10 a convenient frequency and the modulated output then multiplied to the transmitter frequency. The modulation is multiplied with the frequency. To obtain any desired degree of modulation, it is only necessary to start with a low enough oscillator frequency. This method has the advantage over direct methods in that the frequency stability is the same as the oscillator used and can therefore be made much more stable than systems working directly on the phase of
15 an oscillator. This system, however, has a limit of modulation at the modulated frequency, theoretically being a maximum of plus or minus ninety degrees and practically about ten or fifteen, owing to the characteristics of the circuits employed.

25 When frequency of the source is of such an order that it can be multiplied many times to the output frequency, the modulation can be increased in the same order. It is desirable that
30 the source frequency be considerably greater than the modulation frequency and it is therefore difficult to apply this method to cases where the output frequency is low, such as in long wave systems or broadcast transmitters. Where it is desired to use a quartz oscillator, it is not practical
35 to construct and operate such oscillators at frequencies below the order of 50 to 100 kilocycles. The selectivity of related circuits also tends to cut the audio frequency sidebands. The object
40 of my present invention is to overcome these practical obstacles. In carrying my invention into effect, I produce the modulation at a convenient frequency, multiply it to get the desired degree of modulation, as in the normal manner,
45 and then employ a suitably stabilized oscillator such as a piezo-electric oscillator to heterodyne the modulated waves to the transmitter frequency or to a convenient sub-multiple thereof.

50 By this method, the system of modulation becomes standardized for all output frequencies, whether high or low, and can be transferred from one transmitter to another by variation of the heterodyning oscillator and output circuits alone.
55 The heterodyne oscillator could well be a unit of the transmitter rather than the modulator, thereby making it possible to operate several transmitters simultaneously from the same source, if desired.

60 The accompanying drawing shows schemati-

cally and in block diagram form a way of carrying my present invention into effect.

The super-audible oscillation generator 2 feeds energy into a phase modulator 4 which is also supplied with waves from any suitable signal source 6. The relatively low, but superaudible frequency phase modulated output from phase modulator 4 is fed into a suitable frequency multiplier 8 of any number of stages and with a sufficient frequency multiplying power such as to produce the desired amount of phase modulation. The output of frequency multiplier 8 is fed into the heterodyne detector or modulator 10 which is also supplied with energy from the crystal controlled or other form of constant high frequency oscillation generator 12. The output of the heterodyne modulator 10 may then be fed directly into a power amplifier 14 and radiated from a suitable antenna 16. If desired, filter 18 for separating a single side band may be added, and, if desired, an additional frequency multiplier 20 may be used between the filter 18 and the power amplifier 14. Amplifiers may be used wherever desired or found necessary.

Having thus described my invention, what I claim is:

1. The method of signaling by phase modulation which includes generating super-audible oscillations, phase modulating the super-audible oscillations in accordance with a signal, frequency multiplying the phase modulated oscillations, producing constant high frequency oscillations, heterodyning the phase modulated oscillations with the constant high frequency oscillations, filtering the resulting energy to obtain sideband energy, frequency multiplying the sideband energy, and transmitting energy resulting from the frequency multiplying process.

2. Apparatus for transmitting phase modulated waves comprising a source of super-audible oscillations, means for phase modulating the super-audible oscillations in accordance with a signal, means for frequency multiplying the phase modulated oscillations, a source of high frequency oscillations of substantially constant frequency, means for heterodyning the high frequency oscillations with the frequency multiplied phase modulated oscillations, means for selecting from said heterodyned oscillations a single sideband, and means for transmitting said single sideband.

3. Apparatus as claimed in claim 2 characterized by the fact that means are provided for frequency multiplying the output of said sideband-selecting means and being characterized by the fact that means are provided for transmitting the output of said last mentioned frequency multiplying means.

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