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TRANSMISSION OF INTELLIGENCE BY FREQUENCY VARIATION

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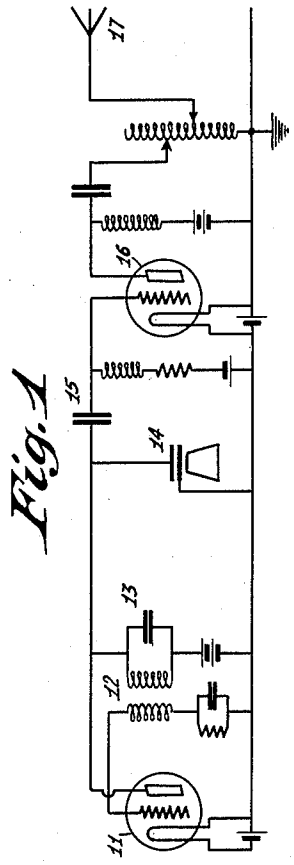


Fig. 1

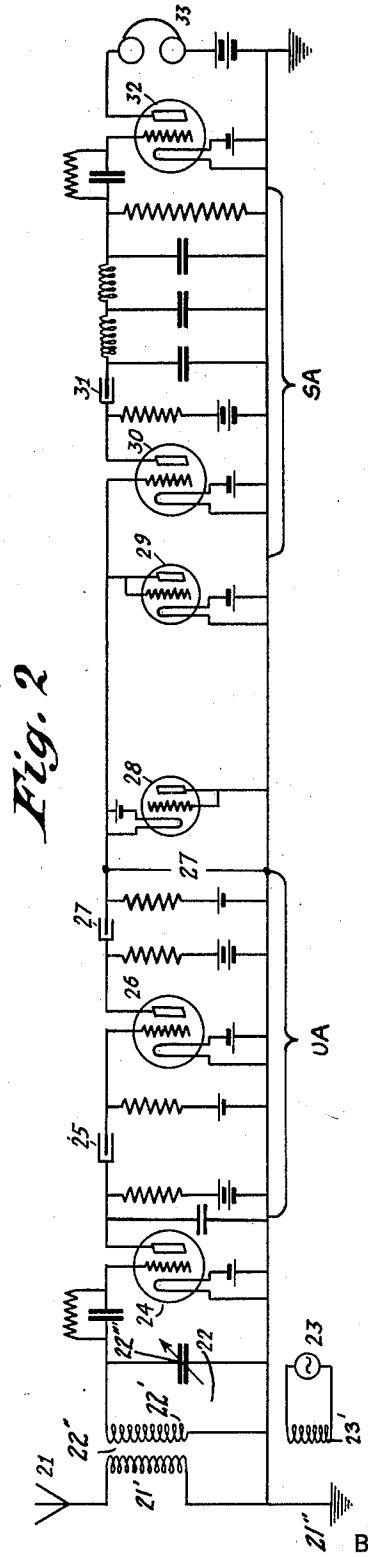


Fig. 2

INVENTOR
JOHN HAYS HAMMOND JR.

BY

ATTORNEY

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TRANSMISSION OF INTELLIGENCE BY FREQUENCY VARIATION

John Hays Hammond, Jr., Gloucester, Mass.

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6 Claims. (Cl. 250—20)

The object of this invention is to provide a system for the transmission and reception of radiant energy for sound communication purposes which will give more nearly perfect reproduction of the audio frequencies transmitted.

A further object is to provide an improved transmission and receiving system to minimize the effects of fading upon the quality of the received signals.

Further objects of this invention will become apparent from the following specification taken in connection with the appended drawing.

Transmitters constructed in accordance with this invention utilize the well known method of frequency-variation transmission, instead of the better known method of amplitude variation. In the construction of transmitters for this invention, it is preferable to arrange that amplitube variations of the emitted radiations be made small.

Receivers constructed in accordance with this invention provide a limiting device which produces a current substantially non-varying with respect to amplitude regardless of considerable fading and regardless of slight amplitude variations produced by the transmitter, but varying in frequency in the same manner as the emitted radiations. This is accomplished by limiting the current supplied to a selective amplifier, by the uniform amplifier, to the lowest amplitude which may at any time obtain due to the most extreme fading to be expected. In other words, the voltage supplied to the selective amplifier is always less than the least voltage supplied by the uniform amplifier when operating under the minimum input voltage.

This current is then introduced into a suitable selective amplifier which produces currents with amplitude variations in accordance with the original frequency variations at the transmitter. Upon detection or demodulation the original speech or sound currents are produced with fidelity unaffected by fading or by the abrupt limiting action of the receiver circuit.

Having thus briefly described my invention, attention is invited to the accompanying drawing in which:

Fig. 1 shows a transmitter adapted to produce and radiate frequency modulated waves; and,

Fig. 2 shows a form of receiver constructed in accordance with my invention for cooperation with the transmitter of Fig. 1.

Referring now more particularly to Fig. 1, there is shown a master oscillator 11 which in cooperation with its associated circuits is adapted to produce the high carrier frequency, the frequency of which is determined chiefly by the inductance 12 and the condenser 13. For slightly modifying the frequency produced by the master oscillator, there is provided the condenser microphone 14. The frequency modulated high frequency thus produced is impressed upon the grid of the radio frequency amplifier 16 across the impedance comprising an inductance and a resistance. The grid of the amplifier tube is biased by means of a battery in the usual and well known manner. The output of the radio frequency amplifier is impedance coupled to the antenna circuit and the coupling condenser is of high capacity in order to transmit all frequencies within the band of frequency modulation with substantially the same amplitude. A system such as shown in Patent No. 1,599,586 to Purington, may be used, instead of that shown, for giving frequency modulation with constant amplitude in a manner similar to that shown in my application for transmission of light sequences by frequency variation, Serial No. 364,106 filed May 18, 1929, concurrently herewith.

Referring now more particularly to Fig. 2, there is shown an antenna circuit composed of the antenna 21, the inductance 21' and the ground 21'' which circuit is inductively coupled to the broadly tuned circuit 22, which is composed of the secondary 22' of the coupling transformer 22'' and the variable condenser 22'''. This receiver is in the nature of a superheterodyne and for providing the heterodyne frequency a local oscillator 23 is provided, the output of which is adapted to be supplied to the tuned circuit 22 by the inductive relation of the inductance 23' of said oscillator circuit to the secondary 22' of the coupling transformer 22'''. The beat frequencies thus produced are detected by the detector 24, which is arranged in the usual and well known manner, and are amplified by a uniform amplifier UA comprising the thermionic device 26, and its associated circuits. This amplifier is of the impedance coupled type, and the coupling condensers 25 and 27 are of high capacity in order to uniformly amplify the entire band of the beat frequencies.

Across the output 27 of the uniform amplifier UA are provided two current limiting devices 28 and 29, each of which consists of either a two electrode thermionic tube or a three electrode tube in which the plate and grid have been connected. These devices are arranged oppositely so that excess voltages on both alternations are bypassed and a constant amplitude varying intermediate

frequency current is thus supplied to the amplifier SA which includes amplifier device 30.

The uniform amplifier has sufficient sections so that the minimum current passed to amplifier 30 under any conditions will be sufficient to produce the maximum output for which the current limiting devices are made.

In other words, even when the minimum input voltage is being received, due to poorest transmission and reception conditions, the uniform amplifier supplies a voltage above the limit determined by the voltage limiting devices 28 and 29. The selective amplifier SA is of the filter type and the coupling condenser 31 is of low capacity in order that there shall be a wide variation between the amplification at one end of the frequency band with respect to the amplification at the other end of the frequency band. The selective amplifier including its filter is of the usual and well known type consisting of an impedance in the output of the amplifying device 30, the coupling condenser 3 and the filter composed of series impedances and bypass condensers. The output of the selective amplifier is adapted to supply the second detector 32 which converts the frequency modulated, amplitude modulated frequency into an audio frequency.

It is evident that a receiver may be built utilizing the system of my invention without the use of the local oscillator in which case the incoming variable frequency would be amplified by a uniform amplifier constructed similarly to that shown, and the current limiting devices would be interposed between the uniform amplifier and the selective amplifier and filter as shown. Also the amplifier in this case would be adapted to operate at the band of frequencies transmitted and received and a single detector would serve to detect the high frequencies which were frequency modulated at the transmitter and amplitude modulated at the receiver, in a manner similar to that of the second detector 32.

Having thus described my invention, I will briefly describe its operation. The high frequency generated at the transmitter is frequency modulated by the audio frequency to be transmitted. The incoming signals may be received with a beat receiver to transform the unmodulated carrier wave, that is the carrier wave when no modulation is taking place, to, say, 25,000 cycles. When frequency modulation occurs, the varying intermediate frequency which results would be between the limits of, say, 20,000 and 30,000 cycles, and the 30,000 cycle current would be adapted to be strongly amplified by the selective amplifier, whereas the 20,000 cycle current would be weakly amplified thereby.

By this graded amplification, amplitude modulated intermediate frequency signals are produced. Therefore, upon second detection of this modulated intermediate frequency, audio frequency currents are produced, which correspond with the transmitted signals, and the amplitude of which has no relation to the amplitude of the incoming signals.

Having thus described my invention, it is to be understood that I do not wish to be limited by the specific embodiment shown and described for the purpose of illustration only, but by the scope of my invention as set forth in the appended claims.

I claim:

1. The method of reception of frequency modulated signals which comprises receiving the frequency modulated energy, transforming the received energy into a varying intermediate frequency, amplifying the intermediate frequency, preventing variations in the amount of amplified energy throughout the range of intermediate frequencies, limiting the amplitude of the amplified intermediate frequency to the minimum amount occurring after amplification due to maximum variations in transmission conditions, selectively amplifying the intermediate frequency thus limited to produce high intensity currents at one end of the intermediate frequency band and low intensity currents at the other end of the intermediate frequency band, and detecting the frequency and amplitude modulated current thus produced to reproduce an audio signal.

2. The method of reception of frequency modulated signals which comprises receiving the frequency modulated energy, transforming the received energy into a varying intermediate frequency, amplifying the intermediate frequency, limiting the amplitude of the amplified intermediate frequency to the minimum amount occurring after amplification due to maximum variations in transmission conditions, selectively amplifying the intermediate frequency thus limited to produce high intensity currents at one end of the intermediate frequency band and low intensity currents at the other end of the intermediate frequency band, and detecting the frequency and amplitude modulated currents thus produced to reproduce an audio signal.

3. The method of reception of frequency modulated signals which comprises receiving the frequency modulated energy, transforming the received energy into a varying intermediate frequency, limiting the amplitude of the intermediate frequency to the minimum amount occurring due to maximum variations in transmission conditions, selectively amplifying the intermediate frequency thus limited to produce high intensity currents at one end of the intermediate frequency band and low intensity currents at the other end of the intermediate frequency band, and detecting the frequency and amplitude modulated currents thus produced to reproduce an audio signal.

4. Means for the reception of frequency modulated signals which comprises means for receiving the frequency modulated energy, means for transforming the received energy into a varying intermediate frequency including a local high frequency oscillator, means for amplifying the intermediate frequency, and for preventing variations in the amount of amplified energy throughout the range of intermediate frequencies, means including a voltage limiting device for limiting the amplitude of the amplified intermediate frequency to the minimum amount occurring after amplification due to maximum variations in transmission conditions, selective amplifying means for amplifying the intermediate frequency, after being thus limited by said voltage limiting means, to produce high intensity currents at one end of the intermediate frequency band and low intensity currents at the other end of the intermediate frequency band, and means for detecting the resulting current to reproduce the original audio signal.

5. Means for the reception of frequency modulated signals which includes means for receiving the frequency modulated energy, means for transforming the received energy into a varying intermediate frequency, thermionic means for limiting the amplitude of the intermediate frequency to the minimum amount occurring due

to maximum variations in transmission conditions, means for selectively amplifying the intermediate frequency, after being thus limited, to produce high intensity currents at one end of the intermediate frequency band and low intensity currents at the other end of the same band, and means for detecting the current thus frequency and amplitude modulated to reproduce the original audio signal.

6. In combination with a source of frequency modulated carrier energy said energy having an undesired amplitude varying component, a uniform frequency amplifier having an input circuit connected to said source and an output circuit, said amplifier acting to amplify the frequency modulated carrier energy and also to thereby accentuate the undesired amplitude varying component thereof, a voltage limiting circuit provided with input terminals and output terminals and comprising, a pair of diodes connected oppositely with respect to both the input and output terminals, means for connecting the input terminals of the voltage limiting circuit to the output circuit of the uniform frequency amplifier, said voltage limiting circuit acting to limit the amplitude of the amplified energy to substantially the minimum amount occurring after amplification due to approximately maximum variations of said amplitude varying component of said energy, a selective frequency amplifier comprising an electronic tube provided with an input circuit and an output circuit, means for connecting the selective frequency amplifier input circuit to the output terminals of the voltage limiting circuit, a filter chain provided with input terminals and output terminals, means including a low capacity condenser for coupling the last named output circuit to the filter chain input terminals, said selective frequency amplifier and filter chain acting to effect upon the limited amplitude frequency modulated energy an amplitude varying component proportional to variations in frequency thereof and a utilizing circuit connected across the output terminals of the filter chain.

JOHN HAYS HAMMOND, JR.