April 10, 1934. J. SEDLMAYER 1,954,185

METHOD OF TRANSMITTING SIGNALS ON SHORT RADIOWAVES

Filed April 6, 1932

Fig. 1

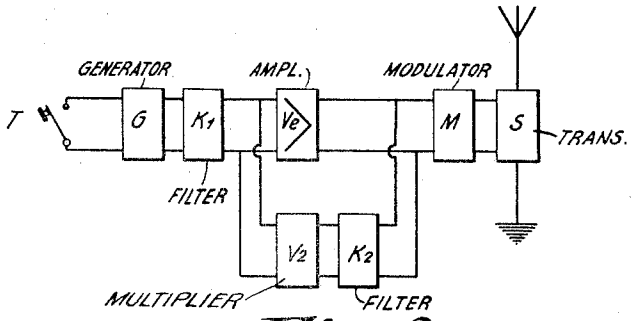


Fig. 2

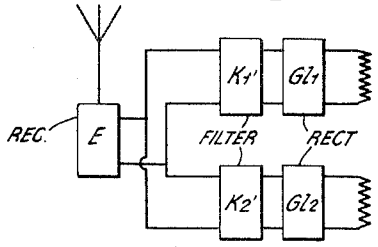


Fig. 3

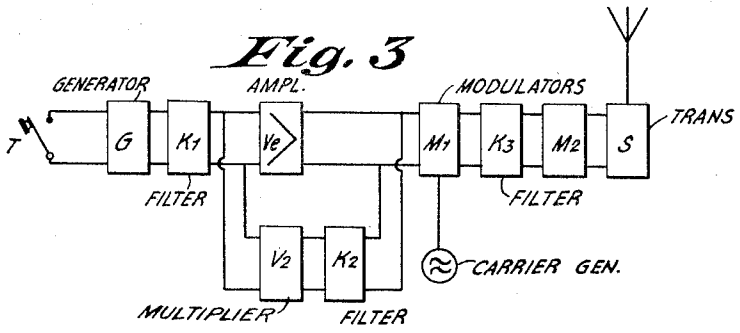
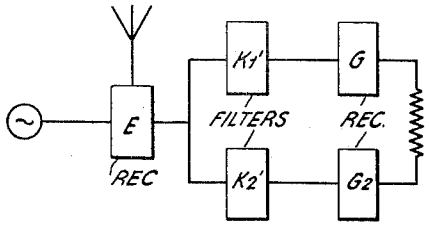


Fig. 4



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METHOD OF TRANSMITTING SIGNALS ON SHORT RADIOWAVES

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2 Claims. (Cl. 250—8)

In the transmission of signals by radio, particularly in the short wave range there frequently occurs a phenomena known as fading, a condition which manifests itself by a variation of the incoming signal intensity, some times resulting in the complete disappearance of the signal. Attempts have been made herefore to render fading harmless by simultaneously transmitting upon a long and a short wave, both being spaced from each other by a desired wide frequency band, the presupposition of this procedure being that fading would manifest itself in a selective manner, in other words, that the signal on one wave length would vary in intensity whereas another signal on another wave would not vary in intensity, at least, not at the same time. The use of two carrier frequencies, however, has been found to be undesirable inasmuch as the space available for the accommodation of waves is very limited, and for this reason such method of communication has been abandoned and the transmission of the signals restricted to the use of only a single short wave.

It has been found in the case of waves in the range below 100 meters that fading phenomena will occur which will not affect the whole frequency band, but only a part thereof. The fading phenomena is known to make itself felt in a very troublesome manner when it is desired to utilize a plurality of transmission channels upon one and the same carrier wave on which several messages, either telegraphic or telephonic, may be sent.

According to this invention fading is eliminated by simultaneously sending the same signal on several transmission channels and modulating a carrier wave by frequencies differing from the frequency of said wave. In this manner there is obtained a highly advantageous arrangement whereby the loss owing to selective fading on one of the channel frequencies influenced by one and the same signal will be rendered harmless inasmuch as transmission may be completed and the same signal received by one or several transmission channels.

Now ordinarily in the use of such a method of transmission, two or more transmission channels will be occupied by one and the same signal, the result being that the chances of transmitting several independent messages or communications will be restricted. This disadvantage, however, is eliminated, according to another object of this invention, by choosing the transmitter channel frequencies used for the modulation of the carrier waves such that they will arise in the receiver in the form of a fundamental wave and its harmonics. In transmitting a fundamental wave, the overtones thereof will, as a matter of course arise upon the reception of such a fundamental wave. It should be noted that these higher harmonics do not admit of the use of a transmission channel inside the frequency range of these harmonics, although these frequencies are not present in the transmission channel. Therefore, without reducing the chances of additional transmission channels on the carrier wave, such higher harmonics which will anyway inevitably arise in the receiver set can be included in the transmission, and these channels playing the part, as it were, of safety channels, may be influenced at the same time by the same signal so that, in the presence of selective fading effects, the above-mentioned reliability of reception is secured providing additional frequencies in the transmission channels which might be used for other purposes. The method herein disclosed is particularly advantageous whenever the carrier wave has been affected by selective fading, since in that case the overtone, which in a limiting case would be the only one that is left over, would take care of the transmission or delivery of the signal.

The present invention may be carried into practice by modulating the carrier wave directly by the transmission frequencies which are in the form of the fundamental and overtones. These frequencies can be taken from a generator by providing for suitable means, such as frequency multipliers or harmonic generators, for promoting the production of higher harmonics. The fundamental wave and the harmonic used in the simultaneous transmission are then employed for modulating the carrier wave. In this case, only the generator needs to be modulated. It will be understood, of course, that, for the production of the fundamental wave and one or more harmonics, different generators can be employed, but in such case several simultaneously controlled keying devices must be provided.

Since it is essential in attaining the end of this invention to receive the transmission frequencies utilized for the modulation of the carrier wave only in the receiver in the form of the fundamental and its harmonics, the transmission channel frequencies used in the communication work may also have other absolute frequency values, as long as they present the same frequency differences as the fundamental and the overtones thereof to be received. Hence, by the aid of suitable well known means, for

instance, by the use of an intermediate or transposition frequency, it is possible to cause frequencies inter-related like fundamental and harmonics to assume different absolute frequency values though presenting the same frequency difference, and use for the modulation of a carrier frequency which, optionally, may not be included in the transmission, while at the receiving end, by the addition of a carrier wave, the transmission channel frequencies bearing an inter-relationship as fundamental and harmonics may be restored.

By suitable distorting means it may be of advantage to cause the harmonics to become especially conspicuous in some instances arising in practice, so that in case of loss of the transmitted harmonic, receiving energy from the fundamental wave will arise in the particular branch of the receiver adapted to and intended for the harmonic.

The invention shall be explained in more detail by referring to the accompanying drawing wherein Figures 1 and 3 are illustrative of two transmitting stations embodying the principles of the present invention and Figures 2 and 4 show two receiving stations adapted to receive the signals transmitted from said transmitting stations.

Figure 1 shows a generator G of any desired kind, say, of a type adapted to produce a wave of 1000 cycles, and a key T serving to act upon the generator. The generator currents are fed to an amplifier V_e by way of a filter circuit K_1 tuned to a frequency of 1000 cycles per second. Between amplifier V_e and K_1 a part of the fundamental wave of the 1000 cycles per second is shunted off and fed into any suitable distorting device V_2, such as a frequency multiplier or harmonic generator. A filter circuit K_2 which is tuned to 2000 cycles allows the first harmonic 2000 cycles to pass, the latter being fed to the modulator M which also supplies the frequency 1000 cycles to the transmitter S which, in turn, produces the carrier wave and sends the same out.

Figure 2 shows the receiver E required therefor in the rear of which there is a by-pass (separating) filter comprising chains K_1' and K_2'. The filter K_1, passes only the fundamental wave of 1000 cycles and the other one, K2, only the overtone of 2000 cycles. Associated with the output of both filter chains are rectifiers $G1_1$ and $G1_2$ by means of which the doubly received signals are fed to any desired receiver device, say, two recorder instruments, not shown. It will be readily understood that in case of loss of one of the transmitted frequencies, the signal will come in on the other wave.

Figure 3 shows a schematic embodiment of the invention in which the simultaneously sent signals do not occur in the transmission channel in the form of a fundamental and overtone. In the same way as in Figure 1, the key T acts upon the 1000 cps. generator, and the wave of 1000 cycles is fed by way of a filler K_1 and an amplifier V_e to a modulator M_1. The shunted portion of the fundamental frequency is passed through a distorter device V_2, the first overtone (harmonic) of 2000 cycles being passed through a filter K_2 also to the modulator M_1. Inside the modulator both frequencies are caused to modulate a carrier of 100,000 cycles, and thereupon by way of a filter chain K_3 having a frequency passing band width ranging from 101,000 and 102,000 fed to a modulator M_2. The latter acts upon the transmitter S, which may utilize a frequency of 10^7 cycles which is suppressed in the transmission by a suitably arranged phase-opposition scheme.

Figure 4 illustrates the receiver E required for receiving the signals sent out by the transmitter of Fig. 3, this receiver comprising means adapted to generate a frequency of 10^7 cycles which is incorporated in the incoming frequency band. Associated with the receiver E, are two filters K_1' and K_2' which are separating filters, each filter being respectively tuned to the fundamental wave of 1000 cycles and the first harmonic of 2000 cycles. The frequency added in the receiver must be so chosen that the signal frequencies resulting after rectification present a relationship to each other as fundamental and overtone, say, as 1000 to 2000 cps.

I claim:

1. The method of radio telegraphic communication to overcome fading which comprises keying a fundamental frequency in accordance with signal characters, separating out and amplifying said fundamental frequency, obtaining a harmonic from said keyed fundamental frequency, modulating a carrier wave by both the keyed fundamental and harmonic waves, and transmitting the resultant wave.

2. The method of radio telegraphic communication to overcome fading which comprises keying a fundamental frequency in accordance with signal characters, separating out and amplifying said fundamental frequency, obtaining a harmonic from said keyed fundamental frequency, modulating a carrier wave by both the keyed fundamental and harmonic waves, transmitting the resultant wave, receiving said resultant wave, separating the received signal characters into waves having the same frequency relationship as said fundamental and harmonic, and utilizing said separated waves.

JOSEPH SEDLMAYER.

CERTIFICATE OF CORRECTION.

Patent No. 1,954,185. April 10, 1934.

JOSEPH SEDLMAYER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 74, after "secured" insert the word without; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of October, A. D. 1936.

Henry Van Arsdale

(Seal) Acting Commissioner of Patents.