

Dec. 29, 1936.

H. O. ROSENSTEIN ET AL

2,065,826

SIGNALING

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2 Sheets-Sheet 1

Fig. 1

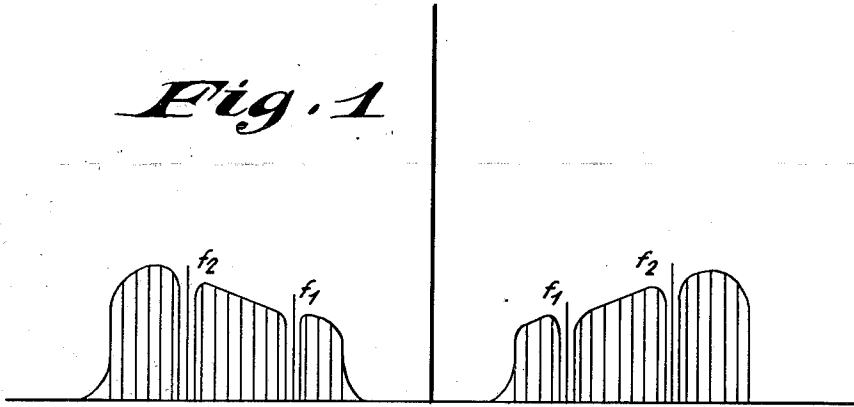


Fig. 2

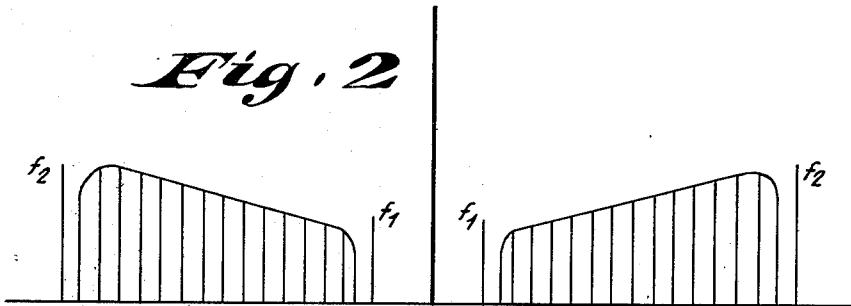
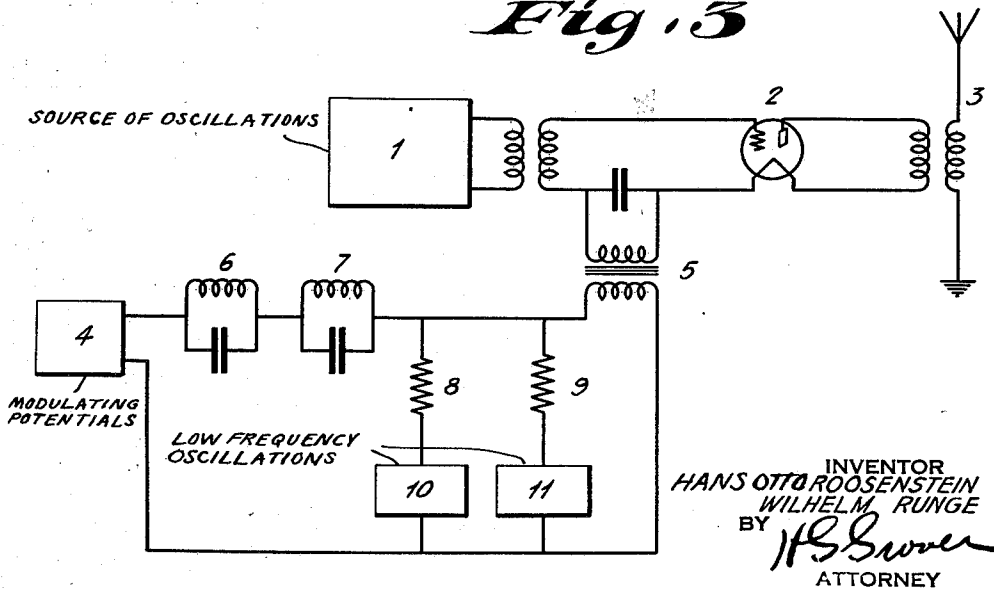


Fig. 3



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Fig. 4

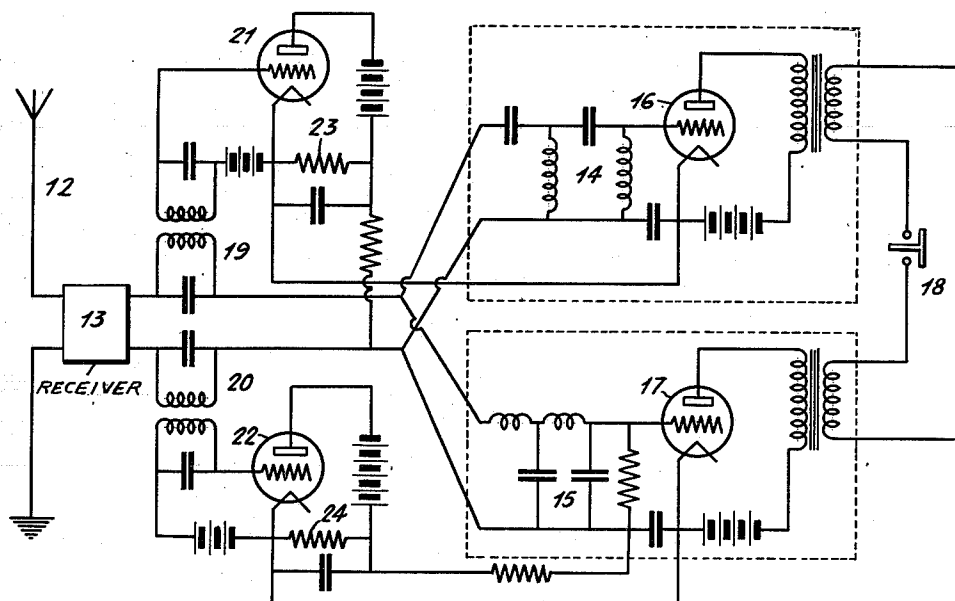
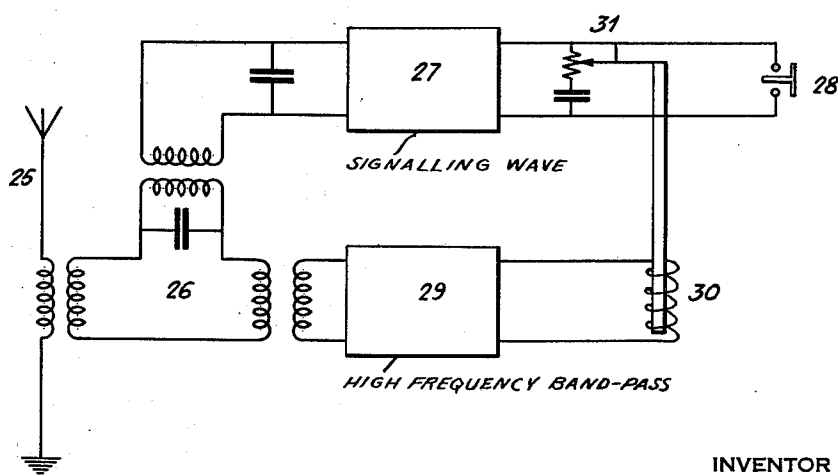


Fig. 5



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SIGNALING

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6 Claims. (Cl. 250—6)

This invention relates to a method of and means for transmitting modulated radio frequency signals.

In the transmission of signals by modulated radio frequency it is known that the troublesome influence of changing conditions of the transmission routes or paths, for instance, fading in transmission on short waves, upon the quality of reception, i. e. the volume or amplitude, may be eliminated by automatic and constantly acting regulation, for instance, of the amplifiers in the receiver apparatus.

Now, this invention is concerned with a method adapted to the transmission of modulated radio frequency the essential feature of which, contrasted to the prior art, where regulation merely embraces and concerns the modulation transmitted as a whole, is that by automatic control the reproduction spectrum of the modulation frequencies themselves is affected. As to details this method may be carried into practice in various ways and for the production of different effects. For example, it is possible to permit the timbre of reception of telephonic signals, say, in dependence upon atmospheric conditions to regulate itself in an automatic manner in order that it may be made to assume the optimum value according to the frequency of atmospheric conditions. One very important form of construction (embodiment) consists in handling partial bands of the total frequency band to be transmitted and to provide them with separate regulator means. In this way there may be obviated, for instance, the effects of what is known as selective fading in short-wave telephony which consist in the distorting of the reproduction spectrum of modulation frequencies. Another application of the method predicated upon automatic regulation of partial bands resides, for instance, in secret telephony which is based upon transposition of partial bands.

In the methods known in the prior art to insure automatic regulation of the entire modulation, the carrier wave included in the transmission has been utilized for the purpose of producing the desired effect at the receiving end. In the present invention it may be convenient in the automatic regulation of partial bands, for example, to include two or more auxiliary frequencies in the transmission which are separated by filters at the receiving end and are employed for rendering operative such means as have been provided for altering the timbre. If these auxiliary waves are suitably chosen and also the means designed to alter the timbre at the receiving end as a function of these frequencies, this tends to diminish

selective fading effects. These latter have this result that certain parts of the spectrum of modulation frequencies are transmitted at different times with different amplitudes. In a case that occurs quite frequently these distortions are so simple that uniform decrease or increase of the transmission in the direction of higher frequencies takes place. Such a distortion according to this invention, may be obviated in that the spectrum of the transmitted frequencies includes two auxiliary frequencies.

The nature of the present invention will be understood from the following detailed description thereof, and therefrom when read in connection with the attached drawings in which Figures 1 and 2 show graphically the position of the auxiliary frequencies relative to the carrier and side bands. Figure 3 shows a circuit arrangement for transmitting signals in accordance with the present invention, while Figures 4 and 5 show receivers arranged in accordance with the present invention.

According to Figure 1 the auxiliary frequencies denoted by f_1 and f_2 may be transmitted inside the side-band in a small frequency gap set aside therefor; or else, as shown in Figure 2 they may be accommodated above the highest or below the lowest side-band frequency.

A transmitter equipment in which the auxiliary frequencies are included is shown, for instance, in Figure 3. The pilot transmitter 1 by way of the main transmitter 2 feeds the antenna 3. The modulation frequencies supplied by way of amplifier 4 are introduced by way of 5 into the grid circuit of tube 2. By stoppers 6 and 7 in the lead carrying the modulation frequencies two gaps are produced in the frequency spectrum of the modulation inside which are accommodated the auxiliary waves supplied from generators 10 and 11 by way of the resistances 8 and 9. If the said auxiliary frequencies are located above or below the modulation-frequency band, then the stopper means 6 and 7 may be dispensed with.

Figure 4 shows an exemplified embodiment of a receiver outfit in which, by the use of a system as hereinbefore disclosed, it is possible to attain selective-fading reduction. The output of the receiver 13 connected with the aerial 12 carries the modulation-frequency band which by way of two filters 14, 15 is split into a band containing the high frequencies, and another band containing the low ones. These partial bands by way of separate amplifiers 16, 17 are conducted to the joint reproducer 18. The two auxiliary frequencies must be separated from the modulation,

and they are fed by way, for instance, of some suitable electrical means 19, 20 into the tubes 21, 22, where they are subjected, say, to plate rectification. As a result of this process direct current voltages are set up across resistances 23 and 24 which, after being rid of disturbing alternating components are fed to the amplifiers 16 and 17. The assumption shall be made that the tube 22 is fed with the lower auxiliary frequency and the tube 21 with the higher auxiliary frequency. The direct current voltage which acts across the resistance 24 and thus also at the grid of the first tube of amplifier 17, as will thus be noted, is due to the lower frequency, and the same is utilized for the object of regulating the gain of the amplifier 17. However, the amplifier 17 is so designed that it will amplify only the lower frequencies within the transmitted side-band, and in line with what has been pointed out, its amplification will be so much less, the stronger the action brought by the transmitted auxiliary wave upon the tube 22. Inasmuch as the auxiliary wave, in line with assumption, is contained inside the band of the lower modulation frequencies and is therefore transmitted under conditions that are as satisfactory as for these particular frequencies, particularly strong transmission of the auxiliary frequency is an indication that the lower modulation frequencies are strongly transmitted also, so that they must be weakened artificially in the receiver. And as can be seen from the explanation this is actually the case in the receiving system described.

Similar is the operation also of the amplifier 16, with this distinction that in this case only the higher side-band frequencies are handled. Also this amplifier whose gain is controlled by the higher auxiliary frequency furnishes as a result a uniform reproduction of the frequencies contained in the modulation.

The effect of an arrangement of the kind hereinbefore described is substantially improvable whenever more than two auxiliary frequencies are employed. But then it is absolutely necessary that at least one of these auxiliary frequencies should lie inside the modulation frequency band.

It is possible by means of arrangements of the kind hereinbefore described to considerably improve the intelligibility of the voice in short-wave telephony over great distances. The arising of non-linear distortions which are noticed in carrier fading, however, will not be obviated in apparatus of the kind described. In order to insure elimination of these distortions it is advantageous either to design the transmitter so that it will radiate only one side-band while the carrier is suppressed entirely or is sent out only with reduced amplitude, or else to suppress at the receiving end a side-band conjointly with the carrier and to subsequently add the carrier required for audio-frequency audibilization of the signal to the remainder of the side-band, and to finally rectify the mixture or combination together.

In known systems of secret telephony (or code telephony), the side-frequency band of a transmitter is split into two or more parts which thereupon may be changed to another frequency or pitch or be exchanged (transposed) or inverted, until perfect garbling of the speech or message for unauthorized persons is attained. In order that in such transmissions the selective fading effects may be minimized it is recommendable to include an auxiliary frequency in the sense

of this invention in the various transmitted side-band parts, said auxiliary wave to be located inside the voice-frequency part or very close thereto. At the receiving end these auxiliary frequencies are then again to be used for the stabilization of the degree or level of transmission for the frequency band in question. If these side-band parts exist and if thus the general application of the method would mean a great complication of the arrangement, one may confine himself to the scheme of stabilizing by means of auxiliary frequencies only the most important frequency "gaps", say, those which include the principal speech formants.

Figure 5 shows furthermore a scheme which comprises an arrangement adapted to regulate the incoming spectrum in dependence upon atmospheric conditions. The signal carrying wave picked up by aerial 25 is fed by way of circuit 26 and unit 27 which may include amplifying, demodulating means, etc., to the receiving apparatus 28. The atmospheric conditions are transferred chiefly by way of circuit 26 to the regulator circuit 29 tuned to the higher frequencies (at which disturbances usually occur). The unit 29 may include amplifying means, demodulating means, etc., to derive a direct current component in the winding of the relay device 30 characteristic of the amplitude of the disturbances and also of the wave frequencies closest in frequency to said disturbances. The relay device 30 controls a movable point on the resistance of a shunt circuit consisting of a resistance and a capacity element in series. In such a manner that, for instance, the highest frequencies in which a good many troublesome noises are included will be attenuated or cut off conjointly with the atmospheric disturbances.

Having thus described our invention and the operation thereof, what we claim is:

1. A transmitting device comprising a carrier wave relay and modulator tube having its output electrodes connected to a transmitting circuit and its input electrodes connected to a source of carrier wave oscillations to be modulated, a source of modulating potentials, a plurality of sources of control potentials, a coupling circuit coupling said source of modulating potentials with an electrode in said relay and modulator tube, circuits connecting said sources of control potentials with said coupling circuit, and a plurality of stopper circuits in series with said coupling circuit intermediate the points at which said sources of control potential are connected to said coupling circuit and the coupling of said source of modulating potentials to said coupling circuit, there being a stopper circuit for each control frequency, each stopper circuit comprising parallel reactances tuned to the frequency of a different control frequency.

2. Receiving means comprising signal absorbing means, a signal demodulator having an input coupled to said absorbing means said demodulating means having an output, a pair of thermionic tubes each having input and output electrodes, a band-pass filter circuit coupling the output of said demodulator to the input electrodes of each of said tubes, each of said filter circuits being tuned to a different band of frequencies, a utilization circuit coupled to the output electrodes of said tubes, a second pair of thermionic tubes each having input and output electrodes, resonant circuits each tuned to a different frequency coupling the input electrodes of said last named pair of tubes to the output of said demodulator, and circuits including smoothing elements cou-

pling the output of each of said last named tubes to the input electrodes of a different one of the tubes in said first named pair.

3. In a radio system the method of reducing the effects of fading on signals transmitted on a carrier wave which comprises, separating the entire signal frequency band into several separate signal frequency bands, allotting to each of the signal frequency bands a control frequency which lies intermediate the upper and lower frequency limits of the band to which it is allotted, impressing said signal bands and control frequencies on said carrier wave and transmitting the same, receiving the carrier wave, separating the received oscillations into sub-bands corresponding to said separate signal frequency bands, separately amplifying the sub-bands, and controlling the amplification of each sub-band in accordance with the amplitude of the control frequencies allotted thereto at the transmitter.

4. In a radio system the method of reducing the effects of fading on signals transmitted on a carrier wave which comprises, separating the entire signal frequency band into several separate signal frequency bands, allotting to each of the signal frequency bands a control frequency which lies intermediate the upper and lower frequency limits of the band to which it is allotted, suppressing from each of said signal frequency bands signal frequencies of the order of the control frequency allotted to the respective bands, impressing said signal bands and control frequencies on said carrier wave and transmitting the same, receiving the carrier wave, separating the received oscillations into sub-bands corresponding to said separate signal frequency bands, separately amplifying the sub-bands, and controlling the amplification of each sub-band in accordance with the amplitude of the control frequencies allotted thereto at the transmitter.

5. In a radio signaling system the method of reducing the effects of fading on signals im-

pressed on a carrier frequency wave for transmission which comprises, separating the entire signal frequency band into several separate sub-bands, allotting to each of the signal frequency sub-bands a plurality of control frequencies which lie intermediate the upper and lower frequency limits of the band to which they are allotted, impressing said signal bands and control frequencies on a carrier wave for transmission, receiving said carrier wave, demodulating said carrier wave, separating the demodulated energy into sub-bands corresponding to said signal frequency sub-bands, separately amplifying the sub-bands, and controlling the amplification of each sub-band in accordance with the amplitude of the control frequencies allotted thereto at the transmitter.

6. In a radio signaling system the method of reducing the effects of fading on signals impressed on a carrier frequency wave for transmission which comprises, separating the entire signal frequency band into several separate sub-bands, suppressing from each of said sub-bands selected signal frequencies of the order of control frequencies, allotting to each of the signal frequency sub-bands a plurality of control frequencies which lie intermediate the upper and lower frequency limits of the band to which they are allotted and are of the order of the suppressed signal frequencies, impressing said signal bands and control frequencies on a carrier wave for transmission, receiving said carrier wave, demodulating said carrier wave, separating the demodulated energy into sub-bands corresponding to said signal frequency sub-bands, separately amplifying the sub-bands, and controlling the amplification of each sub-band in accordance with the amplitude of the control frequencies allotted thereto at the transmitter.

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