

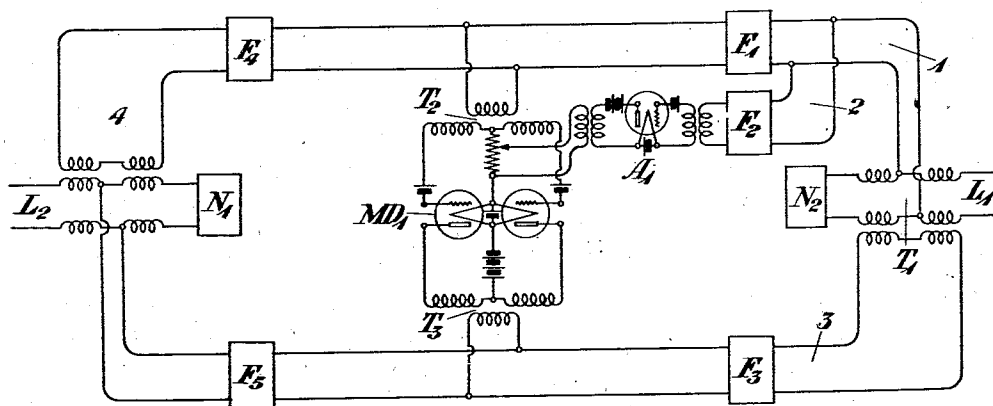
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HIGH FREQUENCY MULTIPLEX SIGNALING SYSTEM

Original Filed Sept. 30, 1919



Inventor

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By his Attorney

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UNITED STATES PATENT OFFICE.

LLOYD ESPENSCHIED, OF QUEENS, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

HIGH-FREQUENCY MULTIPLEX SIGNALING SYSTEM.

Original application filed September 30, 1919, Serial No. 327,501. Divided and this application filed April 9, 1921. Serial No. 459,835.

To all whom it may concern:

Be it known that I, LLOYD ESPENSCHIED, residing at Queens, in the county of Queens and State of New York, have invented certain Improvements in High-Frequency Multiplex Signaling Systems, of which the following is a specification.

This invention relates to high frequency multiplex signaling system and more particularly to a terminal circuit arrangement embodying the use of amplifiers adapted to amplify the side band and the carrier frequency oscillations received by the said terminal circuit.

This application is a division of my co-pending application, Serial No. 327501 filed September 30, 1919, entitled High frequency multiplex signaling system.

The broad object of the invention is to improve the transmission efficiency and the transmission quality of carrier current circuits. One feature is the provision of a carrier current amplifier for improving the transmission efficiency of the carrier circuit. A further object of the invention is to provide means whereby the ratio of the unmodulated carrier current transmitted over the system to the modulated or side band component may be controlled for the purpose of insuring good quality in the carrier transmission circuit.

A comprehensive understanding of the invention will be facilitated by recognizing that in the ordinary form of carrier current transmission represented by radio, there are involved really two channels, one the unmodulated carrier current which is transmitted over the system at the original carrier frequency and the other the modulated or side band component which is transmitted at a frequency differing from the original carrier frequency by an amount corresponding to the signaling frequency. These two channels are commonly treated in radio, for example, as a single channel, and at the receiving end are fed unseparated into the detector. The detecting action obtains, however, only by virtue of modulation between, that is, the beating together of, the currents of the two channels, the carrier and one or both side bands. The present invention is concerned with carrier current systems, both wire and wireless, wherein the carrier is transmitted directly along with the side

bands as per ordinary radio practice, as distinguished from the type of carrier system first employed for multiplex service over wires wherein the carrier channel is suppressed at the sending end and resupplied at the receiving end by a control system.

One feature of the invention resides in the use of an amplifier in the high frequency part of the circuit which amplifies simultaneously both the carrier and the side band currents. A given amplification inserted in this manner in the high frequency circuit results in a twofold amplification of the detected current by virtue of the fact that the amplitude of the detected current is a function of the product of the amplitudes of the carrier and the side band currents.

It has been found that for the obtaining of good quality in carrier telephone transmission, it is necessary that the carrier supply current be large compared with the side band currents. This relation is necessary in order that in detection or demodulation, the product term of carrier and side band, representing the desired detected current of signaling frequency, be large in amplitude compared with the other product terms such as those resulting from modulation between the two side bands or between the component currents of one side band, which currents represent undesired detected currents tending to interfere with and depreciate the quality of the transmission. A further feature of the invention is the provision of means whereby the carrier and the side bands may be amplified in different proportions, that is, the ratio of the amplitudes of the carrier to the side band currents may be varied for the purpose of improving quality in the manner indicated. This is accomplished by combining with the high frequency amplifying apparatus, selective circuits which discriminate as between the carrier frequency and the side band frequency.

The drawing shows the application of the invention to a terminal circuit of the type characterized by a single translating circuit adapted to modulate and demodulate the outgoing and incoming currents. In the figure L_1 represents the high frequency line over which it may be assumed that currents of the frequency n and $n-f$ are being received. These frequencies are impressed by the transformer T_1 upon the input circuit 1.

The high frequency band filter F_1 adapted to pass oscillations represented by the frequency $n-f$ is inserted in the input side of the terminal which is connected with the translating circuit by the transformer T_2 . Bridged across the input circuit 1 is a by-pass 2, having therein a filter F_2 adapted to transmit only the carrier frequency n . The oscillations of this frequency are amplified by the amplifier A_1 and are impressed upon the common conductor of the duplex modulating and demodulating device MD_1 . Associated with the high frequency output branch 2 is a high frequency band filter F_3 . F_4 and F_5 represent low frequency filters which are adapted to transmit currents of the signaling frequency. The mode of operation of this circuit is as follows: Let it be assumed that the carrier frequency n and a band of frequencies represented by $n-f$, are being received over the line L_1 from the circuit at the opposite end of the said line, and are being impressed upon the receiving branch 1 of the terminal circuit shown in the figure. The band of frequencies represented by $n-f$ will pass through the filter F_1 and will be impressed by the transformer T_2 upon the modulating and demodulating device MD_1 . The carrier frequency n will be selectively amplified by the amplifier A_1 and the amplified oscillations of this frequency will be impressed upon the translating device MD_1 . The low frequency signaling current resulting from demodulation will be impressed by the transformer T_3 upon the output side of the terminal circuit and passing through the low frequency filter F_5 will be impressed upon the low frequency signaling circuit L_2 . The low frequency signaling currents set up in the circuit L_2 by the low frequency signaling apparatus associated therewith will be impressed upon the input branch 4 of the transmitting path and passing through the low frequency filter F_4 will be impressed upon the translating circuit by the transformer T_2 . These low frequency currents will modulate the amplified high frequency carrier current impressed upon the translating circuit by the amplifier A_1 and the modulated high frequency current resulting therefrom will be impressed upon the output circuit by the transformer T_2 . These modulated high frequency oscillations will pass through the high frequency band filter F_3 and over the transmission line L_1 .

It will be seen therefore that by means of the arrangement shown in the figure the unmodulated carrier oscillations which are simultaneously transmitted together with one or more of the side bands based upon this carrier frequency may be separated from the said band or bands in the receiving branch of the terminal circuit and may be amplified separately from the side bands

and impressed upon a translating circuit common to the transmitting and receiving paths of the terminal circuits.

It will furthermore be seen that by suitable adjustment of the amplifier A_1 the relative amplitudes of the carrier oscillations and the side band oscillations may be controlled. It will also be seen that by means of the balanced duplex translating circuit oscillations of the carrier frequency are suppressed therein and do not pass through the transformer T_3 . Consequently this tends to reduce the possibility of singing in case the balancing networks did not exactly balance their corresponding line circuits. Although this invention is disclosed as embodied in a wire signaling circuit it is to be understood that it is equally applicable to radio transmission systems.

Furthermore, although this invention has been shown as embodied in certain specific form or arrangement of parts, it is to be understood that it may be embodied in other and different forms and arrangements without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a signaling system adapted for the transmission and reception of high frequency signals, the method which consists in simultaneously receiving from a common medium modulated high frequency oscillations and unmodulated high frequency oscillations, separating the two types of oscillations, amplifying the unmodulated type, and detecting the modulated oscillations by means of the amplified unmodulated oscillations.

2. In a signaling system adapted for the transmission and reception of high frequency signals, the method for improving the quality of detection for signals which consists in simultaneously receiving from a common medium modulated and unmodulated carrier currents, selectively separating the said modulated and unmodulated currents, amplifying the unmodulated carrier current to a definite degree, depending on the amplitude of the modulated current, and detecting the modulated current by means of the amplified carrier current.

3. In a signaling system adapted for the transmission and reception of high frequency signals, the method for improving the quality of detection of signals which consists in simultaneously receiving from a common medium modulated and unmodulated carrier currents, selectively separating the said modulated and unmodulated currents, amplifying the unmodulated carrier current to a definite degree, depending upon the amplitude of the modulated current, detecting the signaling component of the modulated current by means of the amplified carrier current, suppressing the unmodu-

lated carrier current and transmitting the detected current.

4. In a signaling system adapted for the transmission and reception of high frequency signals, the method which consists in simultaneously receiving low frequency signaling variations and unmodulated high frequency oscillations, amplifying the said oscillations, modulating the amplified oscillations by means of said variations, suppressing the unmodulated high frequency oscillations and transmitting the modulated high frequency oscillations.

5. In a signaling system, the combination with two line circuits one of which has a source of unmodulated carrier current associated therewith of a four-wire connecting circuit having a translating circuit associated therewith comprising means to modulate and demodulate impressed oscillations, filters arranged in the two-wire branches of the four-wire circuit so as to provide proper paths for the transmitted and received currents and a by-pass circuit connected with one of said two-wire branches having a filter and an amplifier associated therewith adapted to select and amplify the unmodulated carrier current and means to impress said amplified carrier current upon the said translating circuit.

6. In a signaling system, a combination of two line circuits, one of which has a source of carrier current associated therewith and a four-wire connecting circuit characterized by a translating circuit common to the transmitting and receiving paths of the four-wire circuit and having means to modulate and demodulate the currents flowing through said transmitting and receiving paths, and further characterized by means to select and amplify the carrier frequency current before impressing it upon the said translating circuit.

7. In a signaling system, the combination of two line circuits, having connected therewith sources of low frequency and high frequency currents respectively and a four-wire

connecting circuit characterized by a translating circuit having means to modulate and demodulate said low frequency and high frequency currents impressed thereon by said line circuits, and further characterized by means to select and amplify oscillations of carrier frequency received over one of said line circuits and to impress the amplified oscillations upon the translating circuit, the said modulating and demodulating means being arranged to suppress therein unmodulated oscillations of carrier frequency.

8. In a signaling system, the combination of two line circuits each having sources of current connected thereto and having networks individual thereto adapted to balance said lines, a four-wire connecting circuit electrically related to said line circuits by conjugate transformers, a translating circuit bridged across the two-wire branches of the four-wire circuit, common to the transmitting and receiving paths of the four-wire circuit, low pass and high frequency band filters in each of the said two-wire branches, and a by-pass circuit connecting one of said two-wire branches and said translating circuit and having means to select and amplify currents from one of said sources and to impress the amplified currents on said translating circuit.

9. In a high frequency signaling system, the combination of a receiving circuit adapted for the reception of oscillations of the side band frequencies and oscillations of the carrier frequency, a detector, means for selecting and amplifying oscillations of the carrier frequency to the exclusion of the side band frequencies and means for impressing simultaneously upon the said detector oscillations of the side band frequencies and amplified oscillations of the carrier frequency.

In testimony whereof, I have signed my name to this specification this 7th day of April 1921.

LLOYD ESPENSCHIED.