

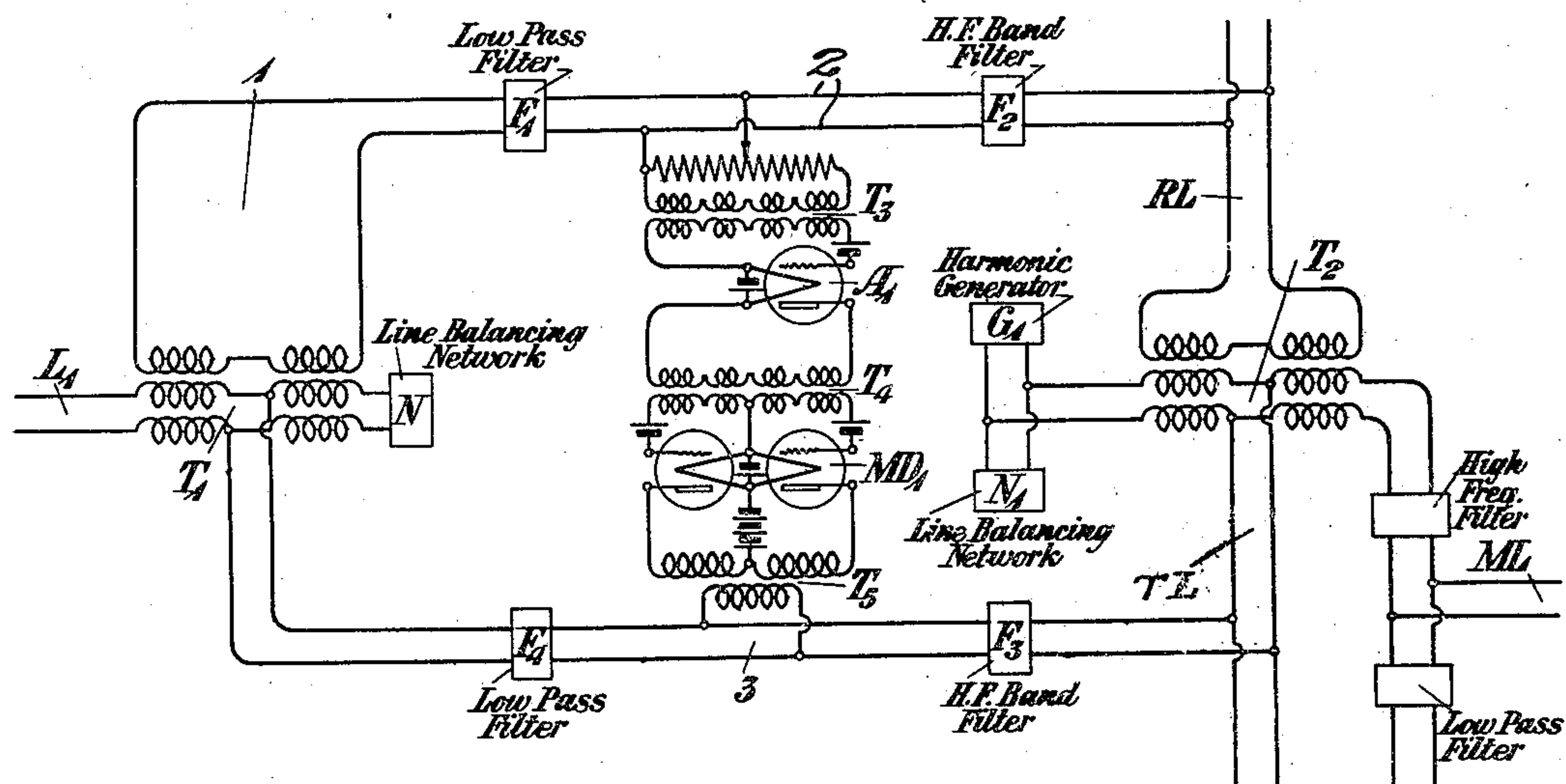
July 29, 1924.

1,502,816

L. ESPENSCHIED

HIGH FREQUENCY MULTIPLEX SIGNALING SYSTEM

Original Filed Sept. 30, 1919



Inventor

L. Espenschied

By his Attorney

getz

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. 327,500. Divided and this application filed April 16, 1921. Serial No. 461,968.

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 systems, and particularly to a terminal circuit arrangement embodying the use of a common translating circuit adapted both to modulate the transmitted current and to demodulate the high frequency received current.

This application is a division of my co-pending application, Serial No. 327,500, filed September 30, 1919, entitled "High frequency multiplex signaling systems".

In the multiplex signaling systems heretofore used which employ a plurality of carrier currents of various frequencies, it has been customary to insert in the transmitting and the receiving branches of the terminal circuit a translating device, individual to each of said branches. It is the object of the present invention to adapt the terminal circuit arrangement so that the processes of modulation and demodulation and amplification of the various currents in both the transmitting and receiving branches of the terminal circuit may be performed by a single translating device. Although the preferable form of translating device is a single thermionic vacuum tube or a plurality of such tubes in combination adapted to function as a single unit with respect to the two branches of the terminal circuit any well known type of translating device such as the mechanical repeater may be used.

Another object of this invention is to provide an arrangement whereby a single harmonic generator may be connected with the common high frequency receiving branch of a plurality of terminal circuits, so that the desired carrier frequency for any particular terminal circuit may be selected therefrom and fed directly into the translating circuit of the said terminal circuit, thus avoiding the necessity of having a separate carrier frequency generator individual to each terminal circuit.

Other and further objects of this invention will be apparent from the following de-

scription when read in connection with the attached drawing showing one form of embodiment of the invention.

The drawing shows a variation of the general circuit having a translating circuit common to the incoming and outgoing paths of the four wire circuit characterized by the connection of a high frequency harmonic generator across the conductors between the network adapted to balance the main transmission line and the triple winding transformer which associates the said line with the terminal circuit. This high frequency harmonic generator may be of any type which is adapted to produce a plurality of high frequency sinusoidal oscillations which may be used as the basic carrier currents for the various signaling channels. In the circuit represented by this figure the low frequency signaling currents of the line L_1 are impressed by means of the transformer T_1 upon the branch 1 of a four-wire terminal circuit. These low frequency oscillations pass through the low frequency filter F_1 to the circuit 2 and are impressed upon the translating circuit which is bridged across the two sides of the four-wire circuit. The high frequency oscillations of, for example, 5,000 to 30,000 cycles, which may be generated by the high frequency harmonic generator G_1 are impressed across two of the windings of the triple winding transformer T_2 and set up oscillations of the same frequencies in the receiving circuit RL and the transmitting circuit TL . If the high frequency band filters F_2 and F_3 are designed to pass a band of frequencies which includes one of these basic carrier frequencies generated by the generator G_1 , these oscillations will pass into the circuits 2 and 3 respectively. Those oscillations which pass into circuit 3 produce substantially no effect upon the translating device MD_1 , since this circuit is connected with the plate side of the translating device. However, the high frequency carrier oscillations which pass through filter F_2 into the circuit 2 are by the transformer T_3 impressed upon the translating circuit together with the low frequency oscillations and both are amplified by the amplifier A_1 and modulated by the modulating and demodulating device MD_1 . The modulated

high frequency oscillations are then impressed by the transformer T_5 upon the circuit 3 and pass through the high frequency band filter F_3 to the transmitting circuit TL, and thence over the main transmission line ML to the terminal circuit at the other end of this transmission line. The high frequency modulated waves received over the line ML pass into the receiving circuit RL and through the filter F_2 assuming that they are oscillations of those frequencies which the filter F_2 is adapted to transmit. These oscillations then pass into the circuit 2 and are impressed upon the translating circuit by means of the transformer T_3 . This band of frequencies is then amplified by the amplifier A_1 and the amplifier oscillations are then impressed upon the modulating and demodulating device MD_1 by means of the transformer T_4 . Simultaneously with the impression of this band of received oscillations upon the said modulating and demodulating device, oscillations of the carrier frequency from the generating source G_1 are likewise being amplified and impressed upon the said device MD_1 . The incoming band of oscillations is therefore demodulated by the carrier oscillations of the same frequency and the low frequency modulating current resulting therefrom passes through the transformer T_5 into the circuit 3 and thence through the low frequency filter F_4 into the low frequency line L_1 .

By this arrangement of the high frequency harmonic generator with the high frequency balancing network and its associated triple winding transformer the basic carrier currents for a plurality of four-wire terminal circuits may be transmitted to each of the said terminal circuits over the regular receiving circuit RL and through the associated high frequency band filters, thereby avoiding the necessity of providing a special supply circuit for transmitting the said carrier current to the translating circuit associated with each terminal circuit such as, for example, circuit 12 of Figure 1, of my copending application, Serial No. 327,500, filed September 30, 1919. It should be pointed out that the high frequency oscillations produced by the generator G_1 will not be transmitted over the main transmission line ML since the conjugate relation between the artificial line N_1 and the real line ML prevents the carrier current from being transmitted. The generator G_1 should be of such high impedance as not to affect the balance which the network N_1 exerts upon the transmission line ML. In view of the balanced relationship that exists between the network N_1 and the line ML and between the circuit RL and the circuit TL, the high frequency carrier oscillations set up by the generator G_1 will pass into the circuit RL and TL, but not into the transmission line

ML, for the same reason that the high frequency oscillations received over the line ML will be impressed upon the circuits RL and TL but not upon the network N_1 or the generator G_1 .

Although this invention has been disclosed as embodied in a particular form and arrangement of parts, it is to be understood that it is capable of embodiment 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 system having a plurality of four-wire circuits connecting a common transmission line with a plurality of signaling circuits, the said line and said signaling circuits each having a source of current connected therewith, each of the said four-wire circuits being characterized by a translating circuit adapted to modify transmitted and received currents, the method which consists in generating carrier currents of a plurality of frequencies, selecting the particular frequency for each four-wire circuit, and modulating the carrier current in accordance with the signaling current.

2. In a signaling system having a four-wire circuit connecting two line circuits and characterized by a translating circuit adapted to modify transmitted and received currents, the said line circuits each having a source of current connected therewith, the method which consists in generating the currents of carrier frequencies, receiving a plurality of bands of high frequency currents, selecting the desired carrier frequency and also the desired band of high frequency currents, and detecting the signaling component by beating together the carrier and the said band of frequencies.

3. In a system having a plurality of four-wire circuits connecting a common transmission line with a plurality of signaling circuits, the said line and the said signaling circuits each having a source of current connected therewith, each of said four-wire circuits being characterized by a translating circuit adapted to modify transmitted and received currents, the method which consists in generating carrier currents of a plurality of frequencies, receiving a plurality of bands of high frequency currents, selecting the particular carrier frequency and particular band of frequencies for each individual four-wire circuit, and demodulating the received band by means of the selected carrier frequency.

4. In a signaling system the combination with a line circuit of a second line circuit, a source of current connected with each line circuit, a four-wire circuit connecting said line circuits, a source of carrier current connected with the said four-wire circuit, the said four-wire circuit being characterized by a translating circuit common to the trans-

mitting and receiving paths of the said four-wire circuit

5. In a signaling system the combination with a line circuit of a second line circuit, a four-wire circuit having a translating circuit associated therewith, and means for impressing upon the translating circuit transmitted currents from one line circuit and received currents from the second line circuit, the said translating circuit having means to modify the transmitted and received currents impressed thereon, conjugate transformers adapted to connect the four-wire circuit with each of said line circuits, networks associated with said transformers adapted to balance said line circuits, and a generator adapted to produce carrier frequency oscillations connected with the transformer of the said second line circuit and arranged to impress its oscillations upon the receiving branch of the said four-wire circuit.

6. In a signaling system the combination with a line circuit of a second line circuit, a four-wire circuit having a translating circuit associated therewith, and means for impressing upon the translating circuit transmitted currents from one line circuit and received currents from the second line circuit, the said translating circuit having means to modify the transmitted and received currents impressed thereon, conjugate transformers adapted to connect the four-wire circuit with each of said line circuits, networks associated with said transformers adapted to balance said line circuits, a generator adapted to produce carrier oscillations of a plurality of frequencies connected with the transformer of the said second line circuit and arranged to impress its oscillations upon the receiving branch of the said four-wire circuit, means to select oscillations of a definite frequency for a particular four-wire circuit, and means to impress the said oscillations upon the said translating circuit.

7. In a signaling system the combination with a low frequency signaling circuit of a high frequency transmission circuit, a four-wire circuit having a translating circuit associated therewith and means for impressing upon the translating circuit transmitted currents from one line circuit and received currents from the second line circuit, the said translating circuit having means to modulate and demodulate the transmitted and received currents impressed thereon, conjugate transformers adapted to connect the four-wire circuit with the said signaling circuit and the said transmission circuit, networks associated with the said transformers adapted to balance the said signaling circuit and the said transmission circuit, a generator adapted to produce a plurality of carrier frequencies connected with the

transformer of the said transmission circuit and adapted to impress carrier frequency oscillations upon the high frequency receiving circuit, means associated with each four-wire circuit to select a definite carrier frequency, and means to impress the selected frequencies upon the translating circuit.

8. In a signaling system the combination with a low frequency signaling circuit of a high frequency transmission circuit, a four-wire circuit having a translating circuit associated therewith and means for impressing upon the translating circuit transmitted currents from one line circuit and received currents from the second line circuit, the said translating circuit having means to modulate and demodulate the transmitted and received currents impressed thereon, conjugate transformers adapted to connect the four-wire circuit with the said signaling circuit and the said transmission circuit, networks associated with the said transformers adapted to balance the said signaling circuit and the said transmission circuit, a generator adapted to produce a plurality of carrier frequencies connected with the transformer of the said transmission circuit and adapted to impress carrier frequency oscillations upon the high frequency receiving circuit, means associated with each four-wire circuit to select oscillations of a definite carrier frequency, and also a definite band of frequencies representing a modulated wave arriving over said transmission circuit, and means to impress said carrier frequency and said modulated wave upon said translating circuit whereby a modulated wave may be detected.

9. In a signaling system the combination with a low frequency signaling circuit of a high frequency transmission circuit, a four-wire circuit having a translating circuit associated therewith and means for impressing upon the translating circuit transmitted currents from one line circuit and received currents from the second line circuit, the said translating circuit having means to modulate and demodulate the transmitted and received currents impressed thereon, conjugate transformers adapted to connect the four-wire circuit with the said signaling circuit and the said transmission circuit, networks associated with the said transformers adapted to balance the said signaling circuit and the said transmission circuit, a generator adapted to produce a plurality of carrier frequencies connected with the transformer of the said transmission circuit and adapted to impress carrier frequency oscillations upon the high frequency receiving circuit, means associated with each four-wire circuit to select a definite carrier frequency, and means to impress the selected frequencies upon the translating circuit simultaneous with the impression

thereon of low frequency signaling variations arriving over the low frequency signaling circuit.

10. In a signaling system the combination with a low frequency signaling circuit of a high frequency transmission circuit, a four-wire circuit having a translating circuit associated therewith and means for impressing upon the translating circuit transmitted currents from one line circuit and received currents from the second line circuit, the said translating circuit having means to amplify currents of all the frequencies impressed thereon, and means to modulate and demodulate the impressed currents, conjugate transformers adapted to connect the four-wire circuit with the said signaling and said transmission circuits, networks adapted to balance said signaling and said transmission circuits, a source of carrier frequencies adapted to impress its oscillations upon the high frequency receiving branch of the four-wire circuit, means for selecting a particular carrier frequency, and means for impressing

the selected carrier frequency together with currents of other frequencies upon the translating circuit whereby the carrier current and the other of said currents might be amplified and modulated or demodulated. 30

11. In a high frequency signaling system the combination of a main transmission circuit adapted to be connected with a receiving branch circuit and a transmitting branch circuit by a triple winding transformer, a balancing network associated with said transformer adapted to balance said main transmission circuit, a translating circuit having means to impress thereon currents from said receiving and said transmitting branch circuits, and a source of unmodulated carrier oscillations connected in parallel with said balancing network, and means connected with the translating circuit for modulating and detecting the transmitted and received currents respectively. 45

In testimony whereof, I have signed my name to this specification this 15th day of April 1921.

LLOYD ESPENSCHIED.