

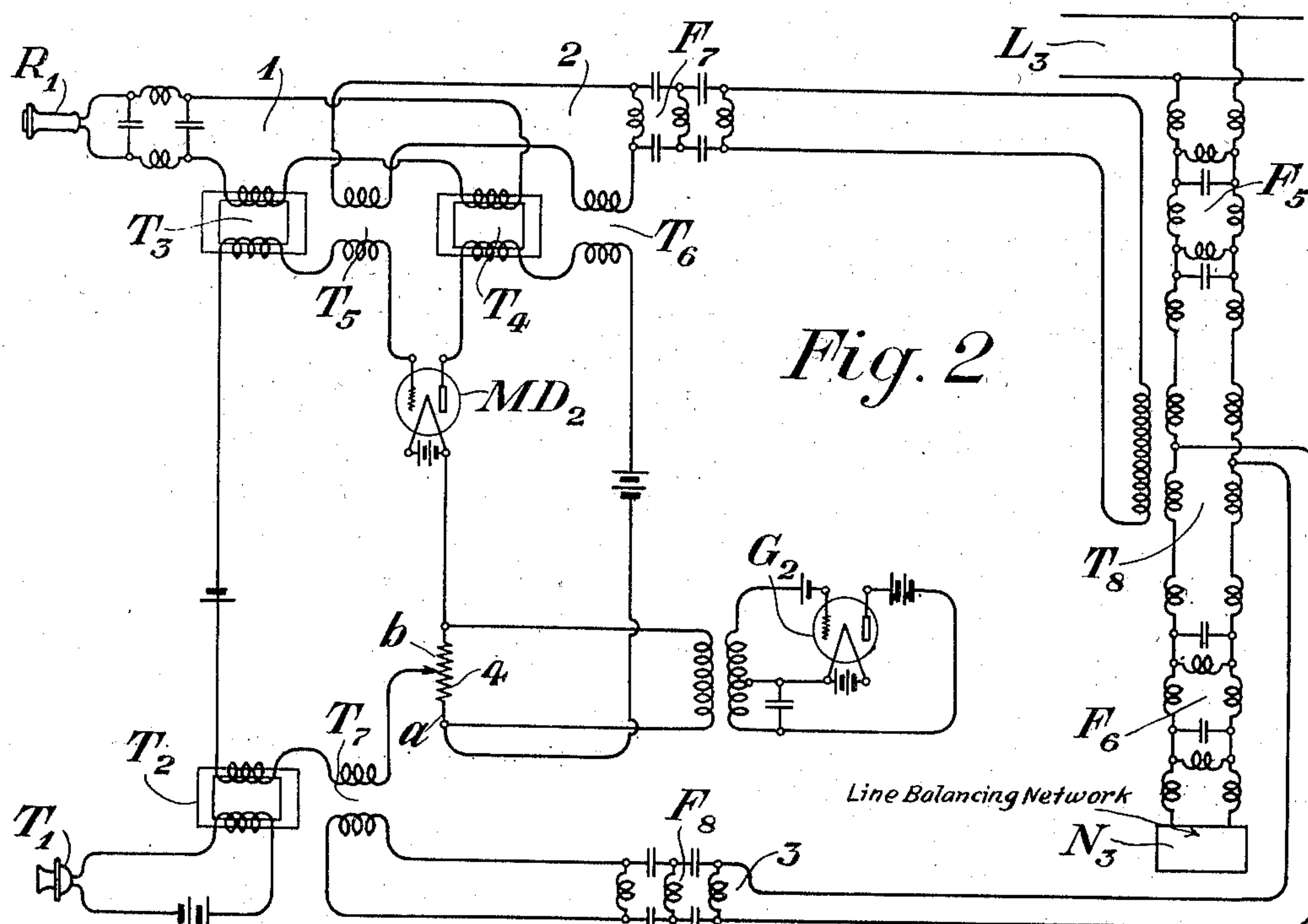
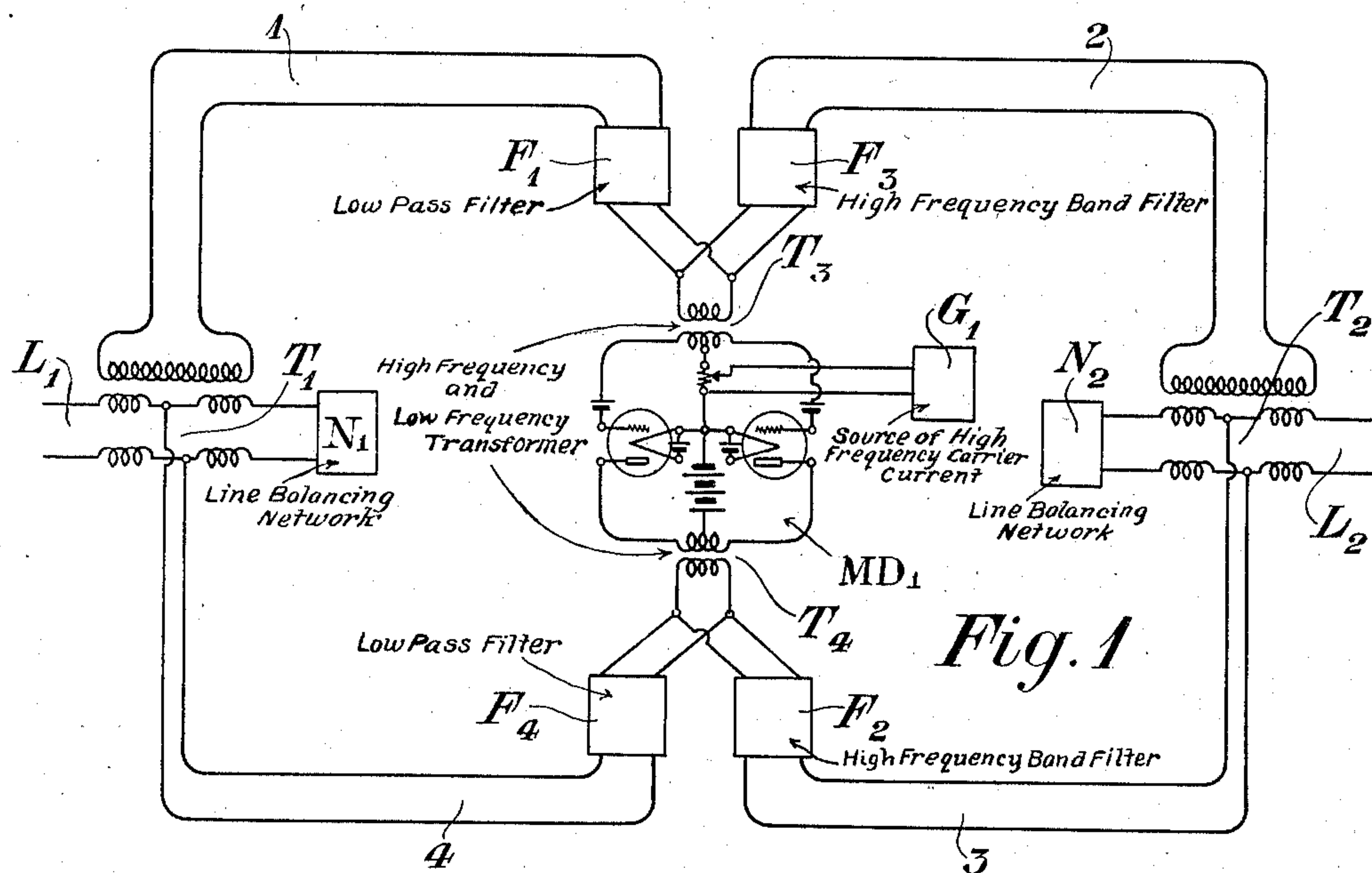
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H. A. AFFEL

HIGH FREQUENCY MULTIPLEX SIGNALING SYSTEM

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HIGH-FREQUENCY MULTIPLEX-SIGNALING SYSTEM.

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To all whom it may concern:

Be it known that I, HERMAN A. AFFEL, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvement in High-Frequency Multiplex-Signaling Systems, of which the following is a specification.

This invention relates to high frequency multiplex signaling systems, and more 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.

In the multiplex signaling systems heretofore used which employ a plurality of carrier frequencies for transmission of a plurality of low frequency signaling currents, it has been customary to insert in the transmitting and receiving paths of the terminal circuits of such system a translating circuit individual to each of said paths. It is the object of this invention to provide means whereby the low frequency signaling current and the high frequency received oscillations may be impressed upon a common translating circuit wherein the carrier oscillations will be modulated by the low frequency variations and also the high frequency received oscillations will be demodulated by the said carrier oscillations, the said translating circuit being so designed as to prevent the transmission of oscillations of the carrier frequency.

This invention will be better understood from the following description when read in connection with the attached drawing of which Figure 1 shows a terminal circuit employing a balanced duplex translating device, and Figure 2 shows a similar type of circuit in which the translating operations are performed by a single translating device.

In Figure 1 L_1 represents a line having low frequency signaling apparatus connected thereto by means of which low frequency signaling currents may be impressed upon the terminal circuit. The line L_1 is related to the terminal circuit by means of the triple-winding transformer T_1 having associated therewith a network N_1 which is adapted to balance the line L_1 . The low frequency branch 1 of the four-wire circuit has the low pass filter F_1 inserted therein which is adapted to pass low frequency

current to the translating circuit and to prevent high frequency oscillations from the branch 2 from passing through the circuit 1 into the low frequency line. The high frequency branch 3 of the transmitting path has therein a high frequency band filter F_2 which is adapted to transmit the modulated high frequency oscillations but prevent the passage of low frequency currents, resulting from the demodulation of the high frequency oscillations. L_2 represents a high frequency line over which the modulated high frequency oscillations are transmitted to and from the terminals at the opposite ends of the said line. The four-wire terminal circuit is related to the line L_2 by the triple-winding transformer T_2 which has associated with it a network N_2 adapted to balance the line L_2 . The high frequency branch 2 of the receiving path has therein a high frequency band filter F_3 which is adapted to transmit the high frequency oscillations to the translating circuit and to prevent the low frequency currents from branch 1 from passing to the line L_2 over the branch 2. The low frequency branch 4 of the receiving path has therein a low pass filter F_4 which is adapted to pass low frequency signaling current and to prevent the high frequency oscillations from the translating device from passing to the line L_1 . A transformer T_3 which may be of a type for the efficient transmission of both low frequency and high frequency currents, impresses these currents upon the circuit containing the translating device MD_1 . The out put side of the translating circuit is connected by the transformer T_4 with the low frequency branch and the high frequency branch of the receiving and the transmitting paths respectively. The unmodulated high frequency oscillations for the translating processes of the device MD_1 are supplied by a source G which may be any well known type of device for generating high frequency sinusoidal oscillations.

Having in mind the functions to be performed by the various parts just described, the invention will be clearly shown from the following description of the mode of operation of the circuit. Low frequency signaling currents set up in the line L_1 by the signaling apparatus associated therewith, will be impressed by means of the transformer T_1 upon the low frequency branch 1

of the transmitting path. This current will pass through the filter F_1 and be impressed by means of the transformer T_3 upon the translating circuit. The unmodulated high frequency oscillations from the source G , which are also impressed upon the translating circuit, will be modulated by the voice currents, and the modulated high frequency oscillations will be impressed by means of the transformer T_4 upon the high frequency branch 3 of the transmitting path. These modulated oscillations will pass through the high frequency band filter F_2 and be transmitted over the high frequency line L_2 to a terminal circuit at the opposite end of the said line which may be of the same type as that shown in Figure 1. Modulated high frequency oscillations received over the line L_2 will be impressed by the transformer T_2 upon the high frequency branch 2 of the receiving path. These oscillations will pass through the high frequency band filter F_3 and be impressed upon the translating circuit by means of the transformer T_3 . These oscillations will be demodulated by the carrier oscillations from the source G and the low frequency currents resulting from demodulation will pass through the low pass filter F_4 into the branch 4 of the receiving path and be impressed upon the line L_1 , actuating the low frequency signaling apparatus associated therewith.

It will be seen that this arrangement discloses a method and means whereby a single translating circuit performs the modulation and the demodulation of the currents in the transmitting and receiving paths of the four-wire terminal circuit which circuit is characterized by the use of networks to balance the two-wire line circuits, by the use of selective networks or filters in the two-wire paths of the four-wire circuit and also by the use of a balanced translating circuit in which the radiation therefrom of oscillations of carrier frequency is prevented.

Figure 2 shows a circuit arrangement in which low frequency signaling apparatus represented by a transmitter T_1 and receiver R_1 is connected with the terminal circuit by means of a four-wire arrangement instead of by a two-wire line such as L_1 in Figure 1 and, in which the translating circuit employs a single tube translating device MD_2 instead of the duplex arrangement as represented by MD_1 in Figure 1. Although the low frequency signaling apparatus is shown connected with the terminal circuit by a four-wire arrangement, the invention of Fig. 2 is not so limited inasmuch as the low frequency apparatus may be located in a two wire circuit, such as L_1 in Figure 1 which, in turn, may be connected with the four-wire circuit by means of a triple winding transformer such as is represented by T_1 in Fig. 1. In Figure 2 the transmitter T_1 is

connected by an input circuit with the input side of the translating circuit by means of the transformer T_2 which is adapted for the efficient transmission of low frequency signaling current. The receiver R_1 is connected by an output circuit with both the input side and the output side of the translating circuit by means of transformers T_3 and T_4 which also are efficient for low frequency currents. The high frequency output circuit 2 is also connected with both the input and the output sides of the translating circuit by means of the transformers T_5 and T_6 which are efficient for passing high frequency currents. A transformer T_7 , efficient for high frequency currents, connects the high frequency input circuit 3 with the translating circuit. A source of high frequency oscillations G_2 is adapted to impress the high frequency carrier current upon the translating circuit across the winding of a potentiometer. This source of high frequency oscillations is represented as a vacuum tube oscillator, but it is to be understood that any well known form of generator of high frequency sinusoidal oscillations may be used. The high frequency output and input circuits 2 and 3 respectively are connected with the high frequency transmission line L_3 by means of a triple-winding transformer T_8 . A high frequency band filter F_5 is connected between the transformer T_8 and the line L_3 in order to permit the passage of oscillations lying within the band of frequencies which this terminal circuit is adapted to transmit and receive. A network N_3 and filter F_6 are also connected with the transformer T_8 to balance the line L_3 and the filter F_5 , respectively.

If in the operation of this circuit the transmitter T_1 is actuated, low frequency signaling current will be set up in the input side of the translating circuit, which will modulate the high frequency oscillations from the source G_2 impressed across the potentiometer 4. The modulated oscillations will be transmitted from the output side of the translating circuit by the transformer T_6 to the high frequency output circuit 2. These oscillations will pass through the filter F_7 and be impressed upon the branch transmission circuit by the transformer T_8 , passing through the filter F_5 and over the line L_3 to the terminal at the opposite end of the latter line. Modulated high frequency oscillations received over the line L_3 will, assuming that they are of the proper frequency to pass through the filter F_5 , be impressed upon the high frequency input circuit 3 of the receiving path of the terminal circuit. These oscillations will pass through the high frequency filter F_8 which is designed to pass one band of frequencies but not the carrier and be impressed by the transformer T_7 upon the

input side of the translating circuit. These modulated high frequency oscillations will be demodulated by the carrier frequency from the source G_2 and the low frequency currents resulting from the process of demodulation will be transmitted by the transformer T_4 to the low frequency output circuit 1 of the receiving path, and thence to the receiver R_1 . The function of the transformers T_3 and T_5 inserted in the input side of the translating circuit, is to balance the translating circuit, so that the carrier oscillations will not be transmitted.

This will be more clearly understood if consideration be given to what occurs when the unmodulated carrier oscillations are impressed across the potentiometer 4 and no voice currents are impressed across the windings of the transformer T_2 . If we consider the condition of the translating circuit at an instant when the point a of the potentiometer is positive with respect to the point b , the potential of the plate and the negative charge of the grid is diminished, which allows a change in the transfer of energy from the plate to the filament. This flow of current in the output circuit of the translating device, which includes, of course, one of the windings of the transformer T_6 , induces a potential in the other winding of the same transformer. Simultaneously the grid current flowing through that winding of transformer T_7 connected with the grid circuit will induce a potential in the line winding of T_5 . Owing to the impedance of the windings of the transformers T_7 , T_2 , T_3 and T_5 connected in the grid circuit, the magnitude of the grid current is relatively small but by proper design of the transformers T_5 and T_6 the induced potentials in the line windings of T_5 and T_6 may be of such magnitude and applied in such manner as to neutralize, in consequence of which no unmodulated carrier current will flow in circuit 2.

If, however, low frequency signaling currents arising within the low frequency input circuit are impressed by the transformer T_2 upon the input side of the translating circuit, the balanced condition of the translating circuit is disturbed thereby and the modulated high frequency oscillations will be transmitted by the transformer T_6 to the high frequency output circuit 2. These high frequency oscillations will pass through the high frequency band filters F_7 and F_8 and be transmitted over the line L_3 or from an antenna. It will be seen from the foregoing description that this circuit arrangement provides means for the transmission and the reception of modulated carrier oscillations in which the processes of modulation and demodulation are performed by a single translating circuit com-

mon to the transmitting and receiving paths, the translating circuit employing a single tube and being so designed as to substantially suppress the transmission of the unmodulated high frequency oscillations. 70

Although this invention has been shown as being embodied in certain specific circuit arrangements; it is, of course, to be understood that it is capable of embodiment in other and different arrangements from those shown, without departing from the spirit of the appended claims. 75

What is claimed is:

1. In a signaling system adapted for the transmission and reception of signals of high frequency carrier oscillations the combination with input circuits and output circuits of a translating circuit having a single translating device and a source of unmodulated high frequency oscillations associated therewith, and a plurality of transformers connecting said input circuits and said output circuits with said translating circuit the said output transformers having their windings so disposed as to balance said translating circuit whereby the transmission thereof of unmodulated high frequency oscillations is substantially prevented. 80 85 90

2. In a signaling system, the combination of a translating circuit having associated therewith a translating device, and a source of unmodulated carrier oscillations adapted to be modulated by low frequency currents and to demodulate high frequency modulated currents, high frequency and low frequency input circuits adapted to impress modulated high frequency and low frequency currents respectively upon said translating circuit, output circuits adapted to receive the resulting low frequency and high frequency currents from the said translating circuit, and a plurality of high frequency and low frequency transformers connecting said output circuits with the said translating circuit and associated with the input and output sides of the said translating circuit, whereby the said translating circuit is balanced to substantially prevent the transmission through the said high frequency transformers of unmodulated high frequency oscillations. 95 100 105 110 115

3. In a signaling system, the combination of a unilateral translating circuit having associated therewith a source of unmodulated carrier current adapted to be modulated by low frequency currents and to demodulate high frequency modulated currents, low frequency signaling apparatus connected with the input and output sides of said translating circuit, high frequency output and input circuits, means for impressing low frequency currents from said low frequency apparatus and high frequency currents from said input circuit upon said translating circuit, and trans- 120 125 130

forming means for impressing the low frequency and high frequency output currents on the respective output circuits, the said latter means having its windings so disposed
5 with respect to the input and output sides of the said translating circuit as to substantially suppress the transmission of unmodulated high frequency oscillations.

4. The combination with a four-wire terminal circuit adapted for high frequency signaling having a translating circuit common to the transmitting and receiving paths of the said four-wire circuit, low frequency signaling apparatus connected with the input and output sides of the said translating circuit, a high frequency output and a high frequency input circuit carrying the high frequency currents from and to the said translating circuit, and coupling means associated with the output side of the said translating circuit and with the high frequency output circuit, the said coupling means being so proportioned and connected as to substantially prevent the transmission to the output circuit of unmodulated high frequency current.

5. In a signaling system, the combination with low frequency input and output circuits of high frequency input and output circuits, a translating circuit common to the said low frequency and high frequency circuits having connected therewith a source of high frequency carrier current, and a single thermionic device whereby the currents from the said low frequency and the said high frequency circuits may be modulated and demodulated respectively.

6. In a signaling system, the combination of low frequency and high frequency input circuits, high frequency and low frequency output circuits, a translating circuit common to the said input and output circuits having a thermionic device and a source of high frequency carrier current associated therewith, and means coupling together the input and output sides of the said thermionic device and the said high frequency output circuit, the said coupling means being so arranged and proportioned as to substantially neutralize and prevent the transmission to the output circuit of the unmodulated high frequency carrier current.

7. In a signaling system the combination of a translating circuit characterized by a single thermionic tube and a source of unmodulated high frequency oscillations, a source of low frequency variations, a source of high frequency modulated oscillations, means to impress said low frequency variations and said high frequency modulated oscillations on the translating circuit, and a low frequency receiving circuit and a high frequency transmission circuit coupled with the said translating circuit in such a manner

as to substantially suppress the transmission of the unmodulated high frequency oscillations.

8. In a signaling system, the combination of a translating circuit characterized by a single thermionic tube having connected therewith a source of unmodulated carrier current, a source of low frequency current for modulating said carrier current and a source of modulated high frequency current to be demodulated by the said carrier current, and low frequency and high frequency output circuits coupled with the said translating circuit whereby the resultant modulated and demodulated currents may be impressed upon their respective high frequency and low frequency output circuits, the said coupling being so arranged and proportioned as to substantially prevent the transmission therethrough of unmodulated carrier oscillations.

9. In a signaling system, the combination with a translating circuit having a thermionic device connected therewith, of a source of carrier frequency current connected therewith, a low frequency input circuit and a low frequency output circuit, each having means to couple them with the translating circuit, a high frequency input circuit and a high frequency output circuit, each having means to couple them with the translating circuit, the coupling means of the high frequency output circuit being so proportioned and connected as to substantially prevent the transmission therethrough of the unmodulated carrier current, and frequency selecting means connected with the high frequency input circuit designed to pass a frequency or frequencies other than the carrier frequency.

10. In a signaling system, the combination with a translating circuit having a thermionic device connected therewith, of a source of carrier frequency current connected therewith, a low frequency input circuit and a low frequency output circuit, each having means to couple them with the translating circuit, a high frequency input circuit and a high frequency output circuit, each having means to couple them with the translating circuit, the coupling means of the high frequency output circuit being so proportioned and connected as to substantially prevent the transmission therethrough of the unmodulated carrier current, and frequency selecting means connected with the high frequency input circuit and the high frequency output circuit to pass a frequency or frequencies other than the carrier frequency.

11. In a signaling system, the combination with a vacuum tube translating circuit comprising a plate circuit and a grid circuit, of a source of unmodulated carrier frequency current connected with the said translating circuit, a high frequency out-

put circuit, means to couple the said output circuit with the said plate and the said grid circuits, the said coupling means being so proportioned and poled as to substantially prevent the transmission of unmodulated carrier current to the said output circuit, means to couple the input circuit of the said translating circuit, and frequency selecting means connected with the said input circuit to prevent the transmission of unmodulated carrier current. 10

In testimony whereof, I have signed my name to this specification this 29th day of September 1919.

HERMAN A. AFFEL.