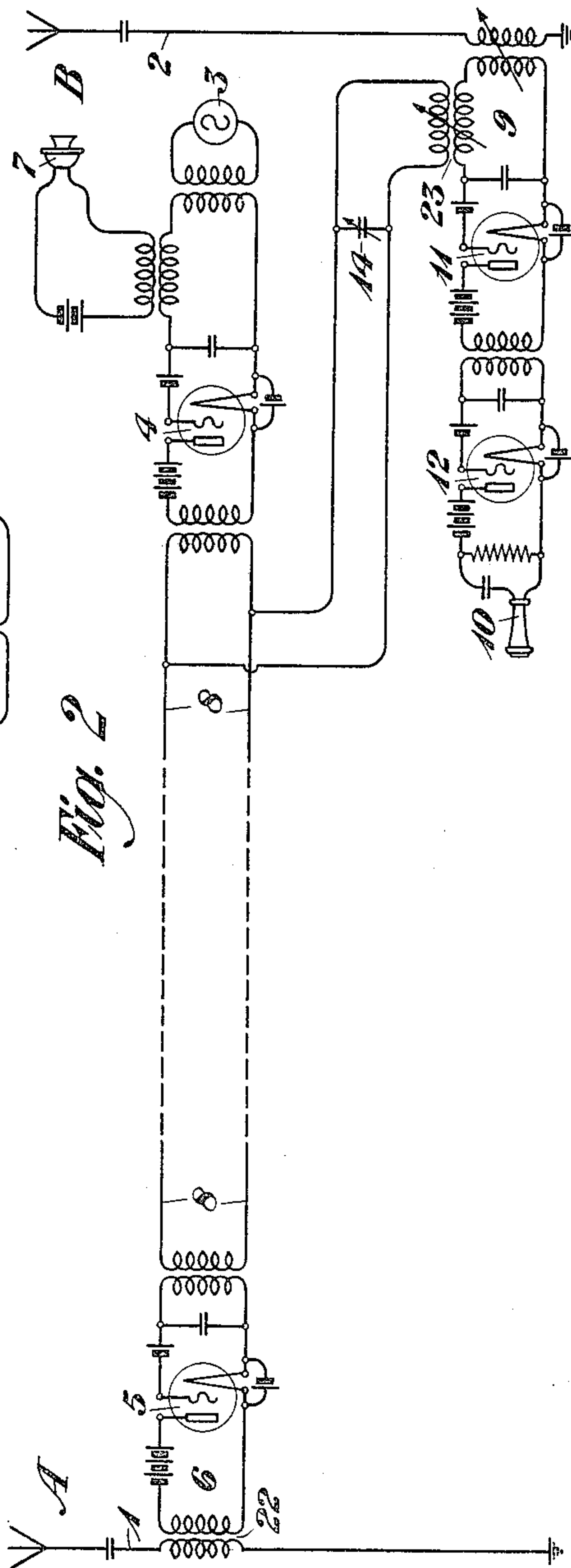
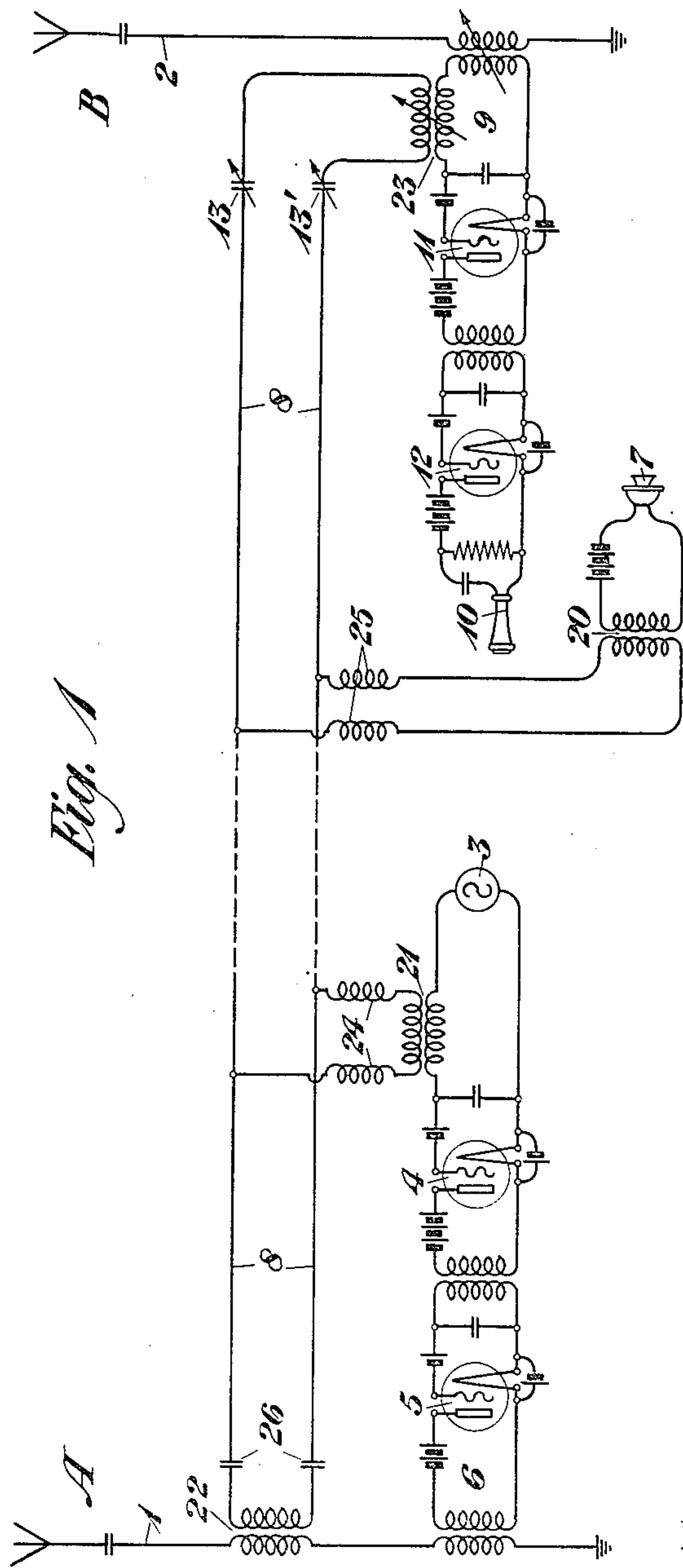


Feb. 6, 1923.

L. ESPENSCHIED,
SIGNALING SYSTEM.
FILED JUNE 21, 1919.

1,443,985



INVENTOR.
L. Espenschied
BY *g. v. 70*
ATTORNEYS.

UNITED STATES PATENT OFFICE.

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

SIGNALING SYSTEM.

Application filed June 21, 1919. Serial No. 305,763.

To all whom it may concern:

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

My invention relates to wireless signaling systems, and more particularly to a wireless duplex signaling system.

The object of the invention is to provide a system for the simultaneous transmission and reception of signals, and in particular to provide means for duplex communication between two stations.

For successful duplex operation it is necessary that the receiving arrangements be effectively protected from interference by the transmitting arrangements associated therewith; that is protected from what is known as "side tone." It is well known that in wireless telegraph and telephone systems the magnitude of the transmission current is enormously greater than that excited in the antenna by the received waves, the relative magnitude of the former with respect to the latter being of the order of one million to one. This enormous ratio renders inapplicable to wireless systems the means of transmission interference elimination which are successfully employed in ordinary wire telegraph and telephone systems. The wireless system is, however, differentiated in two important respects from the ordinary wire system; first, signals are transmitted on high frequency carrier waves of definite frequencies, this fact permitting of the employment of different frequencies for transmission and reception, and secondly resonant tuned circuits may be employed, thus rendering the receiving system selective with respect to the waves it is desired to receive.

In my present invention I provide for successful duplex operation by employing carrier waves of different frequency for transmission and reception, by providing separate antennae for transmitting and receiving, the said antennae being located a considerable distance from each other, and by neutralizing the inductive action of the transmitting system proper on the receiving system by means of balancing circuits.

My invention will be best understood by reference to the accompanying drawings in

which Figures 1 and 2 represent diagrammatic views of two forms and arrangements of apparatus and circuits embodying the invention.

In Fig. 1 reference numeral 1 designates a transmitting antenna and 2 a receiving antenna, the former being tuned to the frequency of transmission, that is, to the frequency of carrier waves generated by a high frequency generator 3 and the latter being tuned to the frequency of the signals to be received, that is to the reception frequency. An oscillation circuit 9 also tuned to the reception frequency and coupled to antenna 2 is associated with a telephone receiver 10 by means of a detector 11 and an amplifier 12. The receiving system is thus rendered selective to waves of the reception frequency so that waves of this frequency impinging on antenna 2 cause a comparatively strong response of the system, whereas waves of other frequencies, particularly the sending frequency, cause a relatively weak response thereof.

The effect of the waves of the transmission frequency on the receiving system is further reduced by locating the transmitting and receiving antennae at separate stations, A and B respectively, a considerable distance from each other so that the waves are considerably attenuated in passing from antenna 1 to antenna 2. A transmission line 8 is provided to connect the two stations and serves also to transmit telephonic currents originated by transmitter 7 at station B to the sending apparatus at station A, which apparatus comprises the high frequency generator 3, a modulating device 4, preferably of the vacuum tube type, and an amplifier 5 whose output circuit 6 is coupled to the antenna 1. Line 8 is associated with transmitter 7 by a transformer 20, and with modulator 4 by a transformer 21. The modulator combines the telephonic currents from transmitter 7 with the carrier currents generated by generator 3 to produce high frequency waves, which waves are amplified by the device 5 and impressed on antenna 1 by means of the output circuit 6 of the amplifying device.

The waves thus caused to be radiated from antenna 1 impinge on antenna 2 and set up oscillations in the receiving system, which oscillations, however, are comparatively weak because of the selectivity of the receiving

ing system and because of the distance between the two antennæ. To neutralize the remaining effect of the waves from antenna 1, I provide a balancing circuit extending from one station to the other, which circuit, as herein shown, comprises the transmission line 8, associated with antenna 1 by means of a transformer 22 and with the oscillation circuit 9 by means of a transformer 23. This circuit causes the high frequency currents in antenna 1 to set up currents in oscillation circuit 9, which currents by proper adjustment of the coupling transformer 23 and condensers 13 and 13' comprised in circuit 8, may be made equal and opposite to and thus neutralize the currents set up in circuit 9 by the waves transmitted from antenna 1 to antenna 2.

In this invention, therefore, the side tone in receiver 10 is overcome by rendering the receiving system selective, by locating the receiving and transmitting antenna at separate stations, a considerable distance from each other, and by neutralizing the remaining effect of the transmission waves by means of a conductive connection between the two stations.

Coils 24 and 25 are inserted between line 8 and transformers 21 and 20 respectively in order to prevent the high frequency currents in line 8 from being impressed on modulating device 4 and transmitter 7. Condensers 26 are inserted in line 8 in series with transformer 22 to prevent the low frequency voice current from transmitter 7 from being short-circuited by transformer 22.

When a third station, not shown on the drawing, is transmitting signals of the reception frequency to station B, the waves cause oscillations in antenna 2 which are strengthened by the resonance of the oscillation circuit 9. The waves also cause oscillations in the antenna 1, these oscillations, however, being very weak since the antenna fails to resonate at the reception frequency. The current induced in line 8 by antenna 1 being only a very small fraction of the antenna current, is exceedingly minute, and unable to cause an appreciable amount of interference in the oscillation circuit 9. The condition of balance which holds for signals received by station B from station A therefore does not hold for signals received from any other station. The circuits of my invention thus operate to prevent side tone but do not interfere with the reception of the signals.

The modification shown in Fig. 2 is similar to the arrangement shown in Fig. 1 except that the modulating device 4 and the high frequency generator 3 are located at station B. Line 8 in this arrangement transmits the modulated current to the amplifier 5, whereby it is impressed on antenna 1. The line is associated with the oscillation

circuit 9 by means of a connection comprising transformer 23 and condenser 14. This connection serves to impress part of the modulated current on oscillation circuit 9 to neutralize the effect of the waves from antenna 1, similarly as explained for Fig. 1.

Although in both of the above described forms and arrangements of my invention the apparatus is associated with the receiver and transmitter of a telephone, it is readily understood that it is not limited thereby, but applicable also to telegraphic or any other suitable type of signal receiving and transmitting apparatus. Many other changes and modifications may be made therein within the scope of the following claims, without departing from the spirit and scope of the invention.

What is claimed is:

1. A duplex signaling system comprising a transmitting apparatus, a receiving apparatus remote from the transmitting apparatus, means for tuning said apparatus to different frequencies, a conductive transmission line extending from the transmitting apparatus to the receiving apparatus, and means associated with said line and said transmitting and receiving apparatus for nullifying the effect on said receiving apparatus of the waves from the transmitting apparatus.

2. A duplex signaling system comprising a transmitting apparatus, a receiving apparatus remote from the transmitting apparatus, means for tuning said apparatus to different frequencies, a conductive transmission line extending from the transmitting apparatus to the receiving apparatus and means associated with said line and said transmitting and receiving apparatus for nullifying the effect on said receiving apparatus of the waves from the transmitting apparatus, and a telephone set having the transmitter and receiver thereof associated with said transmitting and receiving apparatus respectively.

3. The method of preventing interference between the transmitting and receiving circuits of a duplex signaling system which consists in reducing the effect of the transmission waves on the receiving circuit by locating the transmitting and receiving circuits at remote stations and by tuning the said circuits to different frequencies, and in neutralizing the remaining interference effect by conductively transmitting a portion of the transmission current to said receiving circuit and adjusting its phase.

4. In a duplex signaling system, a transmitting antenna, a receiving antenna remote from said transmitting antenna, a transmission circuit comprising said transmitting antenna and tuned to the transmission frequency, a receiving circuit comprising said receiving antenna and tuned to the reception

frequency, said transmission and reception frequencies differing from each other, and a conductive transmission line linking said receiving and transmitting circuits for causing a portion of the transmission current to flow through said receiving circuit.

5 In a duplex signaling system, the combination of a transmitting antenna, a receiving antenna remote from said transmitting antenna, a telephone set, a high frequency generator, a modulator, a circuit for impressing the current from said transmitter and said generator on said modulating device, means for impressing the modulated current from said device on said transmitting antenna, a receiving circuit comprising said receiving antenna tuned to the reception frequency, said frequency differing from the transmission frequency, and a conductive transmission line extending from the transmitting antenna to the receiving antenna for impressing a portion of said modulated current on the receiving circuit to neutralize the effect therein of the waves received from said transmitting antenna.

6. The method of preventing interference between the transmitting and receiving circuits of a duplex signaling system, which consists in reducing the effect of the transmission waves on the receiving circuit by locating the transmitting and receiving circuits at remote stations, and in neutralizing the remaining interference effect by conductively transmitting a portion of the current of said transmission circuit to said receiving circuit and adjusting its phase.

7. A duplex signaling system comprising a transmitting station and a receiving station associated therewith at a considerable distance, said stations being tuned to different frequencies, a conductive transmis-

sion line from the transmitting station to the receiving station to convey current impulses simultaneously with the wave transmission through the ether from the transmitting station to the receiving station, and adjusting means associated with said line to modify the current impulses therein so as to nullify the effect on the receiving apparatus of the said waves from the transmitting station.

8. The method of preventing interference between the separated transmitting and receiving stations of a duplex signaling system which consists in conveying current impulses through a conductor in addition to their conveyance through the ether, adjusting the amplitude and the phase of the current impulses in the conductor, and applying them at the receiving station to neutralize those received through the ether.

9. A duplex signaling system comprising a transmitting apparatus, a receiving apparatus remote from the transmitting apparatus, means for tuning said apparatus to different frequencies, telephone transmitting and receiving elements adjacent to the receiving apparatus, a conductive transmission line extending from the transmitting to the receiving apparatus and means associated with said line and said transmitting and receiving apparatus for nullifying the effect on said receiving apparatus of waves from the transmitting apparatus, said transmission line at the same time serving to conduct the outgoing low frequency telephone signals to the transmitting station.

In testimony whereof, I have signed my name to this specification this 20th day of June 1919.

LLOYD ESPENSCHIED.