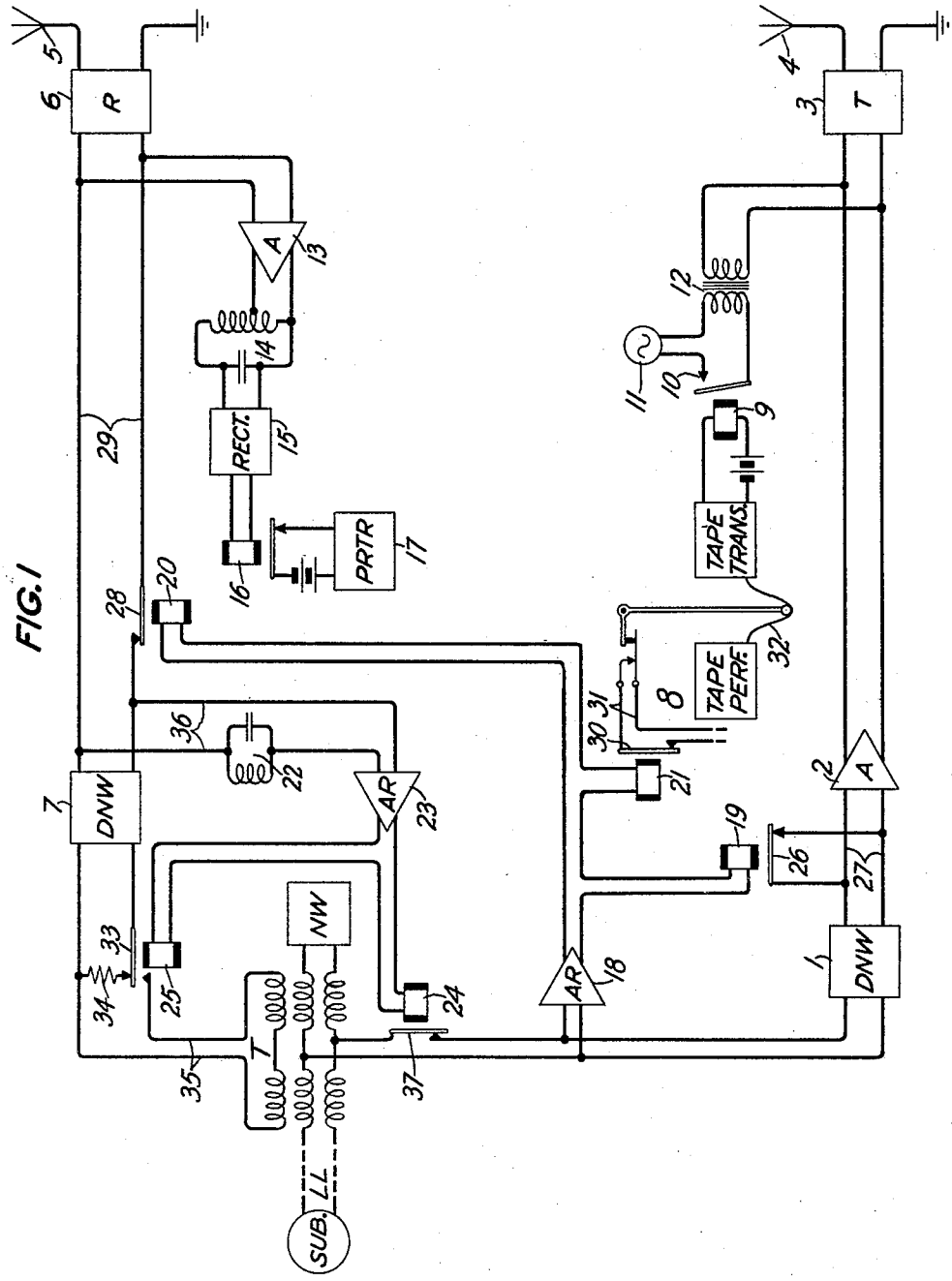
Jan. 31, 1933. R. A. HEISING 1,895,461

COMBINED RADIO TELEPHONE AND TELEGRAPH SYSTEM

Filed March 29, 1929 2 Sheets-Sheet 1

FIG. 1



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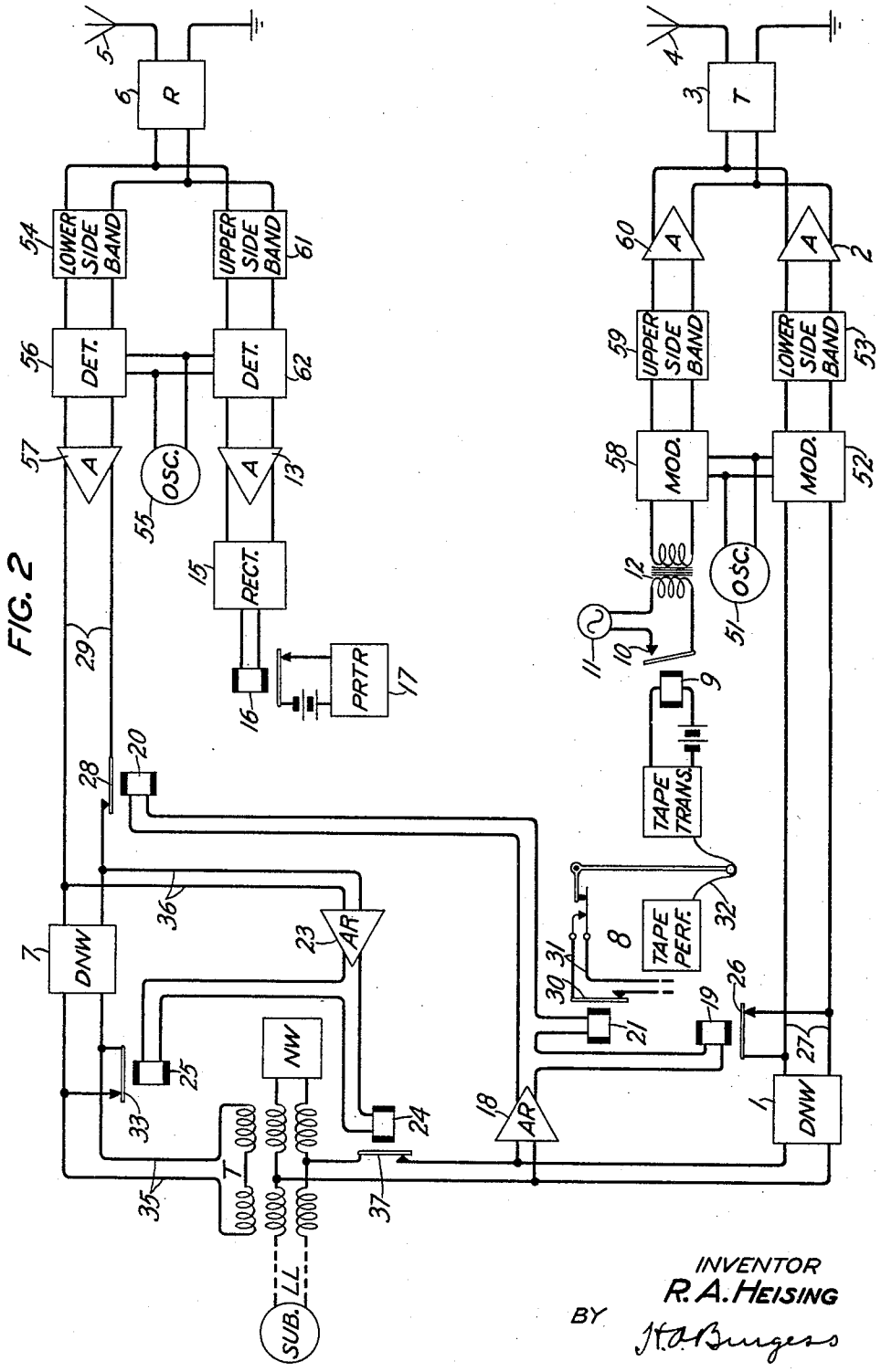

FIG. 2

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UNITED STATES PATENT OFFICE

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COMBINED RADIO TELEPHONE AND TELEGRAPH SYSTEM

Application filed March 29, 1929. Serial No. 351,037.

This invention relates to communication systems and more particularly to wave communication systems over which both telephone and code messages are transmitted.

A general object of the invention is to provide methods and means whereby a two-directional transmission system will transmit code signals in both directions whenever the signal paths are not being used for voice transmission.

Other objects, related to the main object, include the provision of methods and means for the transmission of code signals under speech control whether in a two-directional transmission system or in other types of systems, and the provision of switching means which are operated under control of the voice signals and which are positive in their operation and of simplified and relatively inexpensive construction.

The invention is applicable to any type of transmission system over which both code and voice currents are transmitted, but it has especial application to systems over which voice currents and printer telegraph signals are transmitted and the detailed description will refer specifically to such systems.

A feature of the invention is that voice currents at the sending station are utilized to energize the switching means to start and stop the transmission of printer telegraph signals, the voice current stopping the transmission of printer telegraph signals as soon as the system is used in that direction for the tranmission of speech and again starting the transmission of printing telegraph signals as soon as speech signals cease.

In one specific embodiment of the invention herein shown and described, the telegraph printer operates at a frequency within the regular transmission band.

A voice operated device at the sending station stops the printer sender when speech is being transmitted from that station. As soon as voice currents cease to be transmitted from the sending station the printer sender again starts sending.

At the receiving station a circuit antiresonant to the received demodulated telegraph frequency is inserted in the control circuit to prevent the telegraph signals from disabling the voice transmitter. The telegraph signals cannot reach the telephone receiver as the line to the telephone receiver is normally disabled. Incoming telephone signals disable the voice transmitter and put the telephone receiver in operative condition but do not disable the printer transmitter.

In the other specific embodiment of the invention herein shown and described, two separate modulators connected to the same oscillator are employed. The printer telegraph signals are modulated by one of the two modulators and the upper side band transmitted. The telephone signals are modulated by the other modulator and the lower side band transmitted. At the receiving station the upper and lower side bands are separated by filters and pass to separate detectors which are connected to the same oscillator. In this system the received printer telegraph signals do not pass to the telephone circuit.

The invention will be better understood by referring to the following description and accompanying drawings in which Fig. 1 represents a combined radio telephone and printer telegraph system suitable for continuous transmission in both directions, in which the voice currents control the starting and stopping of the printer at the transmitting station and the printing telegraph signals received disable the telephone receiver at the receiving station, and Fig. 2 represents a similar system in which the printer telegraph signals and voice signals are separated at the receiving station, thereby eliminating the necessity for disabling the telephone line at the receiving station.

Since the terminal stations may be identical in construction it has been deemed sufficient to illustrate only one terminal, and in the following description the manner in which signals are received at and transmitted from a distant station will be clear from reference to the single station shown.

In the particular system illustrated in Fig. 1 the voice transmitting system comprises the low frequency line LL, the delay circuit 1, the one-way amplifier 2, the radio transmit-

ter 3 and the antenna 4, by which combination the voice signals from the low frequency line LL are used to modulate current from an oscillator included in the radio transmitter 3, after which the modulated signal is transmitted from the antenna 4. The delay circuit 1 may be a low pass filter as shown in United States patents to Campbell, Nos. 1,227,113 and 1,227,114, granted May 22, 1917, although a delay circuit is not required to have the characteristics of a filter, or it may be of the type shown in United States patent to Arnold 1,565,302, granted Dec. 15, 1925. The one-way amplifier 2 and the radio transmitter 3 are of the type well known in the art.

The voice receiving system comprises the receiving antenna 5, the radio receiver 6, the delay network 7 and the low frequency line LL, by which means the voice signal waves received by the antenna 5 are detected to reproduce a signal frequency current which is transmitted through the low frequency line LL. The radio receiver 6 is of the type well known in the art. The delay network 7 is similar to the delay network 1.

The low frequency portions of the voice transmitting and receiving circuits are connected to the common line LL through a three-winding transformer T and network NW by means of which the connections may be made substantially conjugate.

The telegraph transmitting system comprises the telegraph printer sender 8, relay 9, switch 10, oscillator 11, transformer 12, radio transmitter 3 and antenna 4, by which means the printer telegraph signals make and break a circuit in which the oscillator 11 is located, producing signals which are used to modulate current from the oscillator included in the radio transmitter 3, after which the modulated signals are transmitted from the antenna 4. The telegraph printer 8 is of the start-stop type, well known in the art, having a tape perforator and a tape transmitter which normally operates by breaking the circuit to send the signals. The oscillator 11 is of the type well known in the art and is arranged to produce a signal within the voice frequency band.

The telegraph receiving system comprises the antenna 5, the radio receiver 6, one-way amplifier 13, network 14, rectifier 15, relay 16 and telegraph printer receiver 17, by which means the telegraph signals received by the antenna 5 are detected to reproduce a signal frequency current which is further rectified to produce a direct current to operate the telegraph printer receiver. The one-way amplifier 13, rectifier 15 and telegraph printer 17 are of the type well known in the art. The network 14 may be a tuned circuit of the type well known in the art, sharply tuned to the frequency of the received telegraph signal after it has been detected by the radio receiver 6 or it may be a narrow band filter of the type disclosed in United States patent to Campbell No. 1,227,113 granted May 22, 1917.

The switching system to prevent singing in the circuit due to voice signals, to start and stop the telegraph printer system, and the means employed to prevent the operation of said switching system by the telegraph signals may be considered as two separate parts, one of which is responsive to voice signals received from the low line LL and the other of which is responsive to signals from the receiving antenna 5. The switching system responsive to voice signals received from the low line LL comprises the amplifier-rectifier 18 and relays 19, 20 and 21. The switching system responsive to signals received by the antenna 5 comprises a circuit 22 which is anti-resonant to the received telegraph frequency and an amplifier-rectifier 23 and relays 24 and 25.

The operation of the switching system is as follows: When the telephone signal currents pass from the low frequency line LL through transformer T part of the signal current is shunted through an amplifier-rectifier 18 by a connection made at points in advance of delay circuit 1. The currents transmitted through this amplifier-rectifier operate relays 19, 20 and 21. Relay 19 actuates switch 26 away from its normal position as shown and removes a short-circuit from the line 27, connecting delay network 1 and one-way amplifier 2, making it possible for the voice currents to be transmitted to the radio transmitter 3. Relay 20 actuates switch 28, which is normally biased to the circuit-closing position, opening the circuit 29 and preventing signals received by the antenna 5 from being transmitted from the radio receiver 6 to the delay network 7 and to amplifier-rectifier 23. Relay 21 actuates a switch 30 which is normally biased to the circuit-closing position, and opens the so-called "auto-stop" circuit 31 within the printer which prevents the printer transmitter from operating after the conclusion of the transmission of whatever letter happens to be in the process of transmission. The functioning of this auto-stop circuit is well known in the art.

An explanation of the method employed in opening the circuit 31 by means of the tape 32 is contained in an article by John H. Bell, entitled "Printer telegraph systems", published in the Transactions of the American Institute of Electrical Engineers, volume 29, part 1, 1920, page 204. Preferably relays 20 and 21 are adjusted to operate before relay 19 in order to disable the receiving circuit before the transmitting circuit is in a condition to transmit and to stop the printer transmitter as soon as possible. The signal currents which pass through the delay

circuit 1, due to the time constant of this circuit do not reach the output end of the delay circuit until after relays 19, 20 and 21 have operated. As soon as these relays have operated the sending station is in condition for voice transmission in one direction only and for telegraph transmission in the other direction. The time lag of relays 19, 20 and 21 is preferably so chosen that the voice frequency circuit and the printer telegraph sender are not rendered operative and the voice circuit not rendered inoperative until after the last part of the voice signals has traversed the delay circuit 1, one-way amplifier 2, radio transmitter 3 to antenna 4.

The action occurring at the receiving station will be understood by considering the receiving side of Fig. 1. At the receiving station, assuming that telegraph signals are being received by the antenna 5 and transmitted to radio receiver 6, switch 28 being closed, allows part of the signals to be shunted through the delay network 7. These signals are prevented from reaching the low line LL since switch 33 in its normal position connects impedance 34 across the output side of delay network 7 to prevent reflections of the telegraph signals back through network 7 and also maintains an open-circuit in the line 35 to prevent the telegraph signals from reaching the low line LL. Part of these signals also reach the line 36 but as circuit 22 is anti-resonant to the received telegraph signals they are prevented from reaching the amplifier-rectifier 23 and the telegraph signals are therefore unable to disable the voice transmitter.

When telegraph signals received by antenna 5 are suddenly followed by voice signals from a distant station, the telephone signals will not operate the printer through the tuned circuit 14 but part of the voice signals will be transmitted through the delay circuit 7 and part of them will be shunted to the line 36 through the anti-resonant circuit 22 to the amplifier-rectifier 23. The current transmitted through the amplifier-rectifier 23 operates relays 24 and 25, thereby actuating switches 37 and 33. Relay 24 is preferably adjusted to operate before relay 25 so that the switch 37 will disconnect the voice transmitting circuit from transformer T before switch 33 removes the impedance 34 from across the line 35 and closes the circuit in line 35 of the telephone receiver to the transformer T. The receiving station is then in condition for voice transmission in one direction only and for telegraph transmission in the opposite direction.

The circuit 22 being anti-resonant only to the telegraph frequency will pass sufficient currents for frequencies in the voice band to the amplifier-rectifier 23 so that the relays 24 and 25 will be operated in the usual manner.

The time of transmission through the delay circuit 7 is so chosen that the voice signaling currents from the radio receiver 6 will not reach the output side of said delay circuit until the means for disabling the voice sending circuit and putting the voice receiving circuit in condition to receive have operated. Also the time lag of relays 24 and 25 is preferably such that they will not render the voice sending circuit operative or disable the voice receiving circuit until the last part of the received voice signal has traversed the delay circuit 7 and transformer T to the low frequency line LL.

Since the voice sending and voice receiving circuits are never in condition to transmit at the same time, singing of the apparatus is impossible and it is also impossible for a voice signal current to be reflected back to the receiver of the sending station.

To prevent the telegraph signal currents from being reflected back in the telegraph receiver of the sending station the frequency of oscillator 11 at the sending station can be made different from the corresponding oscillator at the receiving station. Since, as explained above, the circuit 14 which is located between the one-way amplifier 13 and the rectifier 15 is sharply tuned to the frequency of the telegraph signal transmitted from the distant station, no interference will be encountered. As a further precaution against interference the transmitting antenna 4 may be located at a considerable distance from the receiving antenna 5 and both of them constructed in the manner well known in the art to make them directional.

Fig. 2 illustrates a modification of Fig. 1 which is preferably employed when the radio system is of the short wave single side band type.

The voice transmitting system comprises the low frequency line LL, the delay circuit 1, the oscillator 51, the modulator 52, the filter 53, the one-way amplifier 2, the radio transmitter 3 and the antenna 4, by which combination the voice signals from the low frequency line LL are used to modulate current from the oscillator 51, one side band of the resultant wave is selected to the exclusion of the other and the carrier, the side band selected is amplified and the band used to modulate current from another oscillator included in the radio transmitter 3, after which the signal is transmitted from the antenna 4. The filter 53 may be of any well known form, as, for example, a filter of the band type disclosed in United States patents to Campbell, Nos. 1,227,113 and 1,227,114, granted May 22, 1917. It is designed to transmit only the frequencies in the lower side band and to substantially suppress the other frequencies.

The voice receiving system comprises the receiving antenna 5, the radio receiver 6,

the filter 54, oscillator 55, the detector or demodulator 56, the one-way amplifier 57, the delay network 7 and the low frequency line LL, by which means the voice signal waves received by the antenna 5 are detected to reproduce a signal frequency current which is transmitted through the low frequency line LL. The filter 54 is similar to the filter 53.

The telegraph transmitting system comprises the telegraph printer sender 8, relay 9, switch 10, oscillator 11, transformer 12, oscillator 51, modulator 58, filter 59, one-way amplifier 60, radio transmitter 3 and antenna 4, by which means the printer telegraph signals make and break a circuit in which the oscillator 11 is located, producing signals which are used to modulate current from the oscillator 51, and the opposite side band selected from that which is selected for the voice signals, the band amplified and used to modulate current from another oscillator included in the radio transmitter 3, after which the modulated signals are transmitted from the antenna 4.

The telegraph receiving system comprises the antenna 5, the radio receiver 6, filter 61, detector 62, one-way amplifier 13, rectifier 15, relay 16 and telegraph printer receiver 17, by which means the telegraph signals received by the antenna 5 are detected to reproduce a signal frequency current which is further rectified to produce a direct current to operate the telegraph printer receiver.

The method employed to make possible the sending and receiving of both telephone and telegraph signals over the same system, as illustrated in Fig. 2, is similar to the methods disclosed in United States patents to H. S. Osborne No. 1,361,487 and No. 1,361,488, granted December 7, 1920 and United States patent to L. Espenschied No. 1,361,522, granted December 7, 1920. However since it is impossible to transmit, simultaneously, more than one signal from the same radio transmitter and obtain the maximum power output for either signal, switching means have been provided so that the maximum power output of the radio transmitter can be utilized for both the telephone and telegraph signals.

The switching system to prevent singing in the circuit due to voice signals, to start and stop the telegraph printer system, and the means employed to prevent the operation of said switching system by the telegraph signals may be considered as two separate parts, one of which is responsive to voice signals received from the low line LL and the other of which is responsive to signals from the receiving antenna 5. The switching system responsive to voice signals received from the low line LL comprises the amplifier-rectifier 18 and relays 19, 20 and 21. The switching system responsive to signals received by the antenna 5 comprises an amplifier-rectifier 23 and relays 24 and 25.

The operation of the switching system is as follows: When the telephone signal currents pass from the low frequency line LL through transformer T part of the signal current is shunted through the amplifier-rectifier 18 by a connection made at points in advance of delay circuit 1. The currents transmitted through this amplifier-rectifier operate relays 19, 20 and 21. Relay 19 actuates switch 26 away from its normal position as shown and removes a short-circuit from the line 27 connecting delay network 1 and one-way amplifier 2, making it possible for the voice currents to be transmitted to the radio transmitter 3. Relay 20 actuates switch 28, which is normally biased to the circuit-closing position opening the circuit 29 and preventing signals received by the antenna 5 from being transmitted from the radio receiver 6 to the delay network 7 and to amplifier-rectifier 23. Relay 21 actuates a switch 30 which is normally biased to the circuit-closing position, and opens the so-called "auto-stop" circuit 31 within the printer which prevents the printer transmitter from operating after the conclusion of the transmission of whatever letter happens to be in the process of transmission. Preferably relays 20 and 21 are adjusted to operate before relay 19 in order to disable the receiving circuit before the transmitting circuit is in a condition to transmit and to stop the printer transmitter as soon as possible. The signal currents which pass through the delay circuit 1, due to the time constant of this circuit do not reach the output end of the delay circuit until after relays 19, 20 and 21 have operated. As soon as these relays have operated the sending station is in condition for voice transmission in one direction only and for telegraph transmission in the other direction. The time lag of relays 19, 20 and 21 is preferably so chosen that the voice frequency circuit and the printer telegraph sender are not rendered operative and the voice circuit not rendered inoperative until after the last part of the voice signals has traversed the radio transmitter 3 to antenna 4.

The action occurring at the receiving station will be understood by considering the receiving side of Fig. 2. At the receiving station, assuming that telegraph signals are being received by the antenna 5 and transmitted to radio receiver 6, switch 28 being closed, allows part of the signals to be shunted through the delay network 7. These telegraph signals are prevented from reaching the low line LL since the band pass filter 54 prevents the telegraph signals from reaching the detector 56.

When telegraph signals received by antenna 5 are suddenly followed by voice signals from a distant station, the telephone sig-

nals will not operate the printer through the band pass filter 61 but will be transmitted through the band pass filter 54, detector 56 and one-way amplifier 57. Part of the voice signals will be transmitted through the delay circuit 7 and part of them will be shunted to the line 36 to the amplifier-rectifier 23. The current transmitted through the amplifier-rectifier 23 operates relays 24 and 25, thereby actuating switches 37 and 33. Relay 24 is preferably adjusted to operate before relay 25 so that the switch 37 will disconnect the voice transmitting circuit from transformer T before switch 33 removes the short from across the line 35. The receiving station is then in condition for voice transmission in one direction only and for telegraph transmission in the opposite direction.

While two specific embodiments of the invention have been shown and described in detail, it is to be understood that the invention is generic in character and is not to be construed as limited to these particular embodiments since numerous modifications thereof may be made by persons skilled in the art without departing from the spirit of applicant's invention, the scope of which is to be determined by the appended claim.

What is claimed is:

In a two-way two-channel carrier transmission system comprising normally inoperative telephone transmitting apparatus and normally operative telegraph signaling apparatus at a sending station, a source of carrier frequency waves, the carrier currents from said source of carrier frequency waves adapted to be modulated by signaling currents from said telephone transmitting apparatus and by signaling currents from said telegraph transmitting apparatus, said telephone transmitting apparatus and telegraph transmitting apparatus adapted to be associated with one channel for transmission in the same direction, normally inoperative telephone receiving apparatus and normally operative telegraph receiving apparatus at a receiving station associated with said channel, means adapted to demodulate said received carrier frequency waves, similar apparatus associated with said other channel for transmission in the other direction, voice-operated relays associated with each channel to prevent said telegraph transmitting apparatus from becoming operative when said telephone currents are being transmitted thereover, and means to prevent signals from said telegraph apparatus from reaching said telephone receiving apparatus.

In witness whereof, I hereunto subscribe my name this 27th day of March, 1929.

RAYMOND A. HEISING.