

March 28, 1933.

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1,902,893

SIGNALING SYSTEM

Original Filed March 1, 1928

2 Sheets-Sheet 1

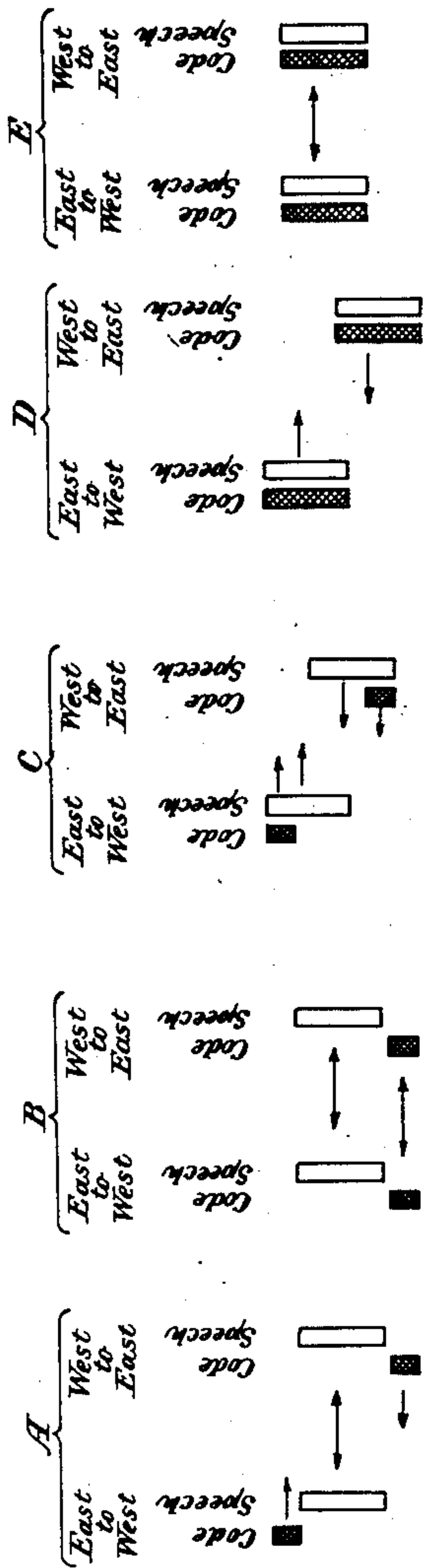


Fig. 1

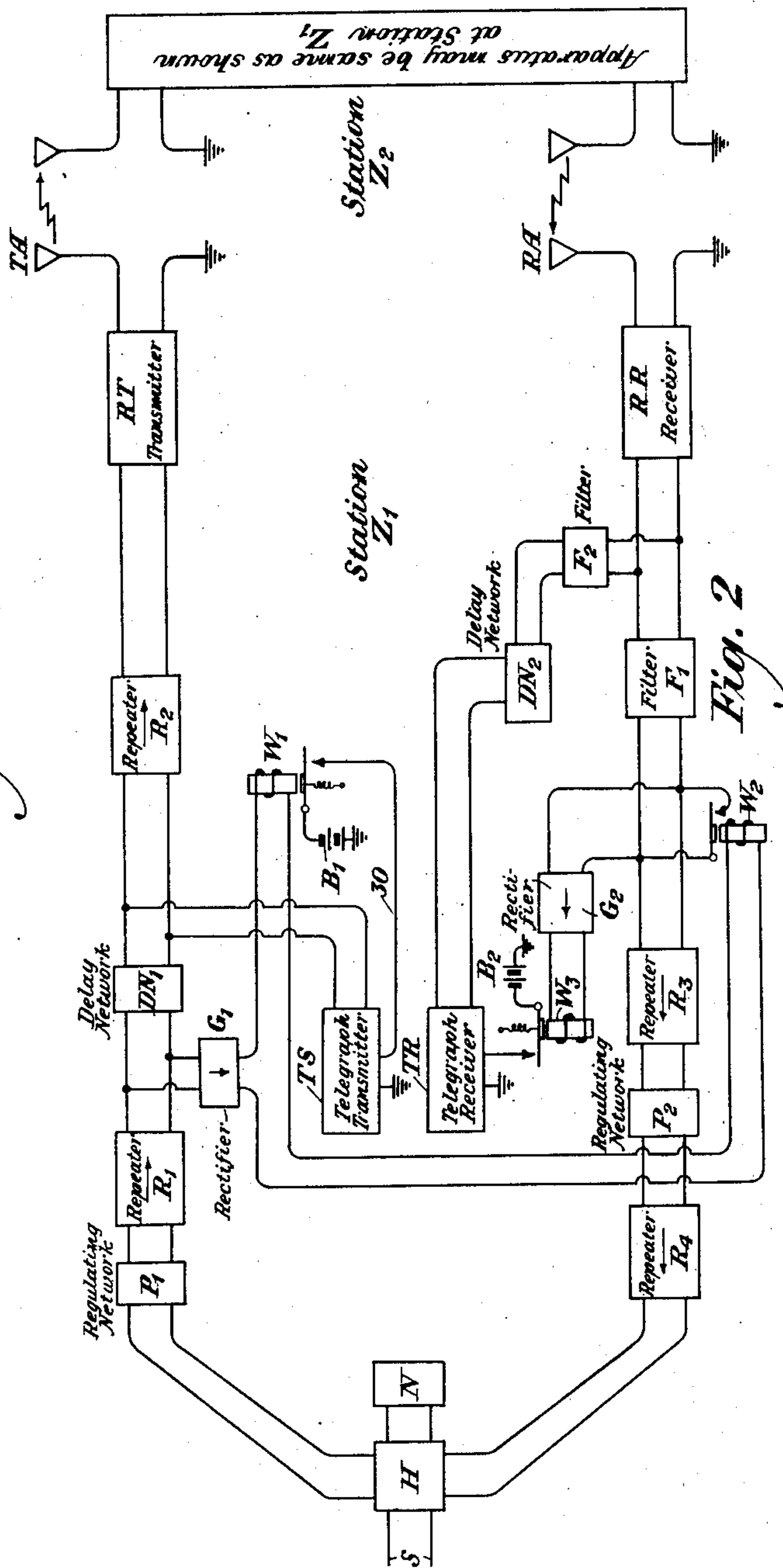


Fig. 2

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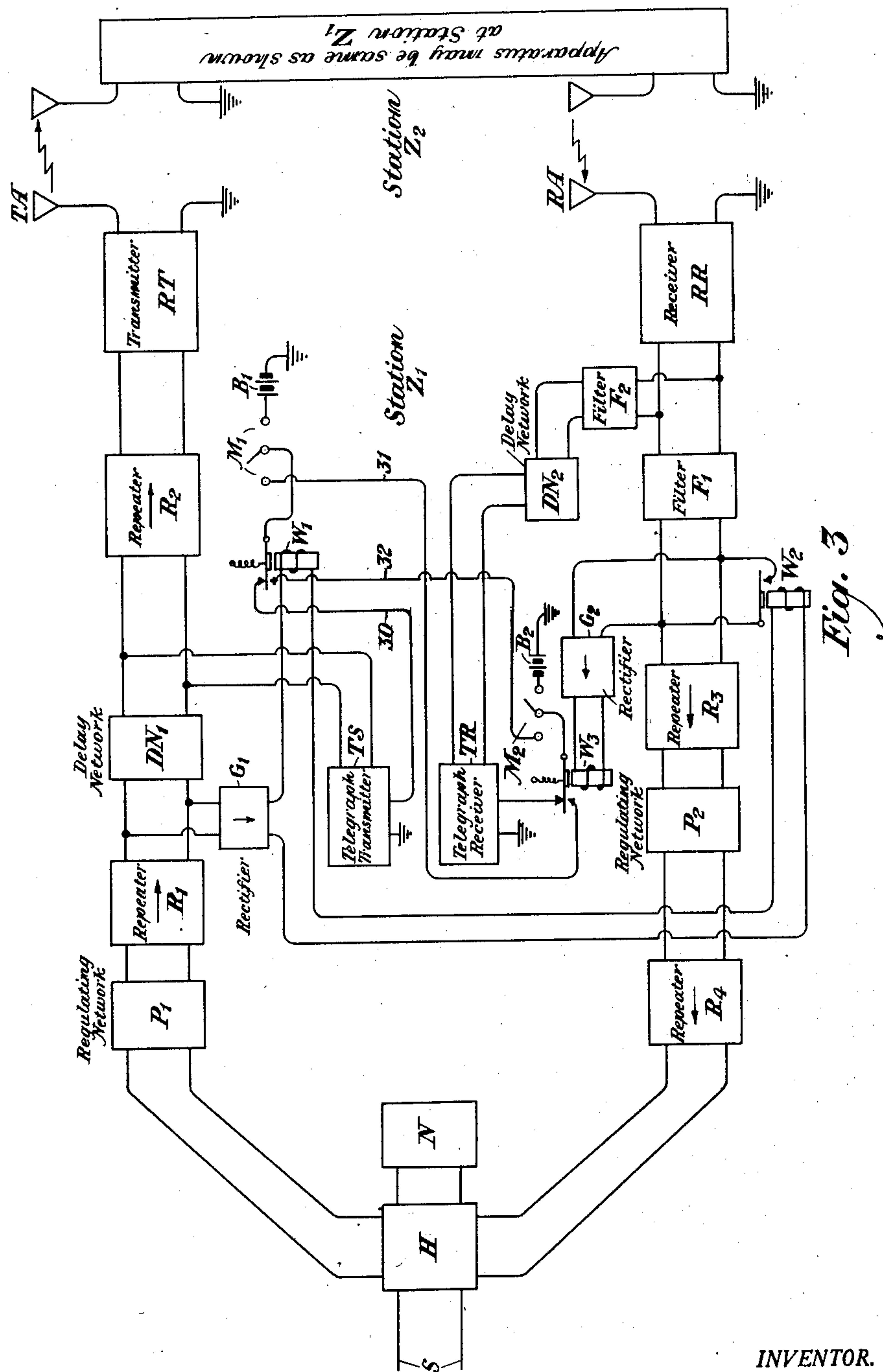
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SIGNALING SYSTEM

Application filed March 1, 1928, Serial No. 258,373. Renewed May 27, 1929.

This invention relates to signaling systems, and more particularly to such systems which employ high frequency waves modulated in accordance with speech or code or picture transmission signals or the like.

In the present signaling systems which are adaptable for use in transoceanic communication, two or more stations are employed, separated by considerable distances. It is frequently the practice to permit one station to transmit signals while another station receives the signals, and vice versa. At one of the stations the sending equipment may be operative while the receiving equipment is inoperative, and at another of the stations the receiving equipment may be inoperative while the sending equipment is operative. Thus, only part of the apparatus at any one station may be continuously employed; sometimes it is the sending equipment and other times it is the receiving equipment. From an economic standpoint this is undesirable and inefficient.

This invention is intended to provide arrangements in signaling systems for interspacing one form of signals, i. e., speech signals, with another form of signals, i. e., code or picture transmission signals. Thus, when speech signals are being transmitted from one station, interspacing signals may be sent from another station in order that the transmitting equipment as well as the receiving equipment may be operative at both stations simultaneously. Accordingly, practically all of the equipment, i. e., transmitting and receiving equipment, may be operated continuously, transmitting, for example, speech signals and receiving either code or other signals, or vice versa. By such continuous operation of the equipment at one or more of the signaling stations it is apparent that the efficiency will be greatly increased.

It is, therefore, one of the objects of this invention to provide arrangements at a signaling station so that when signals are being transmitted therefrom interspacing signals may be received at that station. Thus, it is intended to provide an arrangement whereby when speech signals are being transmitted from a signaling station, telegraph or pic-

ture transmission signals or any other signals may be received at that station.

It is another object of this invention to provide apparatus at a signaling station such that when speech signals are being transmitted therefrom interspacing signals, i. e., code or picture or other signals, may not be simultaneously transmitted.

It is another object of this invention to provide an arrangement at a signaling station whereby when speech signals are being transmitted therefrom, receiving means are rendered operative for the reception of code or picture or other signals.

It is a further object of this invention to provide arrangements at each of a plurality of signaling stations such that when no speech signals are being transmitted, code or picture or other signals may then be transmitted as desired.

It is a further object of this invention to provide apparatus at one or more signaling stations such that preference may be established for the simultaneous transmission of speech signals and reception of interspacing signals, or for the simultaneous reception of speech signals and transmission of interspacing signals.

And it is a further object of this invention to provide arrangements at two or more signaling stations such that when it is preferred to transmit speech signals and to receive interspacing signals, another of the stations associated with the system may be permitted to receive speech signals and to transmit interspacing signals, or vice versa.

While this invention will be pointed out with particularity in the appended claims, the invention itself, both as to its further objects and features, will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawings, in which Figure 1 illustrates certain frequency relationships adaptable in carrying out the principles of this invention; Fig. 2 shows apparatus suitable for carrying out certain of the features of this invention; and Fig. 3 represents apparatus suitable for carrying out still other features of this invention.

To provide for the transmission of either speech signals or interspacing signals, it is apparent that two transmitters may be required at a signaling station. If two transmitters are employed, there may be need for two transmission channels or for their equivalent. As is well known in the art, a duplexed circuit exhibiting a condition of balance represents the equivalent of two individual transmission channels. Fig. 1 of the drawings illustrates certain frequency relationships suitable for carrying out the principles of this invention.

A. It may be desirable to employ a single channel, i. e., a channel having a definite position in the frequency spectrum, for the transmission or reception of speech or voice frequency signals. In that event it may be desirable to locate channels for the transmission and reception of interspacing signals, i. e., telegraph or other signals, on either side of the speech channel. Thus, it may be desirable to employ a narrow band extending upwardly from the upper limit of the speech band for the transmission of the interspacing signals in one direction, and another narrow band located in the spectrum below the speech band for the transmission of interspacing signals in the opposite direction, or vice versa.

B. If it is desirable to employ the same frequency components for the transmission of speech signals in opposite directions, it may be advisable to employ a single channel for interspacing signals which may be located below or above the speech channel, as found desirable. Thus, a single channel may be employed for the transmission of interspacing signals in opposite directions, in which event voice frequency relays or other arrangements may be required to associate the transmitter of interspacing signals with said channel for transmission in one direction when the transmitter of voice frequency signals is transmitting energy in the opposite direction.

C. It may be desirable to employ bands for the transmission of speech signals in opposite directions which are offset or displaced with respect to each other. Thus, the band for the transmission of speech in one direction may be somewhat higher than the band for the transmission of speech in the opposite direction. Two distinct interspacing channels may be employed for the interspacing signals, one of which may be located in the upper portion of the higher speech band while the other may be located in the lower portion of the lower speech band. The upper interspacing channel, may, if desired, be adjacent to the voice channel employed for the transmission of speech signals in a direction opposite to the direction of transmission of the interspacing channel, as shown. Similarly, the lower interspacing channel may, if desired, be adjacent to the upper speech channel transmitting signals in a direction opposite to

that interspacing channel, as shown. Accordingly, the interspacing signals in one direction will not interfere with the voice signals in the opposite direction. The entire frequency range employed for both kinds of signals may not extend beyond a band having the additive frequency components of one speech channel and one interspacing channel.

D. Two distinct voice frequency bands may be employed for transmission in opposite directions, one band transmitting either voice or interspacing signals in one direction and the other band transmitting voice or interspacing signals in the opposite direction. It will, indeed, be necessary to provide arrangements for selectively associating the speech current transmitter or the interspacing current transmitter with the operating equipment for the transmission of speech or interspacing signals in either direction.

E. It is possible to provide a system in which a single voice band is employed for the simultaneous transmission of speech and interspacing signals in opposite directions. Such a system may, with some difficulty, be accomplished by employing balancing means, as is well known in the art. Speech signals may be transmitted from one station while interspacing signals are being transmitted from another station in the opposite direction, simultaneously.

Fig. 2 shows a signaling system comprising two stations Z_1 and Z_2 which may be located a considerable distance apart and which may be operated with a single band for the transmission of speech signals in opposite directions and with a pair of channels on either side of that voice band for the transmission of interspacing signals in opposite directions, as described in paragraph A hereinabove. At station Z_1 there is a line S over which voice currents may flow. Line S may lead to a hybrid coil arrangement which may be constructed in any well known manner, although it may preferably comprise three windings, two of which connect a balancing network N with line S, while the third winding, coupled to the first two, may lead to a regulating network P_1 . This regulating network may be any arrangement capable of controlling the voltage of the current passing there-through. A suitable arrangement may comprise a potentiometer having an element of resistance the terminals of which represent its input terminals, while a regulating element may be associated with the resistance for controlling the magnitude of the current or voltage at its output terminals.

The regulating network P_1 is connected to a repeater R_1 , which may be any arrangement suitable for amplifying currents, preferably such currents as lie within the voice frequency range. One form of repeater may include one or more vacuum tubes which are suitably coupled and arranged in tandem, as

is well known in the art. The repeater R_1 may be connected to a delay network DN_1 which may be employed for delaying the transmission of signals therethrough by a predetermined interval of time. The delay network may be connected to another repeater R_2 which may be of the same general type as repeater R_1 , though preferably an arrangement which may conveniently amplify not only voice currents but also currents corresponding to telegraph signals representing one form of interspacing signals. The repeater R_2 may be connected to a radio transmitter RT which may be of any well known type, preferably one of the vacuum tube type. Such a transmitter should be designed to provide high frequency currents upon which the voice frequency signals as well as the interspacing signals may become superimposed or modulated. Thus, the radio transmitter RT may receive voice frequency signals as well as interspacing signals and beat these signals with locally supplied high frequency current, i. e., a carrier wave, in order to produce one or more sidebands corresponding to the voice frequency signals or to the interspacing signals, as may be the case, with or without the carrier wave. These modulated high frequency currents may be transmitted through space after becoming impressed upon a transmitting antenna TA , connected or otherwise coupled to the radio transmitter RT .

Modulated high frequency waves transmitted from station Z_2 may be impressed upon a receiving antenna RA at station Z_1 . Receiving antenna RA is connected or otherwise coupled to a radio receiver RR . The radio receiver may be any well known type of receiver, preferably one capable of supplying current of the same frequency as is employed at station Z_2 in modulation, in order that the received currents may become suitably demodulated, yielding either voice frequency signals or interspacing signals, as the case may be in transmission. The radio receiver RR is connected to a filter F_1 which may be of any well known type, preferably of the type disclosed in a patent to G. A. Campbell, No. 1,227,113, dated May 22, 1917. Filter F_1 may be designed to freely transmit voice frequency currents while substantially suppressing all other currents resulting from demodulation at the radio receiver. Filter F_1 may also be connected to a repeater R_3 which may be of any well known type and which may be the same as repeater R_1 , referred to hereinabove. Repeater R_3 may be connected to a regulating network P_2 which may also be of any well known type, preferably a network such as P_1 , referred to hereinabove. The regulating network P_2 may be connected to another repeater R_4 and it will be apparent that this repeater may be the same as repeater R_1 . Two leads extend from

repeater R_4 to the midpoints of the two windings of the hybrid coil arrangement H which may be serially connected to the balancing network N . Any voice currents amplified by repeater R_4 will reach line S , it being assumed that the balancing network establishes a high degree of balance.

The repeater R_1 is not only connected to the delay network DN_1 but it is also connected to a rectifier G_1 , rectifier G_1 being in parallel with the delay network DN_1 . This rectifier may be of any well known type, preferably one producing a substantial direct current whenever voice frequency signals are impressed thereon after their passage through repeater R_1 . The output of the rectifier G_1 is supplied to the windings of two relays W_1 and W_2 , which may be connected in series relationship. Voice currents reaching rectifier G_1 cause a flow of current through the windings of relays W_1 and W_2 sufficient to cause their operation, thereby attracting their associated armatures.

A telegraph transmitter TS may also be connected to repeater R_2 and may cause the transmission of telegraph signals to repeater R_2 when relay W_1 is not operated. Telegraph transmitter TS may be of any type well known in the art. Any signals generated thereby pass through the repeater R_2 to the transmitter RT , where the signals become superimposed upon a current of high frequency for transmission through space. The current required to operate the telegraph transmitter TS may be derived from a battery B_1 , which may be any well known source of direct current. When relay W_1 is not energized, its armature is released so that current may flow from battery B_1 over a lead supplying the current required to operate the telegraph transmitter TS . However, when relay W_1 does operate, battery B_1 becomes disconnected from the telegraph transmitter TS so that no telegraph signals may be generated.

A filter F_2 is connected to the radio receiver RR which may be of the same type as filter F_1 , although it may preferably be so designed as to freely transmit the currents derived from the radio receiver RR upon demodulation, which correspond to the telegraph or interspacing signals and it may substantially suppress the transmission of all other currents. Filter F_2 is connected to a delay network DN_2 which may be of the same general type as the network DN_1 , preferably any circuit or network capable of establishing a delay in the transmission of signals for any predetermined time interval. The delay network DN_2 may be connected to a telegraph receiver TR which may be of any well known type, preferably of the type known in the art as a "printer", whereby received telegraph or other interspacing signals may become recorded.

The filter F_1 is connected to a rectifier G_2 as well as to the repeater R_3 . The rectifier G_2 may be of the same general type as rectifier G_1 . Voice frequency currents which reach rectifier G_2 after passing through filter F_1 may cause the flow of a substantial direct current sufficient to operate a relay W_3 , relay W_3 being connected or otherwise coupled to rectifier G_2 . When relay W_3 is not operated, its armature is released so that current may flow from a battery B_2 , representing any direct current source, through the telegraph receiver TR, causing its operation. When relay W_3 is operated, however, battery B_2 is disconnected from the telegraph receiver TR, and accordingly, no telegraph or other signals may be received thereby.

When voice frequency signals are being transmitted from station Z_1 to another station, such as station Z_2 , these voice frequency signals pass through the regulating network P_1 and through the repeater R_1 . Some of the amplified currents reach the delay network DN_1 , while the rest of these currents reach the rectifier G_1 . The energy reaching the network DN_1 passes through the repeater R_2 and becomes superimposed upon high frequency currents at the radio transmitter RT for transmission to the distant station. The rectified currents, however, cause the operation of relays W_1 and W_2 . Relay W_1 effectively disconnects the telegraph transmitter TS so that no telegraph signals may be generated for transmission to the distant station. Relay W_2 , having an armature which is connected so as to shunt the output of filter F_1 , prevents any voice frequency signals which may reach the receiving antenna RA from reaching the repeater R_3 . Moreover, no voice frequency currents may reach the rectifier G_2 , and consequently relay W_3 will not be operated. Upon the release of the armature of relay W_3 the telegraph receiver TR will be rendered operative for the reception of any telegraph signals that may be received by the receiving antenna RA and subsequently demodulated by the radio receiver RR and transmitted through the filter F_2 and through the delay network DN_2 . Thus, it will be apparent that when voice frequency signals are being transmitted from station Z_1 , no telegraph or other signals may be simultaneously transmitted from that station while the receiver will be rendered operative for the reception of interspacing signals.

When voice frequency signals are not being generated or transmitted, relays W_1 and W_2 will be deenergized so that the telegraph transmitter TS may generate telegraph or other interspacing signals for transmission by the transmitting antenna TA through space after suitable modulation at the radio transmitter RT. The armature of relay W_2 becomes released so that any voice frequency currents derived from the radio receiver RR

and passing the filter F_1 may energize the rectifier G_2 and subsequently cause the relay W_3 to become operative. Accordingly, the telegraph receiver TR will become deenergized and will, therefore, be unable to receive any currents which may, perchance, pass through the filter F_2 and through the delay network DN_2 . Thus, when no voice frequency signals are being transmitted voice frequency signals may be received, while telegraph or other interspacing signals may be transmitted.

If it should happen that voice frequency signals are being generated and transmitted through space by the apparatus at station Z_1 , while station Z_2 , for example, simultaneously transmits voice frequency signals modulated upon suitable carrier currents, relays W_1 and W_2 will become operated, relay W_1 preventing the operation of the telegraph transmitter TS, while relay W_2 prevents any voice frequency currents from reaching repeater R_3 . However, the relay W_3 will become deenergized so that the telegraph receiver TR may receive any demodulated interspacing signals provided by the receiver RR after the signals are transmitted through the filter F_2 and through the delay network DN_2 .

If no voice frequency signals are being transmitted from station Z_1 , and no modulated currents corresponding to voice frequency currents are being received from a distant station, relays W_1 and W_2 will not be operated, thereby permitting the telegraph transmitter TS to transmit telegraph signals to become modulated upon carrier current at the transmitter RT. Since no voice frequency currents are being received, the rectifier G_2 will not be operated and consequently the winding of relay W_3 will be deenergized so that the telegraph receiver TR may become receptive to interspacing signals which may be derived from the receiver RR and which pass through the filter F_2 and the delay network DN_2 .

It will be apparent that when speech currents are entering the delay network DN_1 , the rectifier G_1 is spontaneously rectifying these speech currents and causing the relays W_1 and W_2 to become operated and to remain operated in order that the transmitting equipment at the transmitter TS may become stopped and the filter F_2 short-circuited through the armature of relay W_2 , thereby preventing singing in a local circuit including the hybrid coil arrangement H, the transmitter RT and the receiver RR.

It will be apparent that when no voice frequency currents are being transmitted from station Z_1 , and no voice frequency currents are being derived from the radio receiver RR, interspacing signals may be derived from that receiver and these signals may pass through the filter F_2 and reach the

delay network DN_2 , which will act to delay the transmission of these signals until the winding of the relay W_3 has become deenergized to properly associate the receiver TR with the delay network DN for the reception of these delayed signals.

It will be apparent that the equipment at station Z_2 may be the same, or substantially the same, as the equipment at station Z_1 , and that the apparatus at Z_2 operates in the same manner as the apparatus at station Z_1 . No description of the apparatus at station Z_2 is deemed necessary.

Fig. 3 shows a modification of the arrangements described in connection with Fig. 2, in which two single-pole, double-throw switches M_1 and M_2 are employed to enable a preference to be established so that station Z_1 may either transmit voice frequency signals and receive interspacing signals, or receive voice frequency signals and transmit interspacing signals, as found desirable. The telegraph transmitter TS may become operated only when current flows over conductor 30. Current will flow over conductor 30 when relay W_1 is not operated and when switch M_1 is thrown to the right, the current being derived from the battery B_1 . Also, assuming that both relays W_1 and W_3 are not operated, current may flow through conductor 30 if switch M_1 is thrown to the left and switch M_2 is thrown to the right, the current being derived from the battery B_2 and flowing over still another conductor 31.

When speech signals are being transmitted, relays W_1 and W_2 are operated, relay W_1 disconnecting conductor 30 from either of the batteries B_1 or B_2 . Under no conditions may interspacing signals be transmitted by the transmitter TS when speech signals are being transmitted.

When speech signals are not being transmitted, the windings of relays W_1 and W_2 are deenergized. Then if switch M_1 is thrown to the right, current will flow from battery B_1 to the transmitter TS. Accordingly, interspacing signals will be transmitted to the transmitter RT for modulation and subsequent transmission through space. If, however, switch M_1 is thrown to the left, current may still be obtained to operate the transmitter TS if switch M_2 is thrown to the right, assuming relay W_3 is not operated. In that event the required current will be derived from battery B_2 .

When speech signals are being transmitted interspacing signals may be received at the receiver TR if switch M_2 is thrown to the right, the required current being derived from battery B_2 . It will be apparent that when no voice frequency signals are being demodulated at the receiver RR, the relay W_3 will not be operated and will, therefore, not impair the reception at receiver TR. When speech signals are being transmitted,

the receiver TR may still be operated when switch M_2 is thrown to the left, if at the same time switch M_1 is thrown to the right. Then current will flow from battery B_1 through the armature of relay W_1 , over a conductor 32 and over the armature of relay W_3 .

It will be apparent that the arrangement of Fig. 3 is desirable when a single band is employed for the transmission of speech signals in opposite directions and when a single band is employed for the transmission of interspacing signals in opposite directions also, as described in paragraph B hereinabove. Whenever a single channel is employed for transmission in opposite directions, it is highly desirable, though not absolutely necessary, to permit transmission only in one direction at a time. In view of the employment of overlapping bands the signals would become otherwise distorted to such an extent that they might become almost unintelligible. The arrangement of Fig. 3 is one in which the interspacing receiving mechanism located at the receiver TR is unresponsive to interspacing signals transmitted from the same terminal by virtue of the fact that the transmitter TS and the receiver TR cannot be simultaneously operated. By virtue of the switches M_1 and M_2 , it is possible to provide a preference in the use of the one available interspacing channel in the event that no speech signals are being transmitted from either station. By throwing switch M_1 to the left and switch M_2 to the right speech signals may be received while interspacing signals are being transmitted. On the other hand, by throwing switch M_1 to the right and switch M_2 to the left speech signals may be transmitted while interspacing signals are being received.

It will be apparent that the apparatus at station Z_2 is the same, or substantially the same, as the apparatus at station Z_1 , the apparatus at station Z_2 including switches M_1 and M_2 or their equivalents. It is not deemed necessary to describe the details of the apparatus at station Z_2 .

It will be apparent that the offset speech band arrangement described in paragraph C hereinabove may be carried out by the apparatus provided in Fig. 2 of the drawings, and that the operation of the circuit arrangements in Fig. 2 will be the same as already described.

When two separate speech channels are being employed so that the transmission of speech may take place in one direction and the transmission of interspacing signals may take place in the opposite direction, special means may be provided for determining whether the signals received by the receiving antenna RA are speech signals or interspacing signals, since both types of signals may occupy substantially the same positions

in the spectrum, one case of which is described in the paragraph identified by the reference character D, hereinabove. The two types of signals may become differentiated by the use of a series of narrow band-pass filters which may pass the frequencies lying within the interspacing channel most effectively. Since speech currents may occupy a continuous and wider band, some of these speech currents may transverse this filtering arrangement and cause the operation of a relay which may be associated therewith to perform the desired switching. An alternative scheme might include apparatus for the transmission and reception of an identifying signal along with the speech or interspacing signals. If the identifying signal is present, an associated relay may be operated to direct the corresponding signals to one channel or another. Thus, the operation of this relay may be employed for automatically transmitting the received signals to either of two channels suitable for the transmission of currents lying within the same band.

While this invention has been pointed out in certain particular embodiments merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A radio signaling station comprising a voice frequency circuit including a hybrid coil and a balancing network, said voice frequency circuit being capable of transmitting and receiving voice frequency signals without distortion, a telegraph transmitter for generating telegraph signals, a telegraph receiver for receiving telegraph signals, a transmitting radio antenna, a receiving radio antenna, a radio transmitter including a source of current of high frequency upon which the signals to be transmitted through said radio transmitter may become modulated, a radio receiver including a similar source of current of high frequency for demodulating signals received through said receiving radio antenna, automatic means to prevent the telegraph transmitter from generating telegraph signals when voice frequency signals are being transmitted through said voice frequency circuit, and automatic means including a rectifier and a relay responsive to received voice frequency signals to prevent the telegraph receiver from receiving telegraph signals when the receiving antenna is receiving modulated voice frequency signals.

2. A radio signaling station comprising a voice frequency circuit capable of transmitting and receiving voice frequency signals without distortion, a telegraph sender for generating telegraph signals, a telegraph receiver for receiving telegraph signals, a radio

transmitter for converting locally generated voice frequency and telegraph signals into corresponding radio waves for transmission to a distant point, a radio receiver for converting received radio waves into corresponding voice frequency and telegraph signals, means to prevent the telegraph sender from generating telegraph signals when voice frequency signals are being transmitted through said voice frequency circuit, and means including a rectifier and a relay responsive to received voice frequency signals to prevent the telegraph receiver from receiving telegraph signals when the radio receiver is receiving radio waves corresponding to voice frequency signals.

3. At a signaling station, the combination of a circuit including means for generating voice frequency signals and means for receiving voice frequency signals without distortion, means for generating telegraph signals, means for receiving telegraph signals, means for converting locally generated voice frequency or telegraph signals into corresponding high frequency energy for transmission to a distant point, means for converting received high frequency energy into corresponding voice frequency or telegraph signals, means for separating received telegraph signals from received voice frequency signals, the received telegraph signals being applied to the receiving telegraph means, rectifying means for rectifying a portion of the received voice frequency signals, and means responsive to the rectified currents to deenergize the telegraph receiving means.

4. The combination of a radio receiver capable of receiving modulated high frequency energy corresponding to voice frequency and telegraph signals and for demodulating said high frequency energy, means for separating demodulated voice frequency energy from energy corresponding to telegraph signals, a telegraph receiving device capable of receiving the energy corresponding to telegraph signals, a rectifier for rectifying demodulated voice frequency signals, and means responsive to rectified voice frequency signals to dissociate the telegraph receiving device from the radio receiver.

5. The combination of a radio receiver for receiving modulated high frequency energy corresponding to voice frequency signals and telegraph signals, and for demodulating said high frequency energy, means for separating demodulated voice frequency energy from demodulated telegraph signals, a telegraph receiving device capable of receiving said demodulated telegraph signals, a delay circuit interposed between said telegraph receiving device and said radio receiver, a rectifier for rectifying a portion of the demodulated voice frequency signals, and means responsive to the rectified energy to dissociate the telegraph receiving device from the radio re-

ceiver, the delay circuit introducing a time delay of sufficient duration to permit the proper dissociation of the telegraph receiving device from the radio receiver.

- 5 6. The combination of a radio receiver for receiving modulated high frequency energy corresponding to voice frequency signals and telegraph signals and for demodulating said high frequency energy into these respective
10 signals, a telegraph receiving device capable of receiving these demodulated telegraph signals to the exclusion of the demodulated voice frequency signals, and means responsive to the demodulated voice frequency signals for
15 dissociating the telegraph receiving device from the radio receiver.

In testimony whereof, I have signed my name to this specification this 16th day of February, 1928.

20 RALPH K. POTTER.

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