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TWO-WAY TELEPHONE SYSTEM

Filed June 16, 1931

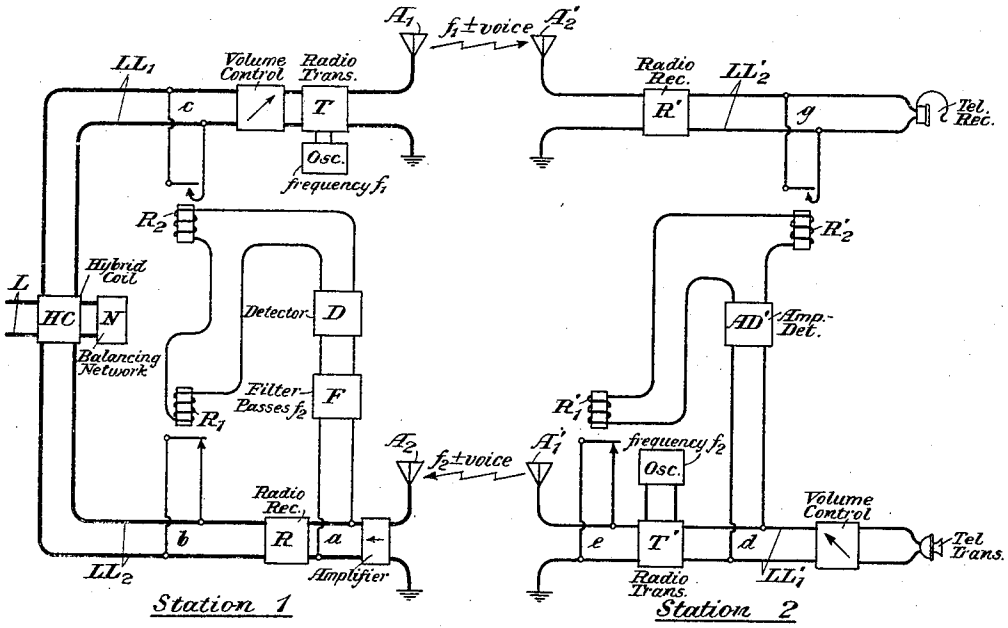


Fig. 1

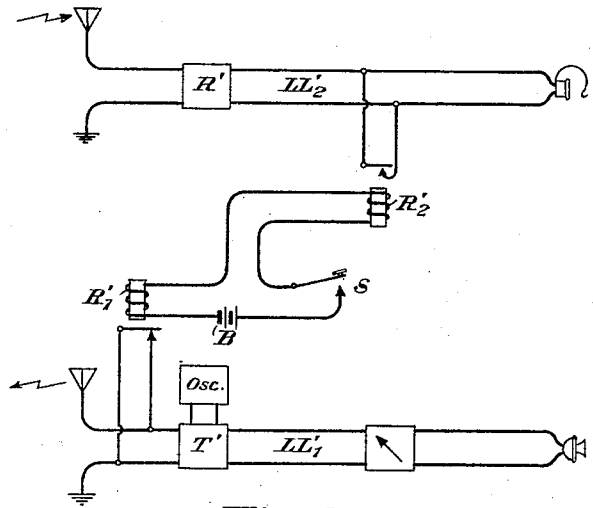


Fig. 2

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UNITED STATES PATENT OFFICE

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TWO-WAY TELEPHONE SYSTEM

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This invention relates to two-way transmission systems, and more particularly to two-way transmission systems having a return loss at one end which is very high and a return loss at the other end which is low enough to permit appreciable reflection of transmitted waves.

While the invention is applicable to many types of two-way transmission systems, it is especially applicable to radio telephone systems for two-way communication between aircraft and the ground and to similar systems for ship-to-shore communication.

The prinicpal object of the invention is the suppression of echoes and singing in the two-way system. A further object is to accomplish such suppression without the requirement of a comparatively elaborate set of apparatus for the purpose.

The invention will be understood when the following description of one desirable embodiment is read with reference to the accompanying drawing. Figure 1 of the drawing shows diagrammatically, and in part schematically, a two-way system such as a ship-to-shore radio telephone system, while Fig. 2 shows in like manner the circuits at one of the stations in a slightly modified arrangement. Like reference characters in the two figures of the drawing designate corresponding elements.

With reference to the details of Fig. 1, there is shown a system for two-way telephone communication between a station 1 at the left and a station 2 at the right. Transmission from left to right takes place over the one-way path LL_1 of station 1 and the one-way path LL_2' of station 2, which are interconnected by a radio link. Similarly, transmission from right to left takes place over the path LL_1' of station 2, the intermediate radio link and the path LL_2 of station 1. At station 1 the four-wire circuit formed by the two one-way paths just described may be extended to the left over the two-wire circuit L, to which the four-wire circuit is connected through a hybrid coil HC. The usual network N balances the two-wire line L. At station 2 the path LL_2' leads to a telephone receiver, while the path LL_1' leads from a telephone transmitter. From this description it will be understood that the two-way system shown is one which has a return loss at station 2 which is very high and a return loss at station 1 which may be quite low so as to cause an appreciable reflection over path LL_1 of waves transmitted in path LL_2.

In connection with transmission from left to right, waves pass through a volume control device and a radio transmitter T and are radiated from the antenna A_1 at station 1 to the antenna A_2' at station 2. They then pass through the radio receiver R' and on to the telephone receiver. The waves from the telephone transmitter at station 2 pass through a volume control device and the radio transmitter T' and may be radiated from the antenna A_1' to the antenna A_2 at the distant station 1. At that station a path is provided through a one-way amplifier and the radio receiver R, and the waves may then be transmitted on to the hybrid coil HC and the two-wire circuit L.

In connection with the applicant's arrangements for transmission control to suppress echoes and singing, it should be noted that the transmitting path LL_1 at station 1 and the receiving path LL_2' at station 2 are normally in operative condition, whereas the transmitting path LL_1' of station 2 and the receiving path LL_2 of station 1 are normally disabled at the points e and b, respectively.

Associated with the radio transmitter T at station 1 is an oscillator which applies to the left-right channel continuously carrier waves of a frequency f_1. When the signals are applied to the system for transmission in this direction they are modulated upon the carrier f_1 and thus transmitted to station 2.

In connection with transmission from station 2 to station 1, there is specifically disclosed an oscillator which impresses upon the radio transmitter T' a frequency f_2. As specifically disclosed or indicated, this frequency f_2 represents the carrier waves which may be employed for the transmission of the voice signals after modulation from station 2 to station 1. It is to be understood, however, that this frequency f_2 might, for the purposes

of the invention, as well be some other control frequency than a carrier frequency employed for modulation. At station 1 it will be noted that a filter F, passing substantially only the frequency f_2, and a detector D are connected across the path LL_2 at the point a in the output of the one-way amplifier, and that the output circuit of the detector D includes the windings of relays R_1 and R_2.

When transmission takes place from left to right, the operation is one well understood in the art. The voice waves pass over circuit L and are divided in the hybrid coil HC, the effective portion of the energy traveling on over path LL_1. Beyond the volume control device the voice waves are modulated in the radio transmitter T upon the carrier f_1 from the oscillator shown, and radiation takes place from antenna A_1 to antenna A_2'. At station 2 demodulation takes place in the radio receiver R', and the waves representing the voice pass over path LL_2' to the telephone receiver.

When the speaker at station 2 talks into the telephone transmitter, the voice waves pass over the path LL_1' and through the volume control device. As indicated above, the oscillator which generates the frequency f_2 is connected to the radio transmitter T', but the path LL_1' is normally disabled at the point e. A portion of the voice energy is diverted from the path LL_1' at point d and operates the amplifier-detector AD'. The relays R_1' and R_2', the windings of which are included in the output of the amplifier-detector, now operate. The operation of relay R_1' removes the disability from the transmitting path LL_1' at point e and permits the radiation from the antenna A_1' of the carrier f_2 upon which the voice has been modulated. Thus, the normal disability at point e is removed in response to the voice energy sent over the path LL_1' to permit transmission to station 1. The operation of relay R_2' disables the receiving path LL_2' at point g. This disability serves to suppress false transmission in LL_2' due to radio coupling between antenna A_1' and antenna A_2', for instance.

At station 1 the waves transmitted from the distant antenna A_1' are picked up in the antenna A_2 and are passed through the one-way amplifier. The receiving path LL_2 is normally disabled at the point b in order to prevent false transmission of static or other interfering energy which might be picked up by the antenna A_2. At point a, a portion of the transmitted energy is diverted, and the carrier or control energy of frequency f_2 passes the filter F, the voice frequencies being substantially excluded. Thus, the detector D operates substantially only in response to energy of the frequency f_2. When the relays R_1 (and R_2) operate in response to the operation of the detector, the path LL_2 is cleared of the disability at point b, and the voice waves are free to pass on to the hybrid coil HC. The operation of relay R_2 places a disability upon the transmitting path LL_1 at point c; thus, any waves reflected back over this path as echoes of the waves in path LL_2 are suppressed and prevented from reaching the radio transmitter.

It is repeated here and should be carefully noted, that the control of relays R_1 and R_2 at station 1 may be effected by any control frequency sent from station 2, which control frequency may or may not be the carrier intermittently applied at station 2 for the transmission of the voice waves.

With reference to Fig. 2 of the drawing, there is shown a somewhat modified arrangement of the circuits of station 2. It will be noted that the transmitting path LL_1' is normally disabled, and that the removal of the disability is effected by relay R_1', as in the case of Fig. 1; likewise, it will be noted that the receiving path LL_2' may be disabled by the operation of relay R_2' as is the case in Fig. 1. These relays, however, are controlled in the arrangement of Fig. 2 not by a portion of the voice energy diverted from path LL_2' but by the manual operation of a switch S, which is connected in series with the windings of relays R_1' and R_2' and a battery B. This switch may take the form of a push button which an operator operates at the proper time to open up the transmitting chanel LL_1' and to permit the radiation of the voice and the carrier or other control energy.

It will be seen, after an examination of the description contained hereinabove, that the applicant's arrangement has the advantage that line noise from circuits connected to the four-wire circuit over the line L at station 1 ceases to be a factor in the problem of controlling transmission over the paths LL_1 and LL_2. Accordingly, the duties of an operator at this point are materially reduced. More specifically, the relays at station 1 cannot be affected by line noise to produce false operation of the transmission controls. It will be noted further that the degree of unbalance of the circuits connected to the hybrid coil HC becomes immaterial since the transmission control relays are rendered quite immune to false operation. The only remaining possibility of false operation at station 1 is connected with radio noise or static picked up by the antenna A_2. Since the filter F is designed to pass substantially only the special frequency f_2, this possibility of false operation becomes negligible. At station 2 it is, of course, possible for noise currents to reach the amplifier-detector AD', but in a system such as that disclosed and such as those to which the invention is especially applicable, the transmitting connection LL_1' is quite short and there is little likelihood of

noise energy of appreciable level being found in the path LL_1'.

While the invention has been disclosed somewhat specifically for the purpose of illustration, it is to be understood that it is capable of embodiment in many other and widely different forms within the scope of the appended claims.

What is claimed is:

1. In a two-way system for the transmission of energy, a first path adapted for transmission in one direction and a second path adapted for transmission in the opposite direction, each of said paths comprising two terminal sections and an intermediate transmission link, the terminal sections of said second path being normally disabled, means near the transmitting end of said first path for applying carrier energy continuously thereto, means near the transmitting end of said second path for removing the disability from the transmitting section thereof and applying control energy thereto, and means responsive substantially only to said control energy for removing the disability from the receiving section of said second path and disabling the transmitting section of said first path.

2. In a two-way system for the transmission of energy, a first path adapted for transmission in one direction and a second path adapted for transmission in the opposite direction, each of said paths comprising two terminal sections and an intermediate transmission link, the terminal sections of said second path being normally disabled, means near the transmitting end of said first path for applying carrier energy continuously thereto, means near the transmitting end of said second path for disabling the receiving section of said first path, removing the disability from the transmitting section of said second path and applying control energy to said second path, and means responsive substantially only to said control energy for removing the disability from the receiving section of said second path and disabling the transmitting section of said first path.

3. In a system for the transmission of energy, a first path adapted for transmission from a first to a second station and a second path adapted for transmission from the second station to the first, the return loss at the first station being comparatively low and the return loss at the second station being comparatively high, each of said paths comprising two terminal sections and an intermediate link, means normally applied to each terminal section of said second path for disabling the same, means near the transmitting end of said second path for removing the disability from the transmitting section thereof and applying control energy thereto, and means responsive substantially only to said control energy for removing the disability from the receiving section of said second path and disabling the transmitting section of said first path.

4. In a system for the transmission of energy, a first path adapted for transmission from a first station to a second station and a second path adapted for transmission from the second station to the first, the return loss at the first station being comparatively low and the return loss at the second station being comparatively high, each of said paths comprising two terminal sections and an intermediate link, means normally applied to the receiving section of said second path for disabling the same, means associated with said first path for effecting transmission over the intermediate link thereof by continuously applied carrier energy, means associated with said second path for effecting transmission over the intermediate link thereof by carrier energy applied intermittently under the control of the energy transmitted to produce the desired overall effect, and means responsive substantially only to said intermittently applied carrier energy for removing the disability from the receiving section of said second path and disabling the transmitting section of said first path.

5. In a telephone system, two distant stations separated by an intermediate link, a two-way extending circuit terminating at the first station, a transmitting connection and a receiving connection adapted for one-way transmission from and to said two-way circuit, respectively, at said first station, a telephone receiver and a telephone transmitter at the second station, a receiving path for transmission to said receiver and a transmitting path for transmission from said transmitter at said second station, said transmitting path and said receiving connection being normally disabled, means at said second station for removing the disability from said transmitting path, applying control energy thereto and disabling said receiving path, and means at said first station responsive substantially only to said control energy for removing the disability from said receiving connection and disabling said transmitting connection.

6. In a telephone system, two distant stations separated by an intermediate link, a two-way extending circuit terminating at the first station, a transmitting connection and a receiving connection adapted for one-way transmission from and to said two-way circuit, respectively, at said first station, a telephone receiver and a telephone transmitter at the second station, a receiving path for transmission to said receiver and a transmitting path for transmission from said transmitter at said second station, said transmitting path and said receiving connection being normally disabled, means associated with said transmitting connection for applying carrier energy continuously thereto for trans-

mission from said first to said second stations, means at said second station responsive to voice waves from said transmitter for disabling said receiving path, removing the disability from said transmitting path and applying carrier energy thereto, and means at said first station responsive substantially only to the carrier energy applied at said second station for removing the disability from said receiving connection and disabling said transmitting connection.

7. In a two-way telephone system including a two-wire circuit, a first one-way path adapted for transmission from said two-wire circuit to a distant telephone receiver and a second one-way path adapted for transmission from the telephone transmitter associated with said receiver to said two-wire circuit, each of said one-way paths comprising two end sections and an intermediate link, the method of rendering the system independent of interfering energy which consists in normally maintaining the two end sections of said second one-way path in disabled condition, removing the disability from the transmitting section of said second one-way path and applying control energy thereto when voice waves travel therein, and causing said control energy upon reaching the other end of said second one-way path to remove the disability from the receiving section thereof and to disable the transmitting section of said first one-way path.

8. In a two-way telephone system including a two-wire circuit, a first one-way path adapted for transmission from said two-wire circuit to a distant telephone receiver and a second one-way path adapted for transmission from the telephone transmitter associated with said receiver to said two-wire circuit, each of said one-way paths comprising two end sections and an intermediate link, the method of rendering the system independent of interfering energy which consists in normally maintaining the two end sections of said second one-way path in disabled condition, causing the voice waves traveling in the transmitting section of said second one-way path to remove the disability therefrom, to apply carrier waves thereto and to disable the receiving section of said first one-way path, and causing said carrier waves upon reaching the other end of said second one-way path to remove the disability from the receiving section thereof and to disable the transmitting section of said first one-way path.

In testimony whereof, I have signed my name to this specification this 13th day of June 1931.

EDMUND R. TAYLOR.