

Jan. 27, 1942.

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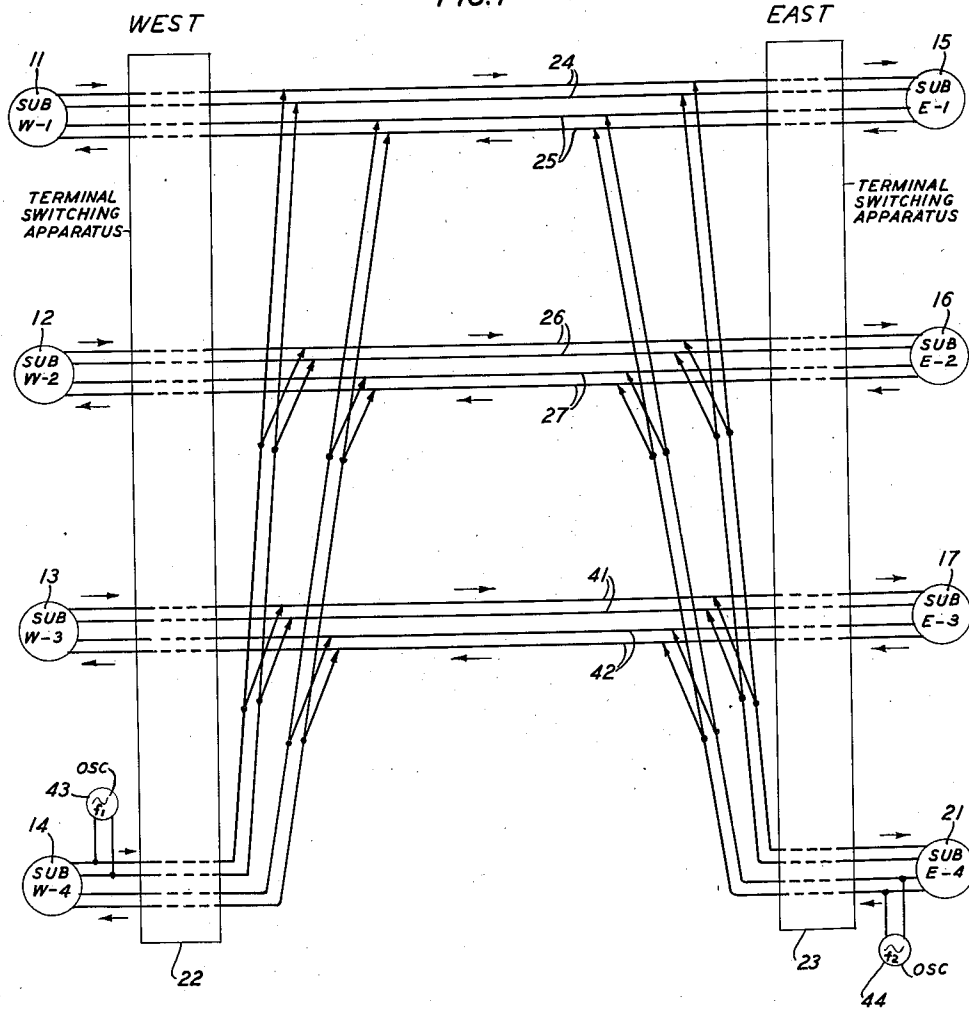
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SPEECH TRANSMISSION SYSTEM

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2 Sheets-Sheet 1

FIG. 1



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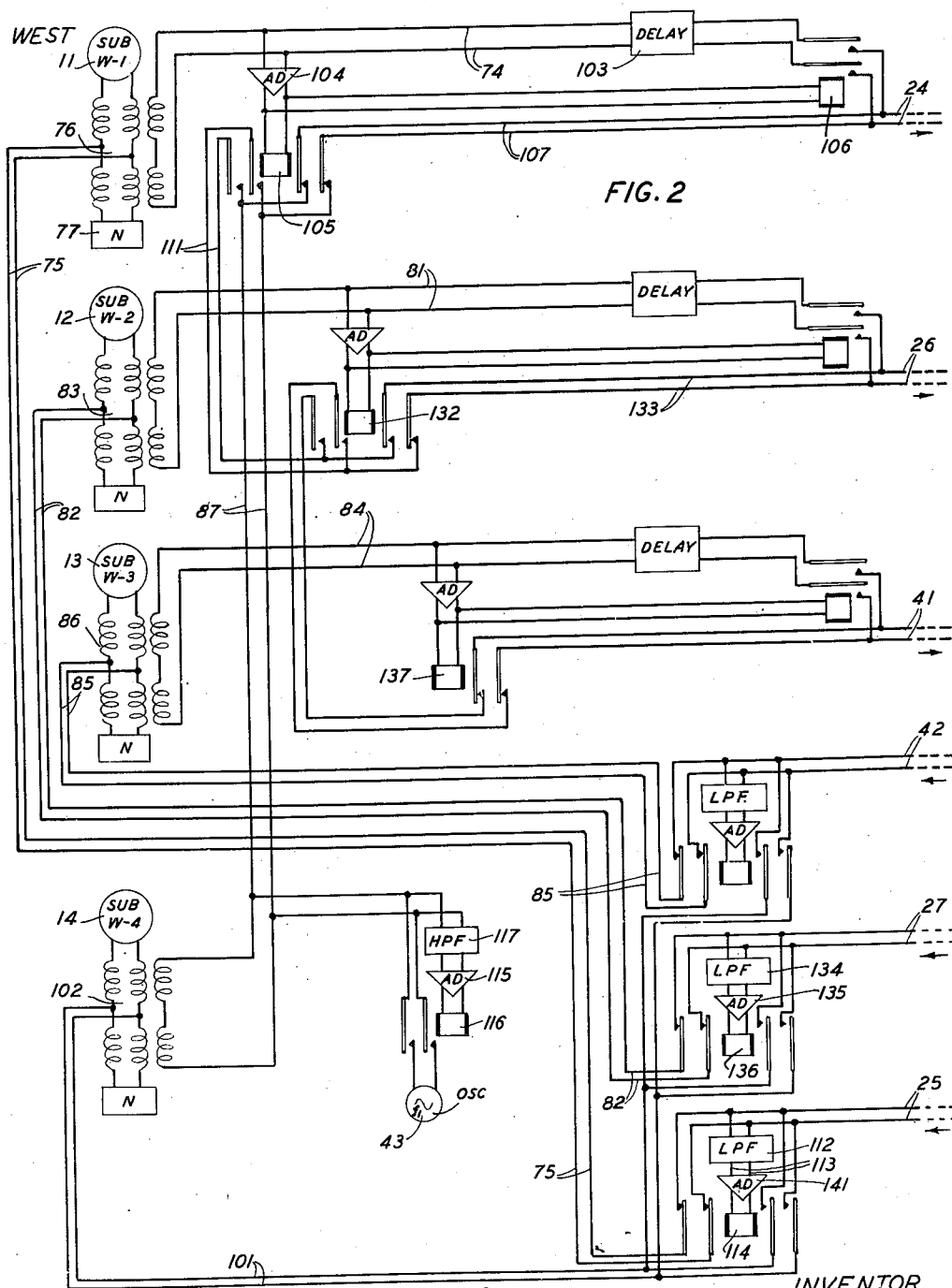
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SPEECH TRANSMISSION SYSTEM

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11 Claims. (Cl. 179—15)

The invention relates to a speech transmission system.

An object of the invention is to achieve increased efficiency in the operation of certain types of speech transmission systems.

A further object of the invention is the transmission of messages in such a manner that intelligible reception of the message by unauthorized persons will be rendered very difficult.

A more specific object of the invention is to decrease the "idle time" of speech transmission circuits.

It is recognized by transmission engineers that, during a so-called conversation period on a four-wire circuit, one side of the circuit is actually in use only about one-third of the time. It has previously been proposed to take advantage of this fact by associating a number of subscribers' telephone circuits with a lesser number of one-way speech channels and switching each different speech portion of vocal interval duration occurring in the various subscribers' circuits to any one of the channels that happens to be idle at a particular moment. While such systems appear, in general, to provide worthwhile advantages particularly from an economic standpoint, there has been some objection to the use of such an arrangement on high quality circuits due both to the fact that distortion may creep in because of the switching operations and to the fact that small portions of the transmission may be lost or delayed at times due to momentary lack of an idle channel.

A feature of the present invention resides in means whereby only a selected circuit is switched about from idle channel to idle channel, the other circuits operating over their individually assigned channels.

In accordance with a specific embodiment of the invention, a given number, such as three, west-east and a corresponding number, such as three, east-west channels are provided for connecting, in the illustrative case, three subscriber stations at the west terminal of a speech transmission system with three subscriber stations at the east terminal for two-way conversations. The resulting circuits, which we will assume to be high quality circuits, are not subject to switching from one channel to another. A fourth subscriber station at the west terminal and a fourth subscriber station at the east terminal are interconnected over a circuit which is switched about from one of the channels mentioned above to another depending upon which is idle. Should a channel seized by the fourth subscriber be

wanted by the subscriber normally assigned thereto such subscriber will take over the channel and the circuit of the fourth subscriber will be switched onto the next idle channel. Should all channels be in use by the preferred stations, interconnection of the fourth pair of subscriber stations will be delayed until an idle channel is available.

The above arrangement results in efficient and economical operation of the system as six one-way channels provide the service ordinarily provided by eight such channels and yet there is no necessity of switching the high quality circuits from one channel to another with consequent possibility of delayed transmission. It is contemplated that the switched circuit may, if desired, be of the type ordinarily termed a low quality circuit wherein a small amount of distortion or occasional delays will not be objectionable. Such a circuit may be utilized, for example, by attendants supervising the operation of the system.

It will be apparent that a measure of privacy will be attained by the arrangement described inasmuch as an unauthorized person "listening-in" on any of the channels between the terminals will hear snatches of two different conversations interspaced one with the other; i. e., the "normal" conversation of the channel and the "switched" conversation. A somewhat higher degree of privacy will be attained, of course, with respect to the switched conversation as snatches of this conversation will appear on different channels.

Complete understanding of the arrangement contemplated by the present invention as well as appreciation of the various features thereof may be had from consideration of the following detailed description in connection with the drawings, in which:

Fig. 1 shows diagrammatically a two-way telephone system embodying features of the present invention; and

Fig. 2 shows in detail the switching arrangement of one terminal of the system of Fig. 1.

Referring now to the drawings, there is illustrated diagrammatically in Fig. 1, two terminals of a two-way telephone system which may be, for example, a two-way radio or line wire telephone system. Four subscriber sets, 11, 12, 13 and 14, are shown at the west terminal each of which is provided with a suitable two-way subscriber's telephone circuit; similarly, four subscriber sets, 15, 16, 17 and 21, are shown at the east terminal, each of these sets also being pro-

vided with a suitable two-way subscriber's telephone circuit.

The west terminal switching apparatus is represented by box 22 and the east terminal switching apparatus by box 23; these switching arrangements will be described in detail subsequently in connection with Fig. 2.

A west-east channel 24 and an east-west channel 25 are provided for two-way conversations between subscriber W—1 and subscriber E—1, the arrangement being such that channel 24 is immediately available to subscriber W—1 whenever a speech portion of vocal interval duration is produced by his subscriber set 11 and that channel 25 is immediately available to subscriber E—1 whenever a speech portion of vocal interval duration is produced by his subscriber set 15. Similarly, west-east channel 26 and east-west channel 27 are provided for two-way conversations between subscribers W—2 and E—2 and west-east channel 41 and east-west channel 42 are provided for two-way conversations between subscribers W—3 and E—3.

It will be observed that conversations between subscribers W—1, W—2 and W—3 and subscribers E—1, E—2 and E—3, respectively, are maintained on a preferred or high quality basis as the terminal circuits are not switched from channel to channel. However, in accordance with the arrangement, a secondary service is provided for two-way conversations between a fourth subscriber W—4 at the west terminal and a fourth subscriber E—4 at the east terminal. It is contemplated that such additional facility might well be utilized by an attendant supervising the operation of the high quality circuits in which case slight distortion or occasional delay would be particularly serious. As indicated schematically, transmission from subscriber set 14 to subscriber set 21 is achieved by switching the terminal circuits about among channels 24, 26 and 41, depending upon which is idle at any one moment while transmission from subscriber set 21 to subscriber set 14 is achieved by similarly switching the terminal circuits about among channels 25, 27 and 42.

When voice frequency currents originating at subscriber set 14 are applied to any of the west-east channels, a distinctive tone of low frequency produced by source 43 is applied to the same channel; similarly when voice frequency currents originating at subscriber set 21 are applied to any of the east-west channels a low frequency tone produced by source 44 is applied to the same channel. The purpose of these tones will be described subsequently in reference to Fig. 2.

The general switching arrangement contemplated is such that, so far as transmission from subscriber W—4 to subscriber E—4 is concerned, channel 24 is superior (i. e. preferred) to channels 26 and 41 and channel 26 is superior to channel 41. That is, speech currents originating at subscriber set 14 are always applied to channel 24 so long as channel 24 is not in use for transmission from W—1 to E—1. Should channel 24 be in use, the speech currents originating at subscriber set 14 are applied to channel 26 so long as channel 26 is not in use for transmission from W—2 to E—2. Should both channels 24 and 26 be in use, the speech currents of subscriber set 14 are then applied to channel 41 so long as channel 41 is not in use for transmission from W—3 to E—3. Should all three channels be in use, transmission of the speech currents of subscriber set 14 is delayed until one of the channels becomes idle.

In like manner with respect to transmission from E—4 to W—4, channel 25 is superior to channels 27 and 42 and channel 27 is superior to channel 42.

The term "vocal interval" as used herein means the duration of one or a succession of syllables no one of which is separated from the preceding syllable by an interval as great as the "hang-over" time of the system, weak beginnings and endings, i. e., portions not capable of causing relay operation, being considered parts of the silent interval. "Hang-over time" is a term commonly used in connection with systems including voice-operated devices and means the period that a voice-operated device remains, due to its own characteristics, in operated position after the operating impulse has been removed.

Referring now to Fig. 2, a detailed showing is set forth of the switching apparatus of the west terminal represented in Fig. 1 by box 22.

Subscriber set 11 is coupled to transmitting line 74 and receiving line 75 by transformer 76, network 77 serving to provide proper balance in the well-known manner. In a similar manner, subscriber set 12 is connected to transmitting line 81 and receiving line 82 through transformer 83, subscriber set 13 is connected to transmitting line 84 and receiving line 85 through transformer 86 and subscriber set 14 is connected to transmitting line 87 and receiving line 101 through transformer 102.

For purposes of further illustration of the invention, the operation of the circuits of Fig. 2 will now be described in detail. Let us assume, first, that subscriber W—1 speaks, at which time speech energy originating at subscriber station 11 will be applied through transformer 76 to transmitting line 74. As the speech energy is delayed somewhat in its passage through delay device 103, let us first see what operations result from passage of a part of the speech energy through amplifier-detector 104.

The rectified and filtered speech currents emanating from amplifier-detector 104 cause operation of relays 105 and 106. Operation of relay 106 connects, through its front contacts, transmitting line 74 to channel 24 so that the speech energy after traversing delay device 103 is sent out over channel 24. Operation of relay 105 interrupts at its back contacts the connection of transmitting line 87 of subscriber set 14 to line 107 and connects, at its front contacts, transmitting line 87 to line 111.

The speech energy passing out over channel 24 is received by subscriber E—1 of the east terminal. As the east terminal equipment has not been illustrated let us refer for the moment to the receiving equipment of the west terminal and assume that speech energy is being received from the distant terminal over channel 25. Low-pass filter 112 prevents passage of the high frequency voice currents into path 113 so that relay 114 remains in normal, unoperated position. The speech energy, therefore, passes through the back contacts of relay 114 to receiving line 75 and over this line to subscriber set 11.

Returning now to consideration of the transmitting portions of the circuit, let us assume that with subscriber W—1 still talking, subscriber W—4 also starts talking, and that neither subscriber W—2 nor W—3 is talking. It will be recalled that relays 105 and 106 are in operated position due to the fact that subscriber W—1 is talking.

Speech energy produced by subscriber set 14 is

applied to transmitting line 87 through transformer 102, a part of the energy passing through amplifier-detector 115 and causing operation of relay 116. Operation of relay 116 completes a path through its front contacts over which a low frequency tone produced by source 43 is applied to line 87. We now have on line 87, therefore, both the speech currents of voice frequency and the characteristic tone of low frequency. High-pass filter 117 serves to exclude the low frequency tone currents from the operating circuit of relay 116.

Relay 105 being in operated position, as set forth above, the voice frequency currents and tone signals impressed on line 87 are applied through the front contacts of relay 105 to line 111 and in turn through the back contacts of relay 132, which is in unoperated position, to line 133. As line 133 is connected to channel 26, the voice frequency signals and the tone signals originating at subscriber station 14 are now impressed on channel 26 for transmission to the east terminal.

The currents impressed on channel 26 are received by subscriber E-4 at the east terminal. As the equipment of the east terminal has not been illustrated let us assume for the moment that voice frequency currents and the characteristic low frequency tone are being received over channel 27. The tone signals are of a sufficiently low frequency to be passed by low-pass filter 134 and are, therefore, impressed on amplifier-detector 135. The energy emanating from amplifier-detector 135 causes operation of relay 136. Operation of relay 136 is effective to interrupt at its back contacts the connection of channel 27 and receiving line 82 and to complete at its front contacts the connection of channel 27 to receiving line 101. The voice frequency currents incoming over channel 27 are received therefore by subscriber set 14. If desired, a high-pass filter may be included in the receiving path in order to exclude any part of the tone signals therefrom.

Returning now to consideration of the transmitting end of the system, it is believed that it will be clear from the above how the arrangement will function with other combinations of talkers. For example, under the conditions described above, i. e., with W-1 and W-4 talking, should subscriber W-2 also start talking, the transmitting path of subscriber W-4 will be transferred from channel 26 to channel 41 by operation of relay 132, relay 137 being in unoperated position as subscriber W-3 is not talking. However, should all three of the preferred subscribers, W-1, W-2 and W-3, be talking, transmission from W-4 will be delayed until an idle channel is available.

Considering again the situation first described, i. e., with subscribers W-1 and W-4 talking, should subscriber W-1 stop talking relays 105 and 106 will drop back to unoperated position and transmitting line 87 of subscriber W-4 will now be connected over line 107 to channel 24 and the voice frequency currents and the tone signals will reach the east terminal over channel 24. In order to make clear the action of the receiving equipment let us assume that the voice frequency currents and tone signals produced by the subscriber set corresponding to set 14 are now received over channel 25. The low frequency tone currents are passed by low-pass filter 112 and impressed on amplifier-detector 141. The energy emanating from amplifier-detector 141 causes operation of relay 114 which

results, in turn, in the transfer of channel 25 from receiving line 75 to receiving line 101. The voice frequency currents are received therefore by subscriber set 14.

It is believed it will be clear from the above that the speech currents and tone signals originating at subscriber set 14 are impressed on channel 24 if subscriber W-1 is not talking; on channel 26 if subscriber W-1 is talking and subscriber W-2 is idle; on channel 41 if subscribers W-1 and W-2 are talking and subscriber W-3 is idle; and that transmission from set 14 is delayed in the event that all three preferred subscribers are talking. It will be clear also, with respect to the receiving arrangement, that incoming channel 42 is normally connected to the receiving equipment of subscriber set 13, channel 27 is normally connected to the receiving equipment of subscriber set 12 and channel 25 is normally connected to the receiving equipment of subscriber set 11. In the event, however, that the low frequency tone originating at the fourth or switched subscriber set is present on a channel, said channel is switched to the receiving equipment of subscriber set 14 which is the fourth or switched set of the west terminal.

While a specific embodiment of the invention has been selected for detailed description it will be understood that the invention is not limited in its application to the embodiment described. It will be apparent, for example, that other combinations of subscriber sets may be provided. For example, one switched subscriber set may be associated with a larger number of preferred subscriber sets than the three illustrated. The embodiment described should be taken as illustrative of the invention and not as restrictive thereof.

What is claimed is:

1. In a speech transmission system including an east terminal and a west terminal, a plurality of transmitters at the east terminal, a corresponding number of receivers at the west terminal, a corresponding number of speech transmission channels connecting said east terminal and said west terminal, means operated by energy caused by production of a speech fragment of vocal interval duration by one of said transmitters for connecting the output of said transmitter to the speech transmission channel associated therewith, an additional transmitter at said east terminal, a corresponding additional receiver at said west terminal, means controlled by voice energy for connecting the output of said additional transmitter to the transmitting end of one of said speech transmission channels, and means controlled over said last-mentioned channel for connecting said additional receiver to the receiving end of the same channel.

2. In a speech transmission system including an east terminal and a west terminal, a plurality of transmitters at the east terminal, a corresponding number of receivers at the west terminal, a corresponding number of speech transmission channels connecting said east terminal and said west terminal, means effective in response to production of a speech fragment of vocal interval duration by one of said transmitters for connecting the output of said transmitter to a predetermined one of said speech transmission channels, an additional transmitter at said east terminal, a distinctive frequency tone source at said east terminal, an additional receiver at said west terminal, means operated by energy caused by production of a speech frag-

ment of vocal interval duration by said additional transmitter for connecting the outputs of said transmitter and of said tone source to the transmitting end of one of said speech transmission channels which is then idle so far as transmission by said plurality of transmitters is concerned, and means controlled by said distinctive tone for connecting said additional receiver to the receiving end of the same channel.

3. In a speech transmission system including an east terminal and a west terminal, a plurality of transmitters at the east terminal, a corresponding number of receivers at the west terminal, a corresponding number of speech transmission channels connecting said east terminal and said west terminal, means operated by energy caused by production of a speech fragment of vocal interval duration by one of said transmitters for connecting the output of said transmitter to one of said speech transmission channels, an additional transmitter at said east terminal, means for connecting the output of said additional transmitter to one of said channels not in use at the time, and means operated by energy resulting from application to said last mentioned channel of a speech fragment of vocal interval duration by one of said plurality of transmitters for transferring the output of said additional transmitter to another of said channels not in use at the time.

4. In a speech transmission system including an east terminal and a west terminal, a first transmitter, a second transmitter and a third transmitter at said east terminal, corresponding first, second and third receivers at said west terminal, a first speech transmission channel between said first transmitter and said first receiver, a second speech transmission channel between said second transmitter and said second receiver, and a third speech transmission channel between said third transmitter and said third receiver, a fourth transmitter at said east terminal, a fourth receiver at said west terminal, means for connecting the output of said fourth transmitter to said first channel, and means operated by energy caused by production of a speech fragment of vocal interval duration by said first transmitter for connecting the output of said first transmitter to said first channel and for transferring the output of said fourth transmitter to said second channel.

5. In a speech transmission system including an east terminal and a west terminal, a first transmitter, a second transmitter and a third transmitter at said east terminal, corresponding first, second and third receivers at said west terminal, a first speech transmission channel between said first transmitter and said first receiver, a second speech transmission channel between said second transmitter and said second receiver and a third speech transmission channel between said third transmitter and said third receiver, a fourth transmitter at said east terminal, a fourth receiver at said west terminal, means for connecting the output of said fourth transmitter to said first channel, means operated by energy caused by production of a speech fragment of vocal interval duration by said first transmitter for connecting the output of said first transmitter to said first channel and for transferring the output of said fourth transmitter to said second channel, and means operated by energy caused by production of speech fragments of vocal interval duration by both said first and said second transmitters for transfer-

ring the output of said fourth transmitter to said third channel.

6. In a speech transmission system including an east terminal and a west terminal, a first transmitter, a second transmitter and a third transmitter at said east terminal, corresponding first, second and third receivers at said west terminal, a first speech transmission channel between said first transmitter and said first receiver, a second speech transmission channel between said second transmitter and said second receiver and a third speech transmission channel between said third transmitter and said third receiver, a fourth transmitter at said east terminal, a fourth receiver at said west terminal, means for connecting the output of said fourth transmitter to said first channel, means operated by energy caused by production of a speech fragment of vocal interval duration by said first transmitter for connecting the output of said first transmitter to said first channel and for transferring the output of said fourth transmitter to said second channel, a distinctive frequency tone source at said east terminal, means operated by energy caused by production of a speech fragment of vocal interval duration by said fourth transmitter for connecting the output of said tone source to that channel to which the output of said fourth transmitter is connected and means controlled by said distinctive frequency tone for connecting said fourth receiver to the receiving end of the channel to which the output of said fourth transmitter is connected.

7. In a speech transmission system including an east terminal and a west terminal, a first transmitter, a second transmitter and a third transmitter at said east terminal, corresponding first, second and third receivers at said west terminal, a first speech transmission channel between said first transmitter and said first receiver, a second speech transmission channel between said second transmitter and said second receiver, and a third speech transmission channel between said third transmitter and said third receiver, a fourth transmitter at said east terminal, a fourth receiver at said west terminal, means for connecting the output of said fourth transmitter to said first channel if idle, and switching means operated by energy caused by production of a speech fragment of vocal interval duration by said first transmitter to transfer the output of said fourth transmitter to another of said channels.

8. In a speech transmission system including an east terminal and a west terminal, a first transmitter, a second transmitter and a third transmitter at said east terminal, corresponding first, second and third receivers at said west terminal, a first speech transmission channel between said first transmitter and said first receiver, a second speech transmission channel between said second transmitter and said second receiver, and a third speech transmission channel between said third transmitter and said third receiver, a fourth transmitter at said east terminal, a fourth receiver at said west terminal, means for connecting the output of said fourth transmitter to said first channel, switching means operated by energy caused by production of a speech fragment of vocal interval duration by any one of said first three transmitters to prevent connection of the output of said fourth transmitter to that channel which is between the speech producing transmitter and the corresponding receiver.

9. In a speech transmission system providing between stations a plurality of transmission paths over a like number of channels definitely assigned for use by said respective stations, the method of providing for an additional transmission path which comprises the step of switching the additional transmission path about among said channels at intervals when said channels are not being used for transmission by said stations.

10. In a speech transmission system providing between stations a plurality of transmission paths over a plurality of westward channels and a like number of eastward channels, said channels being definitely assigned for use by said respective stations, the method of providing for an additional transmission path in each direc-

tion which comprises the step of independently switching the additional westward path and the additional eastward path about among said respective westward channels and said respective eastward channels at intervals when said channels are not being used for transmission by said stations.

11. In a speech transmission system providing between stations a plurality of transmission paths over a like number of channels definitely assigned for use by said respective stations, the method of attaining transmission privacy which comprises the step of switching an additional transmission path about among said channels at intervals when said channels are not being used for transmission by said stations.

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