

Feb. 8, 1938.

B. W. KENDALL ET AL

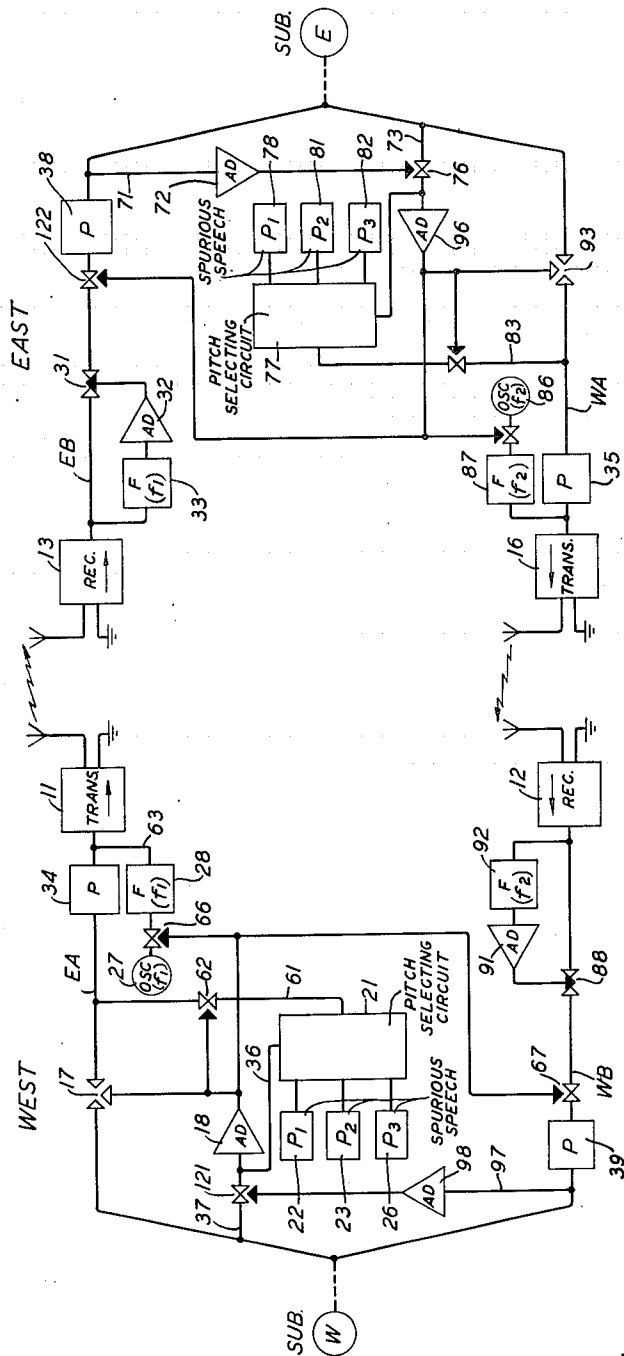
2,107,756

PRIVACY SYSTEM

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3 Sheets-Sheet 1

FIG. 1



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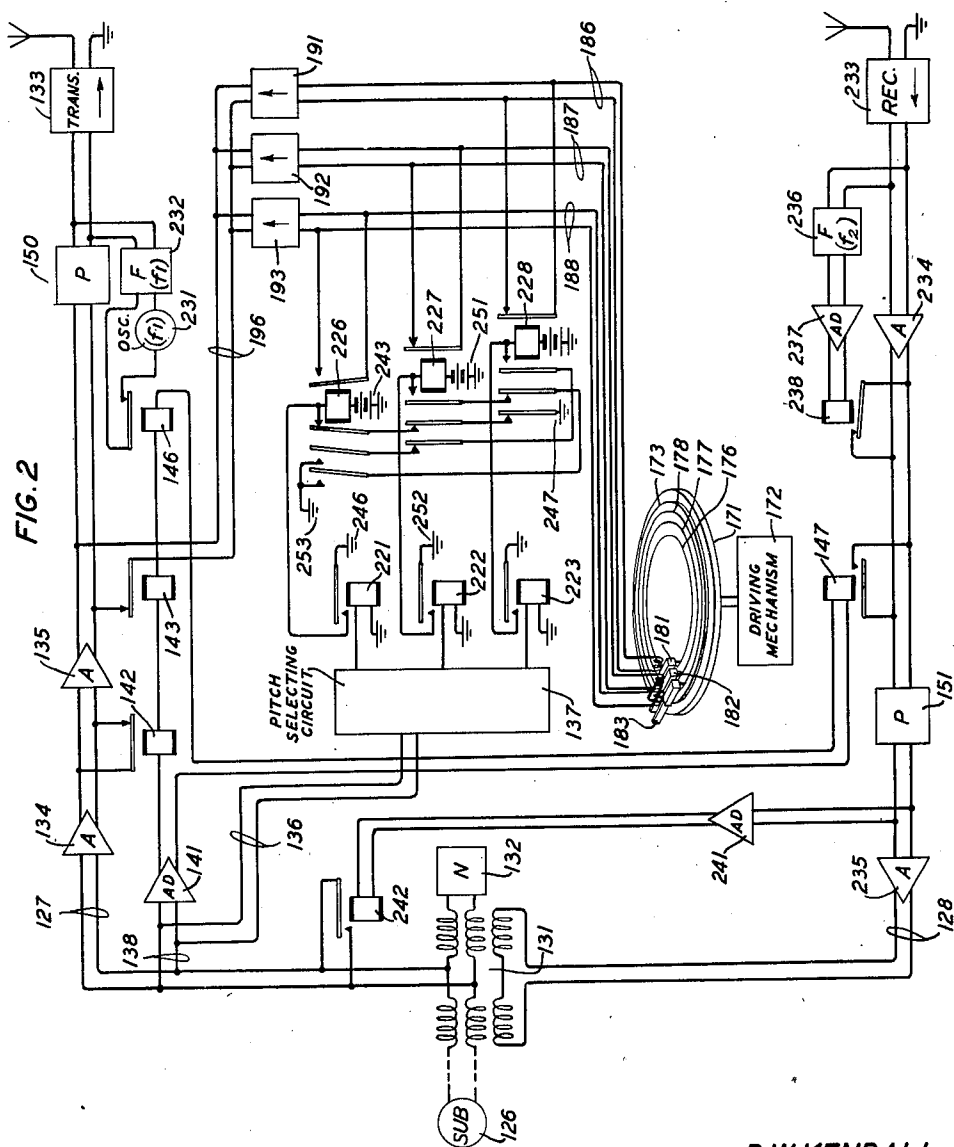
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PRIVACY SYSTEM

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3 Sheets-Sheet 2



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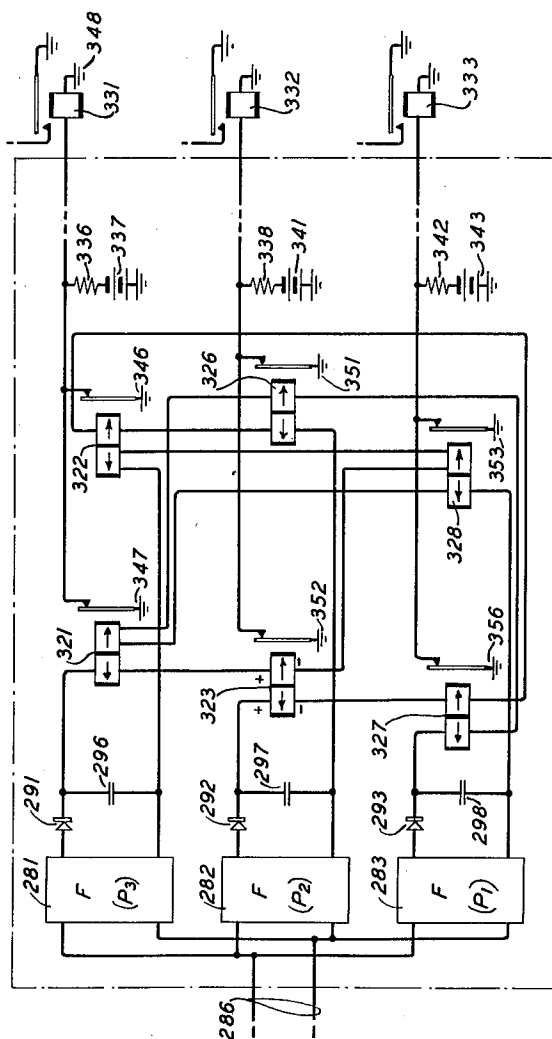
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PRIVACY SYSTEM

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3 Sheets-Sheet 3

FIG. 3



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PRIVACY SYSTEM

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Application May 15, 1937, Serial No. 142,815

9 Claims. (Cl. 179—1.5)

This invention relates to a transmission system and particularly to a method of and means for assuring secrecy in the transmission of messages.

An object of the invention is to disguise or mask the transmitted messages so as to render reception of the messages by unauthorized listeners very difficult.

In accordance with a feature of the invention spurious speech is applied to the transmission channel during the "silent" periods, i. e., when the regular talkers are not speaking, whereby there is present on the channel a practically continuous jargon composed of the useful speech and the spurious speech, the useful speech being so blended with the spurious speech that interpretation of the message by unauthorized listeners will be very difficult.

In accordance with a further feature of the invention the jargon applied to the channel is rendered even more confusing and difficult to interpret by unauthorized listeners as the spurious speech applied to the channel is of a pitch closely simulating the pitch of the useful speech with which it is interspaced.

In accordance with a specific embodiment of the invention a phonograph record is provided having several individual sound tracks thereon each of which is a record of spurious speech of a different characteristic pitch. A suitable "pick-up" unit is associated with each sound track. During the silent intervals, i. e., when the regular talker at the substation is not speaking, spurious speech from the phonograph record is applied to the transmission channel, a pitch selective circuit being provided which is effective to select for application to the channel the output of the particular pick-up unit which is associated with the sound track having recorded thereon spurious speech of a characteristic pitch most similar to the characteristic pitch of the regular talker's speech. During the time the spurious speech is applied to the channel, a control current is also applied thereto being effective to operate switching devices at the distant end of the channel in order to prevent the spurious speech from reaching the regular talker at the distant end. Upon the regular talker again speaking, voice operated devices function to remove the spurious speech from the channel, replacing it with the useful speech, and also to remove the control current from the channel thereby permitting completion of a transmission path to the regular talker at the distant end of the channel.

A full understanding of the operation of the arrangement contemplated by the invention as

well as appreciation of the various advantageous features thereof may be gained from consideration of the following detailed description in connection with the accompanying drawings in which:

Fig. 1 shows diagrammatically a two-way four-wire radio telephone system embodying features of the invention;

Fig. 2 shows in greater detail one terminal of the system diagrammatically illustrated in Fig. 1; and

Fig. 3 shows in detail the pitch selective circuit which is associated with the terminal equipment as indicated schematically in Figs. 1 and 2.

The diagram of Fig. 1 is not an actual circuit diagram but rather a single line layout, each line indicating a transmission path. In this layout a normal break in a path is indicated by separated arrowheads and a normal make by arrowheads in contact. To show that a transmission element is to be controlled by a device, an arrowhead points from the device towards the element. An arrow directed at a make point indicates that the path will be disabled at that point by operation of the control device and an arrow directed at a break point indicates that the break in the path will be eliminated by operation of the control device. Two arrowheads shown actually separated or wedged apart by the third arrowhead indicates that a normal make point is in operated or open condition.

In Fig. 1 the arrangement contemplated by the invention is shown incorporated in a two-way four-wire circuit forming a part of a radio telephone system. The two terminals, "west" and "east", of the system are represented, the circuit at the "west" terminal comprising a one-way transmission circuit EA for connecting the output of subscriber's station W to the west-east radio transmitter 11 and a one-way transmission circuit WB for connecting the east-west radio receiver 12 to the input of subscriber's station W. Similarly at the east terminal, a one-way transmission circuit EB connects the west-east radio receiver 13 to the input of subscriber's station E while the output of the subscriber's station is connected to the east-west radio transmitter 16 by one-way transmission circuit WA.

The west terminal transmitting circuit EA is normally disabled (i. e. when the regular talker is not speaking) so far as the output of subscriber's station W is concerned, at control point 17 by suitable means, for example a short circuit applied by switching relays operating, in turn, under control of amplifier-detector 18. At this

time, however, spurious speech of appropriate pitch is selected by pitch selecting circuit 21 from a plurality of sources 22, 23 and 26, which may be phonographs for example, and applied to circuit EA and conducted thereover to radio transmitter 11. A control current f_1 produced by oscillator 27 is also applied to circuit EA at this time after being passed by filter 28. Pitch selecting circuit 21 acts in a manner to be described in detail subsequently to select from a plurality of sources spurious speech of a characteristic pitch most similar to the pitch of the useful speech which was last applied to circuit EA.

An unauthorized person "listening-in" at this time on the transmission from the west terminal, therefore, would hear only the spurious speech. In order that the authorized talker at subscriber's station E (east terminal) will not be subjected to this spurious speech, circuit EB is held open at control point 31 by suitable means, for example by a short circuit applied through operation of a switching relay. The switching relay, in turn, may be controlled through amplifier-detector 32 which is operated by the control current f_1 transmitted from the west terminal and passed to the amplifier-detector through filter 33.

The privacy arrangement of this invention may be used to advantage in conjunction with other types of privacy arrangements which are now well known, such an arrangement being indicated schematically at 34 of circuit EA, 35 of circuit WA, 38 of circuit EB and 39 of circuit WB. Among the privacy devices commonly used at present are the so-called "band splitting" type and the so-called "speech inverter" type. Full disclosures of two well-known types of privacy devices are furnished respectively by R. W. Chesnut et al. Patent 1,829,783 and D. Mitchell et al. Patent 1,981,114.

Let it be assumed now that the regular talker at subscriber's station W starts to speak. A part of the resulting voice currents is shunted through line 37 to amplifier-detector 18 and to pitch selecting circuit 21 through line 36.

The part of the energy passed by line 36 to pitch selecting circuit 21 causes the circuit to operate (in a manner which will be described in detail subsequently) to select and associate with line 61 the output of that particular one of the plurality of spurious speech sources 22, 23 and 26 which most nearly approximates, with respect to characteristic pitch, the speech of the regular talker at subscriber's station W.

The part of the speech energy passed by line 37 to amplifier-detector 18, after rectification thereby, causes operation of switching relays effective to (a) remove the short circuit at control point 17 thereby "enabling" circuit EA for transmission of speech energy from subscriber's station W to radio transmitter 11, (b) open or "disable" line 61 at control point 62 thereby removing the spurious speech from circuit EA, (c) open or disable line 63 at control point 66 thereby removing control current f_1 from circuit EA, and (d) open or disable circuit WB at control point 67 thereby preventing echoes and singing.

Removal of control current f_1 from the transmission channel results in "enabling" circuit EB at control point 31, the circuit previously having been held open or "disabled" at this point due to the action of control current f_1 passed by filter 33 to amplifier-detector 32. A circuit is now established, therefore, from radio receiver 13 to subscriber's station E.

The useful speech from subscriber's station W

passes, therefore, over circuit EA to radio transmitter 11, is radiated therefrom, picked up by radio receiver 13 and passed over circuit EB to subscriber's station E. A portion of the received speech energy is shunted by line 71 through amplifier-detector 72 and causes, through operation of a switching relay or other suitable means, "disabling" or opening of line 73 at control point 76. This prevents undesirable operation of the transmitting controls of the east terminal by echoes.

When the regular talker at subscriber's station W ceases to speak, the circuits immediately return to the condition illustrated and spurious speech is again applied to the transmission channel. Due to the action of pitch selecting circuit 21 previously referred to, the spurious speech now applied to the line closely simulates with respect to characteristic pitch the useful speech previously transmitted. An unauthorized listener, therefore, upon gaining access to the west-east transmission channel would hear a practically continuous jargon comprised partly of useful speech and partly of spurious speech. Interpretation of the message by recognition of the useful portions and mental masking of the spurious portions is rendered much more difficult by the fact that the spurious speech is so selected that the characteristic pitch thereof closely simulates the characteristic pitch of the useful speech. The message is therefore rendered private so far as unauthorized listeners are concerned. As pointed out above, however, the spurious speech is not allowed to reach the distant authorized talker (due to the action of the control current f_1), only the useful speech portions reaching his station. Transmission and reception from one authorized person to another is not interfered with in any way by the privacy feature of the invention therefore.

As pointed out above, the privacy arrangement invented by applicants may advantageously be used in conjunction with other well-known types of privacy arrangements thereby making it even more difficult for unauthorized persons to interpret the message.

The circuits for east-west transmission function in a manner similar to that described above. For example, when the regular talker at station E is not speaking, spurious speech of appropriate pitch selected by pitch selecting circuit 77 from sources 78, 81 and 82 is applied over line 83 to circuit WA and conducted thereby to east-west radio transmitter 16. Control current f_2 produced by oscillator 86 is also applied to circuit WA after being passed by filter 87.

An unauthorized person "listening-in" on the transmission from the east terminal to the west terminal at this time, therefore, would hear only the spurious speech. In order that the regular talker at subscriber's station W be not subjected to this unwanted speech, circuit WB is "disabled" or held open at control point 88 by suitable means, for example, a short circuit applied through operation of a switching relay. The relay in turn may be controlled through amplifier-detector 91 which is operated by the control current f_2 emanating from source 86 and passed to amplifier-detector 91 through filter 92.

Upon the regular talker at subscriber's station E speaking, the circuits operate in a manner similar to that described above in connection with west-east transmission, circuit WA being "enabled" for useful speech transmission at control point 93 due to the action of amplifier-

detector 96, the spurious speech and the control current f_2 being removed from the line and circuit WB (west terminal) being "enabled" at control point 88 (through removal of the control current f_2) for transmission of the useful speech to the regular talker at subscriber's station W. A portion of the speech energy is shunted by line 97 through amplifier-detector 98 and causes line 37 to be opened or "disabled" at control point 121. Circuit EB is opened or "disabled" at control point 122 at this time also.

Upon the regular talker at station E ceasing to speak the circuits immediately return to the condition illustrated and spurious speech of a characteristic pitch closely simulating that of the regular talker's speech is again applied to the line. An unauthorized listener gaining access to the east-west channel therefore hears only the same meaningless jargon as is heard by unauthorized listeners on the west-east channel. Due to the action of the means controlled through amplifier-detector 91, however, the regular talker at station W receives only the useful speech and is not subjected to the spurious speech.

Referring now to Fig. 2, a more detailed showing is set forth of one of the terminals, for example, the west terminal, of the system illustrated in Fig. 1. Subscriber's station 126 is coupled to the transmitting line 127 and the receiving line 128 by transformer 131, network 132 serving to provide a proper balance in the well-known manner. Speech energy emanating from subscriber's station 126 follows three parallel paths, one over transmitting line 127 through amplifiers 134 and 135 to radio transmitter 133, a second over line 136 to pitch selecting circuit 137 and a third over line 138 through amplifier-detector 141 to relays 142, 143, 146 and 147. (The pitch selecting circuit 137 is shown in detail in Fig. 3 and will be described subsequently in connection with that figure.) Privacy arrangements 150 (transmitting) and 151 (receiving) may be of any well-known type, for example the type disclosed in D. Mitchell et al. Patent 1,981,114.

A phonograph turntable 171 and suitable driving means 172 therefor are provided, phonograph record 173 being rotatably supported on turntable 171. The phonograph record has three individual sound tracks 176, 177 and 178 recorded thereon each sound track being a record of spurious speech having a different characteristic pitch. For example, we shall designate the pitch of track 176 as P_1 , the pitch of track 177 as P_2 , and the pitch of track 178 as P_3 ; P_1 representing "low" pitch, P_2 representing "medium" pitch and P_3 representing "high" pitch. Associated with each sound track is a phonograph pick-up device, pick-up 181 being associated with sound track 176, pick-up 182 with sound track 177 and pick-up 183 with sound track 178.

The respective output paths 186, 187 and 188 of the pick-up units, after leading through respective one-way transmission devices 191, 192 and 193, are connected in parallel to common output line 196 which is connected under certain circuit conditions to transmitting line 127.

The operating windings of relays 221, 222 and 223 are associated with pitch selecting circuit 137; this circuit acting in such a way (manner of operation will be described subsequently with reference to Fig. 3) that one of these three relays will be operated depending upon the characteristic pitch of the regular talker's speech transmitted over line 136. For example, we may

assume that relay 223 will operate if the pitch of the regular talker's speech be P_1 , that relay 222 will operate if the pitch of the regular talker's speech be P_2 and that relay 221 will operate if the pitch of the regular talker's speech be P_3 ; P_1 , P_2 and P_3 representing low pitch, medium pitch and high pitch as before.

Relays 221, 222 and 223 control respectively by their operation, operation of relays 226, 227 and 228. Each of the three last-mentioned relays controls through the right break contact, a short-circuiting path for the respective output lines, 188, 187, 186, of pick-up devices 183, 182 and 181. From the subsequent description it will be apparent that two of these output paths are at all times short-circuited due to the action of relays 226, 227 and 228 leaving the output of only one of the pick-up units effective for transmission to common line 196. Determination of the output path which is effective at any particular instant is dependent upon which of the three relays 221, 222, 223 controlled by pitch selecting circuit 137 has been last operated.

A suitable source of constant frequency current 231 is provided which may be, for example, a vacuum tube oscillator. The output of source 231 is connected to line 127 through the break contact of relay 146, filter 232 also being included in the output circuit. This filter may be of the type well known in the art and described, for example, by Patent 1,227,113, issued May 22, 1917 to G. A. Campbell and is designed to pass only a small band of frequencies including the control frequency f_1 .

Radio receiver 233 is connected to receiving line 128 which line, in turn, is associated with subscriber's station 126 by transformer 131, amplifiers 234 and 235 being included in the line. A path in shunt to line 128 is provided through filter 236 which filter is designed to pass only a small frequency band including frequency f_2 , the frequency of the control current transmitted from the distant terminal. The current passed by filter 236 is rectified by amplifier-detector 237 and controls operation of relay 238. A second path in shunt to line 128 passes through amplifier-detector 241 and relay 242.

For purposes of further description, the actual operation of the circuits illustrated in Fig. 2 will now be described in detail. The circuit condition illustrated is that existing when the regular talker is not speaking. Line 127 is "disabled", so far as the output from subscriber's station 126 is concerned, by the short circuit applied through the break contact of relay 142.

It will be assumed that relay 221 was operated when the useful speech was last removed from the transmission channel (through action of pitch selecting circuit 137, the operation of which will be described subsequently) it being assumed that the useful speech last applied to the transmission channel was of the "high" pitch which we have designated P_3 . Operation of relay 221 established an energizing path for relay 226 traced from battery 243, winding of relay 226, make contact of relay 221 to ground 246, relay 226 operating over this circuit and locking-up over a circuit traced from battery 243, winding of relay 226, left inner make contact of relay 226, left center break contact of relay 227, left outer break contact of relay 228 to ground 247. Due to the operated position of relay 226 (remaining operated over the locking circuit), the short circuit normally applied through the right break contact to line 188 is removed so that the output

of pick-up 183 is effectively associated with line 196 and thereafter with transmitting line 127. It will be remembered that pick-up 183 is associated with the "high" pitch (P_3) sound track so that spurious speech of pitch P_3 , the pitch of the useful speech last applied, is now applied to transmitting line 127.

Pick-up 181 (P_1) and pick-up 182 (P_2) are not effectively associated with line 196 at this time, their output lines 186 and 187 being short-circuited by paths completed respectively through the right break contacts of relays 228 and 227.

Control current f_1 is applied to line 127 at this time also over a path completed through the break contact of relay 146, filter 232 being included in this path.

At this time therefore spurious speech of pitch P_3 and the control current f_1 are supplied to radio transmitter 133 over line 127 and radiated thereby to the radio receiver of the distant terminal.

The receiving circuits of the distant terminal which are not illustrated are the same as the receiving circuits of the terminal illustrated in Fig. 2, and it is believed that the effect of the currents transmitted by radio transmitter 133 upon the receiving circuits of the distant terminal may be better understood if we transfer our attention for the present to the receiving channel of Fig. 2 and assume that spurious speech of pitch P_3 is being received thereby from the radio transmitter of the distant terminal (corresponding to radio transmitter 133) as well as a control current f_2 (corresponding to control current f_1).

Control current f_2 received by radio receiver 233 from the distant terminal is passed by filter 236, which is designed to pass a small band including this particular frequency, and after rectification by amplifier-detector 237 is effective to cause operation of relay 238. At this time, therefore, receiving line 128 is "disabled" by a short-circuiting path completed through the make contact of relay 238 and the received spurious speech is not transmitted to the subscriber's station 126.

Returning now to the transmitting channel of the terminal it will be understood from the above that the spurious speech radiated from transmitter 133 is picked up by the radio receiver of the distant terminal and that the control current f_1 is also picked up by the distant receiver and is effective to "disable" the receiving channel so that the distant talker is not subjected to the spurious speech.

An unauthorized person listening-in on the transmission at this time, therefore, hears only the spurious speech of "high" pitch (P_3).

Let us assume now that the regular talker at subscriber's station 126 starts to speak. The speech energy is divided between three shunt paths 127, 138 and 136.

The speech energy present in path 138, after rectification by amplifier-detector 141, is effective to cause operation of relays 142, 143, 146 and 147. Operation of relay 142 removes the short-circuiting path, previously completed through its break contact, thereby "enabling" line 127 for transmission of the speech energy to radio transmitter 133. Operation of relay 143 interrupts at its break contact the connection of line 196 to transmitting line 127 thereby removing the spurious speech from the transmitting channel. Operation of relay 146 interrupts at its break contact the connection of oscillator 231 to transmitting line 127 thereby removing the control current f_1 from the transmitting channel. Operation of relay 147 completes a short-

circuiting path through its make contact which "disables" receiving line 128 while the regular talker at station 126 is speaking thereby preventing echoes and singing.

The speech energy in shunt path 136 is transmitted to pitch selecting circuit 137 which functions in a manner to be described in detail subsequently to cause operation of either relay 221, 222 or 223 depending upon the pitch of the talker's speech. It will be recalled that in the instance previously described, relay 221 had operated, as the pitch of the talker's speech was "high" (P_3), and that as a result of operation of relay 221, relay 226 had been operated and had "locked-up". Let us assume now that the pitch of the speech applied through line 136 is medium (P_2), relay 222 therefore being operated. Operation of relay 222 completes an energizing circuit for relay 227 traced from battery 251, winding of relay 227, make contact of relay 222 to ground 252. Relay 227 upon operation (1) interrupts at its left center break contact, the locking circuit of relay 226 which relay thereupon drops back to normal position, (2) "locks-up" in operated position over a circuit traced from battery 251, winding of relay 227, left inner make contact of relay 227, left middle break contact of relay 228, left outer break contact of relay 226 to ground 253 and (3) interrupts at its right break contact the short-circuiting path previously applied to output line 187 of phonograph pick-up 182.

Relay 226 upon restoring to normal position reestablished through its right break contact the short-circuiting path for line 188 so that we now have only output line 187 effectively connected to line 196. Output line 187 is, as previously stated, associated with the "medium" pitch (P_2) source of spurious speech so that when line 196 is again connected to line 127, spurious speech of "medium" pitch (P_2) will be applied to the transmitting channel. It will be remembered, however, that relay 143 is operated at the present time so that spurious speech is not being applied to the transmitting channel.

During the actual time the regular talker at subscriber's station 126 is speaking, therefore, useful speech currents alone are radiated by radio transmitter 133 and received by the distant terminal radio receiver (corresponding to radio receiver 233). In view of the fact that the control current f_1 is not transmitted at this time, the receiving line (corresponding to line 128) at the distant terminal is "enabled" permitting reception of the useful speech by the distant talker. A portion of the received speech energy is passed through a shunt path and causes operation of a relay effective to "disable" a portion of the transmitting channel of the distant terminal thereby preventing undesirable operation of the transmitting controls by echoes. It is believed that these operations of the receiving circuits at the distant terminal may be better visualized if we again turn for the moment to consideration of the receiving channel of the terminal illustrated in Fig. 2 and assume that useful speech currents are being received from the distant radio transmitter, the spurious speech and the control current f_2 not being transmitted.

The absence of the control current f_2 results, of course, in relay 238 dropping back to normal, unoperated position (this relay was previously held operated by the control current f_2 after rectification by amplifier-detector 237) thereby removing the short-circuiting path previously com-

pleted through its make contact and "enabling" line 128 for transmission of the received useful speech to subscriber's station 126. A portion of the speech energy is shunted through amplifier-detector 241 and after rectification thereby is effective to cause operation of relay 242. Operation of relay 242 completes through its make contact a short-circuiting path which "disables" line 127 in order to prevent undesirable operation of the transmitter controls associated with station 126 by echoes.

Returning now to the transmitting channel, immediately upon the regular talker at subscriber's station 126 ceasing to speak, relays 142, 143, 146 and 147 drop back to their normal, unoperated positions illustrated and spurious speech and the control current f_1 are again applied to line 127 and radiated by radio transmitter 133. As pointed out above, relay 227 is now in operated position (due to previous operation of relay 222) so that the spurious speech applied now to the line is of "medium" pitch (P_2), that is the pitch simulating most nearly the pitch of the useful speech last applied to the transmission channel. Had the pitch of the useful speech last applied been "high" (P_3) relay 226 would have been operated thereby removing the short circuit from output line 188 associated with pick-up 183 (P_3) while if the pitch of the useful speech last applied had been "low" (P_1), relay 228 would have been operated thereby removing the short circuit from output line 186 associated with pick-up 181 (P_1). It will be apparent from examination of the operating circuits that only one of the three relays 226, 227 and 228, is operated at any one time, as operation of one of the relays interrupts the locking circuits of the other two.

In accordance with the features of the system operating as described above, therefore, the regular authorized talkers receive only the useful speech and are subjected to no spurious speech. Unauthorized persons "listening-in" on the channel, however, hear a meaningless substantially constant jargon comprising the useful speech interspaced, during what would otherwise be the "silent" periods, with the spurious speech. The spurious speech is, as pointed out above, so selected that it closely simulates with respect to characteristic pitch, the useful speech last applied to the line; application of useful speech of a different pitch immediately results in selection of spurious speech of a corresponding pitch which is applied to the channel upon disconnection of the useful speech. As a result of the above actions, intelligible reception of the message by unauthorized persons is very difficult.

Referring now to Fig. 3, a detailed showing is set forth of a pitch selecting circuit of the type shown schematically in Fig. 2. Three band pass filters 281, 282 and 283 are shown connected in parallel across line 286 (corresponding to line 136 of Fig. 2). These filters serve to divide the frequency range of the useful speech transmitted over line 286 into three smaller bands, it being assumed that filter 281 passes the "high" pitch (P_3) band, filter 282 the "medium" pitch (P_2) band and filter 283 the "low" pitch (P_1) band. A rectifier is associated with each of the three filters (rectifier 291 being associated with filter 281, rectifier 292 with filter 282 and rectifier 293 with filter 283) and serves to change the alternating current output therefrom into direct current. A shunt or "by-pass" is provided through

condensers 296, 297 and 298 for the alternating current components of the rectified current. Differential relays 321, 322, 323, 326, 327 and 328 are provided; their function and method of operation will be apparent from the subsequent description. The small arrows shown on these relays indicate by their direction the effect of current passing through the windings; for example, referring to relay 321, current passing through the left-hand winding tends to operate the relay, that is to move the armature to the left or away from the contact while current in the right-hand winding tends to oppose operation of the relay, i. e., to hold the armature in engagement with the contact as illustrated.

Casual inspection will reveal that the relays are so arranged that current from each filter passes through one winding of each of four relays, but that in each instance the current in two relays tends to operate the relays and in the other two relays tends to oppose operation thereof.

To the right of the broken-line enclosure, three relays 331, 332 and 333 are shown, relay 331 being associated with relays 321 and 322, relay 332 being associated with relays 323 and 326 and relay 333 being associated with relays 327 and 328. Relays 331, 332 and 333 correspond respectively to relays 221, 222 and 223 of Fig. 2.

Resistance 336 and battery 337 are associated with the line leading to relay 331, resistance 338 and battery 341 with the line leading to relay 332 and resistance 342 and battery 343 with the line leading to relay 333.

Let us assume that the useful speech transmitted over line 286 is of a predominately "high" (P_3) pitch, that is that maximum power is present in the frequency range passed by filter 281 and let us see how operation of relay 331 is accomplished (it will be remembered that in the description of Fig. 2, it was pointed out that relay 221, corresponding to relay 331, was operated when useful speech of "high" pitch (P_3) was applied to line 136, corresponding to line 286). It may be assumed, further, that the "medium" pitch (P_2) currents passed by filter 282 are next in power and that the "low" pitch (P_1) currents passed by filter 283 are the least powerful.

The current passed by filter 281, after rectification by rectifier 291, passes through the left winding (aiding) of relay 321, right winding (opposing) of relay 323, right winding (opposing) of relay 328 and left winding (aiding) of relay 322 and back to line 286. Now as the current through relays 321 and 322 is in the aiding direction, these two relays will tend to operate while as the current through relays 323 and 328 is in the opposing direction, these two relays will tend to remain unoperated.

Assuming for the moment that relays 321 and 322 operate, the short circuit previously applied to battery 337, over the respective paths, break contact of relay 322 to ground 346 and break contact of relay 321 to ground 347 is removed and an effective operating path for relay 331 traced from battery 337, resistance 336, winding of relay 331 to ground 348 is established. Relay 331 (corresponding to relay 221 of Fig. 2) therefore operates and brings about the desired operations in the associated circuits (as previously described, operation of relay 221, Fig. 2, results in operation of the associated relay 226).

Now let us see the effect upon the circuit of the medium powered current (P_2) and the low powered current (P_1) passed respectively by filters 282 and 283. The medium powered current

passed by filter 282, after rectification by rectifier 292, passes through the left-hand winding (aiding) of relay 323, right-hand winding (opposing) of relay 327, right-hand winding (opposing) of relay 322 and left-hand winding (aiding) of relay 326 and back to line 286. Now while this current passes through relays 323 and 326 in the aiding direction, only one of the relays, i. e. relay 326, operates, relay 323 being held from operating by the more powerful "high" pitch currents passing through the right-hand winding in the opposing direction. Therefore while the short-circuiting path previously applied to battery 341 through the break contact of relay 326 to ground 351 is interrupted, a short-circuiting path through the break contact of relay 323 to ground 352 is still applied so that an effective operating circuit for relay 332 is not established and the relay remains in non-operated position. The opposing effect of the medium powered current passing through the right-hand winding of relay 322 does not, of course, prevent operation of the relay by the more powerful current passing through the left-hand winding of the relay in the aiding direction.

Considering now the effect of the low powered current (P_1) passed by filter 283, this current, after rectification by rectifier 293, passes through the left-hand winding (aiding) of relay 327, right-hand winding (opposing) of relay 326, right-hand winding (opposing) of relay 321 and left-hand winding (aiding) of relay 328. None of the relays is operated by this current, the aiding effect in relays 327 and 328 being overcome by the opposing effect of the more powerful currents in the right-hand windings. Neither of the short-circuiting paths applied to battery 343 (break contact of relay 328 to ground 353 and break contact of relay 327 to ground 356) is interrupted therefore and an effective operating circuit for relay 333 is therefore not established. The opposing effect of the low powered current on relays 326 and 321 does not, of course, prevent their operation by the more powerful currents passing through the windings in the aiding direction.

It will be evident from the above that only one of the three relays 331, 332, 333 will operate, namely, that relay associated with the frequency range P_1 , P_2 or P_3 in which the power is maximum. It will be understood, further, that the circuit operates in a similar manner for other distributions of power. For example, should "medium" pitch (P_2) currents predominate, i. e. the frequency range passed by filter 282, relay 332 would be operated and should "low" pitch (P_1) currents predominate, i. e. the frequency range passed by filter 283, relay 333 would be operated.

While certain specific embodiments of the invention have been selected for illustration and detailed description, the invention is not, of course, limited in its application to these embodiments. For example the invention is applicable to systems other than a two-way four-wire radio telephone system, more than three (or less than three) sources of spurious speech may be provided, other pitch selective circuits may be utilized and so on. In short, those embodiments which have been selected for detailed description should be looked upon as illustrative of the invention and not as restrictive thereof.

A pitch selective circuit of the type described above is disclosed and claimed in the copending application of L. Schott and S. B. Wright, Serial

No. 142,832, filed May 15, 1937, entitled "Transmission circuit".

What is claimed is:

1. In a speech transmission system including a transmitter, a receiver, and a channel between said transmitter and said receiver, the method of maintaining secrecy during the transmission of speech from said transmitter to said receiver which comprises applying useful speech to said channel, selecting from a plurality of sources of spurious speech of different characteristic pitches that source most nearly approximating in characteristic pitch the useful speech and applying spurious speech from said selected source to said channel upon removal therefrom of said useful speech.

2. In a speech transmission system including a transmitter, a receiver and a channel between said transmitter and said receiver, the method of maintaining secrecy during the transmission of speech from said transmitter to said receiver which comprises impressing spurious speech on the channel during each pause in the useful speech whereby a practically continuous jargon is produced on the channel comprising periods of useful speech and periods of spurious speech following one another in close succession, each period of spurious speech being of a pitch closely simulating that of the immediately preceding period of useful speech.

3. In a speech transmission system including a transmitter, a receiver and a channel between said transmitter and said receiver, a source of useful speech waves, a plurality of sources of spurious speech each of a different characteristic pitch, means for applying useful speech waves to said channel, means for selecting the source of spurious speech of characteristic pitch most nearly like that of the useful speech waves, and means effective upon disconnection of said useful speech waves from the channel for applying spurious speech from said selected source to said channel.

4. In a speech transmission system including a transmitter, a receiver and a channel between said transmitter and said receiver, a source of useful speech waves, a plurality of records of spurious speech of different characteristic pitch, a pick-up device associated with each record, an output line for each pick-up device, means for applying useful speech waves to said channel, means for determining the record of spurious speech of a characteristic pitch most nearly like that of the useful speech waves, and means effective upon disconnection of said useful speech waves from the channel for connecting the output line of the pick-up device associated with the determined record to said channel.

5. In a speech transmission system including a transmitter, a receiver and a channel between said transmitter and said receiver, a source of useful speech, a plurality of records of spurious speech of different characteristic pitch, a translating device associated with each record, an output line for each translating device, means for connecting each of said output lines to said channel, means for applying useful speech to said channel and means for rendering one of said translating device output lines effective for transmission of spurious speech to said channel, the others of said translating device output lines being rendered ineffective for transmission to said channel.

6. In a speech transmission system including a transmitter, a receiver and a channel between

said transmitter and said receiver, a source of useful speech, a plurality of records of spurious speech of different characteristic pitch, a translating device associated with each record, an output line for each translating device, means for connecting each of said output lines to said channel, means for applying useful speech to said channel and means for rendering one of said translating device output lines effective for transmission of spurious speech to said channel, the others of said translating device output lines being rendered ineffective for transmission to said channel, said last-mentioned means operating in accordance with the pitch of the useful speech applied to said channel.

7. In a speech transmission system including a transmitter, a receiver and a channel between said transmitter and said receiver, a source of useful speech, a plurality of records of spurious speech of different characteristic pitches, a translating device associated with each record, an output line for each translating device, means for connecting each of said output lines to said channel, means for applying useful speech to said channel, means for analyzing the applied useful speech in order to determine the relative characteristic pitch thereof, a short-circuiting path applied to each of said translating device output lines for rendering said lines ineffective for transmission of spurious speech to said channel, and means operating under control of said analyzing means for removing the short circuit from one of said translating device output lines whereby said line is rendered effective for transmission of spurious speech to said channel.

8. In a speech transmission system including a transmitter, a receiver and a channel between said transmitter and said receiver, a source of useful speech, a plurality of records of spurious speech of different characteristic pitches, a translating device associated with each record,

an output line for each translating device, means for connecting each of said output lines to said channel, means for applying useful speech to said channel, means for analyzing the applied useful speech in order to determine the relative characteristic pitch thereof, a relay associated with each of said translating device output lines effective when in normal non-operated position to disable said line for transmission of spurious speech to said channel, and means operating under control of said analyzing means for causing operation of one of said relays whereby the associated translating device output line is enabled for transmission of spurious speech to said channel.

9. In a speech transmission system including a transmitter, a receiver and a channel between said transmitter and said receiver, a source of useful speech, a plurality of records of spurious speech of different characteristic pitches, a translating device associated with each record, an output line for each translating device, means for connecting each of said output lines to said channel, means for applying useful speech to said channel, means for analyzing the applied useful speech in order to determine the relative characteristic pitch thereof, a relay associated with each of said translating device output lines effective when in normal non-operated position to disable said line for transmission of spurious speech to said channel, and means operated under control of said analyzing means for causing operation of one of said relays whereby the associated translating device output line is enabled for transmission to said channel during idle message transmission periods, of spurious speech of pitch corresponding to that of the useful speech last applied to the channel.

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