Sept. 13, 1938. D. MITCHELL 2,129,860

PRIVACY SYSTEM

Filed May 15, 1937 4 Sheets-Sheet 1

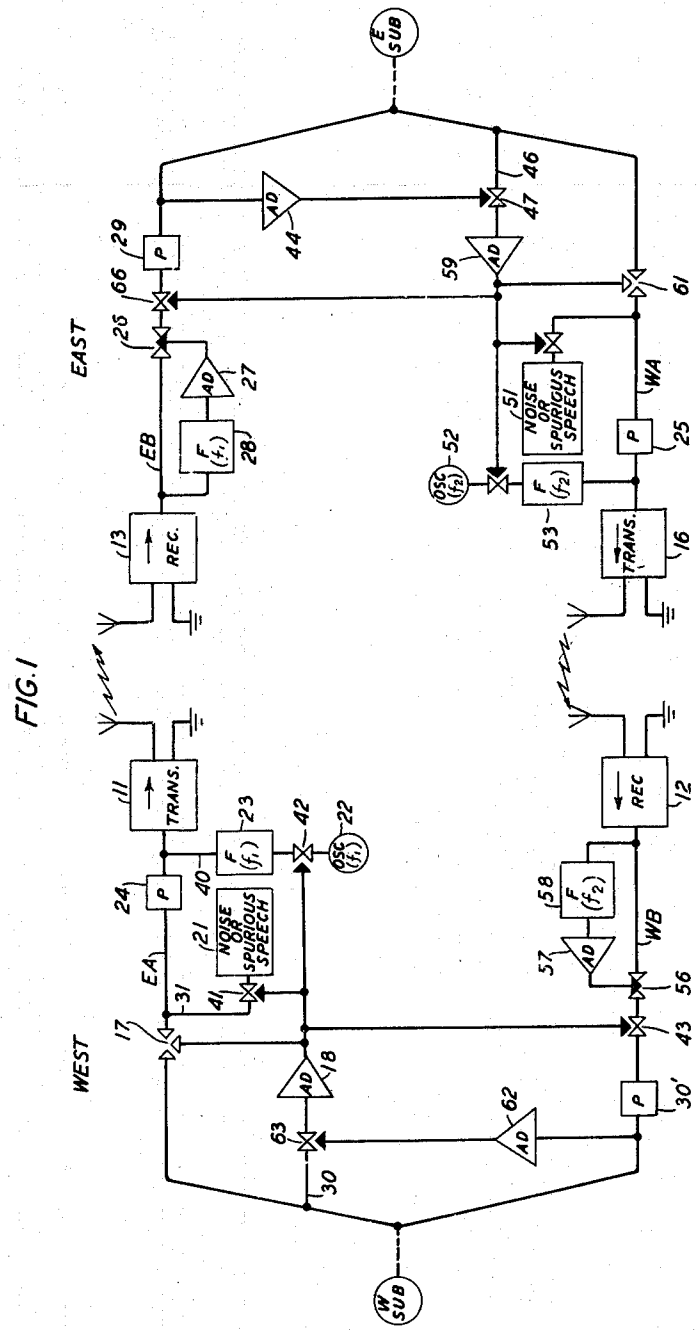

FIG. 1

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PRIVACY SYSTEM

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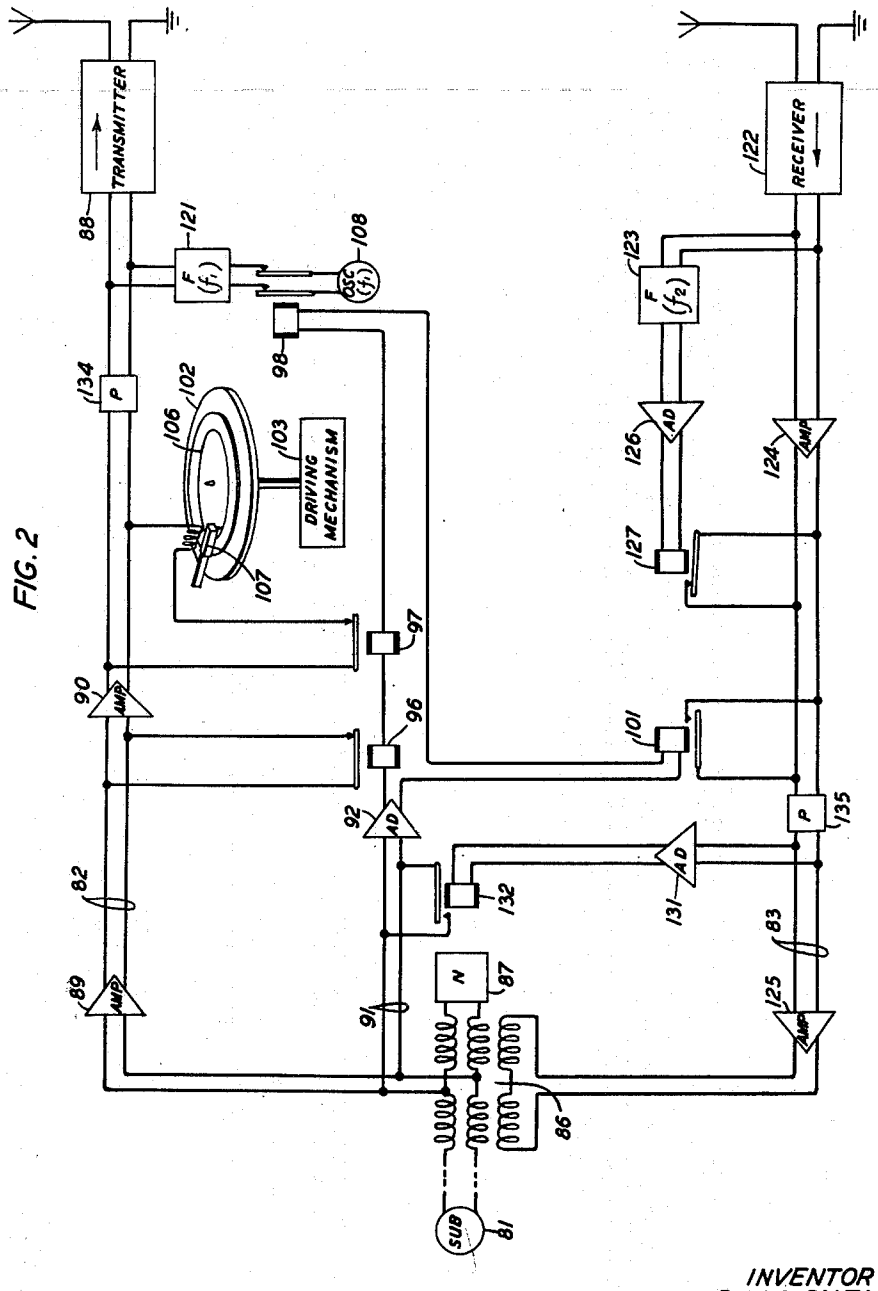

FIG. 2

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PRIVACY SYSTEM

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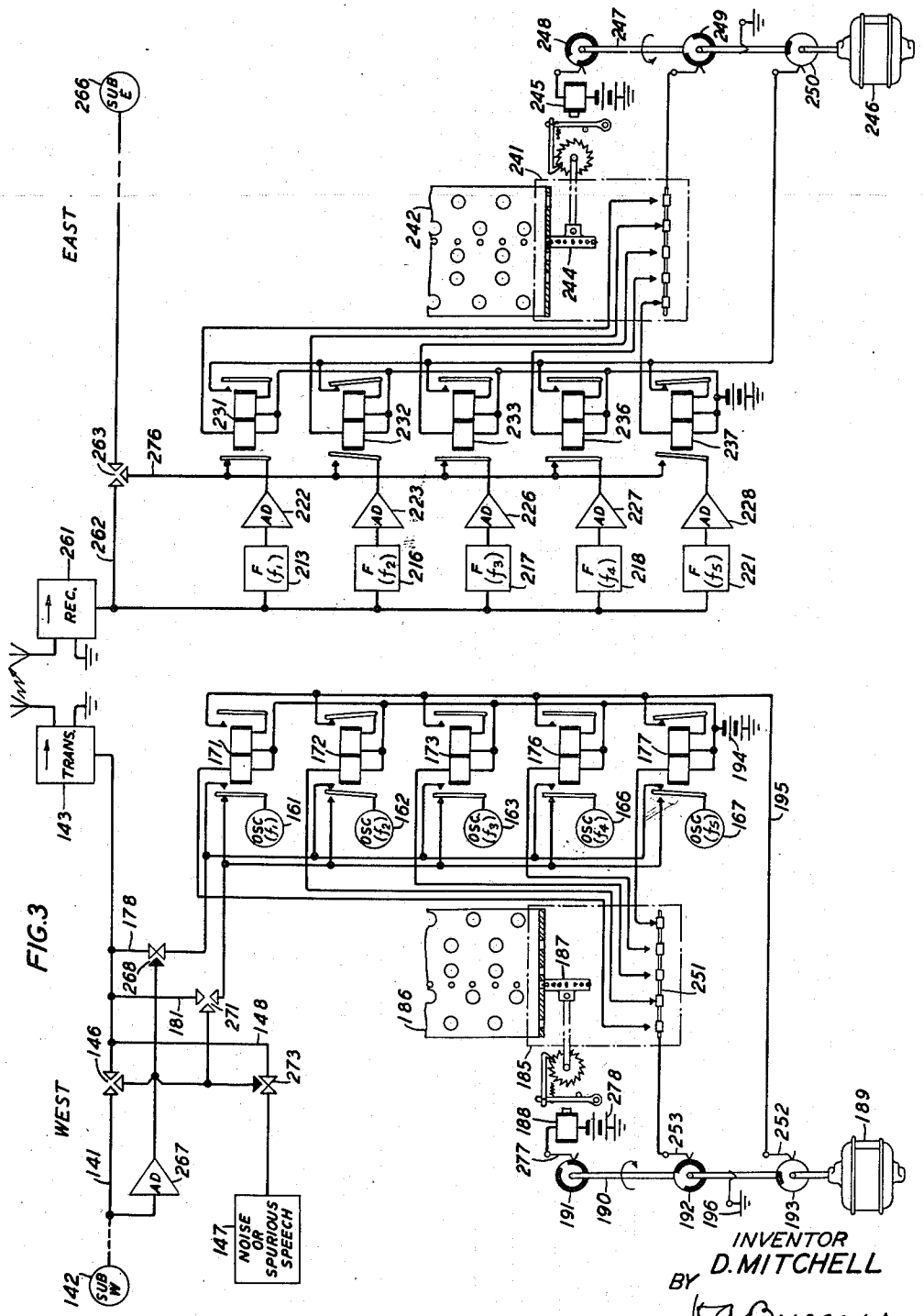

FIG.3

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PRIVACY SYSTEM

Filed May 15, 1937 4 Sheets-Sheet 4

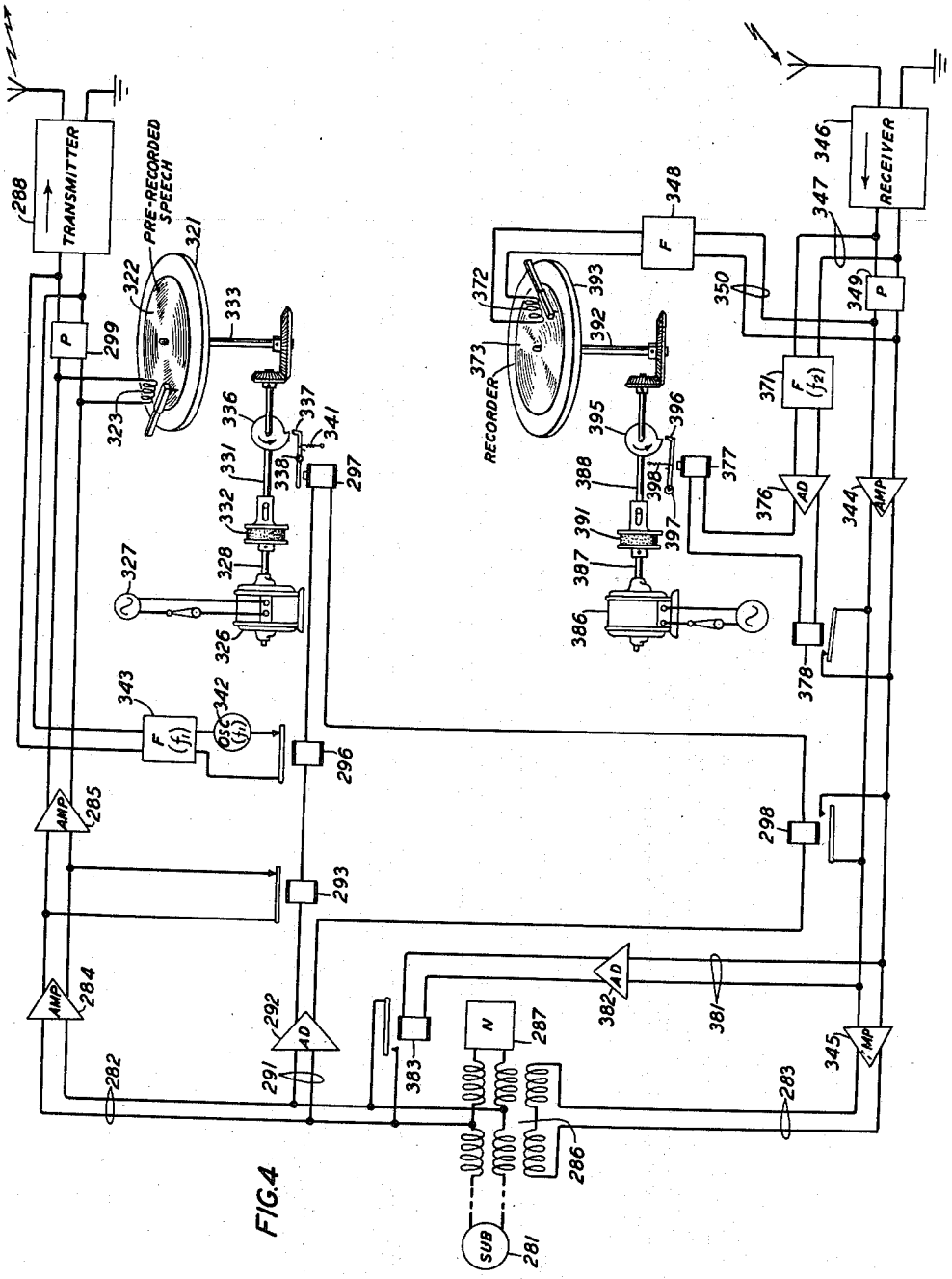

FIG. 4

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UNITED STATES PATENT OFFICE

2,129,860

PRIVACY SYSTEM

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Application May 15, 1937, Serial No. 142,816

23 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 the assurance of secrecy in the transmission of messages and the prevention of intelligible reception of the messages by unauthorized listeners.

In accordance with a feature of the invention noise or spurious speech is applied to the transmission channel during the silent intervals, i. e., when the regular talkers are not speaking, whereby there is produced on the channel a practically continuous train of sound composed of the useful speech and the noise or spurious speech. This train of sound will be in the nature of a meaningless jargon, the useful speech being so blended with the noise or spurious speech that it will be practically impossible for unauthorized listeners to interpret the message.

In accordance with a further feature of the invention means are provided for preventing the noise or spurious speech from reaching the authorized listener at the distant end of the channel thereby avoiding subjecting him to the annoyance and inconvenience of listening to the unwanted speech or noise.

In accordance with a further feature of the invention the frequency of a current used for certain control purposes is periodically changed whereby selection of the proper control current by unauthorized persons is rendered particularly difficult.

In accordance with a particular embodiment of the invention the output of a phonograph pick-up is connected to the line during the silent periods, i. e., when the regular talker is not speaking. Noise or spurious speech has previously been recorded on the phonograph record. At this same time a control current is applied to the line, being effective to operate switching devices at the distant terminal in order to prevent the noise or spurious speech from reaching the regular talker at the distant end of the channel. Upon the regular talker speaking, voice operated devices function to remove the spurious speech from the line, replacing it with the useful speech, and also to remove the control current from the line thereby permitting completion of a transmission path to the distant talker.

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;

Fig. 3 shows diagrammatically a modification of the system shown in Fig. 1 in accordance with which a periodically changing control current is utilized; and

Fig. 4 shows one terminal of a system embodying features of a modification of the invention in accordance with which pre-recorded speech is transmitted when the regular talker is not speaking.

The diagrams of Fig. 1 and Fig. 3 are not actual circuit diagrams but rather single line layouts each line indicating a transmission path. In these layouts a normal break in a path is indicated by separated arrowheads and a normal make by connecting arrowheads. To show that a transmission element is to be controlled by a device, an arrow points from the device towards the element. An arrow directed to 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 normally 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 talkers are 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

controlled by switching relays operating, in turn, under control of amplifier-detector 18. At this time, however, noise or spurious speech from source 21, a phonograph for example, is applied to circuit EA and transmitted thereover to radio transmitter 11. A control current f_1 produced by oscillator 22 is also supplied to circuit EA after passing through filter 23.

The privacy arrangement invented by applicant 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 24 of circuit EA, 29 of circuit EB, 25 of circuit WA, and 30' 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.

An unauthorized person "listening-in" at this time on the transmission from the west terminal, therefore, would hear only the noise or spurious speech emanating from source 21 and, further, if the system included other types of privacy arrangements in addition to that invented by applicant, it would of course be necessary to overcome the masking effects thereof before the bare spurious speech in the form transmitted would be heard. In order that the authorized talker at subscriber's station E will not be subjected to this noise or spurious speech, circuit EB is held open at control point 26 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 27 which is operated by the control current f_1 emanating from source 22 and passed to the amplifier-detector through filter 28.

Let it be assumed now that the authorized talker at subscriber's station W speaks. A part of the resulting voice currents passes over line 30 through amplifier-detector 18 and causes the operation of switching relays which (*a*) remove the short circuit at control point 17 and "enable" circuit EA so far as the output from subscriber's station W is concerned, (*b*) open line 31 at control point 41 thereby disconnecting source 21 from the circuit, (*c*) open line 40 at control point 42 thereby removing the control current f_1 from the circuit and (*d*) open circuit WB at control point 43.

Removal from the circuit of control current f_1 results in "enabling" circuit EB at control point 26, the circuit previously being held open at this point, as pointed out above, by certain operations resulting from the passage of the control current f_1 through filter 28 to amplifier-detector 27.

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 speech energy is by-passed through amplifier-detector 44 and causes, through operation of a switching relay or other suitable means, disabling of line 46 at control point 47. This prevents undesirable operation of the transmitting controls of the east terminal by echoes.

When the regular talker at station W pauses in his speech, the circuits immediately return to the condition illustrated and spurious speech or noise is again applied to the line. An unauthorized listener therefore upon gaining access to the transmission channel would hear a practically continuous "jargon" comprised partly of useful speech and partly of noise or spurious speech. Interpretation of the message by recognization of the legitimate portions and mental masking of the spurious portions would be very difficult thereby rendering the message highly secret so far as unauthorized listeners are concerned. Interpretation will, of course, be even more difficult if the arrangement be used in conjunction with other types of privacy arrangements as the masking effects thereof must first be overcome. As pointed out above, however, the noise or spurious speech is not allowed to reach the distant authorized talker since control point 26 is held "open" by the tone f_1; only the actual message reaches his station. Reception of the message by the authorized person is not interfered with, therefore.

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, noise or spurious speech from source 51 is applied to circuit WA and transmitted thereover to the east-west radio transmitter 16. Control current f_2 produced by oscillator 52 is also applied to circuit WA after being passed by filter 53.

An unauthorized person "listening-in" at this time on the transmission from the east terminal to the west terminal would hear only the noise or spurious speech emanating from source 51. In order that the regular talker at station W will not be subjected to this noise, circuit WB is held open at control point 56 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 57 which is operated by the control current f_2 emanating from source 52 and passed to the amplifier-detector through filter 58.

Upon the regular talker at station E speaking, the circuits operate in a manner similar to that described above, circuit WA being "enabled" due to the action of amplifier-detector 59 for speech transmission at control point 61, the spurious speech or noise from source 51 and the control current f_2 being removed, and circuit WB being "enabled" at control point 56 (through removal of control current f_2) for transmission of the speech to the regular talker at station W. A portion of the speech energy is shunted through amplifier-detector 62 and causes line 30 to be disabled at control point 63. Circuit EB is opened or disabled at control point 66 at this time also.

Upon the regular talker at station E ceasing to speak the circuits immediately return to the condition illustrated and the spurious speech or noise 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. By the action of the means controlled through amplifier-detector 57 however, the regular talker at station W receives only the useful speech and is not subjected to the noise or spurious speech.

Referring now to Fig. 2 a more detailed showing is furnished of the apparatus at one terminal, for example the west terminal of the system illustrated in Fig. 1. Subscriber's station 81 is coupled to the transmitting line 82 and the receiving line 83 by transformer 86, network 87 serving to provide a proper balance in the well-

known manner. Speech energy emanating from subscriber's station 81 follows two parallel paths, one path 82 leading through amplifiers 89 and 90 to radio transmitter 88 and the other path 91 leading through amplifier-detector 92 and relays 96, 97, 98 and 101.

A phonograph turntable 102 and suitable driving mechanism 103 are provided, record 106 being rotatably supported on turntable 102. A pick-up device 107 is associated with record 106 and serves to translate the mechanical undulations on the record, which preferably represent spurious speech, into corresponding electrical undulations which may then be transmitted over line 82.

A suitable source of constant frequency 108, which may be, for example, a vacuum tube oscillator, is provided the output of which is connected to line 82 through wave filter 121. 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 so designed that it will pass only a small band of frequencies including the desired control current of a frequency f_1.

Radio receiver 122 is associated with receiving line 83 which line, in turn, is inductively coupled to subscriber's set 81 through transformer 86, amplifiers 124 and 125 being included in the line. A path in shunt to line 83 is provided through filter 123 which is designed to pass only a small frequency band including the control frequency f_2 transmitted from the distant terminal. The current passed by filter 123 is rectified by amplifier-detector 126 and controls operation of relay 127. A second path in shunt to line 83 passes through amplifier-detector 131 and relay 132.

Privacy devices 134 (transmitting) and 135 (receiving) may be of any of the well-known types, for example, the type disclosed in Patent 1,981,114 issued to applicant and another.

For purposes of further description the actual operation of the circuits illustrated in Fig. 2 will now be described in detail. The condition illustrated is that existing when the regular talker is not speaking. Line 82 is "disabled", so far as the output from subscriber's station 81 is concerned, by the short circuit path completed through the break contact of relay 96. Spurious speech or noise from record 106 is picked up by unit 107 and applied to line 82 over a circuit completed through the break contact of relay 97 while the control current f_1 produced by source 108 is applied to line 82 over a circuit completed through the two break contacts of relay 98, filter 121 being included in this circuit. The spurious speech or noise and the control current f_1 are therefore supplied over line 82 to radio transmitter 88 and radiated thereby to the distant radio receiver.

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 88 upon the distant terminal circuits may be better understood if we transfer our attention for the present to the receiving channel of Fig. 2 and assume that spurious speech or noise is being received thereby from the radio transmitter of the distant terminal (corresponding to radio transmitter 88) as well as a control current f_2 (corresponding to control current f_1). Control current f_2 received by radio receiver 122 from the distant terminal is passed by filter 123, which is designed to pass only this particular frequency, and after rectification by amplifier-detector 126, is effective to cause operation of relay 127. At this time, therefore, receiving circuit 83 is "disabled" by a short-circuiting path completed through the make contact of relay 127 and the spurious speech or noise is not transmitted to the subscriber's station 81.

Returning now to the transmitting channel of the terminal it will be understood from the above that the spurious speech or noise radiated from transmitter 88 is picked up by the radio receiver of the distant terminal and that the control current f_1 is also picked up by the receiver and is effective to "disable" the receiving channel so that the distant talker is not subjected to the spurious speech or noise.

Assuming now that the regular talker at station 81 starts to speak. A portion of the speech energy passes over line 91 and after rectification by amplifier-detector 92, is effective to cause operation of relays 96, 97, 98 and 101.

Operation of relay 96 interrupts the short-circuiting path previously established through its break contact, line 82 now being "enabled" therefore for transmission of the speech currents from station 81 to radio transmitter 88.

Operation of relay 97 interrupts at its break contact the path which previously connected the output of phonograph pick-up 107 to line 82 and the spurious speech or noise produced by record 106 is now removed from the transmitting channel.

Operation of relay 98 interrupts at its break contacts the path previously connecting the output of oscillator 108 to line 82, control current f_1 also being now removed from the line.

Operation of relay 101 completes a short-circuiting path through its make contact which "disables" line 83 while the regular talker at station 81 is speaking thereby assuring against interruption and confusion should the distant talker also start speaking as well as preventing echoes and singing.

During the actual time the regular talker is speaking, therefore, useful speech currents alone are radiated by radio transmitter 88 and received by the distant terminal radio receiver (corresponding to radio receiver 122). In view of the fact that the control current f_1 is not transmitted at this time the receiving line (corresponding to line 83) 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 these operations of the receiving circuits at the distant terminal may best be 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 or noise and the control current f_2 not being transmitted.

The absence of the control current f_2 results of course in relay 127 falling back to unoperated position (this relay was previously held operated by control current f_2 after rectification by amplifier-detector 126) thereby removing the short-circuiting path previously completed through its make contact and "enabling" line 83 for transmission of the received speech to subscriber's sta-

tion 81. A portion of the speech energy is shunted through amplifier-detector 131 and, after rectification thereby, is effective to cause operation of relay 132. Operation of relay 132 completes through its make contact a short-circuiting path which "disables" line 91 in order to prevent undesirable operation of the transmitting controls associated with station 81 by echoes.

Immediately upon the regular talker at station 81 ceasing to speak, relays 96, 97, 98 and 101 drop back to the unoperated positions illustrated and the spurious speech or noise and the control current f_1 are again applied to line 82 and radiated by radio transmitter 88. Therefore in accordance with the features of the system, operating as described above, the regular authorized talkers receive only the useful speech and are subjected to no noise or spurious speech. Unauthorized persons "listening-in" on the channel, however, hear a meaningless, substantially continuous jargon comprising the useful speech interspaced, during what would otherwise be silent periods, with the spurious speech or noise. As a result intelligible reception of the message by unauthorized persons is very difficult and unpleasant.

Referring now to Fig. 3 a modification of a part of the system is schematically illustrated. In accordance with this modification the outputs of a plurality of oscillators are combined to produce a complex frequency wave which is used as the control current. The frequency of this complex wave, further, is periodically changed in order to prevent unscrupulous persons "breaking" the privacy of the system by utilizing, in connection with their receiver, an amplifier-detector operating on the control current to remove the unwanted portion of the transmission, that is the spurious speech or noise.

In order to simplify the showing as much as possible only that part of the apparatus used in transmission from one station and reception at the other station is shown and, further, only parts of the system directly associated with the control current production and utilization have been shown. The system in so far as the general arrangement is concerned is the same as that described above and it is not considered necessary to again describe all the features of the present modification which are common to both systems.

In the condition illustrated in Fig. 3, that is when the regular talker at substation 142 is not speaking, line 141 which connects the substation to radio transmitter 143 is "disabled" at control point 146. Noise or spurious speech from source 147, a phonograph for example, is applied over line 148 to line 141 and conveyed thereover to radio transmitter 143. It will be noticed that in accordance with the present modification, the single control current source of the previous arrangement has been replaced by a plurality of oscillators 161, 162, 163, 166 and 167. Associated with each oscillator is one of a series of relays 171, 172, 173, 176 and 177. Certain of the make contacts of the relays are connected to line 141 by line 178 while the break contacts are connected to line 141 by line 181.

The operating circuits of relays 171, 172, 173, 176 and 177 are controlled through contacts of a telegraph tape transmitter 185 which may be of the type well known in the telegraph art, for example, the general arrangement may be as described in E. F. Watson Patent 2,055,567. The tape 186, which is punched to control the position of the contact fingers, is periodically stepped ahead by drive wheel 187 which is operated in turn by stepping magnet 188. Motor 189 drives shaft 190, discs 191, 192 and 193 being carried by the shaft.

In the condition illustrated in the drawings, it will be noticed that relays 172 and 177 are in operated position while relays 171, 173 and 176 are in non-operated position. Relays 172 and 177 are held in the operated position illustrated over locking paths traced from battery 194, the respective right-hand windings and right make contacts of the two relays, line 195, disc 193 to ground 196. The outputs of oscillators 162 (f_2) and 167 (f_5) are, therefore, applied over line 178 to line 141 at this time and conducted thereover to radio transmitter 143.

At the time the regular talker at station 142 is not speaking, therefore, and when tape transmitter 185 is in the position illustrated, radio transmitter 143 sends out noise or spurious speech from source 147 as well as a complex control current comprising frequencies f_2 from oscillator 162 and f_5 from oscillator 167.

Referring now for the moment to the receiving equipment at the east terminal, we have here five band-pass filters 213, 216, 217, 218 and 221 with respectively associated amplifier-detectors 222, 223, 226, 227 and 228. Filter 13 passes frequency f_1, filter 216 passes frequency f_2, filter 217 passes frequency f_3, filter 218 passes frequency f_4 and filter 221 passes frequency f_5. The output of each amplifier-detector is connected to an armature of a respective one of five relays 231, 232, 233, 236 and 237.

A tape transmitter 241 is provided at the east station which is similar in arrangement and operation to tape transmitter 185 at the west station. Tape 242 is driven by drive wheel 244 which is driven, in turn, by stepping magnet 245. Motor 246 drives shaft 247, discs 248, 249 and 250 being carried on the shaft.

The two motors 189 and 246, are provided with suitable control means whereby they are operated synchronously and the arrangement of the two tape transmitters is such that when relays 172 and 177 at the west station are operated, relays 232 and 237 at the east station will be operated and when relays 171, 173 and 176 at the west station are operated, relays 231, 233 and 236 at the east station will be operated.

As previously stated, noise or spurious speech is being sent out from radio transmitter 143 as well as a control current comprising frequencies f_2 and f_5. This control current is picked up by radio receiver 261, the spurious speech also being received of course. Line 262 is "disabled" at this time at control point 263 thereby preventing transmission of the spurious speech to substation 266.

The control frequency f_2 is passed by filter 216 to amplifier-detector 223 but as relay 232 is in operated condition a path is not provided over which the output of the amplifier-detector may be transmitted to cause operation of the control device at point 263 to closed or "enabled" position. The control frequency f_5 is passed by filter 221 to amplifier-detector 228 but as relay 237 is operated, here again no path is provided for operation of the control device at point 263.

Assuming now that the regular talker at station 142 starts speaking, a part of the speech energy passes through amplifier-detector 267 and operates control devices effective to (*a*) close or "enable" line 141 at control point 146 thereby closing a path for conveyance of the useful speech from station 142 to radio transmitter 143, (*b*)

interrupts or disables line 178 at control point 268 thereby disconnecting frequencies f_2 and f_5 from the line, (c) closes or "enables" line 181 at control point 271 thereby connecting frequencies f_1, f_3 and f_4 to line 141 and (d) opens line 148 at control point 273 thereby removing the noise or spurious speech from the line.

At this time therefore, i. e., when the regular talker at station 142 is speaking, we have sent out from radio transmitter 143 the useful speech as well as a control current comprising frequencies f_1, f_3 and f_4. Frequency f_1 is passed by filter 213 to amplifier-detector 222, frequency f_3 is passed by filter 217 to amplifier-detector 226 and frequency f_4 is passed by filter 218 to amplifier-detector 227 and as relays 231, 233 and 236 are in non-operated position, paths are provided through the respective break contacts to line 276 over which the outputs from the respective amplifier-detectors are applied to the control device at point 263. These output currents are effective to cause operation of the control device to close or "enable" line 262 at control point 263. The line is "enabled", therefore, for transmission of the useful speech to substation 266.

Immediately upon the talker at station 142 ceasing to speak the various elements of the circuit revert to the condition illustrated, noise or spurious speech from source 147 is reapplied to the line and the control current comprising frequencies f_1, f_3 and f_4 is replaced by that comprising frequencies f_2 and f_5 whereby line 262 is again opened or "disabled" at control point 263.

Assuming now that shaft 190 has been rotated sufficiently to bring the conductive portion of disc 191 into contact with spring 277, an operating circuit for stepping magnet 188 is momentarily established traced from battery 278, winding of stepping magnet 188, spring 277, conductive segment of disc 191, shaft 190 to ground 196, tape 186 being stepped ahead one space by operation of stepping magnet 188. The tape is now in position to allow the first, third and fourth (counting from the left) contact fingers of tape transmitter 185 to make contact with conductive bar 251, the other two contact fingers being held out of contact with the bar by imperforate portions of tape. A moment after this "presetting" of the tape transmitter, the insulated segment of disc 193 is brought into contact with spring 252 whereupon the holding circuits of relays 172 and 177 (to ground 196) referred to above are interrupted and the relays drop back to normal, unoperated position. Simultaneously, the conductive segment of disc 192 is brought into contact with spring 253, whereupon an operating path is completed for relay 176, traced from battery 194, left winding of relay 176, fourth contact finger from left of tape transmitter 185, contact bar 251, spring 253, conductive segment of disc 192, shaft 190 to ground 196. Similar operating paths for relays 173 and 171 are completed through the third contact finger from the left and the first contact finger from the left respectively of the tape transmitter, relays 176, 173 and 171 operating at this time therefore. Before the conductive segment of disc 192 breaks contact with spring 253, the conductive portion of disc 193 has again been brought into contact with spring 252 thereby establishing a holding circuit for relays 171, 173 and 176 (over conductor 195 to ground 196). At this same time, relays 231, 233 and 236 at the east station are operated due to the operation of tape transmitter 241 in synchronism with tape transmitter 185.

The operation of the arrangement is similar whichever group of relays is operated; the object of periodically changing the frequency combinations is, as pointed out above, to defeat the possible attempts of unscrupulous persons to remove the undesired spurious speech or noise by utilizing for this purpose an amplifier-detector operating on the control current. Obviously this would be difficult if a control current be utilized which is periodically changed with respect to its frequency characteristics. Thus it would often occur that the eavesdropper would make a mistake and use a wrong control current to operate his relay corresponding to 263. In this case he would hear spurious speech.

It will be appreciated that the showing of Fig. 3 is schematic and that only sufficient parts of the system necessary to illustrate the operation of the control current arrangement have been shown. The system, so far as the general features are concerned should be, preferably, as shown in Figs. 1 and 2 and as described in detail above.

In the instance of the arrangements described above, the material prerecorded on the phonograph record and impressed on the channel during the "silent" or "idle" intervals has been either noise or spurious speech, the transmission of which has served no useful purpose except in the attainment of secrecy. However, in accordance with the modification of the invention illustrated in Fig. 4, useful speech is prerecorded on the record and is impressed on and transmitted over the channel during the "silent" intervals, means being provided at the distant terminal for recording the speech as received. This modification has one particularly advantageous feature, namely, that the material transmitted during the "idle" intervals is not "wasted" after accomplishing the purpose of attaining secrecy but is recorded for future reference. The prerecorded matter may be, for example, a transcription of an address by some notable which it may be desired to transmit to some distant point during the next few hours after delivery, there to be recorded for various purposes such as rebroadcasting.

The arrangement disclosed in Fig. 4, is, in general, similar to that disclosed in Fig. 2 except for the changes occasioned by the fact that prerecorded useful speech is to be transmitted instead of spurious speech or noise and the fact that means for recording the transmitted prerecorded speech have been provided. Only one terminal of the system, for example, the west terminal, is disclosed; it will be understood that the distant terminal, that is, the east terminal, is of similar arrangement.

Subscriber's station 281 is coupled to the transmitting line 282 and the receiving line 283 by transformer 286, network 287 serving to provide a proper balance in the well-known manner. Speech energy emanating from subscriber's station 281 follows two parallel paths, one path 282 leading through amplifiers 284 and 285 to radio transmitter 288 and the other path 291 leading through amplifier-detector 292 to relays 293, 296, 297 and 298. Privacy device 299 may be of any of the well-known types, for example, the type disclosed in Patent 1,981,114 issued to applicant and another.

A phonograph turntable 321 is adapted to support a record 322 of prerecorded useful speech. Pick-up device 323 is operatively associated with record 322, the output of the pick-

up being connected to transmitting line 282. Motor 326 is provided, together with a suitable power source 327, shaft 328 being rotated by the motor. Shaft 328 is resiliently coupled to shaft 331 by clutch 332; shaft 331 is geared to the turntable drive shaft 333. A stop cam 336 provided with a peripheral shoulder is carried by shaft 331. Stop arm 337, which is rotatably mounted on pivot 338, is normally held out of engagement with the periphery of cam 336 by spring 341. Upon operation of relay 297, however, arm 337 is rotated about pivot 338 in a counter-clockwise direction, bringing the end of the arm into contact with the shoulder on cam 336 and preventing further rotation of the cam, thereby stopping turntable 321. This resilient driving arrangement is similar, in general, to that disclosed in Patent 2,055,567, issued September 29, 1936 to E. F. Watson.

A suitable source of constant frequency 342, a vacuum tube oscillator for example, is provided, the output of which is connected to transmitting line 282 through wave filter 343. Filter 343 is so designed that it will pass only a narrow band of frequencies including the desired control current of a frequency f_1.

Radio receiver 346 is associated with receiving line 283, which line in turn is inductively coupled to subscriber's station 281 by transformer 286, amplifiers 344 and 345 and receiving privacy device 349 being included in the line. A path 347 in shunt to line 283 leads to filter 371 and amplifier-detector 376. Path 350 leads to filter 348 and is also in shunt to line 283. Current passed by filter 348 traverses recording unit 372 which is operatively associated with recording blank 373. Current passed by filter 371, which is designed to pass only a narrow frequency band including control current of frequency f_2 transmitted from the distant terminal, is rectified by amplifier-detector 376 and operates relays 377 and 378. A third path 381 in shunt to receiving line 283 passes through amplifier-detector 382 and relay 383.

Motor 386 is provided, driving shaft 387, which is resiliently coupled to shaft 388 by clutch 391. Shaft 388 is geared to drive shaft 392 of the recorder turntable 393. Stop cam 395 which is carried by shaft 388, is provided with a peripheral shoulder. Stop arm 396, which is rotatably mounted on pinion 397, is normally urged into engagement with the periphery of stop cam 395 by spring 398. Relay 377 when operated, however, rotates stop arm 396 about pinion 397 in a clockwise direction out of engagement with cam 395. This resilient driving arrangement of the recorder is similar to that of the reproducer except for the fact that operation of the control relay 377 permits operation of the recorder while operation of the reproducer drive control relay 297 stops the reproducer.

For purposes of further description the actual operation of the circuits illustrated in Fig. 4 will now be described in detail. The condition illustrated is that existing when the regular talker at subscriber's station 281 is not speaking. Transmitting line 282 is "disabled", so far as the output from the subscriber's station is concerned, by the short-circuiting path completed through the break contact of relay 293. The control current f_1 produced by source 342 is applied to line 282 over the path completed through the break contact of relay 296. Prerecorded useful speech from record 322 is also applied to line 282, relay 297 being in normal unoperated condition and stop arm 337 being held out of the path of stop cam 336 by spring 341, allowing rotation of shafts 331 and 333 and, therefore, rotation of reproducer turntable 321. The control current f_1 and the prerecorded useful speech from record 322 are therefore applied to line 282, conducted thereover to radio transmitter 288 and radiated thereby to the distant terminal.

The receiving circuits of the distant terminal (not illustrated) are the same as the receiving circuits of the terminal illustrated in Fig. 4 and it is believed that the effect of the currents transmitted by radio transmitter 288 on the receiving circuits of the distant terminal may be better visualized if we turn our attention for the moment to the receiving channel of Fig. 4 and assume that prerecorded useful speech is being received by radio receiver 346 from the radio transmitter of the distant terminal (corresponding to radio transmitter 288) as well as the control current f_2 (corresponding to control current f_1).

The control current f_2 received by radio receiver 346 passes over line 347 and through filter 371, which is designed to pass only a narrow frequency band including frequency f_2, and, after rectification by amplifier-detector 376, causes the operation of relays 378 and 377. Operation of relay 378 completes through its make contact, a short-circuiting path for receiving line 283 which is therefore "disabled" at this point, thereby preventing transmission of the received current to subscriber's station 281. Operation of relay 377 rotates stop arm 396 out of the path of stop cam 395, thereby allowing rotation of recorder turntable 393. The received prerecorded useful speech passes over line 350 through filter 348 and actuates recorder unit 372. The received prerecorded useful speech is therefore recorded on record 373.

If desired the reproducer may be operated at a low speed so as to cause the output therefrom to occupy a smaller frequency range. In this case the recorder will also be operated at a low speed and filter 348 may be designed to pass only this small frequency range excluding noise in the unused portion of the frequency range. This will give a favorable signal-to-noise ratio and will tend to improve the quality of the recorded speech when selective fading is present. When the recorded speech is played back the record will, of course, be rotated at normal speed.

Returning now to consideration of the transmitting channel of the terminal illustrated in Fig. 4, it will be understood from the above that the prerecorded useful speech transmitted from record 322 is received and recorded at the distant terminal and that the control current f_1 is also received at the distant terminal, "disabling" a part of the receiving channel so that the regular talker at the distant terminal is not subjected to the prerecorded speech.

Let us assume now that the regular talker at subscriber's station 281 starts to speak. A portion of the resulting speech energy passes over line 291 and, after rectification by amplifier-detector 292, causes operation of relays 293, 296, 297 and 298.

Operation of relay 293 interrupts at its break contact the short-circuiting path previously applied to line 28[illegible], thereby "enabling" the line for transmission of speech energy from subscriber's station 281 to radio transmitter 288.

Operation of relay 296 interrupts, at its break contact, the path over which control current f_1 was previously applied to line 282, the control

current therefore being removed from the transmitting channel.

Operation of relay 297 causes rotation of stop arm 337 about its pivot 338 in a counter-clockwise direction, bringing the end thereof into engagement with the peripheral shoulder on stop cam 336, whereby further rotation of the cam as well as shaft 331 is prevented. The reproducer turntable 321 is stopped, therefore, and the prerecorded useful speech of record 322 is removed from the transmitting channel.

Operation of relay 298 completes through its make contact a short-circuiting path which "disables" receiving line 283 at this point, thereby assuring against interruption and confusion should the distant talker also start speaking as well as preventing echoes and singing.

During the time the regular talker at subscriber's station 281 is actually speaking, therefore, only currents originated by his speech are radiated by radio transmitter 288 and received by the radio receiver of the distant terminal (corresponding to radio receiver 346). In view of the removal from the channel of the control current f_1, the receiving line at the distant terminal (corresponding to line 283) is "enabled" for transmission of the received useful speech to the distant talker and the recorder turntable (corresponding to turntable 393) is stopped. 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 may best be visualized if we again turn for the moment to consideration of the receiving channel of the terminal illustrated in Fig. 4 and assume that currents originated by speech of the regular talker at the distant terminal are being received by radio receiver 346 from the radio transmitter of the distant terminal, the control current f_2 and the prerecorded useful speech not being transmitted.

The absence of the control current f_2 results, of course, in deenergization of relays 377 and 378, these relays previously having been held operated by the control current f_2 after rectification by amplifier-detector 376.

Relay 378 by dropping back to unoperated position removes the short-circuit path previously applied through its make contact to line 283, thereby "enabling" the line for transmission of the received useful speech to subscriber's station 281. A portion of the speech energy is shunted through path 381 and, after rectification by amplifier-detector 382, causes operation of relay 383. Relay 383 upon operation completes through its make contact a short-circuiting path which "disables" transmitting line 282 in order to prevent undesirable operation of the transmitting controls by echoes.

Relay 377 upon deenergization allows stop arm 396 to be rotated in a counter-clockwise direction by spring 398, bringing the end of the arm into engagement with the peripheral shoulder on stop cam 395 and preventing further rotation of the cam and of shafts 388 and 392. The recorder turntable 393 is therefore stopped, thereby preventing the recording on record 373 of any portion of the incoming speech energy which may chance to be passed by filter 348.

Immediately upon the regular talker at station 281 ceasing to speak, relays 293, 296, 297 and 298 drop back to the unoperated position illustrated, the reproducer is set into operation to impress upon the transmitting channel prerecorded useful speech from record 322, the control current f_1 is also reapplied to the transmitting channel, and the recorder at the distant terminal is set into operation. In accordance with this modification of the invention, therefore, unauthorized persons "listening-in" on the channel will hear a substantially continuous train of sound comprising the regular talker's speech interspaced, during what would otherwise be the "silent" periods with the unrelated prerecorded speech. The result will be, to say the least, confusing to the unauthorized listener and in many cases he will be unable to mentally "unscramble" the two sections of speech in order to intelligently interpret either. The authorized listeners, however, receive only the regular talker's speech. The prerecorded speech, in addition to serving as an aid to attaining privacy, is recorded as received at the distant terminal for future reference. As a matter of fact, the arrangement has commercial merit entirely apart from a privacy standpoint; it is commercially valuable also from the standpoint of attainment of a more continuous revenue paying use of the costly apparatus which is involved in long telephone circuits such as the transoceanic radio systems.

While certain specific embodiments of the invention have been selected for detailed description, the invention is not, of course, limited in its application to the embodiments described. These embodiments should be taken as illustrative of the invention and not as restrictive thereof.

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 impressing noise on the transmission channel during each pause in the speech whereby a practically continuous train of sounds is produced on the channel comprising periods of speech and periods of noise following one another in close succession.

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 transmission 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.

3. In a speech transmission system, a source of useful speech waves, a source of spurious speech waves, a transmission channel, means for applying spurious speech waves to said channel, means for applying useful speech waves to said channel, and means controlled by application of said useful speech waves to said channel for removing said spurious speech waves from said channel.

4. In a speech transmission system, a source of speech waves, a source of artificial noise currents, a transmission channel, means for applying noise currents to said channel, means for applying speech waves to said channel, and means controlled by application of said speech waves to

said channel for removing said noise currents from said channel.

5. In a signaling system, a transmission channel, a source of spurious signal waves, a source of useful signal waves, means at the sending end of said channel for applying spurious signal waves to said channel, additional means at the sending end of the channel for applying useful signal waves to said channel, said first-mentioned means being rendered ineffective to apply said spurious signal waves upon application of said useful signal waves by operation of the second-mentioned means, and means at the receiving end of the channel controlled from the sending end thereof for disabling a portion of said channel at the receiving end during application of the spurious signal waves at the sending end.

6. In a speech transmission system, a transmission channel, a phonograph record having spurious speech recorded thereon, means for driving said record, a pick-up device in operative relationship to said record, means for connecting the output of said pick-up device to said transmission channel whereby spurious speech waves are applied to said channel, means for applying useful speech waves to said transmission channel, and means controlled by application of said useful speech waves to said transmission channel for disconnecting the output of said pick-up device from said channel.

7. In a speech transmission system including an east terminal and a west terminal, a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at the east terminal, a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at the west terminal, means at the west terminal for disabling said line at the west terminal at a point intermediate said radio receiver and said telephone receiver, means at the east terminal for applying spurious speech waves to said line at the east terminal and for causing operation of said disabling means at the west terminal, said means at the east terminal being rendered ineffective to apply spurious speech waves or to cause operation of said disabling means upon application of useful speech waves to said line at the east terminal.

8. In a speech transmission system including an east terminal and a west terminal, a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at the east terminal, a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at the west terminal, a control device at the west terminal operable by current of a predetermined frequency to disable said line at a point intermediate said radio receiver and said telephone receiver, a source of spurious speech and a source of current of said predetermined frequency at the east terminal, means for applying spurious speech waves and current from said respective sources to said line at the east terminal for conductance to the radio transmitter and transmission thereby to the radio receiver at the west terminal, said means being rendered ineffective for application of the spurious speech waves and said current to said line upon application to said line of useful speech waves.

9. In a speech transmission system including an east terminal and a west terminal, a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at the east terminal, a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at the west terminal, a control device normally in a condition disabling said line at the west terminal at a point intermediate said radio receiver and said telephone receiver, said control device being operable by currents of a predetermined combination of frequencies to enable said line at said intermediate point, a source of spurious speech at the east terminal, a source of control current of said predetermined combination of frequencies at the east terminal, means for applying spurious speech waves to said line at the east terminal for conductance thereover to said radio transmitter and transmission thereby to said radio receiver, additional means for applying control current of said predetermined combination of frequencies to said line at the east terminal for conductance thereover to the radio transmitter and transmission thereby to said radio receiver, said first-mentioned means being rendered ineffective and said second-mentioned means being rendered effective upon application of useful speech waves to said line at the east terminal for conductance thereover to said radio transmitter and transmission thereby to said radio receiver.

10. In a speech transmission system including an east terminal and a west terminal, a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at the east terminal, a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at the west terminal, a control device normally in a condition disabling said line at the west terminal at a point intermediate said radio receiver and said telephone receiver, said control device being operable by current of certain predetermined combinations of frequencies to enable said line at said intermediate point, a plurality of groups of input circuits associated with said control device only one of which groups is connected to said device at one time, a source of spurious speech at the east terminal, a source of control current of certain predetermined combinations of frequencies at the east terminal, means for applying spurious speech waves to said line at the east terminal for conductance thereover to said radio transmitter and transmission thereby to said radio receiver, additional means for applying control current of a predetermined combination of frequencies to said line at the east terminal for conductance thereover to the radio transmitter and transmission thereby to said radio receiver, said first-mentioned means being rendered ineffective and said second-mentioned means being rendered effective upon application of useful speech waves to said line at the east terminal for conductance thereover to said radio transmitter and transmission thereby to said radio receiver, additional means at the east terminal for periodically changing the combination of frequencies applied to the line at the east terminal, and means at the west terminal for periodically changing the group of input circuits connected to said control device whereby it will be operable by the particular combination of frequencies applied at any particular instant to the line at the east terminal.

11. In a speech transmission system including a transmitter, a receiver, and a channel between said transmitter and receiver, the method of maintaining secrecy during the transmission of

speech as uttered by a talker from said transmitter to said receiver which comprises impressing speech unrelated to said uttered speech on the channel during each pause in the uttered speech whereby a substantially continuous train of sounds is produced on the channel comprising periods of speech as uttered and periods of unrelated speech following one another in close succession.

12. In a speech transmission system including a transmitter, a receiver, and a channel between said transmitter and receiver, the method of maintaining secrecy during the transmission of speech as uttered by a talker from said transmitter to said receiver which comprises impressing prerecorded speech unrelated to said uttered speech on the channel during each pause in the uttered speech whereby a substantially continuous train of sounds is produced on the channel comprising periods of speech as uttered and periods of unrelated speech following one another in close succession.

13. In a speech transmission system including an east terminal and a west terminal, a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at the east terminal, a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at the west terminal, a source of prerecorded speech at the east terminal, means for reproducing said prerecorded speech and for applying the resulting speech waves to said line at the east terminal for conductance thereover to the radio transmitter and radiation thereby to the radio receiver at the west terminal, a recorder at the west terminal for recording said speech waves, means at the east terminal for applying speech waves originating at said telephone transmitter to said line at the east terminal and control means effective upon application of said last-mentioned speech waves to said last-mentioned line to render said reproducing means and said recorder inoperative.

14. In a speech transmission system including an east terminal and a west terminal, a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at the east terminal, a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at the west terminal, a source of prerecorded speech at the east terminal, means for reproducing said prerecorded speech and for applying the resulting speech waves to said line at the east terminal for conductance thereover to the radio transmitter and radiation thereby to the radio receiver at the west terminal, a recorder at the west terminal for recording said speech waves, means at the east terminal for applying speech waves originating at said telephone transmitter to said line at the east terminal, and means for controlling the operation of said reproducing means and said recorder, said controlling means allowing operation of said reproducing means and said recorder during periods when said telephone transmitter is not operating to originate speech waves and preventing operation of said reproducing means and said recorder during periods when said telephone transmitter is operating to originate speech waves.

15. In a speech transmission system including a transmitter, a receiver, and a channel between said transmitter and said receiver, a plurality of privacy devices of different types operating in conjunction, one of which types is effective to impress noise on the transmission channel during each pause in the speech whereby a practically continuous train of sounds is produced on the channel comprising periods of speech and periods of noise following one another in close succession.

16. In a speech transmission system including a transmitter, a receiver, and a channel between said transmitter and said receiver, a plurality of privacy devices of different types operating in conjunction, one of which types is effective to impress spurious speech on the transmission channel during each pause in the speech whereby a practically continuous train of sounds is produced on the channel comprising periods of speech and periods of spurious speech following one another in close succession.

17. In a speech transmission system including an east terminal and a west terminal, a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at the east terminal, a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at the west terminal, a control device at the west terminal operable by current of a predetermined frequency to enable said line at a point intermediate said radio receiver and said telephone receiver, a source of spurious speech at the east terminal, a plurality of sources of currents of different frequencies at the east terminal, means for applying spurious speech waves from said source of spurious speech and current from one of said plurality of current sources to said line at the east terminal for conductance to the radio transmitter and transmission thereby to the radio receiver at the west terminal, said applied current being of a frequency different from that effective to operate said control device, said means being rendered ineffective for application of the spurious speech waves and said current to said line upon application to said line of useful speech waves.

18. In a speech transmission system including an east terminal and a west terminal, a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at the east terminal, a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at the west terminal, a control device at the west terminal operable by current of a predetermined frequency to enable said line at a point intermediate said radio receiver and said telephone receiver, a source of spurious speech at the east terminal, a plurality of sources of currents of different frequencies at the east terminal, means for applying spurious speech waves from said source of spurious speech and current from one of said plurality of current sources to said line at the east terminal for conductance to the radio transmitter and transmission thereby to the radio receiver at the west terminal, said applied current being of a frequency different from that effective to operate said control device, and means effective upon application of useful speech to said line for removing the spurious speech and the applied current from the line and for applying thereto current from another of said plurality of current sources, said last current being of the frequency effective to operate said control device.

19. In a speech transmission system including a transmitter, a receiver, and a channel between said transmitter and said receiver, a plurality of

privacy devices of different types operating in conjunction, one of which types is effective to impress speech unrelated to said uttered speech on the channel during each pause in the uttered speech whereby a substantially continuous train of sounds is produced on the channel comprising periods of speech as uttered and periods of unrelated speech following one another in close succession.

20. In a speech transmission system including an east terminal and a west terminal, a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at the east terminal, a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at the west terminal, a source of prerecorded speech at the east terminal, means for reproducing said prerecorded speech, said reproducing means being operated at a comparatively low speed causing the output therefrom to occupy a comparatively small frequency range, means for applying the resulting speech waves to said line at the east terminal for conductance thereover to the radio transmitter and radiation thereby to the radio receiver at the west terminal, a recorder at the west terminal for recording said speech waves, said recorder being operated at a speed comparable to the speed at which the reproducer is operated, means at the east terminal for applying speech waves originating at said telephone transmitter to said line at the east terminal and control means effective upon application of said last-mentioned speech waves to said last-mentioned line to render said reproducing means and said recorder inoperative.

21. In a speech transmission system including an east terminal and a west terminal, a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at the east terminal, a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at the west terminal, a control device at the west terminal operable by current of a predetermined frequency to enable said line at a point intermediate said radio receiver and said telephone receiver, a source of spurious speech at the east terminal, a plurality of sources of currents of different frequencies at the east terminal, an equal number of filters at the west terminal, a relay associated with each of said sources at the east terminal, a relay associated with each of said filters at the west terminal, means at the east terminal for causing the periodic operation of said relays in groups, one group including more than one of the relays and the other group including the rest of the relays, means at the west terminal for causing operation of said relays at said west terminal in groups corresponding to the group operation of the relays at the east terminal, means for applying spurious speech waves and current from one of said plurality of current sources to said line at the east terminal for conductance to the radio transmitter and transmission thereby to said radio receiver at the west terminal, said last-mentioned means being rendered ineffective upon application to said line of useful speech waves.

22. In a speech transmission system including an east terminal and a west terminal, a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at the east terminal, a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at the west terminal, a control device at the west terminal operable by current of a predetermined frequency to enable said line at a point intermediate said radio receiver and said telephone receiver, a source of spurious speech at the east terminal, a plurality of sources of currents of different frequencies at the east terminal, an equal number of filters at the west terminal, a relay associated with each of said sources at the east terminal, a relay associated with each of said filters at the west terminal, means at the east terminal for causing the periodic operation of said relays in groups, one group including more than one of the relays and the other group including the rest of the relays, said means comprising a tape controlled contact mechanism, means for presetting the tape thereof in contact controlling position, means effective after said presetting operation for completing the operating circuits of certain of said relays through predetermined combinations of the contacts of the tape controlled mechanism, and means becoming effective after completion of said operating circuits and before interruption thereof for establishing holding circuits for those relays operated through said previously mentioned means, means at the west terminal for causing operation of said relays at said west terminal in groups corresponding to the group operation of the relays at the east terminal, means for applying spurious speech waves and current from one of said plurality of current sources to said line at the east terminal for conductance to the radio transmitter and transmission thereby to said radio receiver at the west terminal, said last-mentioned means being rendered ineffective upon application to said line of useful speech waves.

23. In a speech transmission system including a transmitter, a receiver, and a channel between said transmitter and said receiver, a plurality of privacy devices of different types operating in conjunction, one of which types is effective to impress spurious speech on the transmission channel during each pause in the speech whereby a practically continuous train of sounds is produced on the channel comprising periods of useful speech and periods of spurious speech following one another in close succession, another of said privacy devices acting to change the characteristics both of said spurious speech and said useful speech.

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