

Aug. 13, 1946.

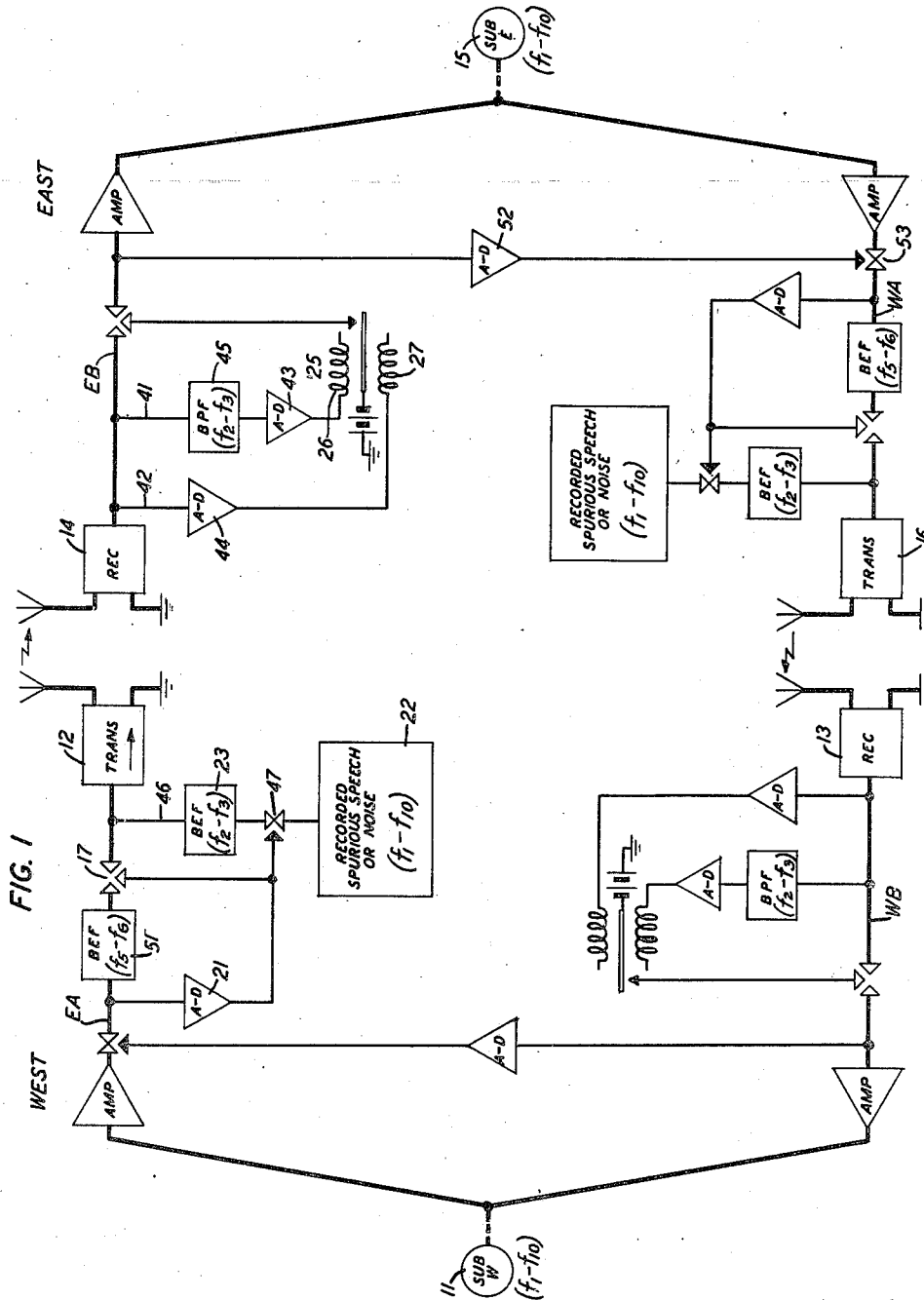
D. MITCHELL

2,405,599

PRIVACY SYSTEM

Filed Sept. 24, 1941

2 Sheets-Sheet 1



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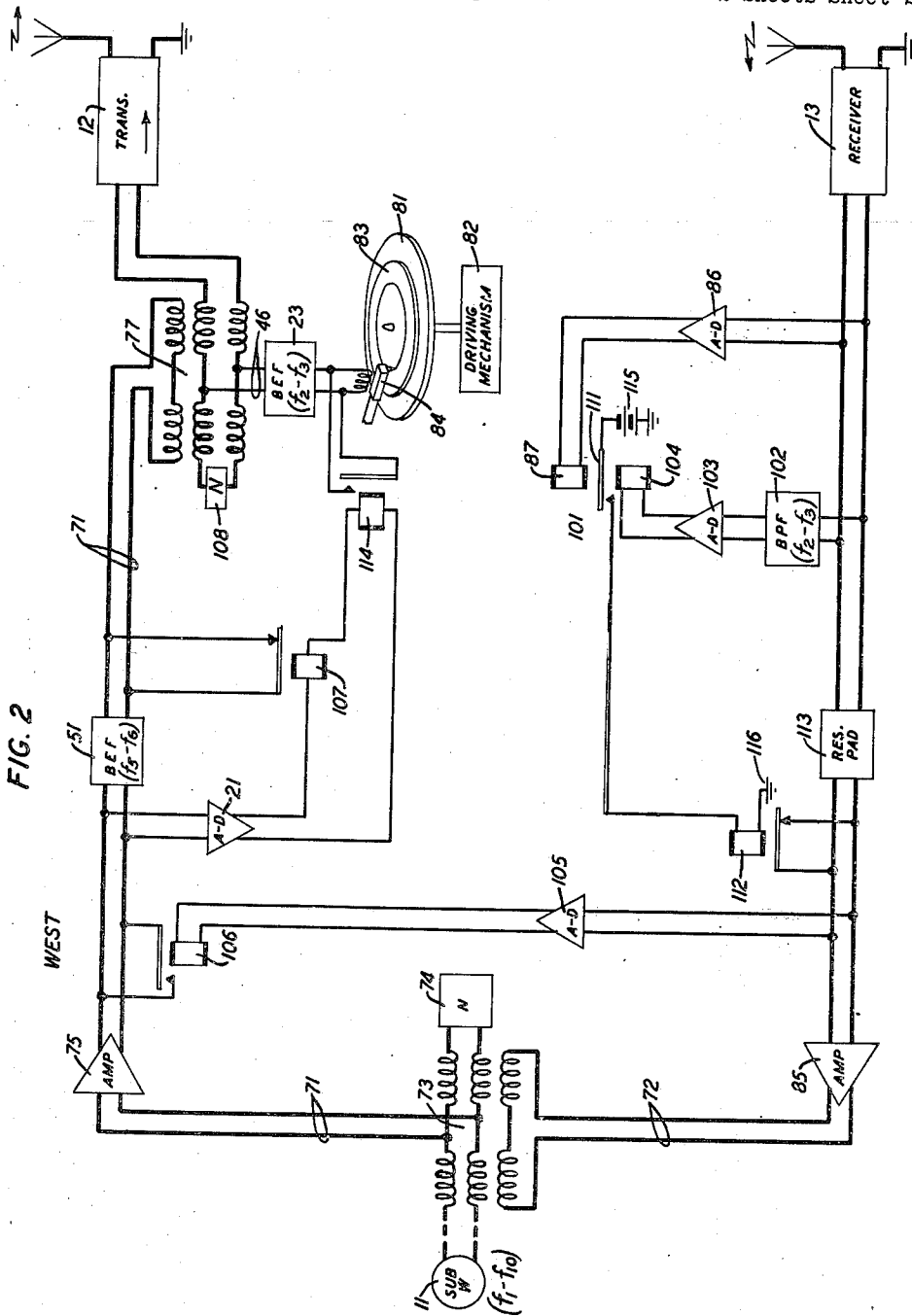
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PRIVACY SYSTEM

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7 Claims. (Cl. 179—1.5)

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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 message by unauthorized listeners.

Applicant has disclosed in an earlier patent (2,129,860, issued September 13, 1938), a privacy arrangement in accordance with which previously recorded 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 is 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.

The arrangement contemplated by the present invention is of the same general type as that disclosed by the above patent, but is an improvement over that prior arrangement in respects that will be pointed out subsequently.

In accordance with a feature of the present invention, the operation of the necessary switching devices is controlled by a small portion of the speech frequency band. As a result, signal frequencies outside the speech band, which were required in the instance of the prior arrangement referred to, are not necessary in the present arrangement.

In accordance with the general method of operation contemplated by the present invention the same frequency band is occupied by the spurious speech and the useful speech. The frequency spectrums of the two are caused to differ in a small but distinctive manner, however, and this difference is utilized at the receiving end of the channel to control operation of the necessary switching devices.

A full understanding of the operation of the arrangement contemplated by the present 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 illustrates schematically a two-way, four-wire radio telephone system embodying features of the present invention; and

Fig. 2 illustrates in greater detail one terminal

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of the system of Fig. 1.

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 connecting arrowheads. In order to indicate that a transmission element is to be controlled by a device, an arrow is shown pointing 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, i. e., the path will be enabled, by operation of the control device.

Referring now to 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 West subscriber's station 11 to the West-East radio transmitter 12 and a one-way transmission circuit WB for connecting the East-West radio receiver 13 to the input of West subscriber's station 11. Similarly, at the East terminal, a one-way transmission circuit EB connects the West-East radio receiver 14 to the input of East subscriber's station 15, while the output of subscriber's station 15 is connected to the East-West radio transmitter 16.

The West terminal transmitting circuit EA is normally disabled (i. e., when subscriber W is not speaking) so far as the output of subscriber's station 11 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 21. At this time, however, spurious speech from source 22, a phonograph for example, is applied to circuit EA and transmitted thereover to radio transmitter 12; radio transmitter 12 transmits this spurious speech to the East terminal.

An unauthorized person "listening-in" at this time on the transmission from the West terminal, therefore, would hear only the spurious speech emanating from source 22. In order to make things even more confusing to an unauthorized listener, the spurious speech may be recorded by the person ordinarily talking from subscriber's station 11 in order that the spurious speech and the useful speech may be "in the same voice."

The frequency band occupied by the useful speech and that occupied by the spurious speech are the same; this frequency band will be referred to as f_1-f_{10} .

Band elimination filter 23 is included in the path over which the spurious speech from source 22 is applied to circuit EA; this filter eliminates from the frequency band of the spurious speech a predetermined, relatively narrow, portion. The eliminated portion of the band will be referred to as f_2-f_3 .

In order that subscriber E, the authorized speaker at subscriber's station 15, may not be subjected to the spurious speech which is now being transmitted as described above, circuit EB is held open at point 24 by suitable means, for example a short circuit, applied and removed under control of differential relay 25. Relay 25 is provided with two windings—winding 26 energization of which tends to operate the armature "up" and winding 27 energization of which tends to operate the armature "down." When the armature is in the "down" position, as illustrated, circuit EB is open at point 24 but when the armature is operated to the "up" position, circuit EB is closed through or enabled at point 24; these operations will be described in detail in connection with Fig. 2.

Windings 26 and 27 are connected to circuit EB through respective lines 41 and 42, amplifier-detector 43 being connected in line 41 and amplifier-detector 44 being connected in line 42. Band-pass filter 45 is also included in line 41; this filter is designed to pass only a small band of frequencies including the portion f_2-f_3 of the spurious speech band which was eliminated by band elimination filter 23.

During the time spurious speech from source 22 is being received at the East terminal, the armature of relay 25 will be held in the "down" position as winding 27 will be energized by current rectified by amplifier-detector 44. Little or no energy will be supplied to winding 26 by amplifier-detector 43 in view of the fact that the portion of the frequency band passed by filter 45 (f_2-f_3) has been eliminated from the frequency band being transmitted.

Let us assume now that the authorized talker at West subscriber's station 11 speaks. A portion of the resulting speech currents passes through amplifier-detector 21 and, after rectification, causes operation of relays which (1) remove the short circuit at point 17 and enable circuit EA so far as the output of subscriber's station 11 is concerned and (2) open line 46 at point 47 thereby removing the spurious speech from the circuit.

The useful speech originating at subscriber's station 11 passes, therefore, over circuit EA to radio transmitter 12, is radiated therefrom and is picked up by radio receiver 14. A small portion f_5-f_6 of the useful speech band is eliminated by band elimination filter 51 in order to heighten the confusion between the useful speech and spurious speech and thereby increase the privacy. The eliminated portions f_5-f_6 and f_2-f_3 , while differing so far as their relative positions in the frequency spectrum f_1-f_{10} are concerned, are of equal width.

A portion of the received useful speech energy passes through line 42 to amplifier-detector 44 and after rectification is applied to winding 27 of relay 25. Portion f_2-f_3 of the useful speech band passes through filter 45 to amplifier-detec-

tor 43 and after rectification is applied to winding 26 of relay 25.

Amplifier-detectors 43 and 44 are so designed that the sensitivity of the first mentioned is appreciably greater than that of the second so that even though the energy of the portion f_2-f_3 is considerably less than that of the total band (which is applied to amplifier-detector 44) the rectified energy applied to relay winding 26 will be substantially greater than that applied to winding 27. Relay 25 will be operated to the "up" position, therefore, thereby enabling circuit EB at point 24 for transmission of the useful speech to subscriber E at subscriber's station 15. A portion of the speech energy is by-passed through amplifier-detector 52 and causes, through operation of a relay or other suitable means, disabling of circuit WA at point 53. This prevents undesirable operation of the transmitting controls of the East terminal by echoes.

When the regular talker at subscriber's station 11 ceases speaking, the circuits immediately return to the condition illustrated and spurious speech is again applied to the transmission channel. An unauthorized listener, therefore, upon gaining access to the 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 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. Confusion and frustration on the part of unauthorized listeners and persons attempting to "crack" the privacy system are heightened by the fact that both the useful speech band and the spurious speech band have similar, small portions eliminated therefrom and may be increased still further if the spurious speech and the useful speech be in the same voice.

Referring now to Fig. 2 a more detailed showing is provided of the West terminal of Fig. 1. Subscriber's station 11 is coupled to transmitting line 71 and receiving line 72 by transformer 73, network 74 providing a proper balance in the well-known manner. Speech energy emanating from subscriber's station 11 passes through amplifier 75 after which it follows two parallel paths, one path leading through amplifier-detector 21 and the other path leading through band elimination filter 51 and windings of transformer 77 to radio transmitter 12.

Phonograph turntable 81 is provided together with suitable driving mechanism 82, record 83 being rotatably supported on the turntable. A pick-up device 84 is operatively associated with record 83 and serves to translate the mechanical undulations on the record into corresponding electrical undulations for transmission over line 46. Record 83 preferably has recorded thereon spurious speech and this spurious speech may, as pointed out above, have been recorded in the voice of the subscriber who ordinarily talks from station 11. The frequency band occupied by the spurious speech is the same as that occupied by the speech energy which emanates from subscriber's station 11; for convenience this band is designated as f_1-f_{10} . The output of pick-up 84 is connected to windings of transformer 77 by line 46, band elimination filter 23 being included in this line. Filter 23 is so designed that it extracts or eliminates from the frequency band f_1-f_{10} a definite small portion which we will designate f_2-f_3 .

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It might be pointed out here that band elimination filter 51, which is included in line 71 and through which the speech energy emanating from subscriber's station 11 passes, is designed to eliminate from the frequency band f_1-f_{10} occupied by that energy a small portion of the band which is of the same width as that removed by filter 23 but which occupies a different relative position in the frequency spectrum; we shall designate the portion eliminated by filter 51 as f_5-f_6 .

Radio receiver 13 is associated with receiving line 72 which, in turn, is inductively coupled to subscriber's station 11 by transformer 73, amplifier 85 being connected in line 72. Two paths for speech energy are provided in shunt to line 72, one path leading through amplifier-detector 86 to winding 87 of differential relay 101 and the other path leading through band-pass filter 102 and amplifier-detector 103 to winding 104 of the differential relay. Band-pass filter 102 is designed to pass only a small band of frequencies including that portion of the frequency band f_1-f_{10} which is removed by band elimination filter 23, that is, the portion designated f_2-f_3 .

A third path for speech energy provided in shunt to receiving line 72 passes through amplifier-detector 105 to relay 106.

The condition illustrated in Fig. 2 is that prevailing when the regular talker at subscriber's station 11 is not speaking. Transmitting line 71 is "disabled" so far as the output of station 11 is concerned by the short-circuiting path completed through the armature and break contact of relay 107. Spurious speech from record 83 is picked up by unit 84 and applied over line 46 to windings of transformer 77. It will be recalled that the spurious speech occupies the band f_1-f_{10} and that the portion f_2-f_3 is removed from the energy supplied to transformer 77 by band elimination filter 23. The spurious speech, minus the portion f_2-f_3 , is, therefore, supplied to radio transmitter 12 by which it is transmitted to the distant receiving station. The arrangement of the windings of transformer 77 and network 108 associated therewith is such that this energy is not diverted through the short circuit applied to line 71 at the break contact of relay 107.

The receiving circuits of the distant terminal, which are not illustrated, are similar to the receiving circuits of the West terminal illustrated in Fig. 2 and it is believed that the effect of the currents transmitted by radio transmitter 12 upon the distant terminal circuits may be better visualized if we transfer our attention for the moment to the receiving circuits of Fig. 2 and assume that spurious speech (f_1-f_{10} minus the portion f_2-f_3) is being received from the radio transmitter of the distant terminal (corresponding to radio transmitter 12).

A portion of the energy received by radio receiver 13 and applied to receiving line 72 is diverted through amplifier-detector 86 and after rectification thereby is applied to winding 87 of differential relay 101. Substantially no energy is diverted through amplifier-detector 103 at this time as band-pass filter 102 is designed to pass only a small band of frequencies including the frequency portion f_2-f_3 and it will be remembered that this portion is missing from the spurious speech band being received. Armature 111 of relay 101 is operated to the up position, therefore, by energization of winding 87 and the energizing path of relay 112 is open. Receiving line 72 is, therefore, short-circuited at this time by a

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path including the armature and break contact of relay 112 and transmission of the spurious speech being received to subscriber's station 11 is prevented, and the subscriber, therefore, is subjected to no annoyance.

Resistance pad 113 provided in receiving line 72 is arranged to prevent the short circuit applied to the line at relay 112 from interfering with the transmission of received energy into the paths leading to amplifier-detectors 86 and 103.

Turning our attention again now to the transmitting circuits of Fig. 2 and assuming that the subscriber at station 11 starts talking, a portion of the speech energy applied to transmitting line 71 is diverted through amplifier-detector 21 and, after rectification thereby, causes operation of relays 107 and 114.

Operation of relay 107 removes the short circuit from line 71 and enables the line for transmission of the speech energy. Operation of relay 114 applies a short circuit to line 46 thereby disabling the line for transmission of the spurious speech. The spurious speech is, therefore, removed from the transmission channel and the useful speech being produced at subscriber's station 11 is applied thereto.

It will be remembered that the useful speech occupies the same frequency band (f_1-f_{10}) as that occupied by the spurious speech. A relatively small portion, f_5-f_6 , of the useful speech frequency band is removed by band elimination filter 51, this removed portion being of the same magnitude as the portion removed from the spurious speech band; the relative positions of the two removed portions in the respective frequency spectrums are different however. The arrangement of the winding of transformer 77 is such that transmission of the useful speech therethrough to radio transmitter 12 is not interfered with by the short circuit applied to line 46 by operation of relay 114.

At this time, therefore, the useful speech produced at subscriber's station 11 (minus the portion f_5-f_6) is transmitted over line 71 to radio transmitter 12 and transmitted thereby to the distant terminal. In order to better visualize the operation of the receiving circuits of the distant terminal which are not illustrated in Fig. 2, let us again consider the receiving circuits of the West terminal illustrated in Fig. 2 and assume that useful speech energy is now being received from the distant terminal and that the spurious speech is not being transmitted.

As before, a portion of the energy supplied to receiving line 72 by radio receiver 13 is diverted through amplifier-detector 86 and, after rectification thereby, energizes winding 87 of differential relay 101. At this time, however, energy is also diverted through amplifier-detector 103 as band-pass filter 102 passes a small band of frequencies including the portion f_2-f_3 of the frequency band and it will be recalled that this portion, while removed from the spurious speech band is present in the band of the useful speech transmitted. This latter energy, after rectification by amplifier-detector 103, energizes winding 104 of differential relay 101. Amplifier-detector 103 is designed for a substantially higher sensitivity than is amplifier-detector 86 so that, while the energy applied thereto may be less than that applied to amplifier-detector 86, the rectified energy applied to winding 104 will still be appreciably greater than that applied to winding 87. Armature 111 is, there-

fore, operated to its lower or make position at this time.

Operation of armature 111 to the lower position completes an operating path for relay 112 traced from battery 115, make contact of relay 101, winding of relay 112 to ground 116. Operation of relay 112 removes the short circuit from receiving line 72 and enables the line for transmission of the useful speech to subscriber's station 11. A portion of the energy is diverted through amplifier-detector 105 and, after rectification thereby, causes operation of relay 106 which operation is effective to short-circuit transmitting line 71 and prevent undesirable operation of the transmitting controls by echoes.

Again considering now the transmitting circuits of Fig. 2, as soon as the subscriber at station 11 ceases talking, the circuits return to the condition illustrated and spurious speech is again applied to the channel. In accordance with the general features of operation, therefore, the regular authorized subscribers hear only the useful speech and are not subjected to the spurious speech. Unauthorized persons "listening in" on the channel, however, hear a meaningless, substantially continuous jargon comprising snatches of useful speech, interspersed during what would otherwise be the "silent" periods, with the spurious speech. Confusion is heightened if the spurious speech be recorded in the voice of the subscriber who ordinarily talks from station 11 while "cracking" is rendered much more difficult by the fact that blank or "no-energy" portion are to be found in both the useful and the spurious speech bands due to the action of the band elimination filters.

If desired, the pass bands of the different filters may be changed from time to time thereby, in effect, varying the "combination" of the system and it will be understood that other types of sharply tuned circuits may be used instead of the filters. It will be understood, further, that the arrangement may be operated in conjunction with other types of privacy devices now well known, for example the arrangements described respectively by R. W. Chestnut et al. Patent 1,829,783 and Patent 1,981,114 of applicant and another.

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, a source of useful speech waves, a source of spurious speech waves, said useful speech waves and said spurious speech waves as produced by their respective sources occupying the same frequency band, a transmission channel, means for applying spurious speech waves from said source to said transmission channel, means for applying useful speech from said source to said transmission channel, means for removing a certain definite portion of the frequency band from the speech energy applied to said channel from one of said sources, means operating in response to application of said useful speech energy to said channel to remove said spurious speech from said channel, receiver means and means at a receiving point of the system selectively operated by wave components having frequencies in said certain definite portion of said frequency band

for controlling the operativeness of said receiver means.

2. In a speech transmission system, a source of useful speech waves, a source of spurious speech waves, said useful speech waves and said spurious speech waves as produced by their respective sources occupying the same frequency band, a transmission channel, means for applying spurious speech waves from said source to said transmission channel, means for removing a certain definite portion of the frequency band from the spurious speech energy applied to said channel, means for applying useful speech from said source to said transmission channel, means for removing a certain definite portion of the frequency band from the useful speech energy applied to said channel, means operating in response to application of said useful speech energy to said channel to remove said spurious speech from said channel, receiver means and means at a receiving point of the system selectively operated by wave components having frequencies in said definite portion removed from the frequency band of the spurious speech for controlling the operativeness of said receiver means, the portion of the frequency band removed from the spurious speech energy and the portion of the frequency band removed from the useful speech energy being of equal widths but occupying different relative positions in the respective frequency spectrums.

3. In a speech transmission system, including a West terminal and an East terminal, a source of useful speech waves at said West terminal, a source of spurious speech waves at said West terminal, said spurious speech waves and said useful speech waves as produced by said sources occupying the same definite frequency band, a transmission channel between said terminals, a line at said West terminal for applying spurious speech waves from said last-mentioned source to said channel, means included in said line for excluding a certain definite portion of the frequency band occupied by said spurious speech waves, means at said East terminal for disabling said transmission channel at a point at said East terminal, and means operating in response to application of said excluded portion of said frequency band to enable said channel at said point.

4. In a speech transmission system including a West terminal and an East terminal, a source of useful speech waves at said West terminal, a source of spurious speech waves at said West terminal, said useful speech waves and said spurious speech waves as produced by their respective sources being of confusingly similar sounds, a transmission channel between said terminals, means for applying useful speech waves from said source to said channel, and means for applying spurious speech waves from said source to said channel, means for removing a certain definite portion of the frequency band from the spurious speech energy applied to said channel whereby the frequency spectrum of the spurious speech waves transmitted over said channel is distinguishable from the frequency spectrum of the useful speech waves transmitted thereover, and switching means at the East terminal operating to distinguish between the useful speech waves and the spurious speech waves on the basis of the difference between the respective frequency spectrums.

5. In a speech privacy system of the type which includes a transmitting terminal, a re-

ceiving terminal, a channel between said terminals and means at the transmitting terminal for impressing spurious speech on the channel during each pause in the useful speech, the method of discriminating between the spurious speech and the useful speech at the receiving terminal which includes producing a distinguishable difference between the frequency spectrum of the useful speech and the frequency spectrum of the spurious speech at the transmitting terminal and utilizing this difference to control the operation of switching means at the receiving terminal.

6. In a speech transmission system including a West terminal and an East terminal, and having a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at said West terminal and a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at said East terminal, means for disabling said East terminal line at a definite point therein, a source of spurious speech at said West terminal, the spurious speech waves as produced by said source occupying the same frequency band as that occupied by useful speech waves as produced by said telephone transmitter, means for applying useful speech waves produced by said telephone transmitter to said West terminal line, a second line at said West terminal for applying spurious speech waves produced by said source to said first West terminal line, a wave filter in said second line for eliminating a definite, relatively small portion from the frequency band of the spurious speech waves applied thereover to said first West terminal line, and switching means at said East terminal operating only in response to application to said East terminal line of the

portion of the frequency band eliminated by said filter to enable said East terminal line at said previously mentioned point.

7. In a speech transmission system including a West terminal and an East terminal, and having a telephone transmitter, a radio transmitter and a line for connecting said telephone transmitter and said radio transmitter at said West terminal and a radio receiver, a telephone receiver and a line for connecting said radio receiver and said telephone receiver at said East terminal, means for disabling said East terminal line at a definite point therein, a source of spurious speech at said West terminal, the spurious speech waves as produced by said source occupying the same frequency band as that occupied by useful speech waves as produced by said telephone transmitter, means for applying useful speech waves produced by said telephone transmitter to said West terminal line, a second line at said West terminal for applying spurious speech waves produced by said source to said first West terminal line, a wave filter in said second line for eliminating a definite, relatively small portion from the frequency band of the spurious speech waves applied thereover to said first West terminal line, a two-position switching device at said East terminal, said device operating to a first position in response to application to said East terminal line of the spurious speech waves after removal of said portion by said filter and operating to a second position in response to application to said East terminal line of the useful speech waves, and means operating in response to operation of said device to said second position for enabling said East terminal line at said previously mentioned point.

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