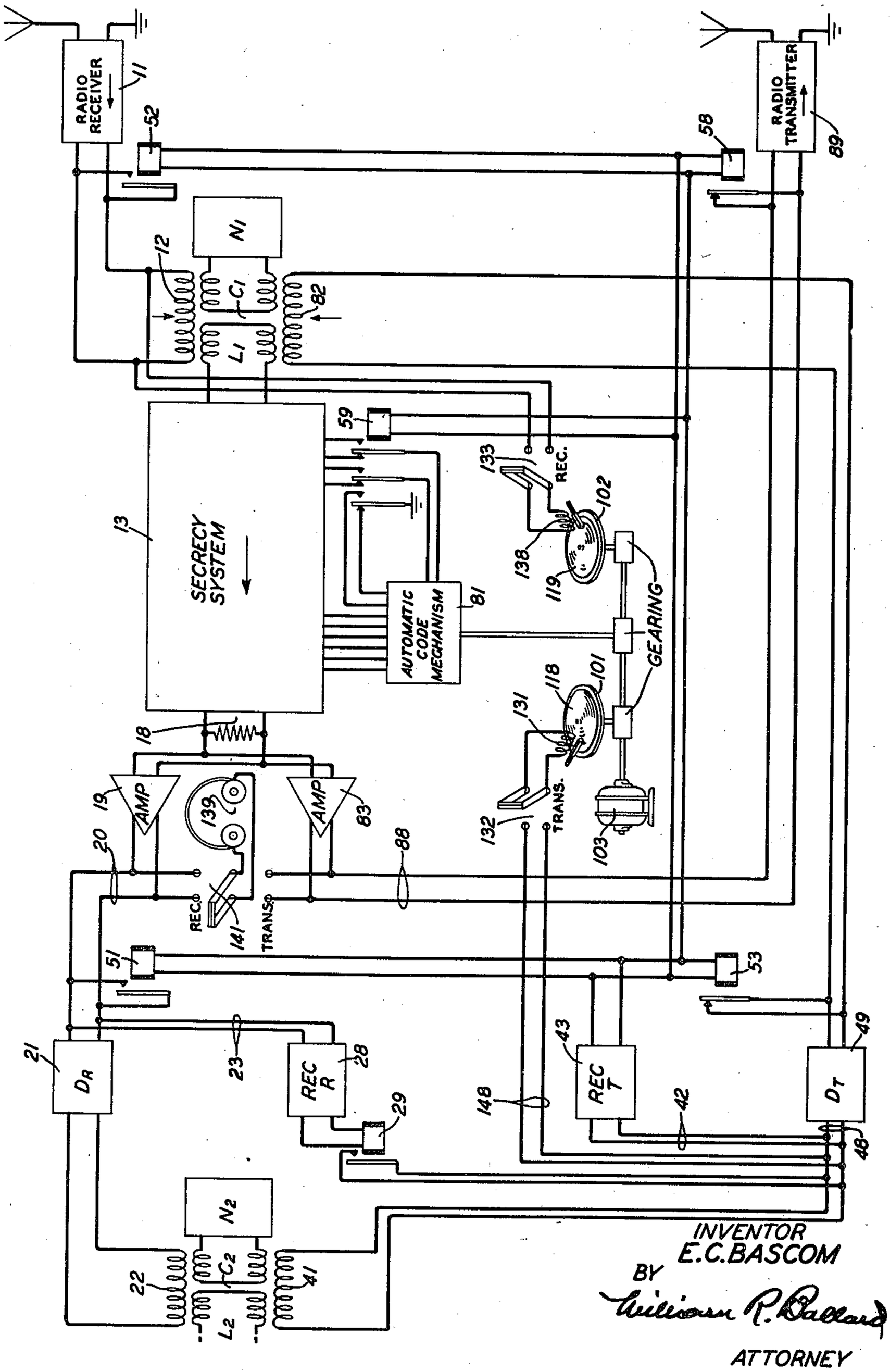
April 11, 1939. E. C. BASCOM 2,153,706

PRIVACY TESTING SYSTEM

Filed July 9, 1937



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Patented Apr. 11, 1939 2,153,706

UNITED STATES PATENT OFFICE

2,153,706

PRIVACY TESTING SYSTEM

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Application July 9, 1937, Serial No. 152,839

8 Claims. (Cl. 179—1.5)

This invention relates to a testing system and more particularly to a system for testing the performance of privacy systems.

An object of the invention is to facilitate testing privacy systems.

A further object of the invention is to provide for quickly and accurately determining which particular portion of a privacy system may be the cause of temporarily unsatisfactory performance of the system as a whole.

The testing system of the present invention is particularly adapted for use with a multi-band privacy system of the type described in R. W. Chesnut et al. Patent 1,829,783 of November 3, 1931. That patent describes a privacy system in which secrecy is attained by separating the signal waves into sub-bands which are then interchanged among themselves. The scheme of frequency transposition is altered from time to time automatically and entirely under local control. Synchronously operating mechanism at the separated terminals of the system cause the shifts in the transposition schemes to take place at each terminal at the same instant.

Considerable apparatus is of course utilized in a privacy system of the type referred to above, each terminal requiring several large bays of equipment. Obviously, if, in case of trouble, it is necessary to test each relay, amplifier, rectifier, etc., of the terminal, considerable time may elapse before the source of the trouble is finally located. In a long transmission system of the type with which privacy devices are commonly utilized, such, for example, as the Trans-Atlantic radio telephone system, it is of course desirable that service interruptions, such as might arise from an involved testing procedure, be avoided so far as possible.

In accordance with a feature of the present invention means are provided whereby previously recorded "scrambled" speech is supplied directly to the privacy system, the frequency components of the speech being so arranged and distributed that, if the privacy system be operating properly, the waves will be "unscrambled" and intelligible speech will result. In order to determine whether or not the privacy system is operating satisfactorily, therefore, it is merely necessary to apply the previously recorded scrambled speech to the input of the privacy system and to listen-in at the output of the system to observe whether or not intelligible speech results.

As fully described by the Chesnut et al. patent referred to above one group of six combinations (or frequency transposition schemes) is used when transmitting and another group of six different combinations is used when receiving. The combinations used for receiving at either terminal are the complementary combinations of the corresponding transmitting combinations at the other terminal.

In accordance with a further feature of the invention means are provided whereby different combinations of previously recorded scrambled speech corresponding to the various combinations to be tested may be supplied to the privacy system.

In accordance with a specific embodiment of the invention, two phonographs are provided, the reproducer output of one of which is connected to the input of the secrecy system through the receive path and the output of the other of which is connected to the input of the secrecy system through the transmit path. A telephone receiver is provided for monitoring on the output of the secrecy system, switching means being provided whereby the receiver may be connected either to the transmit-output path or the receive-output path. A record, or a set of records, is provided for use with each phonograph, one record carrying recordings of complementary scrambled speech for each of the six transmitting combinations and the other record carrying recordings of complementary scrambled speech for each of the six receiving combinations. The order of combinations on each record conforms to the sequence of combinations on the automatic code mechanism of the secrecy system. Each recorded combination preferably includes a suitable explanatory initial and final announcement.

The privacy system described in the Chesnut et al. patent, supra, acts, of course, both as a speech scrambler and as a speech unscrambler. That is, when in the transmit condition, normal intelligible speech is applied to the input of the secrecy system and appears in the output as unintelligible speech having been scrambled by the system in accordance with a predetermined combination or combinations. When in the receive condition on the other hand, unintelligible speech, scrambled by the secrecy system of the distant terminal, is applied to the input of the secrecy system and appears in the output as intelligible speech, being unscrambled by the system. In order that the privacy system, if operating satisfactorily, will act to unscramble and render intelligible the previously recorded scrambled speech for testing purposes, it is obvious that a different form of testing speech should be used for

testing the secrecy system in its transmit condition from that used for testing the system in its receive condition. Briefly, the scrambled speech used for testing the transmit condition should be complementary to the scrambled speech normally appearing in the transmit-output path when normal intelligible speech is applied to the input through the transmit path while the scrambled speech used for testing the receive condition should be of the same combination as the scrambled speech normally supplied to the input of the secrecy system through the receive path and appearing in the receive-output as intelligible speech. This will be further explained in connection with subsequent detailed description of the invention.

Full understanding of the operation of the arrangement contemplated by the invention and appreciation of the various features thereof may be gained from consideration of the following detailed description together with the drawing, the single figure of which is a schematic representation of a radio terminal circuit for two-way operation including testing means in accordance with the present invention.

Referring now to the drawing, a two-way radio terminal is shown which is substantially identical with that shown in Fig. 1 of the Chesnut et al. patent referred to above except for the addition of the testing facilities contemplated by the present invention.

The terminal illustrated is shown in condition for receiving, this being the normal condition. Incoming message waves received by radio receiver 11 are supplied to winding 12 of hybrid coil C_1 through which they are transmitted into circuit L_1. This circuit leads to the secrecy system 13 in which the waves undergo a transformation to render them intelligible, it being assumed that they have been transmitted from a similar station at which their frequency components have been interchanged (i. e., the speech has been scrambled) so as to render them incapable of being understood. The waves after having been unscrambled (i. e., restored to an intelligible form) by secrecy system 13, pass into the output circuit 18, through amplifier 19 to line 20, thence through delay network 21 and winding 22 of hybrid coil C_2 into telephone line L_2. A part of the incoming waves pass through line 23 and, after rectification by rectifier 28, cause operation of relay 29. Relay 29 when operated disables the transmitting circuit of the terminal thereby preventing false operation and echoes.

Waves originating on telephone line L_2 for transmission to a distant point by the two-way terminal illustrated are induced in winding 41 of hybrid coil C_2 and thence through two parallel paths, one path 42 leading through rectifier 43 and the other path 48 leading through delay network 49.

The waves passing through path 42, after rectification by rectifier 43, cause operation of relays 51, 52, 53, 58 and 59. Operation of relays 51 and 52 shorts or "disables" the receiving circuit at two points so chosen as to prevent singing while operation of relays 53 and 58 "enables" the transmitting circuit. Operation of relay 59 effects, through circuits associated with automatic code mechanism 81, a circuit change in secrecy system 13 to cause the waves as now received (transmitted signals) to undergo a different transformation from that used for waves previously applied to the secrecy system (received signals). (As fully described in the Chesnut et al. patent referred to above different transposition combinations are used for transmitting and for receiving in order to render it more difficult to "break" the secrecy scheme.)

Waves passing through path 48, after passing delay network 49 are transmitted to winding 62 of hybrid coil C_1, into circuit L_1 and through secrecy system 13. Here the waves undergo a transformation to render them incapable of being understood (i. e., the speech is scrambled) after which they appear, so distorted, in output circuit 18 and pass through amplifier 33 to line 38 and thence to radio transmitter 39 from which they are sent to the distant point.

When a pause occurs in the conversation and the waves incoming from line L_2 cease for a sufficiently long time, the system again returns to the normal receiving condition illustrated.

The system as thus far described is similar to that described in greater detail in the Chesnut et al. patent supra to which reference may be had for further description of apparatus and circuit details common to both systems. The additional apparatus utilized in the testing method of the present invention as well as the operation thereof will now be described in detail.

Two phonograph turntables 101 and 102 are provided, being driven through suitable shafting and gearing by motor 103. This motor also drives the rotating cams of automatic code mechanism 81, which, it will be understood, is similar in arrangement and operation to the automatic code mechanism fully described in the Chesnut et al. patent referred to above. Phonograph record 118 is adapted to be supported on and rotated by turntable 101; phonograph record 119 is adapted to be supported on and rotated by turntable 102. Record 118 is adapted to be used for testing transmitting combinations while record 119 is adapted to be used for testing receiving combinations. The output of phonograph reproducer 131 may be connected to transmitting paths 42 and 48 by operation of switch 132. Similarly, by operation of switch 133, the output of reproducer 138 may be connected to the input of winding 12 of hybrid coil C_1 coming from the radio receiver. Telephone receiver 139 may be connected for monitoring either on line 20 (receiving) or line 38 (transmitting) by operation of switch 141.

Let us assume now that it be desired to test secrecy system 13 in order to determine whether or not it is operating properly; it being assumed that it is desired first to test the secrecy system when in transmit condition.

As mentioned above and as described in detail in the Chesnut et al. patent supra, secrecy system 13 acts, first, to separate the signal waves applied thereto into sub-bands (for purposes of the present description we will assume that the waves are separated into six sub-bands which we will designate A, B, C, D, E and F) and, second, to interchange the position of the sub-bands among themselves, certain of the bands also being inverted. Different transposition schemes or combinations are used, six combinations being used in transmitting and six different combinations being used for receiving.

The first transmitting combination, for example, may be one that will result in speech so scrambled that we have: AA', DB, CC', ED, BE, F (unchanged), the first letter designating the band being switched, the second letter indicating the band to which it has been moved and a prime mark (') indicating that the band has been inverted. That is, when the first transmitting com-

bination is effective, intelligible speech applied to the input of secrecy system 13 will appear in output circuit 18 so scrambled that the A band is in the A position but upside down in its frequency order, the D band in the B position, the C band in C position upside down, the E band in D position and the B band in E position, the F band remaining unchanged.

Now in order to test the performance of this first transmitting combination in accordance with the method of the present invention, we wish to apply to the input of secrecy system 13, testing speech which has previously been so scrambled that when the bands are rearranged as above, intelligible speech will result. We provide, therefore, in the first group of recordings on transmit test record 118, scrambled speech which is complementary to that described above, namely AA', EB, CC', BD, DE, F (unchanged). Obviously when speech so arranged is subjected to the first transmitting combination rearrangement, intelligible speech will result if the secrecy system 13 be functioning properly.

In order to test the first transmitting combination, therefore, pick-up 131 is placed at the beginning of the first testing combination of record 113, switch 132 is moved to closed position and switch 141 is closed to transmit position thereby connecting headset 139 for monitoring on line 88. The speech reproduced from record 118 passes over line 148 to paths 42 and 48 and causes the same circuit changes as are caused by normal speech originating in line L_2; these circuit operations have been described above. It will be remembered that the transmitting line is enabled, the receiving line is disabled at two points, and relay 59 is operated changing the secrecy system 13 from receive condition to transmit condition.

Now in view of the fact that the testing scrambled speech reproduced from record 118 and applied to the input of secrecy system 13 is, as pointed out above, complementary to normal speech after being scrambled by the secrecy system according to the combination under test, this test speech will if the secrecy system be operating properly, be completely unscrambled and restored to normal intelligible form by passage through the secrecy system. It is merely necessary, therefore to listin in on line 88 by means of receiver 139 in order to determine whether or not secrecy system 13 is operating properly with respect to the transmitting combination under test. If normal intelligible speech is heard in line 88 then it is known that secrecy system 13 is operating properly; if the speech is distorted, i. e., not entirely unscrambled it is known that secrecy system 13 is not operating properly with respect to the combination under test.

Assuming that it be found that the secrecy system is operating satisfactorily with respect to the first transmitting combination, the second combination, third combination, etc., are tested in the same manner, record 118 carrying previously recorded speech sections so scrambled that each section is complementary with respect to the combination to be tested. For example, the second transmitting combination may be such that, when normal intelligible speech is applied to the input of secrecy system 13, it is so scrambled that it appears in output line 88 as scrambled speech of the form CA, BB', DC, AD, EE', F (unchanged). The complementary testing speech for the second transmitting combination would then be of the form, DA, BB', AC, CD, EE', F (unchanged). It will be necessary, of course, in each instance to first operate code mechanism 81 in order to so set the mechanism that the particular combination to be tested is "set-up" or effective.

It is contemplated that each recorded section on the record will be preceded by a suitable explanatory announcement.

While a manual control of the testing arrangement in accordance with which the reproducer is manually moved from one section to another on the record in order to test the various combinations may be utilized, it is also contemplated by the invention that the arrangement may be automatic in its operation, acting to test through all combinations without attention. In such case the various testing sections are recorded on the record in synchronism with the combinations of code mechanism 81. For satisfactory operation of this arrangement, two things are of course necessary, first the phonograph record must be driven at the same speed as the code mechanism and, second, the two must be started in synchronism, i. e., the reproducer must be set exactly at the start of the first recorded section when the first transmitting combination of the code mechanism becomes effective. The first objective may be easily attained by driving the code mechanism and the turntable by the same motor; the second objective may be attained in various ways, for example, by a proper "start" mark on the record, by providing registering pins and notches on the turntable and record or by use of other well-known arrangements.

If it be found by the above testing method that a particular transmitting combination is operating unsatisfactorily, the next step is to determine in which of the sub-bands the trouble exists. In order to do this a second record may be substituted for record 118, this record containing a series of tones, one tone for each combination. Each tone when properly unscrambled, increases gradually in frequency from that of the lowest band to that of the highest so that if each band were functioning properly, a gradually rising continuous tone would be heard in receiver 139. By listening to the tone and observing where a break or lapse in the tone occurs it is possible to readily determine in which sub-band the trouble exists.

The various receiving combinations are tested in a manner similar to that described above except that in this case, switch 133 is closed connecting the output of reproducer 138 to the input of secrecy system 13, and switch 141 is closed to receive position for monitoring on line 20. Secrecy system 13 functions with respect to received signals to unscramble speech previously scrambled according to predetermined combinations by the secrecy system of the distant terminal. The testing speech applied to the input is, therefore, so scrambled that it is similar to that which would be normally supplied thereto from the distant terminal. Now, as before, if the secrecy system be operating satisfactorily, the speech will be unscrambled and undistorted, intelligible speech will be heard in line 20.

While a specific embodiment of the invention has been selected for detailed description, the invention is not, of course, limited in its application to the embodiment described. The embodiment described should be taken as illustrative rather than restrictive.

What is claimed is:

1. The method of testing a secret signaling sys-

tem of the type which includes privacy means for rendering speech signals applied thereto unintelligible by transposing the frequency components thereof in accordance with a transposition scheme which is changed from time to time in a predetermined manner, which comprises passing through said privacy means locally generated testing speech waves which have previously been rendered unintelligible by transposition of the frequency components thereof in accordance with a transposition scheme which is complementary to that effected by said privacy means on waves passed therethrough, and observing whether said testing speech waves are rendered intelligible by passage through said privacy means.

2. The method of testing a secret signaling system of the type which includes privacy means for rendering speech signals applied thereto unintelligible by transposing the frequency components thereof in accordance with a transposition scheme which is changed from time to time in a predetermined manner, which comprises passing through said privacy means locally generated testing signals, the frequency components of which are so arranged and so changed from time to time that said testing signals are complementary to the transposed speech resulting when normal undistorted speech is passed through said privacy means, and observing said testing signals after passing through said privacy means.

3. The method of testing the performance of a secret signaling system of the type which includes a common privacy device for transposing frequency components of the outgoing signals to render them unintelligible and for transposing frequency components of the incoming signals to render them intelligible, and including means for changing the scheme of transposition effected by said means from that to be applied to the transmitted signals to that to be applied to the received signals and vice versa, which comprises the steps of applying to said privacy device locally generated testing signals the frequency components of which are so arranged that said testing signals are complementary to the outgoing signals resulting when normal undistorted speech waves are passed through said privacy device, observing said testing signals after passing through said privacy device, applying to said privacy device locally generated testing signals the frequency components of which are so arranged that said last mentioned testing signals are similar to the incoming signals normally applied to said privacy device, and observing said last mentioned testing signals after passing through said privacy device.

4. The method of testing a secret signaling system of the type which includes privacy means for rendering speech signals applied thereto unintelligible by transposing the frequency components thereof in accordance with a transposition scheme which is changed from time to time in a predetermined manner, which comprises passing through said privacy means locally generated unintelligible testing speech waves the frequency components of which are so arranged that, if said testing waves are subjected to the transposition schemes effected by said privacy means when operating properly intelligible speech results, and observing whether said testing speech waves are rendered intelligible by passage through said privacy means.

5. The method of testing a secret signaling system of the type which includes privacy means for rendering speech signals applied thereto unintelligible by separating the waves into a plurality of frequency sub-bands and transposing said sub-bands in accordance with a transposition scheme which is changed from time to time in a predetermined manner, which comprises applying to said privacy means a locally generated testing tone so arranged with respect to frequency that when subjected to the transposition schemes effected by the privacy means when operating properly a tone gradually increasing in frequency from that of the lowest of said sub-bands to that of the highest of said sub-bands will result, and observing said tone after passage through said privacy means.

6. In a two-way speech transmission system, a common privacy device for transposing frequency components of the outgoing speech waves to render them unintelligible and for transposing frequency components of the incoming speech waves to render them intelligible, means for changing the scheme of frequency transposition effected by said privacy device from that to be applied to the transmitted waves to that to be applied to the received waves, a plurality of sources of pre-recorded unintelligible testing waves, the frequency components of one source being so arranged that if the waves be subjected to the transposition scheme effected by said privacy device with respect to transmitted signals intelligible speech will result and the frequency components of another of said sources being so arranged that if the waves be subjected to the transposition scheme effected by said privacy device with respect to received signals intelligible speech will result, a reproducer for each of said sources, means for applying the output of either of said reproducers to said privacy device and means for determining the effect of said privacy device upon the waves from either source when applied thereto.

7. In a speech transmission system, privacy means for transposing the frequency components of speech waves applied thereto in accordance with a plurality of predetermined transposition schemes, means for changing said transposition schemes from time to time in a definite predetermined manner, a source of pre-recorded testing waves which have been rendered unintelligible by transposition of the frequency components thereof in accordance with transposition schemes which are complementary to those effected by said privacy means on waves passed therethrough, said waves being divided on said source into a plurality of distinct sections, the frequency components of each section being so arranged that if the waves thereof be subjected to a certain one of said transposition schemes effected by said privacy means intelligible speech will result, a reproducer for said source, means for applying waves reproduced from a selected section to said privacy means when a predetermined one of said frequency transposition schemes is effective, and means for determining whether said applied testing waves are intelligible after passage through said privacy means.

8. In a speech transmission system, privacy means for transposing the frequency components of speech waves applied thereto in accordance with a plurality of predetermined transposition schemes, means for changing said transposition schemes from time to time in a definite predetermined manner, a source of pre-recorded testing waves which have been rendered unintelligible by transposition of the frequency components thereof in accordance with transposition schemes

which are complementary to those effected by said privacy means on waves passed therethrough, said waves being divided on said source into a plurality of distinct sections, the frequency components of each section being so arranged that if the waves thereof be subjected to a certain one of said transposition schemes effected by said privacy means intelligible speech will result, the sections on said source being arranged in synchronism with the changes of said transposition schemes, a reproducer for said source, means for causing a synchronous operation of said reproducer and said transposition scheme changing means, means for applying the output of said reproducer to the input of said privacy device, and means for observing the effect of passage through said privacy means on waves reproduced from each of said sections.

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