

June 4, 1946.

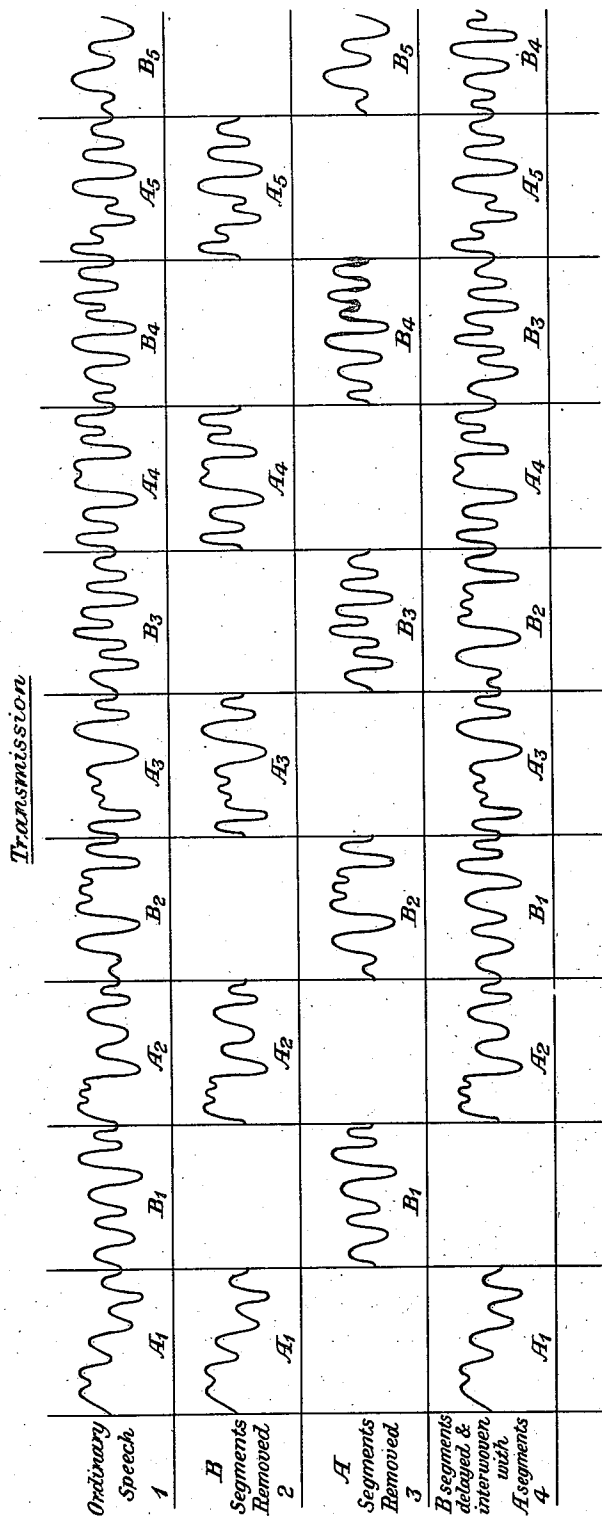
R. C. CORDERMAN

2,401,464

PRIVACY SYSTEM

Filed Nov. 20, 1942

3 Sheets-Sheet 1



Reception

A s received

A_2	B_1	A_3	B_2	A_4	B_3	A_5	B_4
-------	-------	-------	-------	-------	-------	-------	-------

A segments removed

B_1	B_2	B_3	B_4
-------	-------	-------	-------

A segments delayed and
interwoven with
 B segments

B_1	A_2	B_2	A_3	B_3	A_4	B_4
-------	-------	-------	-------	-------	-------	-------

Fig. 1

INVENTOR
R. C. Corderman
BY *Jefferson E. Chabich*
ATTORNEY

June 4, 1946.

R. C. CORDERMAN

2,401,464

PRIVACY SYSTEM

Filed Nov. 20, 1942

3 Sheets-Sheet 2

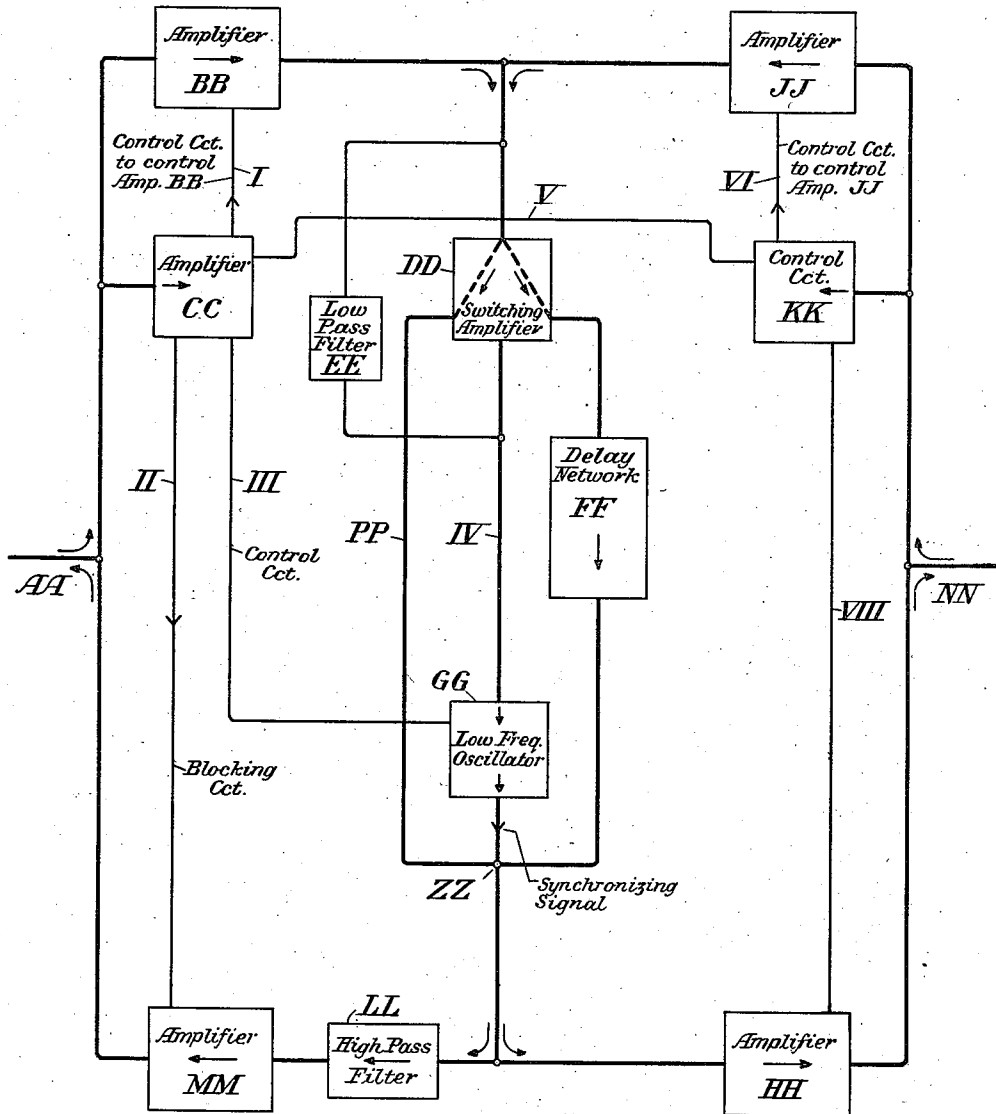


Fig. 2

INVENTOR
R.C. Corderman
BY *Jefferson Ehrlich*
ATTORNEY

June 4, 1946.

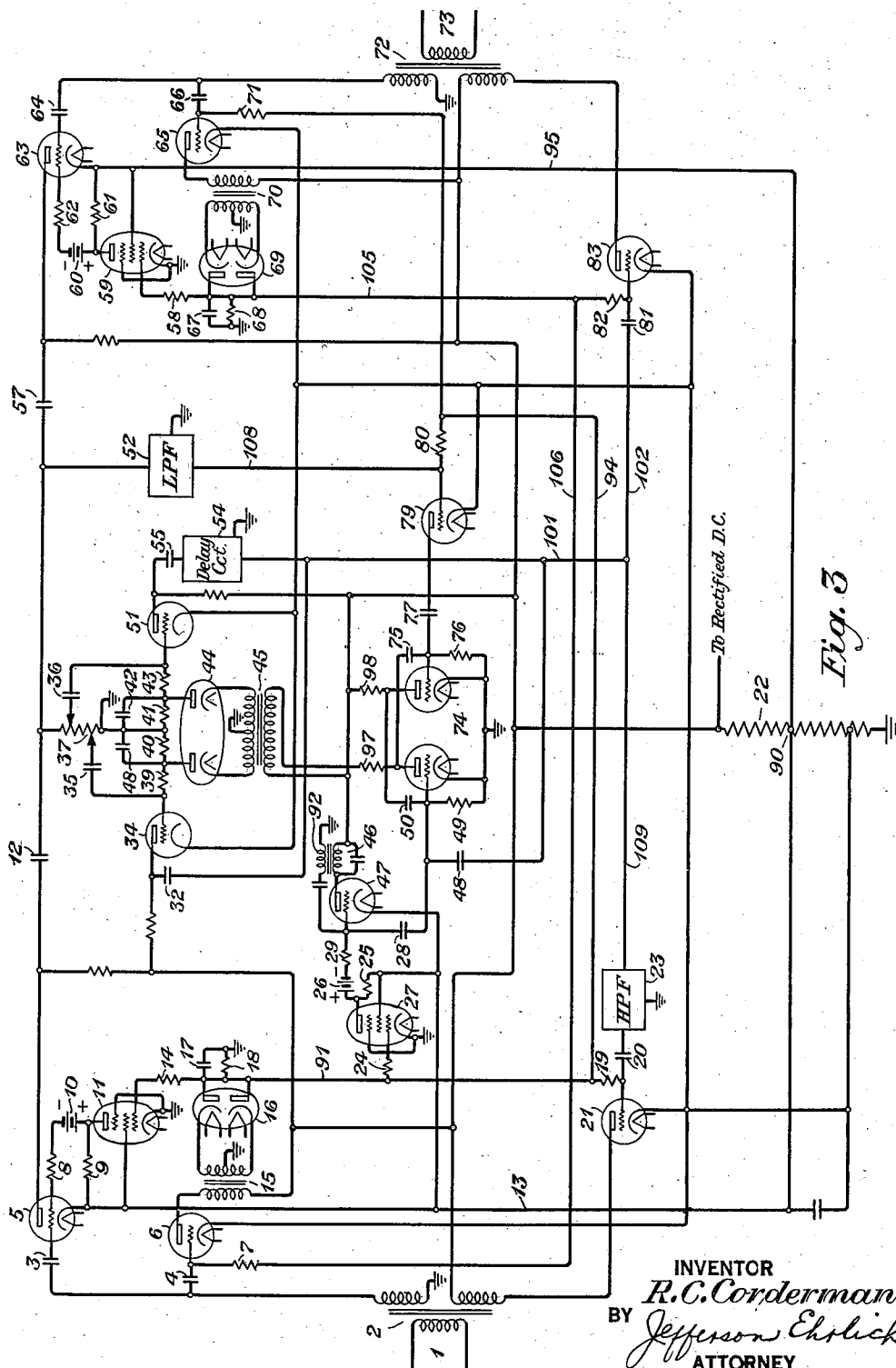
R. C. CORDERMAN

2,401,464

PRIVACY SYSTEM

Filed Nov. 20, 1942

3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

2,401,464

PRIVACY SYSTEM

Roy Clinton Corderman, Chevy Chase, Md., assignor to American Telephone and Telegraph Company, a corporation of New York

Application November 20, 1942, Serial No. 466,371

14 Claims. (Cl. 179-1.5)

1

This invention relates to privacy systems and is especially suitable for providing privacy in signaling systems generally and in telephone systems particularly.

In commercial telephone systems where privacy is desired it has heretofore been the practice to invert part or all of the audio frequency band to be transmitted to render the transmitted signals unintelligible to casual unauthorized receivers. At the receiving point the inverted signals are re-inverted to render the signals intelligible. The simple inversion system produces identically the same sounds each time a particular expression is transmitted and these sounds may be learned as another language and hence the signals may be deciphered by unauthorized parties.

The privacy system of the present invention is designed to obviate the difficulty above referred to. This system avoids the repeated production of the same sounds even though the same expression is originated for transmission by the system to a distant point. A special feature of the privacy system of the present invention is that it is substantially free of mechanically moving parts. The equipment is almost entirely of the electronic type, requiring practically no adjustments or supervision.

This invention will be more clearly understood from the detailed description hereinafter following when read in connection with the accompanying drawings in which Figure 1 illustrates some curves to explain the principles of privacy employed in the apparatus of the invention, Fig. 2 schematically illustrates the apparatus that may be employed in a simple embodiment of the invention and Fig. 3 shows a circuit arrangement at one terminal of a two-wire system for two-way communication, the arrangement illustrating one form of apparatus that may be employed in the invention.

Figure 1 shows in line 1 a curve representing a series of successive audio frequency sounds, such as are obtained in speech, plotted on an abscissa of time. The curve is divided into a plurality of segments A₁, B₁, A₂, B₂, A₃, B₃, etc. In the arrangement of this invention the alternate segments A₁, A₂, A₃, etc., as shown in line 2, are separated from the alternate segments B₁, B₂, B₃, etc., as shown in line 3, by a novel system of apparatus, including what may be termed an electronic switch, the electronic switch transmitting the A segments A₁, A₂, A₃, etc. through one path and the B segments B₁, B₂, B₃, etc. through a different path. Each of these paths may in-

2

clude an amplifier if desired. The A segments are separate portions of the audio frequency sounds or signals illustrated in line 1 of Fig. 1 and are ordinarily unintelligible because they must be combined with the B segments to reproduce the original sounds or signals. Likewise the B segments are themselves equally unintelligible. Although all of the segments are shown of equal lengths on a time basis, they need not be equal, but may be of different or variable lengths if so desired.

The electronic switching apparatus that divides the incoming sounds or signals into groups of segments which traverse different paths has connected thereto a delay network for delaying all of the segments of one of the groups, such as the B segments, by a predetermined time interval. This delay may be equal, for example, to the time interval of two separate adjacent segments of line 1. The undelayed segments, i. e., the A segments, and the delayed segments, i. e., the B segments, are then combined to form a substantially continuous transmission as shown in line 4 of Fig. 1. The combined segments include segment A₁, an open space, then segments A₂, B₁, A₃, B₂, A₄, B₃, etc., as shown in line 4. As so combined, the signals are transmitted to a distant point. It will be apparent that the combined segments are unintelligible. The intelligibility may be restored at the distant or receiving point by similar electronic switching and delay apparatus which not only again separates the A segments from the B segments, but also delays the A segments (rather than the B segments) by a similar time interval. As shown in the lower part of Fig. 1, the delayed A segments received at the distant point and the received B segments (which were delayed at the transmitting point) are re-combined to reproduce the original sounds or signals and render them intelligible.

The apparatus which may be used at each point is shown functionally in Fig. 2. Here signals originating at point AA are amplified by amplifier BB and then impressed on the device DD which may be considered as an electronic switching apparatus. The device DD divides the amplified signals into separate groups of segments A₁, A₂, A₃, etc., and B₁, B₂, B₃, etc., the A segments being transmitted over one path PP to terminal ZZ and the B segments over another path to terminal ZZ, the latter path including a delay network FF. Both groups of segments are combined at ZZ, amplified by amplifier HH and then transmitted through terminal NN to a dis-

3

tant point. The signals that arrive at point ZZ and are amplified by amplifier HH are in transposed relationship so as to be unintelligible, as shown in line 4 of Fig. 1, and as so transposed are transmitted to the distant point.

Similar signals received from the distant point or station enter the terminal NN, are amplified by amplifier JJ, and are then impressed upon the same electronic switching device DD. Here the received unintelligible signals are again separated into similar groups of A and B segments, but in the case of received signals, the B segments will traverse path PP to terminal ZZ while the A segments will traverse the other path which includes the delay network FF. The two groups of segments are then combined in a common circuit at terminal ZZ to render the signals intelligible, then transmitted through a high pass filter LL, then amplified by amplifier MM and transmitted to the terminal AA where they may be rendered audible.

In addition to the apparatus just referred to, there is included a device CC which also receives the signals originating at terminal AA and thence establishes a control circuit I to amplifier BB to permit the amplifier to amplify the signals coming from terminal AA. Device CC also establishes a circuit II to amplifier MM to disable the latter amplifier so that no signals simultaneously received from terminal NN may reach terminal AA. Amplifier MM is also disabled to prevent the occurrence of echo effects.

The device CC also controls over circuit III an oscillating apparatus GG. This oscillating apparatus in turn controls over circuit IV the electronic switching device DD, causing the switching device DD to separate the signals amplified by amplifier BB into two groups of segments, i. e., the A segments and the B segments, as already noted. The oscillating apparatus GG also provides a synchronizing signal to be amplified with the other signals by amplifier HH and then transmitted to the distant point. The control device CC also is connected to a similar control device KK by means of a circuit V to render the device KK non-responsive to any signals received at terminal NN from the distant point which otherwise would interfere with the transmitted signals.

Incoming signals entering terminal NN are amplified by amplifier JJ which is put into operation by the control device KK to which it is connected by circuit VI. These amplified signals pass through the electronic switching device DD where they are again separated into two groups of segments, but in this case the B segments are transmitted over circuit PP while the A segments are transmitted through the delay network FF, as already noted. Both groups of segments are combined at ZZ and then sent through filter LL and amplifier MM to circuit AA where the intelligible signals may be rendered audible.

The control device KK is connected to amplifier HH by circuit VIII to disable the amplifier HH to prevent the occurrence of echo effects. The control device KK is also connected to the similar control device CC by circuit V to prevent the device CC from responding to echo signals received from terminal AA.

The equipment of Fig. 2 is identical to other equipment at a distant station (not shown), the two stations being connected to each other by a wire line or a radio link. The synchronizing current generated at each station is of the same frequency. In Fig. 2, the synchronizing current received from the distant point, after being

4

amplified by amplifier JJ, will be transmitted through the low pass filter EE to control the oscillating apparatus GG. When signals are to be transmitted to the distant point the voltage will be transmitted by device CC over circuit III to oscillator GG to start the oscillator.

Fig. 3 shows a circuit arrangement of the apparatus that may be used at each of the two (or more) stations which may be connected to each other by a wire, radio or other link. The circuit arrangement of Fig. 3 may represent the station shown schematically in Fig. 2 or the Fig. 3 arrangement may be considered to represent the station connected to the Fig. 2 station. Here signals to be transmitted to a distant station arrive at the primary winding 1 of the transformer 2 and are simultaneously applied by the upper secondary winding of transformer 2 through condensers 3 and 4 to the control grids of tubes 5 and 6, respectively, both of which may be amplifier tubes of well-known type. The grid of tube 5 is shown connected to its cathode through a biasing circuit which includes resistors 8 and 9 and battery 10, the battery 10 and the voltage across resistor 9 rendering the grid of tube 5 negative with respect to the cathode so that substantially no current will flow in its plate circuit. The amplified signals from tube 6 are transmitted through transformer 15 to a full wave rectifier 16, the plate electrodes of which are connected to each other and to ground through a resistor 18 and a condenser 17 arranged in parallel with each other. The amplified signals will, therefore, establish a potential across resistor 18 which is negative at its left-hand terminal with respect to its grounded right-hand terminal. The negative potential across resistor 18 will be employed to prevent the simultaneous reception of signals by circuit 1, also to prevent any echo effects from being produced, and to start a local oscillator, as will now be explained.

The negative potential across resistor 18 will be applied through a resistor 14 to the control grid of tube 11, which is of the pentode type as shown. The application of this negative biasing potential to the control grid of tube 11 will prevent any substantial flow of current over the plate circuit of tube 11, the plate circuit including the portion of the potentiometer 22 between contact 20 and ground, conductor 13, resistor 9, the plate and cathode of tube 11 and ground. The absence of current in this plate circuit removes from the grid of tube 5 the potential previously supplied by resistor 9. Hence tube 5 is now able to amplify the signals received from the input circuit 1. In other words, the tubes 5, 6, 11 and 16 are so related to each other that upon the arrival of signals from circuit 1 a bias voltage will be set up across resistor 18, which in turn will effectively remove the voltage across resistor 9 from the grid of tube 5 and thereby enable tube 5 to amplify the received signals.

At the same time the bias voltage across resistor 18 is supplied over conductor 91 and resistor 19 to the grid of tube 21, which is also an amplifier. The plate circuit of tube 21 is connected to the lower secondary winding of transformer 2 for transmitting signals from the distant station to the input circuit 1, as will be explained hereinafter. But the bias voltage of resistor 18 will act to disable tube 21 to prevent any signals or other effects received by tube 21 from being simultaneously transmitted to circuit 1. The disablement of tube 21 also acts to substantially suppress any echo effects in the circuit.

5

The negative bias across resistor 18—produced in response to signals received from the incoming circuit 1—is also applied over conductor 91 and through resistor 24 to the control grid of tube 27. This applied negative voltage substantially reduces the current in the plate circuit of tube 27, the plate circuit including the cathode and anode of tube 27, resistor 25, conductor 13, and the portion of potentiometer 22 which is interposed between contact 90 and ground. Upon the suppression of current through resistor 25, the negative voltage of a battery 26 will then become the only voltage applied through a resistor 29 to the grid of the tube 47 which is employed to act as a local oscillator. This local oscillator includes a tuned circuit 92 connected to its grid electrode and another tuned circuit 46 connected to its plate electrode, these circuits being coupled to each other in a well known manner so that tube 47 may produce sustained oscillations of a substantially low frequency which may be, for example, 250 cycles, or even some lower frequency. Thus in response to signals from the circuit 1 the resistor 18 will supply a bias voltage which will act through tube 27 to remove the blocking voltage across resistor 25 from tube 47, so that the tube 47 may then generate a low frequency current which will be used both for synchronizing the operation of the apparatus at the two stations above referred to and to control a multivibrator 74, as will be explained hereinafter.

The negative biasing voltage of resistor 18 will also be applied over conductor 91, conductor 94 and through resistor 71 to the grid electrode of tube 65, which operates in a manner similar to tube 6. This biasing voltage prevents tube 65 from acting as an amplifier, and, therefore, blocks any flow of current through transformer 70 to the full wave rectifier 69. This then prevents any negative biasing voltage from being set up across the resistor 68 and the condenser 67 which is in parallel therewith. The control grid of tube 59—which is connected to resistor 68 by resistor 58—will then be substantially unbiased with respect to its cathode. Hence a substantial current will flow through its plate circuit, which includes the cathode and anode of tube 59, resistor 61, conductor 95 and that part of potentiometer 22 which is interposed between contact 90 and ground. Due to the presence of a substantial current through resistor 61, the voltage thereacross will supply a biasing voltage in addition to that supplied by battery 60 to the grid of tube 63, whereby tube 63 will be disabled to prevent any amplification of incoming signals received from the circuit 73 and transmitted through transformer 72 and condenser 64.

The negative bias of resistor 18 will also be applied to the grid of tube 79 over a circuit which includes conductor 91, conductor 94 and resistor 80. The plate electrode of tube 79 is connected to the right-hand grid electrode of the multivibrator 74 so that tube 79 may control the multivibrator. The application of the biasing voltage of resistor 18 to the grid of tube 79 prevents a received synchronizing signal which may reach tube 79 (from, for example, filter 52) from affecting the multivibrator 74. The control of multivibrator 74 is, therefore, reserved to oscillator 47, as will be explained hereinafter.

It will be observed, therefore, that upon the receipt of signals from the circuit 1 the tube 5 is caused to act as an amplifier of these signals, amplifiers 21 and 63 are at the same time disabled, and oscillator 47 is started in oscillation

6

to produce a synchronizing frequency. The oscillations of tube 47 are also transmitted through condenser 28 to the left grid electrode of the multivibrator 74 to control the multivibrator.

The multivibrator 74 is of well-known type, including two grids, two plate electrodes and two cathodes which may be enclosed within one or two envelopes, as desired, the multivibrator including also a condenser 50 and a resistor 49, which are connected in series with each other between the right plate electrode of the multivibrator and the grounded cathodes, and a similar condenser 75 and a resistor 76 connected in series with each other between the left plate electrode of the multivibrator and its grounded cathodes. The multivibrator 74 generates a wave which is substantially square-topped, the frequency of the wave being equal to the frequency of the oscillations of oscillator 47 or equal to a submultiple of the frequency of oscillator 47. The multivibrator 74, however, is operated under the control of the oscillator 47 and is locked in step therewith.

It will be observed that the square-topped wave from the multivibrator 74 is applied to the primary winding of a transformer 45 through resistors 97 and 98, which are connected to the two plate electrodes of the multivibrator. The transformer 45 supplies the current of the square-topped wave form to a full wave rectifier 44. During one-half of the cycle of the wave supplied by the multivibrator 74, current will flow over one-half of the circuit of the full wave rectifier 44, which may include the left-hand portion of the secondary winding of transformer 45, the left-hand cathode and anode of tube 44 and resistor 40 to ground. During the opposite half of the cycle, current will similarly flow over the circuit which includes the right-hand portion of the secondary winding of transformer 45, the right cathode and anode of tube 44, resistor 41 and ground. Resistors 40 and 41 are paralleled by condensers 43 and 42, respectively, as shown. Thus voltages are alternately established across resistors 40 and 41 in accordance with the alternate changes in the wave supplied by the multivibrator 74. The resistor 40 is shown connected to the grid of an amplifier 34 through a resistor 39 to control the amplification of that tube. Similarly resistor 41 is connected through resistor 43 to the grid of tube 51 to control the action of this tube as an amplifier.

The voltage established across resistor 40 by the rectifying action of tube 44 renders its left-hand terminal negative with respect to its right-hand terminal and thereby blocks the amplifying action of tube 34. Similarly the voltage impressed across the resistor 41 by the rectifying action of tube 44 renders the right-hand terminal of resistor 41 negative with respect to its left-hand terminal, and when applied to the grid electrode of tube 51 blocks the amplifying action of tube 51. Thus the tubes 34 and 51 are alternately disabled at a rate which is determined by the time constants of the circuit of the multivibrator 74. The circuit interconnecting the amplifiers 34 and 51 with the multivibrator 74 provides an arrangement for separating the signals amplified by tube 5 into segments which are to be grouped together, as already explained in regard to Fig. 1. The A segments will be amplified, for example, by tube 34, and the B segments will likewise be amplified by tube 51, as will be explained more fully hereinafter.

The signals received from the input circuit 1

and amplified by tube 5 are transmitted through condenser 12 to the grid electrode of tube 34 over a circuit which includes part of resistor 37 and condenser 35. Likewise the signals amplified by tube 5 are transmitted through part of resistor 37 and condenser 36 to the grid electrode of tube 51. During the first interval of time when resistor 41, for example, establishes a blocking potential for the grid of tube 51, tube 51 will be disabled, and, therefore, the signals applied to the grid electrode of tube 34 will be amplified. During the next interval of time when resistor 40 establishes a blocking potential for the grid of tube 34, tube 34 will be disabled and the signals will be amplified by tube 51. The signals received during the next interval will be amplified by tube 34, and the signals of the succeeding interval will be amplified by tube 51, and so on. Tubes 34 and 51 will, therefore, amplify alternate segments of the received signals corresponding respectively to the A and B segments shown in Fig. 1. Thus, when tube 34 is amplifying one of the A segments, tube 51 will be blocked as an amplifier, and, conversely, when tube 51 is amplifying one of the B segments, tube 34 will be blocked as an amplifier. The timing of the tubes amplifying the various segments is determined by multivibrator 74.

The A segments which are amplified by tube 34 are then transmitted through condenser 32 and over conductor 101, conductor 102 and condenser 81 to the grid of amplifier 83, where these segments will be again amplified and then transmitted through the lower secondary winding of transformer 72 to the outgoing circuit 73. The B segments amplified by tube 51 are transmitted through a condenser 55, a delay circuit 54, conductor 101, conductor 102 and condenser 81 to the same amplifier 83, where these segments will be amplified and likewise transmitted to the outgoing circuit 73. The delay network 54 is interposed in the path between amplifiers 51 and 83 to delay the B segments by a predetermined interval of time, as already noted hereinabove. The undelayed A segments from amplifier 34 and the delayed segments from amplifier 51 are both impressed upon the same circuit of conductors 101 and 102, and are combined in the relationship illustrated in line 4 of Fig. 1. Thus the amplifier 83 amplifies the signals in transposed relationship according to the privacy pattern employed in the arrangement, thereby rendering the signals in unintelligible form for transmission to the distant station.

Along with the signals in their transposed relationship is transmitted current obtained from the local oscillator 47. The oscillating current of tube 47 is transmitted through condenser 28, condenser 48 and over conductors 101 and 102 and condenser 81 to the grid of amplifier 83, where the local oscillations are amplified and transmitted to the distant station. These local oscillations will be employed for controlling the action of similar equipment at the distant station so as to maintain the multivibrator at the distant station in fixed phase relationship to the multivibrator 74. Thus the apparatus at the two stations will be held in synchronism at all times. This feature permits the apparatus at the two stations to be kept in phase even though the attenuation and delay between the two stations may change from time to time due to atmospheric or other conditions. This arrangement will keep the multivibrators at any two stations locked in step

with each other independently of the impedances of the interconnecting lines.

Signals received from the distant station and applied to the primary winding 73 of transformer 72 are applied to the grid electrodes of tubes 63 and 65 through condensers 64 and 66, respectively, in a manner similar to that already explained hereinabove. The tube 65, however, transmits the received signals through transformer 70 to the full wave rectifier 69 to establish a biasing voltage across resistor 68 and condenser 67. The biasing voltage across resistor 68 is transmitted through resistor 58 to the control grid of tube 59 to substantially reduce the flow of current through the plate circuit of tube 59 and thereby substantially reduce the voltage across resistor 61. Accordingly the voltage of battery 60, which is then alone applied through resistor 62 to the grid of tube 63, will allow the tube 63 to amplify the received signals so that they may be transmitted through condenser 57 to the rest of the receiving circuit. At the same time the biasing voltage across resistor 68 will be applied through conductor 105, conductor 106 and resistor 7 to the grid electrode of tube 6 to block the amplifying action of tube 6. This will prevent any voltage from being established across resistor 18, and, as already explained, tube 5 will remain disabled. Therefore, tube 5 will be unable to amplify any signals which may be received from circuit 1 at the same time. The biasing voltage of resistor 68 will also be applied over conductor 105 and resistor 82 to the grid electrode of the amplifier 83 to disable tube 83 to suppress any echo effects in the circuit.

The signals received from the distant station and applied to the primary winding 73 include not only the desired speech or other signals but also the accompanying synchronizing signal of low frequency produced by the oscillator at the distant station which is similar to oscillator 47. After traversing condenser 57 the synchronizing signal is transmitted through the low pass filter 52 and over conductor 108 to the grid electrode of tube 79. Due to the connection of the plate electrode of tube 79 to the right grid electrode of the multivibrator circuit 74 through condenser 77, the synchronizing signal received through filter 52 will apply a voltage to the multivibrator 74 to lock the multivibrator in step with the received synchronizing signal. The substantially square-topped wave of the multivibrator 74 will, therefore, control the amplifiers 34 and 51 in their action upon the received signals. The A segments will now be delayed by an interval of time identical to the delay interval of the B segments at the distant station. The B segments will, however, undergo no further delay.

Thus the received B segments will be amplified by tube 34, while the A segments will be amplified by tube 51 and delayed by the delay network 54. The portions of the signals will then be combined in the common circuit of conductor 101, and then transmitted through conductor 109 and the high pass filter 23 and condenser 20 to the grid electrode of the amplifier 21. The high pass filter acts to substantially suppress the current of the synchronizing voltage received from the distant point while freely transmitting the re-formed signals in the higher range of the spectrum. When amplified by tube 21 the signals will be transmitted through the lower secondary winding of transformer 2 to the circuit 1 where they will be received in intelligible form and there reproduced. It will be noted that the oscillator 47 is started

in operation in response to signals received from circuit 1 for transmission to the distant point. When these signals are received, the local oscillator generates the required synchronizing current of low frequency, but at other times this oscillator is unoperated. Thus, only one of the two oscillators at the two stations will be operated at any one time.

When oscillator 47 generates oscillations, it causes the multivibrator 74 to be locked in step with it at a predetermined point in the cycle. At other times when the oscillator 47 is unoperated, the similar oscillator at the distant station may generate oscillations which are received with the signals arriving from that distant station. The oscillations generated at the distant station, however, are transmitted through filter 52 to tube 79 so as to lock the multivibrator 74 in step with these received oscillations. Thus the multivibrator is always kept in step with either the oscillations produced locally by tube 47 or with the oscillations of the similar oscillator located at the distant station.

The circuit interconnecting the amplifiers 34 and 51 with the multivibrator circuit 74 constitute an electronic switch for alternately disabling one or the other of the two amplifiers 34 and 51. This arrangement is shown as applied to a privacy system for the separation of the signals into segments, as discussed hereinabove with regard to Fig. 1. This arrangement, however is applicable to other systems and may comprise, therefore, a switching scheme which may be used for other purposes wholly unrelated to privacy systems. This will be fully understood by those skilled in the art.

In the arrangement described the B segments are delayed at the transmitting station and the A segments are delayed at the receiving station by similar time intervals. If desired the A segments may be delayed at the transmitting station and the B segments correspondingly delayed at the receiving station. This may be accomplished, for example, by merely reversing the phase of the multi-vibrator wave as will be understood by those skilled in the art. In this arrangement the transmission of signals from one station to the other will occur substantially without any gaps between the segments of the signals.

In order to simplify the drawings somewhat, the filaments of the various tubes have not been shown connected to a suitable source of voltage. It will be understood that the filaments may be connected to a source of voltage in any well known manner, as will be apparent to those skilled in the art.

Although the arrangement of this invention has been shown as applied to a privacy system in which the signals are divided into two groups of segments which are of equal length, it will be apparent to those skilled in the art that this arrangement may be also applied to a privacy system in which the signals may be divided into any number of groups of segments which may or may not be equal to each other.

While this invention has been shown and described in certain particular embodiments merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a privacy system, the combination of means for dividing signals to be transmitted into two groups of segments of said signals, each of which is of a predetermined time interval, said means including two independent amplifiers upon which said signals are impressed substantially without delay, means controlled by said signals for alternately disabling said amplifiers so that only one of the amplifiers is amplifying the signals at one time, means connected to one of said amplifiers for delaying the segments of the signals which have been amplified by said amplifier, and means for transmitting the two groups of segments over a common circuit to a distant point.

2. In a privacy system in which signals are to be transmitted so that segments of said signals are in transposed relationship with each other so as to be unintelligible, comprising a pair of amplifiers upon which said signals are equally impressed substantially without delay, means controlled by said signals for alternately disabling said amplifiers so that but one of said amplifiers is operative at any one instant, means for controlling the interval of time during which each amplifier is disabled, a delay network connected to one of said amplifiers for delaying the segments of the signals amplified by said amplifier, and means for combining both the undelayed segments and the delayed segments of the signals for transmission in transposed relationship to a distant point.

3. Electronic switching apparatus comprising a pair of vacuum tube amplifiers, a device for producing a substantially square-topped wave of predetermined frequency, means responsive to one-half of the square-topped wave to produce a voltage to disable one of the amplifiers, and means responsive to the other half of the square-topped wave to produce a similar voltage to disable the other of the amplifiers.

4. Electronic switching apparatus comprising a circuit for transmitting signals, a pair of amplifiers upon which said signals are simultaneously impressed substantially without delay, a device for producing a substantially square-topped wave of predetermined frequency, means responsive to the positive half of said wave to produce a voltage to disable one of said amplifiers and responsive to the other half of said wave to produce a voltage to disable the other of said amplifiers, a delay network connected to one of said amplifiers for delaying the segments of the signals amplified by said amplifier, and a common circuit for receiving all of the segments of the signals amplified by both amplifiers, one group of the segments of said signals being delayed by said network so that said segments are in transposed relationship with respect to the other group of segments and the signals thereby rendered unintelligible.

5. The combination of a multivibrator for producing a substantially square-topped wave of predetermined frequency, a pair of vacuum tube amplifiers, and means interconnecting said multivibrator with said amplifiers and responsive to one-half of the wave of said multivibrator to produce a direct current voltage to disable one of the amplifiers and responsive to the other half of said wave to produce a similar voltage to disable the other of said amplifiers.

6. The combination of a multivibrator producing a substantially square-topped wave of predetermined frequency, a pair of vacuum tube translating devices each of which is capable of

translating signals impressed thereon, and a full wave rectifier interconnecting said multivibrator with said translating devices, said rectifier producing a voltage in response to one-half of the wave of said multivibrator to disable one of the translating devices and producing a voltage in response to the other half of the wave of the multivibrator to disable the other of said translating devices.

7. The combination of two stations which are connected to each other and include apparatus for the transmission and reception of signals, means for preventing the simultaneous transmission of signals from both stations, said means including at each station an oscillator of predetermined frequency, means responsive to locally produced signals to operate said oscillator, means for generating a substantially square-topped wave in phase with the wave of said oscillator, and apparatus responsive to a wave of the same predetermined frequency received from the distant station to disable the transmitting apparatus at the station which receives said wave.

8. A privacy system comprising a pair of amplifiers having input circuits upon which signals are simultaneously impressed, a device for producing a substantially square-topped wave, means interconnecting said device with both of said amplifiers for alternately disabling said amplifiers so that only one of the amplifiers is operative at any one time, an output circuit connected to the output circuits of said amplifiers by two separate paths, a delay network inserted in one of said output paths, an oscillator, and means responsive to said signals impressed upon said amplifiers for starting said oscillator and for locking the wave of said device in phase with the wave of said oscillator.

9. In a system including a plurality of stations which may be connected to each other for the two-way transmission of signals between said stations, the combination at each station of two amplifiers, a multivibrator, means interconnecting said multivibrator with said amplifiers for alternately disabling said amplifiers so that only one of said amplifiers is operative at any one time, means including an oscillator for generating a wave to control said multivibrator so as to operate the multivibrator in phase with the wave of the oscillator, means responsive to a wave received from a distant station of a frequency equal to that of the wave of the local oscillator for operating the multivibrator in phase with the received wave, a delay network for delaying the waves amplified by one of the amplifiers, and means for combining both the undelayed waves of one of the amplifiers and the delayed waves of the other of the amplifiers.

10. In a signaling system, the combination of two vacuum tube translating devices upon which signals are simultaneously impressed, means controlled by said signals for alternately producing two voltages of the same polarity for respectively disabling said translating devices at a predetermined rate, an output circuit for receiving the signals traversing said translating devices, and

a delay network interposed in the path between one of said translating devices and said output circuit for delaying the signals impressed thereon for a predetermined interval.

11. The combination of two translating devices upon which signals are simultaneously impressed in substantially equal phases, means for generating a control wave, means responsive to the control wave for alternately producing two voltages of like polarity for respectively disabling said devices so that only one of said devices is operative at a time, means for delaying the signals traversing one of said translating devices for a predetermined interval of time, and means for combining both the delayed signals and the undelayed signals obtained from said translating devices.

12. In a signaling system, the combination of two amplifiers for amplifying signals, a generator of alternating current, a delay network, means responsive to said signals to operate said generator, means interconnecting said generator with said amplifiers to alternately disable said amplifiers at a predetermined rate so that both amplifiers will not be operative at the same time, an output circuit connected to said amplifiers by individual circuits one of which includes said delay network, said generator being also connected to said output circuit so that its alternating current may be transmitted with the amplified signals.

13. In a privacy system, the combination of two stations which are connected to each other for the two-way transmission of signals therebetween, each station including two translating devices upon which all signals are simultaneously impressed, apparatus including a full wave rectifier for producing two voltages of the same polarity for alternately disabling said translating devices so that said translating devices will translate different groups of segments of said signals, an oscillator controlled by said signals and producing a wave for controlling said disabling apparatus, means for delaying the segments of the signals transmitted by one of said translating devices by a predetermined time interval, means for combining the delayed segments and the undelayed segments transmitted by both translating devices and transmitting said segments of the signals with the wave of said oscillator.

14. A signaling system for two stations arranged for the two-way transmission of signals therebetween, each station including two translating devices upon which all signals are simultaneously impressed, a device for alternately disabling said translating devices at a predetermined rate, an oscillator of predetermined frequency, means responsive to the wave of said oscillator to control the phase at which said disabling device operates, a delay network connected to one of said translating devices for delaying the signals traversing said translating device, and means for combining the delayed and undelayed signals traversing said translating devices.

ROY C. CORDERMAN.