

June 11, 1940.

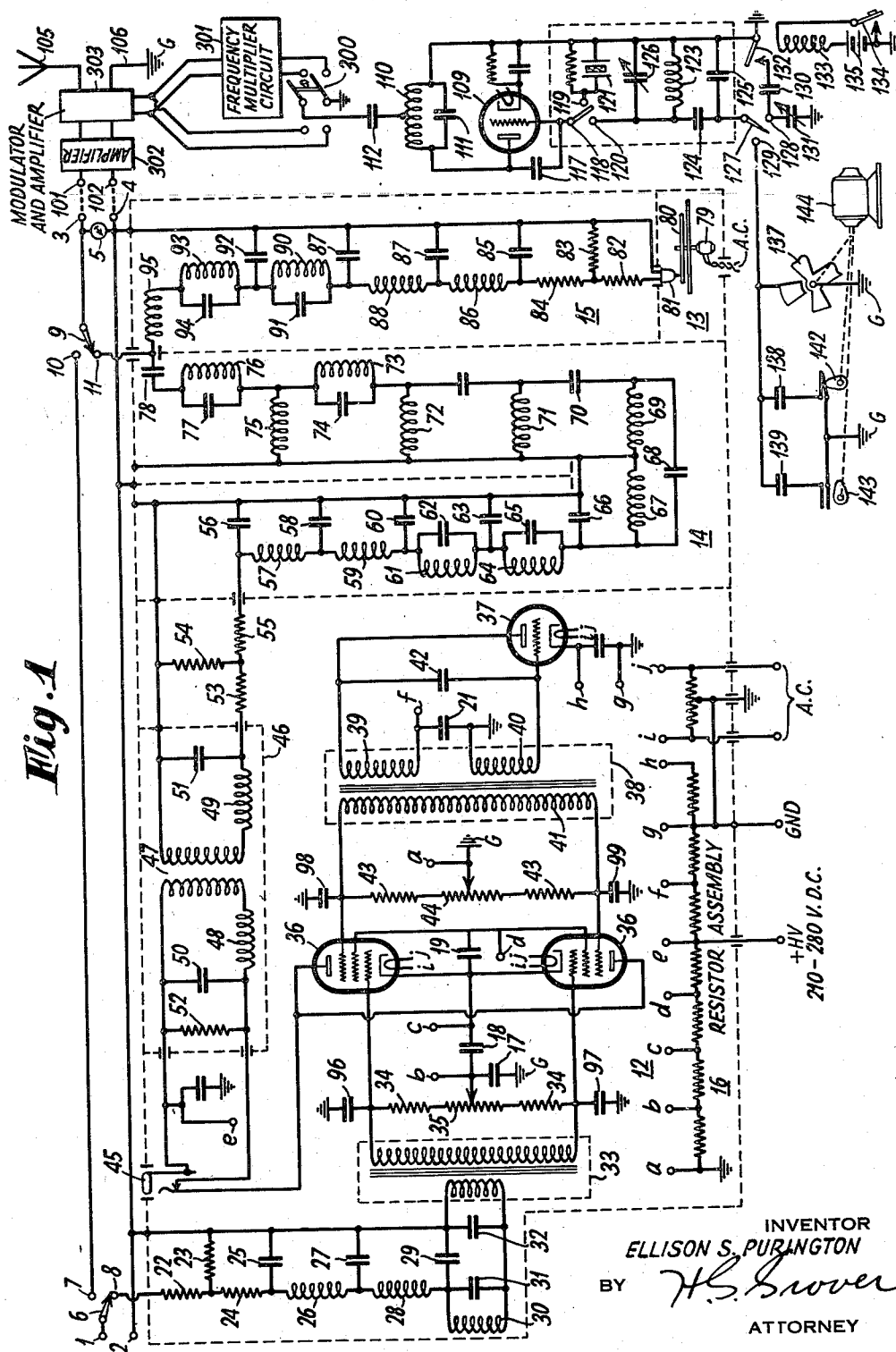
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2,204,050

PRIVACY SIGNALING SYSTEM

Filed Nov. 17, 1938

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2 Sheets-Sheet 2

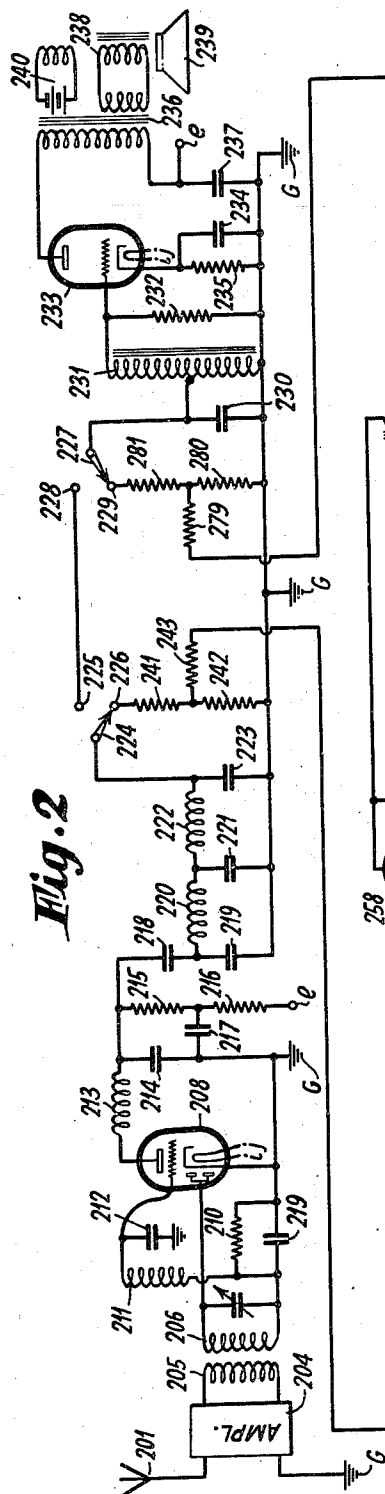


Fig. 2

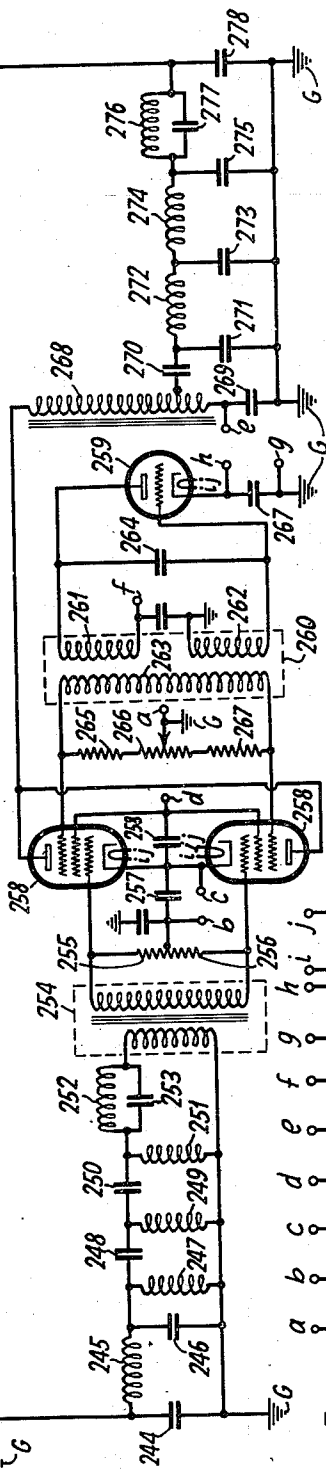
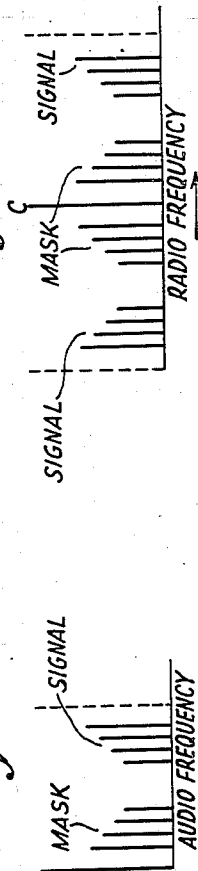


Fig. 3

Fig. 4



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PRIVACY SIGNALING SYSTEM

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13 Claims. (Cl. 179—1.5)

The present invention relates broadly to privacy signaling systems and more particularly to a privacy system of radio telephony using a masking signal.

It is an object of the present invention to devise a privacy system of telephony which has special and marked advantages over the usual types of privacy systems.

Generally speaking, heretofore there did not exist a privacy system of telephony which did not give some indication of the fact that telephony was in progress. This disadvantage has been overcome with the present invention by concealing the true message with a false telephonic signal or message which is on the same carrier wave as the privacy message. In this way the false message, so to speak, masks the presence of the true telephonic signal. In accordance with the present invention, use is made of duplex transmission, with the true signal differing in spectral characteristics from the normal type of telephonic signal by which the masking signal is conveyed.

Briefly outlined, the present invention involves the following steps:

(1) Modulating a carrier wave by a masking signal in the normal manner of usual radio telephony.

(2) Converting the speech frequencies of the true signal to a band of frequencies outside the band used by the masking signal, and modulating the radio carrier also by the modified frequencies.

(3) Varying the carrier, if necessary, at a low rate of speed so that side bands of the carrier wave change from one position to another, whereby any normal type receiver adjustment which might reveal the true signal cannot be maintained.

(4) Reception to produce currents corresponding to the modulation of the carrier, selection of those currents representing the true message, and reconversion of these currents to the initial arrangement to give intelligible indication.

In an actual circuit set up which produced good results, the true signal was sent by converting from the speech range 200–2500 to the modulating range 6200 to 3900 approximately, and the mask signal remained in the band 200 to 2500. This was a conservative choice to give a converted signal completely outside the original speech band, fairly completely free from harmonics of the original speech band, and also to give a good quality masking signal. It is believed the total audio band width of 6200 cycles which was used in the circuit is greater than is necessary or desirable, and that the system can be well operated using modulating frequencies not in excess of 4500 cycles. This would somewhat increase the audibility of the sound pro-

duced by beating of the carrier with the side bands, but would also increase the masking effect due to the masking signal.

The masking signal need not be of good quality, and in fact it is probably better that the masking signal be of a garbled nature with meaningless sounds, such as produced by a phonograph disc operated in the reverse direction. In this way a saving in band width can be effected chiefly by cutting down the masking signal to a range of say 50–1000 cycles, permitting a true message using modulation frequencies in the range 1500–4400 cycles, converted from the range 100–3000 cycles. With this arrangement there is an overlap of the original message band, and the band to which it is converted, with some chance of loss of quality due to imperfections in conversion. However, this should not be a disadvantage since one should not expect as high quality in privacy systems as is possible in normal telephony, due to the difficulty of providing perfectly sharp cut-off in converter filters which usually results in a deficiency of low notes. Moreover, a low quality signal is more easily concealed than a high quality signal, therefore, the user who finds it convenient to use a privacy system must expect a somewhat lower grade of communication than if normal telephony were used.

While the invention has been outlined above in a general manner, it is thought that the nature of the invention will be more readily understood by a more detailed discussion of a particular one of many possible embodiments thereof such as that shown in the accompanying drawings, wherein,

Fig. 1 is a simplified circuit diagram of a transmitter system which may be used for transmitting signals in accordance with the present invention;

Fig. 2 illustrates a receiver which may be used for receiving signals transmitted from an arrangement like that shown in Fig. 1; and,

Figs. 3 and 4 are diagrams used to explain the character of the transmitted signals.

Referring particularly to Fig. 1, the terminals 1 and 2 are arranged to be connected to a suitable source of speech currents such, for instance, as a microphone or pre-amplifier (not shown). The signal energy impressed across terminals 1 and 2 may be transmitted to the transmitting antenna and ground arrangement shown at 105–106 through two paths depending upon whether or not privacy transmission is desired. For this purpose two switches 6, 7, 8 and 9, 10, 11 are provided and arranged so that when switch blade 6 is in contact with terminal 7 and switch blade 9 is in contact with terminal 10, terminals 1 and 2 are directly connected to terminals 3 and 4 respectively, whereas, when switch blade 6 is in contact with contact point 8 and switch blade 9 is in contact with contact point 11, the terminals 60

1 and 2 are connected to terminals 3 and 4 through the privacy circuits, shown at 12, 14 and 13 and comprise a converter circuit, a signal filter (band pass) and a mask circuit respectively. It is seen, therefore, that the arrangement shown in Fig. 1 is constructed so that the privacy circuits may be cut in or out by means of the pair of switches 6, 7, 8 and 9, 10, 11. The terminals 3, 4 are connected to the input terminals 101, 102 of a radio telephone transmitter which may comprise an audio amplifier 302 and a modulator and radio power amplifier 303, which feeds into the antenna ground system 105, 106.

The carrier frequency is generated by means of an oscillation generator circuit including an oscillator tube 109. The output of the tube may be fed directly into the modulator amplifier 303 or to the modulator amplifier 303 through a frequency multiplier circuit 301. Switch 300 is for the purpose of determining the path chosen. The oscillation generator may be operated either as a crystal controlled oscillator in which case switch blade 118 is placed in contact with point 119 thus connecting crystal 121 in the circuit, or as a variable frequency oscillator in which event switch blade 118 is placed in contact with switch point 120 thereby removing the crystal 121 from the control circuit and connecting in its place frequency varying means to be described herein-after.

With the switches arranged so that arm 6 contacts pole 8 and arm 9 contacts pole 11, the signal currents impressed across the terminals 1 and 2 are fed to the converter circuit 12 through an input attenuator 22-24 and an input filter 25-32, and altered by the converter, purified by the signal filter 14, and combined with masking signals from the masking circuit 13, from which the higher frequencies are removed by the masking filter 15. After combining, the converted signals and the masking signals pass through terminals 3 and 4 and are used to modulate the transmitter arrangement 302, 303 and transmitted by the antenna and ground system 105, 106. The converter circuit 12 incorporates a pair of low powered pentodes 36 which may be of any well known type such as commercial type '57 or 6C6 and one oscillator tube 37, which may be a commercial type '56 or '76. The signal frequencies to be converted are impressed upon the first or control grids of tubes 36, 36 from the secondary of a transformer 33 while voltage from the oscillator circuit is impressed upon the third or suppressor grids of the tubes 36. The anodes, screen grids and cathodes are connected in parallel and the output is derived from between anodes and anode battery supply.

Recommended values of currents and voltages for a circuit using the tubes mentioned above are approximately:

Suppres-

sors --- ground or zero potential, no suppressor current

Control

65 grids --- +27.5V, no control grid current
Cathodes +30. V, total cathode current=7.5 ma
Screens --- +150 V, total current=2.5 ma
Plates --- +280 V, total current=5.0 ma

70 Max. volts between control grids... 3.5 volts A. C.
Max. volts between suppressor-grids 17.0 volts A. C.

These should give an output voltage of about 6 volts A. C. to a 50,000 ohm plate load, on each side band.

The ideal relation between plate current and electrode voltage for a tube for use as a converter in this type of circuit is:

$$i_p = a + be_g + ce_s + de_g e_s$$

in which i_p is the plate current, e_s and e_g are the difference of grid and suppressor potentials from the reference bias values, and a , b , c and d are constants. It will be noted that the plate voltage e_p is absent from this ideal equation. This relation is approached by the tubes mentioned above, although there are higher order terms especially for the suppressor voltage. Although the characteristics for the grid control voltage could be improved artificially, the output is fairly free from harmonics of the original frequencies, and those that pass through the modulating system will not seriously disturb the speech quality unless the circuit is excessively forced. There are other more complex methods of avoiding harmonics of the original frequencies passing unconverted through the output system, but it is not believed necessary to use them.

The oscillator circuit shown is of the simplest type suitable for the purpose. For best results it should be constructed in such a manner as to avoid capacity effects through the coupling. In the arrangement shown the anode or plate of oscillator tube 37 is connected to the terminal f of a suitable power supply system, shown as a resistor assembly 16, through a plate coil 39 which is coupled to grid coil 40 connected between the grid of tube 37 and ground. An oscillator or tuning condenser 42 is connected between the plate and grid of tube 37 and acts to determine the frequency of the generated oscillations. A by-pass condenser 21 is connected between the terminal f and ground. The cathode of the oscillator tube is grounded through a condenser and bias voltage is supplied to the tube by connection of this last named condenser across terminals h and g of the resistor assembly 16.

The circuits of tubes 36 are provided with balancing potentiometers 35 and 44 in order that corrections may be made for slight inequalities of the tubes. A phone jack 45 provides for checking the balance, by observation of the currents flowing to the plates from the plate supply source. By adjustment of the potentiometer 35 the original speech frequencies are excluded from the output of the converter 12 and by adjustment of the potentiometer 44 the oscillator frequency does not pass into the output. The upper and lower side bands are thus produced without the presence of the original currents, although second harmonics produced by the tubes also pass into the output. In the event that the oscillator frequency is very high or the transformers 33 and 38 are not sufficiently free from capacity effects, it may be desirable to use trimmer condensers such as 96, 97, 98 and 99 for improving the balance.

The input filter system is made up of reactors 25-32 which serve to choose the band of frequencies which are to be converted, and in this way free the tubes 36 from having frequencies impressed thereon which cannot be utilized. The converter output system 46 which is tuned broadly to the band of frequencies to be used, comprises a ballast resistor 52 shunted by a primary condenser 50 across which is connected a primary choke 48 and the primary winding of a transformer 47, the secondary of the transformer 47 is connected in series with a secondary

choke 49, across the secondary condenser 51. The output system 46 is arranged so that the voltage is stepped down by means of a transformer 47 to permit most of the filtering to be done at a lower impedance level.

Before the converter input filter 25—32 and after the converter output system 46 there are connected attenuators for providing the best adjustment of this circuit for voltage input and output. These attenuators comprise the impedances 22, 23 and 24 connected before the input filter and impedances 53, 54 and 55 connected after the output system 46. These impedances may be fixed after experiment. The power level at the input terminals 1, 2 should preferably be such that the input to the tubes 36 is optimum without using any artificial attenuator. If this is done no amplifiers preceding the converter or subsequent to the converter will be necessary.

The signal filter into which the output from the converter output system 46 is fed in its entirety a band pass filter, made up of a low pass portion 56—66 in series with a high pass portion 67—78. While a system made up of band pass sections may be used, it is believed that the arrangement disclosed is preferable to a system made up of band pass sections because of the high ratio of maximum to minimum frequencies, and because of the great ease of adjusting the upper and lower cut-off characteristics. For systems using speech inversion the high pass cut-off characteristics are not so important at the transmitter as are the lower pass cut-off. The low pass cut-off slightly below the frequency of the oscillator should be quite sharp. If too dull, the quality of the transmission will suffer due to the fact that some of the frequencies of the undesired sideband get through the system, and due to poor transmission of the low speech frequencies.

In some applications, the oscillator 37 may be given a choice of two frequencies, either slightly below or slightly above the band to which the converter output system 46 and signal filter 14 are adjusted. In this case, both portions of the filter must provide sharp cut-off.

The mask circuit 13 is indicated as a phonograph turntable 80 driven by a motor 79 through connection thereof to a suitable power supply system. It is to be understood that any other source of masking frequencies could be used and that the invention is not to be limited to the use of a phonographic device. The phonograph pickup device 81 feeds into a mask filter 15 through an attenuating circuit made up of impedances 82—84, and then through the filter circuit 15 which is made up of the reactors 85 through 95. The filter circuit 15 is arranged for passing frequencies lower than those transmitted by the signal filter. It may be desirable for some purposes to include masking frequencies also higher than those of the signal filter in which case the mask will be on both sides of the signal giving more effective concealment.

The outputs of the signal filter 14 and the masking filter 15 are joined together and fed to the output switch pole 11, preferably through reactors 76, 77, 78 and 93, 94, 95 respectively, suitably designed to avoid reaction effects of one filter upon the other.

A meter 5 is provided for checking the signal strengths of the transmitter input to obtain best transmission condition. While the signal and mask may be made of approximate equal in-

tensity, if the equipment is of sufficient quality and of sufficient power there will be increased advantage as to privacy if the mask is made of much greater intensity than the signal. The limit is reached when the transmission of the privacy is too weak to be intelligible due to various reasons, as, for instance, cross talk from the masking circuit. It has been found that cross talk can result from many causes amongst which are incomplete filtering of the masked filter, production of harmonics of the masking frequencies by the radio transmitter subsequent to the masked filter, non-linearity of detection at the receiver, and incomplete filtering at the receiver.

The improvements in radio transmitters and receivers with respect to linearity of modulation and demodulation is a contributing factor to making the masking circuit practicable under modern conditions, whereas, it might not have been practicable during the earlier developments of radio telephony.

In some applications, it may be desirable to create serious cross interference upon highly selective radio receivers and thereby further conceal the presence of the privacy signal. This may be accomplished by an artificial frequency modulation of the radio transmitter.

Distortions in the audio amplification would result in harmonics of the mask frequencies entering into the signal band. Distortion of modulation would result in second and higher order side bands of the masking circuit being coincident with portions of the signal side bands. Cross talks from these sources with modern designs will be sufficiently small unless the signal side bands are very weak in comparison with the mask side bands. However, if the signal side bands are much greater than the mask side bands, the presence of the privacy signal may be revealed, due to insufficient masking, although not necessarily resulting in intelligibility. The use of artificial frequency modulation is to prevent loss of privacy by continuous wave reception with the local heterodyne frequency set properly at zero beat. If this artificial frequency modulation is required, it may be desirable to simulate privacy transmission on the mask circuit, as, for example, by use of code words, or by simple speech inversion, or by running a phonograph record backwards, so that the real privacy signal may be overlooked.

The artificial frequency modulation may be accomplished most easily by substituting a tank circuit for the crystal of a crystal controlled transmitter. In the drawings, Fig. 1, 109 represents the master oscillator tube, with output tank circuit 110, 111 delivering energy directly or through a frequency multiplier circuit 301 to the higher power radio frequency circuits 303 of the radio transmitter. The frequency generated by the oscillator 109 is controlled mainly by circuits in a constant temperature oven, normally a crystal device 121 which when point 118 is connected to point 119 oscillates by energy fed back from the plate tank circuit 110, 111 through the plate-grid capacity 117. With the points 118 and 120 connected together, however, the frequency is controlled by inductors and condensers 123—126 and low capacity variable condensers beyond point 127 which may be external to the constant temperature chamber or oven. With the points 127—128 connected together, the frequency may be shifted by operating the key 134 which changes the capacity by a slight amount. It will be noted that the key 134 when depressed

energizes the electromagnetic coil 133 by connection thereof across the battery 135. This in turn closes the relay switch 132 which in effect connects the condenser 130 across condenser 131.

5 This type of shift may be used for continuous wave signaling. With the points 127 and 129 connected together a continuously operating wobbler device may be used driven by a motor 144 energized from any suitable available power line and driving the wobbler rotary disc 137 and cams 142 and 143 by gear devices not shown specifically. The wobbler rotary disc 137 should rotate preferably at a slow speed in order to give a fundamental frequency of wobble of between 5 and 50 cycles, and the cams 142 and 143 which cut the fixed condensers 138 and 139 respectively in and out should also be operated at slow speeds. The mean frequency with the wobbler operating when the switch arm 127 is connected to point 129 should be the same as the mean frequency with key relay 132 operating and arm 127 connected to the contact 128. To make this adjustment there has been provided a variable condenser 131. Also the mean frequency should be equal to the crystal frequency, and this is easily achieved by setting a monitoring receiver for zero beat with the crystal operating, and then with the switch thrown to connect switch arm 118 to the contact 120 by adjusting the vernier condenser 126 so that the same tone results in the monitoring receiver with key 134 either up or down. It is believed that a wobbler system such as the one described above should be provided in any high grade crystal control transmitter intended for privacy, to allow for adaptation to service with a wobbler and easy checking of performance.

For convenience the power supply for the arrangement shown in Fig. 1 has been shown generally as a resistor assembly 16. The points *a* through *j* of the resistor assembly are connected to the various points indicated in the remaining portion of the diagram by the same letters.

Broadly speaking, the receiver for the system may be of any general type, however, it is essential for minimum of cross talk that the circuits be linear up to the detector, and that the detections be linear. The selectivity should not be less than that found in a good high fidelity receiver. In case a wobbler is used at the transmitter, excessive selectivity at the receiver would cause variations of the received signal due to detuning, but because of the low frequency of the wobbler devices suggested above, this will produce no serious audible effects.

Referring now more particularly to the receiver arrangement shown in Fig. 2, it will be seen that there is incorporated therein the usual antenna 201 which feeds into the preliminary circuits 204 involving standard practice of a radio receiver. The output of 204 appears across the winding 205 to which is coupled a winding 206. The windings 205 and 206 represent the last radio frequency or intermediate frequency transformer, by which signals representing the transmitter radiations are impressed upon the diodes of a duplex-diode triode tube 208. Tube 208 and its related circuits represents a standard and preferable form of detector device, and may include circuits also for automatic volume control to establish best signal strength conditions for the operation of the detector and other circuits. Such automatic volume control devices have not been disclosed in the diagram nor described in detail since they may be as a matter of fact incorporated in other

circuits of the standard part 204. Furthermore such devices are well known to those skilled in the art. After detection by the diodes of tube 208, the audio frequency voltage component, after filtering of the radio frequency residuals by condensers 209, 212 and choke 211, is impressed upon the triode grid whereby the audio currents are amplified linearly. Choke 213 and condenser 214 serve for filtering any residual radio frequencies. Resistance coupling of the plate load is preferable by the use of resistor 215 and stoppage condenser 218 whereby the output of the rectifier amplifier device 208 is delivered to the low pass filter composed of reactors 219—223. This filter should be designed so as to pass currents below the highest frequencies used to modulate the transmitter, and may be used also in the reception of normal telephonic signals.

For normal reception, switch points 224 and 225 should be connected together and switch 228 and 227 should be connected together which permits the signals to pass directly from the filter 219—223 to the input of the power amplifier tube 233 in the output of which there is connected a loudspeaker arrangement 238—240 or any other desired indicator. The connection between the output of the power amplifier tube 233 to the loudspeaker is through the output transformer 236.

For reception of the privacy signal, the switch points 224 and 226 are connected together and switch points 227 and 229 are connected together thereby cutting in a reconverter circuit and filters. The input attenuators 241—243 and the output attenuators 279—281 may be fixed or with proper design omitted entirely from the circuit. The filter devices 244—253 in connection with the filter 219—223 constitutes a band pass system for selection of the signal frequencies and rejection of the masking frequency. The transformer 254 may be designed to assist further in this separation.

The output of the filter 244—253 feeds into the input of a pair of reconverter tubes 258 through the transformer 254. An oscillation generating circuit including oscillator tube 259 is associated with the reconverter circuit. The reconverter tubes 258, oscillator 259 with all associated circuits may be identical with those used at the transmitter and incorporating the tubes 36 and tube 37 (see Fig. 1) except that the input balancer may be omitted if desired, as shown. A balanced detector of this type is preferable in order to insure complete exclusion of the heterodyne tones from the subsequent circuits. The detector output stepped down by the auto-transformer 268 operates through the output filter 271—278 to purify the signals, and further aids in eliminating the masking tones. The signals now reconverted to the same signals as those operating the converter at the receiver, except for cutting by the filters, is now impressed upon the power tube 233 and further amplified for indication by a suitable indicator device represented generally in Fig. 2 by the loudspeaker combination 238—240.

A clearer idea of the invention will be had from a study of the diagrams shown in Figs. 3 and 4 wherein Fig. 3 shows the relative arrangement of the mask and signal audio energy in the signal amplifier and modulator before it is used to modulate the carrier energy and Fig. 4 illustrates the relative arrangement of the mask and signal energy with respect to the carrier, that is, after modulation of the carrier in the power amplifier output. It will be seen from Fig. 4 that the mask

energy is used to modulate the carrier wave in ordinary fashion and that, therefore, an ordinary receiver tuned to the carrier would receive the mask sidebands. The privacy signal on the other hand has been displaced in frequency as indicated by the displaced signal sidebands in Fig. 4 so that the ordinary receiver would, of course, not receive the privacy signals.

Although a specific embodiment of the invention has been shown for purposes of illustration, it is to be understood that the invention is capable of various uses and that various changes and modifications may be made therein as will be readily apparent to a person skilled in the art. It is intended that the invention be limited only in accordance with the following claims when interpreted in view of the prior art.

I claim:

1. A method of signaling which consists in generating a carrier wave, producing a first band of audio frequencies representative of a set of signals, producing a second band of audio frequencies representative of another set of signals, converting the last named band of audio frequencies to another band of related frequencies, simultaneously amplitude modulating the carrier wave in accordance with both said first band of audio frequencies and the converted band of frequencies, transmitting the resultant carrier and upper and lower sets of side bands, intercepting the transmitted energy at a receiving point, detecting the intercepted energy to derive therefrom the signal components, separating out from the resultant energy the signal components due to modulation of the carrier by the first band of audio frequencies and the signal components due to modulation of the carrier by the converted band of frequencies, reconvertig the last named signal components to a band of related audio frequencies similar to the second band of audio frequencies and deriving the second set of signals from the reconverted energy.

2. The method described in the next preceding claim characterized by that the second band of audio frequencies is also frequency inverted during the conversion process at the transmitter and re-inverted during the reconversion process at the receiving point.

3. A method of privacy telephony utilizing multiplex telephonic transmissions characterized by that one of the multiplex transmissions produces intelligible signals in the normal type of telephonic receiver and another produces unintelligible signals in the normal type of receiver but produces intelligible signals in a specially designed receiver, said second-named transmission constituting the message desired to be conveyed and said first-named transmission constituting a false or masking message to discourage search for the true or hidden message.

4. In a privacy telephonic system, means for generating carrier wave oscillations, means for producing masking signal energy, means for producing the signal energy constituting the message desired to be conveyed, means for altering the characteristics of the message signal energy in a predetermined reversible manner, to thereby render intelligible reception of the message signals possible only in a pre-arranged manner, means for modulating the carrier oscillations by both the masking signal energy and the altered message signal energy, means for transmitting the modulated carrier oscillations, a receiving system including means for intercepting and

detecting the transmitted energy and deriving therefrom the masking signal energy and the altered message signal energy, means for separating out the altered message signal energy and altering the characteristics thereof so as to bring the energy back to its original form and means for utilizing the resultant energy.

5. In a radio telephonic system, the method of imparting a high degree of secrecy to signals desired to be conveyed from one point to another, which method consists in producing a single carrier wave, simultaneously modulating the carrier wave by both the desired signals and by intelligible masking signals, the masking signals being characterized by that the interception and detection of the modulated carrier by a normal type of radio telephonic receiver produces only the masking signals, the characteristics of the desired signals being altered so that translation thereof is possible only in a specially designed radio telephonic receiver, the masking signals constituting a false message calculated to discourage search for the true or hidden message.

6. In a privacy telephony system, means for producing a band of audio frequencies for masking purposes, means for producing a band of audio frequencies for signaling purposes, means for converting the last named band of frequencies to a band of frequencies which is different than the first named band of audio frequencies, means for producing a carrier wave, means for modulating the carrier wave by both the masking energy and the converted signaling energy, means for transmitting the carrier wave thus modulated, a receiving system including means for intercepting the transmitted energy, a first detector circuit coupled to the last named means, for deriving from the intercepted energy the modulation components thereof, means for separating out the masking energy component and the converted signaling energy, means for reconvertig the last named energy to produce therefrom the signaling energy and means for impressing the resultant signaling energy upon a utilizing circuit.

7. The steps in a method of secret signaling which comprise generating a carrier wave, producing two audio frequency signals one of which is the true signal and the other a masking signal, both of said signals occupying the same audio frequency band, generating oscillations of fixed frequency, combining the generated oscillations with the true audio frequency signals to produce from said combination a band of frequencies representative of the true signals but outside the first named audio frequency band, generating carrier wave oscillations, modulating the last named carrier wave oscillations simultaneously by both the masking signals and the last named band of frequencies, and transmitting the modulated carrier wave oscillations, receiving the transmitted energy, detecting the same to derive therefrom the modulation components thereof, selecting therefrom the modulation components due to the last named band of frequencies, generating oscillations of a frequency of such a value that when combined with the selected band of frequencies the original true signal audio frequencies are produced and combining the generated oscillations with said selected band of frequencies.

8. In a multiplex radio telephonic communication system, means for producing a band of audio frequencies representative of a first set of signals

desired to be transmitted, means for separately producing a band of audio frequencies representative of a second set of signals desired to be transmitted, means for converting said first band of audio frequencies to a corresponding but different and inverted band of frequencies, means for producing carrier wave oscillations, means for modulating the carrier wave oscillations simultaneously by both the converted band of frequencies and the band of audio frequencies representative of the second set of signals, means for transmitting the carrier wave oscillations thus modulated, means for intercepting and detecting the transmitted oscillations to derive therefrom the modulation components, means for separating the two modulation components, a pair of transmission circuits associated with said last named means, a utilizing circuit associated with each of said transmission circuits, one of said pair of circuits being adapted to transmit directly to the utilizing circuit the modulation component comprising the band of audio frequencies representative of the second set of signals, said other transmission network including means for reconvert-
 25 ing the other modulation component to produce therefrom a band of audio frequencies having substantially the identical characteristics as the first named band of audio frequencies and transmitting the reconverted band of frequencies to the utilizing circuit.

9. A communication system as described in the next preceding claim characterized by that means are provided at the transmission end for wobbling the produced carrier wave oscillations in a predetermined manner.

10. In a privacy telephony system, means for producing two audio frequency signals simultaneously, one of said signals being the true signal and the other thereof a masking signal, a source of local oscillations, means comprising a balanced modulator for combining the true signal energy and the oscillations from said source, said balanced modulator being arranged to eliminate from the products of said combination both the true signal energy and the source oscillations, means for generating a carrier wave and means for simultaneously modulating the carrier wave by the products of said last named combination and the masking signals.

11. A balanced push-pull modulator circuit comprising a pair of electronic tubes each thereof being provided with an anode, a cathode and at least two grid electrodes, a connection between the cathodes thereof, means for negatively biasing both grid electrodes of each of said tubes with respect to the cathodes thereof, a source of signaling energy, a source of oscillations, an input circuit including a transformer provided with primary and secondary windings, means for connecting the source of signaling energy across the primary winding, means connecting the secondary winding between a grid of one of said tubes and the corresponding grid of the other of said tubes, a resistance circuit connected between said two

grids, a variable tap on said resistance circuit, means for connecting said tap to said first named connection, a second input circuit including a coupling coil connected between the other corresponding grid electrodes of said tubes a balancing circuit connected across said coupling coil, means for electrically connecting said source of oscillations across said input coil, an output circuit for said modulator comprising a common connection between each of said anodes and said cathodes and including an output impedance device, a utilizing circuit and means for coupling the utilizing circuit to said output circuit.

12. The steps in a method of telephony utilizing multiplex telephonic transmissions which comprise generating a carrier wave, producing a first band of frequencies representative of a set of signals, producing a second band of frequencies representative of another set of signals, converting the second named band of frequencies into a third band of related frequencies which is displaced from said second band by a predetermined amount, simultaneously modulating the carrier wave by both the first band of frequencies and the third band of frequencies, transmitting the resultant energy, intercepting the transmitted energy at a receiving point, detecting the intercepted energy to derive therefrom the signal components, separating out from the detected energy the signal components due to modulation of the carrier by said first band of frequencies and the signal components due to modulation of the carrier by the third band of frequencies, reconvert-
 35 ing the last named signal components to a band of related frequencies similar to the second band of frequencies and deriving from said reconverted energy the second set of signals.

13. The steps in a method of multiplex telephony which comprise generating a carrier, producing a band of audio frequency signals representative of a message to be transmitted, producing a second band of audio frequency signals representative of another message to be transmitted, producing from the second band of audio frequency signals a band of frequency inverted signals which are displaced in the frequency spectrum from the first band of audio frequencies by a predetermined amount, simultaneously modulating the carrier by both the first band of frequencies and the band of frequency inverted signals, transmitting the resultant energy, intercepting the transmitted energy at a receiving point, detecting the intercepted energy and deriving therefrom the signal components, separating out from the detected energy the signal component due to modulation of the carrier by the first band of frequencies and the signal components due to modulation of the carrier by the band of frequency inverted signals, and producing from the last named signal components a band of inverted frequencies which is displaced in the frequency spectrum back to the position of the second band of audio frequencies.

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