

May 7, 1940.

W. R. KOCH

2,199,634

SECRET COMMUNICATION SYSTEM

Filed June 21, 1938

3 Sheets-Sheet 1

FIG. 1.

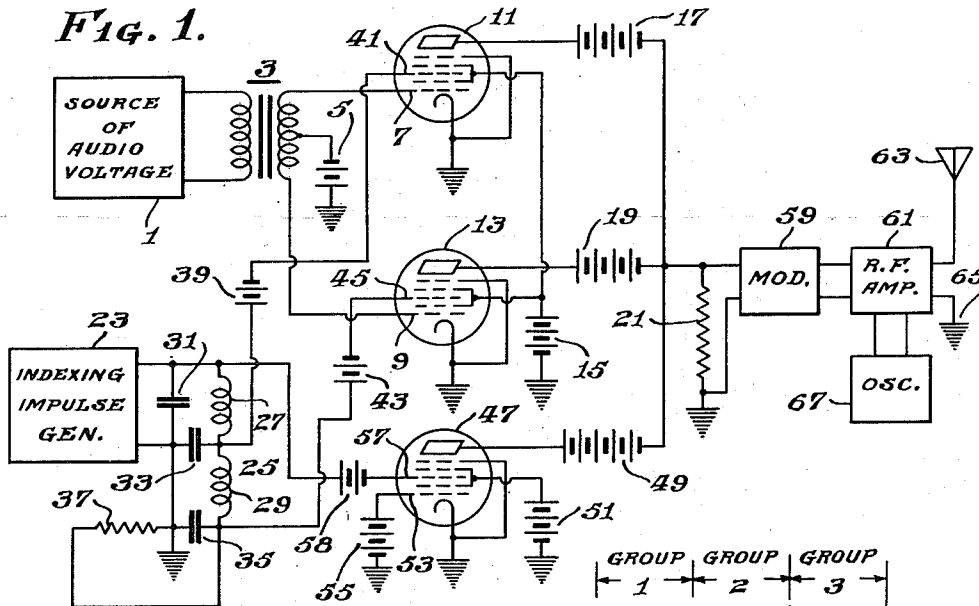


FIG. 2.

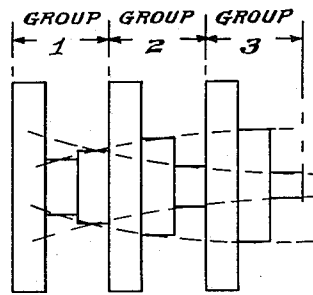
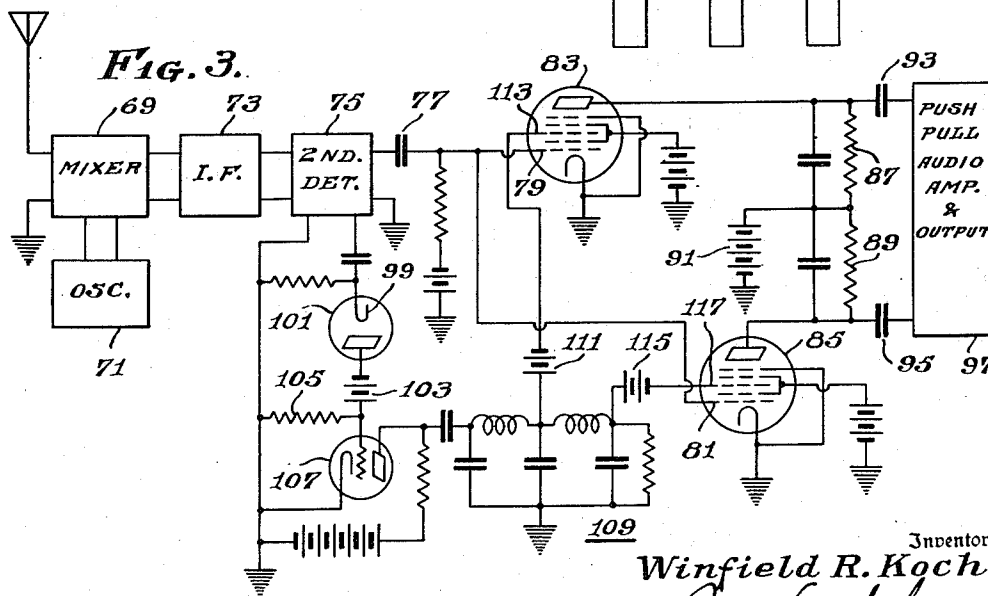


FIG. 3.



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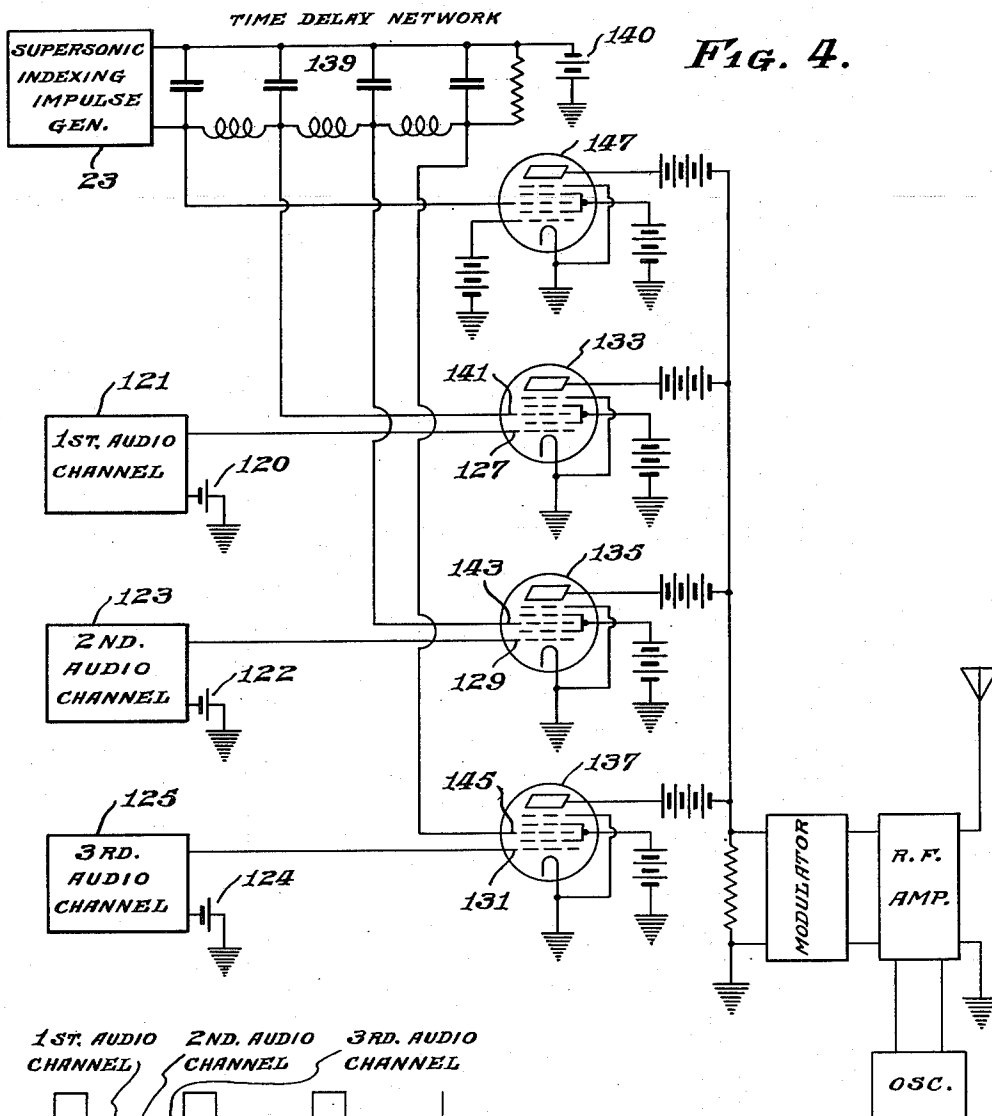


FIG. 4.

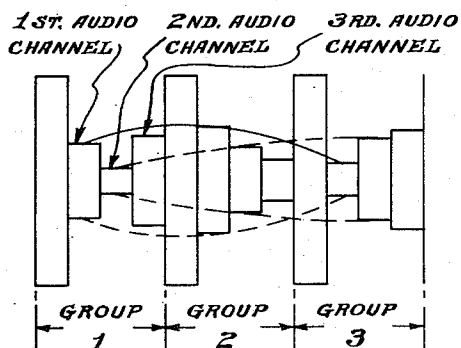


FIG. 5.

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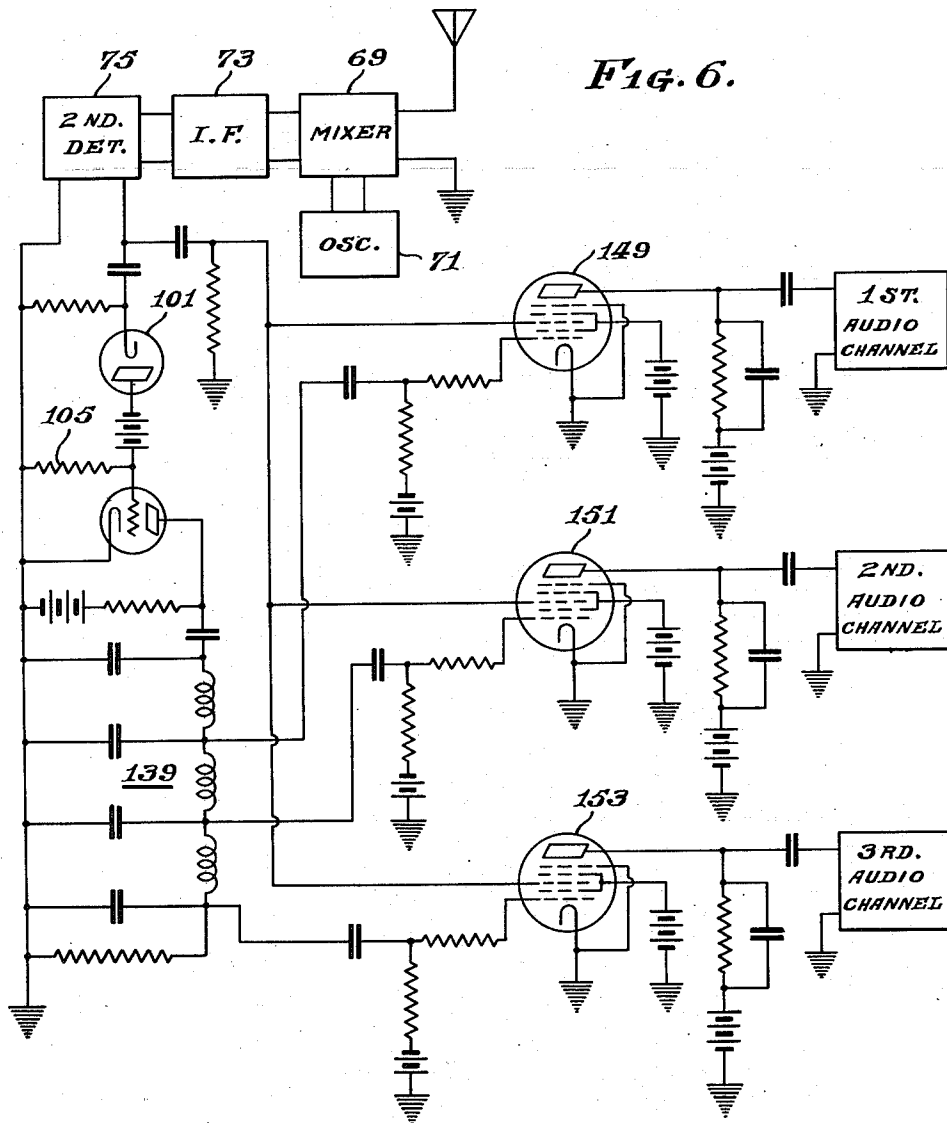
2,199,634

SECRET COMMUNICATION SYSTEM

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FIG. 6.



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2,199,634

SECRET COMMUNICATION SYSTEM

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Radio Corporation of America, a corporation
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Application June 21, 1938, Serial No. 214,866

6 Claims. (Cl. 179-1.5)

My invention relates to secret radiotelephone systems, and more particularly to a communicating system which transmits and receives signals which are unintelligible when received on an ordinary receiver, and which may be readily adapted for use as a secret multichannel communication system.

The importance of maintaining secrecy in certain types of communication systems is well known. Most radio and telephone systems are subject to the disadvantage that the information so transmitted may be intercepted by unauthorized persons. It is, therefore, an object of this invention to provide a communication system which transmits normally unintelligible signals.

It is a further object to provide a communication system which may be used to transmit more than one conversation at the same time, independently but through the same apparatus.

A further object is to provide a transmitter and a receiver, respectively capable of transmitting and receiving a conversation in accordance with this invention.

A still further object of this invention is to provide a secret communication system in which more than one simultaneous conversation may be transmitted and received in complete secrecy.

A further object of this invention is to provide a transmitter whose carrier output peak voltage remains constant during periods of modulation.

A still further object of this invention is to provide a receiver which is capable of detecting the modulating impulses which are impressed on a carrier of the type employed in practicing this invention.

This invention will be better understood from the following description when considered in connection with the accompanying drawings. Its scope is indicated by the appended claims. Similar reference numerals refer to similar parts throughout the several drawings.

Referring to the drawings,

Figure 1 is a schematic drawing of a transmitter which is capable of generating a modulated carrier in accordance with this invention.

Figure 2 illustrates the envelope of three consecutive wave groups of a signal generated by the transmitter shown in Fig. 1.

Figure 3 is a schematic diagram of a receiver for the reception of a signal of the type illustrated in Fig. 2.

Figure 4 is a schematic drawing of an alternative transmitter which is energized by a plurality of separate voice channels,

Figure 5 illustrates the type of signal envelope

which results from the use of a transmitter of the type shown in Fig. 4, and

Figure 6 is a schematic diagram of a receiver for separating and making intelligible the separate audio channels which may be transmitted by the device shown in Fig. 4.

Referring to Fig. 1, a source of audio voltage 1 is connected to the input of a push-pull audio frequency coupling transformer 3. The mid-tap of the secondary of this transformer is connected through a biasing battery 5 to ground. The secondary terminals of this transformer are respectively connected to the control grids 7 and 9 of a pair of pentagrid mixer tubes 11 and 13. Each of the tubes 11 and 13 may have a screen grid which is properly biased by a battery 15. The anode electrodes of the tubes 11 and 13 are respectively connected through a suitable source of anode potential, such as batteries 17 and 19, to the first terminal of a plate circuit resistor 21.

An indexing impulse generator is indicated at 23. This generator produces a rectangular-shaped oscillatory wave at a supersonic frequency. Its output is connected across a time delay network 25, one side of which is grounded. The time delay network may consist of a pair of inductors, 27 and 29, capacitors 31, 33 and 35, and a resistor 37 which are connected to represent an artificial line circuit. Thus, each impulse which is impressed across the input to this circuit appears at a slightly later time across the successive portions of the delay network.

The intermediate point of the network, which establishes the first delay period, is connected through a suitable biasing battery 39 to a grid 41 in a pentagrid mixer tube 11. The output of the delay network, which establishes the second delay period, is connected through a suitable biasing battery 43 to a grid 45 of a second pentagrid mixer tube 13.

A third pentagrid mixer tube 47 is employed to transmit a timing impulse. The anode electrode of this tube 47 is connected through an anode potential battery 49 to the first terminal of resistor 21. Its screen grid is properly biased by a battery 51. The grid 53 of the third pentagrid mixer is not used and may therefore be grounded or biased by means of a battery 55. Grid 57 is connected to the input of the time delay network 25 through a suitable biasing battery 58.

The second terminal of resistor 21 is grounded. The voltage which is developed across this resistor is impressed across the input of a modulator 59 which, in turn, is connected to a radio frequency amplifier 61, to which an antenna 63 and

ground 65 are connected. Energy for driving the radio frequency amplifier 61 is obtained from a local oscillator 67. The modulator 59, amplifier 61 and oscillator 67 are conventional and need not be shown in detail.

The operation of this transmitter may be explained in the following manner: Each of the pentagrid mixer tubes 11, 13 and 47 is biased to plate current cut-off during the period at which no impulse signal is present on their respective grids. If an audio frequency voltage from source 1 is impressed in push-pull on the grids of the first two mixer tubes 11 and 13, no corresponding plate current will flow until a biasing impulse is applied to these grids. This biasing potential is supplied by the impulse generator 23 and the delay network 25. The first biasing impulse will place a positive voltage on the grid of mixer tube 47. Since no modulating voltage is applied to this tube, a pulse of short duration and of uniform amplitude will be applied to the modulator. This, in turn, will cause a pulse of carrier frequency energy to be radiated from the antenna 63.

At some appreciable time after this pulse has been applied to the tube 47, a similar positive pulse will be impressed upon grid 41 of mixer tube 11. This pulse will cause the tube to draw plate current which will correspond to the instantaneous value of the impressed audio frequency voltage. The pulse will finally reach the grid 45 of the mixer tube 13 and will similarly cause this tube to draw plate current. It is to be noted that the audio frequency voltage is applied in push-pull to the first two mixer tubes. Consequently, when the audio frequency voltage on the grid of one is becoming more positive, it is necessarily becoming more negative on the other. As a result, the plate current of the first mixer tube 11 will increase with each successive application of the biasing pulse, while the plate current of the second mixer tube 13 will decrease in response to the applied audio voltage.

Fig. 2 illustrates the resultant carrier which is obtained. Three cycles have been illustrated. Each cycle is started by a timing impulse of uniform amplitude and duration which is generated by a mixer tube 47. The first impulse after each of the timing impulses is shown increasing in amplitude while the second impulse after each of the timing impulses is shown decreasing in amplitude in the manner explained above. A line connecting the peak of similar impulses will define the audio frequency voltage.

The amplitude of the indexing impulse is normally maintained at a value considerably greater than the maximum which may be reached by the successive impulses. It is evident that the peak value of such a carrier wave envelope is constant. Likewise, the average value is constant. Consequently, no intelligible sound will be reproduced when such a signal is received on an ordinary receiver.

While I have shown a uniform spacing for the various impulses in each group, this is not essential, for the time delay periods may be made non-uniform. This will, of course, avoid any possibility of accidental timing or synchronizing to the supersonic group frequency. Also the successive output impulses may be separated by making the time delay period greater than the duration of a biasing impulse.

Fig. 3 illustrates an embodiment of a receiver which is suitable for the reception of carrier frequency waves modulated in the manner described

above. This receiver includes a mixer 69, a local oscillator 71, an intermediate frequency amplifier 73 and a detector 75. Each of these elements is conventional and need not be described in detail. The output of the detector is connected through a coupling capacitor 77 to the grids 79 and 81 of a pair of mixer tubes 83 and 85. The anode electrodes of these tubes are connected respectively through plate loading resistors 87 and 89 to a suitable source of anode potential such as battery 91 or the like. The anodes are also coupled respectively through a pair of coupling capacitors 93 and 95 to the input of a conventional push-pull audio amplifier and output device 97. The detector output is also coupled to the cathode 99 of a diode rectifier 101. This rectifier is biased by a battery 103 which is of such a value that rectification takes place only during the peaks of the index impulses. Consequently, a voltage of impulse frequency is developed across resistor 105 and impressed upon the grid of a triode amplifier 107. The output of this amplifier is coupled to the input of a time delay network 109. This network is identical to the one used in the transmitter illustrated in Fig. 1. Its mid-point, or first delay section, is connected through a suitable biasing battery 111 to the grid 113 of the mixer tube 83. The output or second delay section is connected through a suitable biasing battery 115 to the grid 117 of mixer tube 85. The grids 113 and 115 of the two mixer tubes 83 and 85 are biased to cut off the plate current in the absence of an impulse voltage. Since the applied impulse voltage is of the same frequency as that utilized in the transmitter and, since the time delay periods are identical, mixer tubes 83 and 85 will be successively made conducting by the successive impulses during the interval at which the impulse was applied to the corresponding tube in the transmitter; that is, tubes 83 and 85 will be successively operable and will reproduce in their plate circuits the audio frequency voltage which was originally applied to the mixer tubes in the transmitter of Fig. 1.

While I have shown a transmitter and receiver in which a single audio frequency voltage has been transmitted and received in push-pull, it is possible, by a modification of my invention, to utilize the successive periods of transmission for a plurality of independent simultaneous audio signals. Such a system may utilize the push-pull system just described, or may operate with one impulse period assigned to each separate channel.

Referring to Fig. 4, a device of this nature is illustrated. For example, three separate and distinct audio channels 121, 123 and 125 have been provided, which are respectively connected to grids 127, 129 and 131 of three pentagrid mixer tubes 133, 135 and 137, and to ground through three biasing batteries 120, 122 and 124. A supersonic impulse generator 23 is provided as before. Its output is connected to a time delay network 139 which provides three sections of different delay periods for the three separate audio channels. The successive delay sections of the network 139 are connected respectively to the grids 141, 143 and 145 of the three mixer tubes. Grid bias for these tubes is supplied by a battery 140 which is connected between the low side of the time delay network and ground.

An indexing impulse is provided by means of a fourth pentagrid mixer 147, whose input is connected to the timing impulse generator and

whose output is connected in parallel with that of the other tubes.

The modulated carrier wave envelope is of the form illustrated in Fig. 5. The index impulse is transmitted at regular intervals and with constant amplitude. Between the successive index impulses three separate impulses occur, each one representing the instantaneous value of the signal from the respective audio channels.

Fig. 6 illustrates the schematic diagram of a receiver designed to separate and translate these impulses. A conventional superheterodyne input system may be employed as shown by mixer 69, local oscillator 71, intermediate frequency amplifier 73, and detector 75. The output of the detector 75, which includes the supersonic impulse frequency, is rectified by a biased rectifier 101. The output voltage, which is developed across resistor 105, is of the same frequency and wave shape as the indexing or supersonic impulse generated at the transmitter. A time delay network 139 is employed to produce a series of successive impulses which occur in the same time relation as the impulses at the transmitter. Three mixer tubes 149, 151 and 153 are provided for the separation of the demodulated carrier into the three separate audio channels. Each of the mixer tubes is biased below plate current cut-off in the absence of an impulse signal. Therefore, each tube successively becomes operative upon the application of the impulse signal, at the proper time and in the proper sequence, to separate the carrier into the required separate audio channels.

Although I have illustrated my invention by means of a radio transmitter and receiver, it is not necessarily so operated. The modulating voltage which is present in the modulator 59 may be sent over land wires or the like, to a suitable receiver. Likewise, while pentagrid mixer tubes are preferable, other types may be utilized. They may be operated by superimposing the impulse bias on the control grid or by operating on the cathode.

When using the system illustrated in Fig. 4, it is desirable to transmit a false signal over any audio channel which is not actually in use in order to confuse the signal which is transmitted by the channels which are in use.

I claim as my invention:

1. In a system for the secret communication of intelligence, the method of operation which includes the steps of generating a series of indexing impulses of supersonic frequency; successively delaying said impulses; generating a signal voltage; obtaining components of said signal voltage which are in phase opposition, utilizing said delayed impulses to control said components which are in phase opposition to thereby obtain a series of separate successive impulses representing respectively an instantaneous value of said signal voltage having one phase and a subsequent instantaneous value of said signal voltage having an opposite phase; transmitting said indexing impulse and said successive impulses; receiving said transmitted impulses; separating said indexing impulse from said successive impulses; successively delaying said indexing im-

pulses; and utilizing said successive delayed impulses to reestablish said signal voltage.

2. In a system of the type described for communication by normally unintelligible signals, a source of indexing impulses, a network for successively delaying said indexing impulse; a source of signal-representing voltages; means for causing the transmission of a first signal-representing impulse whose amplitude is directly proportional to said signal-representing voltage; means for causing the subsequent transmission of a signal-representing impulse whose amplitude is inversely proportional to said signal-representing voltage; and means for transmitting said indexing impulse.

3. A device of the character described in claim 2 which is further characterized in that said means for transmitting said impulses includes a radio transmitter.

4. In a system of the type described for communication by normally unintelligible signals, a source of indexing impulses recurring at a supersonic frequency; a network for successively delaying said indexing impulse; a source of signal-representing voltages; means for causing the transmission of a first signal-representing impulse whose amplitude is directly proportional to said signal-representing voltage; means for causing the subsequent transmission of a signal-representing impulse whose amplitude is inversely proportional to said signal-representing voltage; and means for transmitting said indexing impulse.

5. In a system of the type described for communication by normally unintelligible signals, a transmitter which includes a source of indexing impulses having a supersonic frequency; a network for successively delaying said impulses; a source of signal-representing voltages; a pair of mixer tubes, means for impressing said signal-representing voltages on the inputs of said tubes in phase opposition; means for connecting the outputs of said tubes in parallel, means for maintaining said tubes normally nonresponsive to said signal-representing voltages; means for causing said tubes to become successively responsive for the duration of each successively delayed indexing impulse whereby alternate impulses are obtained whose amplitudes are respectively directly and inversely proportional to the instantaneous amplitude of said signal-representing voltages; means for transmitting said indexing impulse; and means for transmitting said alternate impulses.

6. In a system of the character described in claim 5, a receiver which includes means for separating said indexing impulse from said alternate impulses; a pair of thermionic tubes, means for impressing said alternate impulses on the input of said tubes; means for successively delaying said indexing impulse; means for causing said tubes to become alternately responsive to said impulses for the duration of each successively delayed impulse; whereby said signal-representing voltages are reestablished in the output circuit of said tubes.

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