

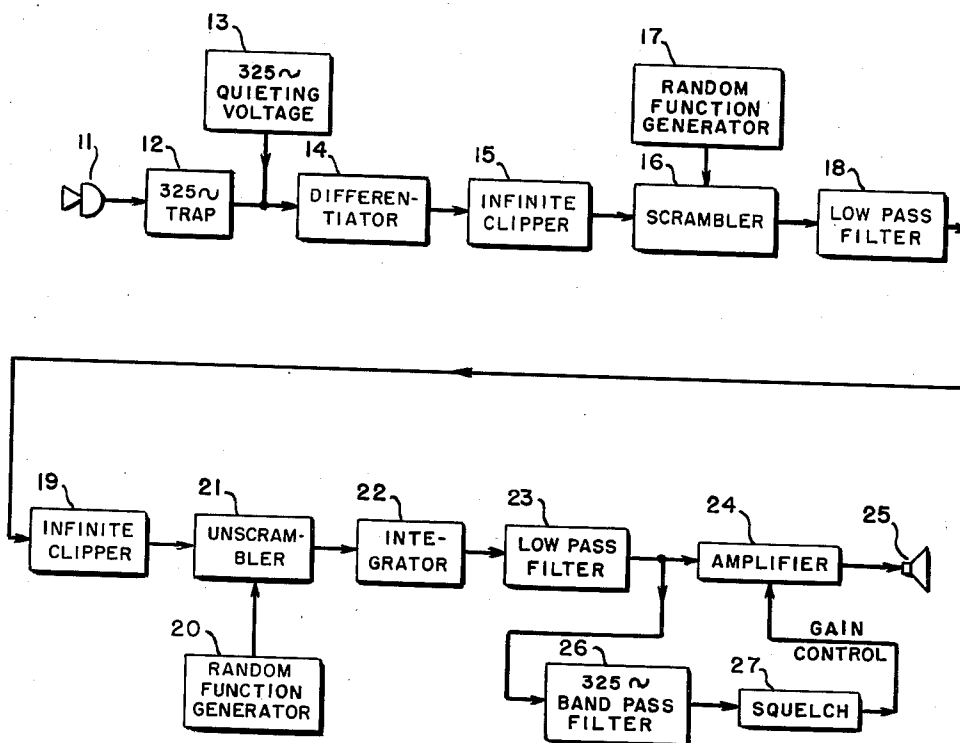
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SPEECH SECURITY SYSTEM

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SPEECH SECURITY SYSTEM

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment of any royalty thereon.

This invention relates to a speech security communication system of the type in which randomly timed phase reversals are introduced into the speech voltage to form a scrambled signal which is unintelligible to unauthorized receivers and, more particularly, to an improved system using a quieting voltage which is at the lower end of the audio pass-band.

It is common in speech security systems to use infinite clipping, i.e., clipping close to the zero line using high gain amplifiers, so that improved scrambling of the input signal may result. However, infinite clipping makes the system extremely sensitive to background noise and, as a result, a loud, annoying intersyllable noise occurs at the audio output of the receiver. In order to overcome this intersyllable noise it has been the practice in prior art systems to supply a supersonic quieting voltage to the infinite clipper in the transmitter in addition to the speech signal. This quieting voltage is of low amplitude so that it is easily overcome by the presence of a speech signal, but it has a high enough amplitude to overcome the background noise applied to the clipper circuit in the transmitter. Thus, intersyllable noise at the output of the receiver is eliminated since, in the absence of speech signals, only the supersonic quieting signal is present at the receiver output.

It has been found that when a supersonic quieting voltage, such as that mentioned above, is applied to a speech security system in which randomly timed phase reversals are introduced into the speech signal, the scrambled signal is somewhat intelligible. This is due to the fact that the speech signal does not always fill the entire audio spectrum, and since the quieting voltage lies outside the audio spectrum, it contributes nothing to the scrambling of the speech signal. If a quieting voltage having a frequency at the lower end of the audio pass-band of the system is used, good scrambling is secured since the higher odd harmonics of the quieting voltage tend to fill up gaps in the audio spectrum which would occur using the speech signal alone. However, the use of a quieting voltage of this type produces a burst of sound in the absence of speech which is nearly as annoying as the intersyllable noise which results when no quieting voltage is used. Thus, it can be seen that the speech security systems of the prior art offer the user an alternative between a system having good scrambling characteristics but high intersyllable noise or a system with poor scrambling characteristics but having no intersyllable noise.

In accordance with this invention a new and improved speech security system is provided which combines the best features of the prior art systems, i.e., good scrambling with no intersyllable noise, into one relatively simple system. This is accomplished by using a low-amplitude quieting voltage having a frequency at the lower end of the system pass-band (just inside the pass-band, say 325 c.p.s. for a pass-band of 300 to 3500 c.p.s.) and, at the receiver, a narrow 325 c.p.s. band-pass filter to separate the 325 c.p.s. energy from that in the rest of the spectrum. A control voltage derived from the filter output is then used to operate a squelch circuit which will

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cut off the audio output of the system in the absence of speech thereby eliminating intersyllable noise.

Accordingly, it is a primary object of the invention to provide a speech security system having good scrambling characteristics and no intersyllable noise.

A more specific object of the invention is to provide a speech security system having no intersyllable noise and using a quieting voltage having a frequency inside the audio pass-band of the system.

Further objects and features of the invention will become apparent upon consideration of the following detailed description taken in conjunction with the drawing, the single figure of which shows a preferred embodiment of the invention.

Referring now to the drawing, there is shown a speech security system having a suitable input shown as a microphone 11. The output of microphone 11 includes audio frequencies in the range of 300 to 3500 c.p.s. and is supplied to a differentiator 14 through a 325 c.p.s. trap 12 which can be either a narrow 325 c.p.s. band-elimination filter or a high-pass filter passing only signals above 325 c.p.s. Differentiator 14 is also supplied with a constant, low-amplitude 325 c.p.s. quieting voltage 13. The output of differentiator 14 is fed to an infinite clipper 15 in which the signals are shaped into a square wave signal having a high amplitude. This square wave signal is supplied to a scrambler 16 in which randomly timed phase reversals are introduced into it by a random function generator 17. The resultant scrambled signal is passed through a suitable low-pass filter 18 and is transmitted by any suitable means, radio or wire, to a distant receiver.

At the receiver of the speech security system the transmitted scrambled signal is supplied to an infinite clipper 19, similar to infinite clipper 15, which reshapes the signal waveform. The signal is then fed to an unscrambler 21 which is controlled by a random function generator 20 which introduces phase reversals into the received signal in unscrambler 21 in synchronism with the phase reversals supplied to scrambler 16 by random function generator 17. The synchronism between random function generators 17 and 20 can be accomplished by any suitable known means and forms no part of this invention. The unscrambled signal is then passed through integrator 22, a suitable low-pass filter 23, and an amplifier 24 to a loudspeaker 25 which reproduces the speech supplied by microphone 11. The output of low-pass filter 23 is also supplied to a narrow 325 c.p.s. band-pass filter 26, the output of which is used to energize a squelch circuit 27. The output of squelch circuit 27 is applied to the gain control of amplifier 24 to cut off amplifier 24 and thereby cut off the audio output of the system.

The operation of the system will now be described. Audio frequency signals, 300 to 3500 c.p.s., and a low-amplitude quieting voltage having a frequency, 325 c.p.s., just inside the lower end of the audio pass-band of the system are fed to scrambler 16. The quieting voltage eliminates the effect of background noise on the system in the conventional manner in infinite clipper 15. In the absence of speech or in the gaps between syllables and words in the speech signal, the quieting voltage also significantly improves the scrambling since the higher odd harmonics of the quieting voltage fill up the audio spectrum whenever gaps in the speech signal occur; and the location of the 325 c.p.s. quieting signal at the low end of the speech range means that gaps in the spectrum of speech are filled in by the harmonics of the infinitely clipped 325 c.p.s. signal. When speech signals are present they overcome the quieting voltage and, in effect, disable it.

At the receiver end of the system, the transmitted scrambled signal is unscrambled and supplied to loudspeaker 25 in the conventional manner except that whenever a speech signal is absent, such as in gaps between

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words and syllables, the 325 c.p.s. quieting voltage is present and is passed by the narrow 325 c.p.s. band-pass filter 26 to the normally disabled squelch circuit 27 which then operates on the gain control of amplifier 24 to cut it off. Thus, it can be seen that when speech signals are present, they will be passed to output loudspeaker 25; but when gaps in the speech signal occur, squelch circuit 27 is energized to cut off the audio output. As a result no intersyllable noise will be obtained from loudspeaker 25.

The 325 c.p.s. trap 12 inserted between microphone 11 and differentiator 14 is necessary to eliminate any 325 c.p.s. frequency components from the input speech signal to avoid operation of squelch circuit 27 by 325 c.p.s. components of the speech energy thereby cutting off the output when speech is present. Thus squelch circuit 27 will not be operated except when no speech is present which is what is desired. As stated previously, trap 12 can be either a narrow 325 c.p.s. band-elimination filter on a high-pass filter passing only signals above 325 c.p.s. since the loss of the lower frequencies would not have much effect on the quality of the speech transmitted.

In an embodiment of the invention constructed for a pass-band of 300 to 3500 c.p.s., filter 18 was a 4000 c.p.s. low-pass filter and filter 23 was a 2700 c.p.s. low-pass filter.

It is to be understood that the various frequencies used in describing the invention are merely illustrative, and that systems having different pass-bands could easily be used so long as the quieting voltage is chosen to be inside the lower end of the system pass-band. Of course, band-pass filter 26 would have to be adjusted accordingly. The speech signal source might also be other devices than the microphone shown, such as tape recorder, a telephone line, the output of a radio receiver, etc. In a like manner, the invention is not limited to a system having a loudspeaker output but could use any suitable output device, such as earphones, tape recorder, etc. The circuit shown is merely illustrative of the principles of the invention and various changes and modifications may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A security communications system comprising: first means for supplying an input signal, second means for

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adding a quieting voltage signal to said input signal, said quieting voltage signal having a frequency inside the pass-band of said system, signal scrambling means connected to the outputs of said first and second means for rendering said input signal unintelligible, transmission means for supplying said unintelligible signal to unscrambling means for rendering said input signal intelligible, output means connected to said unscrambling means for reproducing said input signal, and squelching means responsive to said quieting voltage signal in the absence of said input signal for disabling said output means.

2. A communications system according to claim 1 wherein said input signal has an amplitude sufficient to override the effect of said quieting voltage.

3. A speech security system comprising: first means for supplying a speech signal, second means for adding a low amplitude quieting voltage signal to said speech signal, said speech signal having an amplitude sufficient to overcome the effect of said quieting voltage and said quieting voltage having a frequency just inside the lower end of the pass-band of said system, scrambling means connected to the outputs of said first and second means for rendering said speech signal unintelligible, transmission means for supplying the output of said scrambling means to unscrambling means for rendering said speech signal intelligible, output means connected to said unscrambling means for reproducing said speech signal, and squelching means activated by said quieting voltage signal during the intervals between syllables and words in said speech signal for disabling said output means during said intervals thereby eliminating intersyllable noise.

4. Apparatus according to claim 3 wherein said system pass-band is from 300 to 3500 c.p.s. and said quieting voltage frequency is 325 c.p.s.

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