

Dec. 25, 1945.

G. L. FREDENDALL

2,391,776

INTELLIGENCE TRANSMISSION SYSTEM

Filed May 29, 1943

2 Sheets-Sheet 1

Fig. 1.

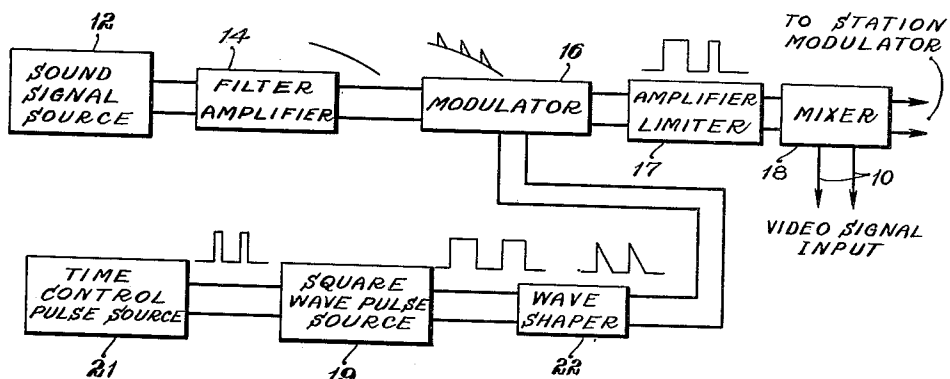
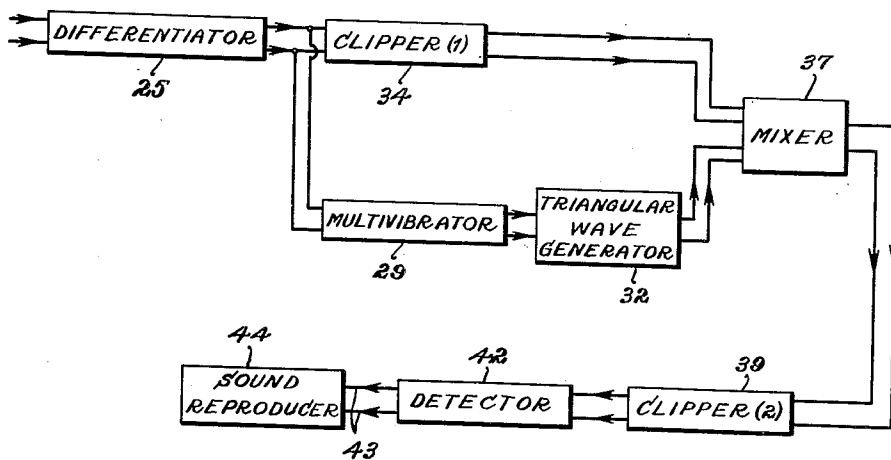


Fig. 2.



INVENTOR.
Gordon L. Fredendall
BY
H. S. Snover
ATTORNEY.

Dec. 25, 1945.

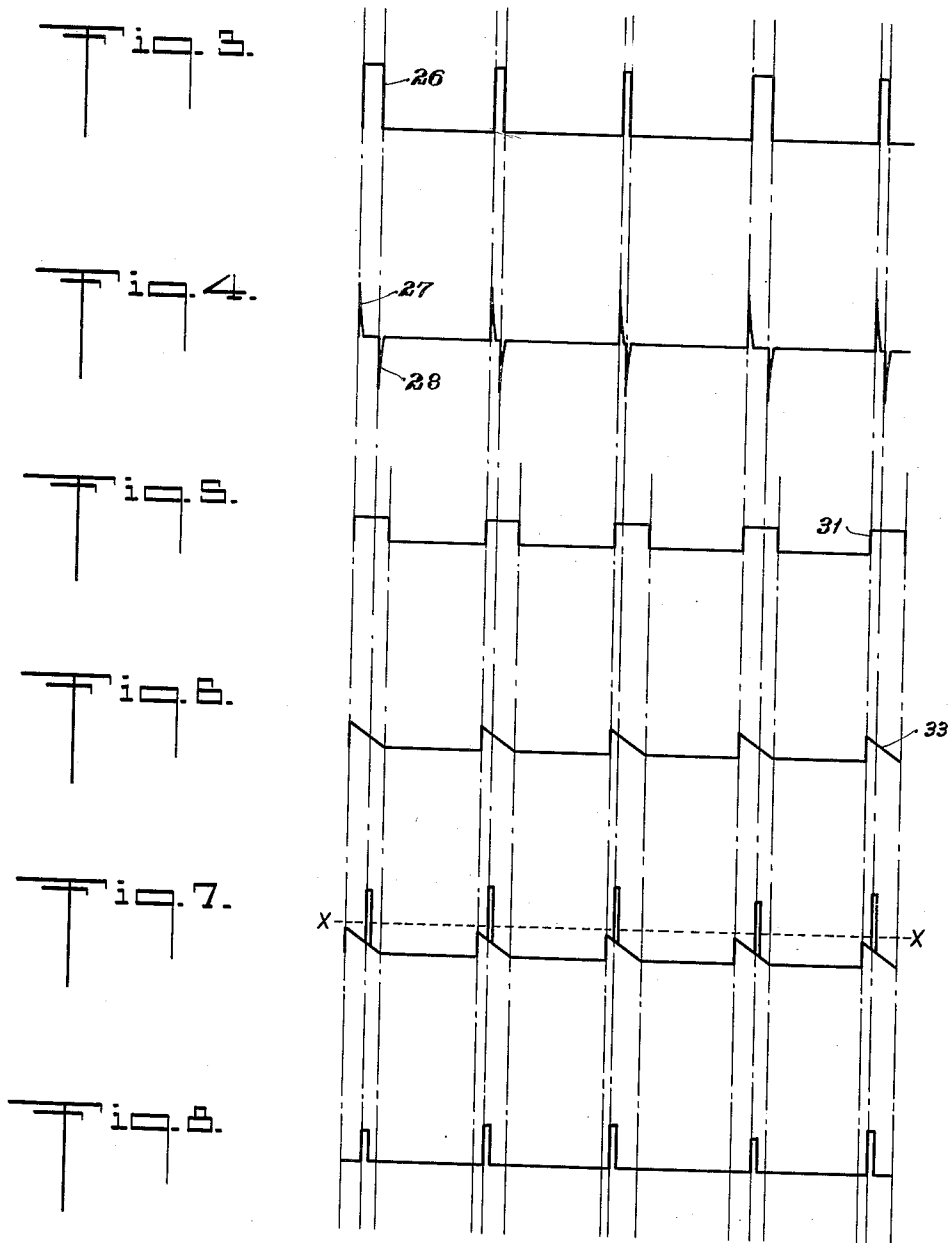
G. L. FREDENDALL

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2 Sheets-Sheet 2



INVENTOR.
Gordon L. Fredendall
BY *H. S. Grover*
ATTORNEY.

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INTELLIGENCE TRANSMISSION SYSTEM

Gordon L. Fredendall, Feasterville, Pa., assignor
to Radio Corporation of America, a corporation
of Delaware

Application May 29, 1943, Serial No. 488,969

6 Claims. (Cl. 250—27)

The present invention relates to the art of signaling, and more particularly to a novel device and method applicable in the transmission and reception of intelligence by signal impulses of varying time duration.

Sound or video signals may be transmitted by modulating a carrier in such a manner that the carrier itself may have constant amplitude and frequency but will be varied as by keying on and off. A system of picture transmission is shown in Patent No. 2,083,245, granted June 8, 1937, to Shore et al. A copending application of G. L. Fredendall et al., Serial No. 488,968, filed May 29, 1943, discloses the transmission of sound by means of derived signal impulses of varying duration. The present invention provides a novel method of and apparatus for converting impulse signals derived, for example, by methods set forth in the Shore patent or in the above noted application into the form of the signals from which they were derived.

The principal object of the present invention is to provide novel apparatus for obtaining a varying amplitude signal from a series of coded impulses representing transmitted intelligence.

Another object of the invention is to employ a detector of any usual type in a novel manner for the conversion of pulse width modulation into a wave of varying amplitude.

Other and more specific objects of the invention will become apparent from a consideration of the following specification and claims in connection with the accompanying drawings, illustrating one form of the invention in which:

Fig. 1 illustrates in block diagram form a television transmitter in which sound is transmitted in the form of variable width pulses.

Fig. 2 is a diagrammatic illustrative arrangement in accordance with the invention for obtaining a wave of varying amplitude from a series of width modulated pulses.

Figs. 3 through 8 are illustrative of the manner of obtaining a wave of varying amplitude by the apparatus of Fig. 2.

Fig. 1 of the accompanying drawings is similar to Fig. 1 of the above mentioned copending Fredendall et al. application and shows by way of example one method of obtaining width modulated impulses representing sound accompaniment in a television system. This arrangement is fully described and claimed in the above noted application and is included here for the sake of completeness of disclosure. The arrangement for obtaining variable width dots representing picture intelligence is disclosed in detail in the above

mentioned Shore et al. patent and therefore need not be described or explained herein in detail.

In Fig. 1, speech or other audible signals, which accompany image or video signals appearing in a connection 10, are caused to influence a sound signal device 12, which may be the usual type of microphone, and are then supplied to a sound amplifier and filter 14 whose output energy is directed to a modulator 16. The wave form of the derived signal from the modulator 16 is changed in an amplifier-limiter 17 and is applied to a mixer 18 so as to be combined with video signals from the connection 10. A square wave pulse source 19, which may be a multi-vibrator, is timed by a source of control impulses 21, which may operate, for example, under control of the synchronizing impulses which are employed in the usual manner to control the television scanner. Square wave pulses from the source 19 are converted by a wave shaper 22 into triangular impulses which are applied to the modulator 16. The wave form of the signals is indicated in the usual manner in the output of each piece of apparatus. The output from the mixer 18 is supplied in any suitable manner to the oscillator and modulator of a radio station transmitter or to a communication circuit of any kind.

In Fig. 2 the incoming signal is demodulated in any well known manner (not shown) so as to obtain the series of variable width dots representing intelligence as shown in Fig. 3 of the drawings. It will be understood that if variable width impulses are obtained in accordance with the arrangement shown in the Shore patent, a simple demodulating step will be used to obtain these pulses from the radio frequency carrier. If the series of impulses represents the sound accompaniment transmitted along with television video signals in accordance with the arrangement shown in the above noted copending application, these pulses will be separated from the video and the synchronizing signals after demodulation of the radio carrier, preferably in the manner disclosed and claimed in the said application.

This method comprises, briefly, an arrangement wherein a thermionic device is biased to cut-off except at times when the video signal is not present, and therefore the output of this electrical device represents reconstructed variable width impulses free of noise and interference and of the type shown by Fig. 3 of the accompanying drawings.

The variable width impulses derived either from a sound or a facsimile signal as in the Shore et al. patent, above noted, are applied to the in-

put of a differentiator 25. This differentiator may comprise a high pass filter or it may be a stage of amplification in which the grid resistor and the input condenser serve as a high pass RC circuit. If the amplifier type of differentiator is employed, the pulses may be of negative polarity so that after inversion, the initial peaks will be of positive polarity.

The output of the differentiator 25 is shown in Fig. 4 of the drawings and comprises narrow pulses 27 and 28 at the leading and trailing edges of the variable width pulses 26 of Fig. 3. The signal illustrated by Fig. 3 is composed of a series of pulses characterized by leading edges which are periodic in time, and trailing edges having positions which are determined in accordance with the modulating wave. As an example, the width of the pulse may be proportional to the instantaneous value of the complex modulating wave at the instant of the occurrence of the trailing edge. The successive pulses 27 are periodic, that is, they occur at equal time intervals; whereas the time of occurrence of a pulse 28, following a pulse 27, is determined by the width of the corresponding impulse 26 of Fig. 3.

The strictly periodic pulses 27 are applied as a synchronizing means to a multivibrator or other suitable type of square wave generator 29. The timed square wave impulses 31 (Fig. 5) from the multivibrator 29 are applied to a wave shaper 32, which may be a triangular wave generator of any suitable type. Fig. 6 illustrates the output of the wave shaper 32 which comprises triangularly shaped impulses 33. The circuit elements 29 and 32 may be similar to the elements 19 and 22 of Fig. 1, a specific type of which is described by way of example in the above mentioned copending application of Fredenall et al.

A clipper 34, which may be of any suitable type, eliminates the pulses 27 and passes along only the pulses 28 amplitude limited in order to remove noise. The triangular wave 33 (Fig. 6) and the pulse wave composed of successive pulses 28 with their polarity reversed are added in a mixer 37, forming the composite wave shown in Fig. 7. The portion of the wave of Fig. 7 below the line $x-x$ is removed by a clipper 39, and the useful remaining signal illustrated in Fig. 8 constitutes a series of modulated pulses which may be detected by a peak detector or an amplitude detector 42 of any desired type. This detector may be a conventional diode detector, a grid-bias detector or a grid leak detector. The output connection 43 of the detector 42 may be connected to a sound reproducer 44. If the variable width pulses 26 are derived at the transmitter from a representation of a picture or object in the manner described in the Shore et al. Patent No. 2,083,245 above referred to, the device 44 may be replaced by a picture recorder so that shaded-tone pictures may be reproduced.

If the variable width pulses 26 represent the sound accompaniment transmitted along with television video signals in accordance with the arrangement shown in the above noted copending application, higher fidelity sound can be obtained by increasing the number of scanning lines so that the number of pulses of sound energy per picture field, assuming the same field repetition rate, will be higher, thus with vertical line scanning, the upper frequency register of the transmitted sound would be increased in the illustrative example from approximately seven kilocycles to approximately ten kilocycles.

Various modifications of the system shown and

described herein by way of example are possible, without departing from the spirit and scope of the invention described herein, and it is desired that any and all of such modifications be considered within the purview of the present invention defined by the hereinafter appended claims.

Having now described the invention, what is claimed and desired to be secured by Letters Patent is the following:

1. The method of converting a series of width modulated impulses into a series of amplitude modulated impulses comprising the steps of producing a series of linearly varying impulses occurring in timed relationship with said series of width modulated impulses, producing a series of impulses occurring in timed relationship with the end of a corresponding width modulated impulse, combining said linearly varying impulses with said series of impulses to produce impulses of varying amplitude, and detecting said impulses of varying amplitude to produce a series of amplitude modulated impulses.

2. The method of converting a series of width modulated impulses into a series of amplitude varying output pulses comprising the steps of producing a series of impulses each having a steep front side and a linearly sloping end and of substantially constant amplitude occurring in timed relationship with said series of width modulated impulses, producing a series of impulses occurring in timed relationship with the end of a corresponding width modulated impulse, combining said two series of impulses to produce impulses of varying amplitude, and detecting said impulses of varying amplitude to produce a series of amplitude modulated impulses.

3. The method of converting a series of width modulated impulses into a series of amplitude modulated impulses comprising the steps of producing a series of triangular impulses occurring in timed relationship with said series of width modulated impulses, producing a series of impulses occurring in timed relationship with the end of a corresponding width modulated impulse, combining said triangular impulses and said series of impulses to produce impulses of varying amplitude, and detecting said impulses of varying amplitude to produce a series of amplitude modulated impulses.

4. Apparatus for converting a series of width modulated impulses into a series of amplitude varying output pulses comprising means to produce a series of linearly varying impulses in timed relationship with said series of width modulated impulses, means for producing impulses in timed relationship with the end of each width modulated impulse, means for combining said linearly varying impulses and said last named impulses, means to suppress a portion of said combined impulses, and wave detecting means for producing a series of amplitude varying output pulses.

5. Apparatus for converting a series of width modulated impulses into a series of amplitude varying output pulses comprising means to produce a series of impulses each having a steep front side and a linearly sloping end and of substantially constant amplitude in timed relationship with said series of width modulated impulses, means for producing impulses in timed relationship with the end of each width modulated impulse, means for combining said linearly sloping end impulses and said last named impulses, means to suppress a portion of said combined impulses, and wave detecting means for producing a series of amplitude varying output pulses.

6. Apparatus for converting a series of width modulated impulses into a series of amplitude varying output pulses comprising means to produce a series of triangular impulses in timed relationship with said series of width modulated impulses, means for producing impulses in timed relationship with the end of each width modu-

lated impulse, means for combining said triangular impulses and said last named impulses, means to suppress the triangular portion of said impulses, and wave detecting means for producing a series of amplitude varying output pulses.

GORDON L. FREDENDALL.