July 5, 1949. M. ARDITI ET AL 2,474,811

TRANSLATING SYSTEM

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Fig. 1.

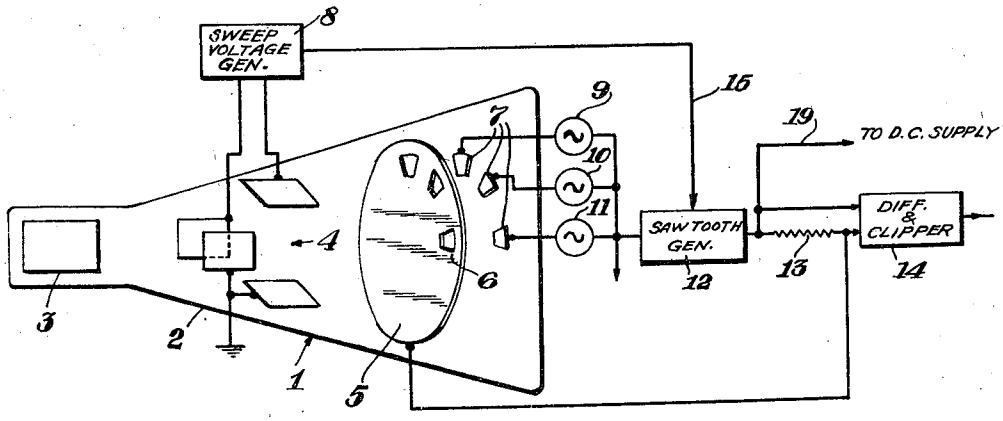

Fig. 2.

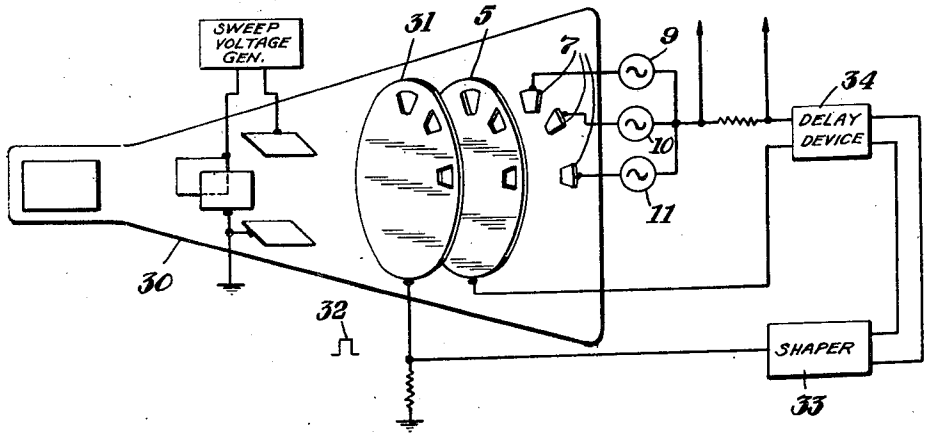

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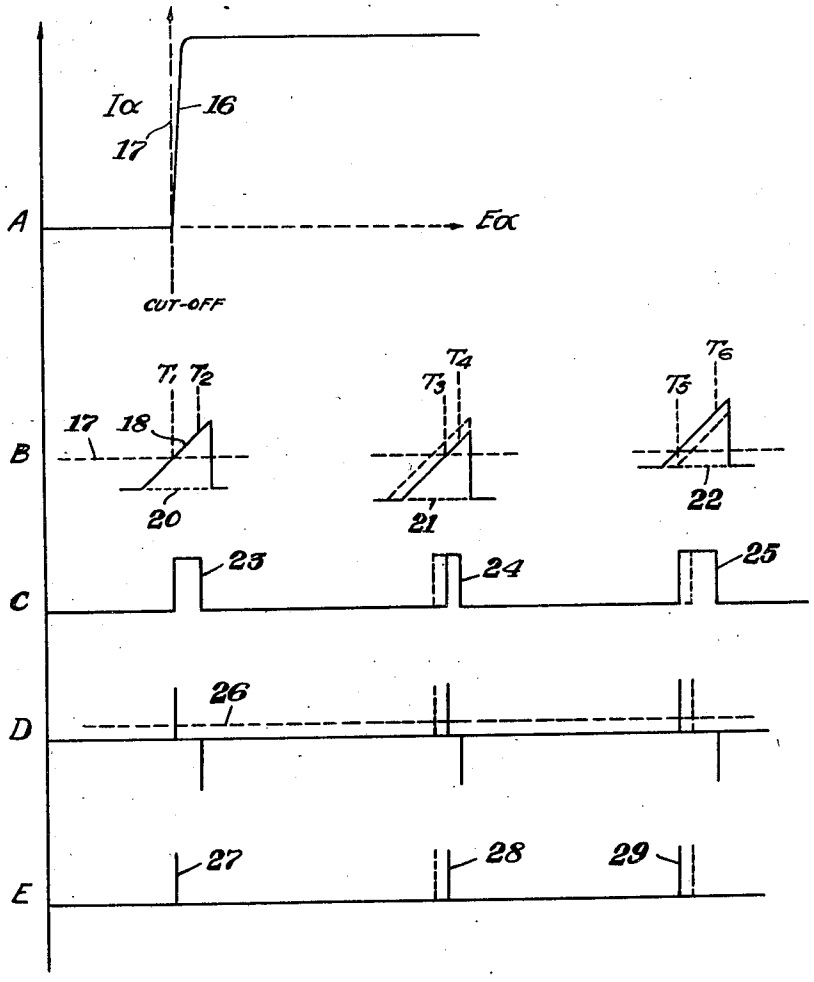
Fig. 5.



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Patented July 5, 1949 2,474,811

UNITED STATES PATENT OFFICE

2,474,811

TRANSLATING SYSTEM

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Application October 5, 1946, Serial No. 701,436

15 Claims. (Cl. 332—13)

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This invention relates generally to electrical translating systems and particularly to systems for translating amplitude varying energy into time modulated pulses.

Translating systems, particularly pulse time-modulation systems have been heretofore proposed which utilize cathode ray tubes in the process of modulation as well as for the distributing of channels in a multi-channel time modulated pulse system. See for example, the co-pending application of E. Labin-D. D. Grieg, Serial No. 567,414, filed December 9, 1944. In such systems, the cathode ray tubes proposed are structurally relatively complex and require precision in manufacture. Moreover exact control is necessary for the beam sweep, beam configuration, and beam density.

An object of the present invention is the provision of an improved translating system.

Another object is the provision of an improved modulator for time modulated pulses characterized by the use of energy having recurrent sloping characteristics for producing the effective modulation.

According to a feature of the present invention, energy having a recurrent sloping characteristic is applied between a pair of electrodes of an electron discharge device at the same time that the signal energy is applied thereto. The instantaneous amplitude of the signal with relation to the portion of the sloping characteristic coincident therewith determines the output from said electrodes and determines when said output has a value over a given level. In terms of said level, therefore, the amplitudes of said signal and said sloping characteristic have an effect that varies in time. Use is made of this to produce time modulated pulses.

In accordance with another feature of the present invention use is made of a cathode ray tube having secondary emitting target elements and a collector. The primary electron beam is regularly interrupted to produce control pulses which are shaped to provide sloping characteristics. The secondary emission between the collector and the secondary emitting target elements is controlled by said controlled pulses and the channel signals to produce a modulation in time whereby the output derived from said collector elements varies in time according to the amplitude variation of the signal. A single common output is used for the target elements and since each of said elements responds to voltages derived from different signal channels, the corresponding pulses are interleaved in the common output to

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produce channel distribution and a single output train of time modulated pulses.

Another object of the present invention is the provision of an improved pulse time modulator and channel mixer utilizing a cathode ray tube.

The above mentioned and other features and objects of this invention will become more apparent and the invention itself though not necessarily defined by said features and objects will be best understood, by reference to the following description of an embodiment of the invention taken in connection with the accompanying drawings, wherein:

Fig. 1 is a schematic and block diagram of a modulator and channel mixer system employing a cathode ray tube;

Fig. 2 is a schematic and block diagram illustrating a modification of the system of Fig. 1; and

Fig. 3 is a set of curves used in describing the operation of the systems of Fig. 1.

Referring now to Fig. 1 the cathode ray tube 1 includes the usual envelope 2 having therewithin a cathode ray gun 3, deflecting elements 4, an aperture plate 5 serving as a secondary emission collector, having apertures 6 through which the beam passes to strike target elements 7, with one target element provided for each channel. The beam is cyclically deflected by means of voltages derived from the sweep voltage generator 8 applied to the deflection plates 4, the sweep generator 8 being in the present example adapted to produce two voltages of the same frequency 90° out of phase with each other, which are separately applied to the horizontally and vertically deflecting plates respectively. The beam, therefore, travels in a circle past the aperture plate sequentially passing through the apertures in said plate to sequentially impinge upon the target elements 7 which latter are likewise arranged in a circle. The target elements 7 are secondary emission electrodes which upon being struck by the primary electrons of the beam emit secondary electrons which, when the voltages applied to the collector electrode 5 are of sufficient value, cause a flow there-between. Separate signal sources 9, 10, 11 etc. each forming part of a different signal channel are connected at one of their terminals to separate ones of the target elements 7, and at their other ends to a sawtooth generator 12. The sawtooth generator 12 is in turn coupled in series with an output resistance 13 to the collector electrode 5. The output voltages appearing across output resistance 13 are fed to a differentiator and clipper 14 where the pulses are differentiated and then clipped. For proper operation it is desirable that the sawtooth generator 12 be syn-

chronized with the sweep voltage generator 8 as indicated by line 15.

The operation of the system of Fig. 1 may be best understood with reference to the curves of Fig. 3. As stated hereinbefore the beam from the electron gun 3 (which is continuously on during operation) is rotated so as to sequentially strike the target elements 7. These emit secondary electrons which go to the collector when the voltages are of sufficient and proper value thereby causing an electron flow between a target element and the collector 5. Referring to curve A the line 16 represents the characteristics of the current flow Ia of the secondary electrons from one of said elements 7 to the collector 5 with changes in voltage Ea applied to the collector 5. When the voltage applied to the collector 5 is below a given level indicated by the broken line 17 no current will flow. When however, the voltage is above the level 17 the current arises steeply as indicated by the line 16. The sawtooth generator 12 is so timed with respect to sweep voltage generator 8 that each time the beam strikes a target element there is applied between said target element and said collector a sawtooth voltage 18 (see curve B). This sawtooth voltage is in series with the amplitude varying signal from one of the sources 9, 10, 11, etc. A biasing voltage is normally applied from source 19 so that the signal voltage itself is insufficient to cause a secondary electron current flow. Thus, for example in curve B the signal level indicated by the broken line 20 is below the cutoff level 17. However, the coincidence of the signal and the sawtooth results in the passing of the cutoff level 17 during some part of the sloping portion of the sawtooth to thereby initiate the flow of secondary electrons. The time of initiation of this flow will vary depending solely upon the amplitude of the signal, since the sawtooth pulses are of constant amplitude. As for example, with the signal level at 21 (curve B) it will be seen that the flow will be later than it would be if the signal were at 20, whereas with the signal level at 22 the flow is initiated earlier. The flow may be terminated by either the end of the sawtooth pulse or it may be terminated by the beam being deflected away from a target element. In either case, since the deflection is uniform and since the sawtooth pulses recur regularly the termination of said flow is always regular, and only the initiation thereof varies. Consequently, as indicated in curve C, pulses 23 through 25 are produced of variable width. These pulses are then differentiated as shown by curve D in the differentiator and clipper 14 and are thereafter clipped in device 14 along the level 26 to produce pulses as shown in curve E which are time modulated in the sense that they are time displaced. It is to be noted that the term "time modulation" is used herein, except when otherwise noted, in a broad sense so that the pulses 23 to 25 are also considered time modulated since they vary in their duration. Assuming that the signal levels 20, 21 and 22 are different instantaneous levels of signals from sources 9, 10 and 11 respectively, it will be seen that the pulses 23, 24 and 25 each represent a different channel and that these pulses are interleaved or mixed so as to form a single train as indiuated in curve E with the first pulse 27 being part of one channel, 28 being part of another channel and 29 being a part of a third channel.

While in the system of Fig. 1 a separate sawtooth generator is disclosed, in the system of Fig. 2 the sawteeth are generated under the control of the cathode ray tube and particularly under the control of its deflection. This is accomplished in the system of Fig. 2 by providing a modified form of cathode ray tube 30 which includes in addition to the elements of the cathode ray tube of Fig. 1 an additional aperture plate 31. The aperture plate 31 is provided with apertures alined with those of aperture plate 5 and the beam passes through both plates to strike the target elements. When, however, the beam strikes between the apertures of plate 31 it strikes the solid portion of said aperture plate 31 and each time produces a rectangular pulse 32. The pulse 32 is suitably shaped in a shaper 33 to provide pulses having sloping characteristics, which may be for example, sawtooth pulses. These, after a suitable delay in delay device 34, are applied between the collector 5 and the target elements 7 in series with the different signals from sources 9, 10 and 11.

While we have described above the principles of our invention in connection with specific apparatus and modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of our invention.

What we claim is:

1. A translating system for varying energy comprising an electron discharge device having a secondary emissive electrode, an electron collector, means for directing electrons to said electrode to cause the emission of secondary electrons, means for producing energy having recurrent sloping characteristics, and means for applying both of said energies for controlling the flow of said secondary electrons from the electrode to the collector to vary the time during which the value of said flow exceeds a given level.

2. A translating system for varying energy comprising an electron discharge device having a secondary emission electrode, an electron collector, means for directing electrons to said electrode to cause the emission of secondary electrons, means for impressing energy having recurrent sloping characteristics in series with the varying energy between said electrode and collector for controlling the flow of said secondary electrons, from the electrode to the collector to vary the time during which the value of said flow exceeds a given level.

3. A translating system for amplitude varying energy comprising an electron discharge device having a secondary emissive electrode, an electron collector, means for directing electrons to said electrode to cause the emission of secondary electrons, means for normally biassing said collector with respect to said electrode to cut off the flow of secondary electrons therebetween, means for producing energy having recurrent sloping characteristics, and means for applying both of said energies for controlling the flow of said secondary electrons, the amplitude of said first mentioned energy determining the time during which said flow occurs.

4. A system for producing time modulated signals in response to varying amplitude signals comprising an electron discharge device having a secondary emissive electrode, an electron collector, means for directing electrons of said electrodes, to cause the emission of secondary electrons, means normally biasing said collector with respect to said electrode to cut off the flow of secondary emission electrons therebetween, means for impressing energy having recurrent

sloping characteristics in series with the signals between said electrode and collector for intermittently causing the flow of said secondary electrons from the electrons to collector to produce output pulses time modulated in accordance with the amplitude modulation of the input signals.

5. A system for producing time modulated pulses in response to varying amplitude signals from a plurality of different channels, and for mixing the pulses corresponding to the different channels to form a single chain of multi-channels time modulated pulses comprising a cathode ray tube having a plurality of target elements, means for producing an electron beam, and means for cyclically deflecting said beam to sequentially scan said target element, a common output for said target elements, means for producing energy having a recurrent sloping characteristic, and means for applying said energy and said signals to said target elements to control the output current therefrom to vary the time during which the value of said current exceeds a given level.

6. A system for producing time modulated pulses in response to varying amplitude signals from a plurality of different channels, and for mixing the pulses corresponding to the different channels to form a single train of multi-channel time modulated pulses comprising a cathode ray tube having a plurality of secondary electron emitting target elements, means for producing an electron beam, and means for cyclically deflecting said beam to sequentially scan said target elements, a secondary electron collector, means for producing energy having a recurrent sloping characteristic, and means for applying said energy and said signals for controlling the flow of said secondary electrons from said elements to the collector to vary the time during which the value of said flow exceeds a given level.

7. In a system for producing time modulated pulses in response to varying amplitude signals from a plurality of different channels and for mixing the pulses corresponding to the different channels to form a single chain of multi-channel time modulated pulses, an electron discharge device having electron emitting means and electron collecting means, means for sequentially switching different signal channels to control the electron flow between said emitting means and said collecting means, means for producing energy having a recurrent sloping characteristic, and means for applying said energy to further control said electron flow, the output being coupled to said collecting means.

8. In a system for producing time modulated pulses in response to varying amplitude signals from a plurality of different channels, and for mixing the pulses corresponding to the different channels to form a single train of multi-channel time modulated pulses, an electron discharge device having electron emitting means and electron collecting means, means for sequentially and cyclically switching different signal channels to control the electron flow between said emitting means and said collecting means, means for producing energy having a recurrent sloping characteristic, and means for applying said energy to further control said electron flow.

9. In a system for producing time modulated pulses in response to varying amplitude signals from a plurality of different channels, and for mixing the pulses corresponding to the different channels to form a single train of multi-channel time modulated pulses, an electron discharge device having electron emitting means and electron collecting means, means for sequentially and cyclically switching different signal channels to control the electron flow betwen said emitting means and said collecting means, means associated with said switching means for producing energy having a recurrent sloping characteristic, and means for so applying said energy to further control said electron flow that a part of the sloping portion of said energy and a part of said signal substantially simultaneously control said flow.

10. A system according to claim 9 further including means for synchronizing said energy producing means with said switching means.

11. A system according to claim 9 further including means for synchronizing the switching means with said applying means so that said recurrent sloping characteristic of said energy occurs substantially simultaneously with the switching of a signal channel to control said electron flow.

12. A translating system for signals comprising an electron discharge device having means for producing a flow of primary electrons, means for producing in response to said primary electron flow, a flow of secondary electrons, means for controlling one of said flows to produce energy having recurrent sloping characteristics, and means responsive to said energy and said signals for controlling the other of said flows.

13. A translating system for signals comprising a cathode ray tube including means for producing a beam of primary electrons, a secondary emissive target element, and a collector element, means for deflecting said beam to strike said target element, means for controlling said beam to produce energy having a recurrent sloping characteristic, and means for applying said energy on said signals to control the flow of secondary electrons to vary the time during which the value of said flow exceeds a given level.

14. A translating system according to claim 13 wherein said controlling means comprises a conductive electrode arranged in the path of said beam and adapted to interrupt said beam as the beam is being deflected.

15. A multiplex time modulation system comprising a plurality of electronic target elements, means for applying a voltage having a recurrent sloping characteristic to each of said elements, means for applying individual signal voltages to respective ones of said elements in series with said recurrent voltage, scanning means for scanning said elements sequentially rendering said elements effective to produce electrical energy dependent upon the applied voltages, and a common output means for said produced energy.

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