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TRANSLATOR

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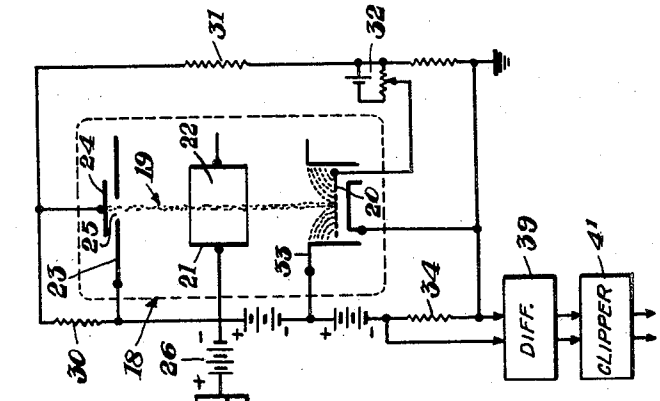

Fig. 1.

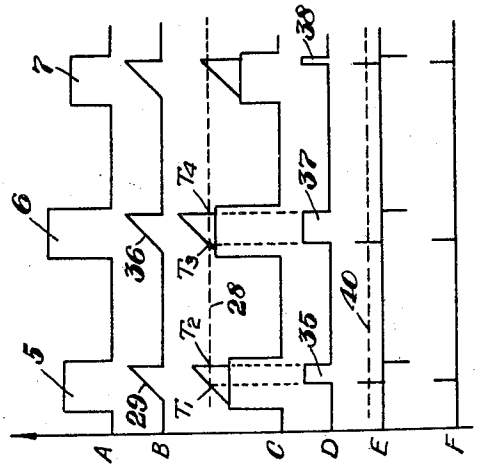

Fig. 2.

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12 Claims. (Cl. 332—13)

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This invention relates to a system for translating amplitude varying electrical energy into time modulated pulses and has particular reference to a modulator and channel mixer for a multi-channel time modulated pulse system.

An object of the present invention is the provision of an improved translating system for translating amplitude modulated energy into time modulated energy.

Another object is the provision of an improved translating system for translating amplitude modulated pulses into time modulated pulses, particularly of the variable width (duration) type.

According to a feature of the present invention, a wave having constantly recurring sloping amplitude characteristics is applied to the control electrode of a trigger tube having sharp cut-off characteristics. The amplitude modulated signal, which may be translated into the form of constant width amplitude modulated pulses, is applied in series with said wave of sloping characteristics and causes the tube to fire at points along said sloping characteristic which vary according to the amplitude of the amplitude modulated pulses. The tube is extinguished at regular intervals. The variation of the time in which the tube fires is used to produce time modulated pulses of the variable width type.

According to a further feature of the present invention, amplitude varying signals from a plurality of different sources are used in a cathode ray tube to produce a single train of amplitude modulated pulses, succeeding pulses representing different channels. This train of multi-channel amplitude modulated pulses is fed into a translating system of the type hereinabove described resulting thereby in an output of multi-channel time modulated pulses of the variable width type. By differentiating and clipping these pulses, multi-channel time displaced pulses are produced.

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 system for use in a multi-channel transmitter; and

Fig. 2 is a set of curves used in explaining the operation of the system hereinabove described.

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Referring now to the system of Fig. 1, amplitude modulated signals from a plurality of separate sources 1, 2, 3, etc., are translated through the use of a cathode ray tube 4 into a train of amplitude varying pulses such as for example, pulses 5, 6 and 7, etc. (curve A of Fig. 3) which pulses 5, 6 and 7 correspond in amplitude to the instantaneous values of the signals from sources 1, 2 and 3, respectively. The pulses 5, 6 and 7 are of constant duration and are of constant time displacement. The tube 4 may include the usual electron gun 8, deflection plates 9, and target elements 10, 11, 12, etc., each of which is connected to one terminal of one of the sources 1, 2 and 3, respectively, the other terminal of said sources being connected together, as indicated at 13, and in series with an output resistor 14 to a collector electrode 15, provided with apertures therein through which the beam from the electron gun 8 strikes the various target elements 10—12, etc. The target elements are preferably secondary electron emissive electrodes of which the secondary electrons are collected by the collector 15. The beam is deflected to sequentially scan the target elements and for this purpose, the target elements may be arranged in a circle aligned with the apertures in collector 15. Suitable deflection voltages from a source 16 may be applied to the deflection plates 9 to sweep the beam in a circle. Each time the beam strikes a target element, a pulse is produced across resistor 14. The amplitude of this pulse is made to vary linearly with the voltages applied from the signal source associated with the impinged-upon target element by suitably biasing the target element with respect to the collector with D. C. voltages from a suitable source 17. The resultant amplitude modulated pulses, curve A, Fig. 2, are used to vary the time at which the beam in a cathode ray type trigger tube is turned on and off, thereby varying the duration of the output pulses produced from said trigger tube 18. More specifically, the trigger tube 18 includes the usual electron gun 19, having a control grid 20, a second control element 21 which may be in the form of an annular ring having an opening 22 therein through which the beam passes when the proper bias is on the control element 21, the beam in turn passing through a second electrode 23 which is a collector for the secondary electrons emitted from the target element 24, the collector 23 having an opening 25 aligned with the opening 22 in control element 21 to permit the beam to

strike the target element 24. Normally the control element 21 is biased by means of voltages from a source 26 so that the beam is cut off and cannot strike the target element. Energy having a recurrent sloping characteristic such as for example, sawtooth pulses which may be derived from a suitable sawtooth generator 27, are applied to the control element 21, to effect the triggering of the beam. These sawtooth pulses (represented in curve B) are so timed with respect to the amplitude modulated pulses derived from the output across resistor 14, that they coincide with the amplitude modulated pulses and are applied in series with said sawtooth pulses to the control element 21, as indicated in curve C. The various potentials are so selected that the tube 18 is triggered when the potential applied to control element 21 reaches a given level, such as level 28, represented in curve C. Thus for example, at time T_1 pulse 5 and its associated sawtooth pulse 29, cause tube 18 to be triggered with the beam striking the secondary emitting target element 24, causing said element to give off secondary electrons which are collected by the collector 23, thereby producing a difference of potential across resistor 30 which is fed back through a suitable separating network 31 to the grid 20 of tube 18 in series with a suitable biasing battery 32. The direction of the voltage fed back is such as to increase the current drawn from the cathode, thereby producing an increase in the density of the beam which causes more current to flow through resistor 30 and higher voltages to be fed back cumulatively to the grid, this cumulative operation continuing until a point of equilibrium is reached. This feedback also causes a defocussing of the beam with the greater part of the defocussed current being picked up by a suitable electrode 33 which may be part of the electron gun 19. The secondary electrons picked up by electrode 33 cause a current flow through its output resistor 34 which will continue as long as there is defocussed current, and this defocussed current will be produced until the beam is cut off by control element 21. The beam is cut off by control element 21 at time T_2 which is the steep trailing edge of the sawtooth pulse. Thus an output pulse 35 having a given duration from T_1 to T_2 is produced. On the other hand, the output pulse produced as a result of the relatively large amplitude modulated pulse 6, and its corresponding sawtooth pulse 36, will have a duration from T_3 to T_4 which is greater than that of pulse 35 with the leading edge of the resulting pulse 37 being displaced with respect to the regularly recurring trailing edge which depends upon the trailing edge of the sawtooth pulses which recur constantly. Thus, since the leading edges of the output pulses, indicated in curve D, coincide with different portions of the leading edge of the sawtooth pulse, depending upon the amplitude modulated pulse in series therewith, the duration of the output pulses thus varies according to the amplitude of the amplitude modulated pulses, and an output pulse 38 of a different duration and with its leading edge differently displaced is produced in response to amplitude modulated pulse 7. The output pulses 35, 37 and 38 of curve D, which are produced across output resistor 34, are all of constant amplitude. Since the cumulative action heretofore mentioned occurs so rapidly as to produce an extremely steep leading edge reaching to a point of equilibrium and maintained at said point of equilibrium until the beam is cut off by control element 21, the value of the defocussed current is substantially constant throughout the duration of the impingement of the beam on target element 24 after the extremely rapid build-up thereof, and thus the output pulses across resistor 34 are of constant amplitude.

While the pulses 35, 37 and 38 in curve D are of constant amplitude and are time modulated in that they are of variable width, they may be translated into pulses that are time displaced by passing them through a suitable differentiator 39 to produce pulses shown in Curve E, which are then clipped along the level 40, in a clipper 41, to produce output pulses, as indicated in curve F, which are time displaced. These may then be used to modulate a carrier or used in any suitable utilization device.

While we have described the principle of our invention in connection with specific apparatus, 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.

We claim:

1. A system for translating amplitude modulated signals into constant amplitude pulses of correspondingly varied duration comprising an electron discharge device having sharp cut-off characteristics, control means normally biased to cut off the electron flow within said device, means for producing energy having a recurrent sloping amplitude characteristic, means for applying said energy and said amplitude modulated signals substantially simultaneously to said control means to trigger said device during the sloping portion of said energy, the point along said portion at which said triggering occurs varying with the amplitude of the signal.

2. A system according to claim 1 wherein said amplitude modulated signals are in the form of amplitude modulated pulses of substantially constant duration and substantially constant recurrence, and said applying means includes means for applying said energy so that the sloping portions thereof are applied during the application of said amplitude modulated pulses.

3. A system according to claim 1 wherein said energy producing means includes means for generating energy having sloping portions, each followed by a steep portion, whereby upon application of said energy and said signals, the device is triggered on during the sloping portions and triggered off at the steep portion.

4. A system according to claim 1 wherein said energy producing means includes a generator for producing sawtooth pulses.

5. A system according to claim 1 wherein said amplitude modulated signals are in the form of amplitude modulated pulses of substantially constant duration and repetition rate, said energy producing means includes a generator for producing sawtooth pulses, and said applying means includes means for applying said sawtooth pulses to said control means during the application of one of said amplitude modulated pulses thereto, said device is triggered on during the sloping portion of said sawtooth pulses depending upon the amplitude of the associated amplitude modulated signal, and being cut off at the steep portion of said sawtooth pulses, to thereby produce output pulses whose leading edges vary with respect to a regular recurrence thereof according to the amplitude of the corresponding amplitude

modulated pulse and whose trailing edges recur regularly, thereby producing output pulses of varying duration.

6. A system according to claim 1 wherein said device further includes a control element adapted to vary the density of the electron flow, and means responsive to said electron flow for applying a voltage to said control element to cumulatively increase said flow until a point of equilibrium is reached.

7. A system according to claim 1 wherein said device includes a grid adapted to control the density of the electron flow, and means responsive to said control flow for applying a voltage to said grid to increase said flow.

8. A system according to claim 1 wherein said electron discharge device includes means for producing an electron beam, a target element adapted to be struck by said beam when the device is triggered, said control means being adapted to cut off the beam from striking the target element.

9. A system according to claim 1 wherein said electron discharge device includes means for producing an electron beam, a target element at which said beam is directed, means for feeding back a voltage in response to the impingement of the beam on said target element to increase the amount of current in said beam and defocus said beam, an electrode for collecting defocussed portions of said beam, and means utilizing the current flow from said electrode to produce an output.

10. A system according to claim 1 wherein said electron discharge device includes means for producing a beam, a secondary emissive target element adapted to be struck by the beam when the tube is triggered on, a collector electrode for collecting electrons from said target element, means responsive to the current flow between said target element and said collector for feeding back a voltage to increase the amount of current in said beam, thereby defocussing the beam, an electrode for collecting the defocussed electrons, and

means controlled by current produced thereby for producing output pulses.

11. A modulator and channel mixing system for multiplex time modulated pulses comprising means for translating the amplitude modulated signals from the different channels into a single train of constant duration and regular repetition pulses each representing a single channel and each having an amplitude corresponding to the instantaneous amplitude of its respective channel, an electron discharge device having sharp cut-off characteristics, control means normally biased to cut off the electron flow in said device, and means for producing energy having a recurrent sloping characteristic, and means for applying said energy and said amplitude modulated pulses substantially simultaneously to said control means to trigger said device on and off during the sloping portions of said energy, the point along said portion at which said triggering occurs varying with the amplitude of the amplitude modulated pulses, to thereby produce output pulses of correspondingly varying duration.

12. A system according to claim 11 further including means for differentiating and clipping said varying duration output pulses to produce correspondingly time displaced pulses.

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