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DEMODULATOR

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Fig. 1.

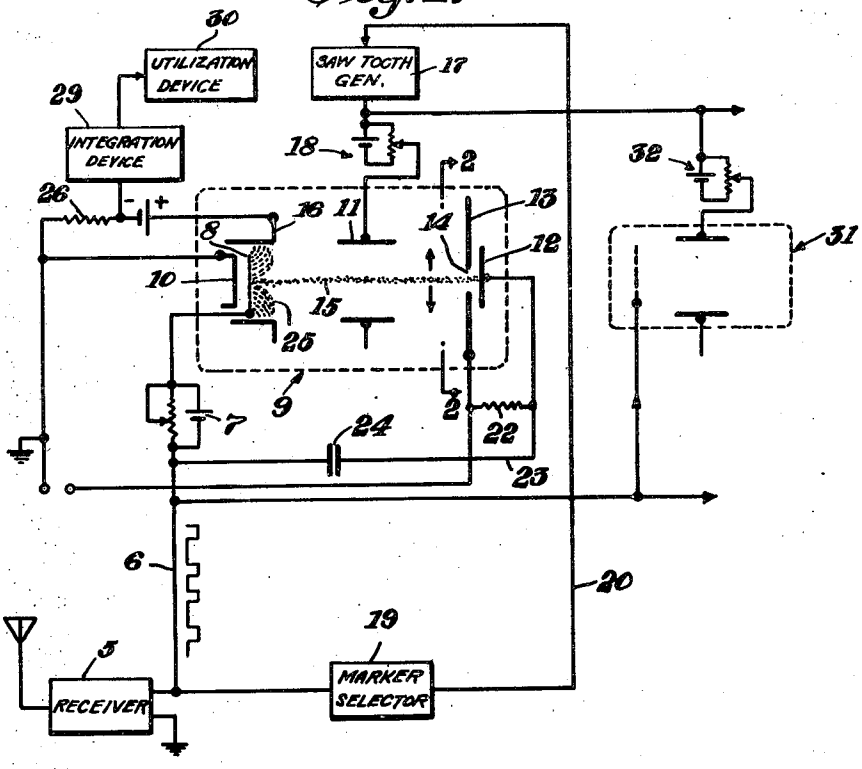


Fig. 2.

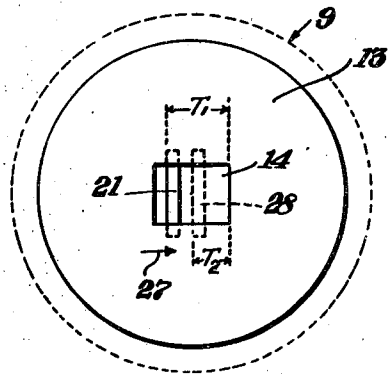
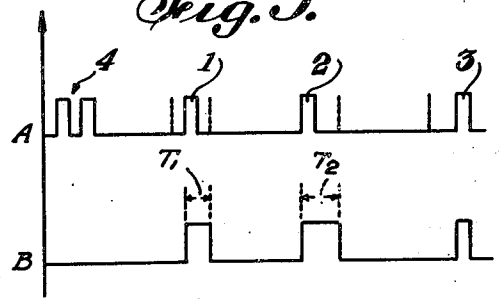


Fig. 3.



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DEMODULATOR

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This invention relates to demodulators for time displaced pulse systems, particularly multiplex systems.

Demodulators for time displaced pulses have been heretofore proposed which utilize cathode ray tubes for demodulation purposes. In general, such demodulators have been characterized by small output and critical control of the beam of the cathode ray tube.

An object of the present invention is the provision of an improved demodulator for time displaced pulses using the cathode ray tube.

A feature of the present invention is the capability of producing a relatively large output derived from said demodulators and the fact that the demodulator is not as critical in regard to beam control as previous systems.

In accordance with a feature of the present invention, the time displaced pulses which are to be demodulated are applied to the grid of a cathode ray tube to initiate operation of the beam. The beam is regularly deflected so that depending upon the time modulation of the pulses, the beam will initially strike a different part of the target element. The target element is a secondary emissive electrode and upon being impinged upon by the beam, emits secondary electrons which are collected by a collector, the current flow between the target element and the collector being used to produce a voltage drop. This voltage drop is fed back to the grid in the proper direction so that even though the incoming signal pulse has terminated, the beam will continue in operation. After a given time, however, the beam will be deflected past the target element so that it no longer strikes the target element. Consequently, no more voltage is fed back to the grid and the beam is then discontinued. During the time that the voltage is being fed back to the grid, this voltage causes more current to be drawn from the cathode of the cathode ray tube and increases the intensity of the beam, which increase of intensity further increases the current between the target element and the collector, and the voltage derived therefrom. This effect is cumulative until a point of equilibrium is reached, and this rise in beam current occurs very rapidly. The increased current drawn from the cathode is mainly defocussed and does not form part of the focussed beam. This defocussed current is drawn to any suitable electrode placed out of the path of the focussed beam such as for example, by applying a suitable voltage to the focussing electrode. The current picked up by the focussing electrode is used to provide an output voltage. The output

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voltage consists of pulses which vary in duration according to the time displacement of the signal pulses. These variable duration pulses may be then integrated and applied to any suitable utilization device.

The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood, by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a schematic and block diagram of a demodulator system showing its arrangement in a multiplex receiver;

Fig. 2 is a cross-sectional view of the cathode ray tube of Fig. 1 taken substantially along the line 2—2 thereof; and

Fig. 3 is a set of curves used in explaining the operation of the present invention.

The present invention is here described in connection with a multiplex time displaced pulse communication system of the type having recurrent series of pulses, such as shown in curve A, Fig. 3, including a plurality of signal pulses such as for example, pulses 1, 2, 3, etc., following a marker signal 4 which latter may consist for example, of a pair of pulses having a different spacing from each other than the signal pulses. The successive pulses of a series each form part of a different channel as for example, pulses 1, 2 and 3 are each part of a different channel. The signal pulses are time displaced with relation to their position following the marker signal, with pulse 1 being shown in its unmodulated position, and the dotted lines on either side thereof indicating the limits of its modulation, pulse 2 shown at one extreme of modulation and pulse 3 shown at the other extreme of modulation. These pulses which may be transmitted through any suitable transmission medium may be received on a receiver 5 and applied over a line 6 in series with a suitable, and preferably adjustable, source of biasing potential 7 to the grid 8 of a cathode ray tube 9, having a cathode 10, beam-deflecting plates 11, a secondary emissive target element 12 and a collector 13 for collecting the secondary electrons emitted from target element 12. The collector 13 is provided with an opening 14 therein through which the electrons from a focussed beam 15 pass to strike the target element 12. The cathode ray tube 9 may be provided with a focussing cylinder 16.

The grid 8 is normally biased by means of battery 7 so that the beam is turned off. How-

ever, when an incoming signal pulse is applied to grid 8, the beam is turned on. The voltages applied to the deflection plates 11 are adjusted so that only the pulses of the desired channel will strike the target element 12. For this purpose, use is made of a sawtooth generator 17 whose output is applied in series with a variable source of D. C. potential 18 to the deflection plates 11. The sawtooth generator is synchronized by the marker signal and for this purpose, the output of the receiver 5 may also be fed to a marker selector 19 which separates the marker signal and in response thereto feeds a synchronizing pulse, as indicated over line 20, to the sawtooth generator. Each sawtooth pulse sweeps the beam transversely so that at some point during its transit, it will strike the target element 12 if the beam is turned on at that moment. By adjusting the D. C. voltage derived from source 18, this deflection of the beam can be controlled with respect to the sawtooth, so that it will pass through the aperture 14 when the pulse of the selected channel turns on the beam. Thus by adjustment of source 18, any channel may be selected. Pulses of other channels will turn on the beam at a time when it is directed at portions of the surface of collector 13 and not through its aperture.

Demodulation is accomplished in the following way. Referring to Fig. 2, it will be seen that the collector 13 has a rectangular aperture 14. The beam is made of a much narrower configuration, as indicated at 21, by suitable construction of the beam forming elements. Assuming that in a given case, the beam is flashed on by an incoming signal pulse, so that it strikes the target element at the position indicated at 21 causing a flow of current between the said target element and the collector 13. This produces a voltage drop across a resistor 22 coupling said element and collector and the voltage thus developed is fed back over line 23 and coupling condenser 24 to the grid 8 in such a direction as to increase the amount of current drawn from the cathode. This causes an increase in the density of the beam 15 which causes a further increase in the current flow between the collector 12 and target element 13 and a larger voltage drop across resistor 22. This larger voltage drop is again fed back to the grid 8 to further increase the value of the current in beam 15. This effect is rapid and cumulative and continues until a point of equilibrium is reached.

As a consequence of the aforementioned effect, almost as soon as the beam 15 strikes the target element 12 in response to an incoming control pulse, the current drawn from the cathode increases to a relatively high value. This causes most of the electrons drawn from the cathode to be defocussed, as indicated at 25, and these defocussed electrons are picked up by the focussing cylinder 16 producing a substantial current flow through an output resistor 26 and a substantial voltage drop thereacross.

The feed-back of the voltages produced across resistor 22, serves not only to produce a large output across resistor 26, due to the increased current from the cathode and the defocussing effect, but also serves in producing demodulation in the following manner. The signal pulses normally have such a relatively short duration with regard to the sweep of the beam across the aperture 14, that the beam will be flashed on and off by the signal pulse before it has been deflected any appreciable distance. Due, however, to the fact that as soon as the beam strikes the target

element 12, energy is fed back to the grid, to increase the current flow from the cathode, it does not matter that the signal pulses terminate almost instantly. The voltages developed across resistor 22 will keep the beam turned on as long as any portion of the beam is striking the target element 12. Thus the beam will remain on for a length of time determined by the time required for the sawtooth deflecting pulses to cause the beam to move across the entire aperture. For example, referring to Fig. 2, if the beam is being deflected in a direction indicated by the arrow 27, and the beam is turned on by the signal pulse in the position indicated at 21, the beam will continue to remain on until the beam has been deflected all the way across the aperture from the initial point of impingement to the end of the aperture. This would require a given length of time and the output pulse obtained across the output resistor 26 would have a width or duration equal to said time. For example, designing the interval required to move the beam from its position at 21 to the end of the aperture as T_1 and assuming that it is pulse 2 which causes the beam to flash on in the position 21, the output pulse obtained will have a duration or width determined by the time required to move the beam from its position at 21 until it no longer passes through the aperture 14. Pulse 2 has been indicated as being at one extreme of time displacement. Assuming that a pulse having another modulation as for example pulse 1, such a pulse might turn the beam on in the position indicated in dotted lines at 28. Due to the feed-back voltage to the grid, the beam would remain on until the beam has crossed the remaining portion of the aperture and the duration of the output voltage produced across output resistor 26 will occupy a time T_2 equal to the time required for the beam to cross from position 28 to the end of the aperture 14. Thus the corresponding output pulse across the output resistor 26 would have a width corresponding to T_2, as indicated in curve B, Fig. 3.

From the foregoing it will be seen that output pulses will be produced across output resistor 26 which vary in width according to the time displacement of the signal pulses. These output pulses may then be fed to any suitable integrating device 29 and thence to a suitable utilization device 30.

While this single cathode ray tube 9 serves to separate and demodulate a single channel, other channels may be separated in similar tubes as for example, tube 31, etc., by applying the signal input to the grid thereof and by adjusting the value of the source of D. C. potential 32 similar to source 18, which source 32 is arranged in series with the sawtooth generator 17 and, together therewith, controls the deflection of the beam. As many cathode ray tubes as there are channels may be employed, each to select a separate channel.

While we have described above the principles of our invention in connection with specific apparatus and particular 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.

We claim:

1. A cathode ray tube translating system for time displaced signal pulses comprising beam producing means, means normally biasing said beam producing means to cut off the beam, a target element, beam control means responsive to incoming pulses for turning on the beam,

means for deflecting the beam so that the beam will initially strike the target element at different positions depending on the time displacement of said signal pulses, and means for maintaining the beam turned on only as long as the beam is being deflected over said target element.

2. A cathode ray tube translating system for time displaced signal pulses comprising beam producing means, means normally biasing said beam producing means to cut off the beam, a target element, beam control means responsive to incoming pulses for turning on the beam, beam deflecting means so timed with respect to the incoming pulses that the beam will strike different positions of the target element depending on the time displacement of the incoming pulses, and means responsive to the turning on of the beam for maintaining the beam turned on until the beam has deflected past said target element.

3. A cathode ray tube translating system for time displaced signal pulses comprising beam producing means, means normally biasing said beam producing means to cut off the beam, a target element, beam control means responsive to the incoming pulses for turning on the beam, means for cyclically deflecting the beam so that the beam will strike different positions of the target element depending on the time displacement of the incoming pulses, and means responsive to the impingement of the beam on the target element for maintaining the beam turned on until the beam has been deflected past said element.

4. A cathode ray tube translating system for time displaced signal pulses comprising beam producing means, means normally biasing said beam producing means to cut off the beam, beam control means responsive to the incoming pulses for turning on the beam, a secondary emissive target element, a collector electrode, beam deflecting means for cyclically deflecting the beam so that the beam strikes different positions of the target element depending on the time displacement of the incoming pulse, means responsive to the current flow between the target element and collector caused by the impingement of the beam on the target element for feeding back energy to said control means to maintain the beam turned on until the beam has been deflected past said target element.

5. A cathode ray tube translating system for time displaced signal pulses comprising beam producing means, means normally biasing said beam producing means to cut off the beam, a target element, beam control means responsive to incoming pulses for turning on the beam, means for cyclically deflecting the beam so that the beam will strike different positions of the target element depending upon the time displacement of the incoming pulse, means responsive to the impingement of the beam on the target element for feeding energy back to the beam control means to maintain the beam turned on and to increase the current density of the beam, this effect being cumulative until a point of equilibrium is reached.

6. A cathode ray tube translating system for time displaced signal pulses comprising beam producing means, means normally biasing said beam producing means to cut off the beam, a control grid responsive to the incoming pulses for turning on the beam, means for cyclically deflecting the beam so that the beam will strike different positions of the target element in accordance with the time displacement of the signal pulses, and means for feeding back the energy resulting from the impingement of the beam on the target element to the control grid for maintaining the beam turned on and increasing the current of the beam as said beam is deflected over the target element.

7. A cathode ray tube translating system according to claim 6 wherein said beam producing means includes a cathode and said control means includes a control grid to which energy is fed back from the target element to increase the current drawn from the cathode, the increased current producing a defocussing of the beam, and means arranged opposite the path of the beam adapted to collect the defocussed electrons.

8. A cathode ray tube system for translating incoming time displaced signal pulses into corresponding variable duration output pulses comprising beam producing means including a cathode, beam control means including a control electrode, means normally biasing said control electrode to cut off the beam, means for applying said signal pulses to said control electrode to turn on said beam, means for cyclically deflecting said beam over a given path, a secondary electron emitting target element mounted in said path so that upon turning on of the beam in response to an incoming signal pulse the beam initially strikes different positions of the target element in accordance with the time displacement of the incoming pulses and is thereafter swept across the target element, a collector adapted to collect secondary electrons during impingement of the beam on the target element, means responsive to the current flow between said collector and target element for applying potentials to said control electrode to increase the current drawn from said cathode thereby cumulatively increasing the current in the beam to a point of equilibrium and causing a defocussing thereof, and means responsive to said defocussing of said beam for producing output voltages.

9. A cathode ray tube system according to claim 8, further including means for integrating said output voltages to produce varying amplitude energy and a utilization device for said energy.

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