March 4, 1952 M. V. KALFAIAN 2,587,734

MODULATOR TUBE AND CIRCUIT

Filed Dec. 22, 1947

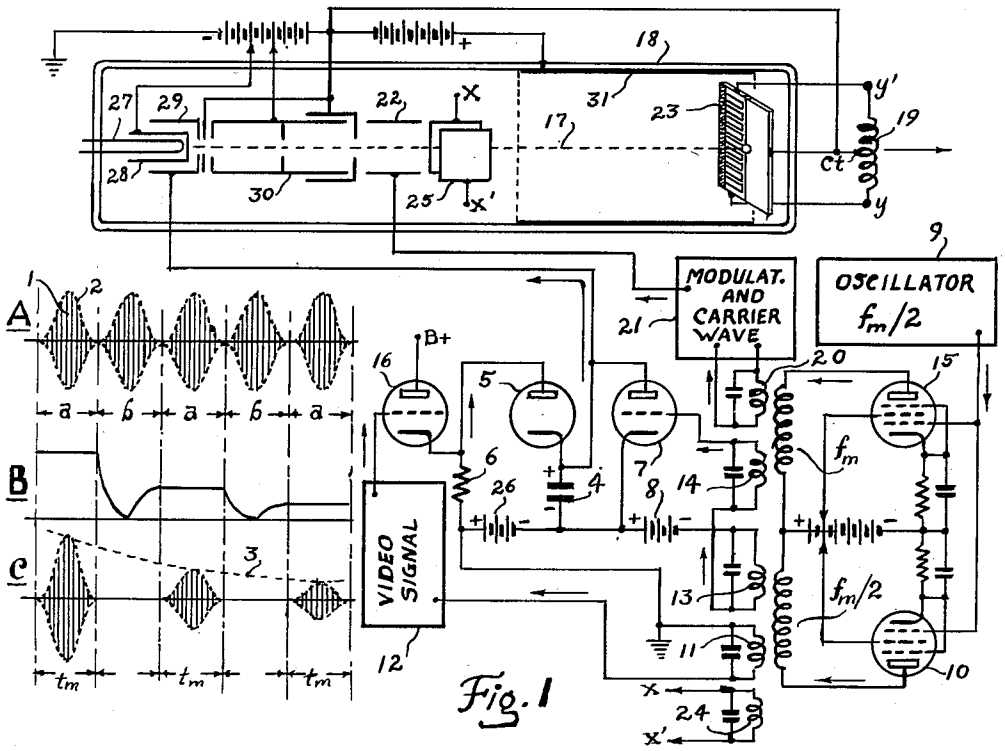


Fig. 1

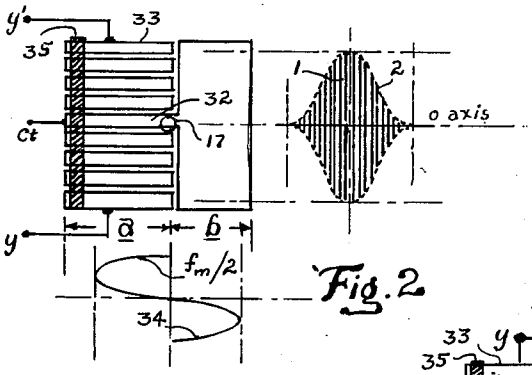


Fig. 2

Fig. 2b

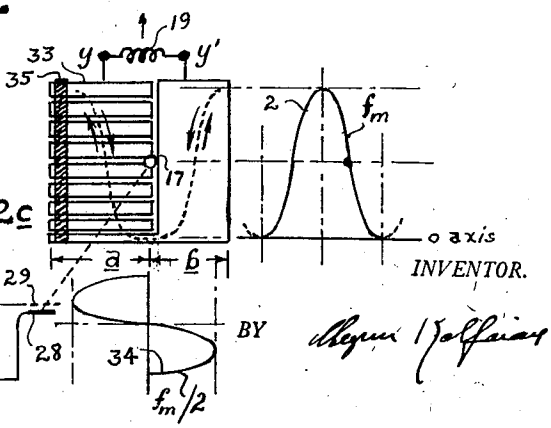


Fig. 2c

INVENTOR.

BY Meyer Kalfaian

Patented Mar. 4, 1952

2,587,734

UNITED STATES PATENT OFFICE

2,587,734

MODULATOR TUBE AND CIRCUITS

Meguer V. Kalfaian, Hollywood, Calif.

Application December 22, 1947, Serial No. 793,145

4 Claims. (Cl. 332—58)

1

The present invention relates to modulator tubes, and more particularly to cathode beam tubes wherein wave shaping targets are utilized for the control and modulation of a time divided carrier wave. A particular object of the invention is to provide structurally efficient targets in the path of a cathode ray beam to serve as effective electrical wave controllers for these and kindred purposes.

In the general mode of time division transmission, the carrier wave is interrupted at a high frequency rate. With such abrupt interruption of the carrier, the sidebands usually expand beyond the assigned limits. However, it is found that, the output products of the modulated carrier wave can be restricted to particular frequency regions by controlling the waveshape of the time divisions of the carrier wave. One instance of modulation by this method is given by F. Gray in his Patent 2,257,795, October 7, 1941.

Where these spectral limitations are observed, it is basic that, the waveshape of the interruption be that of the curve of a cosine function, which rises and falls from substantially a zero level in a definite time interval. To illustrate this state more clearly, reference is made to the periodic envelopes at C, in Fig. 1, wherein, the peak magnitude of each envelope corresponds to a statistical magnitude of the intelligence wave 3. However, in order to produce these envelopes free of the varying changes of the wave 3, this wave is first sampled in steady state electrical quantities, as shown at B, which in turn modulate the envelopes at C. The areas *a* indicate the wave shape relations of the envelopes at C with respect to the simple case of unity modulation at A. In order to convey the maximum amount of information allowed per given time, it is desired that the periods *b* at C be filled in. However, in either case, the carrier envelopes must be first produced in periodic envelopes, as at C, in two separate channels in alternate sequence, and the outputs of the two branches combined for continuous operation. Such operation requires gating means, so that the carrier is not interfered with during the sampling periods *b*. However, gating means in the prior art do not possess ideal characteristics for this purpose, as the waveshape must be accurately predetermined. Accordingly, I provide targets of novel design, which may serve as combined gate and wave shapers, or modulators in general.

In the drawings:

Fig. 1 shows a partly diagrammatic modulator tube of the cathode beam type, and schematic circuit arrangement for producing wave components in accordance with the invention, and A, B and C are waves involved in it.

2

Figures 2, 2*b* and 2*c* are various shapes of target structures in the cathode ray modulator tube.

In Figure 1, the modulator tube comprises a vacuum envelope 18, heater element 27, cathode element 28, an electron intensity control grid 29, focusing gun 30, electrostatic deflecting plates 22 and 25, a cathode beam 17, a preshaped wave-control target 23, and secondarily emitted electron collector anode 31. The tube 18 may be fashioned in general, as of various conventional types, such as employing a suitable type of gun structure for electrostatic focusing, magnetic focusing, magnetic deflection, and multiple stages of electron accelerating anodes. Details of various shapes of the target 23 anodes are shown in Figures 2, 2*a*, 2*b* and 2*c*, with their active faces parallel to the plane of the paper, and the electron beam 17 is indicated in its position of normal flow.

In Figure 2, the target electrode is divided into two sections *a* and *b*. The section *b* consists of a uniform conductive surface in the plane perpendicular to the flow of the beam 17, with a central conductive strip 32, which extends to the left and sub-divides the section *a*. The conductive section *b*, at terminal *ct*, is electrically connected to a terminal such as to have a short electrical path to the emitting cathode. Both sub-divisions of the section *a* consist of a plurality of conductive strips 33 parallel to and extending outwardly from said central extension strip 32 of the section *b*, and are positioned such that, the surface of each elemental strip is perpendicular to the axis of the electron beam 17. The orientation of the target is also such that, the elemental strips 33 are parallel to the direction in which the beam 17 is to be deflected by a wave 34 equal to half the frequency of the sub-carrier wave 2. Sub-carrier wave is referred to a wave having a frequency f_m at which the carrier wave is time divided. The elemental strips 33 in both sub-divisions of section *a* are made to have mutual conductance of some predetermined value by resistance element 35, such that, between the two outgoing terminals *y* and *y'* and the central terminal *ct* the variation of conductance is linear.

Making reference to the wave-control action of the target electrode shown in Fig. 2, the electron beam 17 is deflected horizontally by a gate control wave 34 having a frequency $f_m/2$, so that the beam projects over section *a* during one half period of the wave 34, and projects over section *b* during the next half cycle period of the said wave.

As mentioned previously, the section *b* has direct electrical path to the emitting cathode, hence, the horizontal shift of the beam at the normal central position maintains ideally zero signal at the output terminals *y* and *y'*.

The elemental conductive strips **33** in Figure 2, section *a*, may be constructed in different ways with the same results obtained as given above. For example, the mutual conductance of the elemental strips may be made reactive, instead of resistive. This is shown in Figure 2*b*. The elemental strips **33** are made of metallic sheets stacked up alternatively with dielectric material **42**. The size of the metallic sheets **33**, the spacing between each elemental sheet **33**, and the dielectric material **42** may be chosen to obtain a desired capacity between the outgoing terminals *y* and *y'*, which are connected to the inductance **19** as shown in Fig. 1.

The targets shown in Figures 2 and 2*b* are designed for balanced output operation; however, they may also be used for single ended operation, and as shown in Fig. 2*c*. The elemental strips **33** may be devised either with capacitive or resistive mutual conductance. The extreme lower end strip in section *a* is electrically connected to the conductive section *b*, and the outgoing terminals are taken from the extreme upper end strip of section *a* and the conductor of section *b*, which is the grounded terminal. The switching wave **34** is applied to the electrostatic deflecting plates to sweep the beam **17** in a direction parallel to the elemental strips **33**. The sub-carrier wave **2** is applied to the electrostatic deflecting plates to sweep the beam **17** in a direction right angle to the elemental strips **33**, and the magnitude of the sub-carrier wave **2** is adjusted so that, at the lower slope of the said wave the beam **17** reaches to a point where the elemental impedance in section *a* with respect to the section *b* is zero. The carrier wave is then modulated by the intelligence D. C. components, such as shown at B in Figure 1, and applied to the intensity control grid **29** for the production of the desired waves at the outgoing terminals.

Having described my invention I wish it to be understood that I do not desire to be limited to the details as shown and described, as various modifications coming within the scope of the appended claims will suggest themselves to a person skilled in the art.

I claim:

1. In modulator tubes of the cathode beam type where the output of the beam current is controlled by a target in the path of the beam, a target which comprises first and second parts: the first part comprising electron responsive uniform surface and connecting means therefor to return substantially all of the incident beam-current to the original electron source; the second part comprising a plurality of beam responsive parallel strips adjacent to the first part and said strips having mutual impedances in incremental steps of predetermined values with respect to the said first part, in a sense that, the second part presents to the beam an effective impedance which at any one position in a dimension at right angle to the said parallel strips is a function of the displacement of the beam from a normal position, and at said normal position the impedance is substantially zero to the first part.

2. In combination, a modulator tube comprising beam forming electrodes, a target in the path of the beam, said target comprising first and second parts: the first part comprising an electron responsive uniform surface and connecting means therefor to return substantially all of the incident beam current to the original electron source, the second part comprising a plurality of beam responsive parallel strips adjacent to the first part and said strips having mutual impedances of predetermined values and structural arrangement therefor to electrically connect one elemental member of the said strips to the first part, whereby the second part presents to the beam an effective impedance which at any one position in a dimension at right angle to the said parallel strips is a function of the displacement of the beam from zero impedance at normal incidence upon the said elemental member, means to sweep the beam to and fro upon the first and second parts in a dimension parallel to the said strips at a switching frequency $f_m/2$, means to simultaneously sweep the beam in a dimension perpendicular to the said strips at a frequency f_m or multiple thereof, in a sense that, the switching point of the beam occurs substantially at incidence upon the said elemental member, whereby the beam current flows through incrementally changing divisions of the total impedance of the said second part, and said changing divisions are periodic functions of the wave f_m.

3. As set forth in claim 2, which includes in combination, means to vary the strength of the said beam incident upon the said target at a carrier frequency, whereby said carrier is modulated by the said functions while being swept across the said second part and being suppressed during the sweeping across the said first part of the target.

4. As set forth in claim 2, which includes in combination means to vary the strength of the said beam incident upon the said target by intelligence waves, whereby the said periodic functions are produced in various peak magnitudes corresponding to statistical levels of the said waves.

MEGUER V. KALFAIAN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
913,521	Latour	Feb. 23, 1909
1,613,626	Von der Biji	Jan. 11, 1927
1,976,400	Illberg	Oct. 9, 1934
2,013,162	McCreary	Sept. 3, 1935
2,024,979	Metcalf	Dec. 17, 1935
2,144,337	Koch	Jan. 17, 1939
2,193,539	Shelby	Mar. 12, 1940
2,213,938	Bennett	Sept. 3, 1940
2,220,165	Malter	Nov. 5, 1940
2,224,677	Hanscom	Dec. 10, 1940
2,257,795	Gray	Oct. 7, 1941
2,262,764	Hull	Nov. 18, 1941
2,368,328	Rosencrans	Jan. 30, 1945
2,395,467	Deloraine	Feb. 26, 1946
2,427,500	Houghton	Sept. 16, 1947
2,429,631	Labin	Oct. 28, 1947
2,459,724	Selgin	Jan. 18, 1949
2,522,291	Marrison	Sept. 12, 1950

FOREIGN PATENTS

Number	Country	Date
505,653	Great Britain	May 11, 1939

OTHER REFERENCES

Therman, "Radio Engineer's Handbook," 1943 ed. Published by McGraw-Hill Co., N. Y.