

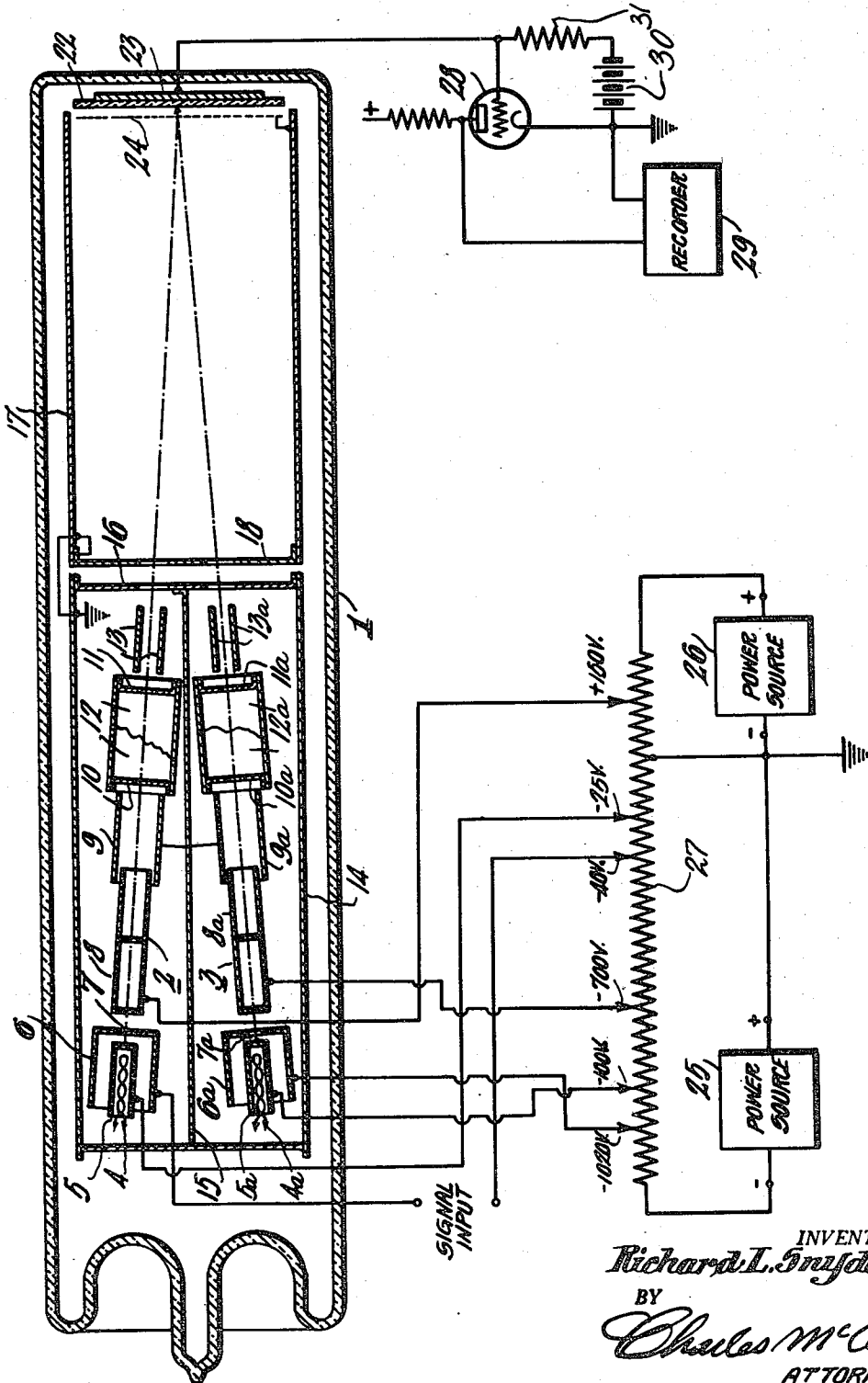
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PLURAL BEAM TUBE

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PLURAL BEAM TUBE

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4 Claims. (Cl. 313-70)

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Cathode beam tubes have heretofore been devised for storing signals on a plurality of isolated conducting strips extending across a target by scanning a signal-modulated "put-on" beam at sufficiently high electron velocity across one end of the strips to bombard more secondary electrons therefrom than land from the beam. The secondaries are collected by a suitable anode. A second or "take-off" cathode beam is scanned at a proportional and lower rate over the other end of the strips at sufficiently low electron velocity to preclude substantial formation of secondary electrons, which brings the potential of the rods down to a uniform negative or near negative value. This take-off beam thus discharges the strips and the stored signals are obtained either from a signal plate on the other side of the target or from the return beam with or without multiplication. This type of storage tube is disclosed in the application of Harley Iams, filed June 26, 1943, Serial No. 492,658, now U. S. Patent 2,454,652, issued November 23, 1948. In my application, filed April 12, 1945, Serial No. 588,046, a somewhat similar type of storage tube is disclosed in which the collection of secondary emission of the target strips under the high velocity impact of both the put-on and the take-off beams is controlled by two grids of relatively negative and positive potential adjacent the ends of the strips.

It is an object of my invention to utilize a dielectric surface for the target, devoid of conducting material.

Another object of my invention is to provide a tube in which the put-on and take-off beams scan the same elemental areas of a dielectric target surface.

Another object of my invention is to provide a tube in which the put-on and take-off beams have a difference in electron velocity to control secondary emission, with a single grid adjacent the scanned areas to establish a reference potential to which the scanned area returns after a cycle of storing and discharging of signals is completed.

Another object of my invention is to construct a tube in which the entire target, instead of a single line thereacross, may be utilized for storing and discharging signals.

Another object of my invention is to store the signals on the dielectric surface of the target by a put-on beam which produces fewer electrons by bombardment than land from the beam on the target surface.

Other objects will appear in the following de-

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scription, reference being had to the drawing, in which:

The single figure is a sectional elevational of a storage tube involving the invention.

The tube may have the usual envelope 1 of glass or other suitable material and may be evacuated in accordance with standard practice. The tube contains two guns, one being designated as a whole by reference character 2 and the other by reference character 3. One of these, for example 2, develops the signal-modulated put-on beam and the other one, 3, develops an unmodulated constant current take-off beam. Gun 2 has the usual heater 4 and cathode 5 for developing a beam of electrons and this cathode is surrounded by the usual control electrode or grid 6 having an orifice 7 for constricting and controlling the beam of electrons projected from the cathode. The first anode 8 has an end and inner wall with openings for passage of the beam. In front of the first anode is arranged the tubular second anode 9. A shield 10 with a suitable opening is placed adjacent the end of the second anode 9 and a second shield 11 with a similar opening is spaced therefrom sufficiently to permit placing of horizontal deflection plates 12 therebetween. Vertical deflection plates 13 are placed in front of the horizontal deflection plates. Horizontal deflection plates 12 will have applied thereacross the voltage of a saw-tooth generator, well known and not shown, and for single line scanning vertical deflection plates 13 may have a D. C. potential applied thereacross, but for page or entire raster scanning plates 13 would have the voltage of a saw-tooth generator of suitably lower frequency applied thereacross.

The gun 3 and associated elements may be of identical construction with those of gun 2 and similar parts have been given similar reference characters except for the subscript *a*. The construction will therefore be apparent without specifically describing these parts.

The guns 2 and 3 are surrounded by a tubular shield 14 and a partition 15 inside this shield one gun from the other. The tubular shield 14 has joined thereto an end shield 16 having openings of suitable size for the beams of the two guns. A collecting anode 17 having end shield 18 surrounds both beams. This collecting anode has an apertured metal wall portion adjacent shield 16. The shields 14, 15, 10, 10*a*, 11 and 11*a*, and anode 17, are grounded to the plus-minus terminal of the supply unit, as indicated.

A target 22 of mica, glass or other suitable dielectric material is placed adjacent the end of

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collecting anode 17. A suitable metal coating or plate 23 serves as a signal plate. The scanned side of the target will receive a charge from the beam in a multiplicity of elemental areas and it thus constitutes a mosaic, in which the charges do not spread to other areas within the scanning time. A few millimeters in front of the target 22 on the scanned side is placed a metal screen 24 of very small mesh. This may be of the type disclosed in the application of Harold B. Law, filed March 31, 1945, Serial No. 585,925, which is now abandoned. This screen may be connected to the anode 17.

The signal recording gun 2 has, for example, been described as developing a beam of low electron velocity and it is scanned over the target at relatively high rate. The gun 3, on the other hand, develops a beam of relatively high electron velocity and is scanned at a relatively low rate over the same elemental areas of the target as the other beam. The velocities and scanning rate may be varied, so long as they have the relation such as referred to. The low velocity beam is of such value as to develop very few or practically no secondaries when the beam strikes the target. The high velocity beam, on the other hand, produces emission of such value as to develop greater than unity electron emission; that is, the electrons bombarded from the target are considerably greater in number than the electrons landed from the beam.

Particular potentials are not required on the various electrodes and other parts of the tube, but by way of example socket power units 25, 26 and bleeder resistance 27 have been shown with the various parts connected thereto so as to indicate a suitable choice of voltages.

The displacement current signals taken off plate 23 may be applied through one or more amplifiers 28 and used to operate a recorder 29, such as disclosed in the patent of Charles J. Young, 1,848,862, March 8, 1932, operated for example in synchronism with the line scanning rate of the low frequency beam of gun 3. The amplifier is shown with the usual bias battery 30 and grid input resistance 31.

The theory of operation of my improved storage tube will be described in connection with a position-locating or radar system. By way of example, single line scanning will be referred to.

It will be understood that signal pulses in a radar system are transmitted in synchronism with the frequency of the line scanning rate of the beam from gun 2 at the beginning of each line. The signals are reflected back from distant objects, such as ships or land elevations, and these reflected signals or echoes are received and used to modulate the beam of gun 2 by impressing the signal on the grid 6. The keying, transmitting and receiving devices are not shown, as illustration is not necessary for an understanding of the operation of my invention. The line scanning rate of this beam is so chosen that the echo from the most distant object likely to be encountered will be received before a succeeding scanion is started. That is, all echoes of a pulse initiating in a line will be received at some phase of that line scanning, depending upon the distance from the receiver. As the beam is repeatedly scanned over the line of elemental areas of target 22 at relatively high rate, echoes from each stationary object will be repeatedly recorded on the target at the same phase of the line. On the other hand, echoes from moving objects will, in general, slowly shift phase. This

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means that echoes of objects will build up charges on the target along the line scanned substantially proportional to the number of scanions of that beam. Since substantially no secondary emission is produced by the bombardment of the target by the low velocity put-on beam, the signals stored will be negative charges from the electrons landed in the successive applications of the beam.

When the unmodulated high velocity beam of gun 3 is scanned at a relatively low rate over the same line on the target, as that scanned by gun 2, secondary electrons are emitted from each elemental area of the target in considerably greater number than the bombarding electrons landing thereon. Hence, the beam of take-off gun 3, as it sweeps over the target, discharges the elemental areas and produces a series of displacement currents to produce voltages in the input of amplifier 28. The voltages are, of course, proportional to the echo signals by which the put-on beam was modulated. The amplifier output is applied to the recorder 29 running in synchronism with the take-off beam. That is, the recorder will have the same line scanning rate and will start each line of the page at the time the take-off beam starts the line scanion of the target. The record produced by recorder 29 readily distinguishes echoes from stationary objects from those of moving objects, because the former appear one above the other on the recording page so as to lie in the same perpendicular line, while the latter appear successively further to the right or left, depending upon direction of movement, so as to lie in diagonal lines.

An important advantage of my improvement resides in the recording of signals while secondary emission from the target is suppressed, because the collection of electrons from the beam is then independent of any non-uniformity of the surface of the scanned areas in respect to emissivity. On the other hand, the collection of secondary electrons produced by the take-off beam is independent of the secondary emission ratio of the elements. Even if the emissivity varies from one area to another, it will have no effect on the signal, because the limiting factor is the reference potential of the grid, to which potential all the elemental areas returned after scanion by the take-off beam.

The signals recorded at 29 are produced at a lower rate than the echoes are stored on the target and hence my improvement is a frequency divider. If, for example, the scanning rate of the put-on beam is 400 lines per second and that of the take-off beam is 2 lines per second, the signal frequency has been reduced 200 times.

The put-on beam tends to produce signals in the recorder 29, but these will be of higher frequency and lower value and will be in the opposite direction to the signals taken off of the target by beam 3. No practical interference is therefore encountered between the put-on and take-off signals in the indicating device, but suitable bias values, for example of battery 30 in the grid circuit of tube 28, will block out the put-on signals.

Having described my invention, what I claim is:

1. An electron discharge tube comprising, an envelope, a target electrode within said envelope, said target electrode formed of a dielectric material and including a conductor closely spaced from a surface thereof, a first electron beam producing means positioned within said envelope on one side of said target and including a beam

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modulating electrode for producing a modulated low velocity electron beam intercepting said dielectric target surface, a second electron beam producing means positioned within said envelope on the same side of said target electrode for producing a high velocity electron beam intercepting said dielectric target surface, a collector electrode mounted within said envelope adjacent said dielectric target surface, and means for scanning said electron beams over said dielectric target surface.

2. An electron discharge tube comprising, an envelope, a target electrode within said envelope, said target electrode including a dielectric sheet and a conductive layer in contact with one surface thereof, a first electron beam producing means positioned within said envelope on the opposite side of said target electrode from said conductive layer and including a beam modulating electrode for producing a modulated low velocity electron beam intercepting the other surface of said dielectric target, a second electron beam producing means positioned within said envelope on said opposite side of said target electrode for producing a high velocity electron beam intercepting said other dielectric target surface, a collector electrode mounted within said envelope adjacent said dielectric target surface, and means for scanning said electron beams over said dielectric target surface.

3. An electron discharge tube comprising, an envelope, a target electrode within said envelope, said target electrode having an insulating surface and a conductor closely spaced from a surface thereof, a first electron beam producing means positioned within said envelope on one side of said target and including a beam modulating electrode for producing a modulated low velocity electron beam intercepting said insulating target surface,

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a second electron beam producing means positioned within said envelope on the same side of said target electrode for producing a high velocity electron beam intercepting said insulating target surface, and means for scanning said electron beams over said insulating target surface.

4. An electron discharge tube comprising, an envelope, a target electrode within said envelope, said target electrode having an insulating surface and a conductor closely spaced from a surface thereof, a first electron beam producing means positioned within said envelope on one side of said target and including a beam modulating electrode for producing a modulated low velocity electron beam intercepting said insulating target surface, a second electron beam producing means positioned within said envelope on the same side of said target electrode for producing a high velocity electron beam intercepting said insulating target surface, a collector electrode mounted within said envelope adjacent said dielectric target surface, and means for scanning said electron beams over said dielectric target surface.

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

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