

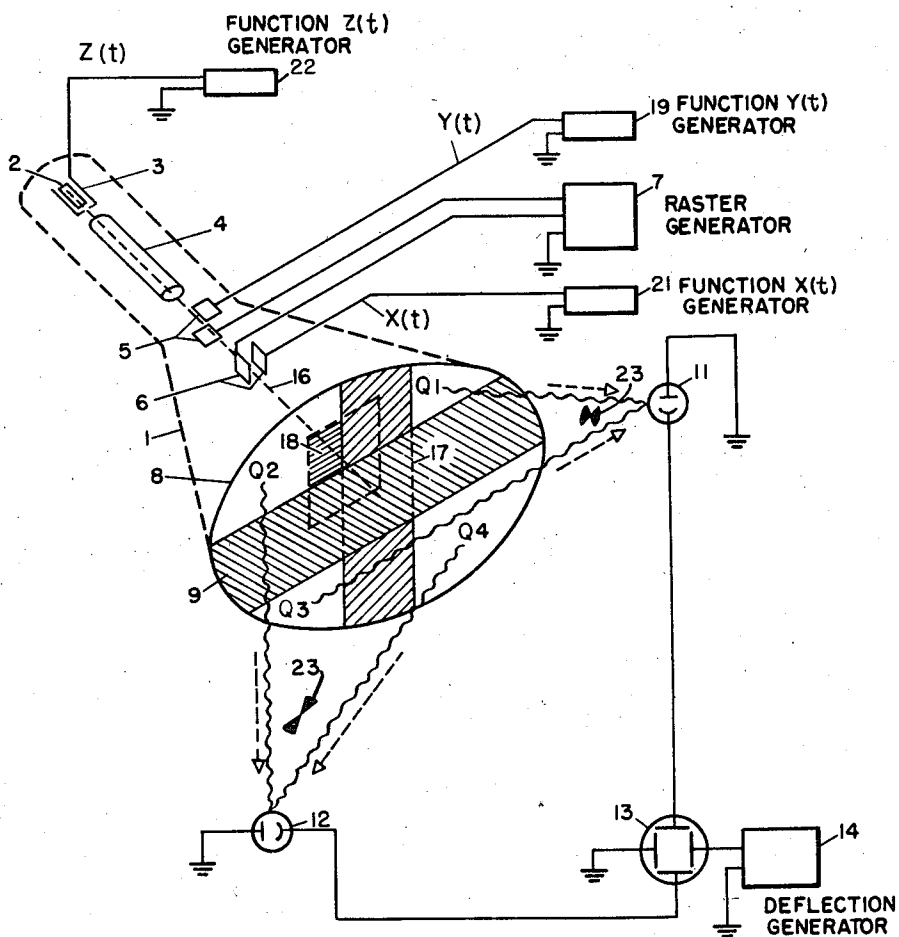
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ELECTRONIC COMPUTER

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ELECTRONIC COMPUTER

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6 Claims. (Cl. 235—61)

This invention relates to means for obtaining an electrical voltage which is proportional to the product of two or more other voltages.

An object of the invention is to provide an electronic circuit which may be used to multiply.

Another object of the invention is to provide a device which may be used as a wattmeter for signals whose frequency components vary from 0 to F cycles per second.

Another object is to provide means whereby the instantaneous energy expended in transients such as a lightning surge or a radar pulse may be determined.

Still further objects will become apparent from the description and claims that follow in connection with the drawing in which the only figure is a diagrammatic representation of one embodiment of the device.

In the drawing is shown an electrostatically focussed and deflected cathode ray tube 1 having a cathode 2, a control grid 3, a focussing and accelerating anode assembly 4, pairs of vertical and horizontal deflecting plates 5 and 6 and a fluorescent screen 8. An opaque mask 9, in the form of a cross, is placed on or in front of the fluorescent screen so that, as viewed from the front, there are four quadrants visible, designated in the drawing as Q₁, Q₂, Q₃ and Q₄. A pair of photocells 11 and 12 are placed in front of the fluorescent screen and selectively masked or shielded in such a manner that one photocell 11 can be actuated only by light emanating from quadrants Q₁ and Q₃ and the second photocell 12 can be actuated only by light emanating from quadrants Q₂ and Q₄. Such selective masking in and of itself well known, is illustrated by opaque, hour-glass shaped masks 23 between each of the photocells 11 and 12 and the face of the cathode ray tube 1.

The output of these photocells may be connected respectively to the vertical deflection plates of a second cathode ray tube 13. The horizontal deflection plates of this second tube 13 are connected to a generator 14 of suitable well known deflection or sweep voltages.

The horizontal and vertical deflection plates 5 and 6 of the cathode ray tube 1 are connected to a source 7 of deflection voltages. Such connections are made respectively to one of each of the pairs of deflection plates. The other plate of one pair 5 is connected to a source 19 of voltage representing a signal Y(t), one of the functions to be measured. Likewise, the second plate of the pair 6 is connected to a source 21 of signal representing the function X(t). A third source 22 of voltage representing the function Z(t) is connected to the grid 3 of the tube 1.

The operation of the device is as follows:

Electrons emitted from the cathode 2 are focussed and accelerated by the anode assembly 4 to a beam 16 which passes between the pairs of deflection plates 5 and 6 and impinges on the fluorescent screen 8. The intensity of this beam is controlled by the potential Z(t) applied to the control grid 3. The amount of light emitted from the screen is a function of the potential applied to the grid.

At the same time, the beam is deflected vertically and horizontally by sawtooth wave signals from generator 7, these signals being applied respectively to one each of the pairs of deflection plates 5 and 6. These deflection signals cause the beam to be deflected so as to trace a rectangular pattern 17 on the fluorescent screen behind the center of the opaque mask 9, shown on the drawing as dotted lines.

In the absence of either signal Y(t) or X(t) with a

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corresponding absence of additional vertical or horizontal deflection, the raster is completely hidden from external view by the opaque mask 9. If both an X(t) and Y(t) signal exist simultaneously, then a portion of the raster may be visible outside of the opaque mask indicated on the drawing by reference character 18; the area visible being dependent upon the product value of X(t) and Y(t) and the intensity depending on the value of Z(t). The quadrant in which this visible portion of the raster appears is dependent upon X(t) and Y(t), as follows.

If X(t) and Y(t) are both positive, a portion of the raster appears in quadrant Q₁. If Y(t) is positive and X(t) is negative, a portion appears in quadrant Q₂. If Y(t) and X(t) are both negative, a portion appears in quadrant Q₃. If X(t) is positive and Y(t) negative, a portion appears in quadrant Q₄.

Since the product of like signed factors is positive, the light output of quadrants Q₁ and Q₃ should be added. Similarly, multiplication of opposite signed factors produces a negative sign, and therefore, the light output of quadrants Q₂ and Q₄ should be added. The photocell pickups produce a voltage which is a linear function of incident light and therefore, the sum of the outputs of the two photocells will represent the multiplication of Y(t) and X(t). The output voltages of the photocells are positive in the presence of light, and therefore, the resultant multiplication may be displayed on a second cathode ray tube 13 by applying the output of one photocell to the upper vertical deflecting plate of the second tube while the output of the other photocell is applied to the lower vertical deflecting plate thereof. The horizontal motion of the electron beam in this second tube is a linear function of time synchronized with Y(t) and X(t), and the resultant pattern on the second tube will then display the equation:

$$X(t)Y(t)Z(t)=R(t)$$

In the event that the output of the photocells is insufficient to operate the cathode ray tube 13, amplifiers may be used after the photocells in the well known manner to obtain sufficient output. Modifications will be apparent which will not depart from the scope of the invention.

What is claimed is:

1. An electronic computer comprising a cathode ray tube having an electron beam and pairs of horizontal and vertical deflecting plates, and a fluorescent screen, a source of deflection voltages connected to said plates to provide horizontal and vertical scanning of said screen by said beam, an opaque mask positioned in front of said screen providing neutral areas between a plurality of visible sections, a plurality of light sensitive electric cells selectively masked so as to receive light emitted from selected said sections of said screen, indicating means connected to said cells to indicate the output thereof, and a plurality of signal sources connected respectively to said pairs of deflecting plates, one side of said source of deflection voltages being connected to one plate of each of said pairs of plates and one side of said plurality of signal sources being connected respectively to the other plate of each of said pairs of plates and the other side of said source of deflection voltages being effectively connected to the other side of said plurality of signal sources.

2. An electronic computer comprising a cathode ray tube having an electron beam and pairs of horizontal and vertical deflecting plates, a control electrode and a fluorescent screen, a source of deflection voltages connected to said plates to provide horizontal and vertical scanning of said screen by said beam, an opaque mask positioned in front of said screen providing neutral areas between a plurality of visible sectors, a plurality of light sensitive electric cells selectively masked to receive light emitted from preselected said sectors of said screen, cathode ray tube indicating means having the deflecting plates thereof connected to said light sensitive electric cells to indicate the output thereof, and a plurality of signal sources connected respectively to said control electrode and each of said pairs of deflecting plates, one side of said source of deflection voltages being connected to

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one plate of each of said pairs of plates and one side of said plurality of signal sources being connected respectively to the other plate of each of said pairs of plates and the other side of said source of deflection voltages being effectively connected to the other side of said plurality of signal sources.

3. An electronic computer comprising a cathode ray tube having an electron beam and pairs of horizontal and vertical deflecting plates, a control electrode and a fluorescent screen, a source of deflection voltages connected to said plates to provide horizontal and vertical scanning of said screen by said beam, an opaque mask positioned in front of said screen in the form of a cross providing neutral areas between four visible quadrants, a plurality of photocells selectively masked to receive light from selected said quadrants of said screen, cathode ray tube indicating means having the deflecting plates thereof connected to said photocells to indicate the combined output thereof, and a plurality of signal sources connected respectively to said control electrode and each of said pairs of deflecting plates, one side of said source of deflection voltages being connected to one plate of each of said pairs of plates and one side of said plurality of signal sources being connected respectively to the other plate of each of said pairs of plates and the other side of said source of deflection voltages being effectively connected to the other side of said plurality of signal sources.

4. An electronic computer comprising a cathode ray tube having an electron beam and pairs of horizontal and vertical deflection plates, a control electrode and a fluorescent screen, a source of deflection voltages connected to said plates to provide horizontal and vertical scanning of said screen by said beam, an opaque mask positioned in front of said screen in the form of a cross providing neutral areas between four visible quadrants of said screen, a pair of photocells selectively masked each to receive the light from two of said quadrants, a second cathode ray tube having deflecting plates, said photocells being connected respectively to one each of a pair of said deflecting plates of said second cathode ray tube, and a plurality of signal sources connected respectively to said control electrode and each said pairs of deflecting plates of said first cathode ray tube, one side of said source of deflection voltages being connected to one

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plate of each of said pairs of plates and one side of said plurality of signal sources being connected respectively to the other plate of each of said pairs of plates and the other side of said source of deflection voltages being effectively connected to the other side of said plurality of signal sources.

5. An electronic computer comprising a cathode ray tube having an electron beam and pairs of horizontal and vertical deflection plates, a control electrode and a fluorescent screen, a plurality of sources of signals connected to said deflection plates to provide horizontal and vertical scanning of said screen by said beam, one side of the output of one of said sources being connected to one plate of each of said pairs of plates, the others of said pairs of plates being connected respectively to one side of the outputs of others of said plurality of sources, said control electrode being also connected to one side of another of said plurality of sources, and the other sides of the outputs of said plurality of sources being effectively connected together, a plurality of photo-cells positioned to receive light from said screen, and cathode ray tube indicating means having the deflecting plates thereof connected to said photo-cells to indicate the instantaneous combined output thereof.

6. The device of claim 5 in which an opaque mask is positioned in front of said screen in the form of a cross providing neutral zones between four visible quadrants.

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