

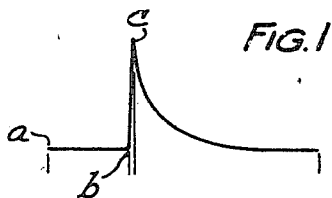
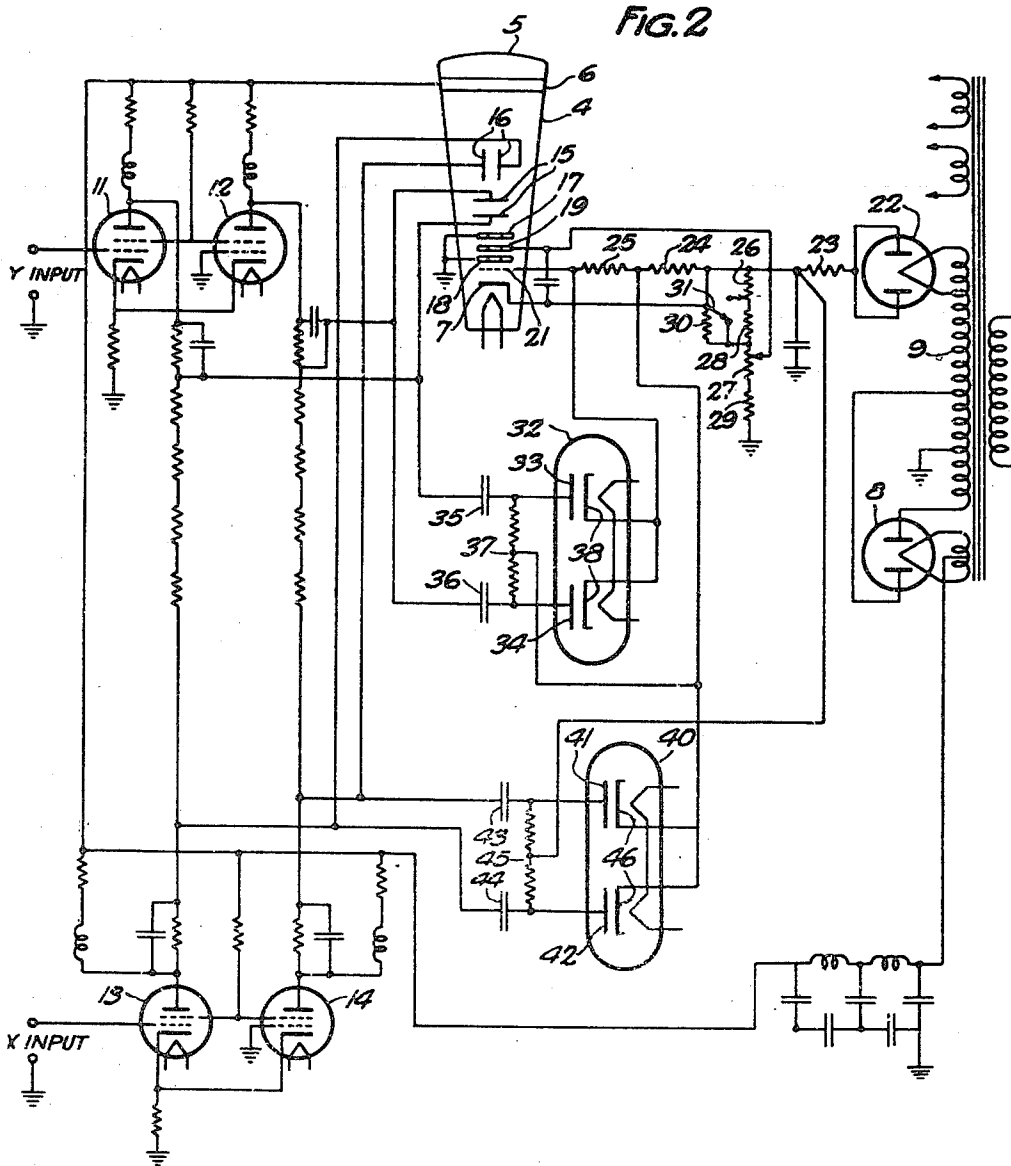
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CATHODE RAY APPARATUS AND METHOD OF CONTROLLING THE RAY

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CATHODE-RAY APPARATUS AND METHOD
OF CONTROLLING THE RAY

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This invention relates to cathode ray apparatus and to a method of controlling the ray, and more particularly to a method of and an apparatus for maintaining a constant and uniform pattern intensity with varying pattern sizes and varying velocities of deflection of the cathode ray beam forming the pattern.

In many types of oscillographs, a change in the dimensions of the cathode ray pattern results in a change in the pattern, the intensity decreasing as the size of the pattern increases and, conversely, increasing as the size of the pattern decreases. Adjustment must, therefore, be provided in the beam intensity to obtain uniform pattern intensity. In the application of Mr. M. R. Miller, Serial No. 471,906, filed January 9, 1943, an apparatus was described whereby a change in the average dimensions of the cathode ray pattern could be compensated for and the average pattern intensity increased or decreased, as required. However, the apparatus therein described does not compensate for instantaneous variations in the velocity of deflection of the electron beam which affect portions of the pattern, these variations being caused by variations in the time rate of change of the voltage on the deflector plates of the oscillograph.

An object of the present invention is to provide an effective method of and apparatus for instantaneously varying the cathode ray beam intensity in accordance with the velocity of deflection of the beam as it forms the pattern.

In accordance with one embodiment of the present invention, a portion of the energy provided for deflecting the cathode ray beam is rectified and applied to the grid of the cathode ray tube to vary the cathode ray intensity in accordance with variations in the velocity of deflection of the beam as it forms the pattern.

Other objects and advantages of the present invention will appear from the following detailed description taken in conjunction with the accompanying drawings, wherein

Fig. 1 shows diagrammatically a typical oscillograph pattern; and

Fig. 2 is a schematic view of an oscillograph circuit incorporating the present invention.

It is easily apparent that with a constant cathode beam intensity, as the dimensions of the pattern are increased, the pattern intensity will decrease and, conversely, that as the pattern is contracted, the pattern intensity will increase. Ordinarily, manual adjustments are made to compensate for such changes or, as stated here-

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application may be employed to compensate automatically. However, with a pattern involving substantial variations in the velocity of deflection of the cathode ray beam due to variations in the time rate of change of the voltages on the deflector plates, individual differences in the intensity of the pattern over selected portions of the pattern occur, the intensity of those portions of the pattern where the velocity of deflection of the beam is greater being less than that on other portions.

For example, referring to Fig. 1, the length of the portion of the pattern from *a* to *b* is somewhat less than the length of the portion of the pattern from *b* to *c* but the time during which the portion of the pattern from *a* to *b* is traced by the electron beam is many times as great as the time during which the portion of the pattern from *b* to *c* is traced. The time during which the portion of the pattern from *b* to *c* is traced may be very much shorter than the time during which the portion of the pattern from *a* to *b* is traced. From this it follows that the velocity of deflection of the beam in forming the portion of the pattern from *b* to *c* may be much greater than the velocity of deflection of the beam in forming the portion of the pattern from *a* to *b* and, consequently, the intensity of illumination of the portion of the pattern from *a* to *b* may be many times as great as that of the portion of the pattern from *b* to *c*. In practice, where a sufficient difference is present in the velocities of deflection of the beam in forming different portions of the pattern, those portions of the pattern in which the velocity of deflection of the beam is greater may not be sufficiently intense to be visible.

The present apparatus is intended to provide a uniform intensity throughout the pattern and, at the same time, to maintain a constant overall intensity with varying pattern sizes. Referring to Fig. 2, a cathode ray oscillograph is there illustrated including a cathode ray tube 4 provided with a fluorescent screen 5 having a band electrode 6 which may be energized positively relative to a cathode 7 by a full wave rectifier 8 connected to a transformer 9. This rectifier may also provide an anode current for tubes 11, 12, 13 and 14 which are preferably of the tetrode type and are used to amplify the energy being analyzed to the required degree.

A pair of deflector plates 15 of the cathode ray tube 4 are connected to the anode circuits of tubes 11 and 12 to impart a vertical deflection along the Y axis to the cathode ray beam, the grid circuit of tube 11 being connected to a source

of energy to be analyzed. Similarly, deflector plates 16 are connected to the anode circuits of tubes 13 and 14 to impart a horizontal deflection along the X axis of the cathode ray beam, the grid circuit of tube 13 being connected to a source of sweep current.

The cathode ray tube is also provided with a pair of accelerating electrodes 17 and 18 and a focusing electrode 19. Energy is supplied to the focusing electrode or grid 19, as well as to a second grid 21, or modulating electrode, through a rectifier 22, also connected to the transformer 9. The anode circuit of the rectifier 22 is connected to the modulating grid 21 through three resistors 23, 24 and 25, and the cathode 7 is supplied with a biasing potential from this circuit through a potentiometer resistor 26 and fixed resistors 27, 28, 29 and 30.

The circuit thus far described is substantially conventional and, therefore, greater detail of description is deemed unnecessary. In such a circuit the intensity of the beam may be adjusted manually by adjusting the potential on the modulating grid 21 through manipulation of the potentiometer resistor 26 or by varying the cathode potential through a switch arm 31 which is connected across the fixed resistor 30. In such a circuit, if the beam current is adjusted to a value giving a satisfactory pattern intensity for a small pattern, then, if the pattern is expanded, the beam current remaining constant, the pattern intensity will be diminished and may be too dim to be satisfactorily visible. Similarly, if the beam intensity is set satisfactorily for a large pattern, then, if the pattern is contracted, the beam intensity may increase to a value which will burn out or seriously decrease the life of the fluorescent phosphor screen 5. It is, therefore, evident that increased cathode ray tube life, as well as increased facility of operation may be had if the beam current is controlled automatically so as to maintain a constant and uniform pattern intensity.

In order to provide instantaneous compensation for variations in the pattern intensity due to changes in the velocity of deflection of the cathode ray beam, a rectifier tube 32 is provided having anodes 33 and 34 which are connected, respectively, through low capacity condensers 35 and 36 to the leads of the vertical deflector plates 15 and the anodes 33 and 34 are bridged by a center tapped resistor 37. Indirectly heated cathodes 38, associated with the tube 32, are connected in parallel and the output of the rectifier tube 32 is connected across the resistor 25 in the lead of the modulating grid 21. A second rectifier tube 40, similar to the rectifier tube 32, is provided having anodes 41 and 42 which are connected, respectively, through low capacity condensers 43 and 44 to the leads of the horizontal deflector plates 16. The anodes 41 and 42 of this tube are also bridged by a center tapped resistor 45. Both center tapped resistors 37 and 45 have low resistance values to provide, in combination with the condensers 35, 36, 43 and 44, a small time constant. A pair of cathodes 46, associated with the tube 40, are connected in parallel and the output of this tube is connected across the resistor 24 in the lead of the modulating grid 21. Both resistors, 24 and 25, have relatively high resistance as compared with that of the center tapped resistors 37 and 45 so that the time constants of the resistor and condensers in the tube circuits will be relatively unaffected.

Thus, rectified voltages from both the hori-

zontal and vertical deflector plates are applied to the modulating grid 21 through a condenser resistance combination of small time constant. In such a circuit, the instantaneous voltage developed across the resistors 24 and 25 in the modulator grid lead is proportional to the instantaneous time rate of change of the input voltage along either axis, and, therefore, is proportional to the instantaneous component of the velocity of deflection of the cathode ray beam in a direction normal to the associated pair of deflecting plates. Consequently, a greater instantaneous velocity of deflection of the beam in either a horizontal or a vertical direction results in a corresponding instantaneous increase in the beam intensity. The degree of compensation may be controlled by changing the values of capacitance of the condensers 35, 36, 43 and 44 and the values of resistance of the resistors 37 and 45. Consequently, since a change in the overall dimensions of the pattern is effected by an increase in the voltage applied to the deflector plates, it will be apparent that, in addition to maintaining uniform intensity throughout all portions of a pattern, the present circuit also maintains uniform pattern intensity for varying sizes of patterns.

It will be apparent that by slight changes in the values of the time constants of the differentiating circuits, the apparatus may be readily adapted to handle a wide variety of wave forms.

What is claimed is:

1. In a cathode ray apparatus, a cathode ray tube having a pair of deflecting electrodes and a modulating electrode, means for applying a deflecting voltage to said deflecting electrodes, means for applying a biasing voltage to said modulating electrode, a rectifier, means for applying a portion of said deflecting voltage to said rectifier, and means for applying a unidirectional voltage proportional to the time rate of change of said deflecting voltage from said rectifier to said modulating electrode to vary the intensity of the cathode ray beam.

2. A cathode ray apparatus comprising a cathode ray tube having horizontal and vertical deflecting electrodes and a modulating electrode, a full-wave rectifier connected to the vertical deflecting electrodes, a second full-wave rectifier connected to the horizontal deflecting electrodes, means for applying a deflecting voltage to said deflecting electrodes, means for applying a biasing voltage to said modulating electrode, and means for applying an additional unidirectional voltage proportional to the instantaneous time rate of change of the input voltage on both the horizontal and vertical deflecting electrodes from said full-wave rectifiers to said modulating electrode.

3. A cathode ray apparatus comprising a cathode ray tube having horizontal and vertical deflecting electrodes and a modulating electrode, a full-wave rectifier connected to the vertical deflecting electrodes, a second full-wave rectifier connected to the horizontal deflecting electrodes, condensers connected in series between said deflecting electrodes and said rectifier electrodes, a center tapped resistor connected between the condensers associated with each full-wave rectifier, means for applying a deflecting voltage to said deflecting electrodes, means for applying voltage to said modulating electrode, and means including said resistors and condensers for applying a voltage proportional to the instantaneous time rate of change of the input voltage on both the horizontal and vertical deflecting electrodes

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from said full-wave rectifiers to said modulating electrode.

4. A cathode ray apparatus comprising a cathode ray tube having horizontal and vertical deflecting electrodes and a modulating electrode, a full-wave rectifier connected to the vertical deflecting electrodes, a second full-wave rectifier connected to the horizontal deflecting electrodes, means for applying a voltage to said modulating electrode, a resistor in series with said means, the output of one of said rectifiers being connected across said resistor, and a second resistor in series with said first resistor, the output of the second rectifier being connected across said second resistor, said rectifiers applying voltage to said modulating electrode proportional to the time rate of change of said deflecting voltage.

5. A cathode ray apparatus comprising a cathode ray tube having horizontal and vertical deflecting electrodes and a modulating electrode, a full-wave rectifier connected to the vertical deflector electrodes, a second full-wave rectifier connected to the horizontal deflector electrodes, means for applying a voltage to said modulating electrode, a resistor in series with said means, the output of one of said rectifiers being connected across said resistor, and a second resistor also in series with said means, the output of the second rectifier being connected across said second resistor, the instantaneous voltage developed across said resistors being proportional to the

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instantaneous time rate of change of the deflecting voltage on either the vertical or horizontal deflecting electrodes.

6. A cathode ray apparatus comprising a cathode ray tube having deflecting electrodes and a modulating electrode, means for applying deflecting voltages to said deflecting electrodes, means for applying a unidirectional biasing voltage to said modulating electrode, a rectifier, means for applying a portion of said deflecting voltages to said rectifier, means for applying a voltage proportional to the time rate of change of said deflecting voltage from said rectifier to said modulating electrode to increase the average intensity of the cathode ray beam.

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