Nov. 18, 1958 E. J. SMURA 2,861,214

BEAM INTENSITY CONTROL

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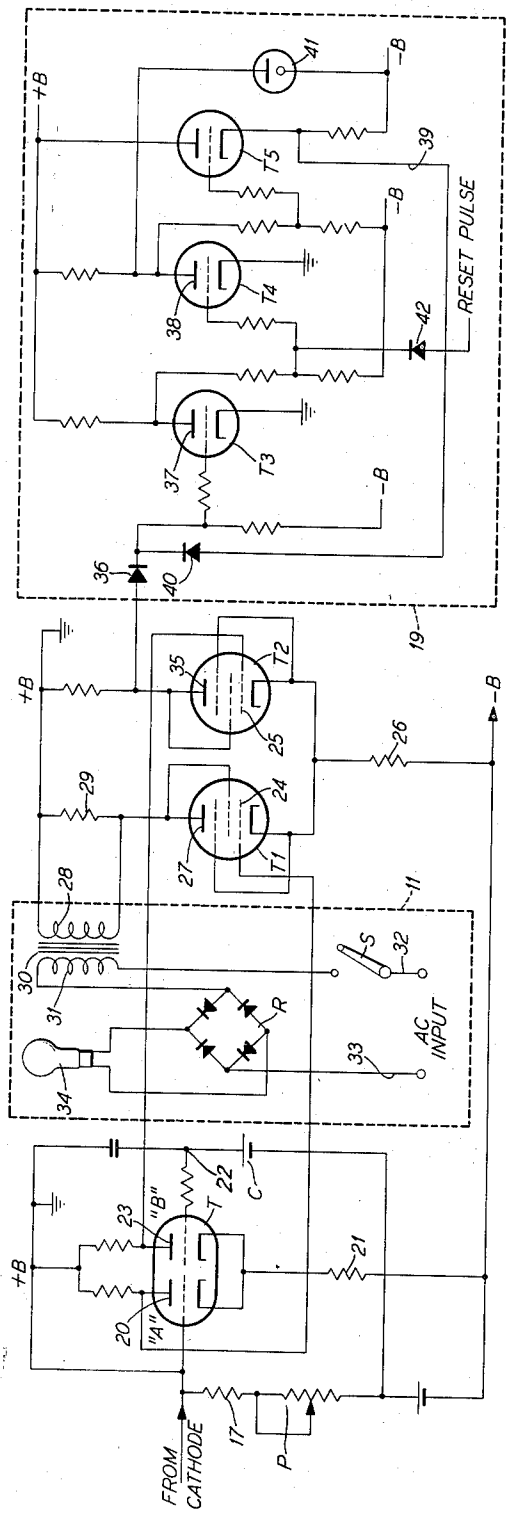

FIG. 2.

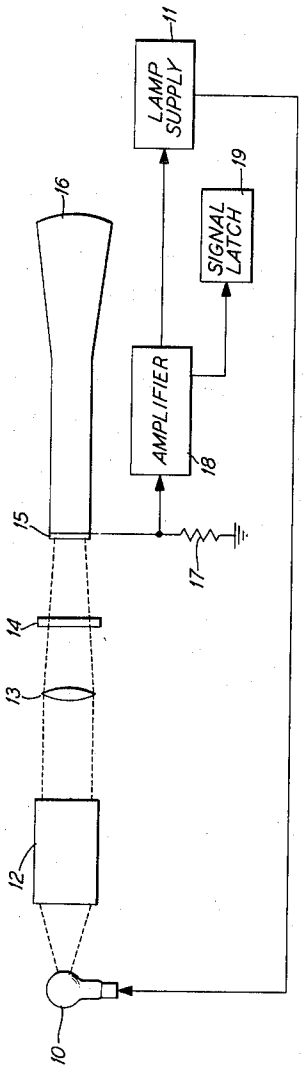

FIG. 1.

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BEAM INTENSITY CONTROL

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5 Claims. (Cl. 315—11)

This invention relates to cathode ray tubes in general and in particular to an arrangement for controlling the intensity of the electron beam in accordance with the amount of light received by the photoemissive cathode.

As is well known, the field of high speed printing now embraces the use of an electron-image tube for selecting and displaying characters in a luminous form, which may then be photographically recorded. Such a tube usually employs a font consisting of a chart of characters which is projected onto a photoemissive cathode. Selections are made from the resulting electron-image stream and directed to the desired position on a phosphor screen. It can be readily understood that in such a printing operation it is important to maintain an electron stream of constant intensity in order to obtain consistent images on the screen and to accomplish this it becomes necessary to compensate for such things as aging of the light source, dust on optical components and aging of the photoemissive cathode itself. Any of these factors will vary the density of the beam current resulting in a change in the initial velocity of the beam electrons which causes the image characters to rotate.

Accordingly, an object of the present invention is to provide an arrangement for controlling the intensity of an electron beam is accordance with the amount of light received by the beam generating means.

A further object of the present invention is to provide a cathode ray tube having a photoemissive cathode for generating an electron beam with amplifier circuit means under control of said cathode for controlling the intensity of the beam in accordance with the amount of light received by the cathode.

A still further object of the present invention is to provide a cathode ray tube as in the preceding object and including signal means conditioned by said amplifier circuit means for indicating that controlling the intensity of the beam is no longer practical due to deterioration of the light source.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of examples, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawing:

Fig. 1 is a block diagram showing the general arrangement of the system embodying the invention.

Fig. 2 is a circuit diagram of the amplifier, signal latch and lamp supply.

Referring to Fig. 1, the system comprises a lamp 10 and a suitable lamp supply 11 therefor, along with a condensing lens 12 and projection lens 13 for directing light from the lamp through a letter chart matrix 14 and onto the photoemissive cathode 15 of a cathode ray tube 16. The letter chart is projected steadily on the photocathode to produce the compound electron stream from which selections are made for projection on the screen of the tube.

When light is received by the cathode the amount of current generated by the incidence of light on it is sensed by a resistor 17. The resistor is temperature stable and the voltage across it is compared to a secondary standard, the difference amplified by an amplifier arrangement 18, which will be described, and fed to a suitable control winding of the lamp supply to control the light. Controlling the light controls the cathode current and thus controls the intensity on the cathode ray tube screen by controlling the electron density. This system is self compensating for aging of the light source, dust on the optics and aging of the photocathode.

As was previously stated an important feature of the present invention is the provision of means for indicating that the light source has deteriorated to the point where controlling of the beam intensity is no longer practical. For this purpose, the output of amplifier 18 is fed to a signal latch circuit 19 which will be described in detail later.

Referring to Fig. 2, there may be seen the detail circuitry for the amplifier 18, signal latch 19 and the lamp supply 11. When a drop in light occurs at the photocathode due to any of the aforementioned reasons a fall off in current will take place at the cathode and a reduction of voltage will occur across the sensing resistor 17. The voltage drop across the resistor will cause a reduction of cathode current in section "A" of a twin triode T resulting in a rise in potential at plate 20 and a drop in potential across the cathode resistor 21 of tube T. With the grid of section "B" of the tube tied to a battery C of constant potential the grid to cathode potential at point 22 will rise causing an increase of cathode current in tube section "B" and consequently a drop in potential at the plate 23.

The first stage or tube T, then, acts as a differential amplifier since it compares the voltage drop across the resistor 17 with the fixed grid bias C and amplifies the difference. In addition it also functions as a phase splitter since a push-pull output from a single input signal is obtained.

The potential rise at plate 20 is fed to the control grid 24 of a pentode T1 and the potential drop at plate 23 is fed to the control grid 25 of a second pentode T2. Pentodes T1 and T2 have their cathodes tied together to a resistor 26 and form a common D. C. differential amplifier which is noted for its stability under supply voltage changes.

The increase in potential on the control grid 24 causes the potential at plate 27 to fall because of the increased current in tube T1. The cathode potential of tube T1 tends to increase with the grid potential but is nullified by the drop of potential at the grid 25 of tube T2 which tends to lower the cathode potential. The increase of current in tube T1 is fed through a control winding 28 to increase the voltage to the lamp and restore the illumination to its original value. The illumination will not reach its original value unless the loop gain of the system is infinity, but for all practical purposes the loop gain is high enough to cause the illumination to return to its original value minus a small almost immeasurable amount. The resistor 29 across the control winding acts as a damping element to suppress system oscillations. A potentiometer P is also provided in the circuit to allow for adjustment of the lamp intensity.

As shown within the dotted section identified as 11 on Fig. 2, the lamp supply includes a reactor which comprises the control winding 28 for the amplifier output, a laminated iron core 30 and a winding 31 one end of which is connected to one of the alternating current input lines 32 through a switch S. A full wave bridge rectifier R is shown with its input terminals connected to the alternating current input line 33 and to the

other end of the winding **31**. The direct current terminals of the rectifier are taken to the lamp **34** and hence it can be understood that an increase in current through the control winding **28** will result in an increase in direct current voltage supplied to the lamp to increase its intensity. Conversely, of course, a decrease in current through the control winding will result in a decrease in the voltage supplied to the lamp to decrease its intensity.

The details of the signal latch circuit for indicating a near end of life condition of the lamp are shown within the dotted section identified as **19** on Fig. 2. It will be remembered that as the photocathode current drops due to a decrease in light from the lamp, tube **T1** increases in conduction and simultaneously the voltage at grid **25** is decreased resulting in decreasing conduction of tube **T2**. Accordingly, the voltage at plate **35** of tube **T2** increases and this increase in voltage is fed through a diode **36** to the grid of a triode **T3** in the latch circuit. The voltage at the plate **37** goes down and this is reflected on the grid of a triode tube **T4** decreasing the conduction of the tube. The resultant rise in voltage at the plate **38** of tube **T4** is fed to the grid of triode tube **T5** raising the cathode potential of tube **T5** and this rise in cathode potential is fed back through wire **39** and diode **40** to the grid of tube **T3** to latch the circuit in its present state.

It will be noted that the plate **38** of tube **T4** is also tied to a neon tube **41** which will be turned on upon the occurrence of a predetermined rise in voltage at plate **38** to signal that the lamp is near end of life and that further intensity regulation of the cathode ray beam is no longer practical. The neon signal will remain on until the circuit is reset by feeding a suitable reset pulse through a diode **42** to the grid of tube **T4** raising the potential of the grid and decreasing the voltage on the plate **38** sufficiently to extinguish the neon tube. The decrease in voltage at plate **38** is also reflected as a decrease in voltage at the grid and cathode of tube **T5** and back to the grid of tube **T3** thus, raising the voltage at the plate **37** and resetting the latch circuit. Of course, in a similar manner, should the light increase the voltage across resistor **17** will increase and the circuit will function to send less current through the control winding **28** causing the lamp supply to decrease. In this case, the latch circuit will not be operated since the potential at plate **35** of **T2** drops.

It will be understood that the above system is not limited to use with cathode ray tubes but can also be applied to other fields using photocells as pick up devices and monitoring face current. Uses of the present system may also extend into the fields of photography and chemistry.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a system for controlling light intensity, a light source, a light source supply, a photosensitive element for receiving light from said light source, an amplifier circuit responsive to the intensity of light received by said element, means under control of said amplifier circuit for controlling said supply to maintain the intensity of the light source constant, a latch circuit operated by a predetermined output of said amplifier, and signal means operated by said latch circuit for indicating near end of life of said light source.

2. In a system for controlling light intensity, a light source, a light source supply, a photosensitive element for receiving light from said light source, said element generating a current proportional to the amount of light received, means for sensing said current and obtaining two push-pull signal voltages, means for amplifying said signal voltages, means included in said light source supply and responsive to one of said signal voltages for controlling said supply to maintain the intensity of the light source constant, a latch circuit operated by a predetermined value of said other signal voltage, and signal means operated by said latch circuit for indicating near end of life of said light source.

3. In a system for controlling light intensity, a light source, a light source supply, a photosensitive element for receiving light from said light source, said element generating a current proportional to the amount of light received, a phase inverter circuit responsive to the output of said element for producing two signal voltages of opposite polarity, an amplifier circuit for amplifying said signal voltages, means included in said light source supply and responsive to the negative going signal voltage from said amplifier for controlling said supply to maintain the intensity of the light source constant, a latch circuit responsive to a predetermined value of the positive going signal voltage from said amplifier, and signal means operated by said latch circuit for indicating near end of life of said light source.

4. In a system for controlling light intensity, a light source, a light source supply, a photosensitive element for receiving light from said light source, said element generating a current proportional to the amount of light received, means for establishing a voltage drop when said current output decreases due to a drop in light, means responsive to said voltage drop for producing two signal voltages of opposite polarity, an amplifier circuit for amplifying said signal voltages, means included in said light source supply and responsive to the negative going signal voltage from said amplifier for controlling said supply to increase the intensity of the light source, a latch circuit responsive to a predetermined value of the positive going signal voltage from said amplifier, and signal means operated by said latch circuit for indicating near end of life of said light source.

5. In a system for controlling the beam intensity of a cathode ray tube, a light source, a light source supply, a photocathode for receiving light from said light source and producing a cathode ray beam which is proportional to the amount of light received, said photocathode also generating a current which is proportional to the amount of light received, means for sensing the current output of said photocathode, means responsive to said sensing means for producing two signal voltages of opposite polarity, means for amplifying said signal voltages, means included in said light source supply and responsive to one of said signal voltages for controlling the intensity of the light source, a latch circuit responsive to a predetermined value of the other signal voltage, and signal means operated by said latch circuit for indicating near end of life of said light source.

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