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LIGHT SHUTTER SYSTEM UTILIZING AN IMAGE INTENSIFIER TUBE

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FIG. 1

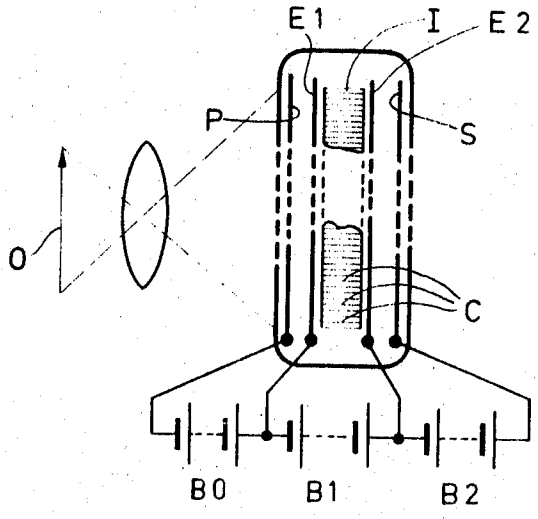
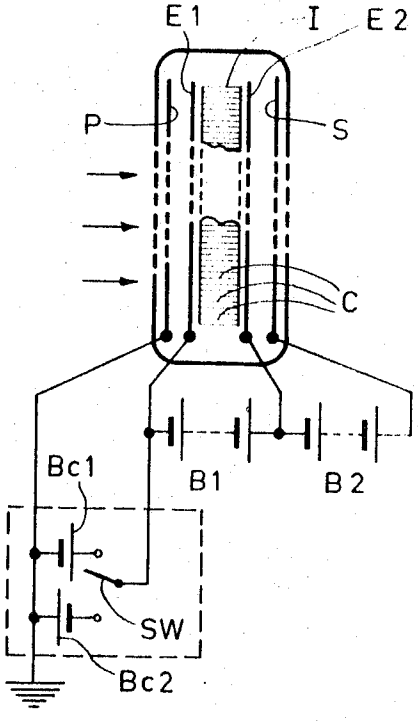


FIG. 2



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LIGHT SHUTTER SYSTEM UTILIZING AN IMAGE INTENSIFIER TUBE

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ABSTRACT OF THE DISCLOSURE

The invention provides a light shutter system comprising a proximity image intensifier tube including a photocathode facing the input electrode and a luminescent screen facing the output electrode of the device. The shutter system comprises a potential source between the input and output electrodes, a potential source between the output electrode and the fluorescent screen, and a control switch for applying either one of two potential sources between the photocathode and the first electrode.

This invention relates to electronic image intensifier devices. More particularly the invention relates to "channel intensifier" devices and to electronic imaging tubes employing such devices. Such devices are secondary-emissive electron-multiplier devices comprising a matrix in the form of a plate having a large number of elongated channels passing through its thickness, said plate having a first conductive layer on its input face and a separate second conductive layer on its output face to act respectively as input and output electrodes.

FIGURE 1 illustrates a proximity-type channel intensifier tube.

FIGURE 2 illustrates the switchable shutter control circuit used in the intensifier tube of FIGURE 1.

Secondary-emissive intensifier devices of this character are described, for example, in British patent specifications Nos. 1,064,073, 1,064,074, and 1,064,076.

In the operation of these intensifier devices (when incorporated in electronic imaging tubes) a potential difference is applied between the two electrode layers of the matrix so as to set up an electric field to accelerate the electrons, which field establishes a potential gradient created by current flowing through resistive surfaces formed inside the channels or (if such channel surfaces are absent) through the bulk material of the matrix. Secondary-emissive multiplication takes place in the channels and the output electrons may be acted upon by a further accelerating field which may be set up between the ouput electrode and a suitable target, for example, a luminescent display screen.

An imaging tube or system employing such a device will be referred to for convenience as an "image intensifier" tube or system rather than as an image converter" tube or system even in applications where the primary purpose is a change in the wavelength of the radiation of the image.

The patent specifications referred to above described inter alia image intensifier tubes of the "proximity" type employing a channel intensifier device (an imaging tube of the "proximity" type is one in which the photo-cathode is placed very near to the channel intensifier device without intermediate electron-optical focusing means).

Such a proximity tube is shown schematically in FIGURE 1 of the accompanying drawing. In FIGURE 1 an object O is focused by an optical system on to a photocathode P. Photo-electrons are liberated simultaneously

from all parts of the photo-cathode with varying local intensities dependent upon the image.

The matrix of the device is usually of glass or other vitreous material and its input and output faces are covered by first and second conductive electrode layers E1–E2 respectively.

In each of the channels C that receives primary electrons at any given instant, multiplication takes place as described in the aforesaid patent specifications and the necessary electric accelerating field is set up by connecting the electrodes E1–E2 to a source shown schematically at B1. A further accelerating field is provided by a source B2 between E2 and a conductive coating (e.g. aluminum) associated with a luminescent screen S.

An additional source is shown schematically at Bo for directing the primary electrons from P to flow towards the electrode E1 and its value is such as to ensure adequate definition for any given P-E1 spacing. In the case of this proximity type of arrangement the photo-cathode P may be very close to electrode E1 (for example 100μ) and the voltage required from Bo may (unlike the voltage of B1 and B2) be very low, usually less than 100 volts.

It is an object of the present invention to exploit this last property so as to provide an improved light shutter system.

The invention provides a light shutter system comprising an image intensifier tube of the proximity type including a channel intensifier device as herein defined, a photo-cathode facing the input electrode of said device and a luminescent screen facing the output electrode of said device, the shutter system comprising means for applying an accelerating potential difference between said input and output electrodes, means for applying a further accelerating potential difference between said output electrode and said screen and control means for causing shutter action by applying between said photo-cathode and input electrode a controlling potential difference which has selectively one or the other of two values, one value being such as to turn the tube off by causing the input electrode to repel photo-electrons back to the photo-cathode while the other value is such as to cause the flow of photo-electrons from the photo-cathode to the input electrode.

Such a system can operate efficiently with very small changes in the controlling potential difference (P.D.) In a typical case, in order that photo-electrons should enter the channel plate, become multiplied and excite the phosphor ("on" condition), a small positive potential with respect to the photocathode is applied to the input electrode of the channel plate. This will be less than 100 volts and may even in some cases be reduced to zero (although zero is not a desirable value). To switch the tube to the "off" condition and prevent photoelectrons entering the channel plate, a small negative potential is applied to the input electrode of the plate. This potential will generally be less than 10 volts. A specific embodiment of the invention will now be described by way of example with reference to FIGURE 2 of the accompanying drawings.

In FIGURE 2, the proximity-type channel intensifier tube is shown comprising (as in FIGURE 1) a channel plate I with electrodes E1–E2, a photo-cathode P and a luminescent screen S. Accelerating potential sources are indicated again at B1 and B2.

The initial source Bo of FIGURE 1 is replaced by a switchable shutter control circuit shown schematically as comprising a switch SW and alternative control potential sources Bc1–Bc2. Bc1 corresponds to the forward source Bo of FIGURE 1 and provides for electrode E1 a positive "ON" voltage in the range +1 to +100 volts. Source Bc2 provides for E1 a negative "OFF" voltage in the range −1 to −100 volts.

Although the photo-cathode P is shown earthed, it is

possible to earth E1 instead, but the arrangement shown is preferably in spite of the small changes in the levels of elements E1–E2–S which occur when the switch SW is actuated.

One practical set of values is given below by way of illustration as applied to an arrangement of the type shown in FIGURE 2.

TABLE

Spacing P–E1	100μ
Spacing E1–E2 mm	1
Spacing E2–S mm	1
Diameter of plate I mm	25
Diameter of channel	15μ
Voltage of B1 v	1000
Voltage of B2 v	5000
Voltage of Bc1 v	+100
Voltage of Bc2 v	−100

Although the overall dimension of the channel plate I is given in the table as a diameter it is, of course, not necessary for the plate to be circular.

The control voltages given in the table (+100 and −100) are very suitable values but other convenient values can be found in the range +25 to +300 for Bc1 and −10 to −200 for Bc2.

What is claimed is:

1. A light shutter system comprising an image intensifier tube of the proximity type including a channel intensifier device as herein defined, a photo-cathode facing the input electrode of said device and a luminescent screen facing the output electrode of said device, the shutter system also

comprising means for applying an accelerating potential difference between said input and output electrodes, means for applying a further accelerating potential difference between said output electrode and said screen and control means for causing shutter action by applying between said photo-cathode and input electrode a controlling potential difference which has selectively one or the other of two values, one value being such as to turn the tube off by causing the input electrode to repel photo-electrons back to the photo-cathode while the other value is such as to cause the flow of photo-electrons from the photo-cathode to the input electrode.

2. A system as claimed in claim 1 wherein the two values of the controlling potential difference are within the range +25 v. to +300 v. and the range −10 v. to −200 v. respectively.

3. A system as claimed in claim 2 wherein the said two values are substantially equal to +100 volts and −100 volts respectively.

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