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(54) Imaging apparatus.

(57) In an image intensifier, a shutter 12 is included in front of the photocathode 7, the shutter 12 has a variable aperture 13. If a scene to be viewed includes a dark region, the aperture 13 is reduced so as to only allow light from the dark region to be incident on the photocathode material 7. This enables the gain to be increased such that the dark region may be viewed without light from the brighter regions causing the automatic gain control 11 to oppose this.

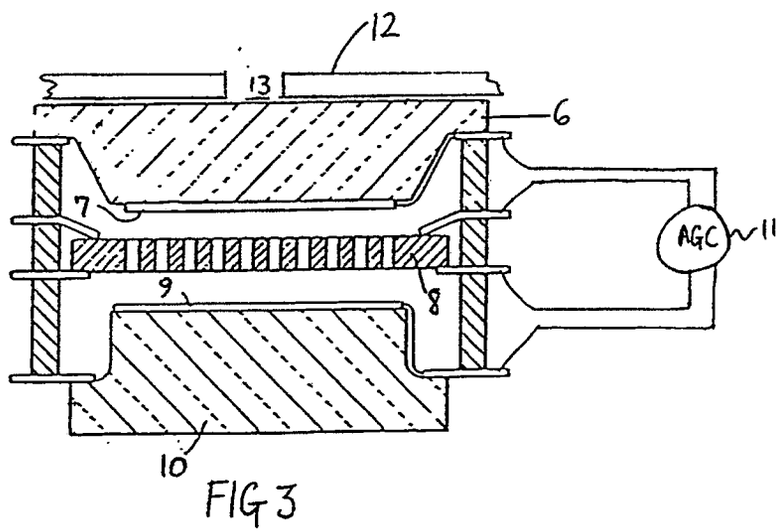

FIG 3

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This invention relates to imaging apparatus and more particularly, but not exclusively, to image intensifiers.

A known image intensifier is schematically illustrated in Figure 1, which is a longitudinal section of the device. The image intensifier includes a glass faceplate 1 on which a photocathode 2 is laid down, a micro-channel plate electron multiplier 3 and a phosphor screen 4 on a glass substrate 5. The glass faceplate 1 and substrate 5 form the end windows of a vacuum envelope in which the other elements are contained. The photocathode 2 comprises a layer of material which emits electrons in response to electromagnetic radiation incident thereon, the number of electrons produced being dependent on the intensity of the received radiation.

In operation, an image is focussed onto the photocathode 2 from which electrons are emitted in a distribution which is representative of the viewed scene. The electrons are accelerated towards the electron multiplier 3 where their number is increased by secondary emission at the micro-channel walls and are then accelerated towards the phosphor screen 4, producing an optical image which is viewed by an operator. The image on the screen 4 is thus an intensified version of the scene focussed on the photocathode 2.

The present invention seeks to provide an improved imaging apparatus and is particularly applicable to image intensifiers.

According to the invention there is provided imaging apparatus comprising material which emits electrons in response to electromagnetic radiation incident thereon and means for varying the size of the surface of the material from which electrons are emitted. By employing the invention, only a part of the total available field of view can be selected for further processing or viewing after emission of the electrons. This may be desirable, for example, where it is wished to optimize the contrast of a particular region of the viewed scene. The invention may be particularly advantageously applied, in an image intensifier for example, where an electron multiplier is included for increasing the number of electrons after emission from the surface and gain control means ensures that the total number of electrons after multiplication is substantially at or below a threshold level. In such a case, it may not be possible to increase the gain sufficiently to detect detail in darker regions of the viewed scene, even at the expense of losing the information in other regions, as the total current after multiplication is limited. However, by employing the invention to ensure that electrons are emitted only from the area of the material on which the darker part of the scene is imaged, the gain from that area may be substantially increased, as there is no contribution to the total number of electrons from other regions of the field of view.

Preferably, the means for varying comprises means for varying the size of the surface area on which radiation is incident, although the surface of the material from which electrons are emitted may be adjustably shielded so as to change the area size.

It is preferred that the means for varying is located substantially in the focal plane of a lens arranged to focus radiation on the material. This arrangement enables the size of the surface from which electrons are emitted to be accurately selected.

Advantageously, the means for varying comprises a shutter having a variable aperture. The shutter may be placed either in front or behind the material to control the area from which electrons are emitted or may be in the focal plane, although the latter position may only be convenient where an optical guide is used to direct incident radiation onto the material.

It may be preferred that the shutter is a mechanical shutter, although other types, such as for example, liquid crystal shielding mechanisms may be employed. In a particularly convenient configuration, the aperture is substantially circular and has a changeable diameter as in many applications, it is the central part of the viewed scene over which greatest control of the imaging process is required. However, the aperture may be more complicated so as to enable different discrete parts of the viewed scene to be selected.

Some ways in which the invention may be performed are now described by way of example with reference to the accompanying drawings, in which:

Figure 2 schematically illustrates imaging apparatus in accordance with the invention;

Figure 3 shows the apparatus of Figure 2 in a different operating mode.

With reference to Figure 2, an image intensifier includes a faceplate 6 on which is laid down a photocathode 7. The image intensifier also includes an electron multiplier 8 and a phosphor screen 9 laid down on a glass substrate 10. An automatic gain control circuit, indicated schematically at 11, adjusts the gain of the electron multiplier such that the total electron current in the phosphor screen 9 remains substantially at or near a threshold level. Thus, if the viewed scene becomes brighter so that more electrons are emitted from the photocathode 7, the automatic gain control circuit 11 acts to reduce the accelerating voltage at the electron multiplier 8 to maintain the total number of electrons incident on the phosphor screen 9 at a substantially unvarying level.

A mechanical shutter 12 is located adjacent to

the glass faceplate 6 and includes a central circular aperture 13 which is of variable diameter. In the position shown in Figure 2, the maximum area of the photocathode 7 is exposed to incident radiation.

If the viewed scene changes so that a darker region is present, the shutter 12 is adjusted so as to reduce the diameter of the aperture 13 and hence reduce the intensity of light incident on the photocathode 7. This in turn decreases the number of electrons emitted from the photocathode 7. In order to maintain the current in the phosphor screen 9 at the threshold level, the accelerating field across the electron multiplier 8 is increased by the automatic gain control circuit 11. Thus the dark region of the scene is amplified so that, when the phosphor screen is viewed,its contrast is improved. The diameter of the aperture 13 may be adjusted either manually or some form of automatic control may be included.

Ideally, the shutter 12 is located in the focal plane of the lens (not shown) which images the viewed scene onto the photocathode 7. However, because of the presence of the faceplate 6, this is not possible in the arrangement shown in Figures 2 and 3. It should be noted that although an electron multiplier of the micro-channel plate type is illustrated, other forms of multiplier could be used.

Also, although the faceplate 6 and substrate 10 are of glass in the illustrated embodiment, either or both of them may be replaced by optical waveguides. This is a particualrly advantageous arrangement as it enables the shutter to be placed substantially in the focal plane of the lens.

Claims

1. Imaging apparatus comprising material (7) which emits electrons in response to electromagnetic radiation incident thereon and characterized by means (12) for varying the size of the surface of the material (7) from which electrons are emitted.

2. Imaging apparatus as claimed in claim 1 wherein the means for varying comprises means for varying the size of the surface area on which radiation is incident.

3. Imaging apparatus as claimed in claim 1 or 2 and including an electron multiplier (8) for receiving electrons emitted from the surface and multiplying their number; and gain control means (11) for ensuring that the total mumber of electrons after multiplication is substantially at or below a threshold level.

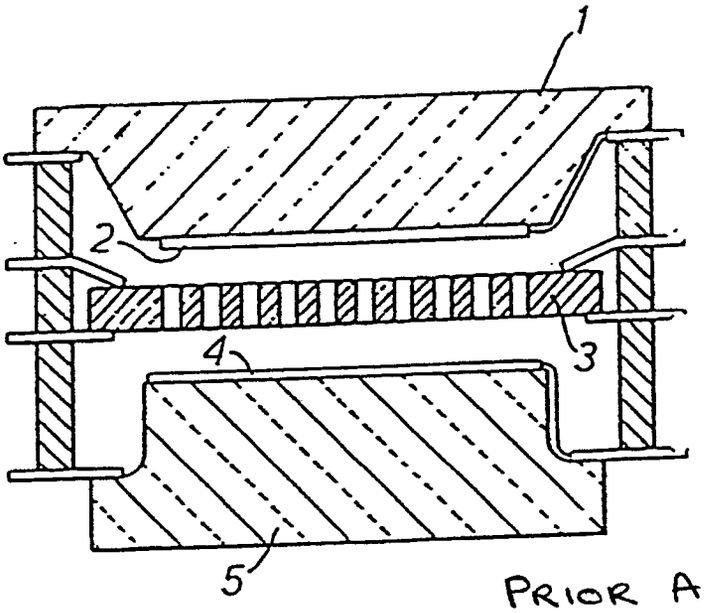
4. Imaging apparatus as claimed in claim 1, 2 or 3 wherein the means for varying is located substantially in the focal plane of a lens arranged to focus radiation on the material.

5. Imaging apparatus as claimed in any preceding claim wherein the means for varying comprises a shutter having a variable aperture (13).

6. Imaging apparatus as claimed in claim 5 wherein the aperture is substantially circular and has a changeable diameter.

7. Imaging apparatus as claimed in claim 5 or 6 wherein the shutter is a mechanical shutter.

8. Imaging apparatus as claimed in any preceding claim and including an optical guide arranged to conduct light to the material.



PRIOR ART

FIG. 1.

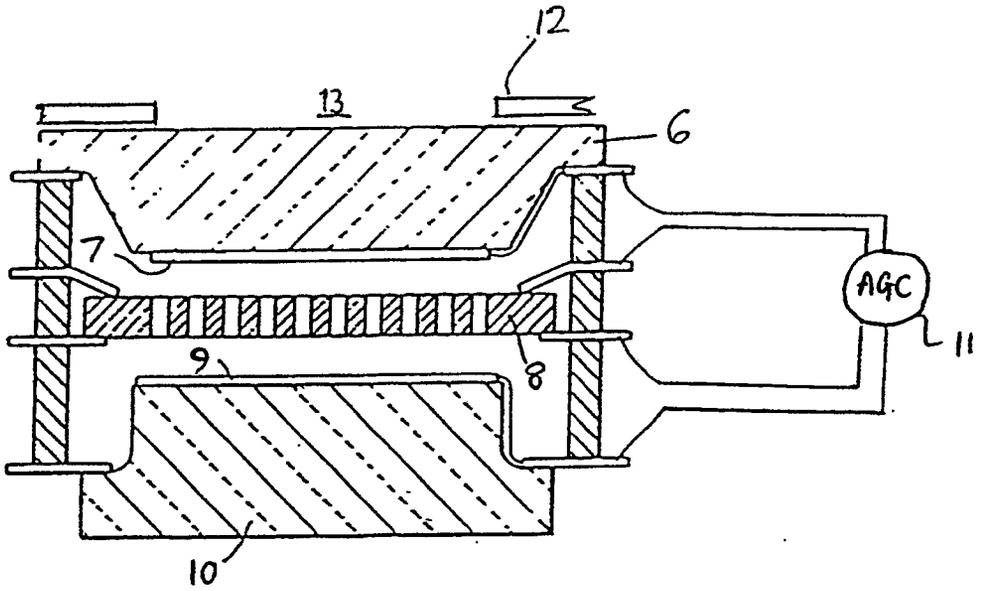


FIG 2

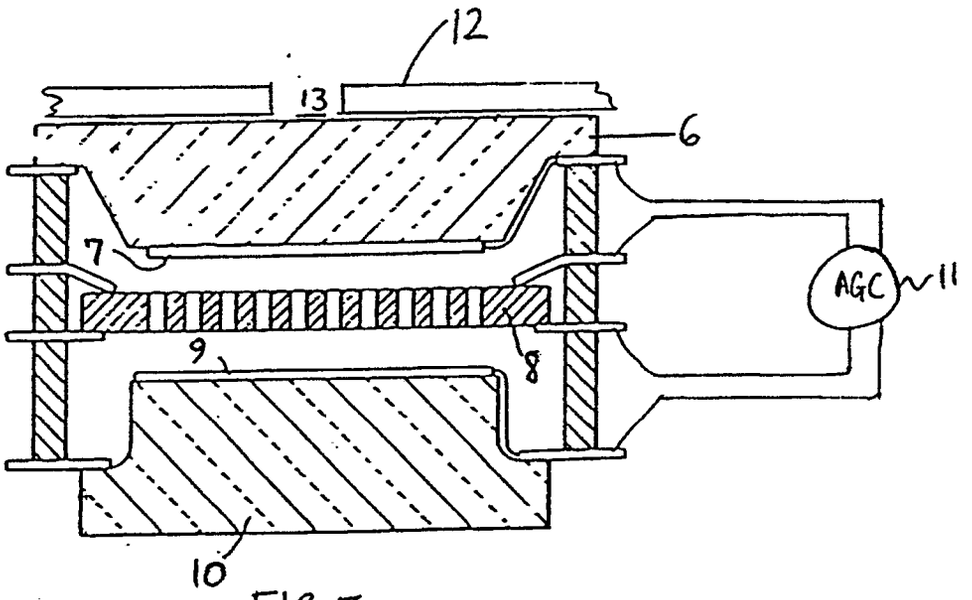


FIG 3

European Patent Office

EUROPEAN SEARCH REPORT

Application number EP 90306302.2

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl⁵)
A	US - A - 4 724 357 (DRINKWINE) * Pos. 15 *	1	H 01 J 43/28

TECHNICAL FIELDS SEARCHED (Int Cl⁵)

H 01 J 43/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	21-09-1990	KUNZE

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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