

[54] IMAGE INTENSIFIER TUBE
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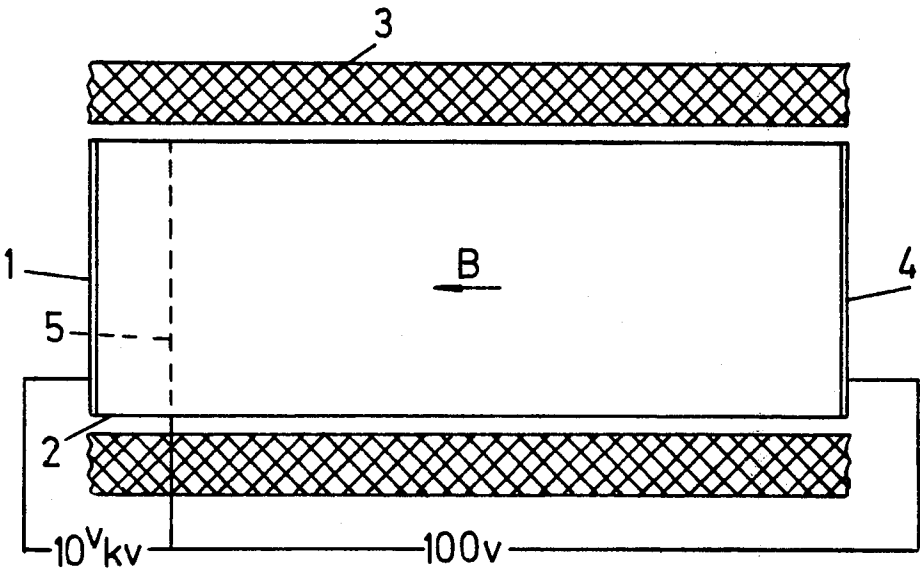
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[51] Int. Cl..... H01j 39/10; H01j 39/02
[58] Field of Search 313/102, 96, 94, 99; 250/213 VT

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[57] ABSTRACT

An image intensifier tube comprising a phosphor screen and a photocathode is provided with a wire mesh adjacent the phosphor screen. This provides an equipotential surface and allows the main part of the focusing of electrons from the photocathode to be carried out in a relatively weak electric field. This leads to a reduction in the length of the tube.

5 Claims, 1 Drawing Figure



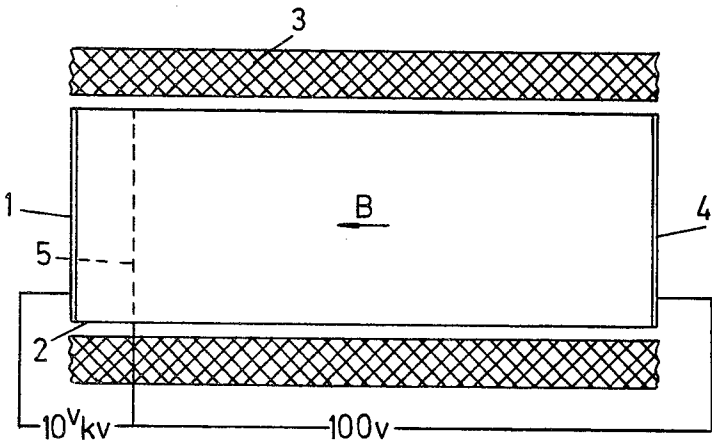


IMAGE INTENSIFIER TUBE

This invention relates to a photoelectronic image intensifier tube.

A photoelectronic image intensifier has been proposed where an optical image is focused on to a plane photocathode in a high-vacuum tube and the resulting liberated photoelectrons are accelerated in a uniform electric field to a plane parallel target coated with a conventional phosphor screen. The photoelectron stream is focused to form an electron image on this target by means of a uniform axial magnetic field the lines of force of which coincide as accurately as possible with those of the electric field.

The relationship between the magnetic field B (Gauss), the electric potential between photocathode and target V (volts) at a separation of d (cm) is given by the formula

$$Bd = 11.2 n \sqrt{V}$$

where n is the integral number of cycloidal loops made by the electrons between the photocathode and the phosphor screen. It is necessary to operate the device with a voltage of ≈ 10 kV between photocathode and screen to obtain an adequate light-gain, and hence even with $n = 1$ the product $Bd \approx 10^3$. Thus even for a moderate magnetic field of 100 Gauss the spacing d must be 10 cm. In general there must be at least three such sections in cascade and hence the tube is rather inconveniently long.

According to the present invention there is provided an image intensifier tube having at least one stage comprising a phosphor screen spaced from a parallel photocathode and between which is provided a means transparent to electrons for producing a substantially equipotential surface in a plane substantially parallel the phosphor screen, the plane being relatively nearer the phosphor screen than the photocathode.

The invention will now be described in more detail, by way of example only, with reference to the accompanying diagrammatic drawing in which the single FIGURE shows an image intensifier tube.

A phosphor screen 1 is mounted at one end of a cylindrical glass tube 2 which is surrounded by a coil 3 for producing an axial magnetic field B . A photocathode 4 is provided at the other end of the tube parallel to the phosphor screen 1. A very fine metal mesh 5, having for example 1000 meshes/in with a shadow rating of 20%, is placed at a relatively small distance from the phosphor screen 1. Typically the distance from the phosphor screen 1 to the mesh 5 may be 5 m.m. and the distance from the mesh 5 to the photocathode 4 may be 2 cms.

In operation a relatively low voltage of 100 V is applied between the mesh 5 and the photocathode 4 to cause photoelectrons to travel relatively slowly to the mesh 5.

The coil 3 produces a field B in the order of 50 Gauss which causes the electrons to execute 97% of their focusing cycloid before arriving at the mesh 5. A large potential difference, in the order of 10 kV is applied between the mesh 5 which provides an equipotential surface and the phosphor screen 1. The electrons are thus accelerated to the full 10 kV energy required before striking the screen 1 and they also complete the remaining 3% of their focusing cycloid during this time.

It can be seen that the formula $Bd = 11.2 n \sqrt{V}$ can be satisfied with the described apparatus by carrying out the main part of the focusing of the electrons before accelerating them to the required energy. This enables the tube to be kept short while still only requiring a moderate magnetic field.

The technique described may be applied to several such intensifying stages in cascade.

I claim:

1. Image intensifier tube apparatus comprising a phosphor screen, a photocathode spaced from and parallel to said phosphor screen, a fine wire electrode for producing a substantially equipotential surface in a plane substantially parallel to said phosphor screen, said plane being disposed intermediate said phosphor screen and said photocathode at a distance from said phosphor screen which is equal to or less than one-fourth of the distance between said photocathode and said phosphor screen, means for applying a first potential between said photocathode and said electrode and a second potential between said electrode and said phosphor screen, said first potential being relatively small with respect to said second potential and means for establishing a magnetic field transverse to said plane to focus photoelectrons emitted from said photocathode onto said phosphor screen, said disposition of said plane and said relation between said first and second potentials causing a major portion of magnetic focusing to occur in a region of relatively low electric field strength.

2. The image intensifier tube apparatus of claim 1 in which the electrode comprises a fine wire mesh.

3. The image intensifier apparatus of claim 1 in which said plane is established at a distance from said phosphor screen which is equal to or less than one fifth of the distance between said photocathode and said phosphor screen.

4. The image intensifier tube apparatus of claim 1 in which the electric field strength established by said first potential between said photocathode and said electrode is in the order of 100 volts/cm and the electric field strength established by said second potential between said electrode and said phosphor screen is in the order of 10,000 volts/cm.

5. Image intensifier tube apparatus comprising a plurality of phosphor screens, a plurality of photocathodes spaced from and parallel to said plurality of phosphor screens, and a plurality of fine wire electrodes for producing substantially equipotential surfaces in planes substantially parallel to said phosphor screens, each of said plurality of photocathodes, electrodes and phosphor screens forming an element of a stage of image intensifier tube apparatus employing a plurality of stages in cascade formation, each of said planes being disposed intermediate related ones of said plurality of phosphor screens and photocathodes at a distance from said phosphor screen which is equal to or less than one-fourth of the distance between said photocathode and said phosphor screen, means for applying a first potential between said related photocathodes and an associated electrode and a second potential between said associated electrode and said related phosphor screen, said first potential being relatively small with respect to said second potential and means for establishing a magnetic field transverse to said planes to focus photoelectrons emitted from each photocathode onto said related phosphor screen, said disposition of said planes and said relation between said first and second potentials causing a major portion of magnetic focusing to occur in regions of relatively low electric field strength.

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