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References Cited

UNITED STATES PATENTS

2,839,699	6/1958	Szegho et al.	250/213 VT X
2,989,643	6/1961	Scanlon	250/213 VT X
3,370,172	2/1968	Hora	250/213 VT X

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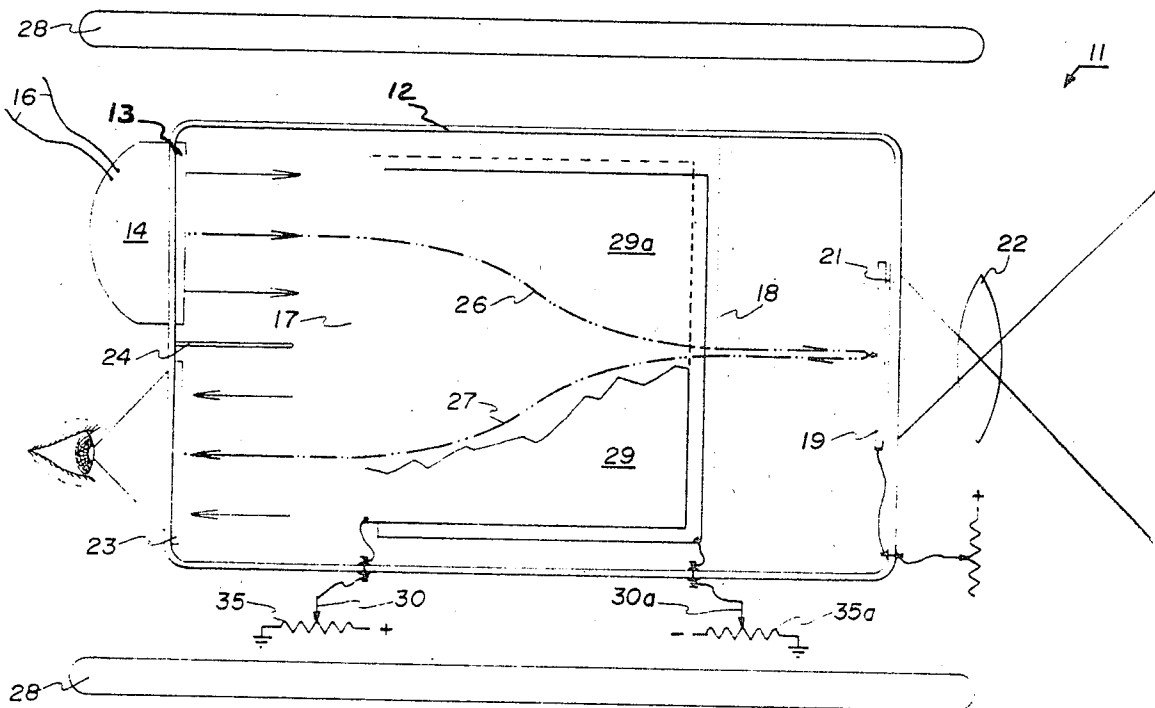
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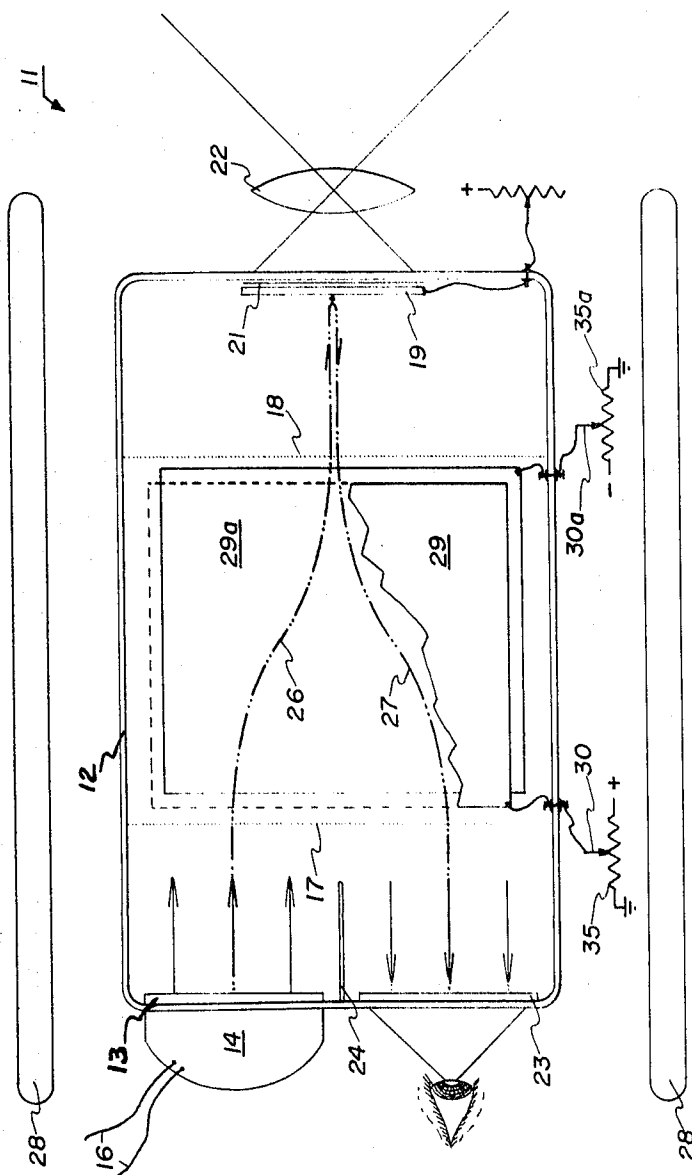
[54] INFRARED IMAGE CONVERTER

4 Claims, 1 Drawing Fig.

[52] U.S. Cl. 250/213,
 250/83.3
 [51] Int. Cl. H01j 31/50
 [50] Field of Search. 250/83.3,
 77, 213 VT

ABSTRACT: An infrared image converter utilizing a flood beam from a cold photocathode source and a solenoidal focus field from a solenoid completely surrounding the entire flood beam; the flood beam being directed by a static deflection system toward a thermally sensitive target placed at the end of a decelerating zone which forms an electron mirror repelling a portion of the electrons toward a phosphor screen for displaying the image of the infrared pattern on the thermally sensitive target.





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INFRARED IMAGE CONVERTER

BRIEF DESCRIPTION OF THE INVENTION

The present invention relates to an infrared image converter and more particularly to an infrared image converter utilizing a thermally sensitive target.

According to the invention, an infrared image converter is provided having a photocathode which is excited by a light source for emitting a flood beam of photoelectrons. The electrons are accelerated toward a thermally sensitive target by any conventional means such as an elevated accelerating mesh and focused and deflected toward the target. The target is exposed on the other side to an infrared image by conventional infrared optical system and is elevated by a small potential. The flood beam then passes through a decelerating zone which can be a mesh at the same elevation as the first one allowing the electrons to decelerate in the direction of a thermally sensitive target. As the electrons approach the target, the portions of the target being sensitized by the infrared image will have a lower resistance and, hence, a lower potential which will modulate electrons in these zones back through the accelerating and decelerating meshes and the deflection system which, in this case, will deflect the beam in an opposite direction. At the other end of the tube, a phosphor screen is located for receiving the modulated flood beam which will reproduce the infrared image optically.

An object of the present invention is the provision of an improved infrared image converter.

Another object of the invention is the provision of an infrared image converter utilizing a thermally sensitive target.

A further object of the invention is the provision of an infrared image converter utilizing a cold photoelectron flood beam.

A still further object of the invention is the provision of an infrared image converter utilizing an axial magnetic focus field.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which the sole Figure is a schematic representation of the preferred embodiment.

DETAILED DESCRIPTION OF THE DRAWING

Referring to the drawing, an infrared image converter tube is shown generally at 11 having an evacuated envelope 12 with a photocathode 13 mounted on one end thereof with blue light source 14 having excitation leads 16 mounted in proximity thereto. An accelerating mesh 17 and a decelerating mesh 18 are placed in the central portions of the tube. A thermally sensitive target 19 is mounted centrally opposite the photocathode having a conductive backing 21 between it and the end of the envelope. A conventional infrared optical system is indicated schematically and generally at 22. A phosphor screen is shown mounted at the same end of the envelope as photocathode 13, but displaced therefrom and separated via shield 24.

A typical electron trajectory from the photocathode to the thermally sensitive target is indicated by an arrowed line 26 and a typical reflected electron trajectory is illustrated by an arrowed line 27 between thermally sensitive target 19 and the phosphor screen 23. A solenoid focusing coil 28 completely surrounds the glass envelope 12. Deflecting plates 29 and 29a are mounted inside envelope 12 to give a static deflection field to the electron beam. Deflecting plate 29 is coupled to wiper 30 on resistor 35, resistor 35 being grounded on one end and coupled to a positive voltage on the other end. Plate 29a is coupled to wiper 30a on resistor 35a, resistor 35a being grounded on one end and coupled to a negative voltage on the other end.

OPERATION

Referring back to the drawing, blue light source 14, energized through energization leads 16, emits a blue light which impinges upon photocathode 13. This will cause a flood beam of photoelectrons to be emitted from photocathode 13 which will be attracted by mesh 17 which is elevated to approximately 1,000 volts. The flood beam will then be deflected by deflection plates 29 and 29a and focused by a solenoidal focus field from solenoid 28 and drift between meshes 17 and 18, assuming that they are the same potential; i.e., mesh 18 would be operated at 1,000 volts also.

After the flood beam passes through mesh 18, it will decelerate toward a thermally sensitive target 19 which is held at a slight positive potential with respect to the photocathode via conductive layer 21. Typically, this would be at +1 volt. The thermally sensitive target at this time has an infrared pattern impinging upon it from infrared optics 22 and will set up a resistive pattern which is dependent upon the infrared pattern; i.e., where the infrared beam pattern is at a high intensity, the resistance of the thermally sensitive target 19 will be low. This will create a voltage gradient across that cross-sectional area from the flood beam 26, resulting in a negative potential which will tend to reflect electrons back toward mesh 18. At other areas of less resistance, the electrons from flood beam 26 will pass through thermally sensitive target 19 to layer 21 and to the source. Hence, the electrons from the high resistance areas of thermally sensitive target 19 will be reflected back toward and accelerated by the deceleration mesh 18, pass through the deflection field from deflection plates 19 and 19a and since it is going in the opposite direction, will be deflected as shown by trajectory path 27 toward the accelerating mesh 17. Hence, the static deflection plates form an electron prism serving to separate incident and reflected electrons.

After the beam has passed the accelerating mesh 18 it will be accelerated further by a high voltage acceleration potential on phosphor screen 23 which would typically be in the neighborhood of 15,000 volts. This will cause the phosphor screen 23 to glow in those areas of the flood beam where the electrons are concentrated, which will correspond to those areas being impinged with infrared radiation on thermally sensitive target 19 and present a visual indication of the infrared image.

The purpose of using a thermally sensitive target is for the detection of long wave length infrared energy images at room temperature without scanning techniques.

The advantage of utilizing a cold source such as a photocathode excited by a blue light is in reducing ambient noise as seen by the thermally sensitive target 19 and obviating any isolation requirement.

The invention we claim is:

1. An infrared image converter comprising:

an evacuated envelope having first and second ends;
a photocathode mounted in proximity with said first end;
a light source mounted in proximity thereto for causing a flood beam to be emitted from said photocathode;
accelerating means between said first and second ends for accelerating electrons emitted from said cathode toward said second end;

a thermally sensitive target mounted in proximity with said second end;

static deflecting means for directing said emitted electrons as a flood beam toward said thermally sensitive target;

decelerating means disposed between said accelerating means and said thermally sensitive target for decelerating said emitted electrons; and

readout means mounted in proximity to said first end of said evacuated envelope for receiving and reading out any electrons reflected by said thermally sensitive target because of an infrared pattern impinging thereon.

2. The infrared image converter of claim 1 wherein:

said static deflecting means comprises an electron prism.

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3. The infrared image converter of claim 1 wherein:
said readout means comprises a phosphor screen having an
acceleration potential thereon.
4. The infrared image converter claim 1 and further includ-

ing:
a shield mounted between said photocathode and said
readout means.

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