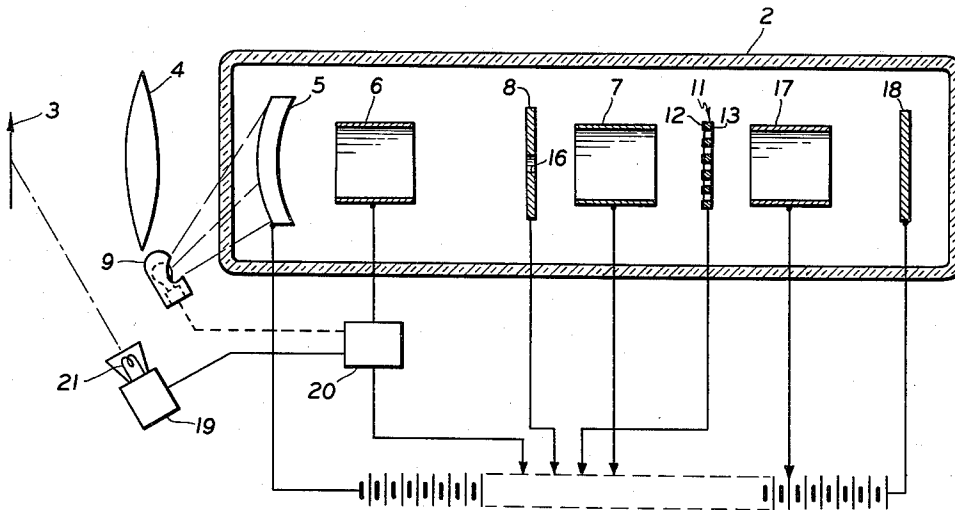


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RADIATION TRANSLATING DEVICE

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1

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RADIATION TRANSLATING DEVICE

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1 Claim. (Cl. 315-11)

This is a continuation-in-part application for co-pending Farnsworth application Serial No. 286,583, filed May 7, 1952, and now abandoned.

This invention relates generally to electronic light translating devices and more particularly to such devices for translating a radiation image (infra-red or visible) of a given intensity into a light image of greater intensity, or for producing from a light image of a given duration a light image of another duration.

Devices are known which convert an infra-red light image into a corresponding visible light image. In many instances the intensity of the resultant visible light image is less than desired. Likewise when the infra-red light image is of short duration, as when stroboscopic flashing is employed, the resultant visible light image is often too brief for adequate viewing.

An object of the present invention is the provision of an improved electronic device for translating a light image of a given intensity into a light image of greater intensity.

Another object of the present invention is the provision of an electronic device adapted to translate a light image of brief duration into a light image of greater duration.

A further object of the present invention is the provision of an electronic device for translating an infra-red light image into a corresponding visible light image which produces an intensified visible light image and is adapted to store and produce from brief infra-red light images visible light images of greater duration.

In carrying out my invention, a photocathode is arranged to receive the impinging light image and to release a corresponding electron image. This electron image is focused on a separate storage electrode for producing a corresponding electrostatic charge pattern or image. The storage electrode comprises a multiplicity of small openings and may be in the form of a fine mesh screen. A flood or spray of photoelectrons (from the photocathode) is directed through the screen openings, and the number of electrons passing through the respective openings is controlled by the electrostatic charge on the portion of the screen surrounding the opening. Thus there is produced an extended electron image of an intensity which varies in its elemental areas in accordance with the corresponding charges on the screen. Under proper operating conditions, the extended electron image is of greater intensity than the original electron image emitted by the photocathode. This intensified electron image is then directed onto a fluorescent screen to produce a correspondingly intensified light image. It will be noted that even if the duration of the incoming light image is short, the intensified light image may be of greater duration due to the storage of the electron image or the storage electrode.

A still further object is to provide a unique but simple method and device for producing flood electrons without necessitating the use of an auxiliary flood electrode in addition to the photocathode.

The foregoing and other features and objects of this invention and the manner of attaining them will become apparent and the invention itself will be better understood by reference to the following description of an embodiment in which the drawing is a schematic representation of an electron discharge light image translating device together with associated apparatus.

Referring now to the drawing, the electron discharge

2

device 1 is provided with an evacuated envelope 2 which contains various electrodes to be described hereinafter. As represented in the drawing, a light image from an object 3 is focused by means of a suitable lens 4 (indicated schematically) onto a photocathode 5, which, in response to said light image, emits a corresponding electron image. This electron image is directed by suitable means, such as accelerating electrodes 6 and 7 and focusing electrode 8, onto a storage electrode 11. This electrode 11 consists essentially of a thin plate 12 of insulating material having fine mesh openings, as in a screen. Preferably, this insulating material consists of a coating of dielectric material on the side of a fine wire mesh screen 13, the dielectric material facing the photocathode 5. The dielectric coating has openings in registry with the wire mesh screen openings. The fine wire mesh screen 13 may be used for purposes of mechanical support, for erasure of the electrostatic charge on the insulation, or for controlling the degree of electron penetration. The storage electrode 11 may be of the type shown and described in my corresponding U.S. application for "Cathode Ray Tube and System," Serial No. 197,612, filed November 25, 1950, and now Patent Number 2,754,449, issued July 10, 1956 and assigned to the assignee of the present application. The electrons from photocathode 5 are preferably given a sufficient velocity by the voltage on the accelerating electrodes so as to produce secondary emission from the insulation 12 which is greater than unity, thus producing a positive electrostatic charge image on the insulation 12 corresponding to the electron image emitted by photocathode 5. Electrode 8 has an opening 16 in the center which is at the cross-over point of the electron image emitted by the photocathode 5.

The photocathode 5, in addition to its function as an electron image-producing electrode, provides flood electrons which are focused through the aperture 16 of the electrode 8 to cover the storage screen 11, and thence to flow onto the image screen 18. In achieving this additional function of the cathode 5, an illuminating lamp 9 is so positioned as to flood the entire cathode with substantially uniform light intensity whereupon a flood of photoelectrons are emitted which are acted upon by the various electrodes 6, 8, 7 and 11 in the same manner as the electron image which issues from the cathode 5. Stating the operation briefly, the illuminating lamp 9 is, of course, off while the object 3 is being projected onto the cathode 5 for forming the electrostatic image on the storage screen 11. After formation of this storage image, the lamp 9 is turned "on" to produce the flood of electrons from the cathode 5. The electrostatic charge on the insulation 12 controls the flow of flood electrons through the screen openings to produce an amplified extended electron image which may be projected onto the fluorescent screen 18. Stated in other words, electrode 11 resembles the grid of an amplifying tube (as more fully described in said U.S. application Serial No. 197,612), so that the electrons from electrode 8 that pass through the electrode 11 produce an amplified electron image on the right side of the electrode 11. This amplified image is accelerated by electrode 17 and directed onto the screen 18 coated with suitable phosphor material. The amplified electron image is thereby translated into an amplified light image.

If the object 3 moves, the electrostatic charge image produced on electrode 11 will vary correspondingly such that a confused or obliterated charge pattern will result. Erasure of this charge pattern may be accomplished by leakage from the insulating material 12 onto screen 13, by varying the potential of the electrons issuing from electrode 8 to produce such erasure, or by other means well known in the art.

An advantage of the invention just described is that

3

even though the input light image of object 3 is so brief that it cannot be discerned by the human eye, because of the development of the corresponding charge image on storage electrode 11, the amplified light image produced on screen 18 will be of longer duration so that in effect the brief input light image is extended in duration as viewed on screen 18. The persistence of the electrostatic charge image on storage electrode 11 is controllable by the particular material used for the dielectric coating 12, the coating thickness, and the coating shape, as well as the potential on screen 13 as will be recognized by one versed in the art.

In accordance with another feature of the present invention, use is made of the above phenomena by providing a stroboscopic light source 19 which flashes light, visible or infra-red, onto the object 3, under the control of the usual stroboscope control means 20. In order that the device 1 will respond only to the reflected stroboscopic light from object 3, a control device 20 momentarily renders device 1 inoperative, for example, by removing the accelerating voltage from accelerating electrode 6. Other means for preventing operation of device 1 will readily occur to those versed in the art. It will thus be seen that very short flashes of stroboscopic light will suffice to produce a light image of object 3, which though extremely short in duration will, by means of the device 1, produce a light image (on screen 18) of sufficient duration to be clearly seen and studied.

The flood of photoelectrons issuing from the cathode 5 upon illumination by the lamp 9 is accelerated by electrode 6 and converged through the focusing aperture 16 to thereafter be further accelerated by electrode 7 to cover the entire storage screen 11. The charge image on the storage screen modulates the flood, as explained previously, to reproduce a visible image on the screen 18. A complete cycle of operation is to produce the charge image of the object 3 on the storage screen 11 and then produce the necessary flood electrons by pulsing or illuminating the cathode 5 with light from the lamp 9.

In order to use this photoelectric flooding with the stroboscopic lamp 21 it is only necessary to alternate the "on-off" periods of both lamps 9 and 21, respectively, such that during the illumination 3 by the lamp 21 the flood lamp 9 will be "off," and when the lamp 21 is "off" the lamp 9 will be "on." While electrostatic focusing of the electron beams has been particularly illustrated and described, it will be readily apparent that magnetic focusing may be used instead. In the case of magnetic focusing, the electrode 8 is eliminated and conventional magnetic focusing coils are telescoped over the envelope 2. These coils are designed to extend the photoelectric image through the tube in parallel, pencil-like electron streams. This principle of magnetic focusing is well-known to the artisan and needs no further elaboration here as to its accomplishment. The use of the flood lamp 9 is the same as explained hereinbefore.

By following the teachings of this invention, it is possible to accomplish the production of an electron image and a flood of image-reproducing electrons by means of a single electrode, thereby considerably simplifying the structure and operation of the tube itself.

While the foregoing description has given specific details of an embodiment of my invention, it will be ap-

4

parent that numerous changes may be made in these details without departing from the spirit thereof. The specific structure of storage electrode 11 can be changed in various ways within the scope of the present invention and still produce the charge image and the amplifying action herein described. Changes in the focusing system are obvious. Furthermore, while I have described a storage screen that is charged positively by the primary electrons of the electron image, the screen may be charged to produce a resulting negative electrostatic image and the device may thus operate in this manner as an amplifier, the theory of operation being similar to that described in my U.S. Patent No. 2,257,942, issued October 7, 1941 for "Image Amplifier."

Accordingly, while I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention.

What I claim is:

A system for viewing objects comprising a stroboscopic light which may be trained on a viewed object for reflected radiation images of said object of short duration, an image-to-image tube comprising a photo-electric cathode responsive to said reflected images for producing corresponding electron images, a storage electrode spaced from said photo-electric cathode for storing said electron images for a predetermined period of time, an accelerating electrode positioned between said photo-electric cathode and said storage electrode in the path of said electron images and coupled to a source of accelerating potential, a lamp positioned instantaneously and uniformly to illuminate all of said photo-electric cathode for flooding said storage electrode with low velocity photoelectrons which are modulated in accordance with the stored images thereon to produce secondary electron images, a phosphor screen responsive to said secondary electron images for reproducing instantaneously all elements of said electron images into corresponding light images, and a signal generator operatively coupled to said accelerating electrode and to both said light and said lamp, said signal generator being arranged alternately to operate said light and said lamp for producing correspondingly said electron images and flooding photoelectrons so that said photo-cathode produces electron images only during reception of a reflected image, said signal generator being arranged to remove said accelerating voltage from said accelerating electrode during illumination of said photo-cathode by said lamp.

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