Simple device for scanning image

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The simple device for scanning image is described. It has much in common with usual TV camera, with an electron beam replaced by an optical one. After the general description of the device, we present a simple experimental illustration.

I. GENERAL DESCRIPTION

In this letter we suggest a simple device for scanning image, which has much in common with usual TV camera with an electron beam replaced by an optical one. The scheme of the device is presented in Fig. 1, where (1) is the transparent electrode; (2) is the semiconductor layer with the gap, wide enough to be transparent for the light from the image; (3) is the semiconductor layer with the gap, narrow enough to be not transparent for the light from the image, and (4) is the electrode, or the substrate with high conductivity. Suppose, that some image is formed in the plane of the layer (3) by means of some optical system. Though the image produces the profile of photoconductivity in the layer (3), there is no current in the circuit, because the layer (2) is still an isolator — note, that the layer (2) is transparent for the image light, which causes no photoconductivity in this layer. Now, let us switch on the narrow reading beam of a short enough wavelength, to produce the photoconductivity in the layer (2). This beam produces the narrow path (5) with high conductivity in the layer (2), which gives rise to the current in the circuit. The value of this current is proportional to the local illumination intensity of the image. For the sake of simplicity we suppose, that the reading beam has absorbing length much shorter, than the thickness of the layer (3), so it does not produce any noticeable photoconductivity in the layer (3). Now, if we move the reading beam along the image, the current in the circuit will drop down, when the reading beam is passing through the dark areas of the image, and will increase, when the beam is passing through the bright areas. This process is similar to that in conventional TV camera, with the optical beam instead of the electron one.
II. EXPERIMENTAL ILLUSTRATION

To test the applicability of the above scheme, we construct the simple installation shown in Fig. 2. The exact scheme of the above device is presented in the inset. Transparent electrode (1) and electrode (4) (notations of Fig. 1) are the water layers. The 3 mkm AlGaAs layer is playing the role of the layer (2) (see Fig. 1) with the relatively wide gap (~1.9 eV). And finally, the 300 mkm of semiconducting GaAs substrate is playing the role of the layer (3) with the narrow gap (~1.5 eV). The beam of the HeNe laser (0.63 mkm, or 1.97 eV), which plays the role of a reading beam, passes through a simple deflecting system (consisting of the loudspeaker, the mirror (1) and the lens (see Fig. 2)), and gives a small spot moving along the linear segment in the plane of the device.

The Nd laser beam (1.06 mkm, or 1.17 eV) forms a small spot in the same plane, which plays the role of the image. Manipulating with the mirror (2) one can force the reading beam to pass through this spot. When this takes place, the short pulses of current occur in the circuit. It should be pointed out that despite GaAs is transparent for the 1.06 mkm radiation, the photoconductivity still occur, due to the presence of the impurities and intrinsic defects in the semiconducting GaAs substrate.

The main property of the described device is its simplicity. This device may be preferable in all cases, when high energy electron beam can damage the light-sensitive surface. Also, the device of this kind can perform some integral transformations, similar to the Fourier transformation. For this purpose one should substitute the narrow running reading beam with the sinusoidal profile, which gives the sinusoidal distribution of the conductivity in the layer (2).

The author is not sure, that such a simple device was not described, or used before, and will be grateful for any references and comments.
Fig. 1

1 - transparent electrode, 2 - a layer transparent for image light and absorbing for reading beam, 3 - semiconductor layer with narrow enough gap for image light to produce photoconductivity, 4 - electrode, 5 - the conducting path produced by the reading beam.
The simple installation for optical scanning of image