

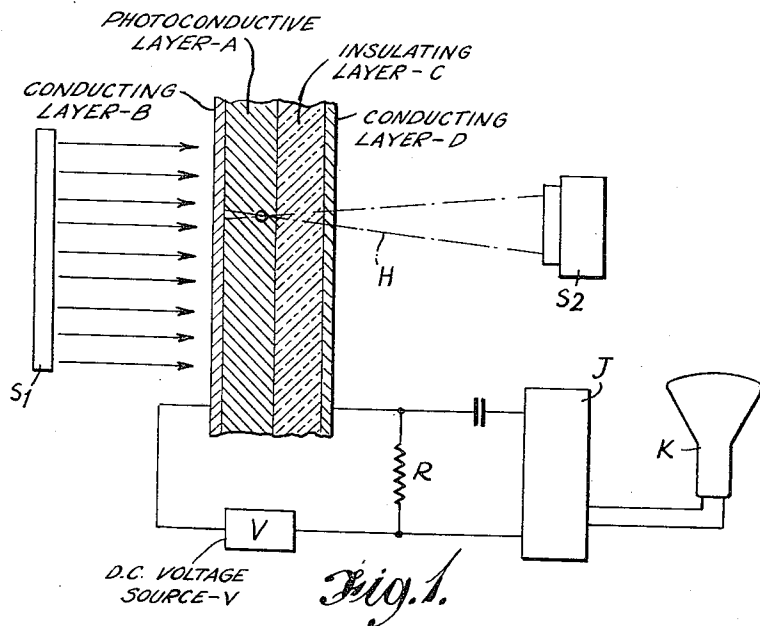
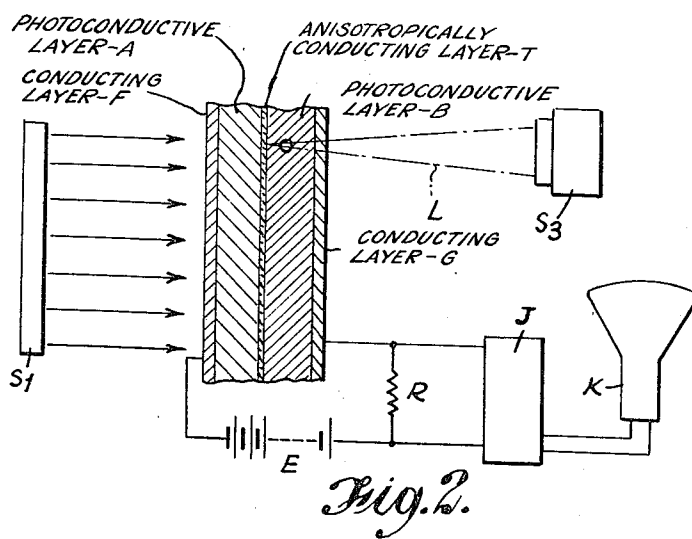
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ELECTRICAL APPARATUS FOR INTENSIFYING IMAGES

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ELECTRICAL APPARATUS FOR INTENSIFYING IMAGES

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1 Claim. (Cl. 250-213)

The present invention relates to electrical apparatus for intensifying an image formed by visible or invisible radiation.

Various forms of image intensifying devices are known both for intensifying light images and also images formed with radiation other than light such as X-rays, ultra-violet or infra-red light. Broadly, these devices may be divided into two classes—static and scanned. In the static system, the original image or a light image derived from it by allowing the radiation (e.g. X-rays) to fall on a fluorescent screen, is allowed to fall on a photo-emission surface in vacuo. Emitted electrons are accelerated in an electric field and focused to form an electron image of high energy which is converted to light again by impingement on a fluorescent screen.

In the scanned system, the original image or a light image derived from it is allowed to fall on a photo-sensitive surface in a scanned image tube such as is used in television cameras. The scanning is performed with an electron beam, and the information concerning the contrast variation across the image is taken out as an electrical signal current varying with time. This signal is amplified and applied to modulate the brightness of a cathode-ray tube scanned synchronously with the image tube scan in a raster such as is used in television.

A third type of image intensifier falling into the first class comprises a sandwich of a photo-conductive layer and an electroluminescent layer between transparent electrically conducting layers. The layers are all thin. An A.C. potential is applied across the conducting layers. The photo-conducting layer is insulating in the dark, but, when irradiated with light (or U-V, or X-rays), becomes conducting by an amount depending on the intensity of the irradiation. The A.C. potential is then applied to the electroluminescent layer in the conducting regions, and so produces light which may be more intense than the original irradiation.

The object of the present invention is to provide improved electrical apparatus for producing an intensified visible image of an image formed by a source of radiation.

According to the present invention electrical apparatus for intensifying a radiation image comprises a composite intensifying plate formed from a first layer of photo-conducting material, a second layer of material having a charge storing surface in contact with said photo-conducting layer, and two layers of electrically conducting material lying one on each side of said photo-conducting layer and said second layer and adapted to be respectively connected to suitable sources of electric potential so as to produce an electric field between the outer surfaces of said intensifying plate, the arrangement being such that if the surface of said photo-conducting layer which is remote from said charge storing surface is irradiated with a beam of radiation of non-uniform intensity so as to form an image on said surface and to cause said photo-conducting layer to conduct to a degree dependent upon the intensity of radiation on each elemental area of said surface thereof each elemental area of said charge storing surface is charged to a potential which is dependent upon the intensity of the radiation on each of said elemental areas, and means for progressively discharging

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said elemental areas in accordance with a raster, amplifying the signals so obtained and applying the amplified signals to a cathode ray tube which is scanned in a synchronised raster and thereby obtaining an intensified visible image of the image formed on the surface of the photo-conducting layer.

The material of the layer which has the charge storing surface has a very high resistance in said surface so that the layer has the property of retaining charges of different potentials at different points on said charge storing surface. Thus it may be an electrically insulating layer or in some cases a thin anisotropically insulating layer which is insulating over its surface but conductive normal to its surface so that the charge extends through the layer.

The invention will now be described with reference to the accompanying drawing in which:

FIG. 1 is a diagram of one embodiment of the invention, and

FIG. 2 is a diagram of an alternative embodiment of the invention.

In FIG. 1 a photo-conductive layer A is coated on one side with a transparent electrically-conducting layer B, and on the other with a transparent insulating layer C. The remote side of the insulating layer is coated with a further transparent conducting layer D. V is a reversible potential source.

In operation, the image to be intensified from the source S_1 is allowed to fall on the photoconductor A for a limited time interval, for example $\frac{1}{100}$ second, with a D.C. voltage of one or other polarity connected across the conducting layers B and D. During this time, charge will flow across the conducting layer to the insulator surface where it will be stopped and will build up at any point to an amount depending on the time interval and the conductivity induced in the photo-conductive layer by the irradiation at that point.

At the end of the time interval, the irradiating beam is switched off and the photoconductor becomes insulating, thus "freezing" the charge into the interface between the solid layers. The applied potential is now reversed or interrupted and the photoconductive layer is swept or scanned by a high intensity narrow beam H of exciting radiation from a source S_2 in a "raster." As each point on the layer surface is scanned, the photoconductive layer becomes conducting and the frozen charge escapes and flows through the load resistor R to produce a voltage pulse proportional to the stored charge. The train of voltage signals produced is amplified in an amplifier J and applied to a cathode-ray tube K scanned in a raster synchronous with the narrow exciting beam raster, thus producing a light image with contrast variations corresponding to the variations in intensity from point to point in the main irradiating beam.

It will be understood that in continuous operation the above process would be repeated in continuous cycles, and, as a result, at the beginning of the irradiation half cycle the charge or reversed sign put on during the scanning half cycle will already exist at the interface, a situation not existing in the first half cycle described. This in no way affects the operation of the apparatus.

It will also be understood that the positive and negative voltages need not necessarily be of equal amplitudes. Advantage may result from increasing one voltage with respect to the other. In particular, the voltage on the scanning half cycle may be increased to give a greater rate of discharge.

It will be appreciated that the successful performance of the device depends upon the use of a photo-conductive layer of adequate sensitivity to the main beam of radiation and the scanning beam of radiation. In addition, the conductivity of the material in the absence of irradiation

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tion must be sufficiently low to prevent the charge leaking away to any appreciable extent during a time equal to the total time for the scanning to take place. Materials which might be suitable include amorphous selenium, antimony, trisulphide, lead oxide, etc. All these materials and others must be deposited by special techniques, known in the art, and may be doped with small quantities of impurity to improve their properties.

A further embodiment of the invention is shown in FIGURE 2. Here, two photoconductive layers A and B of different materials are separated by a thin mosaic T electrically conducting in the direction normal to its surface but insulating in the transverse direction. This anisotropic conductivity can be obtained by using a closely packed mosaic of evaporated metal such as is known in the art. The outer sides of the photoconducting layers carry transparent conducting layers F and G across which a D.C. voltage is applied from a source of potential E.

In operation, one side of A is irradiated continuously with the image radiation from a source S_1 which might be light or X-rays and which does not excite B. Charge is thus allowed to conduct across the layer A and mosaic T and build up at the interface between T and B. The second photoconductive layer is scanned with a spot of exciting radiation L from a source S_2 which discharges the build-up charge point by point as it moves across the layer and gives signals to an appropriate amplifier as before. The advantage of this embodiment lies in the elimination of the necessity for reversing the voltage in cyclic manner as required in the first method.

If the radiation which renders layer A conductive would also render layer B conductive the mosaic T must be opaque to this radiation.

What I claim is:

Electrical apparatus for intensifying a radiation image

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comprising an intensifying plate which includes a first photo-conducting layer, a second insulating layer in contact with one surface of said first layer, two continuous transparent electrodes in which one is located respectively on the free surface of said first layer and the other is located on the free surface of said second layer, means for connecting said two electrodes to sources of potential for producing an electric field between said two transparent electrodes across said intensifying plate, means for irradiating said first photo-conducting layer through the adjacent electrode with a first beam of image carrying radiation forming a charge image on the interface between said two layers, means for reversing the polarity of said electric field, means for scanning said first photo-conducting layer through said second insulating layer with a second beam of exciting radiation when the polarity of said electric field has been reversed to discharge successively each elemental area of said interface, means for amplifying the resultant discharge current, and means for applying the amplified discharge current to display apparatus.

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