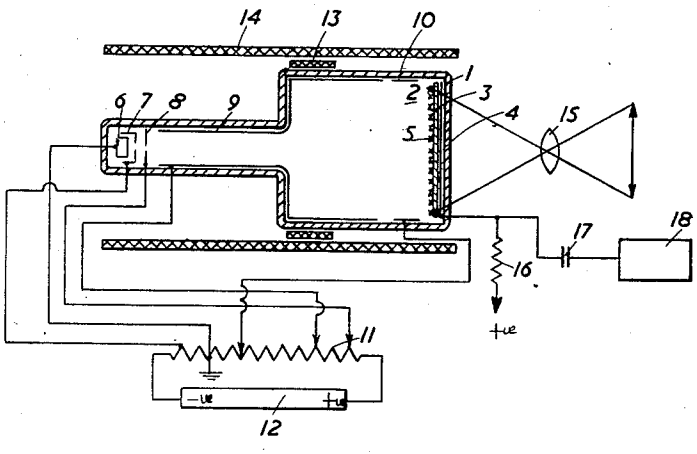
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ELECTRON DISCHARGE DEVICE SUITABLE FOR USE AS TELEVISION TRANSMITTING TUBES

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ELECTRON DISCHARGE DEVICE SUITABLE FOR USE AS TELEVISION TRANSMITTING TUBES

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This invention relates to electron discharge pick-up tubes suitable for use in television.

A known form of pick-up tube includes a target electrode comprising a photo-electric mosaic formed on one side of an insulating surface the opposite side of which is in contact with a signal electrode from which picture signals can be obtained after projecting an optical image on to said photoelectric mosaic and after scanning said mosaic with an electron beam. Such a type of tube can be constructed so that the target electrode is scanned by a low-velocity scanning beam whereby the elements of the mosaic are stabilised at an equilibrium potential corresponding substantially to that of the cathode of the tube. In such a form of tube the beam is usually scanned in the presence of a longitudinal magnetic field so that the scanning beam impinges on the target electrode substantially normally throughout the scanning cycle.

In operating such a tube, if any element of the target is brightly illuminated it may increase in potential to such an extent during a frame scan period that the secondary electron emission ratio of the element when scanned is greater than unity and in such a case it is found that the tube becomes unstable and it is not possible to stabilise such a brightly illuminated element to cathode potential. Furthermore, if a mosaic element is weakly illuminated, such an element does not rise appreciably in potential between successive frame scans with the result that only a small proportion of the electrons from the scanning beam impinge on said element and it may require several successive scans to restore such an element to cathode potential. The result of this is that instead of a maximum signal being developed from such an element when scanned a smaller signal is developed and the element may require to be scanned several times before maximum signal is developed. If an image of a moving object is reconstituted from signals developed in this manner the moving object in the reconstituted image will then produce a low intensity smear as it is moving and the object will exhibit an increased illumination as soon as its motion ceases.

The object of the present invention is to provide an improved pick-up tube with a view to eliminating or reducing either or both of these disadvantages.

Normally the target electrode in the pick-up tubes referred to above comprises a sheet of insulating material, such as glass or mica, and when employing such an insulator there is practically no leakage of charge there-through. We have

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found that the above-mentioned disadvantages can be reduced if instead of using insulating material for the target electrode material is employed which is slightly conducting so as to enable leakage of charge to occur.

According therefore to the present invention a pick-up tube is provided comprising a target electrode in contact with a signal electrode, means for scanning said target electrode with a low-velocity electron beam in such a manner that the elements of the target electrode can be stabilised substantially to the potential of the cathode of said tube and wherein said target electrode has such a conductivity that leakage of charge from the elements of said target electrode can occur through said target electrode to said signal electrode during a frame scanning period. By employing a target electrode of this form it is possible to ensure that the elements of the target electrode are not permitted to increase in potential to an undesirably high extent and to ensure that any charge accumulated by an element of said target electrode which is not neutralised when scanned leaks away appreciably before being scanned again. The extent to which the leakage of charge is permitted to occur during one frame scan will naturally depend on the circumstances under which the tube is being employed, and whilst it is preferable to arrange for the target electrode to have such a conductivity that any charge accumulated on an element of the target electrode which is not neutralised when scanned completely leaks away before being scanned again, nevertheless, a substantial improvement over the known types of tubes which employ an insulating target electrode can be obtained if the conductivity of the target electrode is such that the charge leaks away in two or three frame scan periods. The conductivity of the target electrode will of course also be chosen having regard to the duration of a frame scan and when employing a tube in accordance with the invention in a television transmitting system in which one complete frame of a picture is scanned in 405 lines at 25 frames per second, the specific resistance of the target electrode may be of the order of 3.10^{10}—10^{11} ohm centimetre.

In order that the said invention may be clearly understood and readily carried into effect, it will now be more fully described with reference to the accompanying drawing which illustrates diagrammatically a pick-up tube in accordance with the invention and with circuit connections therefor.

As shown in the drawing, the pick-up tube 1

comprises a target electrode 2 composed of a sheet 3 of partially-conducting transparent material on one side of which is deposited a semi-transparent signal electrode 4 which is in contact with the sheet 3, whilst on the other side of said sheet 3 is a mosaic of photo-electric conducting elements 5. The side of the target electrode having the mosaic elements 5 is arranged to be scanned by a low-velocity scanning beam which is generated by a suitably disposed electron gun. The electron gun comprises a cathode 6, a cathode shield 7, an apertured anode 8 and a further electrode 9 consisting of a metallic wall coating. The cathode 6 may be maintained at earth potential, the shield 7 at a negative potential thereto, the anode 8 at a positive potential and the electrode 9 usually at a slightly lower positive potential than the anode 8. Near to the target electrode 2 is a decelerating electrode 10 which is maintained at a less positive potential than the electrode 9. The electrodes 6 to 10 are conventionally shown as deriving their potentials from a potentiometer 11 connected across a source of potential 12. The electron beam from the gun is accelerated by the anode 8 and decelerated by the electrodes 9 and 10 and is scanned over the surface of the target electrode 2 at line and frame frequencies by scanning coils indicated at 13. The electron beam is focussed by and is arranged to scan the surface of the target electrode in the presence of a longitudinal magnetic field set up by a solenoid 14 and the arrangement is such that the beam is caused to impinge on the target electrode substantially normally throughout the whole scanning cycle in known manner. An optical image for transmission is projected by an optical system 15 through the signal electrode 4 through the sheet 3 on to the photo-electric mosaic elements 5. Photo-electrons are thereby caused to be emitted from the elements 5 causing positive charges to be accumulated according to the intensity of elementary areas of the optical image. The target electrode is then scanned at line and frame frequencies with the low-velocity scanning beam emanating from the cathode 6, in known manner. Scanning of the target electrode with the scanning beam restores the elements of the target electrode to a potential corresponding substantially to that of the cathode 6, restoration of said charges serving to set up across a signal resistance 16 connected to the signal electrode 4 picture signals which are fed via condenser 17 to an amplifier 18. The signal resistance 16 is connected to earth or to a source of positive potential as hereinafter referred to.

The type of tube shown in Figure 1 is known and normally the sheet 3 is made of insulating material such as glass or mica having a specific resistance of the order of 10^{12}—10^{15} ohm centimetre. In accordance, however, with the present invention the sheet 3 is arranged to be slightly conducting and where the tube is employed in a television system in which one complete frame of a picture is scanned in 405 lines at 25 frames per second, the specific resistance of the sheet 3 may be of the order of 3.10^{10}—10^{11} ohm centimetre. Such a material may be a known form of so-called conducting glass. It will be appreciated that the elements of the target electrode form a multiplicity of minute condensers and due to the conductivity of the sheet 3 each of these condensers is effectively shunted by a resistance. By arranging the conductivity of the sheet 3 to be such that the time constants of the condensers and resistances are equal to or less than a frame

scan period, or a half or a third of a frame scan period, the disadvantages referred to above can be substantially reduced since leakage of charge can occur to the signal electrode.

The use of a slightly conducting material gives rise to loss in sensitivity of the tube since the charge accumulated on the mosaic elements is not so high as the charge which would be accumulated if a true insulator were employed. Some degree of sensitivity can, however, be regained as compared with the true insulator for the case of moving objects at low illuminations, where the true insulator produces weak, blurred signals due to insufficient restoring power of the scanning beam, by maintaining the signal electrode associated with the mosaic elements at a few volts positive with respect to the cathode of the tube by connecting the signal resistance 16 to a source of positive potential. Under those conditions, and assuming that the mosaic elements are not illuminated, they will increase in potential due to leakage from the signal electrode through the sheet 3 to the positive potential of the signal electrode during a frame scan period and will be restored to a potential substantially that of the cathode on being scanned. If, however, the mosaic elements are illuminated they will rise to a potential somewhat higher than that of the signal electrode and since all the elements of the mosaic, whether illuminated or not, will be at slightly positive potential when scanned, a large proportion of the electrons of the scanning beam will be able to impinge on the elements so that the signal output will be increased for any given increase of illumination.

In the types of tube shown in the drawing, it is known that electrons from the scanning beam which are not utilised for restoring the elements of the target electrode to an equilibrium potential are returned from the target electrode and can be employed to generate picture signals, said electrons, if desired, being multiplied in an electron multiplier. The present invention can be applied to tubes in which the returned electrons are employed to generate picture signals and in tubes employed in this manner it will still of course be necessary to employ the electrode 4 in contact with the layer 3 although this electrode will not then serve the function of a signal electrode. The signal electrode 4 in tubes employed in this manner may be connected directly to earth or to a source of positive potential. It will be understood therefore that in the following claims the term "signal electrode" is intended to include an electrode whether employed as a signal electrode or not.

What we claim is:

1. A pick-up tube having a cathode, a charge storage target electrode comprising a sheet of partially conducting material, a mosaic of photoelectric conducting elements on one side of said sheet and a signal electrode in contact with the opposite side of said sheet, and means for scanning said mosaic elements with a low velocity electron beam, said sheet having a specific resistance not greater than 10^{11} ohm centimeter to conduct charge from substantially all of said mosaic elements to said signal electrode.

2. A circuit arrangement including a pick-up tube having a cathode, a charge storage target electrode comprising a sheet of partially conducting material, a mosaic of photoelectric conducting elements on one side of said sheet and a signal electrode in contact with the opposite side of said sheet, means for maintaining said cathode

at a predetermined potential, and means for successively scanning each mosaic element with a low velocity electron beam to stabilize said elements substantially to said potential, the time constants of the condensers and resistances effectively provided by said partially conducting sheet having values equal to at least one-third of the interval between successive scannings of the same element.

3. A circuit arrangement including a pick-up tube having a cathode, a charge storage target electrode comprising a sheet of partially conducting material, a mosaic of photoelectric conducting elements on one side of said sheet and a signal electrode in contact with the opposite side of said sheet, means for maintaining said cathode at a predetermined potential, and means for successively scanning said mosaic elements with a low velocity electron beam to stabilize said elements substantially to said potential, said sheet having a specific resistance not greater than 10^{11} ohm centimeter to conduct charge from substantially all of said mosaic elements to said signal electrode.

4. A circuit arrangement according to claim 2 including means for maintaining said signal electrode at a positive potential with respect to said predetermined potential.

5. A circuit arrangement according to claim 3 including means for maintaining said signal electrode at a positive potential with respect to said predetermined potential.

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