

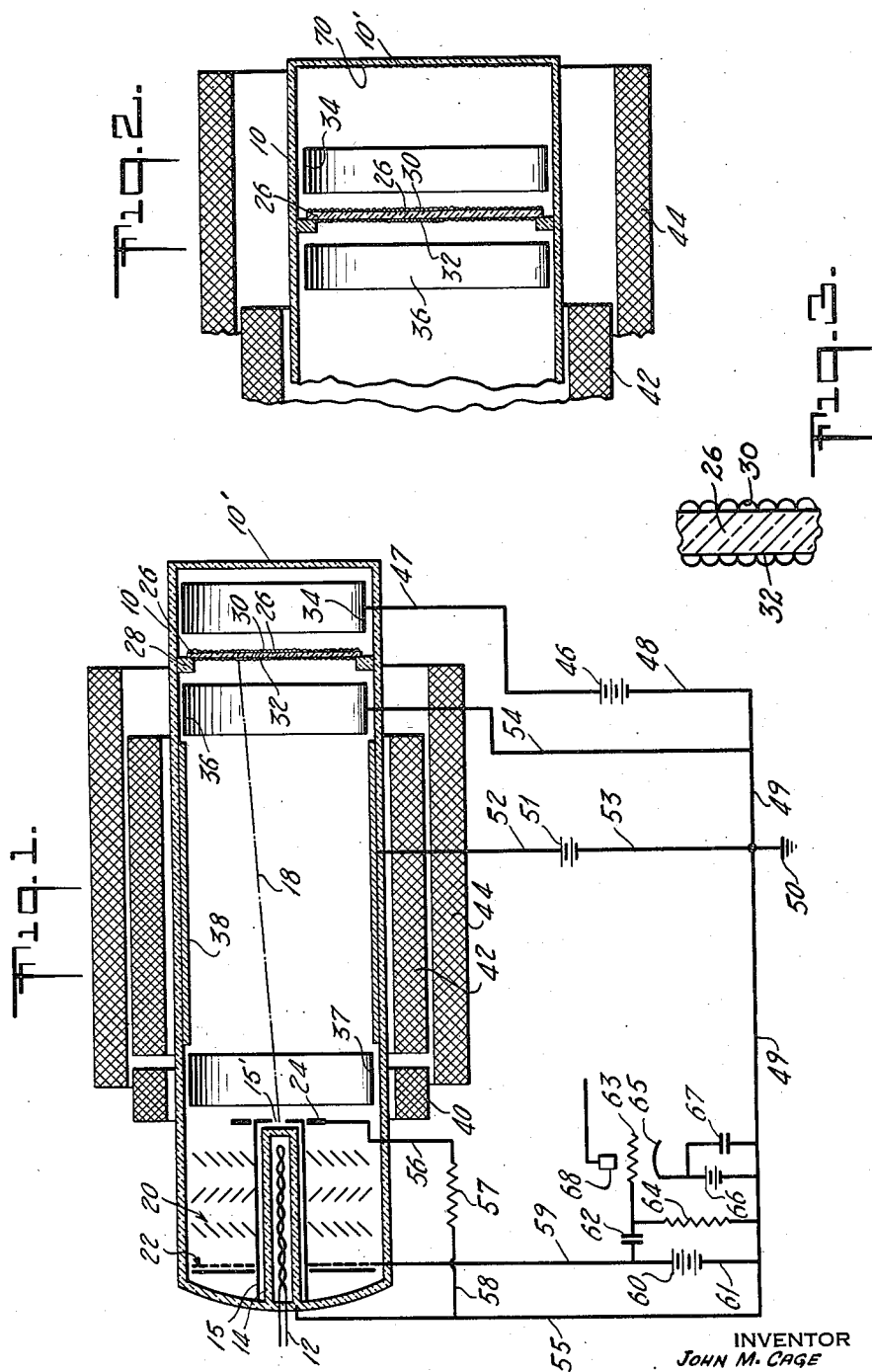
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TELEVISION CAMERA TUBE

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TELEVISION CAMERA TUBE

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This invention relates to television apparatus and more particularly concerns a new and improved electronic camera tube sensitive to light images and adapted to transform them into video signals for transmission to a suitable receiver and reproducer.

One object of this invention is a new and improved camera tube of the character set forth having improved sensitivity and stability over a wide range of light levels.

Another object of the invention is a camera tube of the character set forth having increased photoelectric efficiency and improved definition.

Still another object of the invention is a new and improved camera tube having improved definition and resolution at both low and high light levels wherein electronic blurring of the image during the scanning periods is virtually eliminated.

Still another object is a new and improved television pick-up tube.

These and other objects will become more apparent in the following description and accompanying drawings forming part of this application.

In the drawings—

Fig. 1 illustrates one embodiment of my invention together with a circuit diagram for the operation thereof;

Fig. 2 is an alternate embodiment of my invention; and

Fig. 3 is an enlarged portion of the target of Figs. 1 and 2.

In television, as in photography, it is highly desirable to have the objects adequately lighted so that all the details of the scene or object can be recorded and this can be generally attained in studios provided with controlled artificial light sources. In television, however, the televising of sporting events and the like presents a more serious problem because natural light must be depended upon and conventional television pickup tubes to my knowledge are not sufficiently versatile and do not perform uniformly over a wide range of conditions. For instance, one type of pickup tube is particularly adapted for use at high light levels but has limited sensitivity and is therefore unsatisfactory for the lower levels. On the other hand, another type of tube having a high degree of sensitivity and stability at low light levels is somewhat unstable at higher light levels.

My invention, therefore, contemplates a camera tube that will overcome these shortcomings of conventional devices and is characterized by a fairly high degree of stability over a wide range of light levels coupled with sensitivity to the low light levels.

For the purpose of illustrating the principle

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of my invention I have shown in Fig. 1 one embodiment thereof wherein the target member is provided with a light sensitive surface on one side and a suitable electron emissive surface on the other, with the light sensitive surface adapted to be exposed directly to the light emanating from the object to be televised.

In this embodiment, 10 represents a substantially cylindrical tube of glass or other suitable transparent material for housing the elements of the camera tube. For the purpose of simplifying this illustration this tube has been shown somewhat diagrammatically. At the left end of the tube as illustrated in Fig. 1 is a filament 12 surrounded by the conventional cathode 14 and a control element 15 having an orifice 15' therein through which the electron beam 18, produced by the filament, emerges. Surrounding the control element 15 is an electron multiplier 20 diagrammatically illustrated by three sets of diagonal lines representing the several stages and terminating at the back end in a plate 22 which collects the electrons and forms the signal output electrode for the tube.

A metal plate 24 encircling the front or righthand end of the control element 15 serves to receive electrons which are reflected to the back end of the tube during the scanning process and deflect them into the electron multiplier 20. These electrons form the video signal and when amplified by the multiplier 20 are collected by the plate 22 and conducted to the first video amplifier to be hereinafter described.

In the forward end of the cylindrical tube 10 is a target plate 26 which may be supported transversely of the tube by any suitable means such as an annular flange 28 securely fastened to the tube wall 10. This plate is formed of a material having a high resistivity and dielectric strength so that conduction through the plate as well as over the surface thereof is for all practical purposes substantially avoided.

In this particular form of the invention the front or righthand side of this dielectric plate 26 is coated with a photosensitive material such as a caesiased silver globule 30 (see Fig. 3) adapted to receive a light image and produce a corresponding electron image. Since this silver globule surface or mosaic actually comprises a great number of small, closely spaced and highly insulated islands, a charge pattern when formed thereon will remain and little or no tendency for equalization will be exhibited due to surface conduction at least during a scanning period. As a result, materially improved image resolution and definition are obtained.

On the other side of the target 26 I propose to employ a suitable electron emissive surface 32 also having a plurality of small individually in-

ulated particles or globules. In this instance the surface need not be photosensitive although a photosensitive surface would be satisfactory. Image equalization through surface conduction is in this instance also virtually eliminated. This surface may of course also be formed of caesi-
 5 silver globules in the same manner as the surface 30. Between the photoelectric surface 30 on the target 26 and the closed end 10' of the tube 10 is a cylindrical element or electrode 34 which during the operation of the tube is usually main-
 10 tained at a relatively high positive potential. This element operates to attract electrons liberated from the surface 30 during the operation of the tube so as to insure maximum photoelectric efficiency for that surface.

Just to the left of the target 26 is a second anode or collecting ring 36 which serves to attract liberated electrons from the target surface 32 upon the production of a charge through capacitive coupling between it and the surface 30. At the filament end of the tube is a third ring 37 adapted to shield the electron beam leaving the aperture 15, and the wall 10 of the tube between the rings 36 and 37 is provided with a suitable metallic coating 38.

Surrounding the tube wall 10 are the alinement coil 40, the deflection coil 42 and the focusing coil 44 which operate to control and focus the beam in the scanning process. The operation of these beam controlling coils is well known and a detailed description of their operation and associated circuits is believed unnecessary.

In the operation of the tube a light pattern from the object being televised passes through the transparent tube face 10' which is preferably of uniform thickness and may have a slight convex curvature for the purpose of withstanding the vacuum within the tube 10. This light image upon striking the surface 30 produces a charge pattern thereon with those areas being brightly
 40 lighted producing a positive charge, and those areas which are not brightly lighted forming a lesser positive charge. In the creation of this charge pattern on the surface 30, electrons are liberated and by reason of the high positive charge on the collector ring 34 certain of them will be attracted thereto. With the formation of this charge on the surface 30, a corresponding charge pattern of opposite sign will be produced on the electron emissive surface 32.

The electron beam 18 produced by the filament 12 when in the heated condition passes through the aperture 15' in the control element 15 and upon being alined by the alinement coil 40 is focused so as to produce a small spot at the point where it strikes the surface 32 on the target 26. The deflection coils 42 are operated to move the beam both horizontally and vertically over the screen so as to uniformly scan the entire surface thereof. As the electron beam passes over the surface 32 those areas having a charge which is positive with respect to the electron beam will tend to absorb more or less of the electrons from the beam, while those areas which are charged negatively with respect to the beam will tend to repel all the electrons in the beam.

Certain of the electrons travel backwardly through the tube and strike the circular plate 24 immediately surrounding the righthand edge of the control element 15 and are deflected by that control element into the electron multiplier 20. For each electron entering the multiplier 20 a somewhat greater number of electrons are caused to fall on the plate 22, thereby amplifying the

action of the camera tube and securing an increased or amplified signal for transmission to the video amplifier circuit to be described.

As the beam scans or passes over the surface 32 the surface is neutralized. Because of the capacitive coupling between the surfaces 32 and 30, the charge on the surface 30 will also be neutralized and thereby prepared for the next successive image. In actual practice, however, light is caused to fall continuously on the photoelectric surface 30 and neutralization of a particular spot on the surface produced by the beam 18 exists for only the time the beam is directed on that spot.

The electronic circuit for this tube includes a battery 46 having the positive end thereof connected by means of lead 47 to the collector ring 34, and the negative end by means of leads 48 and 49 to a ground 50. The metallic coating 38 is also positively charged by a battery 51 connected to a coating on one side by means of a lead 52 and connected with ground 50 on the other side by a lead 53. The collector ring 36 is shown as connected to the ground by a lead 54. The cathode 14 is maintained at ground potential by means of a lead 55 connected between the cathode and the lead 49.

The electron multiplier circuit is of a high impedance and consists of the lead 56 connecting the deflector ring surrounding the control anode 15 with a resistor 57, the other side of the resistor being connected to ground by means of the leads 53 and 55. The plate circuit of the electron multiplier includes the plate 22, lead 59 and the battery 60 to ground by means of the leads 61 and 49. In this way the plate is maintained at a fairly high positive potential to attract the electrons in the electron multiplier.

The signal from the tube is obtained from the lead 59 through a condenser 62 connected between the lead 59 and the grid 60 of the first video amplifier tube and the grid 63. A high resistance 64 is connected between the grid 63 and ground so as to maintain the grid substantially at ground potential under quiescent conditions of the amplifier tube. The cathode circuit of the amplifier tube includes the cathode 65 and a battery 66 connected between the cathode and lead 49. A condenser 67 connected across the battery reduces the impedance of the battery 66 to video frequencies. Since the cathode 65 is maintained at a positive potential with respect to the grid, the grid is in effect at a negative potential with respect to the cathode so as to obtain normal
 55 operating action.

The output circuit of the first video tube is not indicated as it is of conventional character and includes the plate 68 of the tube.

With this new and improved camera tube embodying electron emissive surfaces of the character set forth, it is possible to obtain materially improved sensitivity as well as stability over a wide range of light levels. Moreover, improved resolution is also obtained because of the so-called storage facility of a screen composed of a plurality of individually insulated islands adapted to be charged and retain that charge for a period at least as long as that required for the electron beams to completely scan the screen. By reason of the fact that individual surfaces are provided for receiving the image pattern and for intercepting the electron beam 18 in the scanning process, it is possible to obtain materially improved photoelectric efficiencies not heretofore obtainable to my knowledge when a single photo-

electric surface is employed for these purposes.

In Fig. 2 I have illustrated another embodiment of my invention. For simplicity I have indicated like elements in each of the figures by like numerals. The tubes operate in substantially the same character except for the differences now to be described and a detailed description of the operation and structure of certain parts of the tube will therefore be omitted.

The cylindrical tube part 19 in this embodiment extends beyond the target 26 a distance somewhat greater than in the embodiment shown in Fig. 1. The focusing coil 44 is extended to surround that portion of the tube between the front face 10' and the target 26.

In this embodiment the inside of the front face 10' of the tube carries a photoelectric surface 70 which may be a caesiated silver layer of the character heretofore described in connection with the surface 39 in Fig. 1. The surfaces 30 and 32 may also be provided with caesiated silver globules or any other suitable electron sensitive and emissive material adapted to be charged and retain that charge for a period of time of the order of a scanning cycle without substantial surface equalization.

In the operation of the tube a light pattern is intercepted by a surface 70 which then produces a corresponding electron pattern. This electron pattern is transmitted to the surface 39 under the control of substantially uniform magnetic and electric fields and produces a corresponding charge pattern on that surface. Since the target plate 26 is a dielectric material having a high surface as well as transverse resistance, a charge pattern formed on the surface 39 produces a corresponding charge of opposite phase on the surface 32. This second charge pattern is then scanned by an electron beam in the same manner as described in connection with Fig. 1. This form of the invention by reason of the use of electron emissive surfaces of the character set forth also results in materially improved sensitivities and elimination of blur or distortion of the image because there is little or no tendency of the charge patterns to equalize themselves during a single scanning period.

With my invention surface equalization of the charge pattern is materially reduced for time durations of approximately one scanning period and even longer. This is accomplished through the use of high resistivity glass and insulated mosaics of the character set forth and results in improved image definition. Moreover, with my new and improved tube structure, improved sensitivity together with improved stability over a wide range of light levels can be attained.

I claim:

1. A television camera tube comprising a target having electron emissive layers on each side thereof each consisting of a multiplicity of minute insulated particles, one of said layers facing the object to be televised and responsive to produce a charge pattern corresponding to the light pattern produced by the object and the other of said layers capacitively receiving a charge pattern corresponding to the first said charge pattern and means including an electron beam for scanning the other of said layers.

2. A television camera tube comprising a target of dielectric material having electron emissive layers on each side thereof with at least one of said layers being photosensitive and each layer consisting of a multiplicity of minute particles insulated one from the other, the photosensitive

layer facing the object to be televised and responsive to produce a charge pattern thereon corresponding to the light pattern, and the other of said layers receiving a charge pattern from the first said layer and means including an electron beam for scanning the other of said layers.

3. A television camera tube comprising a target of non-conductive material having a photo-sensitive mosaic on each side thereof, one side thereof being charged by a light pattern from the image being televised and the other side being scanned by an electron beam to produce a video signal for transmission to a receiver.

4. A camera tube comprising a pair of closely spaced capacity coupled electron emissive mosaics, one of said mosaics having a charge pattern formed thereon upon the receipt of a light pattern by the tube and the other mosaics responsive to said one mosaic to form a charge pattern thereon, and means for scanning said other mosaic.

5. A television camera tube comprising a target of non-conducting material having a caesiated silver globule mosaic on each side thereof, one side thereof being charged by a light pattern from the image being televised and the other side being scanned by an electron beam to produce a video signal for transmission to a receiver.

6. The combination with a camera tube having a photo cathode, of a target comprising two capacitively coupled electron emissive layers, one of said layers facing the photo cathode to receive an electron image therefrom and the other of said layers capacitively receiving the image from the first layer and adapted to be scanned to produce video signals.

7. In a television camera tube the method of transforming light patterns into electrical signals, comprising forming an electron charge pattern corresponding to the light pattern by means of a first layer, electromagnetically transferring the electron pattern to a second layer to form a charge pattern thereon, capacitively coupling a third layer directly to the second layer, forming a charge pattern on the third layer corresponding to the charge pattern on the second layer and scanning the third layer to produce the video signal.

8. In a television camera tube, a target comprising a sheet of dielectric material, a photo-sensitive layer on one side of the sheet facing the object to be televised, and an electron emissive layer on the other side, said layers each being formed of a plurality of individual globules insulated one from the other and capacitively coupled with the globules of the other layer, said photo-sensitive layer receiving a charge pattern by exposure to light from the object and capacitively transferring said charge to the electron emissive layer.

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