May 28, 1940. R. ANDRIEU 2,202,511

BLACK SPOT COMPENSATION APPARATUS

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Fig. 1

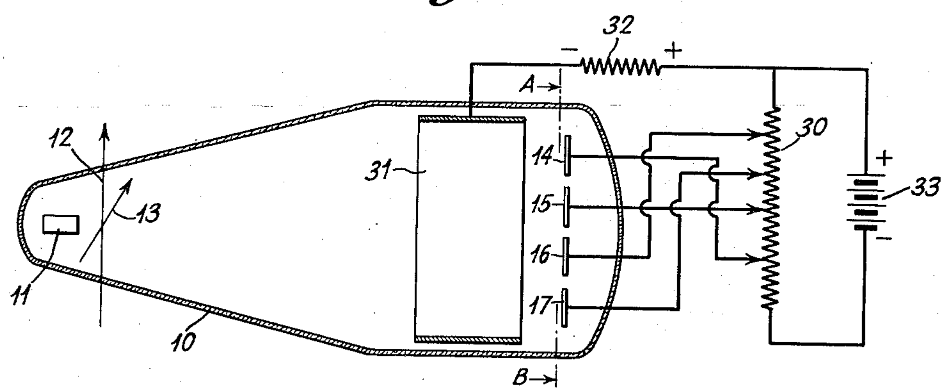

Fig. 2

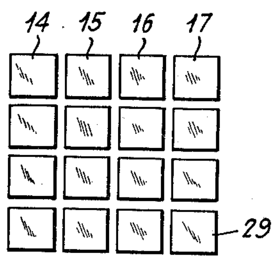

Fig. 4

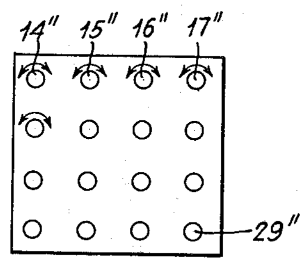

Fig. 3

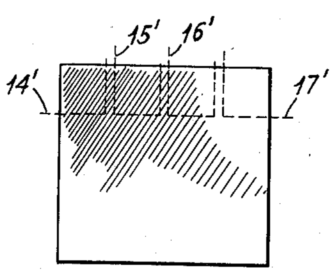

Fig. 5

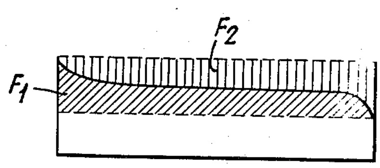

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Fig. 6

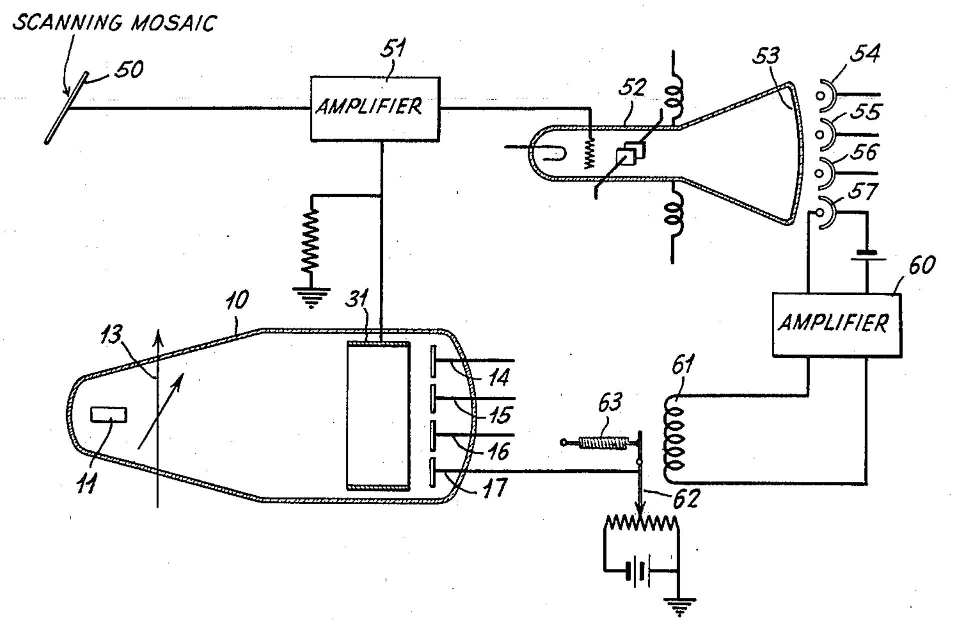
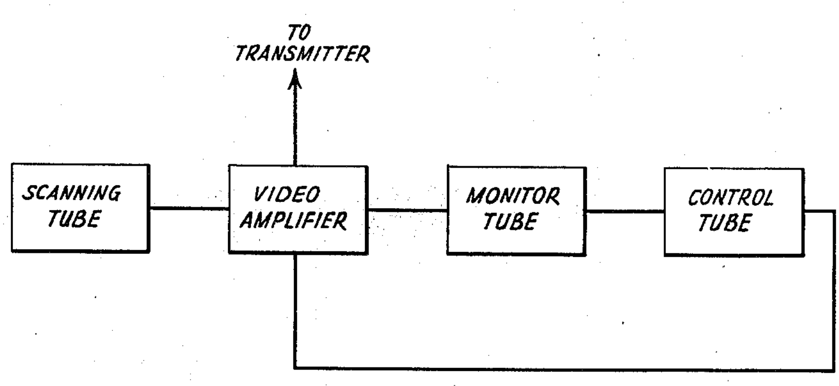


Fig. 7



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BLACK SPOT COMPENSATION APPARATUS

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In Germany April 28, 1936

8 Claims. (Cl. 178—7.2)

My invention relates broadly to apparatus for the compensation of undesired signals in electrical circuits, and more particularly to apparatus of that form which is for use in compensating for so-called "black spot" phenomenon generally associated with television scanners of the photo-mosaic type.

Cathode ray picture scanners of the type in which a mosaic or signal plate produces a charge pattern of the subject to be televised are in general subject to a spurious or undesired phenomenon generally identified as "black spot" phenomenon. This stray signal is additive in nature, that is to say, it also exists when the picture to be transmitted to a remote point consists of a uniformly white or grey color in addition to the situation in which the picture comprises a number of light and dark contrasts.

A number of theories have been proposed accounting for the fact that the mosaic is subjected to dark or light portions which are not present in the optical image itself. There seem to be several distinct causes to which this phenomenon may be attributed, and the first of these is that of a non-uniformity in the beam velocity of the cathode ray beam. This, of course, amounts to a modulation of the beam itself and as a result, its interpretation or measurement as it may be called of the charge values on various portions of the photoelectric mosaic is subject to the same variations as the variations in the beam velocity. As a result, at the receiver a dark spot or region appears on the screen a portion of which at least may be attributable to non-uniformity in the beam velocity either at the transmitter or at the receiver.

The second possible cause for so-called "dark spot" results from the fact that in a number of transmitting tubes, there is provided a first and second anode which are used in conjunction with the photoelectric mosaic. The second anode is usually used to collect secondary electron emission and to focus the beam. The photoelectric mosaic is of necessity at an angle with respect to the major axis of the tube, and it is usual to place the second anode so that its major axis is co-incident with that of the tube; the result is that the various points on the photoelectric mosaic are unequally distant from and with respect to the second anode. Accordingly, this inequality in influence is a contributing factor to black spot production.

Again, due both to the unequal charge pattern and the unequal strength exerted by the field from the second anode, there is developed across the photoelectric mosaic itself a variable field. This variable field influences the path of the electrons emitted by the photoelectric mosaic or the secondary emission occasioned by the cathode ray beam bombardment thereof and, to some extent, this unequal and variable field across the photoelectric mosaic adds to the dark spot phenomenon.

A fourth cause is the influence of either electric or magnetic fields which are generated externally to the tube itself. This may be caused by spurious oscillations in the neigborhood of the apparatus, may be caused by magnetization of objects in the neighborhood of the apparatus, and as a result, these fields may be either constant or variable in nature, and as a general rule they are variable. As a result these influences in fields, whose influence on the apparatus is uncontrolled insofar as the mosaic itself is concerned, contribute their shape to the undesired "black spot" or region produced.

Again, it is also possible that the actual response of the photoelectric material on the photoelectric mosaic to light values of equal intensity may not be exactly the same over a period of time. This may be due either to original unequal characteristics of the definite photoelectric particles or it may be due to an unequal dissipation on the strength of the particle which may possibly be caused by subjecting one portion of the screen to an unusually high electron bombardment or it may be due to a variable response of the photoelectric elements over a period of time. However, the short non-linearity of response may well contribute its share towards the so-called "black spot" phenomenon.

It is customary, or considered good practice at present, to compensate for this undesired stray signal or "black spot" signal by providing for each picture co-ordinate a voltage which is variable in proportion in time to the progress of the cathode ray beam in the picture co-ordinate, and for this purpose there is provided a voltage which will vary according to one sinuous period over the length of the picture or frame co-ordinate and another voltage which is variable according to two sinuous periods over the length of the picture co-ordinate. The amplitude and phase of each of these three components may be adjustable, but with this arrangement it is necessary to adjust twelve variable quantities for a definite distribution of the "black spot" signal if the latter is to be properly compensated. This sort of compensated apparatus however has the undesirable drawback that it is impossible to vary the size of the compensating signal for a definite point of the picture without incidentally and simultaneously effecting a change in the compensating quantity at other points in the picture.

It is, therefore, an object of my invention to provide apparatus and ways and means by which a "black spot" portion at one part of a picture may be properly compensated without incidentally affecting the compensation of the "black spot" region at other points in the picture and, broadly, speaking, I do this by dividing the picture into a plurality of distinct regions and providing means which will vary the compensation for each of these regions, the means being separate, distinct, and independent of each other. By means of my apparatus there is set up in the cathode ray scanner a compensating signal which is a function of the adjustment of a particular device which is adapted to compensate for one region independently of each of the other compensators which provide an adjustment in their separate and distinct regions of the picture.

My invention will best be understood by reference to the drawings, in which

Fig. 1 is an embodiment of my compensation generator,

Fig. 2 is a front view of the sectionalizer along line AB,

Fig. 3 is an explanatory diagram,

Fig. 4 shows a compensating control board,

Fig. 5 is an explanatory diagram,

Fig. 6 is an embodiment of my invention, and

Fig. 7 is a schematic explanatory diagram.

Referring to Fig. 1, an evacuated vessel 10 has means shown as 11 for generating a cathode ray beam. For purposes of simplicity, these means are shown schematically therein. However, they include a cathode, a control grid, and a first anode. The cathode ray pencil is subject to the action of two fields which are at right angles to each other, said fields being indicated by the arrows 12 and 13, and these fields vary in intensity with the horizontal and vertical scanning frequencies with respect to time. Located at the end of the tube remote from the electron pencil generating means is a sectionalized bank of electrodes 14, 15, 16, 17 etc., and in this view there is shown a cross-section of four of the electrodes. However, it will be appreciated that this is a view through one angle and that the entire bank of electrodes therein illustrated comprise sixteen in number. This number has been chosen for purposes of convenience and not for purposes of limitation. A potentiometer is energized by a source of potential 31 and the positive end of the potentiometer is joined through a resistor 32 to the second anode of the tube 31, this anode being common to all of the aforementioned electrodes. Each of the electrodes is joined to the potentiometer 30 by a conductor, and the position of the contact is variable so that the bias on the electrodes may be varied at any desired time. The anode 31 acts as a collector for secondary emission from the electrodes 14 through 29.

Referring to Fig. 2, there is shown the relative relationships in position of the electrodes 14 through 29 as seen from the front of the tube 10.

Referring to Fig. 3, four of the electrodes are shown as 14′ through 17′ and are indicated for purposes of clarity in dotted section. This figure illustrates what may be the relative distribution of shading or dark spot on the received picture or the monitored picture from the transmitter. This view shows a continuous section of dark spot or shading, but it will be appreciated that the shading may be distributed on various spots as well as concentrated in a section.

The operation of the device may be understood with reference to the foregoing explained Figs. 1, 2 and 3. Assuming that the stray or dark spot signal is distributed as shown in Fig. 3, if on the scanning screen of the transmitted tube the cathode ray beam begins to scan the first line of the picture, the cathode ray pencil in the tube 10 which moves synchronously with that in the transmitter begins to move first over the electrode 14, and it will impinge on the electrode marked in dotted lines in Fig. 3 as 14′. The stray signal of this district is comparatively powerful so that during the time when the scanning cathode ray beam sweeps the district of the picture identified as 14′, a proportionately powerful compensating signal must be produced. This is effectd by joining the electrode 14 of the tube 10 to a potential which is comparatively negative relative to that of secondary anode 31 so that through a resistance 32 a continually strong secondary emission current will be caused to flow. The fall of potential occasioned across this resistance may be used to compensate for the dark spot in the picture in the transmitting tube by, for instance, controlling the operating level of the video amplifier, controlling the modulation level of the transmitter, etc., these being well known to those skilled in the television art.

As the scanning beam reaches the district identified as 15′, the cathode ray beam in tube 10 passes over at the same time to an electrode 15. The dark spot is not quite as pronounced in this district and, accordingly, a lower compensating potential will be needed. Accordingly, the electrode 15 is rendered less negative with respect to the secondary emission collecting anode 31 than was the electrode 14. Hence, there will be a lower fall of potential across resistor 32 and this potential is used in the manner indicated with respect to the potential developed by the electrode 14. The black spot in the section 16 is even less than that in section 15 and 14 and, accordingly, the negative potential impressed on 16 with respect to the anode 31 is less than that of either electrodes 14 and 15. Therefore, the compensating signal will be less than the one furnished by those two electrodes, and a careful adjustment of these biasing potentials will eliminate independently the dark spot from each of these sections of the picture. In the region covered by electrode 17, it will be seen with reference to Fig. 3 that there is no dark spot present and hence, there will be no bias on the electrode 17 with respect to the second anode 31. Hence, no compensating potential is produced since no compensation is necessary.

The steady change of the stray signal over the length of individual lines upon the scanning screen is taken into practical consideration by that the cathode ray pencil, as already pointed out, has in the plane A, B, a comparatively large cross-section with the result that in spite of the finite difference of the electrode potential, the current in resistance 32 is subject to steady change, for part of the pencil will already begin to impinge upon a new electrode while another portion thereof is still upon the previous or preceding electrode. In the same manner, a steady change of the stray signal along the time-base and picture coordinate at right angles to the direction of the line is insured in that also in this co-ordinate the cathode-ray pencil in tube 10 changes steadily from one electrode to the next.

An arrangement of the kind hereinbefore described is particularly easily operable if the control knobs whereby the potentials at the various electrodes may be regulated are disposed in a plane in a similar way as the corresponding districts of the scanning screen. This is illustrated in Fig. 4 where the knobs 14'' to 29'' which correspond to the various electrodes numbered 14 to 29 are placed adjacent and below one another (i. e. juxtaposed and infraposed) like the electrodes or the screen districts or subdivisions.

What may also be pointed out is that the compensation of the stray signal is not merely accomplishable by subtraction of a supplemental signal as furnished from a tube as shown in Fig. 1, but that the shape of the additional signal as a function of the time may also be chosen in such a way that upon addition of this supplemental signal to picture (video) and stray signals, the disturbing action is eliminated with the exception of a signal component which is of constant size throughout the length of a frame.

This scheme shall be explained by reference to Fig. 5 which by way of example shows the light intensity distribution as caused only by the stray signal over a frame line. The compensation method hereinbefore disclosed results in a compensatory signal which is altered as the ordinates of the surface F_1 presenting oblique shading, while in the presence of a corresponding adjustment of the electrode potential also a supplemental signal could be generated which varies with the ordinates of the surface F_2 shown with vertical shading, so that by addition to video and stray signal there will just be neutralized the distribution of light intensity occasioned by the stray signal.

Referring to Fig. 6, there is shown an arrangement for automatically adjusting the value of the biasing potentials for the electrodes 14 through 29. The tube 10 having smaller electrodes to that shown in the tube illustrated in Fig. 1 will have its action explained in conjunction with the scanning mosaic and a further arrangement. The scanning mosaic 50 is joined to a video amplifier 51 which in turn controls a monitoring or other reproducing tube 52. Hence, the picture developed by the scanning apparatus will be reproduced by the cathode ray tube 52, having a screen 53 on which the picture is reproduced. In front of this screen and subject to the light values of the particular portions thereof are a set of individual photoelectric cells 54, 55, 56, and 57, and one cell is provided to be used in conjunction with each of the electrodes 14 through 29. Now, for instance, if there is a dark shading on the section of the picture corresponding to 17' the photocell 57 will respond, its impulses will be amplified by the amplifier 60 which is joined to electromagnetic means 61 for attracting the moving arm of the potentiometer 62 which ordinarily may be restrained by spring 63. The photocell may be arranged to control the amplifier in a negative direction, that is to say, that the potential drop may bias the grid of the amplifying tubes in such a direction that a small photocell current renders the amplifying tube more positive so that a greater output results and a large photocell current biases the tube negatively so that a smaller output current results. Hence, it will be obvious that the smaller the light value in the region of photocell 57, the greater will be the pull of the normally restrained moving arm 62 and, accordingly, the electrode 17 will be biased more negatively with respect to the secondary anode 31, and a charge compensating potential will be developed across the resistor 32 which, it will be seen, is arranged so as to control the operating level of the video amplifier 51.

Since television transmitters are of fairly large size, it is not prohibitive that sixteen distinct photocells be furnished and sixteen amplifiers operating in conjunction therewith for the automatic compensation of the black spot signal. It will be appreciated that various modifications of the scheme shown in Fig. 6 may be availed of as, for instance, a selecting system as shown in Alexanderson et al U. S. Patent 1,787,851 might be used to control the biasing potential on each of the individual electrodes 14 through 29 in progressive steps as, for instance, a definite relay might close for absolute dark or black, and this relay might control a definite negative potential which is impressed on one of the electrodes 14 through 29 of the tube 10 since it would be quite possible to adequately compensate with a range of say five voltages corresponding to black, light black, grey, light grey, and some intermediate shade, five distinct potentials would eliminate a constant revision in bias that would take place as the arm moved across the potentiometer. While no specific figure has been shown covering this arrangement, it will be appreciated that it is clearly within my concept.

Referring to Fig. 7, there is shown schematically the operation of the system wherein the scanning tube joins the video amplifier which in turn furnishes potentials to a monitored tube and to the transmitter, the monitor tube energizing the control tube which in turn controls the operating level of the video amplifier.

What I claim is:

1. Apparatus for developing corrective potentials for eliminating black spot effects in television scanners comprising means for developing a cathode ray beam, means for deflecting said beam, a plurality of electrodes each representative of a discrete section of the optical view, the cathode ray beam deflecting means being adapted to sweep the beam sequentially across each of the discrete elements, means for biasing said elements, and load means associated with said elements for developing corrective potentials.

2. Apparatus for developing corrective potentials for eliminating black spot effects in television scanners comprising means for developing a cathode ray beam, means for deflecting said beam, a plurality of electrodes each representative of a discrete section of the optical view, the cathode ray beam deflecting means being adapted to sweep the beam sequentially across each of the discrete elements, common potentiometer means for biasing said discrete electrodes, means for positioning the moving elements on said potentiometer from a potential developed from the monitored image to be transmitted and load means associated with said elements for developing corrective potentials.

3. Apparatus for developing corrective potentials for eliminating black spot effects in television scanners comprising means for developing a cathode ray beam, means for deflecting said

beam, a plurality of electrodes each representative of a discrete section of the optical view, the cathode ray beam deflecting means being adapted to sweep the beam sequentially across each of the discrete elements, means for biasing said elements under the control of discrete sections of the monitored image of the image to be transmitted, load means connected to said elements for developing corrective potentials, and anodic means for collecting the secondary emission from the said electrodes.

4. Apparatus for developing corrective potentials for eliminating black spot effects in television scanners comprising means for developing a cathode ray beam, means for deflecting said beam, a plurality of electrodes each representative of a discrete section of the optical view, the cathode ray beam deflecting means being adapted to sweep the beam sequentially across each of the discrete elements, means for biasing said elements under the control of discrete sections of the monitored image of the image to be transmitted, load means connected to said elements for developing corrective potentials, and anodic means for collecting the secondary emission from the said electrodes, said anodic means being connected to the load means.

5. The method of compensating for black spot effects in television scanning apparatus which comprises the steps of reproducing the image developed by scanning as a monitor image, dividing the produced monitor image into a plurality of sectional areas, developing from the monitor image a potential representative of the background level of each of said sectional areas in sequence, utilizing said potentials to develop proportional corrective signal potentials and utilizing said corrective signal potentials to substantially compensate for black spot effects.

6. The method in accordance with claim 5, wherein the sectional areas into which the monitor image is divided are substantially equal in area.

7. Apparatus in accordance with claim 1, wherein a monitor image of the view to be transmitted is developed and separate photocell means each associated with one of the electrode means are positioned adjacent said monitor image, and wherein the variable biasing means are controlled by the signals developed within said photocell means.

8. Apparatus for developing corrective potentials for compensating for black spot effects in television scanners comprising means for developing a monitor optical view of the signals developed within a scanner, a plurality of photoelectric cells each representing a discrete sectional area of the monitor image, said photocells being positioned adjacent the means for developing the monitor image and adapted to be energized thereby, means for developing a cathode ray beam, a plurality of discrete electrodes each representing a sectional area of the monitor image, potentiometer means electrically connected to each of said discrete electrodes, means under the control of each of said photoelectric means for determining the position of the variable section of said potentiometers, means for deflecting the cathode ray beam whereby said beam sequentially impinges on each of the discrete electrode means, and load means associated with said discrete electrode means for developing corrective potentials.

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