

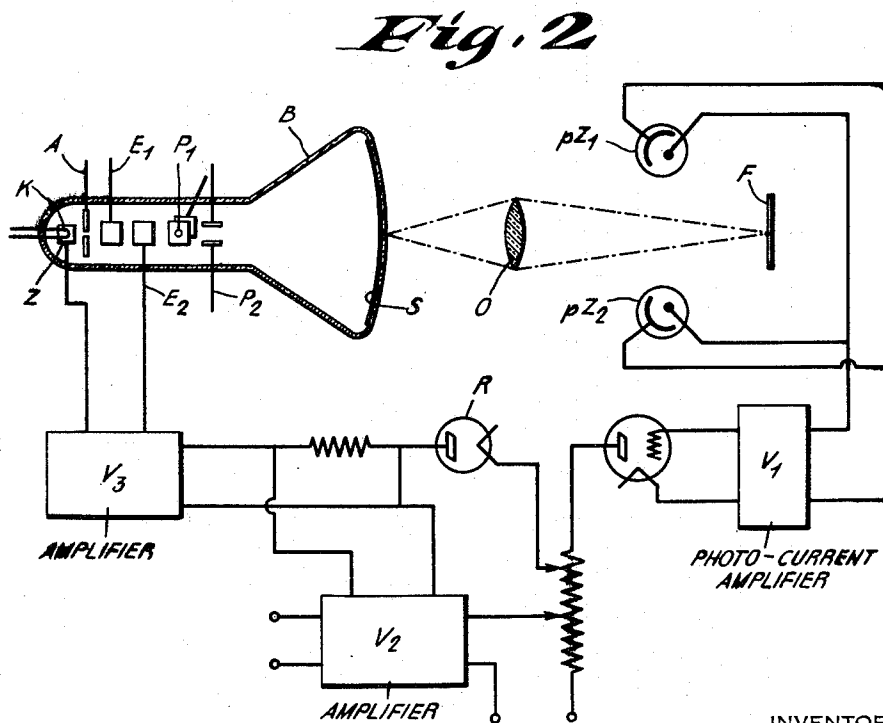
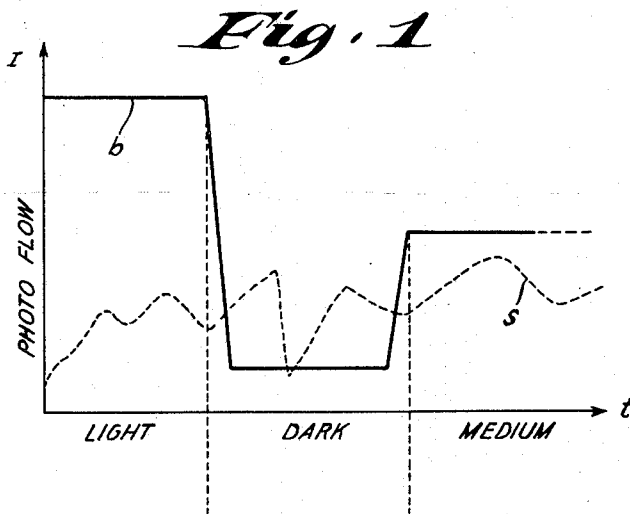
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TELEVISION SCANNING SYSTEM

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TELEVISION SCANNING SYSTEM

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The invention is concerned with the problem of television scanning of reflecting or light-permeable objects or originals of which an electro-optical image is to be produced at a distant point. More particularly the invention relates to systems by which images of living persons and three dimensional scenes may be reproduced. When recourse is had to the scanning devices heretofore used in the art and particularly to devices of the perforated Nipkow disk or mirror-studded wheel type, a limitation is imposed as regards the fineness of scanning of the picture or, in other words, the number of lines into which the subject can be assumed to be divided for scanning purposes. This limitation is due to the optico-photoelectric efficiency of the arrangement, for if the number of lines of the picture is increased, with the size or area of the picture remaining unvaried, the light or photo-flux corresponding to each scanning spot will decrease, and as a result the photoelectric picture signal becomes weaker so that it finally falls into the stray level of the amplifier which is caused by discontinuities in the electron emission, fluctuations, etc.

Therefore, one of the main objects of the invention is to raise the limitation imposed upon the number of lines that may be used in television transmissions as stated, and this is based upon the following considerations:

Experience has shown that the clarity or distinguishableness of a picture is primarily predicated upon the bright or luminous points thereof, whereas the darker portions play a minor or less important role so far as clearness is concerned. Hence, the invention in order to profit by this fact provides ways and means so that the screening or scanning is coarser in the darker areas of the picture than in the brighter areas. The limitation of the former arrangements, in the instance of the method based upon a scanning spot moved over the picture as here chosen, results from the fact that the size thereof is made rigid and invariable by the projected diaphragm in accordance with whatever number of lines has been chosen (with the dimension along and at right angles to the direction of the lines being made roughly equal to the width of the line). Thus, while in the limiting case sufficient illumination, e. g., adequate current intensities in the photocell, may still be obtained at the brighter and therefore strongly reflective points, the photoelectric picture signal *b* (as indicated by Fig. 1) will turn out unduly feeble at the darker spots so that it will finally fall inside the

order of magnitude of the stray level *s* of the photocell.

To obviate the imposition of this limitation as regards amplification, the invention provides for ways and means designed to vary the size of the scanning spot or of the shutter in the following way:

The bright spots of the picture are scanned with a size of spot or diaphragm (shutter) which is correctly adjusted to the desired number of lines so that they result in a sharpness of image corresponding to this line number. Suppose the light density in the shutter shows then its maximum in dependence upon the intrinsic brightness of the source of light and the efficiency of the optical means; so that no increase beyond this point is feasible. In the case of the darker (or more opaque points) parts of the picture or subject of which the image is to be reproduced, according to this invention and by the aid of an arrangement as shall hereinafter be described in more detail, the spot size or the shutter or at any rate the flux of light is increased. But at the same time, the aggregate gain of the photo-current amplifier is reduced in proportion to the said increase in light flux falling upon the subject. In this manner, a more favorable relationship between the picture signal and the input stray level of the amplifier of the photocell current is insured while by reducing the subsequent amplification of the signal amplitude obtained at the output end of the photo-current amplifier is corrected at the proper proportion.

In order to make clearer what has been pointed out before the assumption shall be made that the brightness, or, in an opaque object to be transmitted by television, the reflecting power for two different points to be contrasted, is 10:1. In the same proportion there would also be varied the part of the scanning photo-flux reaching the photoelectric cell and thus the intensity of the photocell current. But if, then, when scanning the darker part the impinging light flux is raised ten times, say, by enlarging the shutter or the spot of light, while at the same time, and in conjunction therewith the aggregate amplification of the picture signal is reduced $\frac{1}{10}$ th, it will be seen that the enlargement of the light flux compared with the reduction in reflective power will just be neutralized with the result that the same light flux as previously will strike the photocell. In other words, the picture signal (Fig. 1) will remain sufficiently far above the stray level. But since then the later amplification amounts to one-tenth of what it was

previously, the potential at the output end will be one-tenth of what it was before so that at the receiving end the proper ratio between light and dark in the re-created picture will be realized.

5 The result of this procedure is that in the re-created picture transmitted to a remote point the portions of greater brightness and therefore essential for clearness are fine-lined (spot small), whereas the lines are less fine in the darker portions (larger spot). It will be understood that it is not necessary, as has been done in the preceding numerical example, to effect compensation inside the entire brightness interval, indeed, it may suffice to effect compensation for a part of the darker shades. It will also be obvious that the spot and thus the line or screen element need not be enlarged in such cases where a temporary increase of the scanning light density at the darker parts of the picture would be permissible.

10 All that would then be necessary is to raise the light flux corresponding to the same size of spot. An instance of this kind would be involved, for instance, in a Braun tube as scanner when the intensity of the spot in reference to the durability of the screen material is so chosen that it will withstand transient, but not continuous, increases.

The increase of the luminous flux supplied from the scanning light spot to the picture element in dependence upon the brightness (or density) prevailing at the time or place is insured according to this invention automatically by the aid of a device which, as stated, causes at the same time a regulation of the amplification of the picture signal.

35 Fig. 1 shows the relation of the amount of light received by the photocell when the tone of the picture points varies.

Fig. 2 shows a transmitter used in the system disclosed in this application.

40 One exemplified embodiment of the idea is shown schematically in Fig. 2. The scanning device consists here of a Braun tube B furnished with a cathode K, Wehnelt cylinder Z for the dosage of the electrons constituting the electron pencil, anode A and the electrostatic lenses E1, E2 serving for the centering of the pencil. The spot as known in the art is moved by the aid of the pairs of deflector plates P1, P2, along lines and is thrown by optical means O upon the object to be transmitted. It is moreover presupposed that the fluorescent brightness at the impinging point of the electron ray pencil upon the screen S is already saturated so that a mere increase in the density of the electron stream would be of no use.

50 In practice, the aim will always be to operate near the said state since naturally it is desirable to insure the maximum luminous density at all attainable in the spot. But the size of the same, with corresponding increase in the electron stream may be varied by ways and means known in the art electrostatically, and these vary both the volume of electrons drawn across the anode diaphragm as well as the active cross-section of the pencil. As shown for instance, in Fig. 2, these two functions are fulfilled by the rectifier R coupled with the photo-current amplifier V1 at the input end of which the two photocells are connected, the rectified potential of the said rectifier corresponding to the photoelectric input signals

70 acting backwards upon the scanning spot by regulation of the amplifier V3 and well as in forward sense upon the following amplifier V2.

In mechanico-optical scanning devices, to carry the invention into effect recourse may be had, for instance, to supplementary light fluxes which are

rendered operative whenever needed by inertialess light relays (light valves). Another chance consists in that, when projecting the positive crater of an arc-lamp to act as the scanning spot, the current flowing through the arc is raised to a point so that the diameter of the crater and at the same time, though to a diminished degree, the density of illumination. In this instance, of course, no limiting shutters or diaphragms placed in the path of the ray-pencil would be permissible.

10 Having thus described my invention, what is claimed is:

1. The method of television transmission which comprises subjecting successive elemental areas of the subject of which the electro-optical image is to be produced to a spot of light of constant intensity per elemental area and varying the fineness of scanning by varying the size of the scanning spot proportionally with the brilliance of the subject to reduce the range of output variation of the electrical energy produced by the scanning operation.

2. The method of television transmission which comprises illuminating successive elemental areas of a subject of which an electro-optical image is to be produced, producing electrical energy proportional to the total illuminating light flux and varying in accordance with the darkness of the area scanned, amplifying the electrical energy produced, increasing the illuminating light flux for dark areas of the subject and simultaneously decreasing said amplification.

3. The method of intelligence transmission from a record surface having areas of differing light reactive value which comprises subjecting successive elemental areas of the record area to an illuminating light spot of constant intensity per elemental area and varying the area illuminated proportionally with the light brilliance of the record while maintaining a constant relationship between the illuminating light flux per elemental area to reduce the range of output variation of the electrical energy produced by the illumination.

4. The method of intelligence transmission from a record surface having areas of differing light values successively scanned by an illuminating light spot which comprises producing electrical energy proportional to the record density as influenced by the total illuminating light flux per elemental area reaching the record surface, amplifying the electrical energy produced, varying the area of the surface illuminated in accordance with the darkness of the area scanned while maintaining the total light flux per elemental area substantially constant, and decreasing the amplification simultaneously with increases in areas illuminated.

5. In a system for television transmission, means for illuminating a subject of which the electro-optical image is to be produced with a light beam of predetermined flux per elemental area of the subject, means for producing electrical energy varied proportionally to the variations in intensity of light and shadow on elemental areas of the subject as illuminated, means for amplifying the produced electrical energy, means for increasing the total light flux illuminating the subject for dark areas of the subject, and means for decreasing simultaneously the gain in the amplifying system with increases in the light flux illuminating the subject.

6. In television transmission systems, an electronic device for producing light spots of substantially constant light flux per elemental area for illuminating a subject of which the electro-

optical reproduction is desired along successive elemental areas of the subject, means for converting into electrical energy the varying intensities of light and shadow upon successive elemental areas of the subject as illuminated, means for amplifying the electrical energy produced, means for increasing the total light flux illuminating the subject at time periods of decrease in the amplitude of the electrical energy produced due to light values of the subject changing in a direction toward black, means for simultaneously decreasing the gain in the amplifying system, and an output circuit connected with the amplifying means.

7. In a system for intelligence transmission from a record surface having areas of differing light reactive values indicating different characteristics, means for illuminating successive elemental areas of the surface with a light beam of predetermined flux per elemental area, means for producing electrical energy varied proportionally to the variations in intensity of light and shadow on elemental areas illuminated, means for amplifying the produced electrical energy, means for increasing the illuminated area of the subject for dark areas thereof while maintaining the light flux per elemental area substantially constant, and means for decreasing simultaneously the gain in the amplifying system with increases in the total illuminating light flux so as to improve the relationship between signal and stray levels in the amplifying system.

8. In a television system, a cathode ray tube having means therein to produce on the fluorescent viewing screen thereof light spots of substantially fixed light flux per elemental area, a subject of which the electro-optical reproduction is desired adapted to be illuminated along successive elemental areas and predetermined paths by the light produced from said cathode ray tube, photoelectric means responsive to the total illuminating light flux and varying in accordance with the brightness and darkness of the area scanned for producing electrical current varying proportionally with the variations in intensity of light and shadow on the successively illuminated elemental areas of the subject, amplifying means connected with the photoelectric light converting means, a rectifier connected with the amplifying means, means responsive to the rectified currents for varying the total light flux produced by the cathode ray tube at time periods when the amplitude of the electrical energy resulting from scanning decreases so that the amplitude of the electrical energy will be increased proportionally with the increase in total light flux, and means for simultaneously decreasing the gain in the amplifying system proportionally with the increase in total illuminating light flux so as to improve the relationship between signal and stray levels in the amplifying system, and an output circuit connected with the amplifier.

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