

Aug. 8, 1933.

J. H. O. HARRIES
METHOD AND APPARATUS FOR THE RECORDING AND PROJECTION
OF PICTURES, IMAGES, AND THE LIKE
Filed Dec. 1, 1930

1,921,464

2 Sheets-Sheet 1

Fig. 1.

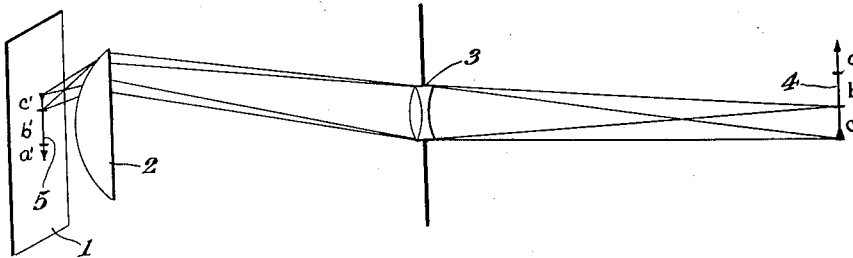


Fig. 2.

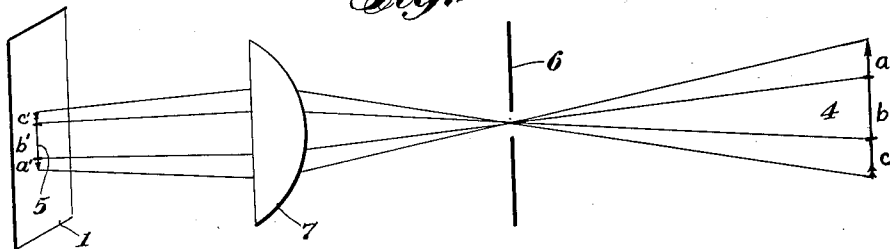
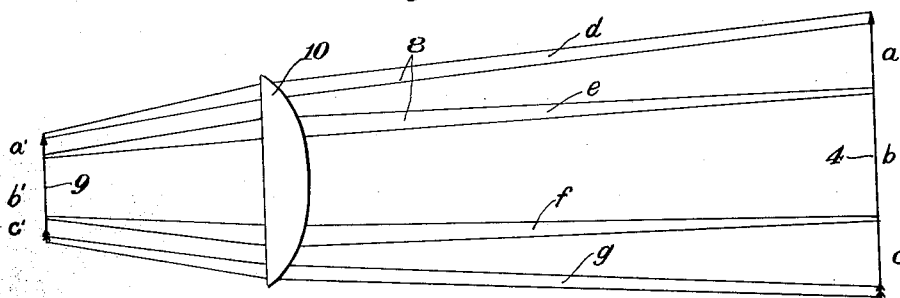


Fig. 3.



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Fig. 4

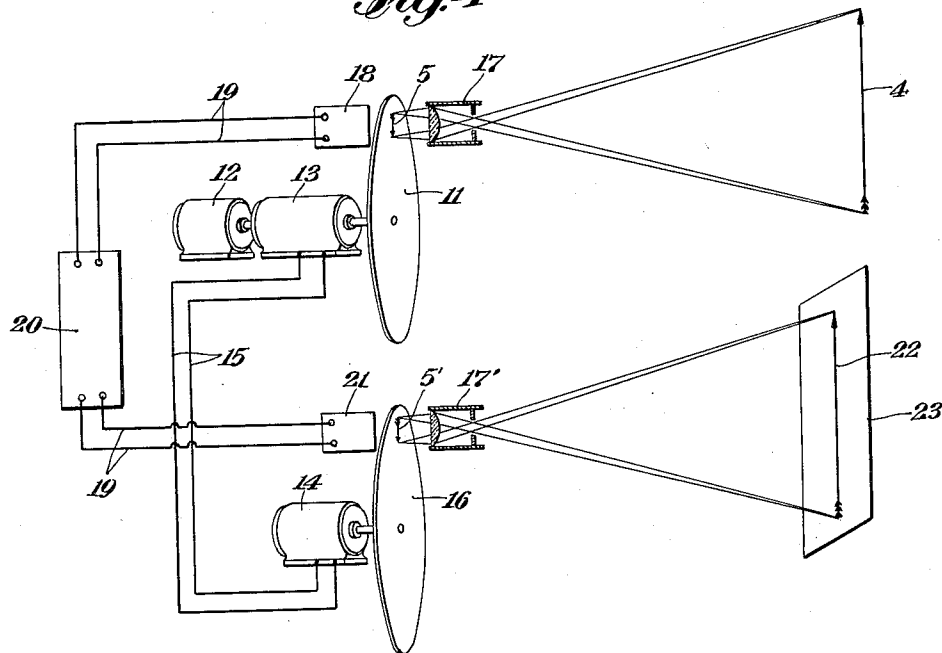
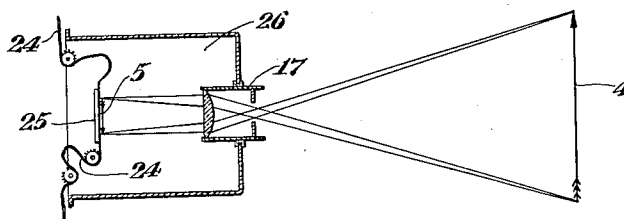


Fig. 5.



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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR THE RECORDING AND PROJECTION OF PICTURES, IMAGES, AND THE LIKE

John Henry Owen Harries, Frinton-on-Sea,
EnglandApplication December 1, 1930, Serial No. 499,325,
and in Great Britain December 2, 1929

6 Claims. (Cl. 178—6)

This invention relates to a method and apparatus for the recording and subsequent reproduction of pictures, scenes, views, images and the like, and is particularly applicable for use in the picture transmission and cinematograph arts.

It is known that the human eye has a field of view of comparatively indistinct vision with a small area of acute vision which is moved over parts of especial interest in the scene being viewed. It may be proved from this that in a large picture, only the centre of interest need be really clear, and therefore the background or edges of said picture may be more blurred or indistinct without detriment to the representation of the scene or object portrayed.

This latter effect is obtained in the case of pictures employed in, for instance, the cinematograph and picture transmission (e. g. television) arts, by means of the present invention.

An object of the invention is to enable a larger image of the centre of interest of a picture of given size to be recorded on or reproduced from a photographic film that would be possible with the usual methods wherein the magnification of the image forming apparatus was the same over the whole area of the picture.

Another object is to enable a larger image or picture of given size to be sent through a given picture transmission apparatus than has been possible hitherto.

A still further object is to produce a picture having parts of lower definition than other parts thereof.

A fourth object being to produce a picture in which the centre of interest is more highly defined than adjacent parts of said picture.

Another object is to produce the effect of moving the scanning beam with unequal velocity over the object to be scanned so that higher definition is obtained over parts of the area than over other parts thereof, and yet to produce this effect with the comparatively simple apparatus which is necessary to move the scanning beam or the like at constant velocity. In other words, by my invention I am able to use constant velocity scanning means to scan at varying velocity.

The invention therefore consists of recording, in the case of cinematography, or transmitting in the case of television, a partly compressed or unevenly distorted picture or image, hereafter referred to as the distorted image, which latter is subsequently reproduced in such manner as to neutralize the partial compression or

uneven distortion and produce an undistorted image of the original scene or the like.

In referring herein to uneven distortion of the image I mean to describe that important feature of my invention which is characterized by the fact that whether the distortion be effected in two dimensions of the picture or only one, it is invariably uneven along such dimension or dimensions; that is, the unit areas of the distorted image are of uneven density. It is by this means that I economize in transmission band-width and emphasize the center of interest of the picture, a result which would not be obtainable by an even distortion of the image, for example, as by an even or proportionate compression of the unit areas in one or both dimensions.

Apparatus for carrying out the invention may consist in the case of cinematography, of a recording instrument such as a camera, or in the case of picture transmission a television transmitter, having an arrangement of optical devices of such characteristics as will produce a distorted image. The arrangement of the optical devices would preferably be such that the distorted image produced would, when viewed by the human eye before neutralization, have a distinct and clear centre or centres of interest surrounded by a distorted area in which the individual parts of the image are crowded together or compressed.

It will be understood that the distorted image may, in the case of cinematography be recorded on a photographic film or the like of smaller area than if the image were undistorted and the magnification of the whole of the image was the same as that of the centre of interest in the distorted image.

Alternatively, in the case of picture transmission the distorted image may for example, be transmitted through a television system of smaller image transmission capabilities than if the image were undistorted and the magnification of the whole of the image was the same as that of the centre of interest in the distorted image.

A picture thus obtained could be viewed, in the case of cinematography, or in the case of picture transmission received and viewed, by apparatus employing an arrangement of optical devices to neutralize the above distortion and produce an undistorted picture of the original scene or image.

It will be appreciated that when the distortion in the picture is neutralized, the crowded or

compressed portion will be subject to a higher magnification than the adjacent parts thereof and therefore will appear as of lower definition.

It is preferable for artistic reasons that the change of magnification over the area of the picture be gradual rather than sharp.

The distortion and subsequent neutralization may obviously be carried out by the use of special distorting lenses, mirrors or the like in the optical systems: the exact design of such lenses or mirrors will depend on the degree and nature of the distortion required in any given case. Also the distortion or neutralization may be carried out partly or wholly by recording (and/or receiving in the case of picture transmission) the image on a curved instead of a plane surface, e. g. in the case of cinematography, if the film is curved in its breadth in passing through the gate of the camera, then the recorded image will be the distorted projection of the plane optical image onto the curved film. The focal depth of the lens system should be sufficient for the projection not to be seriously out of focus.

Due to the reversibility of optical systems in general the same apparatus which is used for recording (or transmitting) the distorted image may be used to reproduce the image and remove the distortion subject to such modifications of design as may be necessitated by different distance from image to lens in the recording and reproducing apparatus respectively.

The invention will be further described with reference to the accompanying drawings, wherein:

Figure 1 illustrates diagrammatically a lens system to obtain results in accordance with the invention.

Figure 2 similarly illustrates an alternative lens system, and

Figure 3 diagrammatically illustrates an optical system applicable for use with television beam scanning means.

Figure 4 illustrates an example of a circuit applicable for use with the invention in the television art.

Figure 5 illustrates an example of use of the invention in connection with cinematography.

Referring to Figure 1, in the recording instrument in the case of cinematography (or in a television transmitter) a lens 3 produces an image 5 of the object 4 in the plane 1. The lens 2, which has a much greater refraction at the edges than at the centre, bends the rays at the edge of the image 5 inwards, but does not substantially effect those at the centre. The result is an image 5 distorted as heretofore explained.

In Figure 2 an alternative system is shown, according to which instead of the lens 2, a stop 6 is employed in conjunction with the lens 7, causing said lens 7 to produce an image having the desired distortion, in accordance with known optical theory. (Vide Sylvanus P. Thomson, "Contribution to Photographic Optics" 1900, pp. 29-30).

In Figure 3 a scanning beam of light 8 is shown diagrammatically at four successive positions: *d*, *e*, *f* and *g*. The light beam from the scanner indicated at 9 is intercepted by a lens 10 (which may be rather similar to the abnormally curved lens 2 in Figure 1) and is caused to scan the object 4 in the desired manner and reflected light from the object acts on a light-

sensitive device in the usual manner to transmit a distorted image.

In the cases illustrated in Fig. 1 and 2 it will be seen that the portions *a* and *c* of the object 4 are made to form correspondingly smaller portions *a'* and *c'* of the image 5 while the central portion *b* of object 4, which may be the centre of interest, forms a disproportionately large part *b'* of the image 5.

Similarly in Fig. 3, the scanning beam 8 is caused to move more rapidly over the border portions of the object 4 (i. e. from position *d* to *e* and *f* to *g*) while passing relatively slowly over the central portion of the object 4 (i. e. from *e* to *f*), thus causing a more highly defined image of the centre of interest to be transmitted.

Figs. 1, 2 and 3 illustrate method and means for unevenly scanning the picture, whereby it is possible to scan more slowly the center of interest thereof than the margin, yet employing scanning means having an even velocity in both dimensions of the picture.

In order diagrammatically to illustrate an application of the invention to the television art, I have shown it in Fig. 4 as it may be applied in connection with the Nipkow system of television. Thus, a transmitting scanning disc 11 is driven by the prime mover 12 which also drives an alternator 13. The current from the alternator 13 is transmitted to a synchronous motor 14 by lines 15, said synchronous motor 14 being arranged to drive a receiving scanning disc 16 in synchronism with the transmitting disc 11.

In the transmitter the optical system 17 of the type illustrated in Fig. 2 produces a distorted image 5 of the object 4 on the scanning disc 11. A photo-electric cell 18, acting in conjunction with the disc 11 in the usual manner, produces a picture current, which current is transmitted through lines 19 and through amplifier 20 to an electrical light modulating device and light source 21 (e. g. Kerr cell or the like) which, acting in conjunction with the receiving disc 16 in the usual manner, reproduces an image 5' similar to the distorted image 5 at the transmitter.

The lens system 17', which is similar to lens system 17 at the transmitter, is arranged to neutralize the distortion and produce an undistorted image 22 on a viewing screen 23.

An application of the invention to the cinematograph art is diagrammatically illustrated in Fig. 5 wherein a cinematograph film 24 is fed in the usual manner through the gate 25 in a camera 26. The lens system 17, similar to that illustrated in Fig. 2, produces a distorted image 5 of the object 4 on the film in the gate 25.

In the case of picture transmission (e. g. television) in order to remove "grain" in the edges of the received image due to the coarser scanning at that part, the lens systems above described should be designed to throw the beam slightly out of focus over this part of the image. It will be appreciated by those skilled in optics that such an effect would be hard to eradicate rather than hard to produce.

It is to be understood that the preceding examples merely illustrate general types of apparatus which may be used and other modifications which will be obvious to those skilled in the art may be employed without departing from the scope of the invention.

The invention may be used in conjunction with uneven scanning devices (either transmitting or

receiving). The distorted image may be unevenly scanned (in the case of television) by apparatus such as that disclosed in the specification of my co-pending application Ser. No. 499,322 filed Dec. 1, 1930. As a further example, the distortion produced in scanning the received image evenly, when the transmitted image is scanned unevenly as described in the co-pending application referred to, may be removed by means of the present invention; or distortion may be produced in the transmitted image as herein described for subsequent removal in the received image by other means, for example, by uneven scanning.

It is also within the scope of the invention to arrange that the relative position and/or colouring of the respective areas of high and low magnification may be adjustable by suitable adjustments to the optical devices, or other distorting and neutralizing means.

For example, referring to Figure 1, the lens 2 may be moved, or a colour filter (not shown) may be placed over the centre of said lens 2, in order to give the desired effect.

It will be understood that any such adjustments of the objective lens system or the like must necessitate a corresponding adjustment of the viewing apparatus. This may be effected by manual means, the operator adjusting the viewing apparatus until the picture is undistorted. Alternatively the movements of the objective lens system or the like are arranged to control the corresponding movements of the viewing apparatus or vice versa. For instance, in the case of a picture transmission system, any of the many well known remote control devices (e. g. telewriters and the like) may be employed for this purpose; and in the case of cinematography and the like, similar means may be employed, but instead of transmitting the controlling currents, they may be recorded on the film or on a separate synchronized record and then reproduced and caused to control the viewing apparatus as the film is viewed.

In the picture transmission systems in particular, the (received) picture to be neutralized may not remain in one position. For example, in television this movement is due to failure of synchronism of the apparatus transmitting the picture. In this case the neutralizing optical system may be automatically adjusted to counteract the movement which would otherwise prevent neutralization being obtained.

This adjustment may be controlled, by any convenient remote control device, from the variations in the picture transmission synchronizing current which causes the movement of the image.

For instance, the synchronizing current may energise a solenoid proportionally to its strength, so that with changes in the synchronizing current the solenoid will move either the whole neutralizing optical system, or the angle of a plane pivoted mirror reflecting the image from the picture receiver to the optical system.

For a better understanding of the invention the following examples of an application to television and cinematography are appended.

In television it is well known that there is a limit to the amount of detail it is possible to transmit, principally due to the allowable transmission bandwidth. This limits the size of the usual evenly defined picture it is possible to use.

Similarly in the cinematograph art the area of the film is limited, and therefore (due, for

instance, to the film grain appearing with high magnification) there is a limit to the size of picture which can be utilized.

In both these cases the present invention enables a larger picture to be used, with practicable television apparatus or with standard sized cinematograph film respectively, than would otherwise be the case.

Consider for instance a 4×5 cms. (=20 sq. cm. area) evenly defined picture. For televising this picture let the bandwidth at the particular number of pictures to be sent per second be 500 cycles per sq.cm. the total bandwidth is then $20 \times 500 = 10,000$ cycles wide.

Now, let a quarter cm. be cut off the picture all round. The dimensions are then $3.5 \times 4.5 = 15.7$ sq. cms. The total bandwidth is reduced to $15.7 \times 500 = 7,850$ cycles: that is, there is a reduction of $10,000 - 7,850 = 2,150$ cycles. (The quarter cm. off all round will have made but little difference to the field of view of the picture). Now, in accordance with the present invention, the border is replaced by one four times as broad, which is therefore nearly five times the area. The spare 2150 cycles bandwidth may be used to transmit this. The definition of the border will therefore be about one-fifth that in the centre of the picture.

Thus, the total bandwidth is 10,000 cycles as before.

The total area of the picture is now increased to $(2+3.5) \times (2+4.5) = 36$ sq. cms. (approx.) and in accordance with the previously mentioned effect of the smallness of the point of distinct vision on the observer's mental impression of a picture, this is equivalent to an evenly defined picture of this area. But such an evenly defined picture would have required a total transmission bandwidth of $500 \times 36 = 18,000$ cycles.

Thus, by the use of the invention, there is produced an economy of $18,000 - 10,000 = 8,000$ cycles, or about 0.45 times.

Applying the same principles to cinematography it will be realized that whereas a film frame 5.5 by 6.5 cms. in size would have been required to produce the large image by known methods, by means of the present invention the 4×5 cm. frame will suffice.

In the case of cinematography instead of recording the image in distorted form directly onto the film from which it is to be reproduced, an undistorted image may be recorded in the usual manner on a film and a distorted image, in accordance with the present invention recorded on a second film for reproduction and projection.

It will be appreciated that in certain cases this method will be simpler optically than to produce a distorted image directly from an open scene.

I claim:

1. A method of television which comprises producing an image of an object with a portion of the image differently proportioned to the object than the remainder of the image, translating said image into electrical impulses, transmitting said electrical impulses, receiving said impulses and translating the same to form a received image, and producing from the received image a visible image uniformly proportional to said object.

2. A method of television comprising producing an image of an object with the central portion of the image differently proportioned to the object than the border portion of the image,

translating said image into electrical impulses, transmitting said electrical impulses, receiving said electrical impulses and translating the same to form a received image, and producing from the received image a visible image uniformly proportional throughout to said object.

3. Television apparatus comprising optical means for producing an image of a body with a portion of the image differently proportioned to the object than the remainder of the image, means for translating said image into electrical impulses, means for transmitting said electrical impulses, means for receiving said impulses and translating the same to form a received image, and means for producing from the received image a further image uniformly proportional to said object.

4. Television transmitting and receiving apparatus comprising optical means for producing an image of an object with a portion of the image differently proportioned to the object than the remainder of the image, means for scanning said image, a receiver, means to transmit electrical impulses from said scanning means to said receiver, and apparatus associated with the receiver for producing a visible image, said apparatus having optical characteristics identical with those of the optical means associated with said scanning means, whereby the visible image is uniformly proportional throughout to said object.

5. In television apparatus, a transmitting system, a receiving system, means for transmitting impulses from said transmitting to said receiving system, optical means associated with said transmitting system for producing an image of an object with a portion of the image differently proportioned to the object than to the remainder of the image, means associated with said transmitting system for translating said image into electrical impulses, means associated with said receiving system for translating received impulses into an image, and optical means associated with the receiving system having characteristics identical with said first optical means for producing an image uniformly proportional to said object.

6. A television transmitting and receiving apparatus comprising means for forming an image of selected portions of a picture, means integral with said means for forming an image compressed with respect to the first image of the remainder of said picture, means for rendering the images continuous in one complete image, means for translating said complete image into electrical impulses, means for transmitting said electrical impulses to a receiver, means at the receiver for translating said electrical impulses to form a received image, means for forming a further image from selected portions of the received image, means for forming an image expanded with respect to said further image of the remainder of said received image, means for rendering said further and expanded images continuous in one complete image, and means for rendering this complete image visible.

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