350-6.2
SR
XR 2,010,764
TX 3020P
ADDED

Aug. 6, 1935. J. V. L. HOGAN 2,010,764

SCANNING SYSTEM

Filed Feb. 10, 1931

Fig. 1.

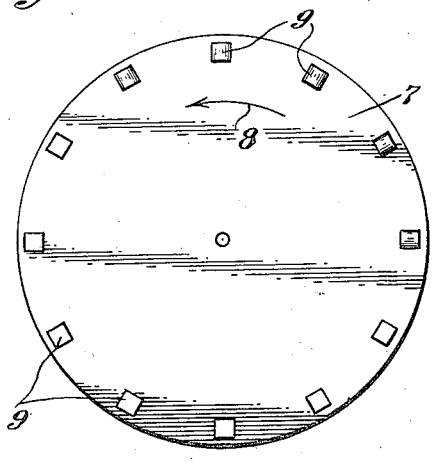


Fig. 2.

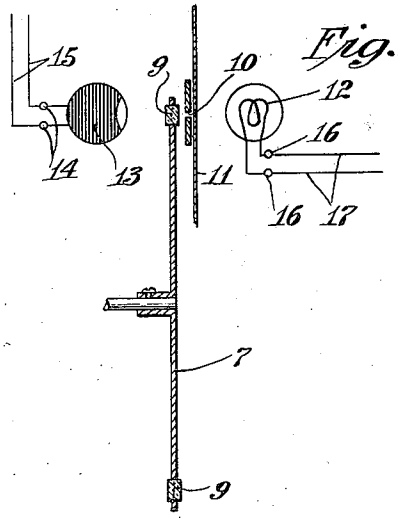


Fig. 1a

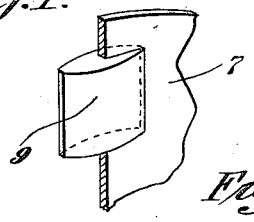


Fig. 3.

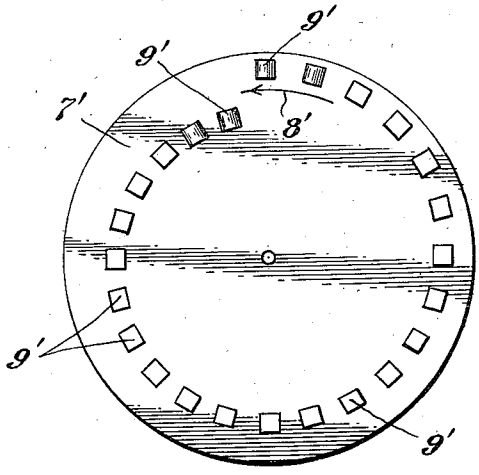


Fig. 4.

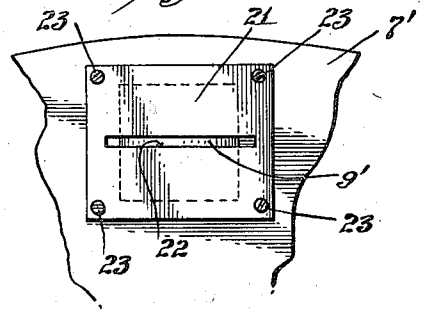


Fig. 5.



Fig. 6.



John V. L. Hogan
INVENTOR.

BY John F. Allyn.
ATTORNEY

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2,010,764

SCANNING SYSTEM

John V. L. Hogan, Forest Hills, N. Y., assignor to Radio Inventions, Inc., New York, N. Y., a corporation of New York

Application February 10, 1931, Serial No. 514,717

4 Claims. (Cl. 178—6)

My invention relates to a method and apparatus for the optical scanning of an image, for television or other purposes. The fundamental principle of scanning by optically dividing a field of view into a number of elementary areas and exposing a light sensitive device sequentially to the light proceeding from each of these elementary areas is well known in the art. This invention relates more particularly to the apparatus employed for securing this sequential exposure, and its analog at the receiver for sequentially exposing the elements of the field of view to light from a source modulated by the signals from the transmitter.

Devices of this character usually scan by some form of mechanical motion, vibratory or rotary. One common form of scanner moves a series of apertures before the field, which apertures may be physically existent upon a single moving member or only virtually formed by the coaction of two or more series of apertures in separate members, whose positions and movements are so coordinated that the shifting intersection of the separate series of apertures scans the field.

One widely employed scanner has a series of apertures spirally disposed upon a rotating disc, and will be hereinafter referred to as a Nipkow disc. As one representative of another class where a plurality of moving members are employed, the scanner disclosed in the co-pending application of Harold P. Donle, Serial No. 425,785, will be hereinafter referred to as a drum and disc scanner.

In connection with the scanning process it has been found that for various reasons it is possible to secure an apparently better reproduction of the ordinary field of view when the number of elements into which the field is divided are not distributed evenly between the two dimensions, but are made greater in one dimension, usually the horizontal one. This method of scanning is set forth in detail in the co-pending application of Harold P. Donle, Serial No. 433,670, and will be hereinafter referred to as high detail scanning.

One object of my invention is to provide greater illumination by admitting the passage of more light in at least one direction of the elementary area than would pass through a similarly employed slit.

Another object of this invention is to allow high detail scanning to be practiced in either direction without decreasing the illumination in that direction.

Another purpose is to allow high detail scanning in one direction to be combined with greater brilliancy in the same direction.

A still further object is to allow more light to pass in both dimensions, by the use of my invention with a plurality of scanning members.

In transmitting scanners of the "moving spot of light" type, another object is to allow greater illumination from a given source of light, than could otherwise be obtained.

In transmitters of the "total subject illumination" type, an object of my invention is to allow a greater area of the light-sensitive cell to receive the light from a single elementary scanning area, than would otherwise be possible.

Other objects of my invention will be evident from the following specifications and drawing, where—

Fig. 1 represents a front elevation of one form of scanner utilizing my invention suited for scanning in one dimension only.

Fig. 1*a* shows a perspective sectional view of the edge of the disc of Fig. 1, illustrating one method of arranging the lenses relative to the surface of the disc.

Fig. 2 is a sectional view of apparatus embodying my invention and suited for scanning motion-picture film.

Fig. 3 is a view of a device for scanning in both dimensions simultaneously.

Fig. 4 is an enlarged detail view showing one form of limiting diaphragm.

Fig. 5 illustrates another form of lens, which may be used according to my invention and is of especial value when the lenses are radially placed.

Fig. 6 shows another form of lens suited for exerting unequal magnification in two dimensions, and yet giving a substantially rectangular field of magnification, when radially disposed upon a disc or the like.

The broad idea of my invention is the replacement of slits or perforations in scanning devices by cylindrical lenses, which will act to concentrate the light in at least one dimension. In this fashion a scanning element can be of a given width and yet pass as much light as though it were much wider. Thus the detail of scanning can be preserved, and a higher product of illumination times area be secured. This means a greater brilliancy of the image at the receiver or a greater response of an appropriate light-sensitive cell at the transmitter.

It is also possible with the use of my invention so to choose the cylindrical lenses that the light passing therethrough will be narrowed still

further than is feasible with a slit when employed with ordinary illumination, if full brilliancy is to be retained. In this case scanning will be of the high detail type in one dimension.

When a plurality of scanning members is used, it will be possible to incorporate the lenses of my invention in more than one member so that the advantages accruing from their employment may be utilized in both dimensions. In this case it is feasible to increase the detail materially in both dimensions within the frequency limits of transmission. It may be used in one dimension so as to increase the brilliancy, and in the other dimension so as to increase the detail, or detail and brilliancy.

In Fig. 1 the scanning disc 7, rotating as indicated by the arrow 8, is provided with cylindrical lenses 9, arranged about its outer edge, with their axes lying substantially along radii of the disc. A disc of this type operates to scan a scene in one dimension only. Scanning in the other direction may be accomplished by another scanning member, (not shown) such as a slow-moving slitted disc, a mirror drum or the drum of the drum disc type scanner. If motion picture film is being scanned, the film itself may conveniently be continuously in motion along its length past a slit which delimits the scanning area in this one dimension. This method of operation is in accordance with the scanning method disclosed in the co-pending Patent application Serial No. 433,670 of Harold P. Donle.

If the other scanning element is in motion relative to disc 7, the lenses 9 must be of sufficient length so that some portion of the lens shall at all times be in a position to co-operate with the other scanning element. However if this element be stationary relative to disc 7, only a portion of the lens, optically equivalent in length to the width of the other scanning dimensions, needs be used. Therefore the cylindrical lenses can be made very short in this latter case.

Fig. 2 shows a lens 9 passing by a fixed aperture 10, before which moves continuously motion picture film 11. Light from source 12 fed with energy through terminals 16 and conductors 17 passes through the film 11, the slit 10, the lens 9 and finally impinges on the photo electric cell 13, having terminals 14 and output conductors 15.

While only a lamp is shown herein, it is to be understood that in practice suitable optical means, such as lenses and/or reflectors and/or the like may be employed in conjunction therewith to secure greater efficiency and/or other well known advantages.

In Fig. 3 the scanning disc 7', rotating as indicated by the arrow 8' has the cylindrical lenses 9' disposed in spiral contour thereon, but with their axes radially placed. In this form scanning in both directions simultaneously takes place by the movement of the single disc. It is necessary, however, with this form to provide synchronous means preferably rotating with the disc, which shall act to limit the height of an elementary area, in the radial direction. One convenient means for accomplishing this purpose is to have the openings in the disc before each lens take the form of narrow slits, of width corresponding to the height of the elementary area. In this form of my invention the length of the lenses need only be sufficient to cover such limiting slits as have just been described.

Fig. 4 shows a view partially in section, of a portion of the form of Fig. 3, enlarged and showing the use of a limiting diaphragm 21 with an aperture 22 extending across lens 9'. This diaphragm may be fastened to the disc by clamping means as indicated at 23, and may be flat as indicated or may lie close to one surface of the lens, or can be a slit in an opaque painting on one or both surfaces thereof.

The mode of operation of my invention is according to procedures well known in the art and will be readily apparent to one skilled therein. It can be employed in connection with various other devices to constitute a complete television system. While my invention can be used with light sensitive cells and light producing means of existing types, its optimum action is to be secured when the photo-electric cell has its sensitive surface or the reproducing device its light reproducing surface, respectively, so dimensioned and arranged that the light proceeding thereunto from the cylindrical lenses, or collected therefrom by the lenses, shall cover or proceed from such surface in its entirety.

In the case of the form of my invention shown in Fig. 1, used with a moving member for scanning in the other dimension, or in the case of Fig. 2, the surfaces which would be sufficient for use with an ordinary apertured disc may well be enlarged in order that the area correspondent to the light gathering or displaying powers of the lenses shall be uniform throughout the area scanned. This means an enlargement in a direction at right angles to the axis of the lenses. In the case of a film moved past a stationary slit as with the scanner of Fig. 1, the photo-electric cell or reproducing lamp can have one dimension reduced to a value correspondent to the width of the fixed slit, while the other dimension is increased to accord with the lens coverage, as in the case of the preceding forms.

This smaller total area may allow greater use of such area, since the portion of the total area in use at any one instant can then be represented by a fraction whose denominator is the ratio of the total length covered by the lens in a direction at right angles to its axis to the length covered at any single instant. In the case of the scanner with elements moving in both dimensions the denominator of this fraction will be the total number of elements into which the area is to be divided by the combined action of the scanning in both directions.

While any suitable number of lenses may be employed according to my invention, I have shown 12 in Fig. 1, which would give 24 line scanning at 15 pictures per second, if the disc revolves 1800 R. P. M. and a complete scanning in the other direction takes 1/15 second, which might be accomplished by using to cooperate with the disc a slow-scanning member with 8 slits, mirrors or lenses, revolving at 112.5 R. P. M., or by moving motion picture film at the rate of 15 views per second, past a fixed slit, as in the case of the embodiment shown in Fig. 2.

In Fig. 3, 24 lenses are indicated, which will give 24 line scanning. An appropriate speed for such a disc is 900 R. P. M.

I do not confine my invention to the illustrative values just given, however.

When my invention is employed with a single disc such as that of Fig. 1, it is possible to move the light source itself in order to secure scanning in the other dimension. In this case the light source can be narrowed in one dimension, with consequent economy of energy and increased efficiency. This method of scanning in one dimen-

sion by the use of a moving source of light forms the subject of my co-pending application Serial No. 495,601. In this latter case it may also be advantageous to employ a cylindrical lens in conjunction with each of the moving sources of light, in case that these sources are wider than necessary to cover a single elementary area.

It is likewise possible to use two moving members, each bearing cylindrical lenses in accordance with this invention, and co-operating with a fixed source of light, in the case of a receiver or with the illuminated image and the photoelectric cell in the case of a transmitter. Thus greater concentration of light will be secured in both dimensions.

In all cases of the use of cylindrical lenses according to my invention, it may be found to be advisable or necessary to use in conjunction therewith, aperture slits, which shall "cut the fringes" of the light rays passed by the lenses, in order to secure more perfect definition of the edges or the focus thereof, after the manner well known in the optical art. Even if the employment of such aperture slits be needed, yet there will still remain a greater passage of light by the use of my invention than would be possible by the use of slits or holes alone, as has been customary hitherto in the art.

Due to the radial placement of the lenses of my invention, when they are employed upon a disc as in the case of Fig. 1, the portion of the lens nearer to the centre of revolution will not traverse a space as great as the portion which is nearer the periphery of the disc. As a consequence of this action, the image produced by such a disc having slits thereon when used with a co-operating member with apertures moving radially in reference to the disc would not be strictly rectangular, but would rather be the outer section of a sector of a circle, its sides being bounded by radii of the same. The same effect arises from the individual lenses of Fig. 3 being radially displaced relative to one another. In the case of a disc provided with the cylindrical lenses of my invention, it is possible to compensate for this error, by fitting the lenses so that their axes are not in, or parallel to the plane of the disc itself, but are inclined thereunto. Due to the divergent character of the light rays passing through such lenses this angular placement can be adjusted so that the light passing through the portion of the lens nearer to the centre will actually traverse a space as great as that passing through the portion of the lens which is nearer the periphery. Thus the total available width of the picture produced will be that correspondent to the peripheral separation of the radial lenses rather than that correspondent to the shorter distance by which they are separated near to the centre. Therefore the effective width of the image may be made greater and more nearly or exactly uniform by this mode of construction.

While I have shown the cylindrical lenses in the illustrative figures as being of the double cylindrical type of lenses, it is to be understood that I do not confine myself to this particular type of cylindrical lens, but plano-convex or other types may be employed. The use of the term cylindrical lens is designed to cover broadly lenses which refract light to much greater degree along one axis than along an axis at right angles thereto.

In employing my invention with disc like structure, it is also possible to correct for the radial error due to the placement of the lenses by the employment of lenses not mathematically cylindrical but with one or more faces tapered or of varying degrees of curvature so as to modify their refractive powers according to the distance of a given spot from the centre of the disc. These lenses might be said to be conical in character.

While the invention has been described largely in terms of the action of lenses which are plane in one dimension and curved in the other, i. e., the conventional type of cylindrical lens, I contemplate the use of lenses having curvature in both dimensions. By using a slight curvature in the radial dimension of Fig. 1, together with a greater curvature in the circumferential dimension as in Fig. 6, I may control separately two important functions of lenses in scanning systems by varying (in designing the lenses) the degree of light concentration produced in the direction of scanning motion and at right angles thereto. Such lenses are sometimes called ellipsoidal, though I prefer the term substantially cylindrical.

My invention of the use of cylindrical lenses may also be combined with the use of a disc bearing a small number of lenses rotated at a high rate of speed, co-acting with a shutter member to give the equivalent effect of a larger number of lenses operated at a lower speed. As an example of such an arrangement, reference may be made to the co-pending application of Harold P. Donle, Serial No. 328,337, wherein a disc bearing a plurality of convolutions is shown. A single cylindrical lens may be substituted for each radially disposed series of apertures of that disclosure, and appropriately arranged shutters coact therewith to give the effect of a plurality of cylindrical lenses. This construction may be desirable on account of the economy of lenses and easier placement of parts possible therewith.

My invention is also readily adaptable to any form of device where slits or openings of other characters are employed. According to its disclosures cylindrical lenses may be employed in connection with drums, strips, belts, cones and the like, either moving or stationary, and to cover broadly the use of cylindrical lenses as adjuncts to, or substitutes for optical slits in television scanning apparatus.

I claim:

1. In television scanning apparatus using radially disposed scanning apertures, means for producing a substantially rectangular picture including lenses at least partially of a conical character and tapering substantially in proportion to the radial angle at which said lenses are placed.

2. In television scanning discs, means for reducing the distortion due to radially placed optical apertures, including tapered cylindrical lenses whose curvature varies substantially in accordance with the radial distance of the different portions of said lenses.

3. A television scanner including means for moving motion picture film so as to scan in one direction, a stationary screen having an aperture limiting the optically active portion of said film in the dimension corresponding to the direction of motion of said film to a fractional part of a complete image, a stationary light source illuminating said active portion of said film, a series of lenses having differing refractive powers in two dimensions moving substantially at right angles to said motion picture film and coacting therewith and with said stationary screen so as to scan in the other direction and defining an elemental scanning area in said other direction.

4. A television scanner including means for moving motion picture film so as to scan in one

direction, a stationary screen having an aperture limiting the optically active portion of said film in the dimension corresponding to the direction of motion of said film to a fractional part of a complete image, a stationary light source illuminating said active portion of said film, a series of lenses having differing refractive powers in two dimensions moving substantially at right angles to said motion picture film and coacting therewith and with said stationary screen so as to scan in the other direction, and a plurality of shutters one over each of said lenses, said lenses and said shutters defining an elemental scanning area in said other direction.

JOHN V. L. HOGAN.