Dec. 18, 1928. 1,695,924

S. M. KINTNER

TELEVISION APPARATUS

Filed Oct. 15, 1926 2 Sheets-Sheet 1

Fig. 1.

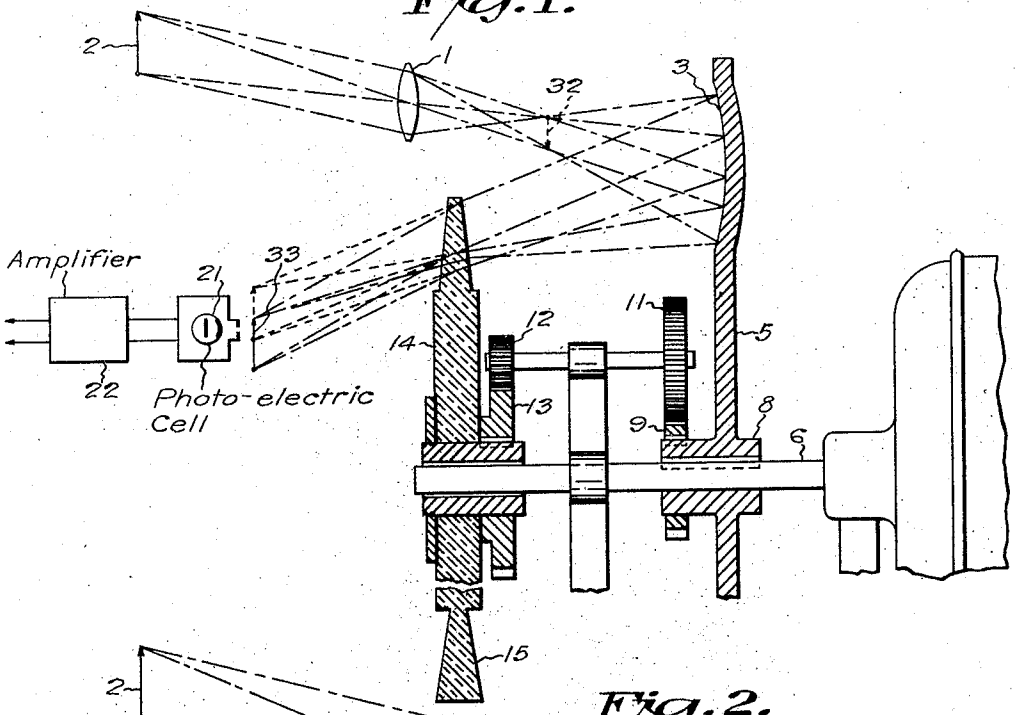
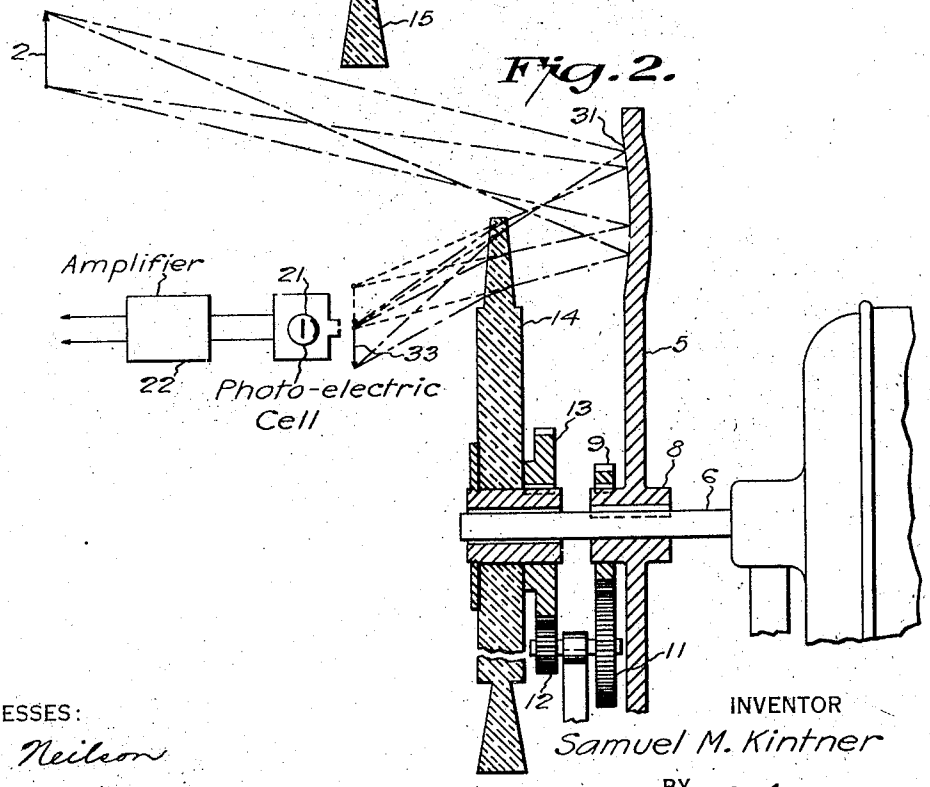


Fig. 2.



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Fig. 3.

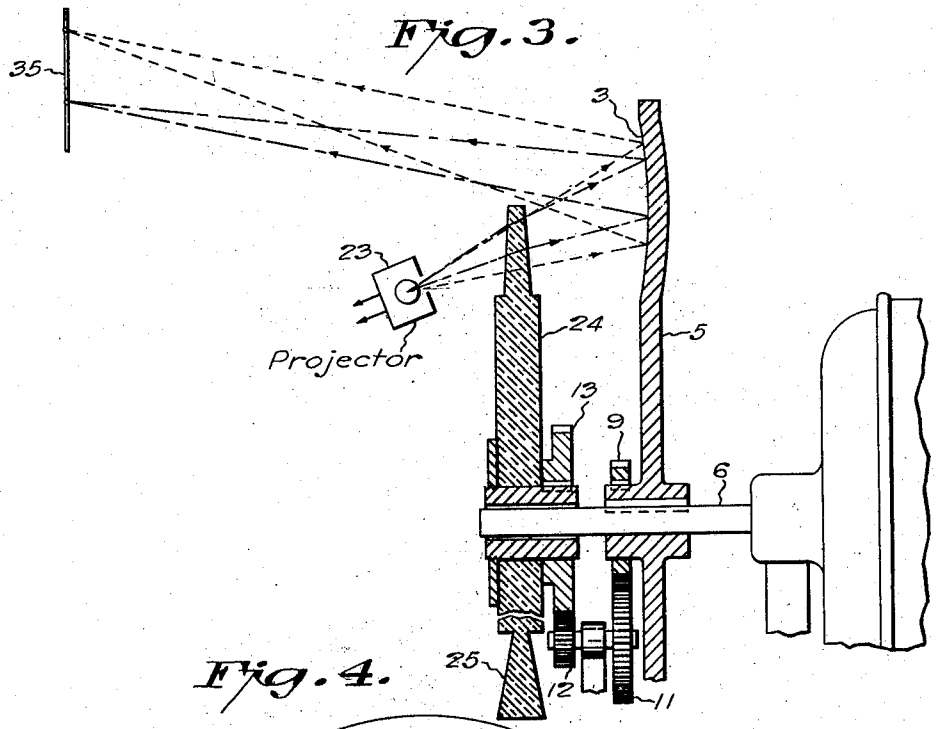
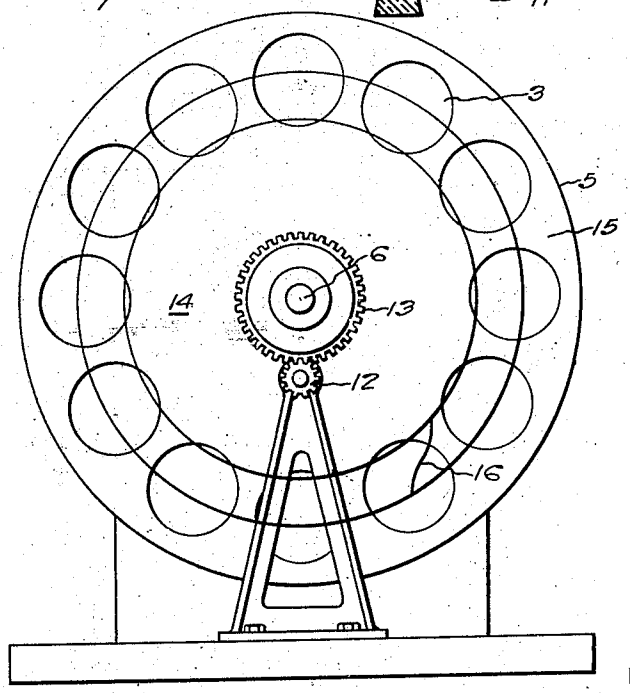


Fig. 4.



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UNITED STATES PATENT OFFICE.

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TELEVISION APPARATUS.

Application filed October 15, 1926. Serial No. 141,728.

This invention relates to devices used in the transmission of pictures. Such devices ordinarily include a scanning apparatus at the sending station and a device at the receiving station for reproducing the picture. My invention is applicable to both the scanning device and to the picture-reproducing device.

It has heretofore been proposed to provide, in such devices, a rotating disc having a circular or a spiral row of lenses. As the disc must be rotated at high speed, large centrifugal stresses are thereby introduced. To provide sufficient strength to sustain such stresses is particularly difficult in a structure partly of glass and partly of metal. The lenses, because they differ greatly in density from the disc itself, increase this difficulty by causing highly localized inertia forces.

It is an object of my invention to provide adisc for use in devices of the classes indicated which shall avoid the difficulties encountered when lenses are mounted in the moving disc.

It is a further object of my invention to provide a disc and a focusing device integral therewith.

It is a further object of my invention to so add the focusing devices to the disc as to produce a substantially homogeneous structure.

It is a further object of my invention to avoid causing any change of a mechanical character in the rotating body by the provision of the focusing devices.

It is a further object of this invention to form focusing devices of the material of the revolving disc itself.

It is a further object of my invention to provide a rotating disc which may be driven at high speed without danger of breakage.

It is a further object of my invention to reduce the number of lenses required in a scanning or picture-reproducing device.

It is a further object of my invention to provide a focusing device which shall not introduce any substantial mechanical alteration of the disc itself, whereby the disc shall have a substantially uniform density.

It is a further object of my invention to provide a plurality of concave reflecting surfaces in a disc, at a minimum expense.

Other objects of my invention will be apparent from the following description and the accompanying drawings, in which:

Fig. 1 is a view, partly diagrammatic and partly in section, showing my invention applied to one form of scanning device;

Fig. 2 is a similar view showing my invention applied to another form of scanning device;

Fig. 3 is a similar view showing the application of the invention to a picture reproducing device; **and**

Fig. 4 is a front elevation of the rotating part of the mechanism shown in the other figures.

In Fig. 1, the lens 1 is a diagrammatic representation of any optical system intended to produce an image of the object 2. The image is reflected by means of a concave mirror 3, which is one of a series of mirrors, best illustrated in Fig. 4.

As shown in Fig. 4, the mirrors are formed adjacent to the circumference of the disc 5, the center of which is in the axis of the shaft 6. In certain forms of device, the concave mirrors may be formed in a spiral instead of adjacent to a circumference. The hub 8, keyed to the shaft 6, carries both the disc 5 and the first member 9 of a train of reducing gears 9, 11, 12 and 13, by means of which the refracting device 14 is driven at a slower speed than the disc 5.

The refracting device is of glass and includes an annular portion 15 having a prismatic cross section. The angle of the prism varies progressively from point to point along the circumference of the annulus. As a consequence of this variation, the glass tapers outwardly in one portion of the annulus. This outward taper diminishes progressively around the annulus until a point is reached where the faces of the glass are parallel. The variation of the angle continues in the same sense, whereby the margin at this part of the circumference tapers inwardly with a gradually increasing taper until the point at which the outward taper begins is reached. At this point, there is an abrupt change in the shape of the prism. At all other points throughout the annulus, the change in the shape is gradual. The abrupt change is shown at 16 in Fig. 4.

A photo-electric cell 21, suitably positioned with respect to the parts just described, constitutes a usual part of many picture-transferring systems. The amplifier 22 and the leads extending therefrom are intended to represent any system by which the changes

in the illumination of the photo-electric cell are translated into modulations of the energy used for signalling. My invention is applicable to any form of picture-transmitting system and the system is, therefore, not indicated or described in any further detail.

In Fig. 3, a projector 23 is shown which is at any one of the receiving stations associated with the sending station represented in Fig. 1 to constitute a picture-transmitting system. The refracting device 24, with its annular prismatic portion 25, is similar to the refracting device 14, with its prismatic portion 15, described in connection with Fig. 1. The disc 5 in Fig. 3 is similar in construction to the disc 5 in Fig. 1.

The apparatus shown in Fig. 2 differs from that shown in Fig. 1 by the omission of the lens 1. The concave mirror 31 corresponds to the concave mirror 3, but, because of the absence of any optical system corresponding to the lens 1, this mirror will, in general, have a longer radius of curvature. The other portions of Fig. 2 are like the corresponding portions of Fig. 1 and need not be separately described. Fig. 2 is presented to show how, by proper choice of the curvature of the concave mirrors, the mirrors, by themselves, may be made to perform the function of the optical system represented by the lens 1. Obviously, by choosing an intermediate radius of curvature for the mirrors, an optical system of less magnification than that represented in Fig. 1 may be employed.

In the operation of the device, light which comes from the object 2 is caused to produce an image at the point 32 in Fig. 1 by means of the optical system 1. The light from this image, or from the object itself, if the system shown in Fig. 2 be used, is reflected by the concave mirror toward the refracting device 14. It is refracted by this device to an extent and in a sense which depends upon the angle of the prismatic section of the annulus.

The light, as it emerges from the refracting device, falls upon the photo-electric cell 21. Preferably, this cell is provided with a small light opening so that only a small portion, practically a point, of the object 2 or of the image 32, is correlated with the opening of the photo-electric cell at any one time. The illumination of the cell and, consequently, the modulation of the transmitted energy, is thus made to correspond to the brightness of any one point of the object 2 at any one time.

As the disc 5 revolves, the motion of the mirror 3 at right angles to the plane of the section in Fig. 1 causes the point in the object 2 corresponding to the opening of the photo-electric cell to trace a line at right angles to the plane of said section. As the mirror 3 passes beyond the position in which it is in operative relation to the object 2 and the photo-electric cell 21, and the next mirror of the set represented in Fig. 4 comes into said operative position, the point in the object 2 correlated with the opening in the photo-electric cell changes abruptly from one end of said line to the other. The passage of successive mirrors through the operative position is thus accompanied by the tracing of lines in one direction in the scene, and the position of the mirror at any one instant is thus correlated to one coordinate of the point in the object or scene corresponding to the opening of the photo-electric cell.

The rotation of the disc 5 is accompanied by a rotation of the refracting device 14. The position of the image 33 in front of the photo-electric cell is shifted in the plane of the section in Fig. 1 by the action of the refracting device. This is indicated on the drawing by showing two positions of the image 33. The one shown in solid lines corresponds to a portion of the annulus 15 tapering outward; the one in dotted lines corresponds to the portion of the annulus at which the two faces are parallel.

The shift is progressive, the image 33 being moved farther and farther in one direction as the angle of the prism changes gradually and being shifted abruptly in the other direction when the shoulder 16 in the refracting device passes the operative position.

For clearness, the window in the photo-electric cell is shown at a little distance from the plane of the image 33. Preferably, the window is in the plane of the image. The whole image 33 does not illuminate the photo-electric cell. Only that portion of the image which is immediately in front of the opening in the housing of the photo-electric cell controlls the illumination of the cell.

The point in the object 2, corresponding to the opening in the photo-electric cell, varies, therefore, with the position of the refracting device 14, and this variation is at right angles to the variation caused by the rotation of the disc 5. The position of the refracting device 14 is, therefore, correlated to a second coordinate of the point in the scene or object 2. The two positions, therefore, that of the disc 5 and that of the refracting device 14, fix the two coordinates of the point in the scene which is to control the modulation of the transmitted energy.

The transmitted energy controls the brightness of the source of light in the projector 23 at the receiving station. This control is effected by any means known to the art. The system used to transmit the modulated energy and to control the brightness of the projector in correspondence to the modulation does not form any part of my invention and, for this reason, is not described.

The light from the projector 23 is refracted by the moving prism 25 and falls upon the mirror 3 in a direction fixed by the position of

the refracting device 24. The mirror 3 reflects this light to the screen 35. The position of the point at which the reflected light impinges upon the screen 35 is dependent, therefore, upon the position of the refracting device 24. It is also dependent upon the position of the mirror 3 which changes with the rotation of the disc 5.

The co-ordinates of the point on the screen illuminated by the projector 23 are fixed, therefore, by the positions of the refracting device 24 and the disc 5. The illuminated point traces a line at right angles to the plane of the section (Fig. 3) for each passage of a mirror 3 through the operative position. These lines progress as the refractor 24 rotates, and the direction of said progression is parallel to said plane. The lines move abruptly to their original positions when the shoulder 16 in the prismatic portion of the refracting device passes the operative position.

In the manufacture of the disc 5, the depressions which are to be the concave mirrors may be produced either by stamping, as illustrated in the drawing, or by grinding or by any other convenient method. The curvature of these mirrors is greatly exaggerated in the drawing for the purpose of clearly showing them. Actually, the stamping or grinding changes the shape of the disc so slightly that it produces no sensible weakening of the disc.

After the depressions have been formed, they are given approximately their final shape by a grinding operation and are rendered optically correct. The stamping or preliminary grinding and the finer grinding and the figuring may all be performed with automatic machinery, with the result that the disc 5, with its series of mirrors, may be produced inexpensively.

Preferably, the mirrors are spherical mirrors but other forms of reflectors may be used. The concave surface only of the disc 5 need be of good reflecting character. The remainder of the disc preferably will have as small a reflecting power as can conveniently be obtained. For example, the disc may be made of stainless steel or plated with chromium and all of it except the mirrors covered with a non-reflecting substance, such as platinum-black, or the disc may be made of dull metal and the mirrors alone plated with a reflecting metal.

As the disc 5 is rotated at high speed, severe centrifugal strains are caused, but, because the concave mirrors introduce substantially no weakening of the disc, the disc may readily be made strong enough to withstand such stresses. The refracting device 24 rotates at a lower speed. The fact that this device, being of glass, is not mechanically strong need, therefore, cause no inconvenience. As at present contemplated, the gear ratio is such that the disc 5 rotates with four times the speed of the refracting device 14, but, obviously, a very much greater ratio may be used, if desired.

This invention has the advantage over a disc carrying a plurality of lenses, which has been used heretofore, that the cost of the spherical mirrors is much less than the cost of the lenses. My invention has the further advantage that a disc having spherical mirrors may be rotated at a much higher speed without breakage than is possible if lenses are employed, and also the advantage that the spherical mirrors will cause very much less unbalancing of the disc than would be caused by lenses, and, consequently, vibration of the rotating parts, with consequent blurring of the picture, will be diminished.

It has the further advantage that the disc and focusing devices constitute one integral body.

Although I have illustrated and described specifically only a few modifications of my invention, many other changes will be apparent to those skilled in the art and I do not intend to include any limitations except such as are indicated in the claims or are required by the prior art.

I claim as my invention:

1. In a translating device for picture transference, a rotatable member of approximately disc form and a series of reflecting devices disposed in rotative sequence on said rotatable member, each of said reflecting devices having its reflecting surface a surface of revolution, whereby each reflecting device is capable of producing a point focus.

2. In a translating device for picture transference, a disc, means for rotating said disc about its axis, a plurality of reflective-focusing devices disposed in rotative sequence on one face of said disc, each of said reflecting devices having its reflecting surface a surface of revolution, whereby each reflecting device is capable of producing a point focus and an optical system including each of said reflective devices in turn, whereby the position of said included reflective device relative to the non-rotating parts of said optical system may be made to correspond to one coordinate of the points in the picture.

3. In a translating device for picture transference, a disc, means for rotating said disc about its axis, a plurality of reflective focusing devices arranged in circumferential sequence on one face of said disc and an optical system including each of said refletcive devices in turn, whereby the position of said included reflective device relative to the non-rotating parts of said optical system may be made to correspond to one coordinate of the points in the picture, said optical system also including a moving element, the position of which may be made to correspond to the other coordinate of said points.

4. In a translating device for picture trans-

ference, a rotatable member and a plurality of reflecting focusing devices so positioned thereon that rotation of said member brings them successively into operative position, each of said focusing devices having its reflecting surface a surface of revolution, whereby each focusing device is capable of producing a point focus and said member having substantially the same mechanical strength in a radial direction at the positions of said focusing devices as at other postiions.

5. In a translating device for picture transference, a disc of sheet material, concave mirrors constituting depressions in the surface of said disc and means for rotating the disc about an axis eccentric to each of said mirrors.

6. In a translating device for picture transference, a disc of sheet material, concave portions constituting depressions in the surface of said disc, means for rotating the disc about an axis eccentric to each of said portions, and a reflective surface material on the concave portions.

7. In a translating device for picture transference, a disc of sheet material, concave portions constituting depressions in the surface of said disc, means for rotating the disc about an axis eccentric to each of said portions, and a plating of highly reflective metal on the concave portions.

8. In a translating device for picture transference, a disc of sheet material, concave portions constituting depressions in the surface of said disc and means for rotating the disc about an axis eccentric to each of said portions, the surface of said concave portions being finished with optical accuracy to constitute them focusing devices.

9. In a translating device for picture transference, a disc of sheet material, a plurality of concave reflecting portions constituting depressions in the surface of said disc, means for rotating the disc about an axis eccentric to each of said portions.

In testimony whereof, I have hereunto subscribed my name this 12th day of October, 1926.

SAMUEL M. KINTNER.