Oct. 6, 1931. L. H. DAWSON 1,825,781

TELEVISION SCANNING DEVICE

Filed July 30, 1929 4 Sheets-Sheet 1

FIG. 1

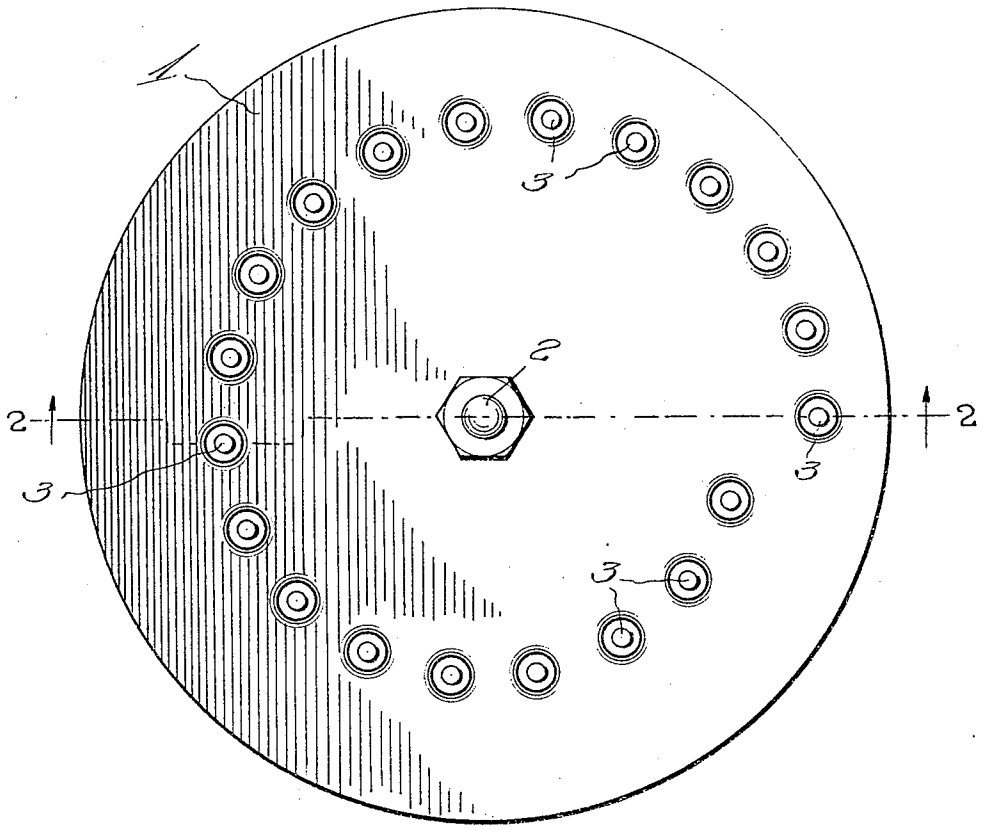
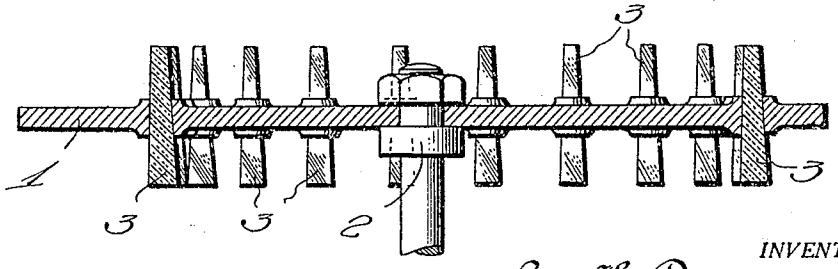


FIG. 2

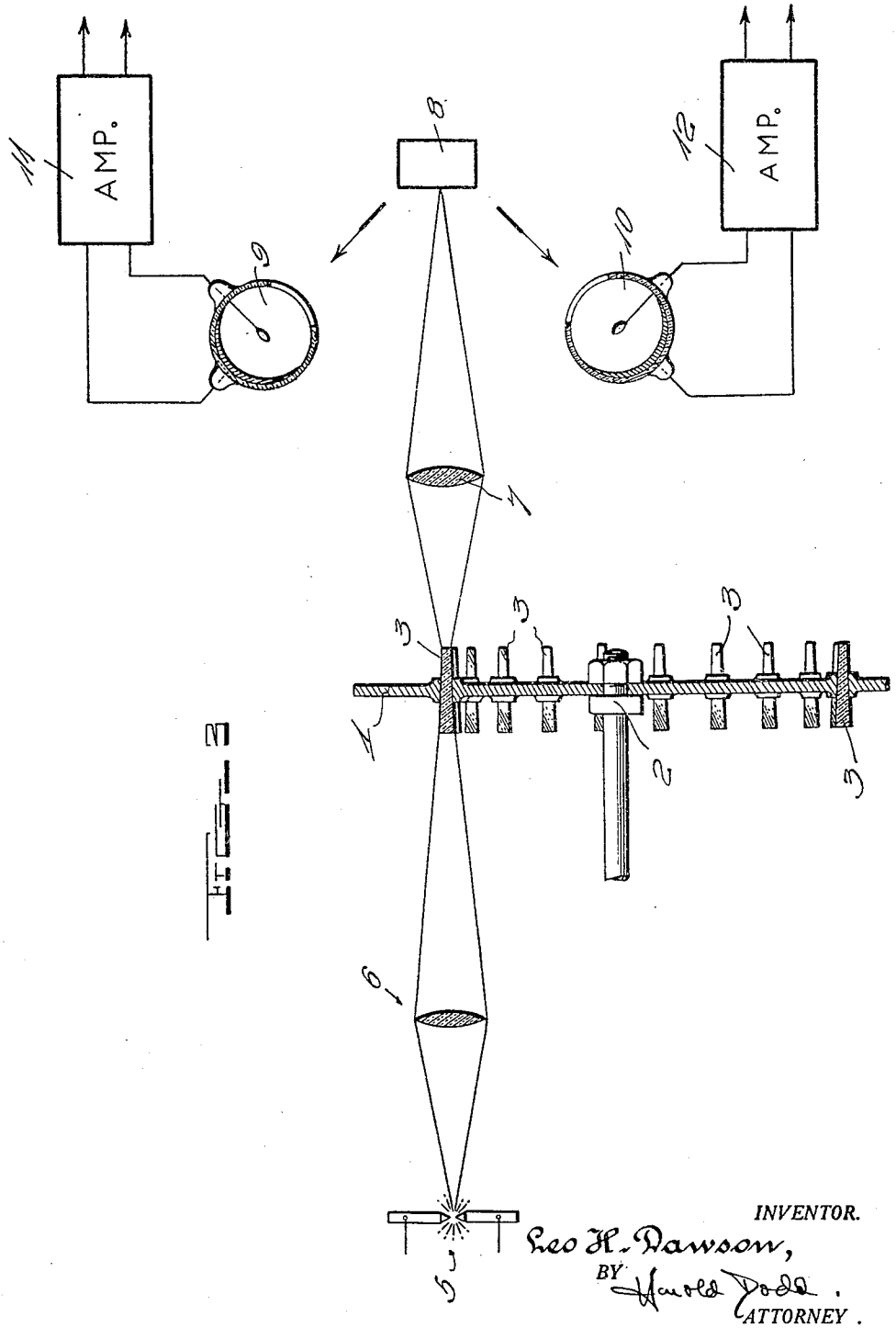


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FIG. 4

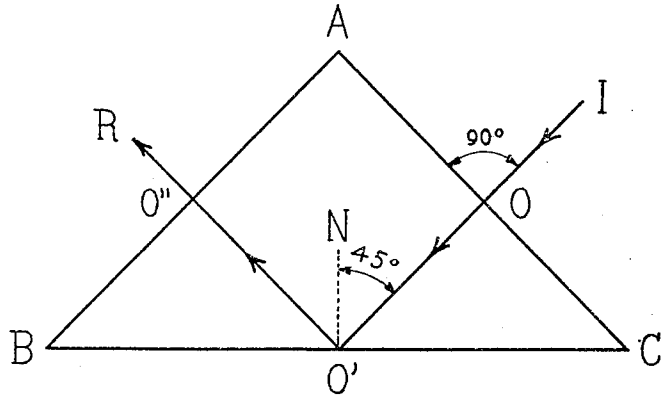
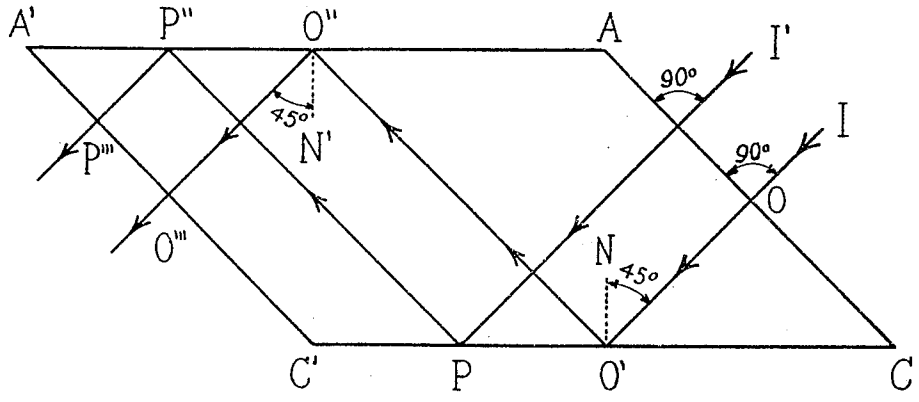


FIG. 5



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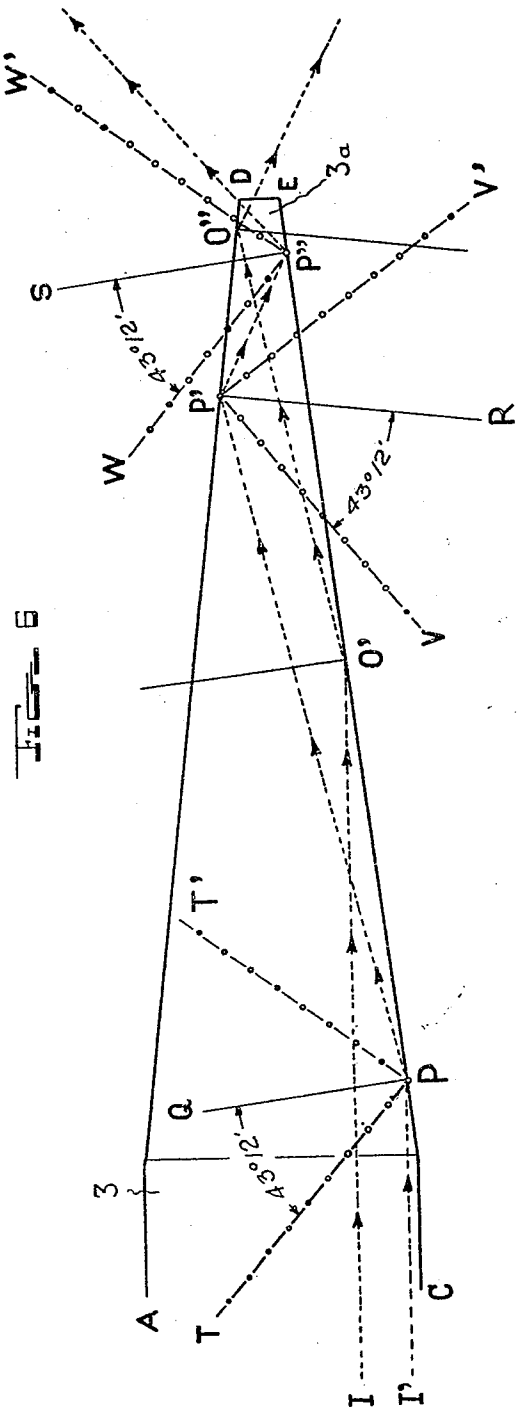
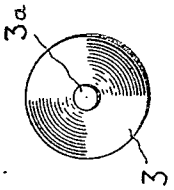


FIG. 6

FIG. 7



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Patented Oct. 6, 1931

1,825,781

UNITED STATES PATENT OFFICE

LEO H. DAWSON, OF WASHINGTON, DISTRICT OF COLUMBIA

TELEVISION SCANNING DEVICE

Application filed July 30, 1929. Serial No. 382,162.

My invention relates to scanning devices generally and more particularly to scanning devices employed in television transmitters and receivers.

An object of my invention is to provide an improved scanning device whereby greater transfer of luminous energy is possible.

Another object of my invention is to provide a scanning device whereby greater detail of the transmitted and received image is possible.

A further object of my invention is to provide a scanning device whereby diffraction of the luminous energy is reduced.

Other and further objects of my invention reside in certain structural features employed whereby an improved and inexpensive scanning device may be had.

A better understanding of my invention can be had from the specification following and from the accompanying drawings, wherein:

Figure 1 is a plan view of the scanning device of my invention; Fig. 2 shows a section in side elevation of my invention; Fig. 3 is a diagrammatic illustration showing the scanning device of my invention employed in a television system; Figs. 4 and 5 illustrate the optical features employed in the scanning device of my invention and Figs. 6 and 7 show side and end views respectively of a part of the scanning device of my invention.

Systems for the transmission and reception of pictures or images are generally of a certain design and operate upon certain common principles. The picture is scanned in a manner generally well known to those skilled in the art, which comprises the operation of sweeping a plurality of lines across the picture if at the transmitter, and across a source of variable luminous energy if at the receiver. The scanning device usually comprises a disc or band having perforations or light apertures arranged in the proper formation. The perforations are merely holes which offer a path of low resistance to light energy. The intensity of the light energy therethrough is proportional to the dimensions of the holes or apertures, employing a constant source of energy. In the television scanning device of my invention greater intensity of the luminous energy is possible and other advantages as will appear from the specification following.

Figure 1 of the accompanying drawings shows a plan view of a scanning disc embodying my invention. The disc comprises a circular member 1 of suitable metal or other material the center of which is mounted on a hub 2. A plurality of apertures are arranged in a spiral formation with respect to the plane of the circular member in which are mounted a plurality of light conducting and concentrating members 3. The distance between the successive light concentrating members 3 usually determines one dimension of the object while the difference between the radius of the member nearest hub 2 and the radius of the member nearest the periphery of circular member 1 determine the other dimension of the object.

Fig. 2 shows the light concentrating members 3 in greater detail. Circular member 1 is shown in section. Light concentrating members 3 comprise lengths of conical shaped or wedged shaped transparent material such as glass, quartz, silicate or boro-silicate composition. Any material may be employed having a high refractive index. In the case of glass and air the refractive index is 1.5. The refractive index of quartz exceeds this value and is preferred for most uses. The conducting and concentrating action of members 3 depends upon the principle of internal reflection which will be discussed in connection with Figs. 4, 5, 6 and 7.

Fig. 3 is a diagrammatic illustration showing the scanning device of my invention associated with the principal parts of a televsion transmitter. Hub 2 of the scanning disc is associated with a source of mechanical energy, as by coupling to the shaft of an electric motor. Source of light energy 5 may be an electric arc, incandescent bulb or any suitable source, the rays from which are directed toward lens 6. From lens 6 the rays converge and are caused to be incident on the large end of light conducting member 3. The rays of lights are concentrated through member 3

emerging from the small end thereof and caused to be incident on lens 7. Rays from lens 7 in turn are directed upon image 8. The reflected light energy from image 8 actuates light sensitive elements 9 and 10 converting variations of light energy into variations of electrical energy which are in turn amplified by amplifiers 11 and 12. The property of member 3 to conduct and transmit luminous energy is more fully described in Figs. 4, 5 and 6.

Fig. 4 shows a right angled prism ABC of glass. If a ray of light is incident normally on one of the shorter faces AC at point O, it will enter the glass without refraction and will be incident on the hypotenuse BC at an angle of 45°. As this angle is greater than the critical angle, in the case of glass and air, the ray will not be able to pass out into the air which is a less dense medium at O', but will be reflected along O'O'', and will be incident normally at O'', and continue along O''R. The prism has therefore acted as a plane mirror and simply reflected the ray, turning its direction through a right angle. This is total internal reflection which depends upon the refractive index and hence upon the critical angle.

Fig. 5 shows another form of prism, reference characters corresponding to those of Fig. 4. A ray of light I normally incident on surface AC is reflected at O' along the line O'O'' incident at an angle of 45° and reflected along O''O'''. Here the light ray continues in the same direction but is moved to one side from its original path. A second ray I' is caused to likewise be normally incident on surface AC penetrating the glass to point P without being refracted. Ray I' is reflected from point P to point P'' because the ray will not pass from the denser medium to one less dense when it is within the critical angle but will be reflected back into the denser medium. In like manner this ray will be reflected from point P'' through the face A'C' since it is normally incident thereto.

Figs. 6 and 7 show the light conducting member which is employed in the scanning device of my invention. Member 3 is of quartz, glass or suitable transparent material, conically shaped and having a reduced or tapered portion 3*a*. A circular cone as shown in the figure is a very suitable and effective form and gives good results. There may be tapering varied in accordance with the application intended, the extreme end reduced to as small dimensions as desired. The tapering may be governed by exponential functions or depart from this relation. Ray of light I is caused to be normally incident on face AC of member 3. The ray enters the quartz and continues to the point O'. Since the density of quartz is greater than that of the surrounding media, the ray does not continue in the direction IO' but is reflected at O'. The ray continues along O'O'' again reaching the region of less density and passes through end face DE.

In a similar manner ray I' is caused to be normal to face AC of member 3, travels along the line I'P and is reflected at P along the line PP'. At P' the ray is again reflected along the line P'P'' and is again reflected through end face DE. It is seen that the rays I and I' are concentrated or brought nearer together in the tapered portion 3*a* of member 3 without appreciable loss of energy. From the small end 3*a* of member 3 the concentrated rays of light are directed as desired depending upon the television system employed. Fig. 7 shows an end view of the light concentrating and conducting member employed in the scanning device of my invention. The small end portion 3*a* may be drawn down to a point. This depends upon the television system employed and the scanning desired. In some cases it may be sufficient where member 3 does not taper to the same extent required in other cases where greater detail is necessary.

Fig. 6 illustrates the course of a ray in fused quartz for which the index of refraction is 1.45843 for the sodium 5890 line. The figure shows a cone of vertical angle 14 degrees and is drawn to scale showing the angle of reflection equal to the angle of incidence. The sine of the critical angle of total reflection is equal to the reciprocal of the index of refraction, whence for fused quartz the critical angle is 43° 12'. Another material of high refractive index which is suitable is light flint glass having an index of refraction of 1.5750 for the same sodium line.

It may be easily shown that for a concentrating member which is a circular cone with vertical angle $2m$, for rays entering parallel to the axis, the angle of incidence at the nth reflection is equal to $90° - (2n-1)m$.

In Fig. 6, the lines PQ, P'R and P''S are the normals to the surface at points P, P' and P'', and the critical angles as TPQ are shown as equal to 43° 12'. So long as the angle of incidence exceeds this critical angle, total reflection will occur as shown.

By referring to Fig. 3 of the accompanying drawings many advantages of my invention may be learned. In television systems generally, disc 1 is not provided with any light conducting members or light concentrating members. A multiplicity of holes are provided arranged in spiral formation on member 1. The aperture, through which member 3 extends but without member 3, may be likened to that usually provided. By employing the aperture in the absence of member 3, an appreciable and serious loss of intensity is experienced which may be attributed to diffraction. In the scanning device of my invention a member 3, of

quartz, glass or the like having a high refractive index is inserted in the apertures or holes normally provided. A material having a refractive index exceeding 1.40 is effective.

Due to the high refractive index the quartz or glass has a large critical angle of internal reflection. Thus a beam of light entering the large end of member 3 will emerge from the small end with almost undiminished intensity. The spot of light emerging from the small end of member 3 is clearly defined, the edges being easily discerned. The edges of the spot without member 3, but merely employing the aperture, are not clearly defined. The size of the spot may be varied at will by inserting concentrating members having different size points. It is therefore possible to provide an image of much less dimension than is possible with the smallest drill without obtaining objectionable diffraction patterns. This is to be especially desired where the transmission and reception of images in great detail are necessary, such as for instance, images of writing, maps and identification. Members 3 may be of glass or suitable silicate composition, however quartz is to be preferred. Systems of lenses have been proposed heretofore but the cost of such apparatus is an effective obstacle preventing their practicability. Lens systems providing a combination of conducting and concentrating arrangement for scanning discs would necessarily require great precision in matching each individual lens so employed and elaborate focusing to obtain efficient results. The small cost of manufacturing the conical shaped conducting and concentrating members employed in the scanning device of my invention presents an advantage over other arrangements heretofore employed. The light conducting and concentrating members employed in the scanning device of my invention may be arranged in stepped formation on a movable band instead of the disc illustrated in the accompanying drawings.

It is obvious that many modifications of my invention are possible as to the arrangement and dimensions of the light conducting and concentrating members employed and it is to be strictly understood that the embodiments of my invention are not to be restricted by the foregoing specification or by the accompanying drawings but only by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A scanning device for television systems comprising in combination an opaque member adapted to be moved in a path of light, said member having a plurality of light conducting and concentrating members and said last mentioned members comprising individual conical shaped sections of material having a relatively high refractive index.

2. A scanning device comprising in combination a movable disc having a plurality of conical shaped light conducting and concentrating members extending through said disc perpendicular to the plane thereof and said light conducting and concentrating members comprising individual lengths of material having a high refractive index.

3. In a scanning device the combination of members inserted in apertures provided in a movable member for conducting and concentrating luminous energy normally incident thereto through said movable member, said first mentioned members comprising conical shaped sections of material having a high refractive index.

4. In a scanning device for television wherein apertures are arranged in spiral formation in a movable disc member the combination of individual conical shaped quartz sections positioned in said apertures for conducting and concentrating luminous energy through said disc without diffraction.

5. A scanning device comprising in combination a movable member having a plurality of conical shaped light conducting and concentrating members of material having a high refractive index provided in the apertures for normally conducting the luminous energy through said movable member.

6. In a scanning device wherein apertures are normally provided in a movable opaque member for admitting luminous energy therethrough the combination of a plurality of individual conical shaped lengths of quartz positioned in said apertures for conducting and concentrating the luminous energy through said aperture.

7. In a scanning device wherein apertures are normally provided in a movable opaque member for admitting luminous energy therethrough the combination of a plurality of individual conical shaped lengths of glass of high refractive index positioned in said apertures for conducting and concentrating the luminous energy through said apertures.

8. In a scanning device wherein apertures are normally provided in a movable opaque member for admitting luminous energy therethrough the combination of a plurality of individual conical shaped lengths of fused silicate positioned in said apertures for conducting and concentrating the luminous energy through said apertures.

9. In a scanning device wherein apertures are normally provided in a movable opaque member for admitting luminous energy therethorugh the combination of a plurality of individual conical shaped lengths of borosilicate material positioned in said apertures for conducting and concentrating the luminous energy through said apertures.

10. In a scanning device wherein apertures are normally provided in a movable opaque member for admitting luminous energy therethrough the combination of a plurality of individual conical shaped lengths of material having a high refractive index positioned in said apertures for conducting and concentrating the luminous energy through said apertures.

11. In a scanning device wherein apertures are normally provided in a movable opaque member for admitting luminous energy therethrough the combination of a plurality of individual conical shaped lengths of material having a high refractive index positioned in said apertures for conducting and concentrating the luminous energy through said apertures thereby eliminating a substantial loss of energy due to diffraction normally caused by said apertures.

12. In a television system, a scanning disc, a plurality of light conducting members mounted on said disc in special relation and substantially perpendicular to the plane of said disc, said light conducting members being composed of a material having a refractive index exceeding 1.40.

13. In a television system, a scanning disc, a plurality of light conducting members mounted on said disc in special relation and substantially perpendicular to the plane of said disc, said light conducting members being composed of fused quartz.

14. In a television system, a scanning disc, a plurality of light conducting members mounted on said disc in special relation and substantially perpendicular to the plane of said disc, said light conducting members being composed of a material having a refractive index exceeding 1.40 and being in the form of the frustum of a right circular cone, whereby light impinging upon the base of said frustum is delivered from the smaller face of said frustum as an intense spot of light without diffraction patterns.

15. In a television system, a scanning disc, a plurality of light conducting members mounted on said disc in special relation and substantially perpendicular to the plane of said disc, said light conducting members being composed of a material having a refractive index exceeding 1.40 and being in the form of a right circular cone, whereby light impinging upon the base of said frustum is delivered from the smaller face of said frustum as an intense spot of light without diffraction patterns.

16. In a television system, a scanning disc, a plurality of light conducting members mounted on said disc in special relation and substantially perpendicular to the plane of said disc, said light conducting members being composed of a material having a refractive index exceeding 1.40 and being in the form of the frustum of a right circular cone having the smaller face of approximately pin head dimensions, whereby light impinging upon the base of said frustum is delivered from the smaller face thereof as an intense spot of light without diffraction patterns.

17. In a television system, a plurality of light conducting members mounted on said disc in special relation and spiral formation and substantially perpendicular to the plane of said disc, said light conducting members being composed of a material having a refractive index exceeding 1.40 and being in the form of the frustum of a right circular cone, whereby light impinging upon the base of said frustum is delivered from the smaller face thereof as an intense spot of light without diffraction patterns.

18. In a television system, a scanning disc, a plurality of light conducting members mounted on said disc in special relation and substantially perpendicular to the plane of said disc, said light conducting members being composed of fused quartz, and being in the form of the frustum of a right circular cone, whereby light impinging upon the base of said frustum is delivered from the smaller face of said frustum as an intense spot of light without diffraction patterns.

19. In a television system, a scanning disc, a plurality of light conducting members mounted on said disc in special relation and substantially perpendicular to the plane of said disc, said light conducting members being composed of fused quartz and being in the form of the frustum of a right circular cone having the smaller face of approximately pin head dimensions, whereby light impinging upon the base of said frustum is delivered from the smaller face thereof as an intense spot of light without diffraction patterns.

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