

[54] **READER MECHANISM FOR OPTICALLY DISCERNIBLE CHARACTERS**

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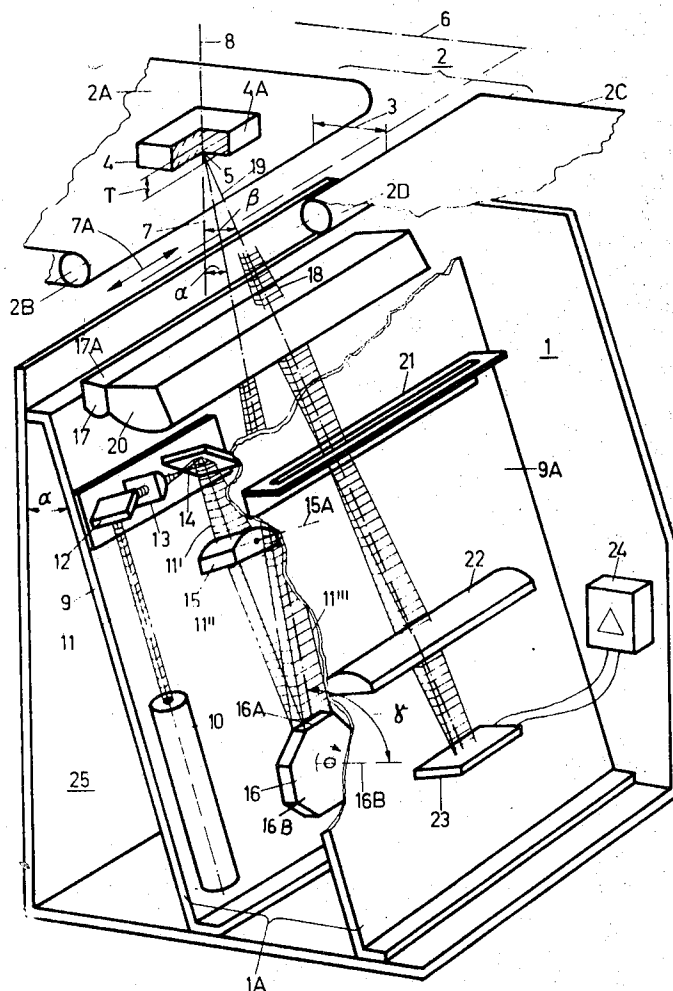
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[57] **ABSTRACT**

A reader mechanism for optically discernible characters, especially characters associated with an article and applied thereat or thereto and which can be located within a predetermined depth of focus region about a reference plane and can be scanned by means of a light spot, wherein there is also present a photo-electrical receiver which takes-up a portion of the light reflected back from the character and delivers an electrical signal corresponding to the incident light current. The invention provides for a collecting lens arranged between the reference plane and the receiver. A diaphragm arranged at the focal plane of the collecting lens confronting the receiver at the region of the light current extending to the receiver. The diaphragm is provided with an opening dimensioned such that a light beam emanating from the forwardmost situated plane of the depth of focus region and directed towards the receiver at least completely fills-out the diaphragm opening in the transverse direction.

15 Claims, 3 Drawing Figures



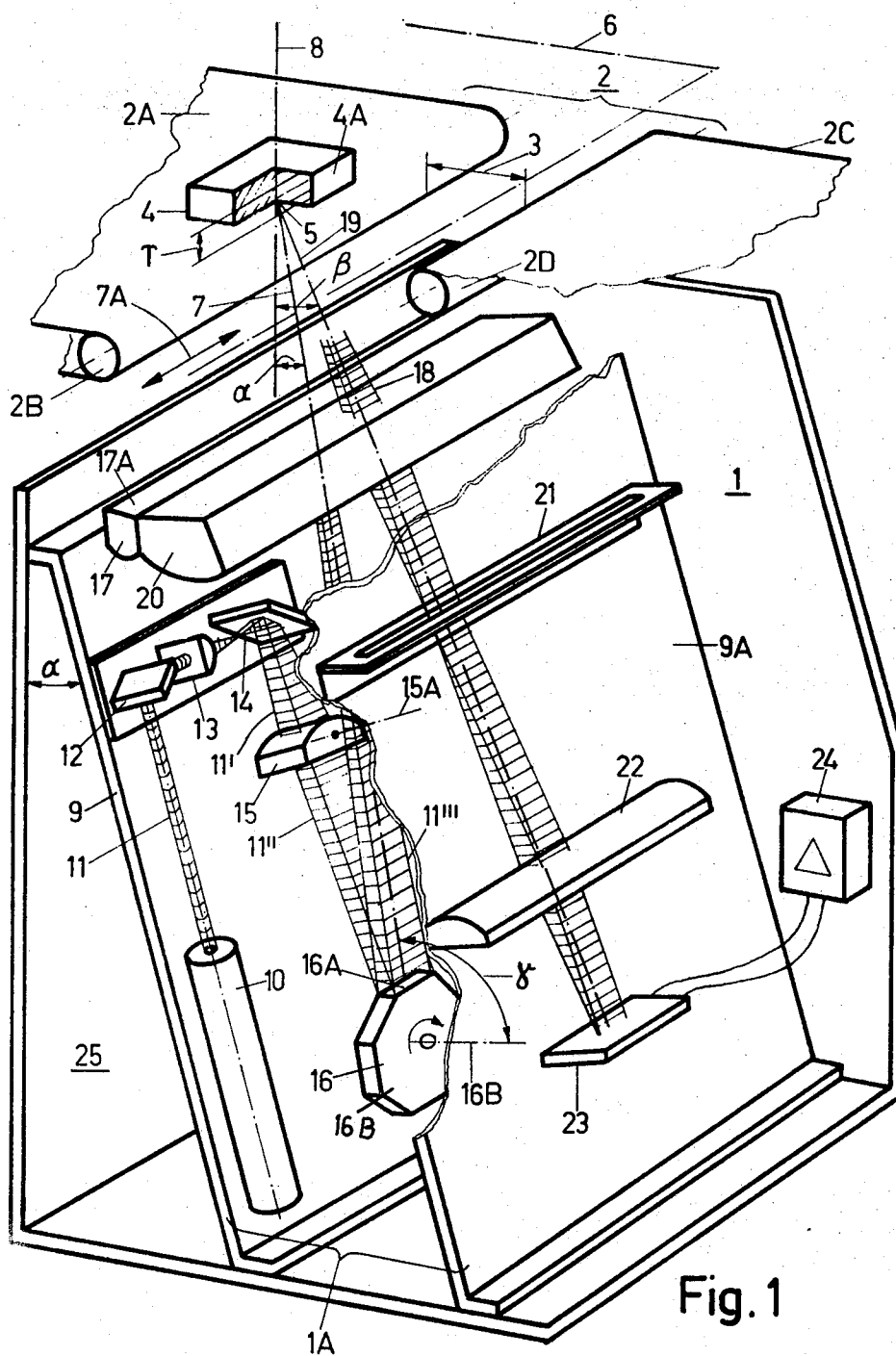
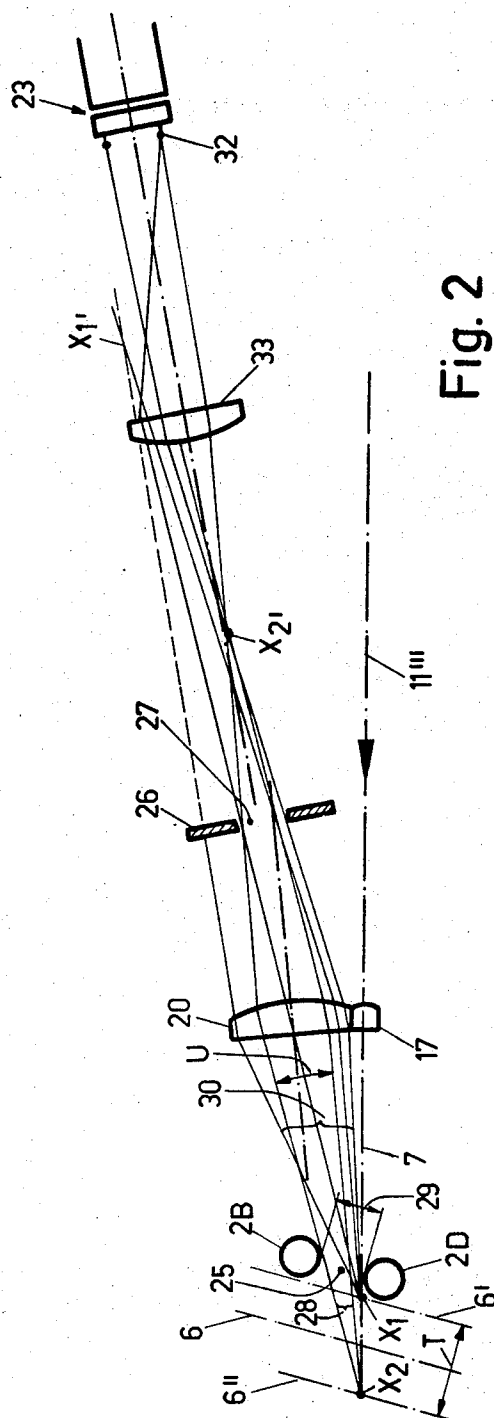
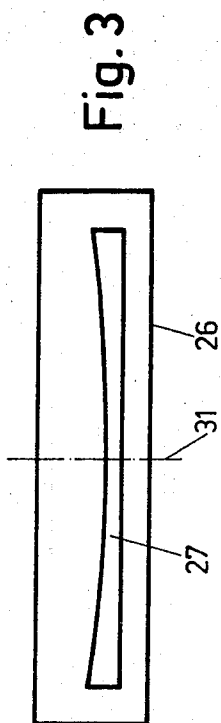


Fig. 1



READER MECHANISM FOR OPTICALLY DISCERNIBLE CHARACTERS

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved reader mechanism or reader for optically discernible characters, and in particular, this invention deals with a reader mechanism for optically discernible characters which are associated with goods of various types and preferably applied thereto. The term "article" as used herein is employed in its broadest sense to encompass different types of goods, wares, products or the like which can have information applied directly or indirectly thereto.

These characters can constitute information associated with the relevant goods, preferably in coded form. For the purpose of reading-out such character a transmitted beam or bundle of light is guided over the character and depending upon the reflection capability of the location of the character impinged by such transmitted light beam, a portion of the latter is reflected. A received bundle of light formed at least from part of the reflected light is delivered to an electro-optical receiver which transforms the received light beam into an electrical signal. This electrical signal can be delivered in conventional manner to a computer and evaluated. The evaluation result can concern the indication of the price of the goods, the introduction of the price of the goods into a calculating installation, the determination of the sale of different articles, the article numbers of which are coded in character form, and quite generally can serve for controlling the warehouse and storage supply, just to mention a few possibilities.

With readers of the aforementioned type a character which is to be read-out is arranged or moved past a spatial zone or region associated with the reader, this spatial region encompassing for instance the depth of focus region or definition depth of the optical system. If the reflecting location of the character to be read is located at a random position within such depth of focus region, then the light current flowing to the photoelectric receiver varies as a function of the actual position of such character. This positional-dependency of the light current represents a drawback in photoelectric read-out techniques.

SUMMARY OF THE INVENTION

Accordingly, from the foregoing it will be recognized that the art is still in need of a reader or reader mechanism for optically discernible characters which is not associated with the previously mentioned drawbacks and limitations of the prior art constructions. Hence, a primary object of the present invention is to provide an improved reader mechanism for optically discernible characters which is not associated with these prior art drawbacks and limitations and effectively and reliably fulfills the existing need in the art.

Another and more specific object of the present invention relates to an improved construction of reader mechanism of the previously mentioned type by means of which the light current delivered to the receiver for different positions of the character to be read located within a predetermined spatial region is independent of the actual position of the character.

Now, in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, the inventive

reader mechanism for optically discernible characters, in particular optically discernible characters associated with goods and applied thereat or thereto and which can be disposed within a predetermined depth of focus about a reference plane and can be scanned by means of a light spot, comprises a photoelectric receiver which receives a portion of the light reflected by the character and delivers an electrical signal corresponding to the incident light current. According to important aspects of this development a collecting lens is disposed between the reference plane and the receiver. A diaphragm is arranged in the focal plane of the collecting lens which faces the receiver at the region of the light current or flow travelling to the receiver. This diaphragm is equipped with an opening dimensioned such that a bundle of light rays emanating from the furthest located plane of the depth of focus and transmitted to the receiver at least completely fills out the diaphragm opening in the transverse direction.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. 1 is a simplified perspective view of a preferred constructional form of inventive reader mechanism for optically discernible characters as designed according to the teachings of this invention;

FIG. 2 is a schematic showing of the course of the received light beam or rays; and

FIG. 3 illustrates details of a particular constructional form of diaphragm.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawings, FIG. 1 illustrates in simplified perspective view a first exemplary embodiment of inventive reader or reading mechanism for optically discernible characters, part of the apparatus being cutaway in order to improve illustration. Furthermore, for the purpose of simplifying the drawings some of the individual components have only been partially or schematically depicted and it should be understood that the depicted reading mechanism has not been shown to scale.

With the above in mind, and turning now specifically to FIG. 1 it is to be understood that the reading mechanism 1 depicted therein is arranged, for instance, beneath a conventional conveying mechanism 2 having a read-out space or gap 3. This conveying mechanism 2 consists of a conveyor band or belt 2A travelling over a roller 2B as well as a further conveyor band or belt 2C travelling over a further roller 2D, only part of which has been shown. Between the rollers 2B and 2D and between the conveyor belts 2A and 2C trained over these rollers there prevails the aforesaid gap or space 3. The reader mechanism 1 is operable through the region of this space or gap 3 upon a character 5 applied preferably at the bottom of an article or object 4. It is here to be mentioned that it is not absolutely necessary to convey the articles by a conveyor mechanism such as the one illustratively depicted, rather such articles 4 can also be manually guided over or across the gap 3.

Now as far as concerns the character 5 which is provided at the article 4 such can advantageously comprise a conventional code character consisting of concentric circles. By means of this code character or symbol it is possible, for instance, to indicate desired information, such as the price of the relevant article 4 and/or its article number, or even possible other relevant information, such as weight, dimensions, the final permissible sales date and so forth. The character 5 could also be applied, for instance, in the form of a bar or beam type code at a side surface 4A of the article 4. In the ideal situation, the character 5, during such time as it is being read, is located within a reference plane 6 which, in FIG. 1, has been represented by the phantom line border. In the exemplary embodiment under consideration this reference plane 6 has been conveniently assumed to be horizontally disposed. However, it could also be located in an inclined position. Since as a practical matter it is not readily possible to ensure that the character 5 will always be exactly arranged or moved in the reference plane 6 in front of the reading or read-out mechanism 1 the latter is advantageously constructed such that within a spatial tolerance zone or region T associated with the reference plane 6 it ensures for a sufficiently sharp optical scanning of the character 5 in consideration of the structure of the character.

The reading mechanism 1 and its means or component 1A forming the transmitted light beam is advantageously constructed and arranged in such a manner that a transmitted light beam 7 encloses an angle α with respect to a perpendicular or normal 8 taken with regard to the reference plane 6 and which angle reduces the specular or mirror reflections at a receiver component or receiver, as will be considered more fully hereinafter. It is to be understood however that the general arrangement of the reader will be considered herein to the extent necessary to fully comprehend the underlying features of this development, although certain specific facets thereof constitute subject matter of other commonly assigned copending applications. Additional specifics of such reader therefore have been disclosed in our copending United States application, Ser. No. 221,702, filed Jan. 28, 1972, and entitled "Reading Apparatus for Optically Discernible Characters" to which reference may be readily had.

Now for the embodiment under consideration the optical components still to be described hereinafter are secured to a base plate 9 which, in turn, at least approximately likewise encloses the angle α with regard to the perpendicular 8 taken with respect to the reference plane 6. In this way there is realized a particularly simple construction of the optical system as well as a very efficacious utilization of the available space beneath the conveying mechanism 2.

In the embodiment depicted in FIG. 1 a laser 10 serves as the light source for the transmitted beam, the laser 10 can be for instance a helium gas laser. This laser 10 is mounted upon the base plate 9 and can be exactly positionally adjusted by any conventional means. The bundle of light rays or light beam 11 emanating from an end face of the laser 10, and which bundle of light rays are practically parallel, is delivered via a first deflecting mirror 12 to a first lens member 13. Owing to the first lens member 13 there appears a diverging bundle of light rays 11' which is transmitted via a second deflecting mirror 14 through a second lens member 15, leaving such in the form of a converging

bundle of light rays or light beam 11' in the direction of a beam deflecting mechanism 16.

The deflection of the direction of the bundle of light rays or beam 11 via the deflecting mirrors 12 and 14 is not an absolute requirement. However, it is advantageous for the purpose of obtaining the proper beam length required for optical reasons when the reading mechanism 1 possesses relatively small dimensions. In similar manner the use of the lens members 13 and 15 is not an absolute requirement. However, if the character 5 which is to be read-out possesses a very fine structure and if the bundle of light rays 11 emanating from the light source, for instance the laser 10, is not sufficiently fine or parallel, then, such lens arrangement or an equivalent lens arrangement is advantageous for the purpose of realizing a particularly fine scanning light spot and a thin scanning trace or track at the character 5.

Furthermore, it is advantageous to slightly incline at least one of the deflecting mirrors 12 and 14, for instance through a number of angular degrees, with respect to the perpendicular taken to the base plate 9. By so doing it is ensured that the light ray bundles 11, 11' travel at an inclination away from the base plate 9 and distance themselves therefrom, so that with the reflector or mirror surface 16A of the beam deflecting mechanism 16 in a position perpendicular to the base plate 9 the bundle of light rays 11'' reflected therefrom will move past the lens member 15 and the deflecting mirror 14 which otherwise would be in the way.

The bundle of light rays or light beam 11''' is directed towards a third lens member 17, preferably a cylinder or cylindrical lens, extending in the direction of the space or gap 3, i.e. also parallel to the rollers 2B and 2D. This third lens member 17 is advantageously constituted by a cylindrical lens, the length of which is at least equal to the scanning amplitude of the bundle of light rays or light beam 11''' at the location of the lens member 17. This lens member 17 functions as a transmitting lens. The transmitted beam 7 emanates from the narrow side of the component 1A producing the transmitted light beam, this narrow side being formed by a surface 17A of the third lens member 17. The transmitted light beam 7 is focused at the reference plane 6. The details of this portion of the equipment have been further considered in our commonly assigned copending United States application, Ser. No. 221,703, filed Jan. 28, 1973 and entitled "Scanner Apparatus for Optically Discernible Characters", to which reference may be readily made. Now as clearly indicated by referring to FIG. 1 a boundary surface of the schematically depicted article 4 at which there is arranged the optically discernible character 5 to be read-out is located in the reference plane 6 or within predetermined spatial regions externally of such reference plane 6. This just mentioned boundary surface of the article 4 is preferably horizontally arranged. Yet, by virtue of the inclined incidence of the transmitted light beam 7 it would be permissible for this boundary surface to assume an inclined position within certain limits.

The scanning operation takes place in such a manner that the bundle of light rays 11''' emanating from the beam deflecting mechanism 16, which may be for instance a rotating mirror wheel 16B, periodically impinges upon the narrow side of the third lens member 17 confronting the beam deflecting mechanism 16.

Owing to focusing of the transmitted light beam 7 at the reference plane 6 this transmitted light beam produces a fine light spot or a fine scanning trace or track at the character 5 located at such reference plane 6.

Now a received bundle of light rays or light beam 18 is formed from the light which is essentially diffusely reflected by the scanned surface of the article 4 or the character 5. The main ray 19 of this received bundle of light rays 18 extends at an angle β with regard to the perpendicular 8 taken with respect to the reference plane 6.

The received light beam 18 is directed towards a fourth lens member functioning as a collecting lens 20. This collecting lens 20, preferably likewise in the form of a cylinder lens or a torus lens, is arranged parallel to the third lens member 17 and to the character scanning direction. A light-absorbing layer is advantageously arranged between the third lens member 17 and the collecting lens member 20 in order to prevent transfer of light from the transmitted light beam to the received light beam.

Now from the location of the collecting lens 20 the received bundle of light rays or light beam 18, as contemplated by the teachings of this invention, is delivered through a diaphragm 21 (indicated by reference character 26 in FIG. 2) and preferably through an image-reproducing device 22 (indicated by reference character 33 in FIG. 2), for instance a further lens or a hollow mirror, to a photoelectric receiver 23, such as a photomultiplier. An electrical output signal of the photoelectric receiver 23 can be delivered to an amplifier 24 prior to the time that it is transmitted in known fashion for evaluation, for instance, to a computer.

FIG. 2 schematically illustrates the course of the received bundle of rays or light beam. Here also the same reference characters have been used to represent the same or analogous components described above with regard to the embodiment of FIG. 1. Hence, it will be seen that the bundle of light rays 11''' arrives at the third lens member 17. The transmitted beam 7 emanates from this third lens member 17. This third lens member 17 preferably focuses the transmitted beam 7 through the read-out window defined by gap 3 and within a spatial depth of focus or definition depth T associated with reference plane 6. The arrangement is such that a faultless read-out of a character 5 which is located or moving within the depth of focus T is also then possible even if the character is tilted or displaced somewhat out of the reference plane 6 or is located at some locality between the boundary surfaces 6' and 6'' delimiting such depth of focus T. This will be explained in greater detail hereinafter.

The fourth lens, the collecting lens 20 serving as the receiving lens, is arranged parallel to the third lens 17. As already mentioned, this collecting lens 20 is preferably a cylindrical lens having an axis which likewise is disposed perpendicular to the plane of the drawing. The collecting lens 20 can also possess the configuration of a torus as also discussed above and may be conceptually so considered. The use of such type lens has been disclosed in the aforementioned United States application, Ser. No. 221,703. The focal or image line 25 of the collecting lens member 20 is clearly located in front of the reference plane 6 in such a manner that the points X_1 and X_2 disposed at the boundary planes 6' and 6'' will be portrayed between the lens member 20 and the receiver 23 at X_1' and X_2' , respectively.

The invention contemplates the provision of a diaphragm 26 which is arranged at the focal plane of the collecting lens 20 which confronts the receiver 23, this diaphragm 26 possessing an elongate opening 27 dimensioned such that the bundle of light rays or light beam 28 emanating from the outermost boundary plane 6'' still just completely illuminates the diaphragm opening 27.

In the illustrated embodiment this light beam 28 possesses an aperture angle U which is determined by a window 29 located in front of the collection or collecting lens member 20. This window 29, in the embodiment under consideration, is formed by the two deflecting rollers 2B and 2D and the conveyor bands 2A and 2C of the article conveying mechanism 2, which conveying bands 2A and 2C run over the two deflecting rollers 2B and 2D, as best recognized by referring to FIG. 1. However, it would also be possible to form this window 29 by other boundary edges of the reader or reading mechanism 1. The focal length of the collecting lens is for instance 5 to 20 times as large as the window 29.

At this time consideration is directed to a point X_1 disposed at the forwardmost boundary plane 6'. The bundle of light rays or light beam 30 falling from this point X_1 upon the collecting lens member 20 has a considerably greater aperture angle than the aperture angle U, but however only the portion of this light beam 30 possessing the aperture angle U is effective. The remainder is covered or blocked by the diaphragm 26. As a result, from all of the points disposed between the boundary planes 6' and 6'' the same light current or flow arrives through the diaphragm opening 27.

The diaphragm 26 is reproduced or portrayed by a further optical image-reproducing mechanism 33, preferably by means of a further cylindrical lens or torus lens, at the receiver 23.

As best seen by referring to FIG. 3 showing details of a particular constructional form of diaphragm, it will be recognized that the elongate opening 27 of the diaphragm 26 widens to both sides of the central transverse axis 31. This has the purpose that in the case of light spots which are deflected laterally of the central transverse axis 31 it is possible for a somewhat greater light current to arrive at the receiver 23. This can be desirable when the received light beam from lateral scanned positions encompasses a lesser light current owing to a more pronounced inclined orientation of the transmitted light beam and/or the received light beam. By means of the variable opening 27 of the diaphragm 26 depicted in FIG. 3 it is possible to compensate directional-dependency of the receiver 23. Such directional-dependency of the receiver 23 can be, for instance, caused by a line filter 32 arranged in front of the receiver 23 for the purpose of improving the signal-noise ratio, as discussed more fully in the copending commonly assigned United States application, Ser. No. 221,705, filed Jan. 28, 1972, and entitled "Correction Apparatus for Optical Reading Mechanism". By means of the diaphragm depicted in FIG. 3 there is compensated for the reduction in the light passage capability or light permeability of the line filter 32 with varied angle of incidence of the incoming or arriving light.

It is important that the diaphragm 26 be arranged within the light current or flow arriving at the receiver 23. With the illustrated embodiment employing cylindrical lenses 20 and 33, it is only important that there

be undertaken an illumination of the diaphragm opening 27 in the direction of the central transverse axis 31 depicted in FIG. 3.

The focal point or line 25 of the collecting lens member 20 is preferably disposed between the deflecting rollers 2B and 2D, whereas the forwardmost or innermost boundary plane 6' of the depth of focus region T coincides with the surface of the conveyor bands 2A and 2C carrying the articles 4.

The diaphragm 26 ensures for an approximately equal inlet pupil or opening of the collecting lens member 20 for all positions of the scanning light spot which have to be taken into account.

While there is shown and described present preferred embodiments of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims. Accordingly,

What is claimed is:

1. A reader mechanism for optically discernible characters, especially characters associated with an article and applied thereat or thereto and which can be located within a predetermined depth of focus region about a reference plane and can be scanned by means of a light spot, said depth of focus region being delimited by an outermost plane and an innermost plane disposed to opposite sides of the reference plane, photo-electrical receiver means serving to take-up a portion of the light reflected from the character and delivering an electrical signal corresponding to the incident light current, the improvement comprising a collecting lens arranged between the reference plane and the receiver means, diaphragm means for compensating for fluctuations in intensity of the incident light current arriving at the receiver means, said diaphragm means being arranged at the focal plane of the collecting lens confronting the receiver means at the region of the light current directed towards said receiver means, said diaphragm means being provided with an opening dimensioned and positioned such that a light beam emanating from the outermost plane of the depth of focus region and directed towards the receiver means at least completely fills-out the diaphragm opening in the transverse direction.

2. The reader mechanism as defined in claim 1, wherein said collecting lens comprises a cylindrical lens having an axis extending in the scanning direction.

3. The reader mechanism as defined in claim 1, wherein said collecting lens comprises a torus lens.

4. The reader mechanism as defined in claim 1, wherein said diaphragm opening is substantially elongate, and extends substantially parallel to the scanning direction.

5. The reader mechanism as defined in claim 4, wherein said elongate opening varies in size to both sides of a central transverse axis of said diaphragm means in such a manner as to at least partially compensate for an incidence angle-dependency of the sensitivity of the receiver means or an interference filter arranged forwardly of the receiver means and/or intensity change of the incident light.

6. The reader mechanism as defined in claim 1, further including an image-reproducing system for reproducing the diaphragm means at the receiver means.

7. The reader mechanism as defined in claim 6, wherein said image-reproducing system comprises a cylindrical lens member.

8. The reader mechanism as defined in claim 1, wherein the focal point of the collecting lens is disposed at the region of the innermost plane bounding the depth of focus region.

9. The reader mechanism as defined in claim 1, wherein the focal point of the collecting lens is located outside of the depth of focus region.

10. The reader mechanism as defined in claim 1, further including means for providing a character read-out gap between the reference plane and said collecting lens, said gap defining a window which intersects the light beam emanating from the outermost plane of the depth of focus region such that it still completely illuminates the diaphragm opening in the transverse direction.

11. The reader mechanism as defined in claim 10, wherein said window is formed by an interruption in a conveying mechanism.

12. The reader mechanism as defined in claim 11, wherein said window of said conveying mechanism is formed by two deflecting rollers covered by a respective conveyor band.

13. The reader mechanism as defined in claim 12, wherein the surface of the conveyor bands facing away from the collecting lens coincides with the innermost plane forming the boundary of the depth of focus region of the side of the collecting lens.

14. The reader mechanism as defined in claim 10, wherein the focal point of the collecting lens is disposed within said window.

15. The reader mechanism as defined in claim 10, wherein the focal length of the collecting lens is 5 to 20 times as large as said window.

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