US00RE41683E

(19) **United States**
(12) **Reissued Patent**
Huang

(10) **Patent Number: US RE41,683 E**
(45) **Date of Reissued Patent: *Sep. 14, 2010**

(54) **OPTICAL LENS OF OPTICAL SCANNER**

(76) Inventor: **Chih-Wen Huang**, 3F., No. 13, Alley 3, Lane 33, Gongkou St., Siangshan District, Hsinchu City 300 (TW)

(*) Notice: This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/174,416**

(22) Filed: **Jul. 1, 2005**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **6,674,560**
Issued: **Jan. 6, 2004**
Appl. No.: **10/439,872**
Filed: **May 16, 2003**

U.S. Applications:

(62) Division of application No. 09/921,949, filed on Aug. 3, 2001, now Pat. No. 6,587,247.

(51) **Int. Cl.**
G02B 26/08 (2006.01)

(52) **U.S. Cl.** **359/205.1**; 358/474; 358/483; 359/215.1; 399/199

(58) **Field of Classification Search** 359/205.1–207.6, 359/209.1–210.1, 362, 676, 721, 813–814, 359/819, 821, 827, 215.1; 358/474–475, 358/482–483, 487, 494, 496–497, 401, 501; 355/41, 45, 55–57; 399/196, 199–202, 218
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,576,897	A	*	11/1996	Kuo	359/822
5,610,755	A	*	3/1997	Ohtsuka	359/210
5,703,729	A		12/1997	Takeda et al.	
5,883,727	A	*	3/1999	Tsai	358/475
6,424,433	B1	*	7/2002	Miyauchi et al.	358/471
2002/0122142	A1	*	9/2002	Lin	348/785

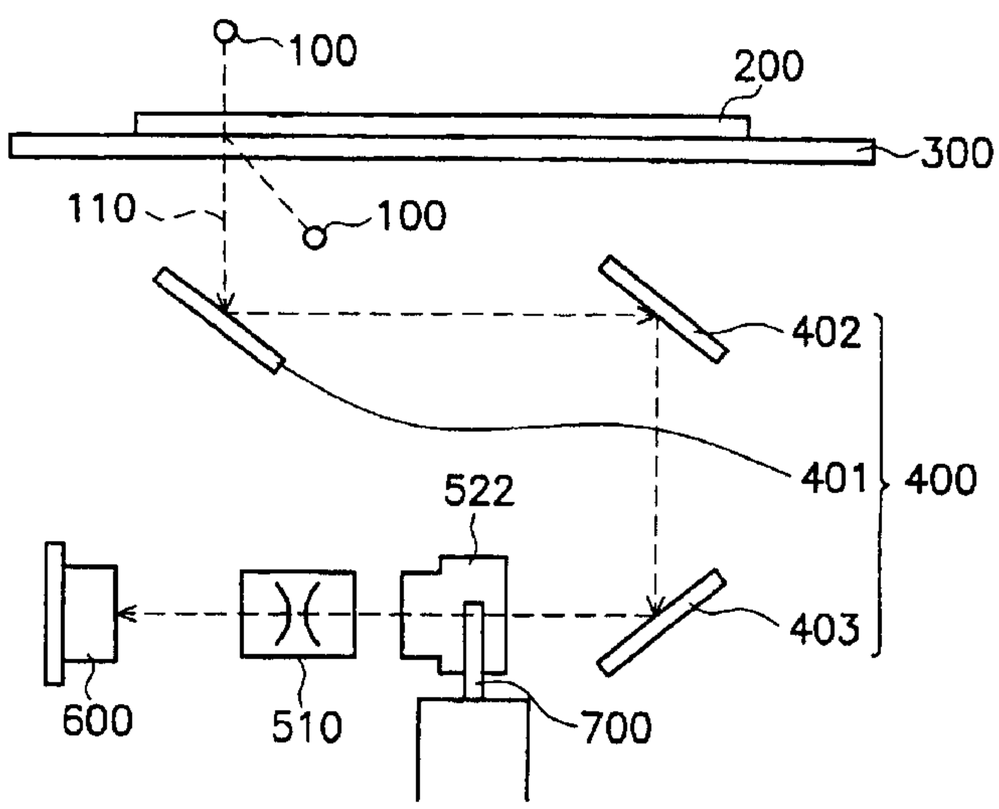
* cited by examiner

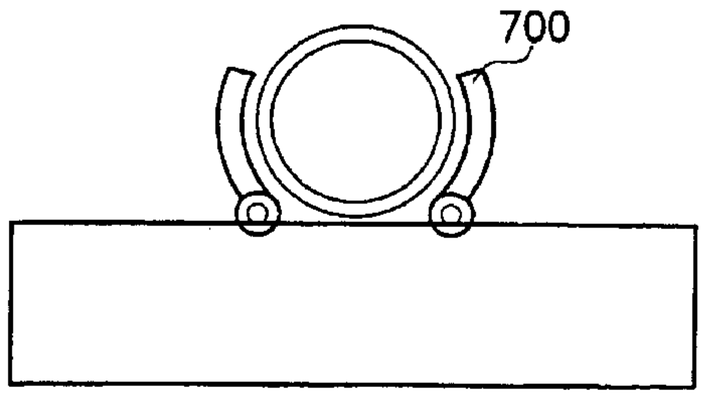
Primary Examiner—James Phan
(74) *Attorney, Agent, or Firm*—Stolowitz Ford Cowger LLP

(57) **ABSTRACT**

An optical scanner that may assemble the lens design for varying the focus and resolution, having a light source, a reflection compound mirror, a charge coupled device, a basic objective lens and a compound lens. The basic objective lens is designed by simulation software. According to the lens design theory, the compound lens is designed. By incorporating the basic objective lens and the compound lens, different resolutions such as 1200 dpi, 1600 dpi and 2400 dpi of the optical scanner are obtained without redesigning the lens device, the current specification of the optical scanner is also varied.

11 Claims, 11 Drawing Sheets





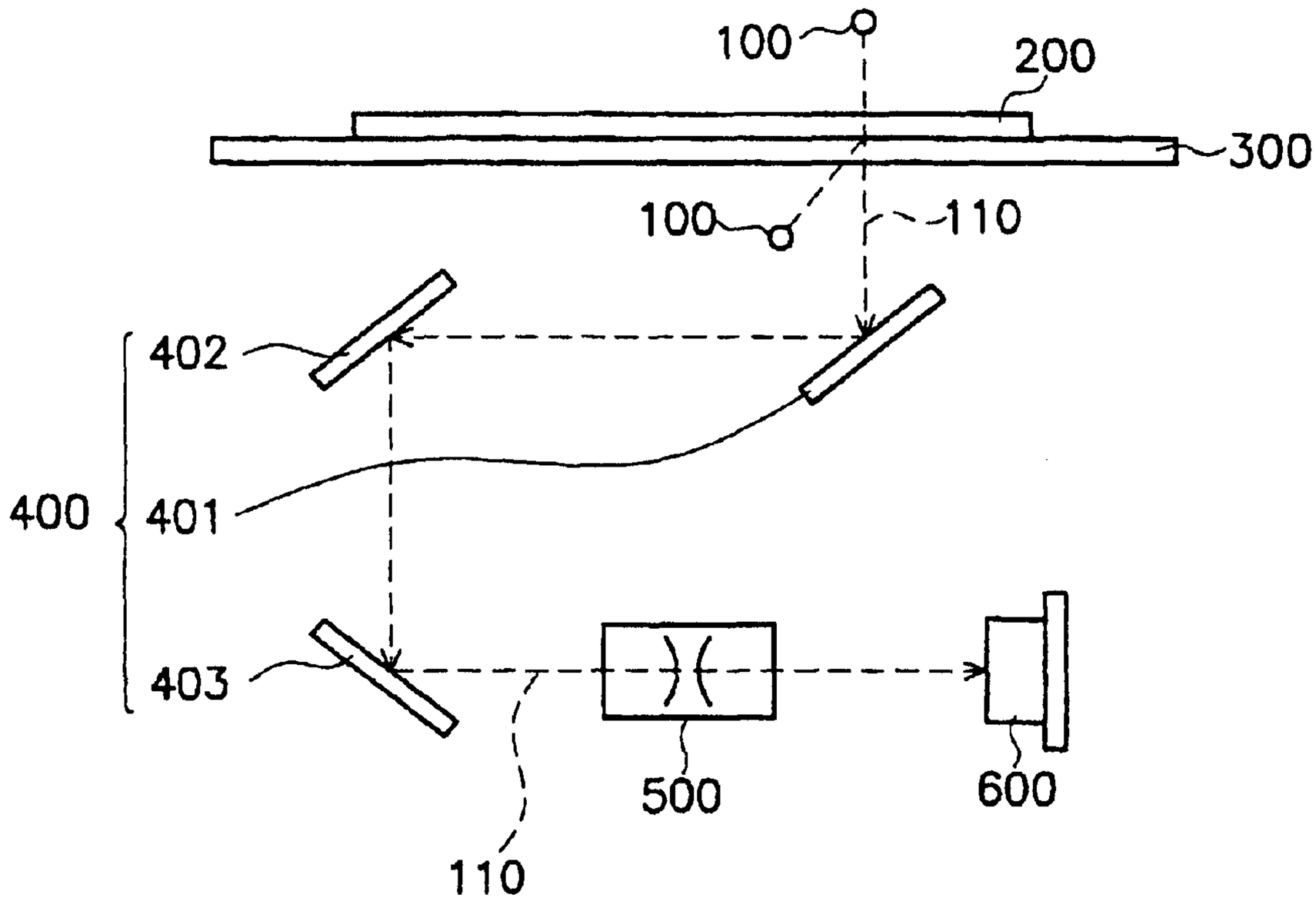


FIG. 1 (PRIOR ART)

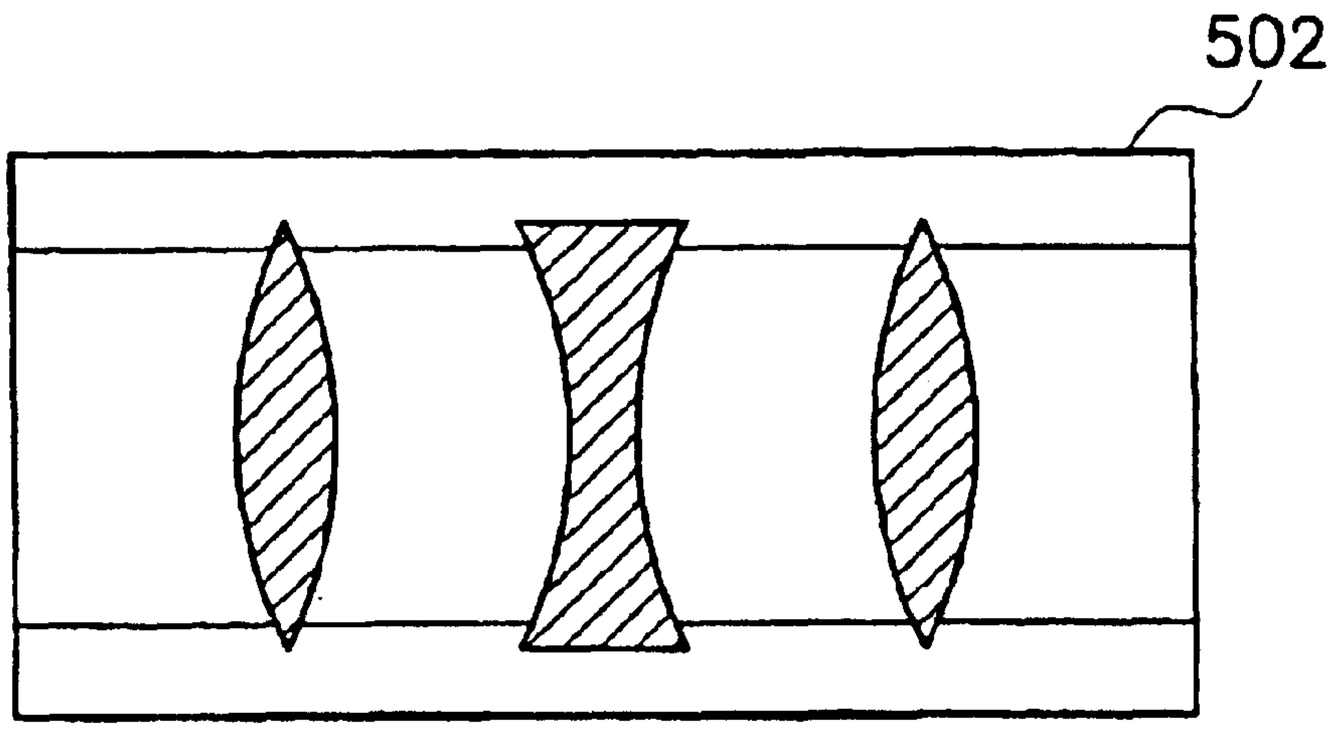


FIG. 2a(PRIOR ART)

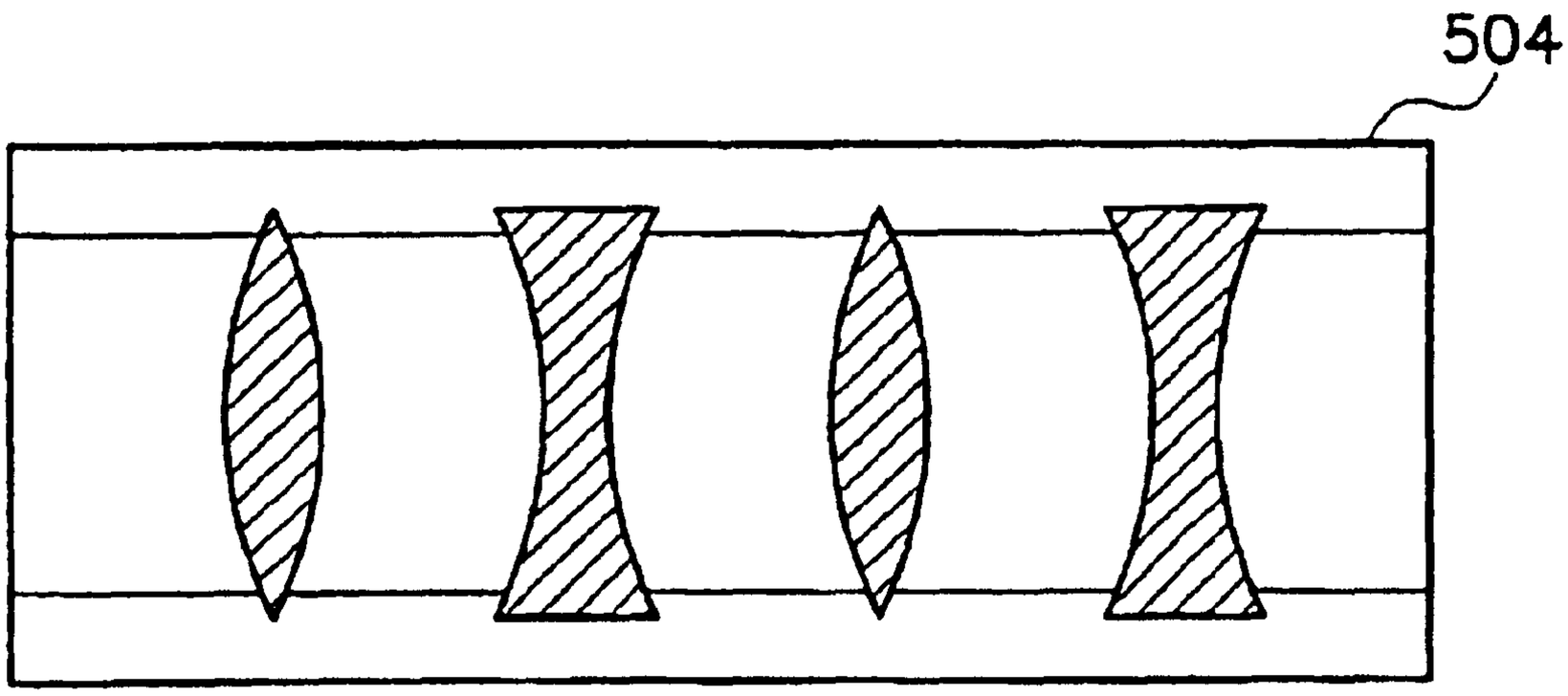


FIG. 2b(PRIOR ART)

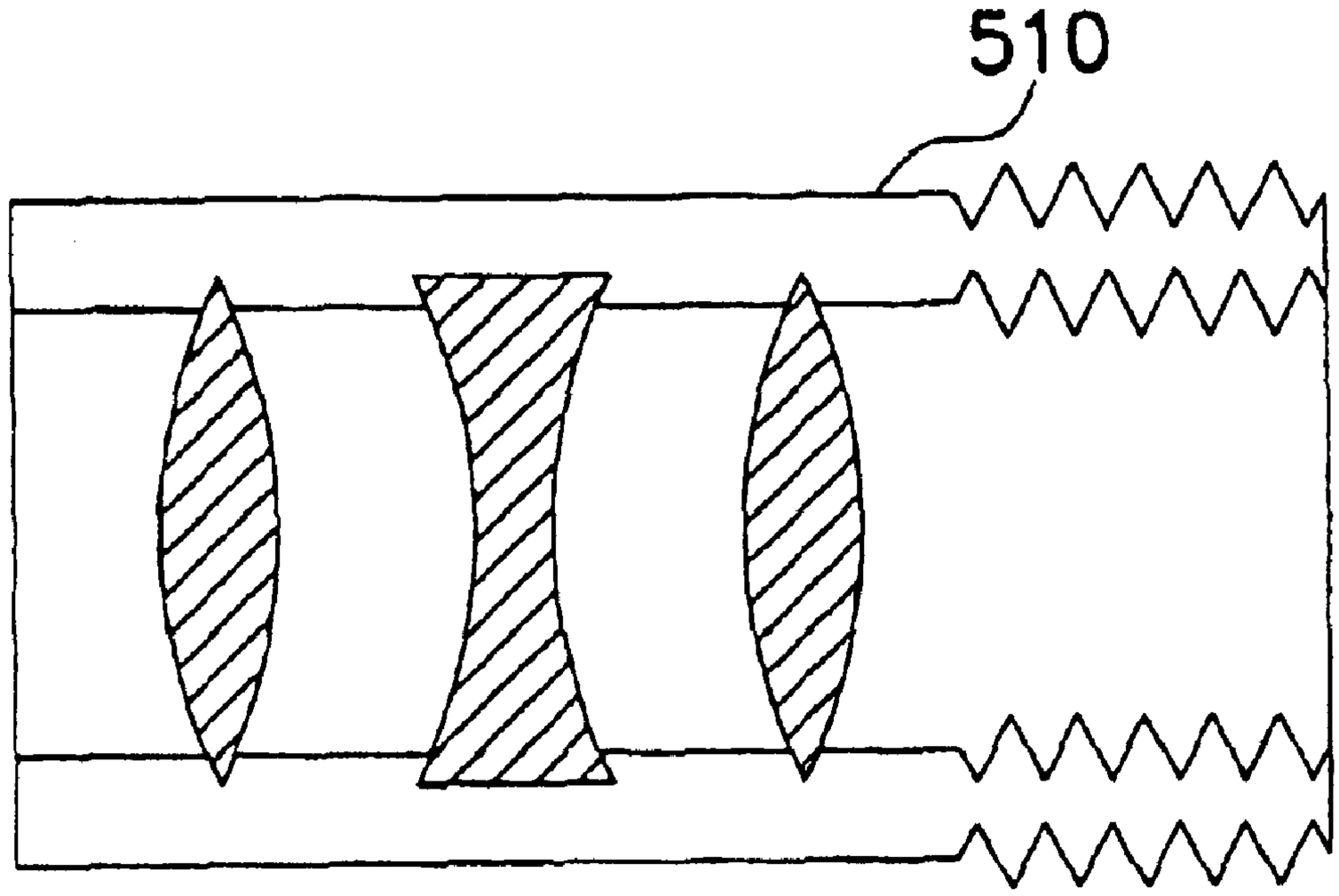


FIG. 3

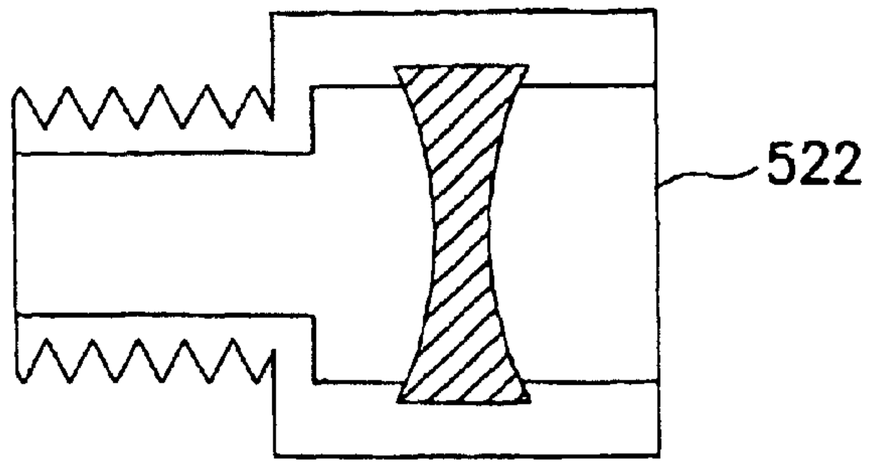


FIG. 4a

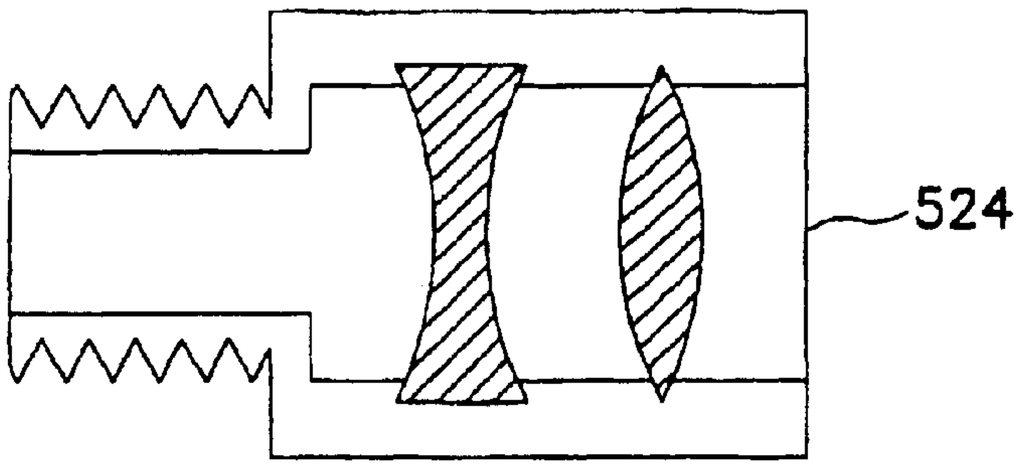


FIG. 4b

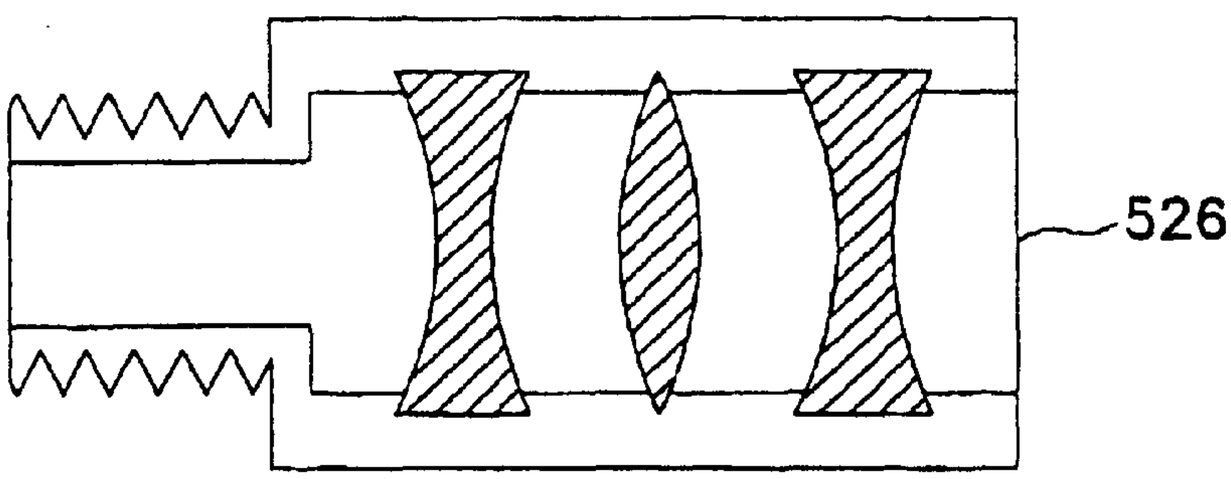


FIG. 4c

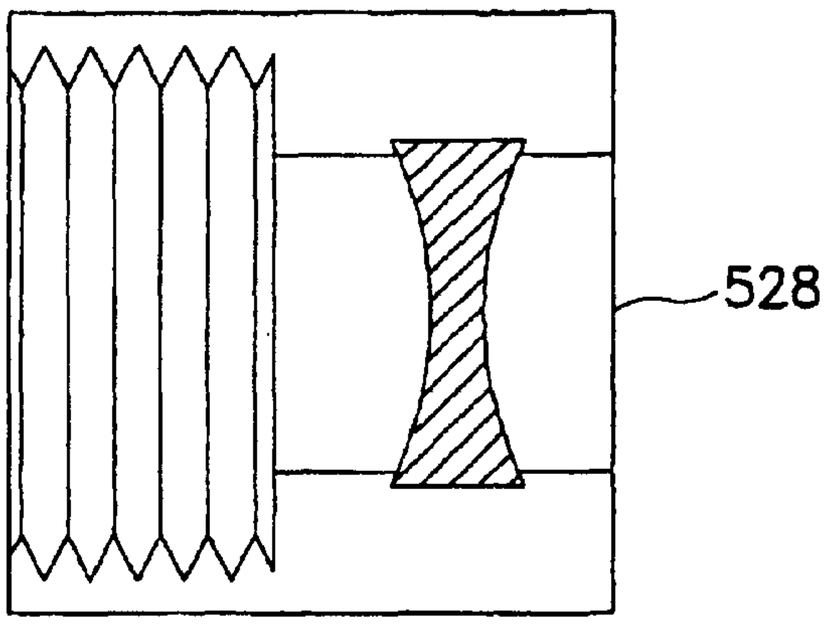


FIG. 4d

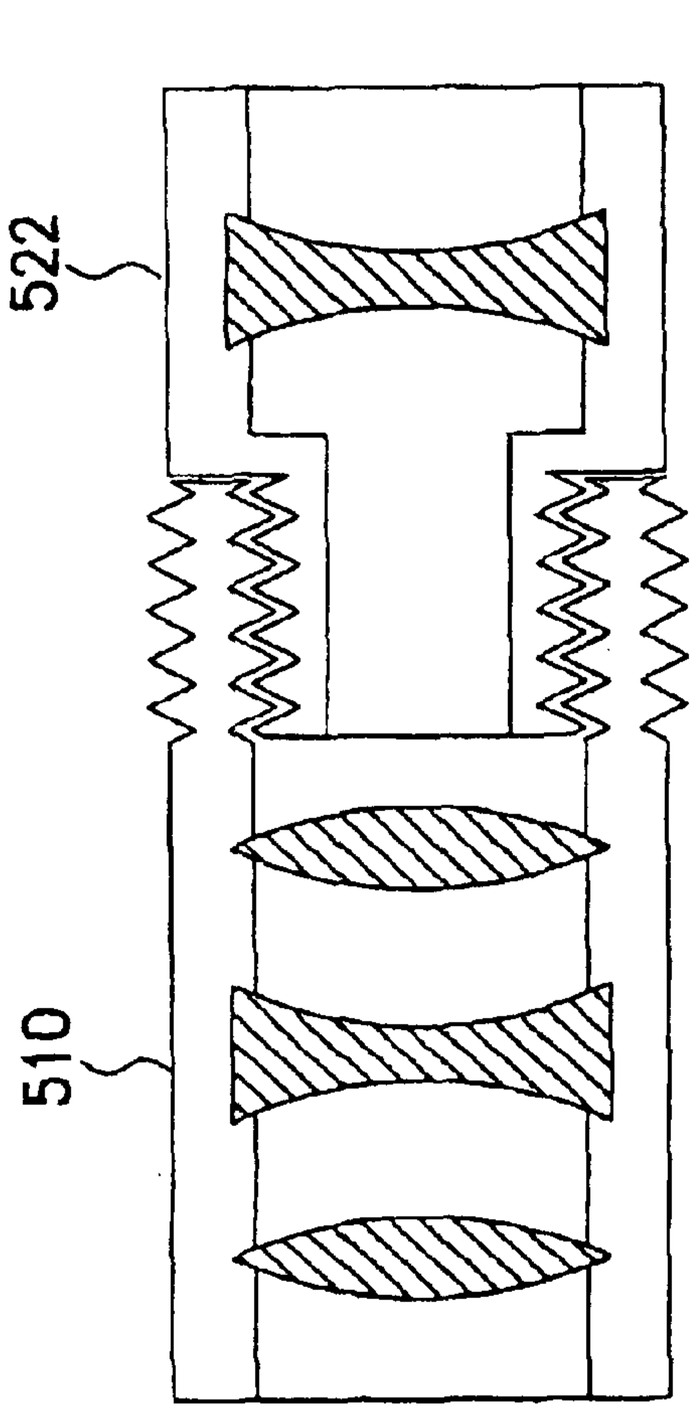


FIG. 5a

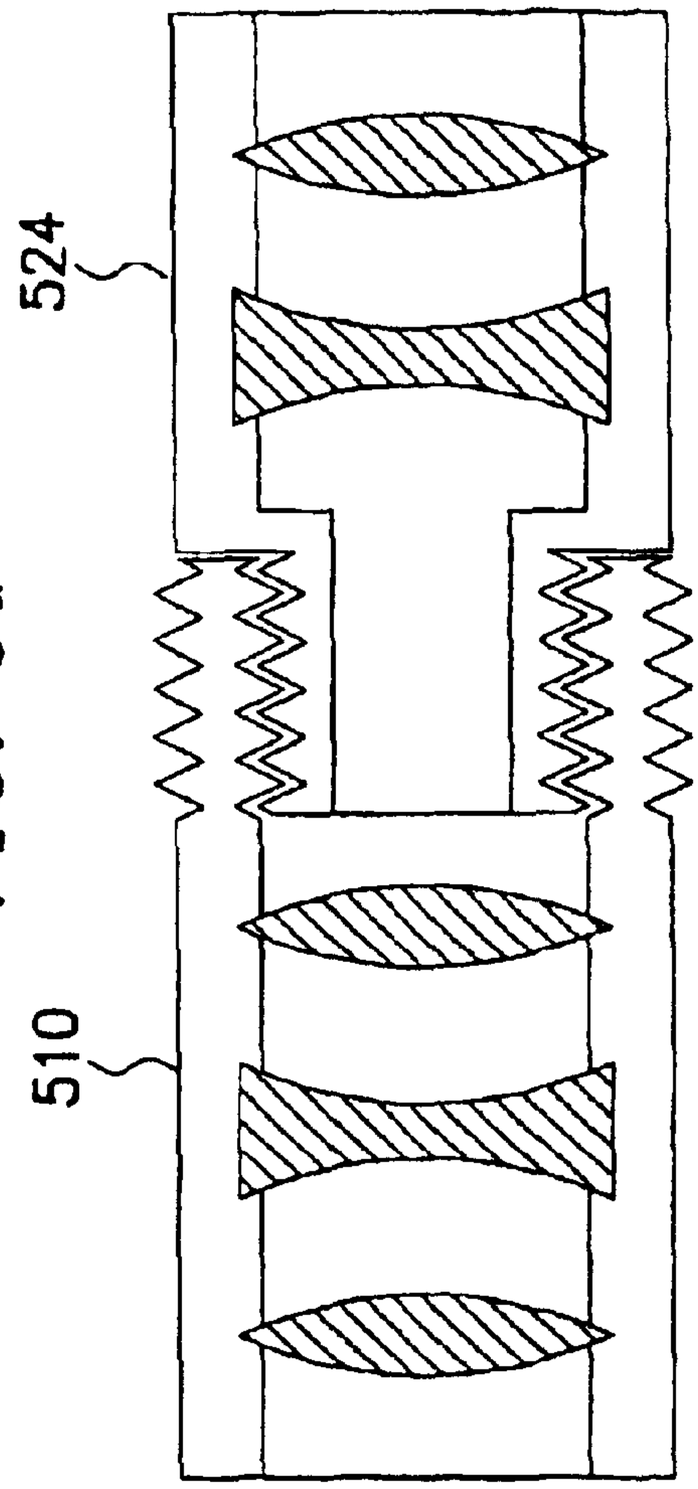


FIG. 5b

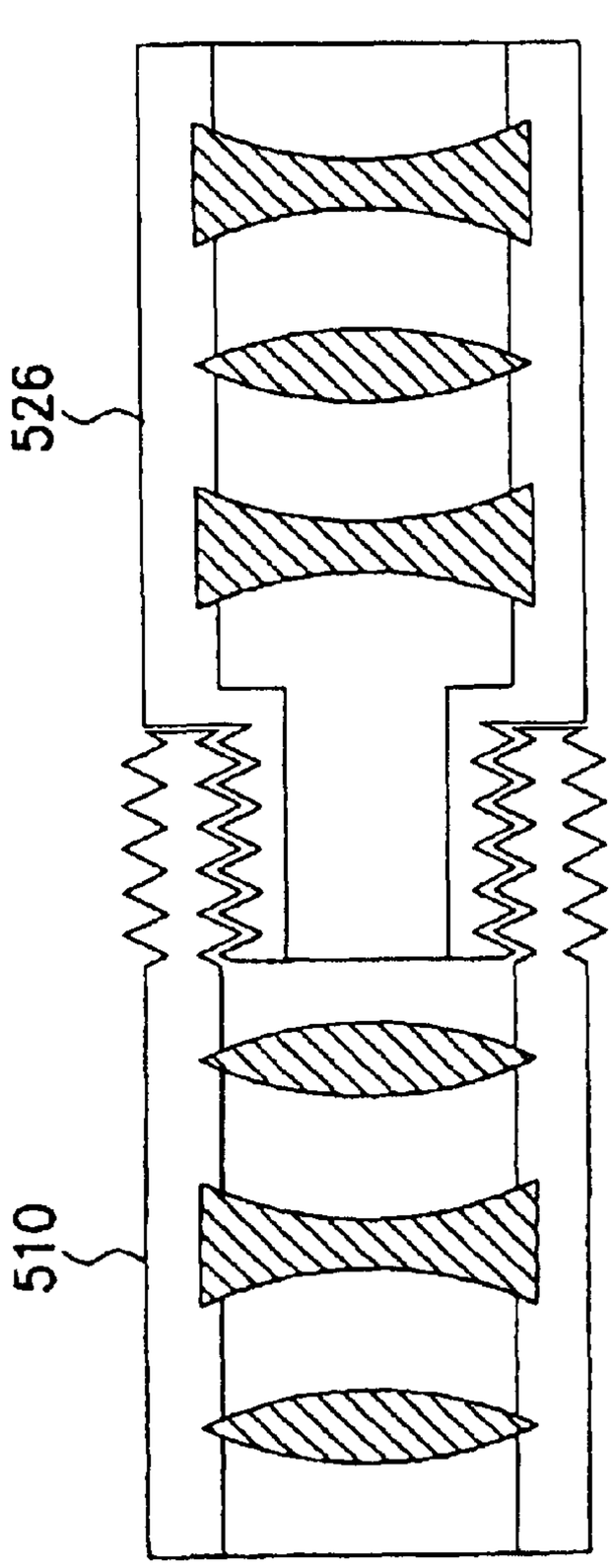


FIG. 5c

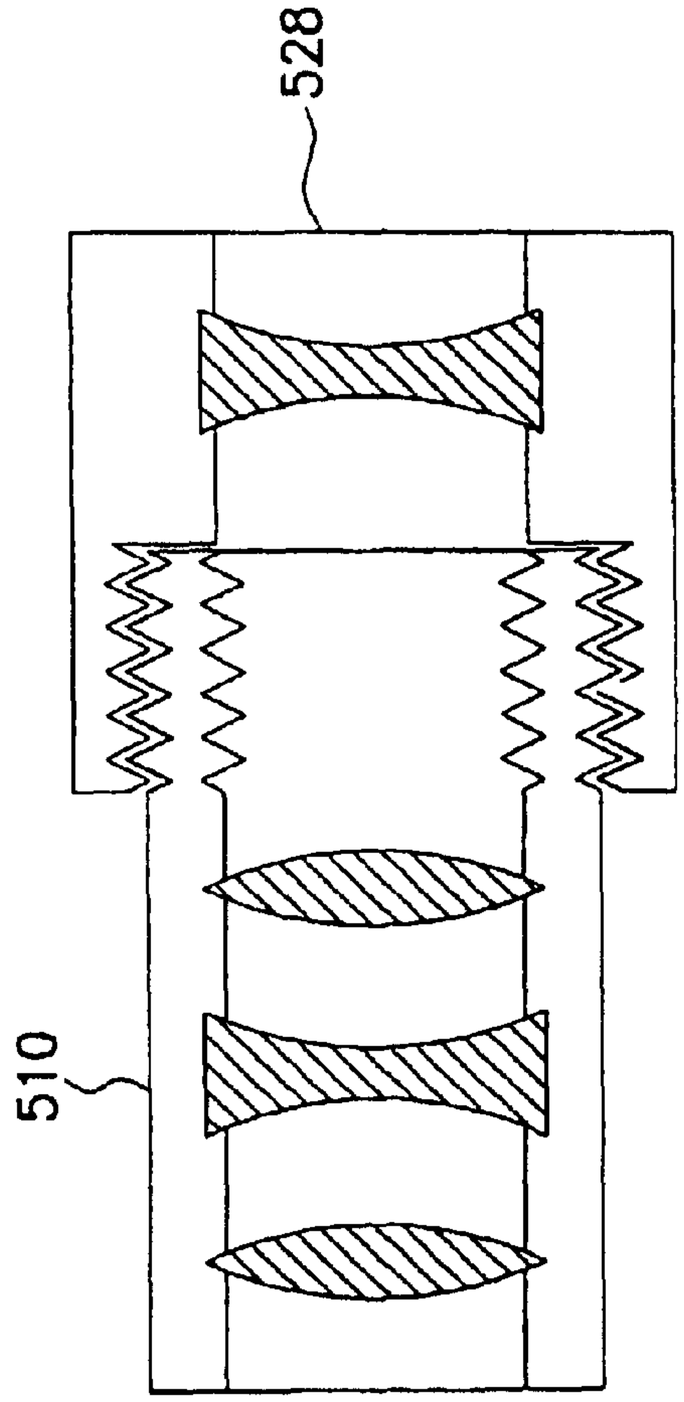


FIG. 5d

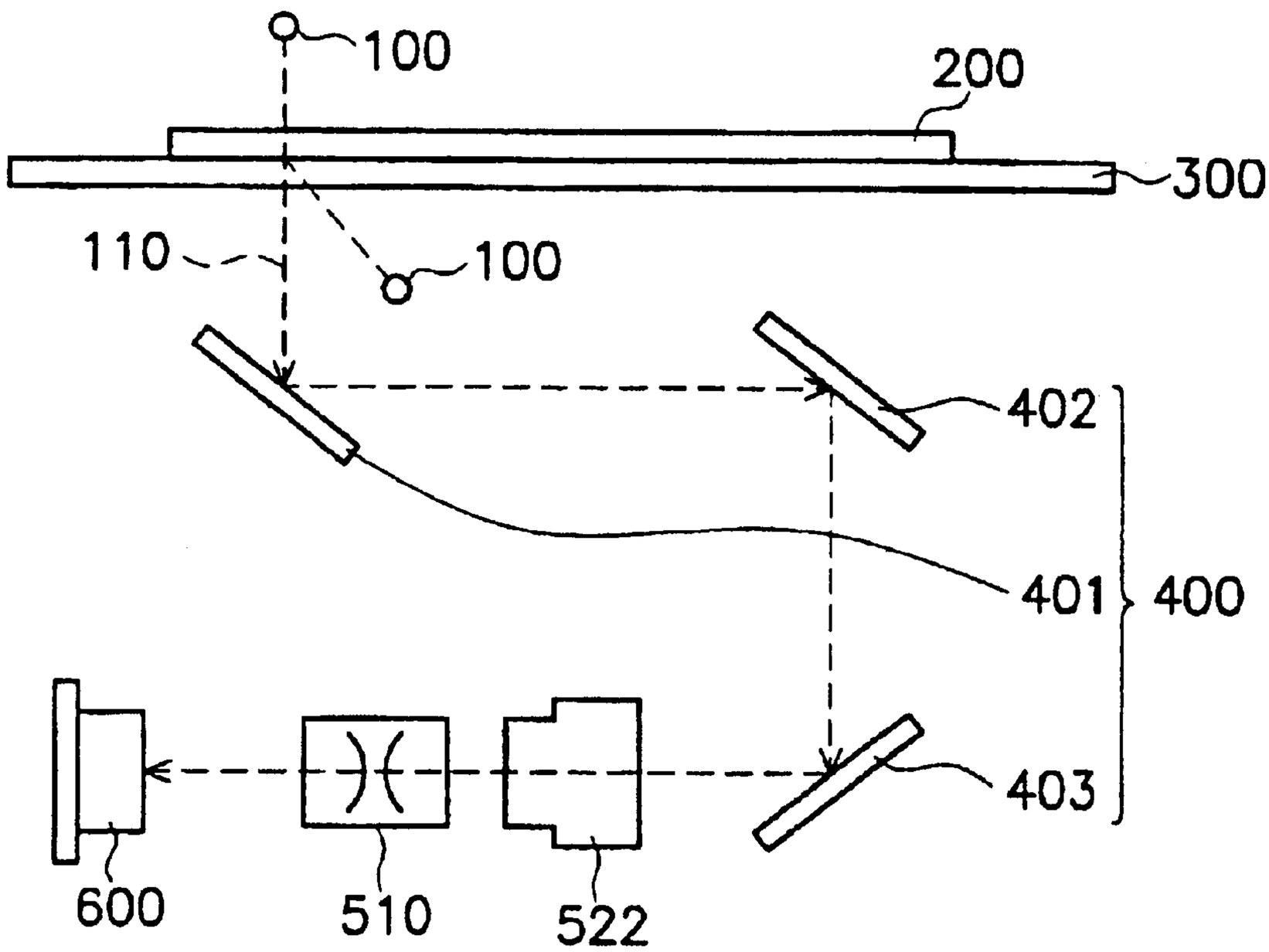


FIG. 6

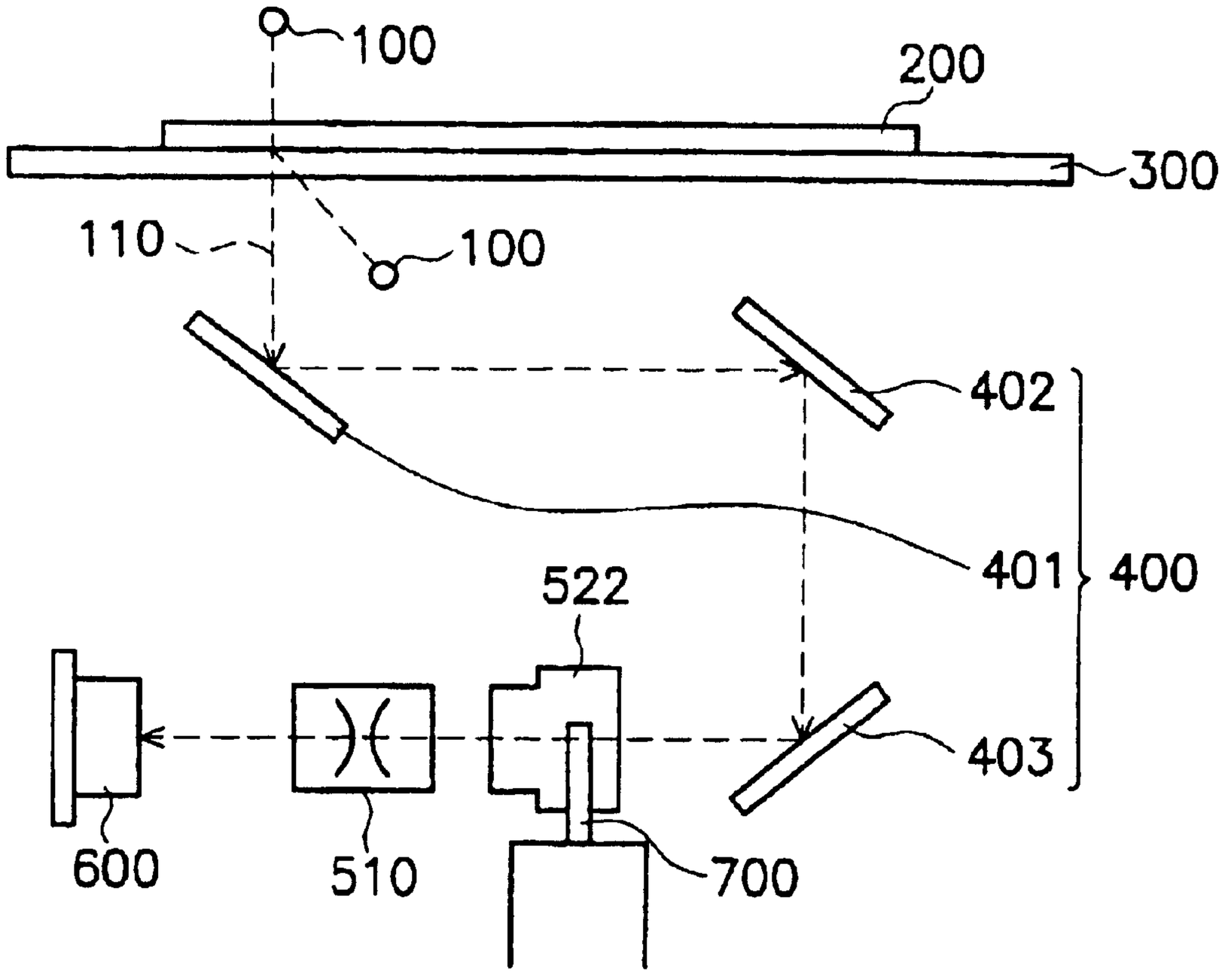


FIG. 7a

FIG. 7b

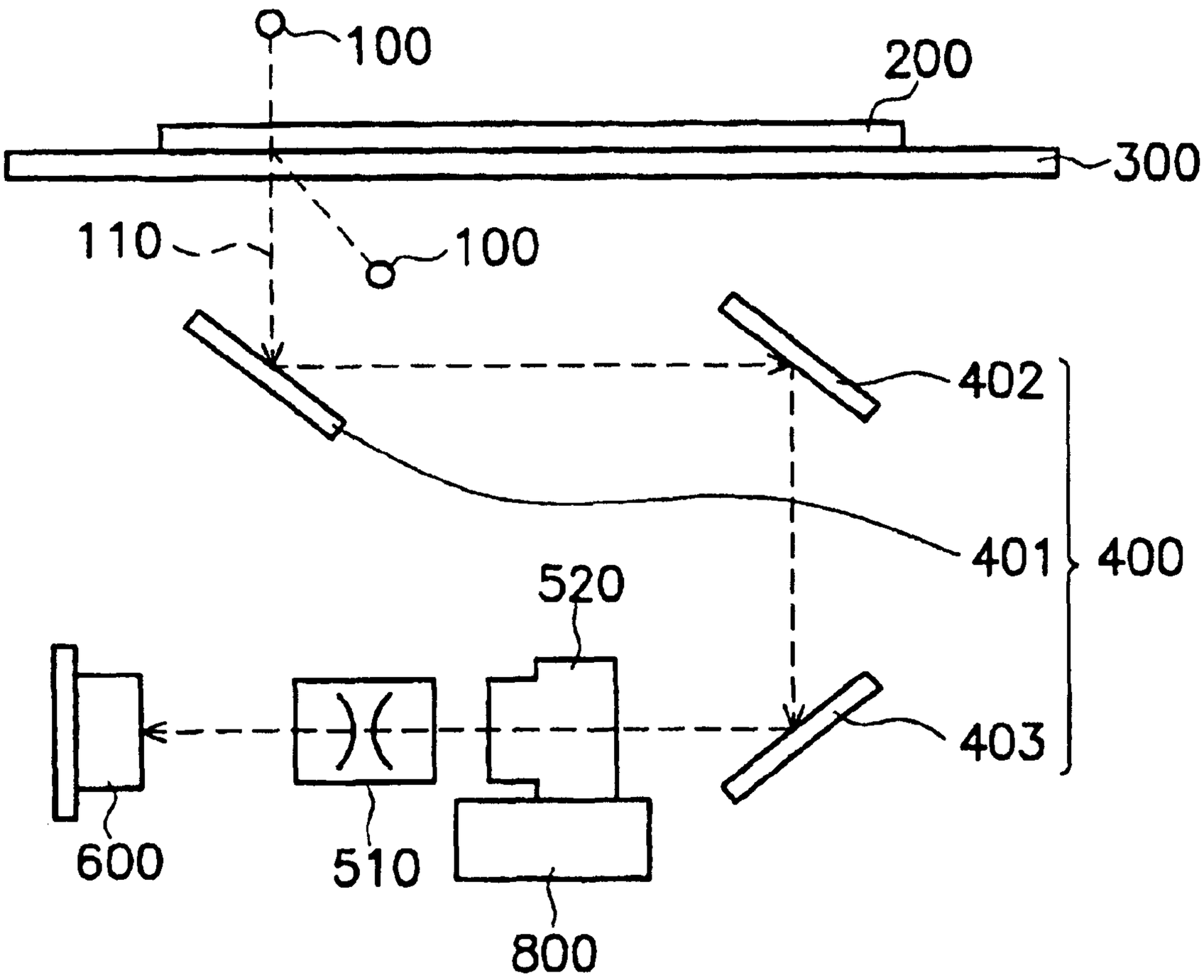


FIG. 8a

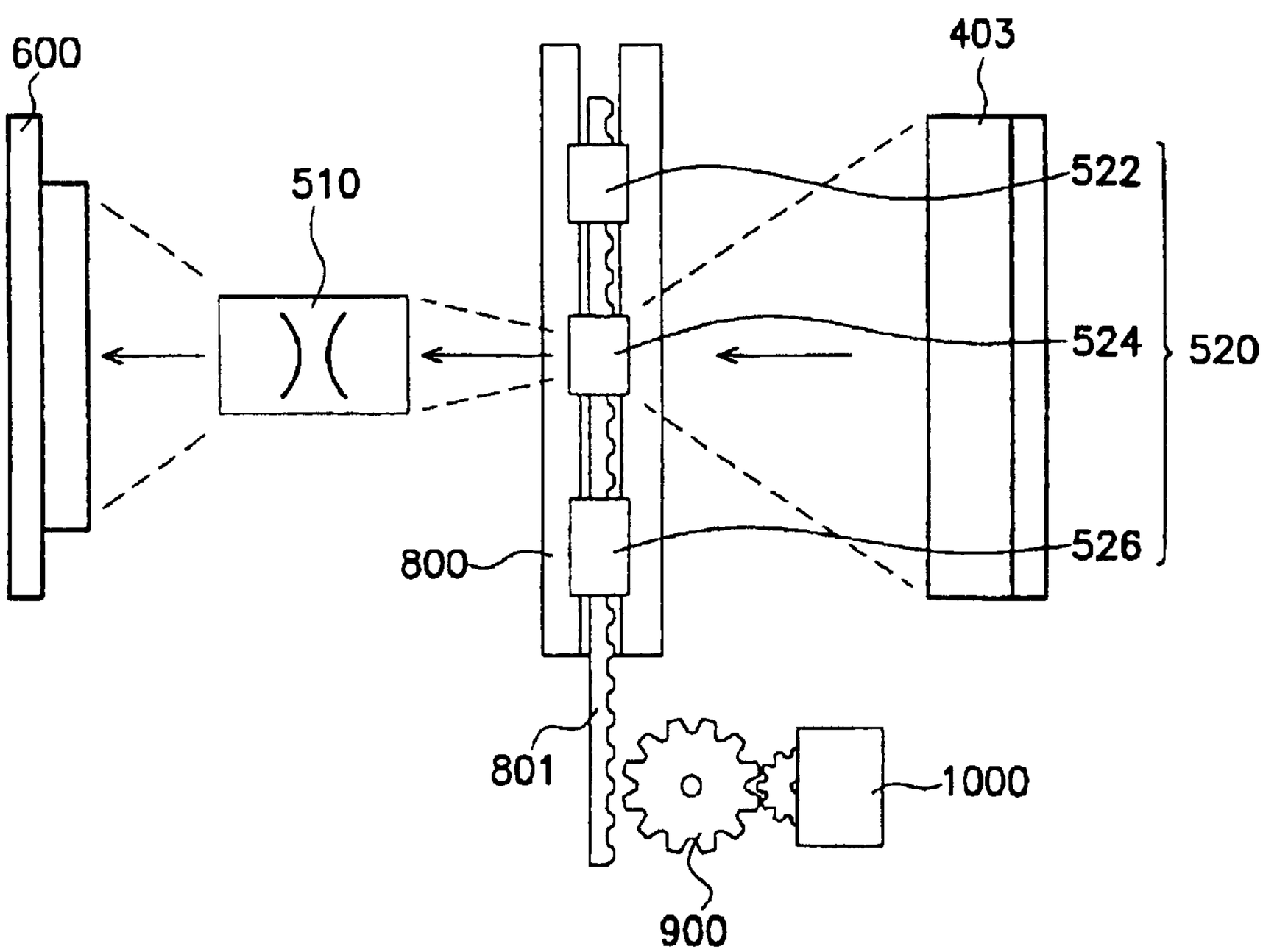


FIG. 8b

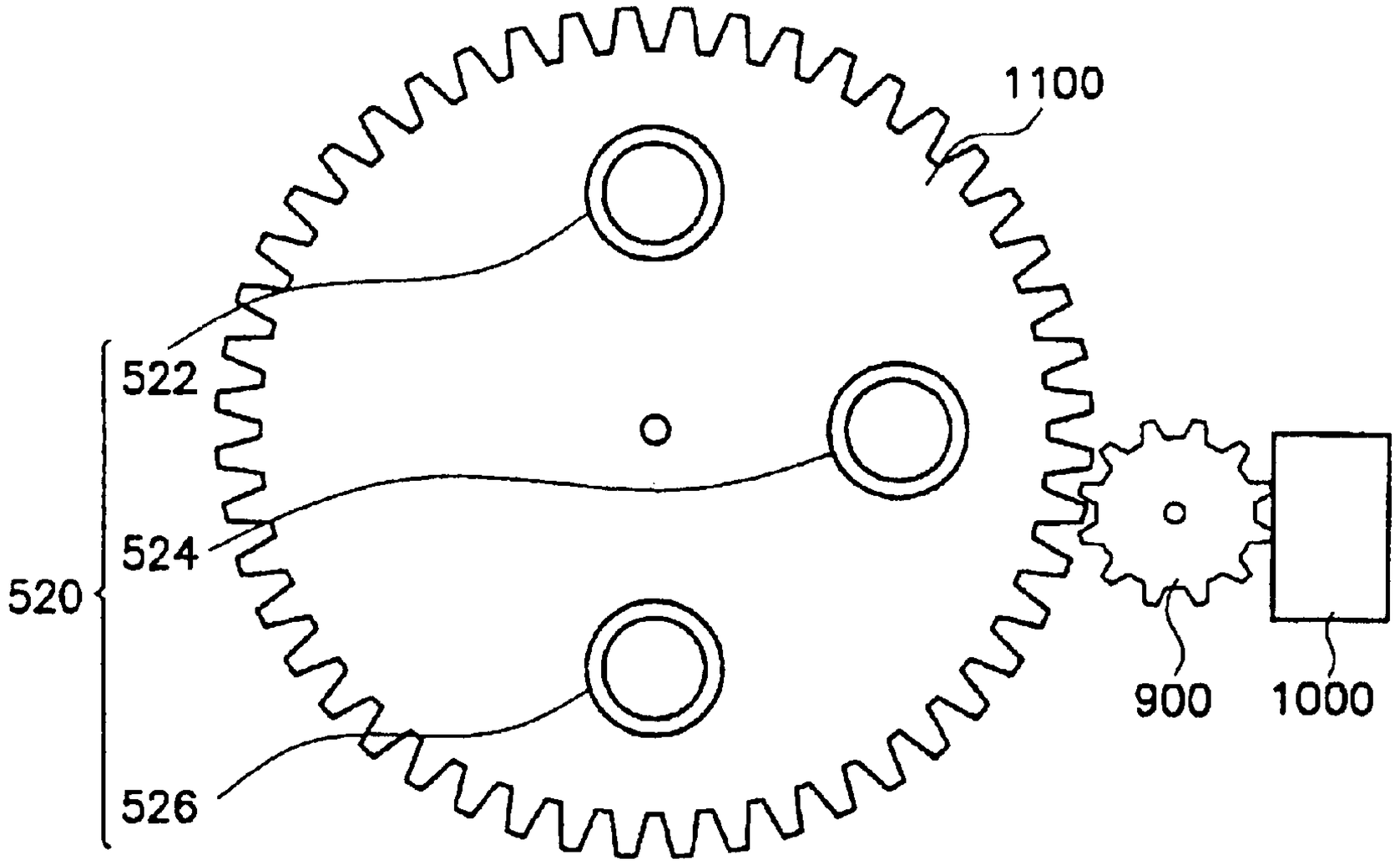


FIG. 8c

OPTICAL LENS OF OPTICAL SCANNER

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

CROSS-REFERENCE TO RELATED APPLICATION

This application is a divisional application of, and claims the priority benefit of, U.S. application Ser. No. 09/921,949 filed on Aug. 3, 2001, U.S. Pat. No. 6,587,247.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates in general to an optical scanner, and more particularly, to an optical scanner that may assemble different lens designs for changing focus and resolution.

2. Description of the Related Art

The conventional optical scanner (referring to FIG. **1**) comprises a light source **100**, a reflection compound mirror **400**, an object lens **500** and an optical sensor, such as a charge coupled device (CCD) **600**. While scanning, the light source **100** radiates on the document **200**, an image light is obtained via reflection or transmission. The reflection compound mirror **400** is comprised of several reflection mirrors (**401**, **402**, **403**) located along the optical path. Therefore, the image of the document **200** is incident to the reflection compound mirror **400**. Being reflected by the reflection compound mirror **400**, the image is transmitted to the objective lens **500**. The objective lens can receive the image of the document **200** transmitted from the reflection compound mirror **400**, and display such image in the charge coupled device **600**.

The conventional objective lens is designed by simulation software according to the requirements of resolution, total track (TT), magnification and modulation transfer function (MTF) provided by the client. The factors of lens, material, curvature, number of lenses, size, and length of the objective lens are thus determined. The sample is then fabricated, and the inspection of the sample and simulation are performed. For example, the objective lens **502** of 600 dpi as shown in FIG. **2**a is normally formed of three lenses. The objective lens **504** of 1200 dpi as shown in FIG. **2**b is normally formed of four lenses.

According to the above, the conventional design of the objective lens has to meet the specification requirements including the resolution, the total track, the magnification and the modulation transfer function. For different specification requirements, a new objective lens has to be designed. Alternatively, the specification of the current optical scanner has to be changed.

SUMMARY OF THE INVENTION

The invention provides an objective compound lens design that may change the focus and resolution without a redesign. By appropriately designing the basic objective lens and incorporating it with various compound lenses, the required resolution and specification can be obtained.

The object compound lens structure may change the focus and resolution of the optical scanner by switching the object lenses.

The objective compound lens can be used in an optical scanner that comprises at least a light source, a reflection compound mirror and an optical sensor. A light source is used to radiate a document to obtain an image light. The objective compound lens is located along the optical path of the image light between the optical sensor and the reflection compound mirror. The object compound lens comprises a basic object lens and at least a compound lens. The compound lens can be adjacent to or detached from the basic objective lens. Or alternatively, more than one compound lens can be installed on a seat and disposed between the basic objective lens and the reflection compound mirror. Via a driving device, the seat can be driven, and the compound lenses on the seat can be incorporated with the basic objective lens.

While connecting the compound lens with the basic objective lens, or incorporating the compound lens with the basic objective lens, the compound lens is located along the optical path of the image light between the basic objective lens and the reflection compound mirror. The optical scanner can thus have different resolutions. Without incorporating the compound lens, the image light can be projected to the optical sensor via the basic objective lens only, so that only a basic resolution is obtained.

Both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a conventional optical scanner;

FIGS. **2**a and **2**b show the conventional objective lens design;

FIG. **3** shows the basic objective lens design of the invention;

FIGS. **4**a to **4**d show the compound lenses designed for different resolutions (**4**a, **4**d for 1200 dpi, **4**b for 1600 dpi and **4**c for 2400 dpi);

FIGS. **5**a to **5**d show the basic objective lens assembled with various compound lenses;

FIG. **6** shows a first embodiment of the invention;

FIG. **7**a shows a second embodiment of the invention;

FIG. **7**b shows a fixed seat used in the second embodiment;

FIG. **8**a shows a third embodiment of the invention;

FIG. **8**b sows the linear seat used in the third embodiment of the invention; and

FIG. **8**c shows the disk-like seat used in the third embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

FIG. **6** shows a first embodiment of an optical scanner according to the invention. This embodiment belongs to a contact assembling type. The optical scanner comprises a light source **100**, a reflection compound mirror **400**, an optical sensor such as a charge coupled device **100**, a basic objective lens **510** and a compound lens (**522** in this embodiment). In FIG. **3**, the basic objective lens **510** is designed by simulation software according to various resolutions such as 600 dpi, 1200 dpi, 1600 dpi and 2400 dpi. The compound lens is selected from the compound lenses **520** to meet the required resolution, for example, the compound lens **522** can be selected. As shown in FIGS. **4**a, **4**b, **4**c and **4**d, the compound lenses **522** and **528** are selected to meet the resolution 1200 dpi, the compound lens **524** is selected to meet the resolution 1600 dpi, and the compound

lens **526** is selected for the resolution 2400 dpi. After assembling the basic compound lens **510** and the compound lens, an objective compound lens that meets the resolution requirement is obtained, as shown in FIGS. **5**a (1200 dpi), **5**b (1600 dpi), **5**c (2400 dpi) and **5**d (1200 dpi). In FIG. **3**, the compound lens is detachable from the basic objective lens. Via the screw thread (linkage apparatus) inside or outside of the basic objective lens, the compound lens can be connected with the basic object lens. It is appreciated that the skilled person may apply other mechanisms to connect these two lenses. With different resolution requirements, compound lenses with different resolutions can be changed without redesigning the whole objective compound lens. In addition, the additionally applied compound lens is located at the optical path of the image light **100** between the basic objective lens **510** and the reflection compound mirror **400**. The basic objective lens **510** can also be used independently to result in a basic resolution (600 dpi) of the image light **110** projected to the optical sensor **600**.

Second Embodiment

In FIG. **7**a, a second embodiment of an optical scanner is illustrated. The embodiment is a non-contact assembling type. The optical scanner comprises a light source **100**, a reflection compound mirror **400**, an optical sensor such as a charge coupled device **600**, a basic objective lens **510**, a compound lens (**522** in this embodiment) and a mounting seat **700**. The basic objective lens **510** is designed by simulation software to meet the resolution requirement (such as 600 dpi) and other resolution requirements such as 1200 dpi, 1600 dpi and 2400 dpi. The compound lens is selected from the compound lenses **520** to meet the specific resolution requirement. For example, the compound lens **522** is selected. The compound lens **522** is mounted on the mounting seat **700** as shown in FIG. **7**b. Each objective lens is incorporated to meet different resolution requirements. By incorporating the basic objective lens with different compound lenses, various resolution requirements can be met without redesigning the whole objective compound lens.

In FIG. **8**a, a third embodiment of an optical scanner is illustrated. The embodiment is a non-contact assembling type. The optical scanner comprises a light source **100**, a reflection compound mirror **400**, an optical sensor such as a charge coupled device **600**, a basic objective lens **510**, a compound lens **520**, a seat **800**, a gearing and a driver. The basic objective lens **510** is designed by simulation software to meet the resolution requirement (such as 600 dpi) and other resolution requirements such as 1200 dpi, 1600 dpi and 2400 dpi. Various compound lenses **522**, **524** and **526** are included in the compound lenses **520** to meet different resolution requirements (1200 dpi, 1600 dpi, 2400 dpi). The compound lenses **522**, **524** and **526** are arranged and mounted on a gear strip **801** of the seat **800** as shown in FIG. **8**b. The gear strip **801** is driven by the gearing to shift linearly. To switch between different resolutions, a motor **1000** drives the gearing **900** according to a firmware command to drive the compound lens **520** on the seat, until the compound lens meeting the resolution requirement is selected. In FIG. **8**c, the seat **800** that switches the compound lens linearly is replaced with a rotation disk **1100**. The compound lenses **522**, **524** and **526** are evenly distributed on the perimeter of the disk **1100** with the same distance to the center of the disk **1100**. While switching between different resolutions, firmware can be used to command the motor **100** to drive the gearing **900** to rotate the seat **1100**, so that the compound lens that meets the resolution requirement is selected. By incorporating the objective lens with the compound lens, various objective compound lenses to meet different resolution requirements are obtained. The gearing is selected from a group consisting of gear strips, gear, lead screw, steel tape, belt and a combination of the above.

Accordingly, the invention comprises at least the following advantages:

(1) The objective lens design of the scanner is modularized. According to different resolutions, magnifications, optical lengths and image quality requirements, a compound lens is incorporated without redesigning the objective lens or changing the current scanner design. The reuse rate of the scanner is also increased.

(2) In the objective lens design provided by the invention, the basic objective lens has a constant form, so that it can be reused for different resolution requirements. The design cost is reduced, and the redefine and lens simulation required by changing lens design are also avoided.

(3) The compound lens in the first and second embodiment can be adjusted by the user without effecting a major adjustment of the system. In the third embodiment, the compound lens is automatically changed according to the resolution required by user. The optical scanner is upgraded for having different optical resolutions.

(4) The design of the compound lens can be switched for various resolutions so that the design cost of the objective lens is decreased.

(5) The compound lens can be adjusted according to the image requirement of the customers.

Other embodiments of the invention will appear to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples to be considered as exemplary only, with a true scope and spirit of the invention being indicated by the following claims.

What is claimed is:

1. An objective compound lens, applied to an optical scanner having at least a light source, a **[**reflection compound**]** mirror and an optical sensor, wherein the light source is used to **[**radiate**]** *illuminate* a document to obtain an image light, the **[**reflection compound**]** mirror is located in an optical path of the image light to protect the image light on the optical sensor, and the objective compound lens is located **[**between**]** *on* the optical path of the image light between the optical sensor and the **[**reflection compound**]**mirror, the objective compound lens comprising:

a basic objective lens; *and*

[a mounting seat; and**]**

[a plurality of compound lenses, only one of which is suited for connecting and detaching with the mounting seat,**]** *a mounting seat configured to releasably couple a compound lens thereto, the mounting seat configured to support and fix the compound lens in alignment with the basic objective lens when the compound lens is releasably coupled thereto,* wherein when **[**only one of**]** the compound **[**lenses**]** *lens* is **[**selected to be allocated on**]** *releasably coupled to* the mounting seat, the optical scanner has a resolution corresponding to the **[**selected**]** *releasably coupled* compound lens, and when **[**any one of**]** the compound **[**lenses**]** *lens* is not **[**connected**]** *coupled* to the mounting seat, the image light is projected on the optical sensor via the basic **[**object**]** *objective* lens only.

2. The **[**optical**]** *objective* compound lens according to claim **1**, wherein *when* the **[**selected**]** compound lens *is*

coupled to the mounting seat, the compound lens is located on the optical path of the image light between the basic objective lens and the **[**reflection compound**]** mirror.

3. The **[**optical**]** *objective* compound lens according to claim **1**, wherein *when* the **[**selected**]** compound lens *is coupled to the mounting seat, the compound lens* is **[**allocated on the mounting seat, separating from**]** *non-contacting with* the basic objective lens.

4. An optical scanner, comprising:

a basic objective lens positioned to receive light and to project the received light onto an optical sensor; and

a mounting seat configured to releasably couple a compound lens thereto, the mounting seat configured to support and fix the compound lens in alignment with the basic objective lens when the compound lens is releasably coupled thereto, wherein when the compound lens is releasably coupled to the mounting seat the light passes through both the basic objective lens and the compound lens before being projected onto the optical sensor, and when the compound lens is not coupled to the mounting seat the light does not pass through the compound lens before being projected onto the optical sensor.

5. The optical scanner of claim 4, wherein the optical scanner is configured to scan objects according to a first resolution range when the compound lens is releasably coupled to the mounting seat, and the optical scanner is configured to scan the objects according to a second resolution range when the compound lens is not coupled to the mounting seat, wherein the second resolution range is different than the first resolution range.

6. The optical scanner of claim 4, wherein when the compound lens is releasably coupled to the mounting seat, the compound lens is non-contacting with the basic objective lens.

7. The optical scanner of claim 4, wherein when the compound lens is releasably coupled to the mounting seat, a distance between the compound lens and the basic objective lens is fixed.

8. The optical scanner of claim 4, wherein when the compound lens is releasably coupled to the mounting seat, a position of the compound lens is fixed and non-moving relative to the basic objective lens.

9. An optical scanner, comprising:

means for focusing light to be projected onto an optical sensor; and

means for mounting a compound light focusing component in alignment with the light focusing means, wherein the means for mounting is configured to releasably affix the compound light focusing component thereto, such that the mounted compound light focusing component is readily interchangeable with other compound light focusing components;

wherein the means for mounting is positioned in the optical scanner, such that when the compound light focusing component is releasably affixed to the means for mounting the light is focused by both the means for light focusing and the compound light focusing component before being projected onto the optical sensor, and when the compound light focusing component is not affixed to the means for mounting, the light is focused by the means for light focusing and not the compound light focusing component.

10. The optical scanner of claim 9, wherein the optical scanner is configured to scan objects according to a first resolution range when the compound light focusing component is releasably affixed to the means for mounting, and the optical scanner is configured to scan the objects according to a second different resolution range when the compound light focusing component is not affixed to the means for mounting.

11. The optical scanner of claim 10, wherein the optical scanner is configured to scan the objects according to a third resolution range when another compound light focusing component is releasably affixed to the means for mounting.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : RE41,683 E
APPLICATION NO. : 11/174416
DATED : September 14, 2010
INVENTOR(S) : Huang

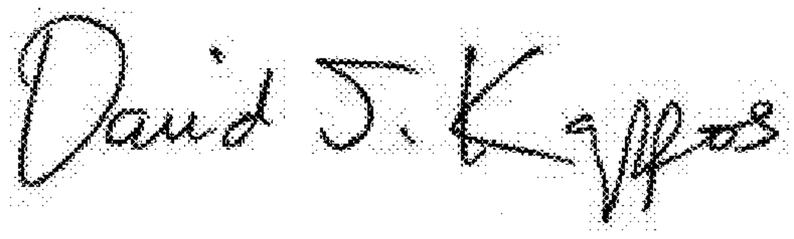
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 4, line 44, in Claim 1, delete "protect" and insert -- project --.

Column 4, line 47, in Claim 1, delete "compound]mirror," and insert -- compound] mirror, --.

Column 5, line 24, in Claim 5, delete "*wherein*" and insert -- *where* --.

Signed and Sealed this
Third Day of July, 2012



David J. Kappos
Director of the United States Patent and Trademark Office