668464

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PATENT REQUEST: STANDARD PATENT

We, Nippon Conlux Co., Ltd., being the person(s) identified below as the Applicant, request the grant of a standard patent to the person identified below as the Nominated Person, for an invention described in the accompanying complete specification.

Full application details follow.

Applicant: Nippon Conlux Co., Ltd.

Address: 2-2 Uchisaiwaicho 2-chome, Chiyoda-ku, Tokyo JAPAN

Nominated Person: Nippon Conlux Co., Ltd.

Address: 2-2 Uchisaiwaicho 2-chome, Chiyoda-ku, Tokyo JAPAN

Invention Title: "Laser output control device for an optical information recording and reproducing apparatus"

Name(s) of Actual Inventor(s): Kazuo NODA; Eiichi NAKAMURA; Koichi YAMAZAKI

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Attorney Code: RI

BASIC CONVENTION APPLICATION(S) DETAILS

Application No	Country	Country Code	Date of Application
5-122028	Japan	JP	26 April 1993

Applicant(s):Nippon Conlux Co., Ltd

We are not an eligible person described in Section 33 - 36 of the Act.

Drawing number recommended to accompany the abstract Fig. 1

Dated this 26 day of April 1994

Nippon Conlux Co., Ltd.

By: _____
Registered Patent Attorney

S 045616 260494

PW/spp2/63592

AUSTRALIA

#21547 CN-31A

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NOTICE OF ENTITLEMENT

I ~~(We)~~ Masaharu OKADA

authorised by NIPPON CONLUX CO., LTD.

of 2-2, Uchisaiwaicho 2-chome, Chiyoda-ku, Tokyo, Japan.

the applicant in respect of an application for a patent for an invention entitled

Laser output control device for an optical information recording and reproducing apparatus

filed under Australian Application No. 60692/94, state the following:

PART 1 - *Must be completed for all applications.*

The person~~(s)~~ nominated for the grant of the patent

☐ ~~is (are) the actual inventor(s)~~

or

☒ has, for the following reasons, gained entitlement from the actual inventor(s)

The nominated person is the assignee of the invention from the said actual inventor(s)

PART 2 - *Must be completed if the application is a Convention application.*

The person~~(s)~~ nominated for the grant of the patent is ~~(are)~~:

☒ the applicant~~(s)~~ of the basic application~~(s)~~ listed on the patent request form

or

☐ ~~entitled to rely on the basic application(s) listed on the patent request form by reason of the following~~:

The basic application~~(s)~~ listed on the request form is ~~(are)~~ the first application~~(s)~~ made in a Convention country in respect of the invention.

PART 3 - *Must be completed if the application was made under the PCT and claims priority.*

The person(s) nominated for the grant of the patent is (are):

☐ the applicant(s) of the application(s) listed in the declaration under Article 8 of the PCT

or

☐ entitled to rely on the application(s) listed in the declaration under Article 8 of the PCT by reason of the following:

The basic application(s) listed in the declaration made under Article 8 of the PCT is (are) the first application(s) made in a Convention country in respect of the invention.

Dated this 5th day of April 1994

NIPPON CONLUX CO., LTD.

Signed Masaharu Okada Status President

Signatory's Name Masaharu OKADA

F.B. RICE & CO PATENT ATTORNEYS

AU9460692

(12) PATENT ABRIDGMENT (11) Document No. AU-B-60692/94
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 668464

(54) Title
LASER OUTPUT CONTROL DEVICE FOR AN OPTICAL INFORMATION RECORDING AND REPRODUCING APPARATUS

International Patent Classification(s)
(51)[5] **G11B 007/125** **G11B 007/00** **H01S 003/13**

(21) Application No. : **60692/94** (22) Application Date : **26.04.94**

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5-122028	**26.04.93**	**JP JAPAN**

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(56) Prior Art Documents
US 5191204
EP 183569

(57) Claim

1. An optical information recording and reproducing apparatus comprising:-

a semiconductor laser device arranged for use as a light source for information recording and reproduction;

a housing for accommodating said semiconductor laser device and having a laser light emitting window section for allowing passage therethrough of laser light generated by said semiconductor laser device;

light detection means including light receiving means disposed at a predetermined place adjacent the periphery of said laser light emitting window section, said light detection means receiving, by means of said light receiving means, peripheral light of forward radiated light of the laser light which is generated by said laser device and which passes through said window section, said light detection means being arranged to output an

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electrical signal representing an intensity of the received peripheral light;

control means for, in accordance with the output electrical signal of said light detection means, automatically controlling output power of the laser light generated by said laser device to maintain the output power at a predetermined value; and

an optical system including an optical path for allowing the forward laser light which is generated by said laser device and passes through said window section, to be irradiated onto an optical information recording medium, said optical system being arranged in such a manner that laser light reflected from said optical information recording medium is fed back along the optical path and branched towards a reading light receiving element via splitter means provided midway in the optical path;

characterized in that said laser light emitting window section includes a window formed of a transparent plate and said light receiving means includes a light receiving element disposed on the outside of said housing on the periphery of the window formed by said transparent plate.

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Nippon Conlux Co., Ltd.

ORIGINAL
COMPLETE SPECIFICATION
STANDARD PATENT

Invention Title:

"Laser output control device for an optical information recording and reproducing apparatus"

The following statement is a full description of this invention including the best method of performing it known to us:-

Laser Output Control Device for an Optical Information Recording and Reproducing Apparatus

The present invention generally relates to a laser output control device for use in an optical information recording and reproducing apparatus that records and reproduces information onto and from an optical information recording medium, and it more particularly relates to a device for controlling output power of a semiconductor laser.

Semiconductor lasers provide light outputs that vary with changes in temperature and in luminous energy. On the other hand, optical information recording and reproducing apparatus provides automatic power control (hereinafter referred to as APC) of laser light utilized therein, because they require constant laser light output for recording and reproducing information in an uniform condition. Examples of the prior techniques relating to such automatic control of laser light output are disclosed in Japanese Patent Laid-open Publication Nos. SHO 50-23902 and 51-29821, Japanese Patent Publication Nos. HEI Nos. 2-47015 and 5-6260, and Japanese Patent

Laid-open Publication No. HEI 4-330646.

For example, in an optical information recording and reproducing apparatus as shown in Fig. 7, the peripheral light component 5 of forward radiated light output from a semiconductor laser chip 1 is eliminated via a collimating lens 3, so that only the non-peripheral light component 2, i.e., light component in and around the center of the forward radiated light enters the collimating lens 3 to be converted into a collimated light beam and then enters a beam splitter 4. The non-peripheral light component 2 is divided into transmitted light 6 and reflected light 7 by the beam splitter 4. The transmitted light 6 is converged by a converging lens 8 and directed onto an information recording medium 9 as a very minute laser light spot 10 to be utilized for effecting information recording or reproducing as needed. The reflected light 7 from the beam splitter 4 enters a light receiving element 15.

Reflected light from the information recording medium 9 goes back the same path that the transmitted light 6 took to reach the recording medium 9. The reflected light is converted via the converging lens 8 into a collimated beam, which is then directed to the beam splitter 4. Light transmitted through the beam splitter 4 is then directed onto the semiconductor chip 1 as return light, while light 11 reflected by the beam

splitter 4 is received by a light receiving element 13 via light receiving lenses 12. Thus, information signal, focus controlling signal and tracking controlling signal are derived from the light receiving element 13. The APC executes output control to maintain the laser light output at a constant value by means of a loop circuit configured such that a part of the light output from the semiconductor laser is received by the light receiving element 14 or 15, the light output from the element 14 or 15 is amplified by an output control circuit and fed back to the semiconductor laser chip.

To this end, the light receiving element 14 is designed to receive rearward radiated light 16 from the semiconductor laser chip 1 so as to provide the light output 17, and the light receiving element 15 is designed to receive the reflected light 7 from the beam splitter 4 to provide the light output 18.

In the illustrated embodiment, the rearward radiated light 16 output from the semiconductor laser chip 1 is derived via the light receiving element 14 that is mounted within a semiconductor laser housing (not shown). However, this prior arrangement presents a problem that, because the forward and rearward radiated lights output from the semiconductor laser chip 1 are not in a complete correlation with each other, it can not maintain the laser light output at a constant value and hence can not

provide a satisfactory APC operation.

Further, because the light receiving element 15 receives the reflected light 7 from the beam splitter 4, the element 15 greatly depends on the characteristics of the beam splitter 4. Thus, if, for example, a polarizing beam splitter is employed as the beam splitter 4 to reduce the transmitted light loss in the splitter and improve the optical efficiency of the optical system (usually, the beam splitter is combined with an 1/4 wave plate so as to constitute a light isolator), the reflected light 7 will not exist, so that no output can not be obtained from the light receiving element 15.

Furthermore, the light receiving element 15 becomes large in size because it is designed to receive the reflected light 7 directly from the beam splitter 4, and thus the interelectrode capacity of the element 15 is increased, with the result that the response speed is objectionably decreased. This problem may be overcome such as by converging the light incident on the light receiving element 15 so as to reduce the size of the element 15. To do this, it is necessary to newly provide a light converging means, but such a new provision of the converging means is not compatible with the current demand for reducing the size and cost of the apparatus.

It is therefore an object of the present invention to provide a laser output control device for an optical

information recording and reproducing apparatus which is capable of performing control to maintain the output of a semiconductor laser constant, by receiving peripheral light component of forward radiated light output from the semiconductor laser chip.

To achieve the abovementioned object, the present invention provides an optical information recording and reproducing apparatus comprising:-

a semiconductor laser device arranged for use as a light source for information recording and reproduction;

a housing for accommodating said semiconductor laser device and having a laser light emitting window section for allowing passage therethrough of laser light generated by said semiconductor laser device;

light detection means including light receiving means disposed at a predetermined place adjacent the periphery of said laser light emitting window section, said light detection means receiving, by means of said light receiving means, peripheral light of forward radiated light of the laser light which is generated by said laser device and which passes through said window section, said light detection means being arranged to output an electrical signal representing an intensity of the received peripheral light;

control means for, in accordance with the output electrical signal of said light detection means, automatically controlling output power of the laser light generated by said laser device to maintain the output power at a predetermined value; and

an optical system including an optical path for allowing the forward laser light which is generated by said laser device and which passes through said window section, to be irradiated onto an optical information recording medium, said optical system being arranged in such a manner that laser light reflected from said optical information recording medium is fed back along

the optical path and branched towards a reading light receiving element via splitter means provided midway in the optical path;

characterized in that said laser light emitting window section includes a window formed of a transparent plate and said light receiving means includes a light receiving element disposed on the outside of said housing on the periphery of the window formed by said transparent plate.

The non-peripheral light component in and around the centre of the forward radiated light from the

semiconductor laser device passes through the laser light emitting window of a housing containing the laser device toward an optical information recording medium. On the other hand, the peripheral light component of the forward radiated light enters the light receiving element disposed on the periphery of the laser light emitting window, from which light output is obtained which corresponds to the forward radiated light from the semiconductor laser device. Similarly, in such a case where a reflection section may be provided on the periphery of the laser light emitting window so as to receive light reflected from the reflection section, light output is obtained which corresponds to the forward radiated light output from the semiconductor laser device. This light output is provided to an output control circuit of the semiconductor laser device, which controls the output power of the laser device.

With such arrangements, the present invention can control the output power of the semiconductor laser device corresponding to the forward radiated light output from the laser device, and thus the invention can achieve advantages that the output power control provided by the invention is far more effective than the correlation-lacking feedback control provided by the prior technique using rearward radiated light, and any sort of beam splitter can be employed. Further, because a smaller-

size light receiving element can be utilized, the response speed of the element never decreases and thus it is not necessary to provide any means for converging the light incident on the light receiving element in order to prevent such a response speed decrease, with the result that the output power control and APC response characteristics of the laser light can be highly enhanced, limitations on the device design can be eliminated, and it is also allowed to substantially reduce the size and cost of the device.

The present invention will be described by way of example only with reference to the accompanying drawings.

In the accompanying drawings:

Fig. 1 is a schematic side elevational view of an optical system employed in one embodiment of the present invention;

Fig. 2 is a schematic side elevational view illustrating a structure of a semiconductor laser section;

Fig. 3 is a schematic side elevational view illustrating the structure of the semiconductor laser section in the embodiment of Fig. 1;

Fig. 4A is a schematic top plan view illustrating one example of the structure and arrangement of a light-receiving element in the embodiment of Fig. 1;

Fig. 4B is a schematic top plan view illustrating another example of the structure and arrangement of the light-receiving element;

Fig. 4C is a schematic top plan view illustrating still another example of the structure and arrangement of the light-receiving element;

Fig. 4D is a schematic top plan view illustrating still another example of the structure and arrangement of the light-receiving element;

Fig. 5 is a schematic side elevational view illustrating a structure of a semiconductor laser section;

Fig. 6 is a schematic side elevational view illustrating a structure of a semiconductor laser section invention; and

Fig. 7 is a schematic side elevational view illustrating the structure of an optical system employed in a prior art optical information recording and reproduction device.

Referring to Fig. 1 in which is shown an embodiment of the present invention, the same reference characters as in Fig. 7 denote the same components as in the figure. To first describe the optical configuration of the embodiment, the non-peripheral light component 2 in and around the center of forward radiated light output from a semiconductor laser chip 1 passes through a central aperture formed in a light receiving element 19 which is, for example, in the shape of a doughnut or ring, and then enters a collimating lens 3, from which the non-peripheral light component enters a beam splitter 4 in a collimated light beam. The beam splitter 4 may be a polarizing beam splitter through which all the incident light is allowed to

pass. After that, in a similar manner to the abovementioned shown in Fig. 7, information signal, focus control signal and tracking control signal are derived from a light receiving element 13.

Fig. 2 shows in greater detail parts of the embodiment of Fig. 1 and more particularly a semiconductor laser section that accommodates the semiconductor laser chip 1. The semiconductor laser chip 1 is mounted within a housing 21, and the interior of the housing 21 is maintained airtight. The housing 21 has a laser light emitting window 22 which is covered with a transparent flat plate 23, and, for example, the doughnut-shaped or ring-shaped light receiving element 19 is preferably adhered to the transparent flat plate 19.

The doughnut-shaped light receiving element 19 is shown in Fig. 2 as adhered to the side of the transparent flat plate 23 facing the semiconductor laser chip 1; however, according to the invention the light receiving element 19 is adhered to the side of the plate 23 opposite to the laser chip 1 as shown in Fig. 3.

As shown in Figures 1 and 3 the light receiving element 19 is disposed adjacent to, or on the periphery of the laser light emitting window 22 in the semiconductor laser chip 21 and the light output from the element 19 is fed back to a semiconductor laser output control circuit 20.

Namely, in Fig. 3 the non-peripheral light component 2 in and around the center of the forward radiated light output from the semiconductor laser chip 1 enters the collimating lens 3 through the central

aperture of the doughnut-shaped light receiving element 19, and the peripheral light component of the radiated light enters the light receiving element 19 after passing through window 23. In this case, the percentage with which the peripheral light component 2 enters the collimating lens 3 depends on the NA (numerical aperture) of the collimating lens 3. If, for instance, the NA of the collimating lens 3 is chosen to be 0.3 (NA = 0.3) as is often the case with the conventional optical information recording and reproducing systems, the light component within a 35^0 solid radiation angle of the forward radiated light output from the semiconductor laser chip 1 can enter the collimating lens 3. This accounts for about 60% of the forward radiated light, and the remaining 40% is contained in the peripheral light 5 and is received by the light receiving element 19.

The light receiving element 19 may be of any shape as long as it can receive the whole or part of the peripheral light 5 of the forward radiated light. For instance, the light receiving element 19 may comprise a doughnut-shaped element 19-1 as shown in item Fig. 4A or a square or rectangular element 19-2 having a central aperture formed therein as shown in Fig. 4B, or it may comprise a predetermined plurality of separate elements 19-3 or 19-4 as shown in Fig. 4C or 4D.

Fig. 5 shows a structure in which a mirror 24 is disposed in place of the light receiving element 19 in the above described embodiment, and light reflected from the mirror 24 is received by a light receiving element 25. The

mirror 24 and light receiving element 25 may be shaped like any of the elements 19-1 to 19-4 shown in Figs. 4A to 4D.

Fig. 6 shows a structure in which the mirror 24 is composed of a concave mirror 26 in addition to a plane mirror. The use of the concave mirror 26 can converge reflected light from the mirror 26 into a single minute spot and thus can minimize the size of a light receiving element 27. Consequently, it is possible to minimize the

interelectrode capacitance of the light receiving element 27, to thereby greatly increase its APC response speed.

According to a feature of the present invention as has been described so far, light output corresponding to the peripheral light component of forward radiated light from a semiconductor chip is obtained by a light receiving element and fed back to and controlled by a semiconductor laser output control circuit. Because of this feature, the invention can achieve superior advantageous results that the output power control provided by the invention is far more effective than the correlation-lacking feedback control provided by the prior technique using rearward radiated light, and any sort of beam splitter can be employed. Further, because a smaller-size light receiving element can be utilized, the response speed of the element never decreases and thus it is not necessary to provide any means for converging the light incident on the light receiving element in order to prevent such a response speed decrease, with the result that the output power control and APC response characteristics of the laser light can be highly enhanced, limitations on the device design can be eliminated, and it is also allowed to substantially reduce the size and cost of the device.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. An optical information recording and reproducing apparatus comprising:-

a semiconductor laser device arranged for use as a light source for information recording and reproduction;

a housing for accommodating said semiconductor laser device and having a laser light emitting window section for allowing passage therethrough of laser light generated by said semiconductor laser device;

light detection means including light receiving means disposed at a predetermined place adjacent the periphery of said laser light emitting window section, said light detection means receiving, by means of said light receiving means, peripheral light of forward radiated light of the laser light which is generated by said laser device and which passes through said window section, said light detection means being arranged to output an electrical signal representing an intensity of the received peripheral light;

control means for, in accordance with the output electrical signal of said light detection means, automatically controlling output power of the laser light generated by said laser device to maintain the output power at a predetermined value; and

an optical system including an optical path for allowing the forward laser light which is generated by said laser device and passes

through said window section, to be irradiated onto an optical information recording medium, said optical system being arranged in such a manner that laser light reflected from said optical information recording medium is fed back along the optical path and branched towards a reading light receiving element via splitter means provided midway in the optical path;

characterized in that said laser light emitting window section includes a window formed of a transparent plate and said light receiving means includes a light receiving element disposed on the outside of said housing on the periphery of the window formed by said transparent plate.

2. An optical information recording and reproducing apparatus as defined in claim 1 wherein said light receiving means is disposed in a ring-shaped configuration on the periphery of the window section.

3. An optical information recording and reproducing apparatus as defined in claim 1 wherein said light receiving means comprises a plurality of segments disposed on the periphery of the window section.

4. An optical information recording and reproducing apparatus as claimed in any preceding claim and substantially as hereinbefore described with reference to Figures 1 and 3 and Figures 4A to 4D of the drawings.

DATED this 9th day of February 1996

NIPPON CONLUX CO LTD
Patent Attorneys for the Applicant:

F.B. RICE & CO.

Abstract

"Laser Output Control Device for an Optical Information Recording and Reproducing Apparatus"

In a laser output control device for use in an optical information recording and reproducing apparatus which uses output light from a semiconductor laser device (1) to record and reproduce information onto and from an optical information recording medium (9), a light receiving element (19) is provided on the peripheral portion of a laser light emitting window (22) formed in a housing (21) of the semiconductor laser device (1). The peripheral component (5) of forward radiated light of the laser light output from the semiconductor laser device (1) is received by the light receiving element (19), so as to control the output power of the semiconductor laser device (1) in accordance with output of the light receiving element corresponding to the received light.

(Figure 1)

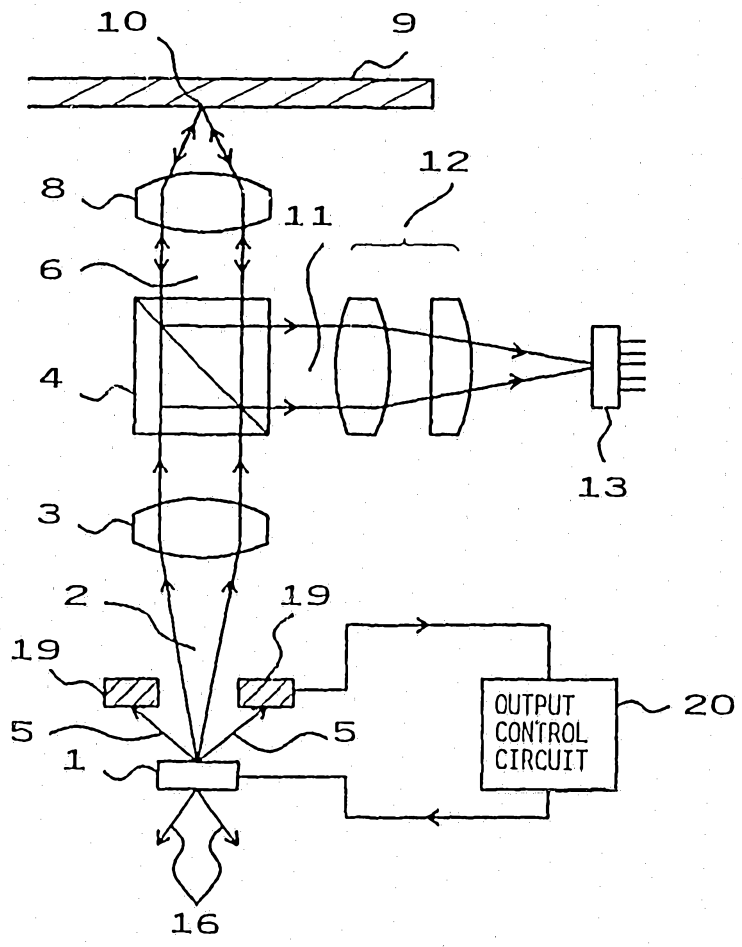
10
9
12
8
11
6
4
13
3
2
19
19
5
5
1
OUTPUT
CONTROL
CIRCUIT
20
16

FIG. 1

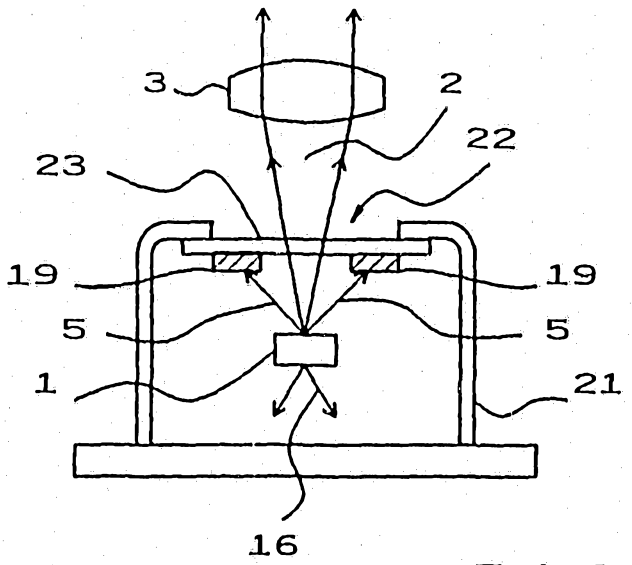
3
2
22
23
19
19
5
5
1
21
16

FIG. 2

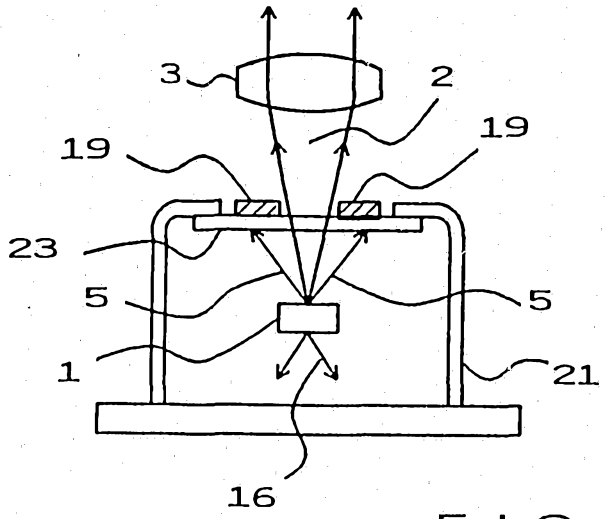

FIG. 3

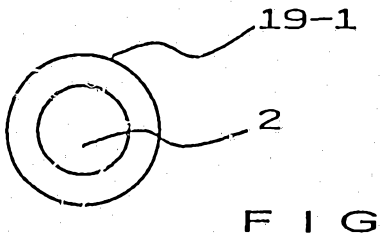

FIG. 4A

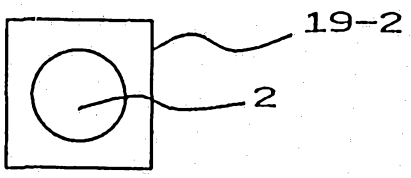

FIG. 4B

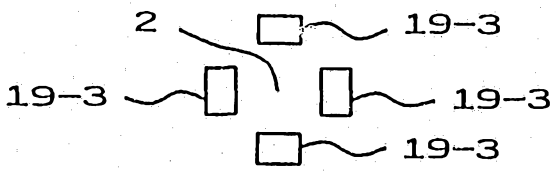

FIG. 4C

FIG. 4D

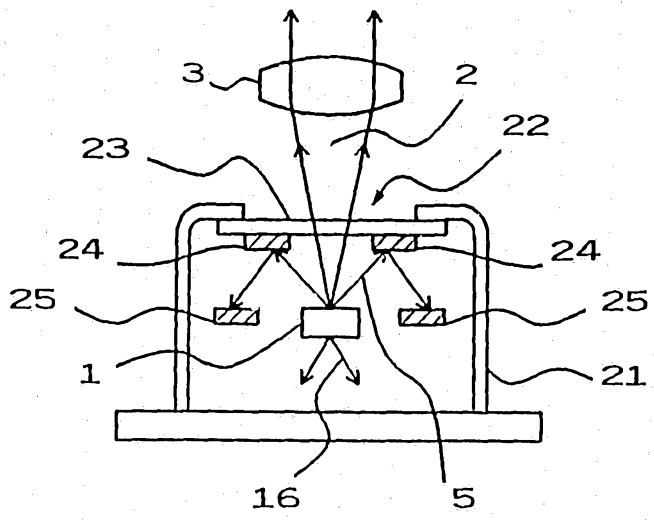

FIG. 5

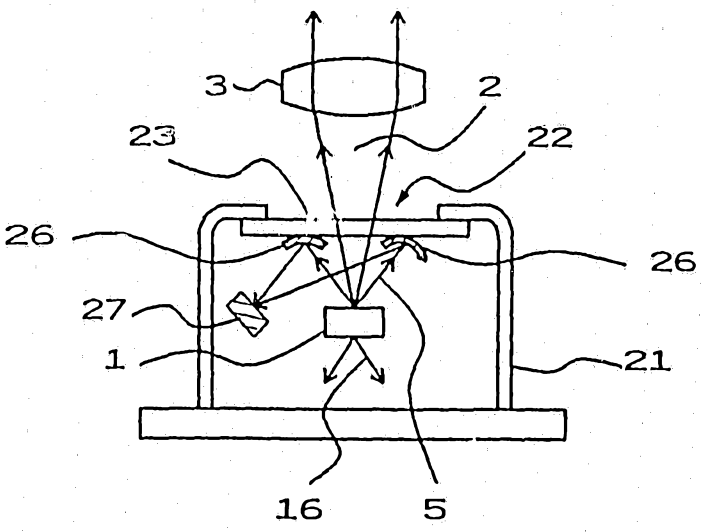

FIG. 6

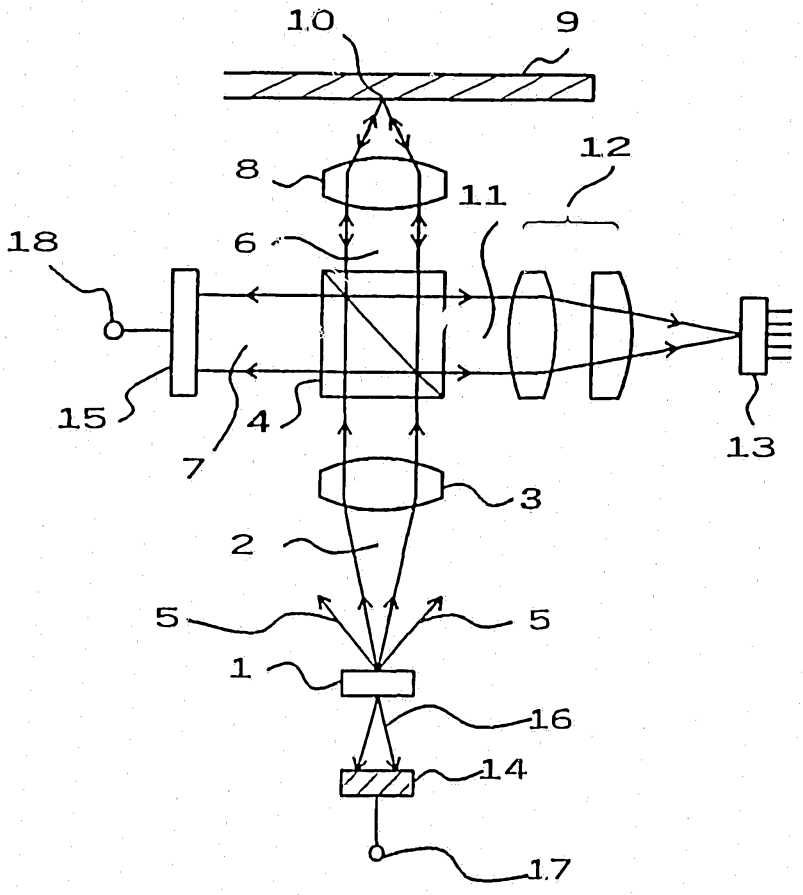

FIG. 7