

(12) UK Patent Application (19) GB (11) 2 139 784 A

(43) Application published 14 Nov 1984

(21) Application No **8407780**

(22) Date of filing **26 Mar 1984**

(30) Priority data

(31) **58/050247** (32) **25 Mar 1983** (33) **JP**

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(51) INT CL³
G11B 13/04 G05D 3/14

(52) Domestic classification
G3R A273 B246 BC22
U1S 2102 2115 G3R

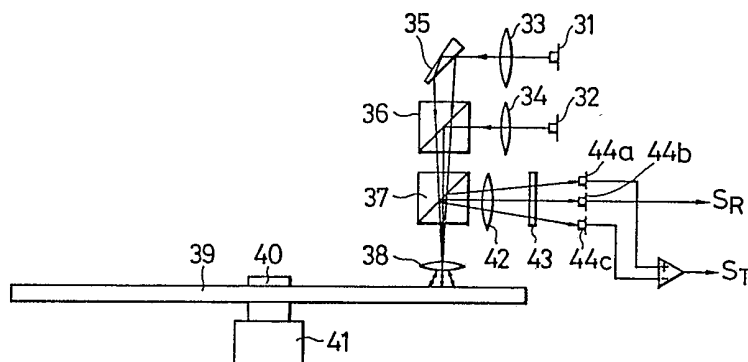
(56) Documents cited
None

(58) Field of search
G3R

(54) Optical information processing apparatus

(57) This specification discloses an optical information processing apparatus in which a primary radiation beam is applied to an information track on a recording medium to reproduce information and at least two secondary radiation beams are applied to positions different from each other widthwise of the information track to which the primary beam has been applied and the beam from the recording medium, of the secondary beams, is detected to thereby obtain a tracking signal for accurately directing the primary beam to the information track, characterized in that the primary beam and the secondary beams have different wavelengths and these beams emitted from discrete radiation sources are combined together and directed to the recording medium through a common optical path.

FIG. 2



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The diagram illustrates a hybrid optical-electronic system for measuring the surface profile of a specimen. The system is divided into two main parts: an optical section on the right and an electronic section on the left.

Optical Section:

- A light source (1) emits a beam that passes through a lens (2) and a beam splitter (3).
- The transmitted beam passes through a filter (4) and is reflected by a mirror (5) towards a lens (6).
- The reflected beam from the mirror (5) is directed by the beam splitter (3) towards a lens (15) and a specimen (21).
- The specimen (21) is mounted on a stage (22) with a vertical actuator (23).
- Light reflected from the specimen (21) is collected by the lens (15) and directed towards a beam splitter (14).
- The beam splitter (14) directs the light towards a lens (13) and a beam splitter (16).
- The beam splitter (16) directs the light towards a lens (17) and a detector (18).
- The detector (18) is connected to a signal processing unit (20).

Electronic Section:

- The signal processing unit (20) receives signals from the detector (18) and the beam splitter (14).
- The signals are processed by two comparators (19a and 19b) and a logic unit (19c).
- The logic unit (19c) outputs three signals: S_T (Transmitted), S_R (Reflected), and S_F (Focus).

FIG. 3

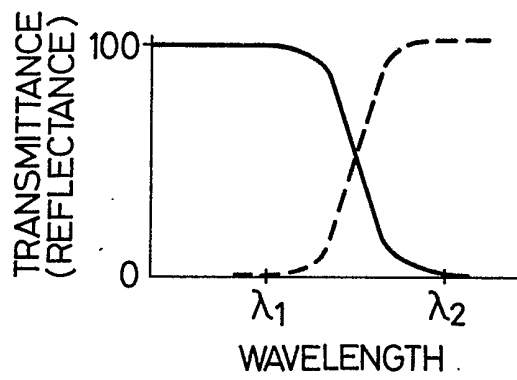
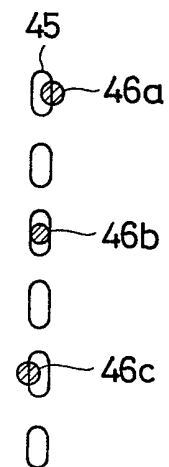


FIG. 4



SPECIFICATION

Optical information processing apparatus5 *Background of the invention**Field of the invention*

This invention relates to an optical information processing apparatus to be used to record various types of information on a recording medium by a

- 10 light beam or to reproduce the information recorded on the recording medium, by a light beam.

Description of the prior art

- 15 Optical disk apparatuses, magneto-optical disk apparatuses, etc. are known as optical information processing apparatuses. For example, in the case of a magneto-optical disk apparatus, recording and reproduction are effected in the following process.

- As a recording medium, use is made of a so-called
20 magneto-optical disk comprising a disk-like substrate formed of glass, plastics or the like and a perpendicularly magnetized film usually having a thickness of several microns provided on the substrate. The perpendicularly magnetized film is formed
25 of an amorphous alloy or the like and has a characteristic that it is magnetized perpendicularly to the film surface.

- In recording information on such a magneto-optical disk memory, the directions of magnetization
30 of the perpendicularly magnetized film of the magneto-optical disk memory are first arranged in one direction, and then a laser beam spot digitally modulated by an information signal is applied to the perpendicularly magnetized film to bring the temperature of the perpendicularly magnetized film to
35 the curie point or higher. Thereupon, in the portion to which the laser beam spot has been applied, the direction of magnetization is reversed by the influence of the magnetic field around the portion and
40 logic "1" (or "0") is recorded and thus, a recording bit is formed.

- To read the information thus recorded on the magneto-optical disk memory, a reading beam spot is applied to the perpendicularly magnetized film
45 and the information is read by the utilization of the magneto-optic Kerr effect in which the direction of polarization of the reflected beam is varied by the difference in the direction of magnetization of the perpendicularly magnetized film or the Faraday
50 effect in which the direction of polarization of the transmitted beam is varied.

- On the other hand, during the information reading as described above, tracking control for ensuring a light beam to accurately follow an information track
55 comprising a continuously recorded recording bit train is indispensable. Heretofore, the so-called three-beam method described in U.S. Patent No. 3,876,842, etc. has been used for this tracking control because it enables highly accurate position detection
60 to be accomplished. Particularly, where a magneto-optical disk is used as the recording medium, the signal component detected by the utilization of the magneto-optic effect such as the Kerr effect is minute and therefore, in the so-called far filed
65 method used with an optical disk or the like, tracking

control is difficult and the three-beam method is effective. An example of the construction of a conventional optical information processing apparatus using such a three-beam method is shown in
70 Figure 1 of the accompanying drawings.

- In Figure 1, in a writing system shown in the right half of the Figure, a laser beam emitted from a self-modulatable semiconductor laser 1 is collimated by a collimator lens 2 and enters a polarizing beam splitter 3. The polarizing beam splitter 3 is designed to transmit P-polarized light therethrough and reflect S-polarized light. The direction of polarization of the semiconductor laser 1 is disposed so as to be horizontal with respect to the plane of the drawing sheet and accordingly, the beam is transmitted through the polarizing beam splitter 3, enters a quarter wave plate 4 and becomes a circularly polarized light, and is deflected by 90° by a reflecting mirror 5. Further, the beam enters an objective lens 6, is imaged on the surface of a disk-like recording medium (hereinafter referred to as the disk) 21 and reverses the direction of magnetization of the perpendicularly magnetized film on the surface of the disk 21. The beam reflected from the disk 21 passes through the objective lens 6 and the reflecting mirror 5, is made into S-polarized light by the quarter wave plate 4, is reflected by the beam splitter 3 and enters a detector 8. The light having entered the detector 8 is photoelectrically converted and utilized as a servo signal SF (auto focus signal) so that the focus position of the objective lens always lies on the disk. The disk 21 is rotated at a predetermined speed by a drive motor 23 through a spindle 22. A reading system to which the three-beam method is applied is shown in the left half of Figure 1. A laser beam emitted from a semiconductor laser 9 is collimated by a collimator lens 10, has its degree of polarization enhanced by a polarizing plate 11 and is divided into three beams by a grating 12. These beams pass through the half-mirror 13, are reflected by a tracking mirror 14 and are imaged as three beam spots on the surface of the disk 21 by an objective lens 15. These light beams having impinged on the disk 21 have their directions of polarization rotated by the Kerr effect, are reflected by the objective lens 15, a tracking mirror 14 and a half-mirror 13, are divided into two beams by a half-mirror 16, pass through polarizing plates 17 and 18 and a photoelectrically detected by detectors 19a, 19b, 19c and 20. The polarizing plates 17 and 18 have their polarization azimuth angles shifted by a predetermined angle in advance. The reflected light from the central spot enters the detectors 19b and 20 and is taken out as an information signal SR. Also, a signal for focusing control, not shown, is detected by a conventional method. The reflected lights from the spots on the opposite sides are photoelectrically detected by the detectors 19a and 19c, are differentiated and are taken out as a tracking signal ST.

- 125 In the optical information processing apparatus as shown in Figure 1, the reading system and the writing system cannot be made common because use is made of the three-beam method, and this has led to a disadvantage that the apparatus becomes
130 bulky.

Japanese Laid-open Patent Application No. 17546/1983 propose an apparatus which uses two light sources of different wavelengths and in which the reading system and the writing system are made common. However, even in this apparatus, parts of the optical parts of a recording beam and a reproducing beam including an objective lens, etc. are only made common, and this apparatus does not essentially differ from the apparatus of Figure 1 in that a recording beam is obtained from one light source and three reproducing beams are obtained from the other light source. Accordingly, in this apparatus, the construction of the optical system and of the detecting system is complicated and thus, it has not been possible to make the apparatus sufficiently compact.

As a problem common to the apparatus of Figure 1 and the apparatus of the aforementioned Japanese Laid-open Patent Application No. 17546/1983, it may be mentioned that since the light beam from a light source is divided into three beams by the use of a grating, the output of the light source must be made great in order that each of the divided beams may have sufficient intensity and thus, the burden applied to the light source is great. In contrast, Japanese Laid-open Patent Application No. 94842/1976 proposes using as the light source a semiconductor laser array comprising three or more light-emitting areas formed on a substrate. In this case, however, the positional relation between the beam spots on the disk is determined by the positions whereat the respective light-emitting areas of the semiconductor laser array are formed, and this has led to a disadvantage that due to the irregularity of the manufacturing always accuracy of the semiconductor laser array, it is difficult to effect reproduction under predetermined conditions between apparatuses.

40 Summary of the invention

Accordingly, the present invention aims in one aspect to provide an optical information processing apparatus in which highly accurate tracking control can be accomplished by the use of a low-output light source and irregularity of performance between apparatuses is small.

In another aspect the present invention aims to provide an optical information processing apparatus in which highly accurate tracking control is possible and which is capable of accomplishing recording and reproduction by a compact construction.

In accordance with the above aspects, the present invention provides an optical information processing apparatus in which a primary radiation beam is applied to an information track on a recording medium to reproduce information and at least two secondary radiation beams are applied to positions different from each other widthwise of the information track to which the primary beam has been applied and the beam from the recording medium, of the secondary beams, is detected to thereby obtain a tracking signal for accurately directing the primary beam to the information track, characterized in that the primary beam and the secondary beams

have different wavelengths and these beams emitted from discrete light sources are combined together and directed to the recording medium through a common optical path.

70 The invention will become more fully apparent from the following detailed description thereof taken in conjunction with the accompanying drawings.

Brief description of the drawings

75 *Figure 1* is a schematic view showing an example of the construction of an optical information processing apparatus according to the prior art.

Figure 2 is a schematic view showing an embodiment of the optical information processing apparatus according to the present invention.

80 *Figure 3* is a graph showing the spectral transmittance (reflectance) characteristic of the beam splitter of the apparatus shown in *Figure 2*.

85 *Figure 4* shows the arrangement of beam spots on a recording medium by the apparatus shown in *Figure 2*.

Description of the preferred embodiment

Figure 2 is a schematic view showing an example of an optical information recording-reproducing apparatus according to the present invention. In Figure 2, reference numeral 31 designates a semiconductor laser of wavelength λ_1 , reference numeral 32 denotes a semiconductor laser of wavelength λ_2 , reference numerals 33 and 34 designate collimator lenses for collimating the lights from the semiconductor lasers 31 and 32, respectively, reference numeral 35 denotes an optical wedge for separating the light from the semiconductor laser 31 into two parallel beams of different inclinations, and reference numeral 36 designates a beam splitter which transmits a light of wavelength λ_1 therethrough and reflects a light of wavelength λ_2 and whose characteristic is shown in Figure 3. In Figure 3, solid line indicates the spectral transmittance and broken line indicates the spectral reflectance. Reference numeral 39 denotes a magneto-optical disk which may be rotated by a drive motor 41 through a spindle 40. Three beams combined together by the beam splitter 36 enters a polarizing beam splitter 37 (having a P-polarized light transmittance of 95% and an S-polarized light reflectance of 98%) and almost all of them are transmitted through the polarizing beam splitter 37 because the light having left the beam splitter 36 is P-polarized light, and are imaged as spots on the magneto-optical disk 39 by an objective lens 38. The spots imaged on the magneto-optical disk 39 are shown in Figure 4. In Figure 4, reference numeral 45 designates a recording bit, reference characters 46a and 46c denote the spots by a light beam of wavelength λ_1 , and reference character 46b designates the spot by a light beam of wavelength λ_2 . The light reflected by the magneto-optical disk 39 has its direction of polarization rotated $\pm \theta_k$ by the direction of magnetization, passes through the objective lens 38 and is reflected by the polarizing beam splitter 37, and its Kerr rotation angle is apparently amplified. This light passes through a condensing lens 42 and through a polarizing plate 43 and enters detectors 44a, 44b and 44c. Accordingly,

the light from the light beam spot 46a of Figure 4 is photoelectrically detected by the detector 44a, the light from the light beam spot 46b is photoelectrically detected by the detector 44b and the light from the light beam spot 46c is photoelectrically detected by the detector 44c. A tracking signal ST is obtained by taking the difference between the signals from the detectors 44a and 44c, whereby tracking control is effected. The light on the disk surface from the spot 46b is detected by the detector 44b and although not shown, focus control is effected in a conventional manner. The beam forming the spot 46b becomes a writing beam during writing by intensifying the power of the semiconductor laser 32, and becomes a reading beam during reading by weakening the power of the semiconductor laser 32. Accordingly, the detector 44b obtains a reading signal also.

In the above-described embodiment, the light from the semiconductor laser 31 is divided into two beams by the optical wedge 35. The optical wedge 35 is formed by endowing its two reflecting surfaces with a predetermined angle, and may be made as by working a glass material into a wedge-like form. The optical wedge 35 has various advantages as compared with other beam dividing means such as grating. For example, by disposing the optical wedge 35 as shown in Figure 2 so that the principle ray of each of the two beams divided thereby travels toward the center of the pupil of the objective lens 38, the lens diameter can be effectively utilized in a simple construction.

In the present embodiment, the semiconductor laser 31 may be turned off during writing when tracking control is not necessary. Where a guide track such as a groove is provided in the recording medium in advance, it is also possible to write information while effecting tracking control. Further, in the magneto-optical disk, it is possible to erase recorded information by applying a light beam thereto while applying a magnetic field in one direction, and in the present embodiment, by changing over the output of the semiconductor laser 32 to the output for erasing, it is possible to accurately erase the recording bit while effecting tracking control.

The previously described embodiment is constructed such that the beams from two light sources of different wavelengths are used while being combined together and the output of one of the light sources is changed to thereby provide a recording beam during writing and provide a reproducing beam during reading and the beam from the other light source is divided into two beams and tracking control is effected by the two beams. By adopting such a construction, the writing system and the reading system can be arranged compactly and since the beam obtained from one of the light sources is made into two beams, the output of the tracking beam can be increased without applying so great a burden to the light sources. Where a magneto-optical recording medium is used, a high output of the tracking beam is desired to improve the S/N ratio because the signal component by the magneto-optic effect is minute. Accordingly, in such case, the construction of the present embodiment is

particularly effective. By the same reason, the present invention is also suited to use an erasable recording medium utilizing a phase variation of a substance.

In the previously described embodiment, an example has been shown in which the recording and reproduction on the recording medium are effected by a common optical system, but the present invention will be effective to alleviate the requirement for the high output of the light source even if it is used in an apparatus which effects only recording or reproduction of information. Moreover, as compared with a case where a semiconductor laser array is used as the light source, adjustment of the beam arrangement is easy and the irregularity of performance between apparatuses can be minimized.

The present invention permits various modifications without departing from the scope of the invention as defined in the appended claims. For example, the recording medium is not limited to the magneto-optical disk, but may be any recording medium on which information may be recorded and reproduced by application of a light beam thereto, such as recording medium utilizing the unevenness of the recording layer or a variation in reflectance. The shape of the recording medium is not limited to the disk-like shape, but may also be a card-like shape, a tape-like shape, a drum-like shape or the like. Also, the recording medium may be made light-transmissive and design may be made such that the beam transmitted through such medium is detected. It is also possible to make such a design that the beam from the recording medium is further divided into two beams by a half-mirror or the like and the respective beams are received by detectors and the reproducing signal, the tracking signal, etc. are heterodyne-detected.

CLAIMS

1. An optical information processing apparatus in which a primary radiation beam is applied to an information track on a recording medium to reproduce information and at least two secondary radiation beams are applied to positions different from each other widthwise of the information track to which said primary beam has been applied and the beam from the recording medium, of said secondary beams, is detected to thereby obtain a tracking signal for accurately directing said primary beam to the information track, characterized in that said primary beam and said secondary beams have different wavelengths and these beams emitted from discrete radiation sources are combined together and directed to the recording medium through a common optical path.

2. An optical information processing apparatus according to Claim 1, wherein the information track on said recording medium is recorded by modulating said primary beam in accordance with the information and applying it to said recording medium.

3. An optical information processing apparatus according to Claim 2, wherein said secondary beams are not applied to the recording medium when

information is being recorded by said primary beam.

4. An optical information processing apparatus according to Claim 1, wherein said secondary beams are formed by the use of a radiation source and an optical wedge member for dividing the radiation beam emitted from said radiation source into two beams and having two reflecting surfaces forming a predetermined angle therebetween.

5. An optical information processing apparatus according to Claim 1, wherein said primary beam and said secondary beams are applied to the recording medium through an objective lens, and said optical wedge member is disposed so that the principle rays of the secondary beams reflected by the respective reflecting surfaces thereof travel toward the center of the pupil of said objective lens.

6. An optical information processing apparatus according to Claim 1, wherein said primary beam and said secondary beams are combined together by a beam splitter whose transmittance and reflectance differ depending on wavelength.

7. An optical information processing apparatus according to Claim 1, wherein said recording medium comprises an erasable recording medium.

8. An optical information processing apparatus according to Claim 7, wherein the information recorded on said recording medium is erased by applying said primary beam thereto.

9. An optical information processing apparatus according to Claim 7, wherein said recording medium comprises a magneto-optical recording medium.

10. An optical information processing apparatus comprising:

a first radiation source for emitting a first radiation beam modulated in conformity with information; a second radiation source for emitting a second radiation beam different in wavelength from said first beam;

dividing means for dividing said second beam into two beams;

an optical system for combining said first beam with said divided second beams and for directing the same to a recording medium through a common optical path, said first beam being applied by said optical system to a guide track provided in the recording medium in advance, said divided two second beams being applied to positions different from each other widthwise of the guide track to

which said first beam is applied; and

detecting means for receiving the beam from the recording medium, of said second beam, and obtaining a tracking signal for accurately directing said first beam to the guide track.

11. An optical information processing apparatus according to Claim 10, wherein said dividing means comprises an optical wedge member having two reflecting surfaces forming a predetermined angle therebetween.

12. An optical information processing apparatus according to Claim 11, wherein said first and second beams are applied to the recording medium through an objective lens, and said optical wedge member is disposed so that the principle rays of the second beams reflected by the respective reflecting surfaces

thereof travel toward the center of the pupil of said objective lens.

13. An optical information processing apparatus according to Claim 10, wherein said first beam and said second beam are combined together by a beam splitter whose transmittance and reflectance differ depending on wavelength.

14. Apparatus for recording information on and/or reading information from, a recording medium using a primary beam of electromagnetic radiation, wherein there is provided tracking means for causing the point of impingement of said primary beam on said recording medium to conform to a desired tracking path, said tracking means comprising means for directing tracking electromagnetic radiation onto said medium in the region of said point of impingement, and means for detecting tracking radiation from said medium to produce a tracking signal, said tracking radiation and said primary beam radiation having different characteristics.

15. Apparatus for recording information on and reading information from a recording medium using electromagnetic radiation, wherein means is provided for selectively deriving from a common beam source and directing onto the medium via a common optical path a recording beam or a reading beam, said recording beams differing in beam intensity.

16. Apparatus according to claim 15 wherein there is further provided tracking means including a source of tracking electromagnetic radiation, means for directing said tracking radiation onto said medium via an optical path partly common with that of said recording or reading beam, means for detecting tracking radiation from the medium to produce a tracking signal, and means responsive to said tracking signal to cause the point of impingement of the recording or reading beam on the medium to follow a desired track.

17. Apparatus according to claim 14 or claim 16 wherein said tracking means is arranged to form a pair of tracking beams and to cause said tracking beams to impinge on said recording medium at respective points which are laterally spaced in opposite directions from the track of the impingement point of the recording or reading beam.

18. An optical information processing apparatus substantially as hereinbefore described with reference to Figure 2 of 4 of the accompanying drawings.