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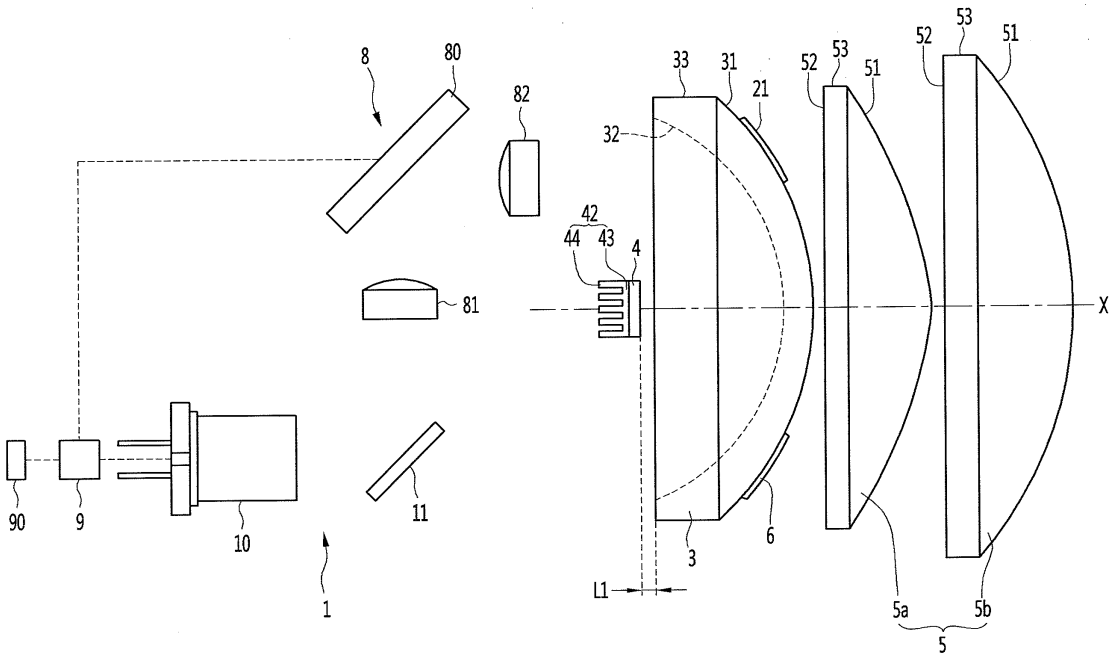
(54) LIGHTING APPARATUS FOR VEHICLE

(57) A lighting apparatus for a vehicle according to an embodiment of the present invention may include a main lens; a light source device from which light is emitted; a first reflecting unit which is provided in a portion area of the front surface of the main lens; a scanning module which converts a light path of light emitted from the light source device and emits the light to the first reflecting unit; and a reflective fluorescent body which converts wavelength of light reflected by the first reflecting unit and then reflects the light into the main lens. The scanning module may includes a scanning unit which is driven according to a predetermined frequency and converts the light path by reflecting an incident light, and a first light condensing device which condenses the light emitted from the light source device into the scanning unit.

FIG. 1



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Description

Field

[0001] The present invention relates to a lighting apparatus for a vehicle, and more specifically to a light device for a vehicle in which a scanning unit is provided and thus is capable of scanning light in the front side of a vehicle.

Background

[0002] A lighting device such as a lamp which causes a driver to secure visibility or can inform the outside of the current running state of the vehicle by increasing intensity of the illumination of the surrounding of the vehicle during running state of the vehicle is installed in a vehicle.

[0003] The lighting apparatus for a vehicle installed in the vehicle may be include a head lamp which irradiates light to the front of the vehicle and a rear lamp which displays the heading direction of the vehicle, indicates whether or not the brake operation, or the like from the rear of the vehicle.

[0004] The lighting apparatus for a vehicle may form a low beam or a high beam for securing visibility of a driver at the time of night driving. Recently, use of an LED which has a high power efficiency and a long service life is gradually increased. In addition, it is possible to use a laser diode having a long irradiation distance.

[0005] An adaptive driving beam (ADB) among implementing technology of a lighting apparatus for a vehicle is a technology that allows a driver to get a field of view as much as possible by operating a high beam feature required while driving without dazzling the driver's eyes of an oncoming vehicle.

[0006] The ADB implementing technology in the related art has mainly used the matrix LED, but the matrix LED has a limit that needs a lot of LEDs.

SUMMARY

[0007] An objective of the present invention is to provide a lighting apparatus for a vehicle which is capable of implementing a scanning feature and minimizing the number of component and thus being made compact.

[0008] A lighting apparatus for a vehicle according to an embodiment of the present invention may include a main lens; a light source device from which light is emitted; a first reflecting unit which is provided in a portion area of the front surface of the main lens; a scanning module which converts a light path of light emitted from the light source device and then emits the light to the first reflecting unit; and a reflective fluorescent body which converts wavelength of light reflected from the first reflecting unit and then reflects the light into the main lens.

[0009] The scanning module may include a scanning unit which is driven according to a predetermined frequency and converts the light path by reflecting an incident light, and a first light condensing device which condenses the light emitted from the light source device into the scanning unit.

[0010] The lighting apparatus for a vehicle may further include an external sensor which collects external information of a vehicle; and a control unit which controls the light source device based on the external information.

[0011] The first light condensing device may be a light reducer which reduces a light width of the beam emitted from the light source device and then emits the light to the scanning unit.

[0012] The scanning module may further include a second light condensing device which condenses the light reflected from the scanning unit and then emits the light toward the reflecting unit.

[0013] The first light condensing device and the second light condensing device may be secondary lenses which condense light.

[0014] The second light condensing device may be disposed on a non-axis which gets out of the optical axis of the main lens (i.e. displaced, or spaced apart, from the main lens optical axis).

[0015] The optical axis of the first light condensing device and the optical axis of the second light condensing device may be perpendicular to each other.

[0016] The light source device may include a light source and a reflecting member which converts the light path of the light emitted from the light source.

[0017] The light source device, the reflective fluorescent body and the scanning module may be disposed in the rear side of the main lens.

[0018] The reflective fluorescent body may be disposed to face the rear surface of the main lens.

[0019] The reflective fluorescent body may be disposed on the optical axis of the main lens.

[0020] The lighting apparatus for a vehicle may further includes a secondary light source which is disposed in the rear side of the main lens, and a second reflecting unit which is provided in the main lens, and reflects the light emitted from the secondary light source.

[0021] The lighting apparatus for a vehicle may further includes a third reflecting unit which is provided in a portion area of surface of the main lens and reflects a portion of the light reflected from the reflective fluorescent body to the main lens to the rear side of the main lens.

[0022] The third reflecting unit may be spaced apart from the first reflecting unit.

[0023] The secondary light source may be disposed on a non-axis which gets out of the optical axis of the main lens.

[0024] The secondary light source may emit light in a direction parallel to the optical axis of the main lens.

[0025] The distance between the light source device and the secondary light source may be smaller than the diameter of the main lens.

[0026] The reflecting unit may be disposed on a non-axis which gets out of the optical axis of the main lens.

[0027] The front surface of the main lens may have a

convex shape, and the cross sectional shape of the reflecting unit may be an arc shape.

[0028] The reflecting unit may be a concave mirror which is formed in the surface of the main lens.

[0029] According to the embodiment of the present invention, a lighting apparatus for a vehicle having a scanning feature may be provided. The lighting apparatus for a vehicle does not need an additional optical component which allows light to be incident on the reflective fluorescent body in the front side spaced apart from the main lens. Accordingly, the disposition of optical components is easy. Further, the first reflecting unit is provided in the portion area of the surface of the lens and thus the number of components is capable of being minimized and being made compact.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

FIG. 1 is a construction view schematically illustrating a lighting apparatus for a vehicle according to a first embodiment of the present invention,

FIG. 2 is a construction view schematically illustrating an light path of the lighting apparatus for a vehicle according to the first embodiment of the present invention,

FIG. 3 is a perspective view schematically illustrating an light path of the lighting apparatus for a vehicle according to the first embodiment of the present invention,

FIG. 4 is a perspective view illustrating a construction of a scanning unit,

FIG. 5 is a view schematically illustrating a path change of an incident position in a reflective fluorescent body on which light is incident,

FIG. 6 is a construction view schematically illustrating a lighting apparatus for a vehicle according to a second embodiment of the present invention,

FIG. 7 is a construction view schematically illustrating an light path of a lighting apparatus for a vehicle according to a third embodiment of the present invention,

FIG. 8 is a perspective view schematically illustrating an light path of a lighting apparatus for a vehicle according to the third embodiment of the present invention,

FIG. 9 is a perspective view schematically illustrating an light path of a lighting apparatus for a vehicle according to a fourth embodiment of the present invention,

FIG. 10 is a plan view schematically illustrating a light path of a lighting apparatus for a vehicle according to the fourth embodiment of the present invention,

FIG. 11 is a construction view schematically illustrating a light path of a lighting apparatus for a vehicle according to a fifth embodiment of the present invention,

FIG. 12 is a perspective view schematically illustrating an light path of a lighting apparatus for a vehicle according to a sixth embodiment of the present invention, and

FIG. 13 is a plan view schematically illustrating a light path of a lighting apparatus for a vehicle according to the sixth embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0031] Hereinafter, a specific embodiment of the present invention will be described in detail with reference to the drawing.

[0032] FIG. 1 is a construction view schematically illustrating a lighting apparatus for a vehicle according to a first embodiment of the present invention, FIG. 2 is a construction view schematically illustrating an light path of the lighting apparatus for a vehicle according to the first embodiment of the present invention, and FIG. 3 is a perspective view schematically illustrating an light path of the lighting apparatus for a vehicle according to the first embodiment of the present invention.

[0033] According to the embodiment of the present invention, a lighting apparatus for a vehicle may include a main lens 3, a light source device 1 from which light is emitted, a first reflecting unit 21 which is provided in the a portion area of the front surface 31 of the main lens 3, a scanning module 8 which converts a light path of light emitted from the light source device 1 and then emits the light to the first reflecting unit 21, and a reflective fluorescent body 4 which converts the wavelength of the light reflected from the first reflecting unit 21 and then reflects the light to the main lens 3.

[0034] Preferably, the lighting apparatus for a vehicle according to the embodiment of the present invention may further include a third reflecting unit 6 which is provided in a portion area of the surface of the main lens 3 and reflects the light reflected from the reflective fluorescent body 4 to the main lens 3 to the rear side of the main lens 3.

[0035] The lighting apparatus for a vehicle may constitute a head lamp of the vehicle and may be used as a high beam lighting device which generates a high beam or may be used as a low beam lighting device which generates a low beam.

[0036] According to an embodiment of the present invention, the light source device 1 is capable of emitting light to the scanning module 8, more specifically toward the first light condensing device 81. The light source device 1 is capable of emitting light toward the first light condensing device 81. The light emitted toward the first light condensing device 81 is condensed at the first light condensing device 81 and then may be incident on the scanning unit 80.

[0037] The light source device 1 may be disposed on the rear side of the main lens 3.

[0038] The light source device 1 is capable of emitting

light toward the rear surface of the first light condensing device 81.

[0039] The light which is incident on the rear surface of the first light condensing device 81 from the light source device 1 is condensed at the first condensing device 81 and then may be incident on the scanning unit 80.

[0040] The light source mechanism 1 may include the light source 10. The light source 10 receives the electric energy and may be converted the received electric energy into light energy. The light source 10 may be a light emitting source such as an ultra high pressure mercury lamp (UHV Lamp), a light emission diode (LED), and a laser diode.

[0041] A light source 10 preferably is a light source which is capable of being irradiated with light from a long distance while having an excellent straightness and high efficiency. Also, The light source is a laser diode. The laser diode which is a light source 10 preferably is a laser diode which irradiates with a blue based laser light having high efficiency.

[0042] A heat radiation member (not illustrated) which radiates heat generated in the light source 10 may be connected to the light source 10. The heat radiation member may includes a contact plate which is in contact with the light source 10 and a heat radiation fin which is projected from the contact plate.

[0043] The light source device 1 may include a reflecting member 11 which reflects the light emitted from the light source 10 and then converts the light path of the light.

[0044] The reflecting member 11 is disposed so that the incident angle of the light is 45 degrees and then converts the light path of the light emitted from the light source 10 to be vertical to the incident angle.

[0045] According to the disposition of the reflecting member 11, the light emitting direction to disposition position of the light source 10 is capable of be changed and thus the lighting apparatus for a vehicle can be made compact.

[0046] In a case where the light source device 1 includes both the light source 10 and the reflecting member 11, the light emitted from the light source 10 is capable of being reflected to the first light condensing device 81 by the light path being converting at the reflecting member 11. In a case where the light source device 1 includes the light source 10 and does not include the reflecting member 11, the light emitted from the light source 10 is capable to being emitted toward the first light condensing device 81.

[0047] In a case where the light source device 1 includes the reflecting member 11, the light source 10 may emit the light to be parallel to the optical axis X of the main lens 3.

[0048] The main lens 3 may has a greater size than the sizes of the reflective fluorescent body 4 and the first reflecting unit 21. The main lens 3 is capable of protecting the reflective fluorescent body 4 and the first reflecting unit 21 at the front side of the reflective fluorescent body 4.

[0049] The main lens 3 may include a front surface 31 and a rear surface 32. The main lens 3 may further include a perimeter surface 33 according to a shape of the main lens 3. The front side of the main lens 3 can mean the front side of the front surface 31 of the main lens and the rear side of the main lens 3 can mean the rear side of the rear surface 32 of the main lens 3.

[0050] The main lens 3 may be a meniscus lens of which the front surface 31 and the rear surface 32 have curvatures in the directions with each other.

[0051] The main lens 3 may include a front surface 31 having a convex shape and a rear surface 32 having a concave shape. More specifically, the front surface 31 of the main lens 3 may have a convex curved surface and the rear surface 32 of the main lens 3 may have having a recessed curved surface. At this time, the inner portion of the recessed space of the rear surface 32 of the main lens 3 may means the rear side of the main lens 3.

[0052] In a case where the rear surface 32 of the main lens 3 is a recessed curved surface, that is, a concave curved surface other than a flat surface, an incident angle at which the light reflected from the first reflecting unit 21 is emitted to the rear surface 32 of the main lens 3 may be decreased. Accordingly, an optical loss by reflection generated at the rear surface 32 of the main lens 3 is reduced. In addition, the incident angle of light which is reflected from the first reflecting unit 21 and passes through the rear surface 32 of the main lens 3 on the reflective fluorescent body 4 is reduced and thus the optical efficiency may be increased.

[0053] The front surface (31) and/or the rear surface 32 of the main lens 3 may be an aspherical surface.

[0054] The rear surface 32 of the main lens 3 may be a spherical surface having the same curvature in all the portions of the rear surface 32. The speherical surface has an advantages that manufacture thereof may be easy, the cost of the manufacture may be low and may be improved the sensitivity to the point at which the light reaches the main lens 3, compared to the aspherical surface.

[0055] The curvature of the rear surface 32 of main lens 3 may be smaller than the curvature of the front surface 31 in order to condense the white based light emitted from the reflective fluorescent body 4.

[0056] The curvature of the rear surface 32 of the main lens 3 may be a curvature that the light reflected at the first reflecting unit 21 is transmitted through the rear surface 32 of the main lens 3.

[0057] In a case where the first reflecting unit 21 is provided in the front surface 31 of the main lens 3, the light reflected at the first reflecting unit 21 transmits through the rear surface 32 of the main lens 32 and then may reach the reflective fluorescent body 4. At this time, a portion of the light reflected from the first reflecting unit 21 is not transmitted through the rear surface 32 of the main lens 3 but may be reflected from the rear surface 32 of the main lens 3.

[0058] In this case, optical loss is generated, and there are concerns that the eyes of the human suffer injury or

the eyesight of the human may be damaged by the blue based light of which the wavelength is not converted at the reflective fluorescent body 4 being capable of being emitted to the front side of the lighting apparatus for a vehicle.

[0059] Accordingly, it is preferable that the curvature of the rear surface 32 of the main lens 3 is a curvature through which the light reflected from the first reflecting unit 21 is transmitted to the rear surface 32 of the main lens 3 so that the optical loss which is generated by the light reflected at the first reflecting unit 21 being reflected at the rear surface 32 of the main lens 3 is decreased.

[0060] More preferably, the curvature of the rear surface 32 of the main lens 3 may be a curvature that an incident angle is 0 degrees when the light reflected at the first reflecting unit 21 is incident on the rear surface 32 of the main lens 3. At this time, when the light reflected at the first reflecting unit 21 is transmitted through the rear surface 32 of the main lens 3, a refraction may not occur. Further, when the light reflected at the first reflecting unit 21 is transmitted through the rear surface 32 of the main lens 3, the reflection occurred at the rear surface 32 of the main lens 3 may be minimized. Even if the reflection occurs at the rear surface 32 of the main lens 3, the beam reflected at the first reflecting unit 21 may be re-reflected at the first reflecting unit 21 and thus may be not emitted to the front side of the main lens 3.

[0061] The main lens 3 may include an optical axis X. Here, the optical axis X of the main lens 3 may be rotating symmetric axis or center axis of the main lens 3. The optical axis X of the main lens 3 may mean a straight line which passes through the centers of the front surface 31 of the main lens 31 and the back surface 32 and the main lens 3.

[0062] The lighting apparatus for a vehicle may further include a projection lens 5 which is disposed on the front surface of the main lens 3 for condensing light which is emitted from the front surface 31 of the main lens 3.

[0063] The projection lens 5 may have a greater size than the size of the main lens 3.

[0064] The optical axis of the projection lens 5 can be matched with the optical axis X of the main lens 3.

[0065] In order to improve the effect of condensing light, a plurality of projection lens 5 may be provided and the optical axes of the projection lens 5a and 5b may be matched with each other.

[0066] In order to condense the spread out light, the diameter of a second projection lens 5b disposed away from the main lens 3 may be greater than the diameter of a first projection lens 5a disposed adjacent to the main lens 3.

[0067] The projection lens 5 may include a front surface 51, a rear surface 52, and a peripheral surface 53. The front surface 51 of the projection lens 5 may be a convex curved surface toward the front side. The rear surface 52 of the projection lens 5 may be a flat surface.

[0068] The front surface 31 of the main lens 3 may have a convex curved surface toward the front side and the rear surface 32 of the main lens 3 may have a flat surface. At this time, the first reflecting unit 21 may be attached to the front surface 31 of the main lens 3.

[0069] In a case where the rear surface 32 of the main lens 3 is flat surface, since the inside of the rear surface 32 of the main lens 32 is not empty unlike the meniscus lens, the optical loss which is generated at the air layer may be reduced. Accordingly, optical power may be relatively high and only one projection lens 5 may be provided.

[0070] In a case where the rear surface 32 of the main lens 3 may be a flat surface, machinability is excellent, manufacturing is easy and cost may be reduced. Further, the size of the main lens 3 is decreased, the number of the projection lens 5 is decreased and thus the lighting apparatus for a vehicle is capable of being compact.

[0071] The reflective fluorescent body 4 may be disposed on the rear side of the main lens 3 and allows light of which wavelength of the light reflected at the first reflecting unit 21 is converted and then reflected to the main lens 3.

[0072] Heat may be generated at the reflective fluorescent body 4 at the time of wavelength conversion of the light and thus preferably is disposed to be separated from the main lens 3. The reflective fluorescent body 4 is disposed on the rear side of the main lens 3 to be spaced apart from the main lens 3.

[0073] The reflective fluorescent body 4 may be disposed on the rear side of the main lens 3.

[0074] The reflective fluorescent body 4 may be disposed facing the rear surface 32 of the main lens 3 and may reflect light toward the rear surface 32 of the main lens 3.

[0075] The reflective fluorescent body 4 may be disposed on the optical axis X of the main lens 3 and disposed to be spaced apart from the rear surface 32 of the main lens 3.

[0076] The reflective fluorescent body 4 is capable of being eccentrically disposed with respect to the optical axis X of the main lens 3 in addition to being disposed on the optical axis X of the main lens 3.

[0077] However, in this case, the efficiency is low because an area through which light reflected at the reflective fluorescent body 4 in the main lens is transmitted is smaller than the area in a case where the reflective fluorescent body 4 is disposed on the optical axis X of the main lens 3. In other words, the reflective fluorescent body 4 is preferably disposed to the optical axis X of the main lens 3.

[0078] In addition, assembly of the lens 3 is improved at the manufacturing of the lighting apparatus for a vehicle by the reflective fluorescent body 4 being disposed on the optical axis X of the main lens 3.

[0079] More specifically, if the reflective fluorescent body 4 is not disposed on the optical axis X of the main lens 3, a correct relative position between the main lens 3 and the reflective fluorescent body 4 is set so that the light emitted from the optical source 10 reach the reflec-

tive fluorescent body 4 and then the main lens 3 and the reflective fluorescent body 4 have to assemble with each other according to the correct relative position. In other words, the assembly may be difficult.

[0080] Contrary to this, in a case where the reflective fluorescent body 4 is disposed on the optical axis X of the main lens 3, the optical axis X of main lens 3 may be matched with the center axis of the main lens 3. Therefore, in this case, the assembly is performed so that the reflective fluorescent body 4 is assembled only the center axis of the main lens 3. In other words, the assembly is relatively simple.

[0081] The reflective fluorescent body 4 may include a reflecting unit for reflecting light and a wavelength conversion layer which converts wavelength of light.

[0082] The wavelength conversion layer may face the rear surface 32 of the main lens 3 and the reflective unit may be disposed on the rear side of the wavelength conversion layer.

[0083] The wavelength conversion layer may include a wave conversion film and may include an opto ceramic. The wavelength conversion layer is capable to converting the wavelength of the light reflected at the first reflecting unit 21 in a state of being positioned at the front side of the reflecting unit.

[0084] When the blue based light is incident from the outside, the wavelength conversion layer may be a wavelength conversion film which converts into the yellow based light. The wavelength conversion layer may include an opto-ceramic having yellow color.

[0085] The reflecting unit may include a plate and a reflecting coating layer which is coated the outside surface of the plate. The plate made of a metal.

[0086] The reflecting unit may support the wavelength conversion layer and light transmitted through the wavelength conversion layer may reflect toward the rear surface of the main lens 3 by the reflect unit.

[0087] When blue based light is reflected to the reflective fluorescent body 4 by the first reflecting unit 21 in the surface of the wavelength, a portion of the blue based light is surface-reflected and the light which is incident on the inner portion of the wavelength conversion layer among the blue based light is capable of being excited in the inner portion of the wavelength conversion layer. A portion of the blue based light which is incident on the inside of the wavelength conversion layer may convert into the yellow based light and may be reflected to the front side of the wavelength conversion layer by the reflecting unit.

[0088] The proportion that the blue based light which is incident on the inside of the wavelength conversion layer is converted into the yellow based light may be changed according to the proportion of the Yag included on the wavelength conversion layer.

[0089] The blue based light and the Yellow based light which are emitted to the front side of the wavelength conversion layer may be mixed, and the white based light may be emitted to the front side of the reflective fluorescent body 4. The white based light transmits through the main lens 3 and then may be emitted toward the front side of the main lens.

[0090] At this time, the white based light emitted to the front side from the reflective fluorescent body 4 is spread out in a radial shape toward the front side other than the laser beam having the constant size and the directional nature. The main lens 3 disposed on the front side of the reflective fluorescent body 4 and the projection lens 5 disposed on the front side of the main lens 3 may perform a role condensing the white based light which is radiated.

[0091] The width in the longitudinal direction of the lighting apparatus for a vehicle may be determined by the distance L1 between the reflective fluorescent body 4 and main lens 3.

[0092] The width in the longitudinal direction of the lighting apparatus for a vehicle is lengthened and thus an optical efficiency thereof is reduced when the distance L1 between the reflective fluorescent body 4 and main lens 3 is too long. The main lens 3 may be damaged by heat of the reflective fluorescent body 4 when the distance L1 between the reflective fluorescent body 4 and the main lens 3 is too short.

[0093] Accordingly, preferably, the reflective fluorescent body 4 is closely disposed to the main lens 3 within the range in which the damage of the main lens 3 by heat is minimized.

[0094] The heat radiating member 42 which assists to radiate heat of the reflective fluorescent body 4 may be disposed in the reflective fluorescent body 4. The heat radiation member 42 may include a contact plate 43 which is in contact with the reflective fluorescent body 4, and a heat radiation fin 44 which is projected from the contact plate 43.

[0095] In a case of a transmissive fluorescent body, the heat radiation member should be disposed on a side surface or the border of a transmissive fluorescent body, since a surface on which light is incident and the other surface from which light is emitted are different from each other. Accordingly, there is a problem which the heat radiation is not efficiently performed since the contact area between the heat radiation member and the transmissive fluorescent body is narrow.

[0096] The contact plate 43 may be attached to the rear surface of the reflective unit to be surface-contacted since the surface on which light is incident and the surface from which is emitted entirely same in the reflective fluorescent body 4 according the present embodiment. At this time, the heat radiation may be effectively performed since a contact area between contact plate 43 and the reflective fluorescent body 4 is broad.

[0097] Meanwhile, the first reflecting unit 21 may be provided to reflect the light which is emitted from the scanning module 8 to the reflective fluorescent body 4.

[0098] The first reflecting unit 21 be capable of being provided to main lens 3 to be integrated with the main lens 3 or be capable of being provided separately from the main lens 3 to be spaced apart from the main lens 3.

[0099] The first reflecting unit 21 may be determined the position thereof according to an arrangement position of the reflective fluorescent body 4. In a case where the reflective fluorescent body 4 is disposed on the rear side of the main lens 3, the first reflecting unit 21 may be positioned on the rear side 32 of the main lens 3 to be spaced apart from the main lens 3, may be provided on the rear surface of the main lens 3, or may be positioned on the front side 31 of the lens 3 to be spaced apart from the main lens 3.

[0100] The first reflecting unit 21 allows the light emitted from scanning module 8 to reflect between the reflective fluorescent body 4 and the main lens 3, in a state where the first reflecting unit 21 is provided on the rear side of the lens 3 to be spaced apart from the lens 3.

[0101] The first reflecting unit 21 allows the light emitted from the scanning module 8 to reflect between the reflective fluorescent body 4 and the main lens 3, in a state where the first reflecting unit 21 is provided on the rear surface of the main lens 3 to be integrated with the main lens 3.

[0102] The first reflecting unit 21 allows the light transmitted through the main lens 3 after being emitted from the scanning module 8 to reflect to the main lens 3 to be reflected toward the reflective fluorescent body 4, in a state where the first reflecting unit 21 is provided on the front surface of the main lens 3 to be integrated with the main lens 3.

[0103] The first reflecting unit 21 allows the light transmitted through the main lens 3 after being emitted from the scanning module 8 to reflect to the main lens 3 to be reflected toward the reflective fluorescent body 4, in a state where the first reflecting unit 21 is provided on the front surface of the lens 3 to be spaced apart from the main lens 3.

[0104] In a case where the first reflecting unit 21 is provided the rear side or the front side of the main lens 3 to be spaced apart from main lens 3, the component number of the lighting apparatus for a vehicle may be increased and the size of the lighting apparatus for a vehicle may be increased by the separating distance between the main lens 3 and the first reflecting unit 21 from each other.

[0105] Preferably, the first reflecting unit 21 is provided in the front surface 31 or the rear surface 32 of the main lens 3 to be integrated the first reflecting unit 21 and the main lens 3 in order to minimized the component number of the lighting apparatus for a vehicle and be made compact the lighting apparatus for a vehicle.

[0106] In a case where the first reflecting unit 21 is provided on the entire rear surface 32 of the main lens 3 or the entire front surface 31 of the main lens 3, the light of which wavelength is converted and reflected in the reflective fluorescent body 4 may be all reflected to the rear side of the main lens 3. In other words, light is not emitted to the front side of the main lens 3 since the wavelength of the light is converted in the reflective fluorescent body 4.

[0107] Therefore, preferably, the first reflecting unit 21 is provided on the a portion of the rear surface 32 of the main lens 3 or a portion of the front surface 31 of the main lens 3. Preferably, the first reflecting unit 21 has a size that the main lens 3 is capable of securing the sufficient light emitting area.

[0108] Preferably, the first reflecting unit 21 is disposed on a non-axis which gets out of the optical axis X of the main lens 3. Preferably, the first reflecting unit 21 is disposed between the optical axis X of the main lens 3 and the perimeter surface 33 of the main lens 3.

[0109] The first reflecting unit 21 may be provided on a portion area of the rear surface 32 of the main lens 3 or a portion area of the front surface 31 of the main lens 3. The first reflecting unit 21 may be provided to reflect the light emitted from the scanning module 8 to the reflective fluorescent body 4.

[0110] The first reflecting unit 21 may reflect the incident light to the rear side of the main lens 3.

[0111] Preferably, the first reflecting unit 21 may be determined the deposition position thereof considering the curvature of area to which the first reflecting unit 21 is attached and the positional relationship between the reflective fluorescent body 4 and the main lens 3.

[0112] In the present embodiment, the first reflecting unit body 21 may be attached to the front surface 31 of the main lens 3. At this time, the light emitted from the scanning module 8 transmits through the rear surface 32 of the main lens 3 and then reaches the first reflecting unit 21 and the light reflected at the first reflecting unit 21 transmits through the rear surface 32 of the main lens 3 again and then is incident on the reflective fluorescent body 4.

[0113] The optical efficiency may be increased since the incident angle on the reflective fluorescent body 4 of the light is reduced, in a case where the first reflecting unit 21 is attached to the front surface 31 of the main lens 3 than in a case where the first reflecting unit 21 is attached to the rear surface 32 of the main lens 3.

[0114] The wider light emitting area may be secured in a case where the first reflecting unit 21 is attached to the front surface 31 of the main lens 3 than in a case where the first reflecting unit 21 is attached to the rear surface 32 of the main lens 3 when the first reflecting unit 21 has a same size.

[0115] In other words, the first reflecting unit 21 may be provided on some area of the front surface of the main lens 3 and light emitted from the scanning module 8 may be transmitted through the main lens 3 and then may be incident on the first reflecting unit 21. The light reflected at the light source 21 transmits through the main lens 3 and then is incident on the reflective fluorescent body 4. The light of which the wavelength is changed by the reflective fluorescent body 4 is transmits through the main lens 3 and then may be illuminated to the front side of the main lens 3.

[0116] In a case where the first reflecting unit 21 is attached to the front surface 31 of the main lens 3, the

light is transmitted three times through the main lens 3. More specifically, the light emitted from the scanning module 8 transmits through the main lens 3 and then is incident on the first reflecting unit 21. The light reflected from the first reflecting unit 21 transmits through the main lens 3 and then is incident on the reflective fluorescent body 4. The light of which wavelength is converted and reflected from the reflective fluorescent body 4 transmits through the main lens 3 and then emitted to the front side of the lens 3.

[0117] Accordingly, the main lens 3 may be three-path lens through which light is transmitted three times. The lighting apparatus for a vehicle can be made compact by the three-path lens.

[0118] In a case where the main lens 3 is the three-path lens, the beam may be not emitted to the front direction of the main lens 3 before the light emitted from scanning module 8 reaches the reflective fluorescent body 4. Accordingly, the entire optical device except for the first reflecting unit 21, for example, the lighting device 1, the scanning module 8, and the reflective fluorescent body 4 may be disposed at the rear side of the main lens 3.

[0119] Accordingly, the disposition of the optical components may be facilitated, since an additional optical component that allows light to be incident on the reflective fluorescent body 4 in the front side spaced apart from the main lens 3 is not needed.

[0120] In other words, the manufacturing of the lighting apparatus for a vehicle become facilitate, the replacement or the design change of the light source device 1 the scanning module 8 to the reflective fluorescent body 4 also becomes simple, and a further provision of an additional optical device to the light source device 1 and the scanning module 8 may be facilitated.

[0121] In addition, the main lens 3 and the projection lens 5 may be disposed so that the distance between the main lens 3 and the projection lens 5 may be reduced and thus the optical efficiency and the light condensing effect of the projection lens 5 may be increased, since an additional optical component that allows light to be incident on the reflective fluorescent body 4 in the front side spaced apart from the main lens 3 is not needed.

[0122] The first reflecting unit 21 is formed according to a concave front surface 31 in a portion of a concave front surface 31 of the main lens 3 and the cross-sectional shape of the first reflecting unit 21 may be formed as an arc-shape. The first reflecting unit 21 may be a round shape or a polygonal shape when viewed from the front side of the main lens 3.

[0123] The first reflecting unit 21 may be a concave mirror formed on the front surface 31 of the main lens 3. The first reflecting unit 21 may have a convex front surface and a concave rear surface.

[0124] The front surface of the first reflecting unit 21 may face the projection lens 5. The first reflecting unit 21 may be projected by the main lens 3 and the projection lens 5 between the main lens 3 and the projection lens 5.

[0125] The first reflecting unit 21 may be a coating layer coated on a non-axis which gets out of the optical axis X of the main lens 3 in the front surface 31 of the main lens 3.

[0126] The first reflecting unit 21 may be a reflective sheet coated on a non-axis position which gets out of the optical axis X of the main lens 3 in the front surface 31 of the main lens 3.

[0127] The reflective fluorescent body 4 is disposed on the optical axis X of the main lens 3 and the scanning module 8 may emit light in the parallel direction to the optical axis X of the main lens 3. The first reflecting unit 21 may be disposed on a non-axis which gets out of the optical axis X of the main lens 3 so that the light emitted from the scanning module 8 reaches the first reflecting unit 2.

[0128] The lighting apparatus for a vehicle may further include a lens holder (not illustrated) which supports the lens 3 and the projection lens 5.

[0129] Meanwhile, the scanning module 8 may convert the light path of the light emitted from the light source device 1 and then emit the light toward the main lens 3.

[0130] The scanning module 8 may be disposed on the rear side of the main lens 3 and may emit light toward the rear surface 32 of the main lens 3.

[0131] The scanning module 8 may include a first light condensing device 81 and the scanning unit 80 The scanning module 8 may further include a second light condensing device 82.

[0132] The first light condensing device 81 may be condense the light emitted from the light source device 1 and then allows the light to be incident on the scanning unit 80.

[0133] In a case where the reflecting member 11 is included in the light source device 1, the light emitted from the light source 10 is capable of being reflected to the first light condensing device 81 by the light path being converting at the reflecting member 11. The light reflected at the reflecting member 11 may condense at the first light condensing device 81 and then is incident on the scanning unit 80.

[0134] In a case where the reflecting member 11 is not included in the light source device 1, the light emitted from the light source 10 is capable of being incident on the first light condensing device 81. The light being incident on the first light condensing device 81 is condensing at the first condensing device 81 and then may be incident on the scanning unit 80.

[0135] The first light condensing device 81 may be light reducer which allows the size of the light emitted from the light source device 1 to be reduces and then emits the light to the scanning unit 80. In a case where the first light condensing device 81 is a light reducer, the scanning module 8 may not include a second light condensing device 82. Hereinafter, detailed description regarding this will be described.

[0136] The first light condensing device 81 may be a secondary lens which condenses the light emitted from the light source device 1.

[0137] In a case where the first light condensing device 81 is a secondary lens, the light may be condensed so

as to gather light to a point at the scanning unit 80. Accordingly, the size of the scanning unit 80 may be decreased.

[0138] In a case where the first light condensing device 81 may be a secondary lens, since the light condensed at the scanning unit 80 is reflected and spreads out at the scanning unit 80, a second light condensing device 82 at which condenses the light is necessary.

[0139] The second light condensing device 82 may condense the light which is converted the light path at the scanning unit 80 and then reflected and then emit the light to the rear surface 32 of the main lens 3.

[0140] The second light condensing device 82 condenses the light of which the light path is converted at the scanning unit 80 and then allows the light to be incident on the rear surface 32 of the main lens 3. This light may transmit through the main lens 3 and then be incident on the first reflecting unit.

[0141] The second light condensing device 82 may be disposed between the scanning unit 80 and the main lens 3.

[0142] Since the first reflecting unit 21 is provided on the surface positioning on the non-axis which gets out of the optical axis of the main lens 3, the second light condensing device 82 which emits the light toward the first reflecting unit 21 may be disposed on the non-axis which gets out of the optical axis of the main lens 3.

[0143] The second light condensing device 82 may be a secondary lens which condenses the reflected light at the scanning unit 80. The second light condensing device 82 is capable of condensing the light so that the light which is reflected and spreads out at the scanning unit 80 has a constant size and a directionality. The light condensed and emitted at the second light condensing device 82 is incident on the rear surface 32 of the main lens 3 and then may be reflected from the first reflecting unit 21.

[0144] The optical axis of the first light condensing device 81 and the optical axis of the second light condensing device 82 may be perpendicular to each other. In other words, the optical axis of the first light condensing device 81 and the optical axis X of the main lens 3 may be perpendicular to each other and the optical axis of the second light condensing device 82 and the optical axis X of the main lens 3 may be parallel to each other.

[0145] Since the scanning unit 80 to be described below moves according to the predetermined frequency, the position of the light which is incident on the second light condensing device 82 in the operating range of the scanning unit 80 may be changed. Accordingly, in order to condense the light, the size of the second light condensing device 82 may be larger than the size of the first light condensing device 81.

[0146] FIG. 4 is a perspective view illustrating a construction of a scanning unit 80.

[0147] The scanning unit 80 may be a Mems scanner. The scanning unit 80 may have a structure which resonates and vibrates in a seesaw manner.

[0148] By the scanning unit 80, a lighting apparatus for a vehicle of the present invention according to this embodiment can implement a scanning feature.

[0149] A device which allows the air to flow, such as an ultrasound device or the like may be provided around the scanning unit 80 and the scanning unit 80 may be driven by the flow of the air generated by the device.

[0150] A driving coil may be wound around the scanning unit 80 and a pair of magnets generating magnetic field may be disposed around the scanning unit 80. The scanning unit 80 may be driven by rotating moment generating according to the magnetic field by current flowing through the coil and the pair of magnets.

[0151] The scanning unit 80 may be 2-axis drive type Mems scanner which is driven in a vibrating manner with respect to the two axes perpendicular to each other.

[0152] The scanning unit 80 may include a reflector 800, a first drive shaft 801, a second drive shaft 802, and a drive member 803. More specifically, the scanning unit 80 may include a first drive shaft 801 which is rotatable, a drive member 803 to the outside of which the first drive shaft 801 is connected, a second drive shaft 802 which is rotatably connected to the inside of the drive member 803, and a reflector 800 which is connected to the second drive shaft 802.

[0153] The reflector 800 may be a mirror which reflects the incident light. The reflector 800 may be a circular or rectangular mirror. The reflector 800 may be connected to the second drive shaft 802.

[0154] The reflector 800 and the second drive shaft 802 may be disposed in the inside of the drive member 803. More specifically, the rotatable second drive shaft 802 may be connected to the inside of the drive member 803 and the reflector 800 may be connected to the second drive shaft 8.

[0155] The first drive shaft 801 may be connected to the outside of the drive member 803.

[0156] The first drive shaft 801 and/or the second drive shaft 802 may be an elastic member which is Capable of torsional deformation in the axial direction in order to elastically support a rotating drive member 803.

[0157] The first drive shaft 801 and/or the second drive shaft 802 may be a rotating rigid body in which an additional rotating shaft is provided.

[0158] The first drive shaft 801 may be connected to the outside of the drive member 803. The first drive shaft 801 is capable of rotating about the longitudinal direction of the first drive shaft 801.

[0159] The second drive shaft 802 may be connected to the inside of the drive member 803 and the reflector 800. The second drive shaft 802 is capable of rotating about the longitudinal direction of the second drive shaft 802. The second drive shaft 802 is capable of independently rotating with the drive member 803.

[0160] The drive member 803 is supported by the first drive shaft 801 and may be rotated together with the first drive shaft 801 as the first drive shaft 801 rotates. Accordingly, the drive member 803 is capable of rotating

about the longitudinal direction of the first drive shaft 801.

[0161] The reflector 800 is supported by the second drive shaft 802 and may be rotated together with the second drive shaft 802 as the second drive shaft 802 rotates. At this time, the first drive shaft 201 and the second drive shaft 802 are perpendicular to each other and is capable of independently rotating, respectively. As a result, since the second drive shaft 802 connected to the drive member 803 which rotates about the longitudinal direction of the first drive shaft 801, the reflector 800 may be two-axis driven with respect to the first drive shaft 801 and the second drive shaft 802 which are perpendicular to each other. At this time, since reflector 800 drives by external force according to a predetermined frequency, the reflector is capable of rotating according to a predetermined frequency.

[0162] The scanning unit 80 may be driven independently of two axes. More specifically, the second drive shaft 802 is rotated while not vibrating and the first drive shaft 801 may be rotated while vibrating according to a predetermined frequency. Contrary, the first drive shaft 801 is rotated while not vibrating and the second drive shaft 802 may be rotated while vibrating according to a predetermined frequency.

[0163] The scanning unit 80 may move according to a predetermined frequency, reflect the incident light and then convert the light path. The scanning unit 80 may reflect the condensing light at the first light condensing device 81, convert the light path and then be incident light on the first condensing device 82.

[0164] More specifically, the light which is incident on the scanning unit 80 may be reflected from the reflector 800. The reflector 800 is driven on two axes perpendicular to each other and converts the light path by reflecting the incident light which is incident on the reflector 800.

[0165] The light of which light path is converted by the scanning unit 80 and then which is reflected may be condensed at the second light condensing device 82 and then be incident on the rear surface 32 of the main lens 3. The light which is incident on the rear surface 32 of the main lens 3 transmits through the main lens, be reflected from the first reflecting unit 21, and be incident on the reflective fluorescent body 4.

[0166] FIG. 5 is a view schematically illustrating a path change of an incident position in a reflective fluorescent body on which light is incident.

[0167] Hereinafter, with reference to FIG. 5, the path change of position at which the light reflected from the reflector 800 according to driving of the scanning unit 80, in particular, the reflector 800 is incident on the reflective fluorescent body 4 will be described.

[0168] Since the scanning unit 80 may be driven on the two axes perpendicular to each other respectively, the path change of the incident position P on the reflective fluorescent body 4 is described in a state of dividing into the horizontal direction and the vertical direction.

[0169] The incident position P of the reflective fluorescent body 4 of light according to the rotation of the first drive shaft 801 is capable of moving in the horizontal direction and the incident position P of the reflective fluorescent body 4 of light according to the rotation of the second drive shaft 802 is capable of moving in the vertical direction.

[0170] Contrary, the incident position P of the reflective fluorescent body 4 of light according to the rotation of the first drive shaft 801 is capable of moving in the vertical direction and the incident position P of the reflective fluorescent body 4 of light according to the rotation of the second drive shaft 802 is capable of moving in the horizontal direction. Hereinafter, this case will be described, as an example.

[0171] Further, as described above, the drive shaft 801 does not vibrate but is rotated and the second drive shaft 802 may vibrate according to a predetermined frequency and be rotated. Hereinafter, this case will be described, as an example.

[0172] First, the light reflected from the reflector 800 may be incident on the right upper end area of the reflective fluorescent body 4 via the path described above. At this time, the second drive shaft 802 is rotated in one direction, and thus the incident position P of light incident on the reflective fluorescent body 4 may be moved to the left side. At this time, the first drive shaft 801 is not rotated and the incident position of the light does not move in the vertical direction.

[0173] When the incident position of the light reaches the left area of the reflective fluorescent body 4, the first drive shaft 801 may be rotated and thus the incident position P of light which is incident on the reflective fluorescent body 4 may be moved down. At this time, The horizontal direction of the incidence position (P) of the light is reversed by the second drive shaft 802 rotating in the other direction opposite to the direction in which the second drive shaft 802 rotates by immediate before.

[0174] When the incident position P of the light moves down by a predetermined position from the reflective fluorescent body 4, the first drive shaft 801 stops rotating and the second drive shaft 802 continue to rotate in the other direction. Accordingly, the incident position P of the light on the reflective fluorescent body 4 may move in the right side not in the vertical direction.

[0175] When the incident position P of the light reaches the right side area of the reflective fluorescent body 4, the first drive shaft 801 which is in a state of stopping may be rotated in the same direction as the previous direction again and thus the incident position P of light incident on the reflective fluorescent body 4 may be moved down. At this time, The horizontal direction of the incidence position (P) of the light is reversed by the second drive shaft 802 rotating in one direction opposite to the other direction in which the second drive shaft 802 rotates immediate before.

[0176] When the incident position P of the light moves down by a predetermined position in the reflective fluorescent body 4, the first drive shaft 801 stops rotating and the second drive shaft 802 continue to rotate in one

direction._Accordingly, the incident position P of the light on the reflective fluorescent body 4 may move in the left side not in the vertical direction.

[0177] In other words, the first drive shaft 801 may repeat some of rotation and stoppage and the second drive shaft 802 may vibrates and rotates according to a predetermined frequency. The first drive shaft 801 may continue to rotate in the same direction as a previous before rotating direction and the second drive shaft 802 is rotated in one direction and the other direction in a periodically repeated manner.

[0178] As a result, the incident position P of the light to the reflective fluorescent body 4 moves to a little below in the both end areas in the lateral direction of the reflective fluorescent body 4 and may continue to reciprocate the left and right both end areas in the lateral direction, as illustrated in FIG. 5.

[0179] When this type of the drive repeats several times, the incident light on the reflective fluorescent body 4 reach right side lower end area of the reflective fluorescent body 4. At this time, the first drive shaft 801 may be rotated in the direction opposite to previous rotating direction, and thus the incident position P of light incident on the reflective fluorescent body 4 may be moved to the initial position. Hereinafter, the process described above can be repeated from the beginning again.

[0180] The reflective fluorescent body 4 may be larger than a range which includes the movement path of the incident position P of the light described above in order to stably reflect the incident light.

[0181] The description is only an example. The embodiment of the present invention is not limited to this. the movement path of the incident position P of the incident light on the reflective fluorescent body 4 may be changed according to the driving method of the first drive shaft 801 and the second drive shaft 802.

[0182] The lighting apparatus for a vehicle may further include an external sensor 90 which collects the external information of a vehicle, a control unit 9 which controls the light source device 1, particularly the light source 10 based on the external information collected at the external sensor 90.

[0183] Hereinafter, since the lighting apparatus for a vehicle provided the Mems scanner generally constitutes a head lamp of the vehicle, this case will be described as an example. However, it is apparent that the present invention is not limited to this.

[0184] The external sensor 90 may be a camera. Preferably, the external sensor 90 may be a camera which is disposed toward the front side of a vehicle. At this time, the external sensor 90 may collect the external information of the front side of a vehicle, specifically image information.

[0185] The existence of oncoming vehicles approaching from the front side of the vehicle, the position of the oncoming vehicle, the speed of the oncoming vehicle, or the like may be include in the external information collected by the external sensor 90.

[0186] The external information collected in the external sensor 90 may be sent to the control unit 9.

[0187] The control unit 9 is capable of controlling the light source device 1 based on the external information collected at the external sensor 90. More specifically, ON-OFF of the light source 10 included in the light source device 1 may be controlled.

[0188] As described above, the incident position of the incident light on the reflective fluorescent body 4 according to the driving of the scanning unit 80 may periodically change according to the constant path.

[0189] When the incident position P of the incident light on the reflective fluorescent body 4 is changed, the position of light which is reflected from the reflective fluorescent body 4 and then is emitted to the front side of the main lens 3 and the projection lens 5 may be changed. In other words, the direction of the light emitted to the front side of a vehicle may be periodically changed.

[0190] In a case where the light emitted to the front side of a vehicle is toward the driver of the oncoming vehicle, there is a danger of occurring of an accident by causing glare problems to the driver of the oncoming vehicle.

[0191] According to the embodiment of the invention, in a case where the light emitted to the front side of a vehicle heads to the driver of the oncoming vehicle, the control unit 9 causes the light source 10 to turn off, and in other cases, the control unit 9 causes the light source 10 to turn on. Accordingly, the present invention solves the glare problems.

[0192] When the oncoming vehicle approaches from the front side of the vehicle, the external sensor 90 may detect this by collecting the external information.

[0193] The external information collected at the external sensor 90 is sent to the control unit 9 and thus the control unit 9 may recognize the speed information and the position information of the oncoming vehicle according to the sent external information.

[0194] When the position of the light emitted to the front side heads to the oncoming vehicle recognized by the control unit 9 according to the drive of the scanning unit 80, the control unit 9 may turn off the light source 10.

[0195] Preferably, when the position of the light emitted to the front side heads to the driver of the oncoming vehicle, control unit 9 may turn off the light source 10.

[0196] When the light emitted to the front side of the vehicle does not head the oncoming vehicle recognized by the control unit 9 according to the drive of the scanning unit 80, the control unit 9 may turn on the light source 10.

[0197] The control unit 9 may be control the scanning unit 80. More specifically, the control unit 9 controls the external force applied to the scanning unit 80 and thus may control the drive of the scanning unit 80. For example, the drive of the scanning unit 80 may control by controlling current flowing to the drive coil wound around the scanning unit 80.

[0198] Since the scanning unit 80 may vibrate at a very fast speed, the driver of the vehicle may not recognize

the change of direction of the light emitted to the front side of the vehicle and thus may recognize as a whole the light emitted to front side of the vehicle. In addition, as described above, only when the light emitted from the front side of the vehicle heads in the specific direction, the control unit 9 turns off the light source 10. In other cases, in a case where the light source 10 turns on, the driver of the vehicle may recognize that only a portion of the light emitted to the front side of the vehicle is a dark portion.

[0199] Meanwhile, the lighting apparatus for a vehicle may further include a third reflecting unit 6 which is provided in a portion area of the main lens 3 and reflects the light reflected from the reflective fluorescent body 4 to the main lens 3 to the rear side of the main lens 3.

[0200] Since the light source 10 may be a laser diode and a blue based laser beam having a high efficiency may be illuminated, in a case where the light leakage phenomenon generates and thus the blue based laser beam is not converted into the white based light at the fluorescent body and is emitted to the front side of the lighting apparatus for a vehicle, there is a concern that the eye of the person is damaged or eyesight is damaged.

[0201] In order to prevent the light leakage phenomenon, the third reflecting unit 6 is capable of reflecting the blue based light which is surface-reflected without the wavelength converting at the reflective fluorescent body 4 to the rear side of the lens 3.

[0202] The third reflecting unit 6 is capable of reflecting the blue based beam of which the wavelength is not changed and the white based light of which the wavelength is changed to the rear side of the main lens 3. At this time, when the white based light is reflected to the rear side of the main lens 3, the optical efficiency of the lighting apparatus for a vehicle is reduced.

[0203] Accordingly, preferably, the third reflecting unit 6 having a size and a position which sufficiently secure the optical emitting area of the main lens 3 and is capable of reflecting the blue based beam surface reflected at the reflective fluorescent body 4 to the rear side of the lens as much as possible is provided.

[0204] The third reflecting unit 6 may constitute a single reflecting unit by being connected to the first reflecting unit 21, but preferably the third reflecting unit 6 is separately provided a front surface 31 or rear surface 32 of the main lens 3 in order to sufficiently ensure the light emitting area of the main lens 3.

[0205] The third reflecting unit 6 may be provided in the front surface 31 of the main lens 3, or be provided in the rear surface 32 of the main lens 3.

[0206] The third reflecting unit 6 may have an arc shape as a cross-sectional shape on the convex front surface 31 of the main lens 3.

[0207] The third reflecting unit 6 may have a concave mirror formed along the front surface 31 of the main lens 3 on the convex front surface 31 of the main lens 3.

[0208] The first reflecting unit 21 and the third reflecting unit 6 may be provided to be spaced apart with each other.

[0209] The first reflecting unit 21 and the third reflecting unit 6 may be provided symmetrically relative to the optical axis X of the main lens 3.

[0210] The first reflecting unit 21 and the third reflecting unit 6 may be provided symmetrically to have a 180 °phase difference to the front surface 31 of the main lens 3.

[0211] In a case where the first reflecting unit 21 may be provided on the left area in the front surface 31 of the main lens 3, the third reflecting unit 6 may be provided on the right area in the front surface 31 of the main lens 3.

[0212] In a case where the first reflecting unit 21 may be provided on the upper side area in the front surface 31 of the main lens 3, the third reflecting unit 6 may be provided on the lower side area in the front surface 31 of the main lens 3.

[0213] The first reflecting unit 21 and the third reflecting unit 6 may be provided at the same distance from the optical axis X of the main lens 3 with each other or at the different distance from the optical axis X of the main lens 3 from each other.

[0214] At the surface of the main lens 3, the curvature of a portion thereof to which the first reflecting unit 21 and the third reflecting unit 6 is attached may be the same with each other.

[0215] The first reflecting unit 21 and the third reflecting unit 6 may be a reflective coating layer coated on the portion other than the optical axis X of the main lens 3 in the front surface 31 of the main lens 3, respectively. The first reflecting unit 21 and the third reflecting unit 6 may be a reflective sheet attached on the portion other than the optical axis X of the main lens 3 in the front surface 31 of the main lens 3, respectively.

[0216] The first reflecting unit 21 provided on the front surface 31 of the main lens 3 may reflect the light which is emitted from the scanning module 8 and then is transmitted through the main lens 3 to the reflective fluorescent body 4. The light which is reflected from reflective fluorescent body 4 may be reflected to the main lens 3. A portion of light which is reflected from the reflective fluorescent body 4 to the main lens 3 may be incident on the third reflecting unit 6.

[0217] The light which is incident from the reflective fluorescent body 4 on the third reflecting unit 6 may be reflected in the direction of the lens 3 by the third reflecting unit 6.

[0218] The light which is reflected to the rear direction of the main lens 3 by the third reflecting unit 6 transmits through the rear surface 32 of the main lens 3 and the light may be emitted in the rear side of the main lens 3.

[0219] The third reflecting unit 6 may minimize the light leak phenomenon which may be generated when the light which is surface-reflected without the wavelength conversion in the reflective fluorescent body 4 is transmitted through the area on which the third reflecting unit 6 is formed.

[0220] Hereinafter, with reference to FIG. 2. an oper-

ation of the present invention conFIGured as in the present embodiment will be described as follow: Reference numeral to refer to the illustrated light on each path is for ease of understanding, the reference numeral does not refer to the component of the invention or do not limit the scope of the invention.

[0221] Hereinafter, the light source 10 emits the blue based light and the reflective fluorescent body 4 converts the wavelength of the blue based light into the wavelength of the yellow based light will be described, as an example. Further, the operation of the third reflecting unit 6 is omitted since the operation is already described above.

[0222] First, when the light source 10 included in the light source device 1 turns on, the blue based light A may be emitted from the light source 10 and the light path of the light A may be changed by the light being reflected from the reflecting member 11.

[0223] The light B of which the light path is changed in the reflecting member 11 may be reflected to the first light condensing device 81.

[0224] The light C which is incident on the first condensing device 81 is condensed and then the light path of the light C may be changed being reflected at the scanning unit 80, more specifically the reflector 800.

[0225] The light D of which the light path is changed in the scanning unit 80 may be reflected to the second light condensing device 82.

[0226] The light E which is incident on the second light condensing device 82 may condensed and then may be emitted toward the rear surface 32 of the main lens 3.

[0227] The light F which may be incident on the rear surface 32 of the main lens 3 transmits through the main lens, be incident on the first reflecting unit 21. The light being incident on the first reflecting unit 21 may be reflected from the reflecting unit 21 to the main lens 3.

[0228] The beam G reflected at the first reflecting unit 21 may be reflected in the direction toward the optical axis X of the main lens 3 by the first reflecting unit 21 and may refract at the rear surface 32 of the main lens 3.

[0229] The light H refracted at the rear surface of the main lens 3 may be incident on the reflective fluorescent body 4.

[0230] The light which is incident on the reflective fluorescent body 4 may change the wavelength of the light by the reflective fluorescent body 4. The white based light I in the reflective fluorescent body 4 may be reflected to the rear surface 32 of the main lens 3. The white based light I may be collected while transmitting through the main lens 3. The white based light I may transmit through the front surface 31 of the main lens 3 and then may be incident on the projection lens 5 through the rear surface 52 of the projection lens 5.

[0231] The light J which is incident on the rear surface 52 of the projection lens 5 is condensed at the projection lens 5 and then may be emitted in parallel and this light J may be illuminated to the front side of the vehicle.

[0232] FIG. 6 is a construction view illustrating a lighting apparatus for a vehicle according to a second embodiment of the present invention.

[0233] Hereinafter, the detailed description to the same or the similar construction as the construction described above will be omitted. Accordingly, only different construction from the construction described above will be described.

[0234] In the present embodiment, the scanning unit 80 may include the first light condensing device 81 and the scanning unit 80 and at the same time, may not include the second light condensing device 82.

[0235] The light emitted from the scanning module 8 should have straightness. If the light emitted from the scanning module 8 spreads out, optical loss may occur since a portion of the light reach the first reflecting unit 2.

[0236] The second light condensing device 82 condenses the light which is reflected from the scanning unit 80 and then spreads out in the first embodiment. However, the light which is reflected from the scanning portion does not have to spread out since the second light condensing device 82 is not included in the present invention, Therefore, The light which is incident on the scanning module 80 should have straightness.

[0237] Since the light emitted from the light source device 1 has straightness, if the first light condensing device 81 is not included in the scanning module 8, the right which is incident on the scanning unit 80 may have the straightness. However, in this case, since the light which is incident on the scanning unit 80 is not condensed and thus the size of the scanning unit 80 should be large, the compactness of the lighting apparatus for a vehicle which is a technical effect of the present invention may be unlikely to be achieved.

[0238] The first light condensing device 81 may be light reducer which allows the size of the light emitted from the light source device 1 to be reduces and then emits the light to the scanning unit 80 so that the light which is incident on the scanning unit 80 has straightness.

[0239] In a case where the first light condensing device 81 is a light reducer, the first light condensing device 81 may include a first reducer lens 811 in which light width is reduced while the light emitted from the light source device 1 transmits through the first reducer lens 811 and a second reducer lens 812 which is spaced apart from the first reducer lens 811 and in which light width is reduced while the light emitted from the first reducer lens 20 transmits through the second reducer lens 30.

[0240] The first reducer lens 811 and the second reducer lens 812 may be spaced apart having air between the first reducer lens 20 and the second reducer lens 30.

[0241] The first reducer lens 811 may be positioned between the light source device 10 and the second reducer lens 812 and the second reducer lens 812 may be positioned between the first reducer lens 811 and the scanning unit 80.

[0242] The optical axis of the first reducer lens 811 and the optical axis of the second reducer lens 812 may be the same each other.

[0243] The size of the second reducer lens 812 may

be smaller than the size of the first reducer lens 811 in order to increase the peripheral space utilization, since the light width is primarily reduced at the first reducer lens 811.

[0244] While the light which is incident on the first light condensing device 81 according to the construction has a straightness as it is, the width of the light is reduced and then emitted. In other words, since the light which is emitted from the first light condensing device 81 and then is incident on the scanning unit 80 has a sufficiently small width of the light while having straightness, the size of the scanning unit may be reduced. Accordingly, the lighting apparatus for a vehicle is made compact.

[0245] Hereinafter, with reference to FIG. 6, an operation of the present embodiment having the construction as above will be described as follow: Reference numeral which is to refer to the light illustrated on each path is for ease of understanding, and the reference numeral does not refer to the component of the invention or do not limit the scope of the invention.

[0246] First, when the light source 10 included in the light source device 1 turns on, the blue based light A may be emitted from the light source 10 and the light path of the light A may be changed by the light A being reflected from the reflecting member 11.

[0247] The light B of which the light path is changed in the reflecting member 11 may be reflected to the first light condensing device 81.

[0248] The light C which is incident on the first condensing device 81 is condensed and then the light path of the light C may be changed by the light C being reflected at the scanning unit 80. More specifically, the width of the light which is incident on the first reducer lens 811 is reduced and then the light may be emitted toward the second reducer lens 812. The width of the light which is incident on the second reducer lens 812 is reduced and then the light may be emitted toward the scanning unit 80. The light which is incident on the scanning unit 80 is reflected from the scanning unit 80 and then the light path may be converted.

[0249] The light E of which the light path is converted at the scanning unit 80 may be reflected toward the rear surface 32 of the main lens 3 without an additional condensing.

[0250] The light F which is incident on the rear surface 32 of the main lens 3 transmits through the main lens, be incident on the first reflecting unit 21. The light being incident on the first reflecting unit 21 may be reflected from the reflecting unit 21 to the main lens 3.

[0251] The beam G reflected at the first reflecting unit 21 may be reflected in the direction toward the optical axis X of the main lens 3 by the first reflecting unit 21 and may be refracted at the rear surface 32 of the main lens 3.

[0252] The light H refracted at the rear surface 32 of the main lens 3 may be incident on the reflective fluorescent body 4.

[0253] The light which is incident on the reflective fluorescent body 4 may change the wavelength of the light by the reflective fluorescent body 4. The white based light I in the reflective fluorescent body 4 may be reflected to the rear surface 32 of the main lens 3 and be condensed while transmitted through the main lens. The white based light I may transmit through the front surface 31 of the main lens 3 and then may be incident on the projection lens 5 through the rear surface 52 of the projection lens 5.

[0254] The light J which is incident on the rear surface 52 of the projection lens 5 is condensed at the projection lens 5 and then may be emitted in parallel and this light J may be illuminated to the front side of the vehicle.

[0255] In a case where the first light condensing device 81 which is a light reducer is not included in the scanning module 8 and the light reducer is further included in the light source device 1 by changing the present embodiment, this change is a simple design change in which the position of the light reducer is changed from between the scanning unit 80 and the reflecting member 11 to between the light source 10 and the reflecting member 11. Accordingly, it is apparent that this change is included within the scope of the present invention.

[0256] In addition, it is apparent that the light reducer is included in the light source device 1 and both the first light condensing device 81 and the second light condensing device 82 is included in the scanning module 8 is included within the scope of the present invention.

[0257] FIG. 7 is a construction view illustrating a lighting apparatus for a vehicle according to a third embodiment of the present invention, and FIG. 8 is a perspective view schematically illustrating an light path of a lighting apparatus for a vehicle according to the third embodiment of the present invention.

[0258] Hereinafter, the detailed description to the same or the similar construction as the construction described above will be omitted. Accordingly, only different construction from the construction described above will be described.

[0259] In the present invention, the lighting apparatus for a vehicle may further include a secondary light source 100 which is disposed in the rear side of the main lens 3 and a second reflecting unit 22 which is provided in the main lens 3 and reflects the light emitted from the secondary light source 100.

[0260] The secondary light source 100 is capable of emitting the blue based light like the light source 10.

[0261] The secondary light source 100 may be disposed on the rear surface 32 of the main lens 3 and may emit light toward the rear surface 32 of the main lens 3.

[0262] The secondary light source 100 may be disposed on non-axis which gets out of the optical axis of the main lens 3 and may emit light in parallel to the optical axis X of the main lens 3.

[0263] The distance between the light source device 1 and the secondary light source 100 is smaller than the diameter of the main lens 3 for the compactness of the lighting apparatus for a vehicle.

[0264] The light emitted from the secondary light source 100 is incident on the rear surface 32 of the main

lens 3, transmits through the main lens 3 and then may be reflected from the first reflecting unit 2.

[0265] The second reflecting unit 22 may be provided in the a portion area of the front surface 31 or the rear surface 32 of the main lens 3.

[0266] The second reflecting unit 22 and the first reflecting unit 21 may have the same shape with each other.

[0267] The second reflecting unit 22 may constitute a single reflecting unit by being connected to the first reflecting unit 21, but preferably the second reflecting unit 22 is provided in a front surface 31 or rear surface 32 of the main lens 3 in a separated manner from the first reflecting unit 21 in order to sufficiently ensure the light emitting area of the main lens 3.

[0268] The light which is emitted from the scanning module 8 and is incident on the first reflecting unit 21 may change the incident position at which the light is incident on the first reflecting unit 21 according to the driving of the scanning unit 80. Contrary, the light which is emitted from the secondary light source 100 and is incident on the second reflecting unit 22 has a constant incident position at which the light is incident on the second reflecting unit 22. Accordingly, the second reflecting unit 22 may have a smaller size than the size of the first reflecting unit 21.

[0269] The second reflecting unit 22 may be provided to reflect the light emitted from the secondary light source 100 and then is incident on the reflective fluorescent body 4.

[0270] The control unit 9 may be control the secondary light source 100. More specifically, ON-OFF of the secondary light source 100 may be controlled. For example, in a case where the front side of the vehicle is too dark, according to external information collected by the external sensor 90, the control unit 9 may turn on the secondary light source 100. Alternatively, the control unit 9 may be turn on the secondary light source 100, according to the operation of the driver of the vehicle.

[0271] A plurality of secondary light sources 100 and a plurality of second reflecting units 22 corresponding thereto may be provided in order to further brighten the light which is emitted to the front side of the vehicle.

[0272] Hereinafter, with reference to FIG. 7, an operation of the present embodiment having the construction as above will be described as follow:

> Reference numeral to refer to the illustrated light on each path is for ease of understanding, the reference numeral does not refer to the component of the invention or do not limit the scope of the invention.

[0273] Since the path and the operation of the light emitted from the light source device 1 may be same as the first embodiment, hereinafter, the path and the operation of the light emitted from the secondary light source 100 is described.

[0274] First, when the light source 100 turns on, the blue based light K may be emitted from the light source 10 and the light may be incident on the rear surface 32 of the main lens 3.

[0275] The light L which is incident on the rear surface 32 of the main lens 3 transmits through the main lens 3 and is incident on the second reflecting unit 22, and then may be reflected to the main lens 3 at the first reflecting unit 22.

[0276] The beam M reflected at the second reflecting unit 22 may be reflected in the direction toward the optical axis X of the main lens 3 by the second reflecting unit 22 and may be refracted at the rear surface 32 of the main lens 3.

[0277] The light N refracted at the rear surface of the main lens 3 may be incident on the reflective fluorescent body 4.

[0278] The light which is incident on the reflective fluorescent body 4 may change the wavelength of the light by the reflective fluorescent body 4. The white based light in the reflective fluorescent body 4 may be reflected to the rear surface 32 of the main lens 3. At this time, as like the first embodiment, the wavelength of the light H which is reflected from the first reflecting unit 21 and then is incident on the reflective fluorescent body 4 is converted in the reflective fluorescent body 4 and the white based light may be reflected in the rear surface 32 of the main lens 3. Accordingly, each of white based light may be mixed and the mixed white based light I may be brighter.

[0279] The white based light I may be condensed while transmitting through the main lens 3, transmit through the front surface 31 of the main lens 3 and then may be incident on the projection lens 5 through the rear surface 52 of the projection lens 5.

[0280] The light J which is incident on the rear surface 52 of the projection lens 5 is condensed at the projection lens 5 and then may be emitted in parallel and this light J may be illuminated to the front side of the vehicle.

[0281] Accordingly, the brightness of the light emitted to the front side of a vehicle may be even brighter.

[0282] In the present embodiment, the first reflecting unit 21 and the second reflecting unit 22 may be perform a light leakage prevention feature between each other respectively.

[0283] The first reflecting unit 21 and the second reflecting unit 22 may be provided to be spaced apart with each other.

[0284] The first reflecting unit 21 and the second reflecting unit 22 may be provided symmetrically relative to the optical axis X of the main lens 3.

[0285] The first reflecting unit 21 and the second reflecting unit 22 may be provided symmetrically to have a 180 °phase difference to the front surface 31 of the main lens 3.

[0286] In a case where the first reflecting unit 21 may be provided on the left area in the front surface 31 of the main lens 3, the second reflecting unit 22 may be provided on the right area in the front surface 31 of the main lens 3.

[0287] In a case where the first reflecting unit 21 may

be provided on the upper side area of the front surface 31 of the main lens 3, the second reflecting unit 6 may be provided on the lower side area in the front surface 31 of the main lens 3.

[0288] The first reflecting unit 21 and the second reflecting unit 22 may be provided at the same distance from the optical axis X of the main lens 3 with each other or at the different distance from the optical axis X of the main lens 3 with each other.

[0289] At the surface of the main lens 3, the curvature of a portion thereof to which the first reflecting unit 21 and the second reflecting unit 22 is attached may be the same with each other.

[0290] More specifically, a portion of the blue based light which is emitted from the scanning module 8, is reflected from the first reflecting unit 21, and is incident on the reflective fluorescent body 4 is not converted the wavelength and may be surface-reflected from the surface of the reflective fluorescent body 4. At this time, the blue based light surface-reflected may be incident on the rear surface 32 of the main lens 3, transmits through the main lens, and be reflected to rear side of the main lens.

[0291] This light may be emitted from the secondary light source 100 and then may be interfere with the light which is incident on the second reflecting unit 22. However, since the light does not have a physical reality, the light does not affect each other. In other words, there is no problem regarding feature implementation of the lighting apparatus for a vehicle.

[0292] Further, a portion of the blue based light which is emitted from the secondary light source 100, is reflected from the second reflecting unit 22, and is incident on the reflective fluorescent body 4 is not converted the wavelength and may be surface-reflected from the surface of the reflective fluorescent body. At this time, the blue based light surface-reflected may be incident on the rear surface 32 of the main lens 3, transmits through the main lens, and be reflected from the first reflecting unit 21 to rear side of the main lens 3.

[0293] This light may be emitted from the scanning module 8 and then may be interfere with the light which is incident on the first reflecting unit 21. However, since the light does not have a physical reality, the light does not affect each other. In other words, there is no problem regarding feature implementation of the lighting apparatus for a vehicle.

[0294] In other words, the first reflecting unit 21 and the second reflecting unit 22 may be perform a light leakage prevention feature between each other respectively. Accordingly, according to the present invention, the light leakage phenomenon may be prevented, while an additional third reflecting unit 6 is not provided.

[0295] FIG. 9 is a perspective view schematically illustrating an light path of a lighting apparatus for a vehicle according to a fourth embodiment of the present invention, and FIG. 10 is a plan view schematically illustrating an light path of a lighting apparatus for a vehicle according to the fourth embodiment of the present invention.

[0296] Hereinafter, the detailed description to the same or the similar construction as the construction described above will be omitted. Accordingly, only different construction from the construction described above will be described.

[0297] In the present embodiment, the lighting apparatus for a vehicle further includes a third reflecting unit 6 which is provided in a portion area of the surface of the main lens 3 and reflects a portion of the light reflected from the reflective fluorescent body 4 to the main lens 3 to the rear side of the main lens 3. More specifically, the third reflecting units 6a and 6b corresponding to the each of the first reflecting unit 21 and the second reflecting unit 22 may be provided in the a portion area of the surface of the main lens 3.

[0298] The positions of the first reflecting unit 21 and the second reflecting unit 22 are dependent on each other so that the first reflecting unit 21 and the second reflecting unit 22 perform the light leakage prevention feature with each other, like the third embodiment described above. In other words, the position of each of the first reflecting unit 21 and the second reflecting unit 22 does not independently determine. In addition, the position of each of the scanning module 8 and the secondary light source 100 which emit the light to the first reflecting unit 21 and the second reflecting unit 22 does not independently determined.

[0299] According to the present embodiment, the position of each of the first reflecting unit 21 and the second reflecting unit 22 is capable of being independently determined. Accordingly, the position of each of the scanning module 8 and the secondary light source 100 may be freely determined and then disposed.

[0300] Further, the detecting unit 7 to be described below may be disposed on the rear side of the third reflecting units 6a, 6b. Hereinafter, regarding this, the detailed description will be described.

[0301] The third reflecting units 6a and 6b may be provided a portion area of the surface of the main lens 3 to the first reflecting unit 21 or the second reflecting unit 22.

[0302] Preferably, as illustrated in FIG. 9, the third reflecting units 6a and 6b may be provided to the first reflecting unit 21 and the second reflecting unit 22. In other words, the third reflecting unit 6a corresponding to the first reflecting unit 21 and the other third reflecting unit 6b corresponding to the second reflecting unit 22 may be provided in the a portion area of the surface of the main lens 3. Hereinafter, this case will be described, as an example.

[0303] The third reflecting units 6a and 6b is connected to the first reflecting unit 21 or the second reflecting unit 22 and thus may constitute a single reflecting unit. However, in order to sufficiently obtain the light emitting area of the main lens 3, the first reflecting unit 21 and the second reflecting unit 22 are provided on the front surface 31 and the rear surface 32 of the main lens 3 in a separated manner from each other, respectively.

[0304] The first reflecting unit 21 and the third reflecting

unit 6a corresponding thereto may be provided symmetrically relative to the optical axis X of the main lens 3. The second reflecting unit 22 and the third reflecting unit 6b corresponding thereto may be provided symmetrically relative to the optical axis X of the main lens 3.

[0305] The first reflecting unit 21 and the third reflecting unit 6a corresponding thereto may be provided symmetrically to have a 180 °phase difference to the front surface 31 of the main lens 3. The second reflecting unit 22 and the third reflecting unit 6b corresponding thereto may be provided symmetrically to have a 180 °phase difference to the front surface 31 of the main lens 3.

[0306] In a case where the first reflecting unit 21 may be provided on the left area in the front surface 31 of the main lens 3, the third reflecting unit 6a corresponding thereto may be provided on the right area in the front surface 31 of the main lens 3.

[0307] In a case where the first reflecting unit 21 may be provided on the upper side area in the front surface 31 of the main lens 3, the third reflecting unit 6a corresponding thereto may be provided on the lower side area in the front surface 31 of the main lens 3.

[0308] In a case where the second reflecting unit 22 may be provided on the left area of the front surface 31 of the main lens 3, the third reflecting unit 6b corresponding thereto may be provided on the right area in the front surface 31 of the main lens 3.

[0309] In a case where the second reflecting unit 22 may be provided on the upper side area of the front surface 31 of the main lens 3, the third reflecting unit 6b corresponding thereto may be provided on the lower side area of the front surface 31 of the main lens 3.

[0310] The first reflecting unit 21 and the third reflecting unit 6a corresponding thereto may be provided at the same distance from the optical axis X of the main lens 3 with each other or at the different distance from the optical axis X of the main lens 3 with each other. The second reflecting unit 22 and the third reflecting unit 6b corresponding thereto may be provided at the same distance from the optical axis X of the main lens 3 with each other or at the different distance from the optical axis X of the main lens 3 with each other.

[0311] At the surface of the main lens 3, the curvature of a portion thereof to which the first reflecting unit 21 and the third reflecting unit 6a corresponding thereto is attached may be the same with each other. At the surface of the main lens 3, the curvature of a portion thereof to which the second reflecting unit 22 and the third reflecting unit 6b corresponding thereto is attached may be the same with each other.

[0312] The first reflecting unit 21, the second reflecting unit 22, and the third reflecting units 6a and 6b may include a reflective coating layer coated on the portion other than the optical axis X of the main lens 3 in the front surface 31 of the main lens 3, respectively. The first reflecting unit 21, the second reflecting unit 22, and the third reflecting units 6a and 6b may include a reflective sheet attached to the portion other than the optical axis X of the main lens 3 in the front surface 31 of the main lens 3, respectively.

[0313] The first reflecting unit 21 provided on the front surface 31 of the main lens 3 may reflect the light which is emitted from the scanning module 8 and then is transmitted through the main lens 3 to the reflective fluorescent body 4. The light which is reflected at the reflective fluorescent body 4 may be transmitted through the main lens 3. A portion of light which is reflected from the reflective fluorescent body 4 to the main lens 3 may be incident on the third reflecting unit 6a corresponding to the first reflecting unit 21. In particular, the blue based light surface-reflected without wavelength conversion at the reflective fluorescent body 4 may be incident on the third reflecting unit 6a.

[0314] The second reflecting unit 22 provided on the front surface 31 of the main lens 3 may reflect the light which is emitted from the secondary light source then is transmitted through the main lens 3 to the reflective fluorescent body 4. The light which is reflected at the reflective fluorescent body 4 may transmit through the main lens 3. A portion of light which is reflected from the reflective fluorescent body 4 to the main lens 3 may be incident on the third reflecting unit 6b corresponding to the second reflecting unit 22. In particular, the blue based light surface-reflected without wavelength conversion at the reflective fluorescent body 4 may be incident on the third reflecting unit 6b.

[0315] The light which is incident from the reflective fluorescent body 4 to the third reflecting units 6a and 6b may be reflected in the rear direction of the lens 3 by the third reflecting units 6a and 6b.

[0316] The light which is reflected in the rear direction of the main lens 3 by the third reflecting units 6a and 6b transmits through the rear surface 32 of the main lens 3 and the light may be emitted in the rear side of the main lens 3.

[0317] FIG. 11 is a construction view illustrating an light path of a lighting apparatus for a vehicle according to a fifth embodiment of the present invention.

[0318] Hereinafter, the detailed description to the same or the similar construction as the construction described above will be omitted. Accordingly, only different construction from the construction described above will be described.

[0319] The present embodiment may further include a detecting unit 7 which detects light which is reflected to the rear side of the main lens 3 at the third reflecting unit 6 and the control unit 9 is capable of controlling the light source 10 according to the detecting value of the detecting unit 7.

[0320] Since the other construction and operation other than the detecting unit 7 are same or similar to those of the first embodiment of the present invention, they use the same numeral reference and the detailed description regarding them is omitted.

[0321] The detecting unit 7 may be disposed on the rear side of the main lens 3.

[0322] The detecting unit 7 may be disposed outside of the optical axis X of the main lens 3.

[0323] The detecting unit 7 may be disposed on the rear side of the area on which the third reflecting unit 6 of the main lens 3 is attached.

[0324] The detecting unit 7 may include a first filter 71 through which a blue light is transmitted, a first optical sensor 72 which detects light which transmits through the first filter 71, a second filter 73 which blocks the blue light, and a second optical sensor 74 which detects light which transmits through the second filter 73.

[0325] The present embodiment may further include a third filter 78 which is disposed in the front side of the first filter 71 and the second filter 73 and detects light which is towards the first filter 71 and the second filter 73.

[0326] The control unit 9 may allow the light source 10 to be turned off when the control unit 8 detects light which is more than the reference value in the first optical sensor 72. The control unit 9 may allow the light source device 10 to be turned off when the control unit 8 detects light which is equal to and less than the reference value in the second optical sensor 74 or does not detect the light in the second optical sensor 74.

[0327] When the light which is more than the reference value is detected at the first optical sensor 72, it may mean that the reflective fluorescent body 4 does not converted the blue based light into the white based light. In this case, the light source 10 may be turned off in order not to emit the blue based light in the front side of the vehicle.

[0328] Further, when the light which is equal to and less than the reference value is detected or when the light is not detected in the second optical sensor 74, it may be meant that the reflective fluorescent body 4 does not normally functioned. In this case, the light source 10 may be turned off in order not to emit the blue based light in the front side of the vehicle.

[0329] FIG. 12 is a perspective view schematically illustrating an light path of a lighting apparatus for a vehicle according to a sixth embodiment of the present invention, and FIG. 13 is a plan view schematically illustrating an light path of a lighting apparatus for a vehicle according to the sixth embodiment of the present invention.

[0330] The lighting apparatus for a vehicle according to the present invention may include a first detecting unit 7a and a second detecting unit 7b which detect the light which is reflected to the rear side of the main lens 3 in the third reflecting units 6a and 6b corresponding to each of the first reflecting unit 21 and the second reflecting unit 22, respectively. The control unit 9 may control each of the light source 10 and the secondary light source 100 according to the detecting value of the first detecting unit 7a and the second detecting unit 7b.

[0331] Since the other construction and operation other than the detecting unit 7 are same or similar to those of the fourth embodiment of the present invention and the construction and operation of the detecting unit 7 are same or similar to those of the fifth embodiment of the present invention, they use the same numeral reference and the detailed description regarding them is omitted.

[0332] The detecting unit 7 may be disposed on the rear side of the area to which the third reflecting unit 6 of the main lens 3 is attached. More specifically, the first detecting unit 7a may be disposed on the rear side of the area to which the third reflecting unit 6a corresponding to the first reflecting unit 21 of the main lens 3 is attached. The second detecting unit 7b may be disposed on the rear side of the area to which the third reflecting unit 6a corresponding to the second reflecting unit 22 of the main lens 3 is attached.

[0333] The first detecting unit 7a and the second detecting unit 7b may include a first filter 71 through which a blue light is transmitted, a first optical sensor 72 which detects light which transmits through the first filter 71, a second filter 73 which blocks the blue light, and a second optical sensor 74 which detects light which transmits through the second filter 73, respectively.

[0334] The present embodiment may further include a third filter 78 which is disposed on the first filter 71 and the second filter 73 and detects light which is towards the first filter 71 and the second filter 73.

[0335] The control unit 9 may allow the light source device 10 to be turned off when the control unit 8 detects light which is more than the reference value in the first optical sensor 72 of the first detecting unit 7a. The control unit 9 may allow the light source 10 to be turned off when the control unit 8 does detect light which is equal to and less than the reference value or when the light is not detected, in the second optical sensor 74 of the first detecting unit 7a.

[0336] The control unit 9 may allow the secondary light source 100 to be turned off when the control unit 8 detects light which is more than the reference value in the first optical sensor 72 of the second detecting unit 7b. The control unit 9 may allow the secondary light source 100 to be turned off when the control unit 8 does not detect light which is equal to and less than the reference value or when the light is not detected, in the second optical sensor 74 of the second detecting unit 7b.

[0337] When the light which is more than the reference value is detected at the first optical sensor 72, it may mean that the reflective fluorescent body 4 does not converted the blue based light into the white based light. In this case, the light source 10 and/or the secondary light source 100 may be turned off so that the blue based light is not emitted in the front side of a vehicle.

[0338] Further, when the light which is less than the reference value is detected or the light is not detected in the second optical sensor 74, it may be meant that the reflective fluorescent body 4 does not normally functioned. In this case, the light source 10 and/or the secondary light source 100 may be turned off so that the blue based light is not emitted in the front side of a vehicle.

[0339] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other

modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure.

[0340] Accordingly, embodiments disclosed in the present invention are for illustrating but not for limiting the technical scope of the present invention, and the scope of the technical spirits of the present invention is not limited by the embodiments disclosed in the present invention.

[0341] In addition, the protective scope of the present invention should be construed by the following claims, and all technical spirits within a scope equivalent to the protective scope will be construed as being included in the scope of the invention.

Claims

1. A lighting apparatus for a vehicle; comprising,
a main lens (3);
a light source device (1) adapted to emit light;
a first reflecting unit (21) provided in a portion of a front surface (31) of the main lens (3);
a scanning module (8) adapted to convert a light path of light emitted from the light source device (1) and emit the light to the first reflecting unit (21); and
a reflective fluorescent body (4) adapted to wavelength-convert light reflected by the first reflecting unit (21) and then reflect the light into the main lens (3),
wherein the scanning module (8) comprises a scanning unit (80) controlled to be driven according to a predetermined frequency and adapted to convert the light path by reflecting an incident light, and a first light condensing device (81) adapted to condense the light emitted from the light source device (1) into the scanning unit.

2. The lighting apparatus for a vehicle according to claim 1, further comprising:

an external sensor (90) adapted to collect external information of a vehicle; and
a control unit (9) adapted to control the light source device (1) based on the external information.

3. The lighting apparatus for a vehicle according to claim 1 or 2,
wherein the first light condensing device (81) is a light reducer designed to reduce a light width of a beam emitted from the light source device (1) and then emit the light to the scanning unit(80).

4. The lighting apparatus for a vehicle according to any one preceding claim,
wherein the scanning module (8) further comprises a second light condensing device (82) adapted to condense the light reflected from the scanning unit (80) and then emit the light to the first reflecting unit (21), wherein the second light condensing device (82) is preferably displaced from an optical axis of the main lens (3).

5. The lighting apparatus for a vehicle according to claim 4,
wherein the first light condensing device (81) and the second light condensing device (82) are a secondary lens which condenses light;.

6. The lighting apparatus for a vehicle according to claim 4 or 5,
wherein an optical axis of the first light condensing device (81) and an optical axis of the second light condensing device (82) are perpendicular to each other.

7. The lighting apparatus for a vehicle according to any one preceding claim,
wherein the light source device (1) comprises a light source (10) and a reflecting member (11) arranged to convert the light path of light emitted from the light source (10).

8. The lighting apparatus for a vehicle according to any one preceding claim,
wherein the light source device (1), the reflective fluorescent body (4) and the

9. The lighting apparatus for a vehicle according to any one preceding claim,
wherein the reflective fluorescent body (4) is disposed facing a rear surface (32) of the main lens (3) and/or is disposed on an optical axis of the main lens (3).

10. The lighting apparatus for a vehicle according to any one preceding claim, further comprising:

a secondary light source (100) disposed at a rear side of the main lens (3), and
a second reflecting unit (22) provided on the main lens (3) and adapted to reflect light emitted from the secondary light source (100).

11. The lighting apparatus for a vehicle according to any one preceding claim, further comprising:

a third reflecting unit (6) provided in a portion of a surface of the main lens (3) and arranged to reflect a portion of the light reflected from the reflective fluorescent body (4) to the main lens (3) to a rear side of the main lens (3),
wherein the third reflecting unit (6) is preferably spaced apart from the first reflecting unit (21).

12. The lighting apparatus for a vehicle according to claim 10 or 11, wherein:

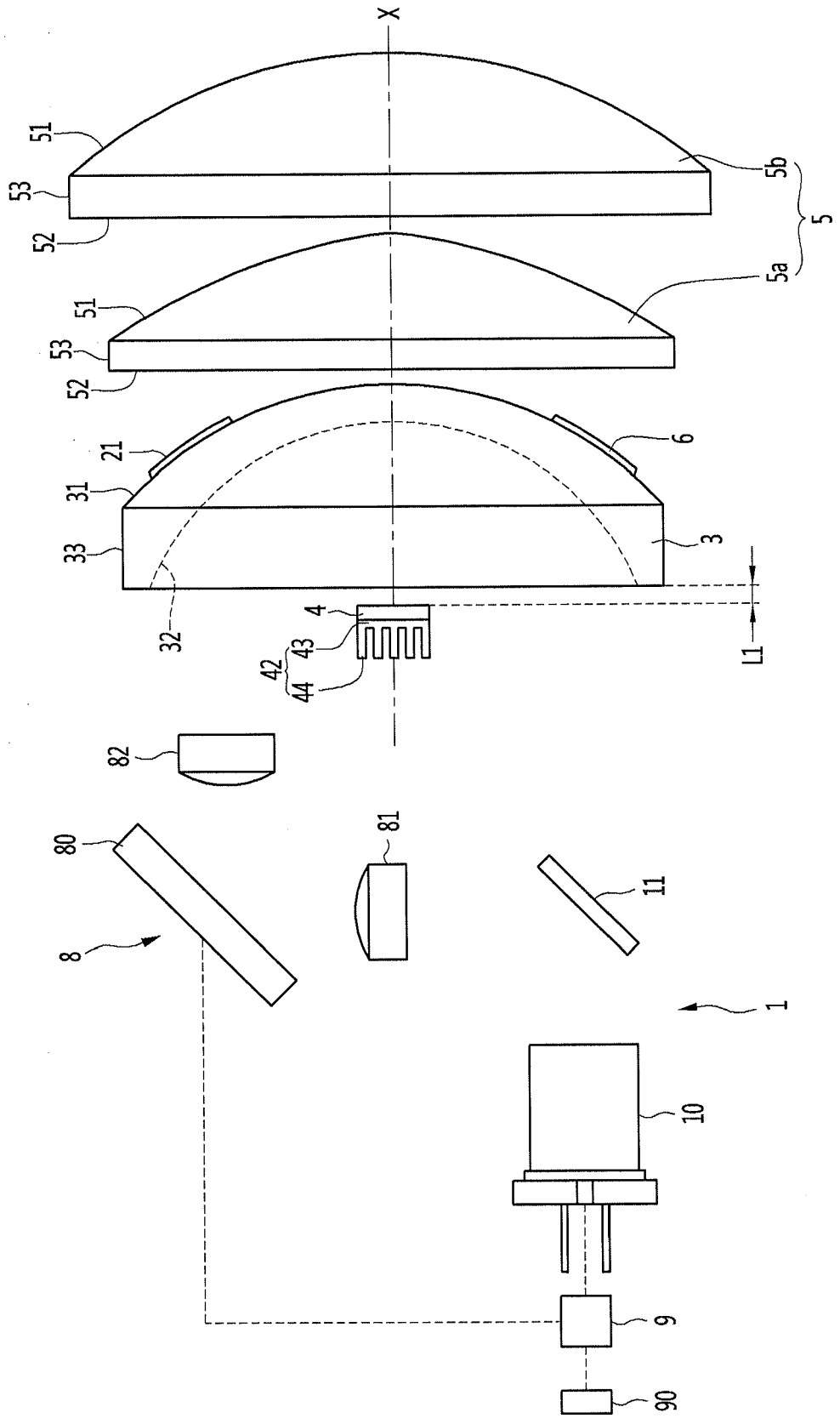
the secondary light source (100) is displaced from an optical axis of the main lens (3) and/or is arranged to emit light in a direction parallel to an optical axis of the main lens (3).

13. The lighting apparatus for a vehicle according to any one of claims 10 to 12,
wherein a distance between the light source device (1) and the secondary light source (100) is smaller than a diameter of the main lens (3).

14. The lighting apparatus for a vehicle according to any one preceding claim,
wherein the first reflecting unit (21) is displaced from an optical axis of the main lens (3) and/or is a concave mirror which is formed at a surface of the main lens (3).

15. The lighting apparatus for a vehicle according to any one preceding claim,
wherein the front surface (31) of the main lens (3) has a convex shape, and the first reflecting unit (21) has an arc-shaped cross section.

FIG. 1


X
51
53
52
5b
5
5a
51
53
52
21
31
33
6
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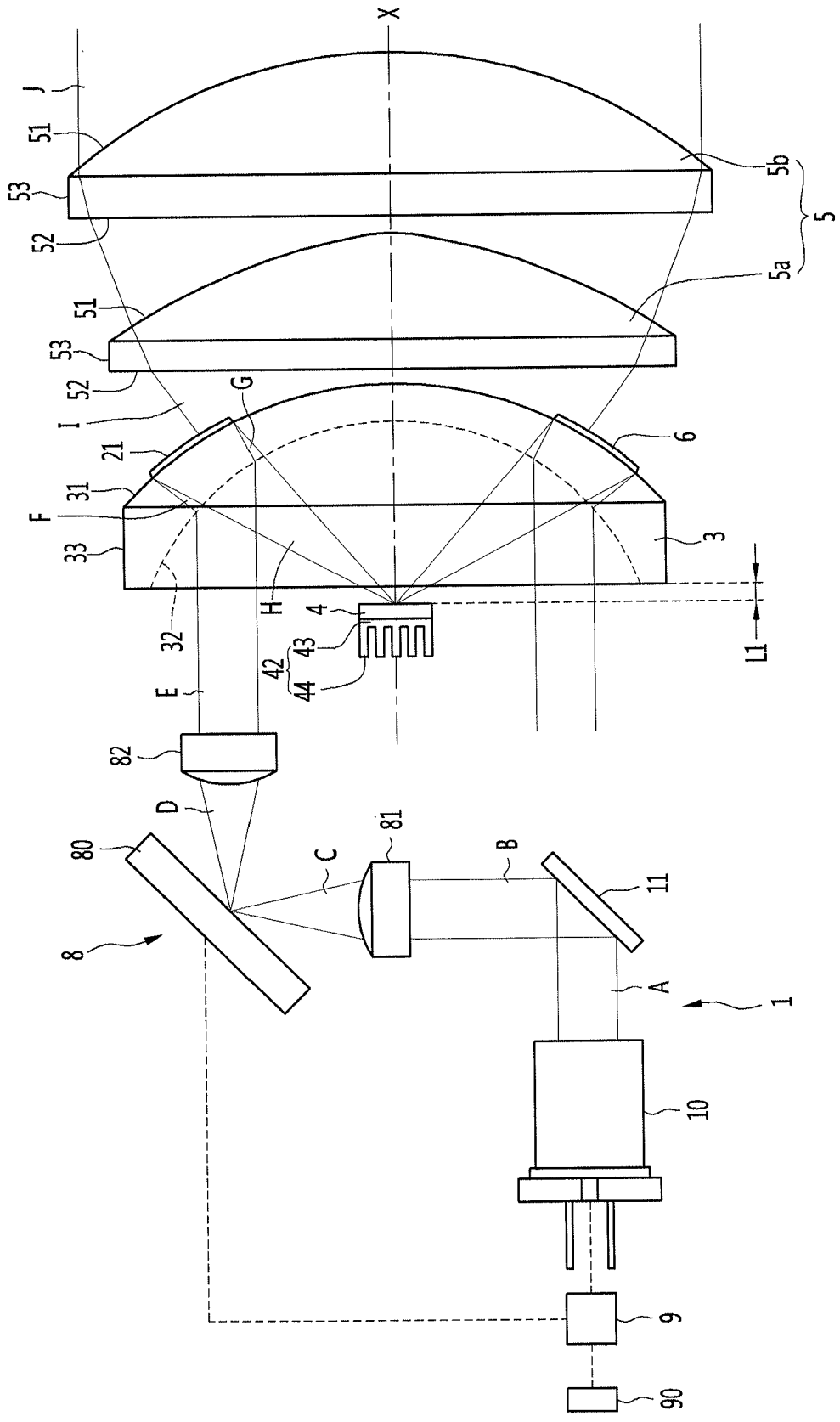
4
43
42
44
L1
82
80
81
11
8
1
10
9
90

FIG. 2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J
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53
52
5b
5
5a
51
53
52
G
I
21
31
F
33
6
3
H
4
43
42
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10
9
90
L1

FIG. 3

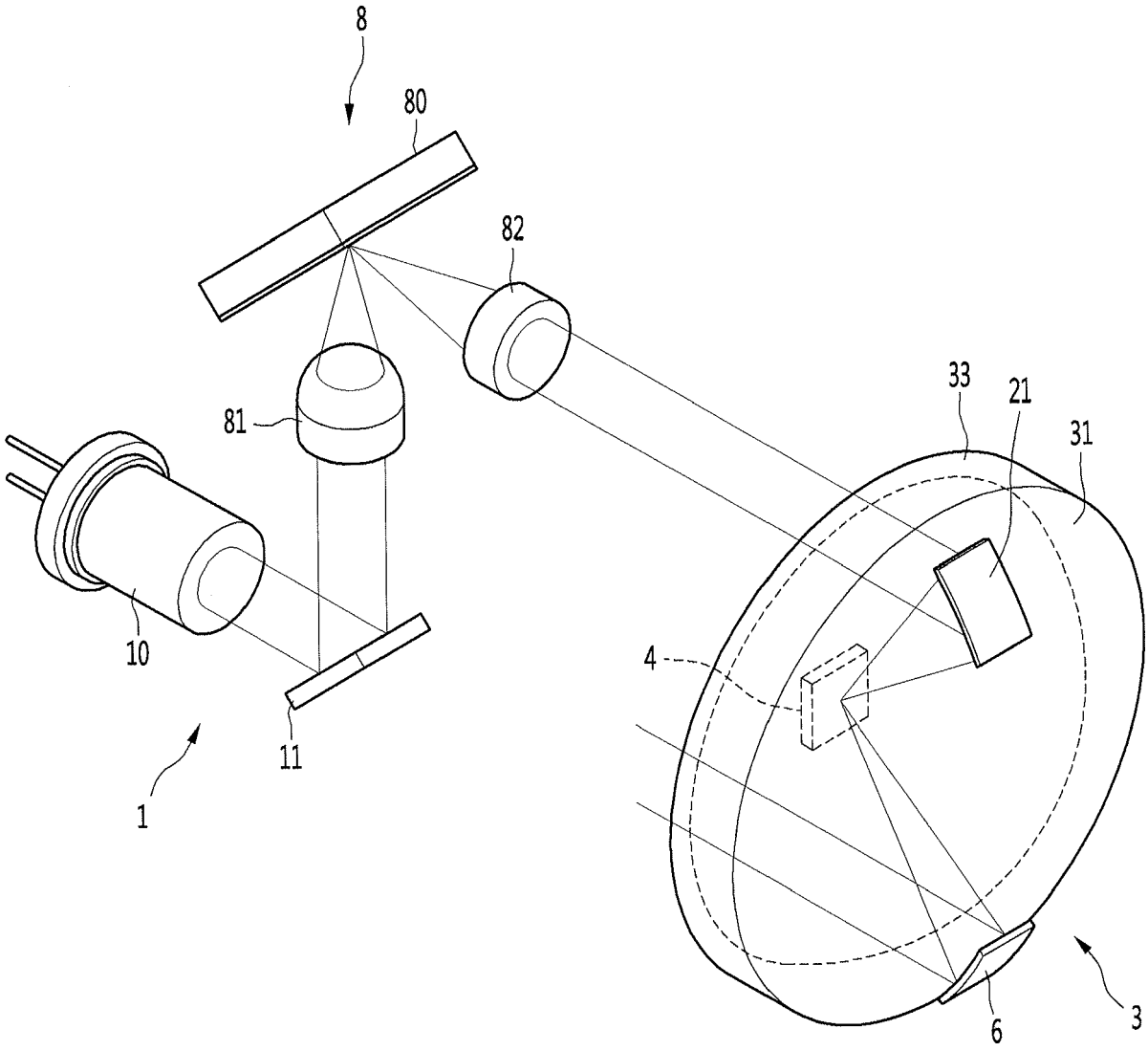

FIG. 4

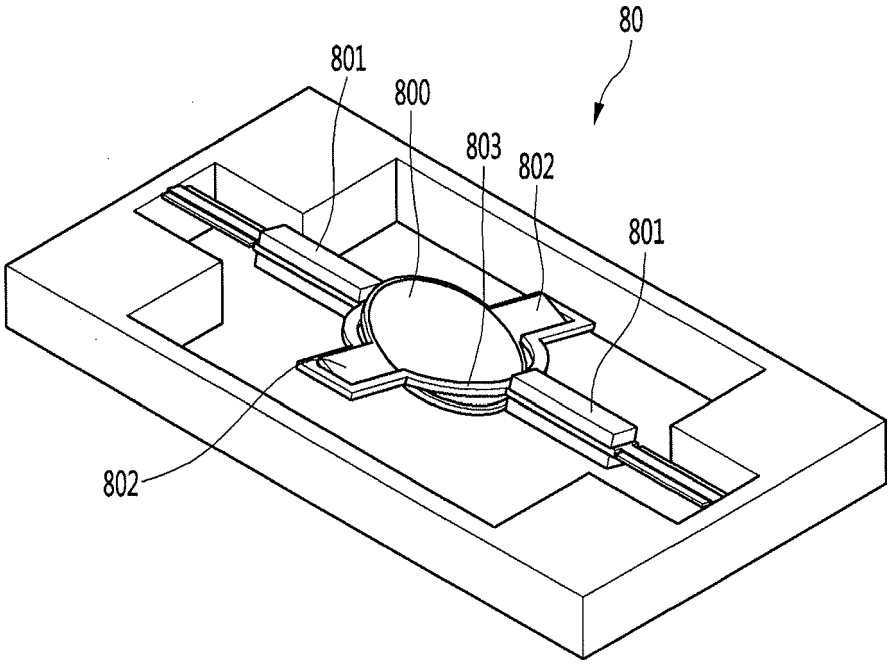

FIG. 5

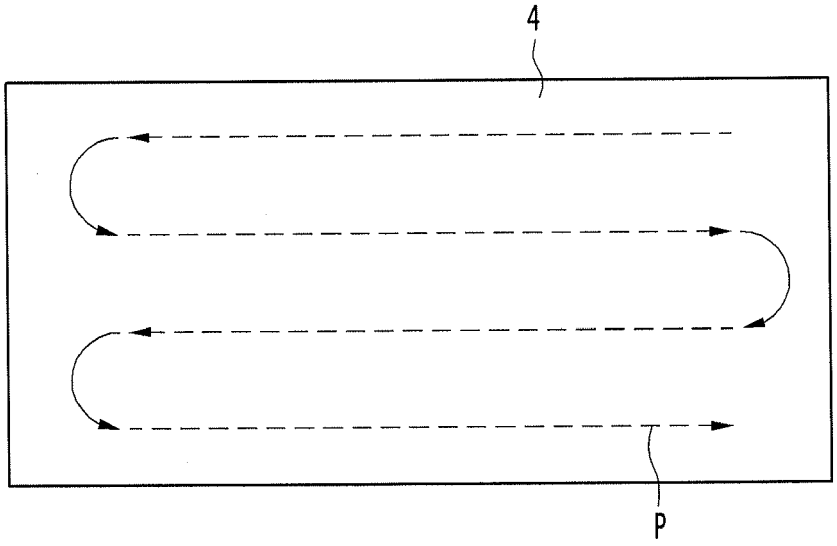

FIG. 6

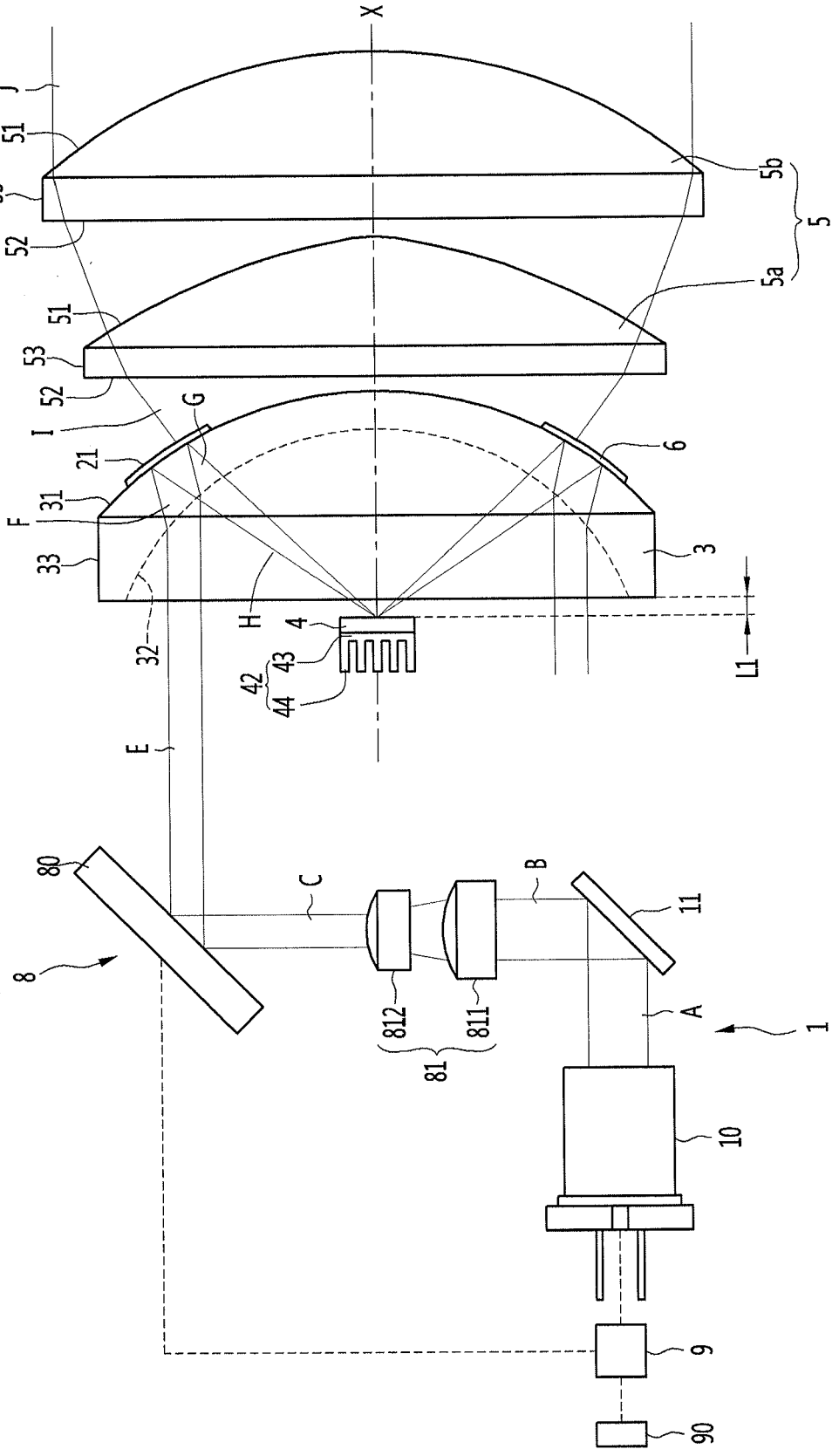
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FIG. 7

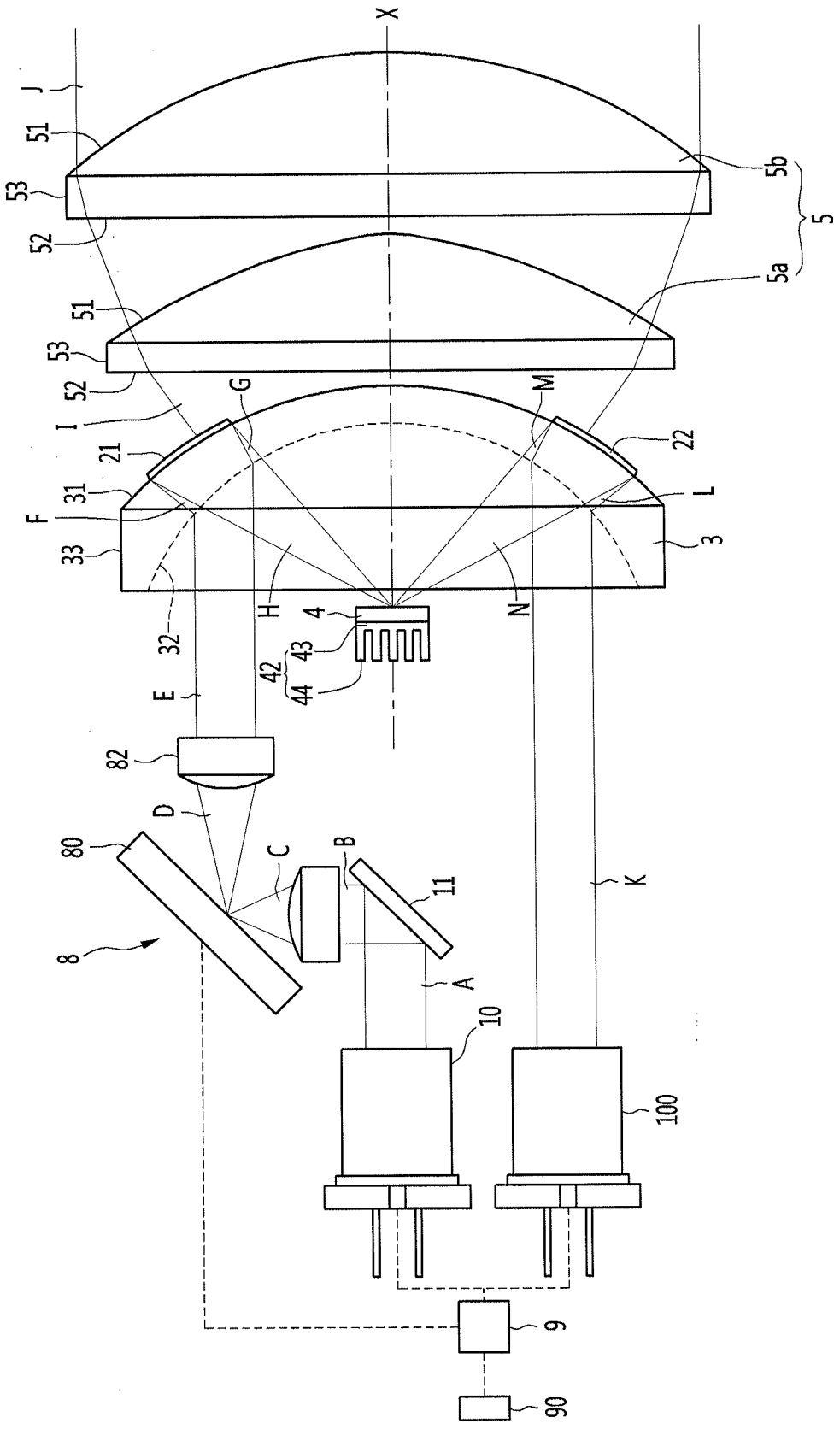
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FIG. 8

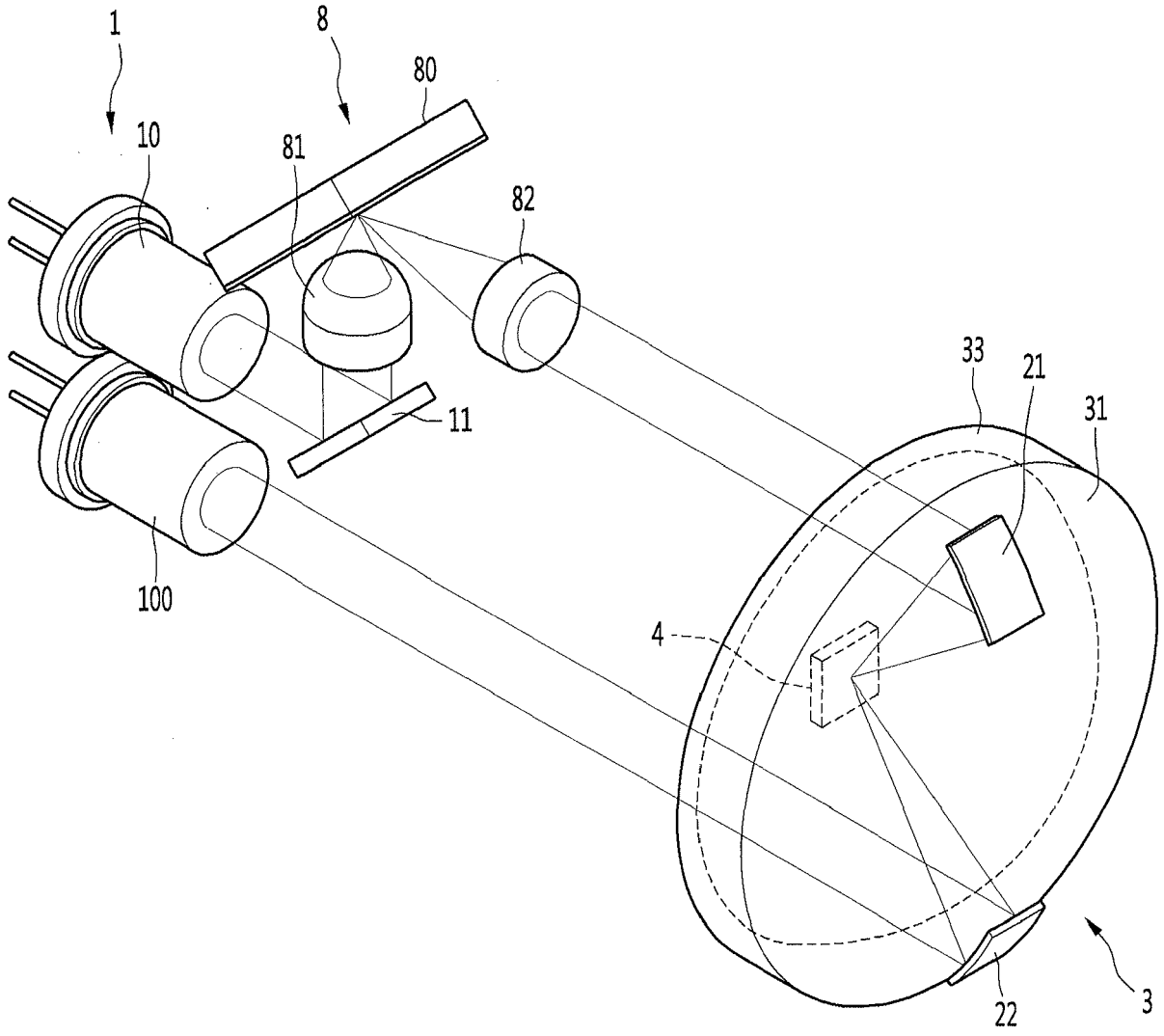

FIG. 9

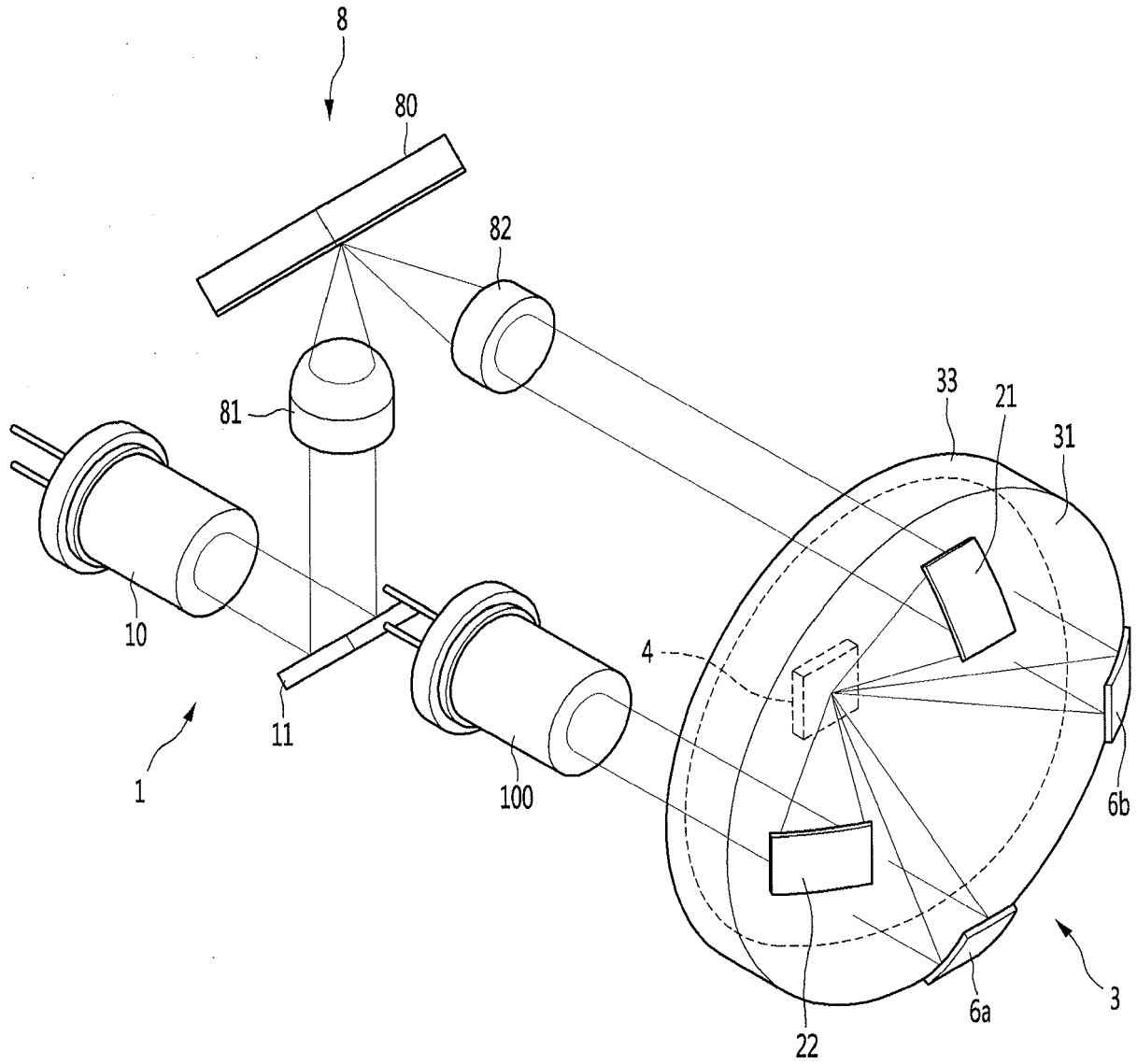

FIG. 10

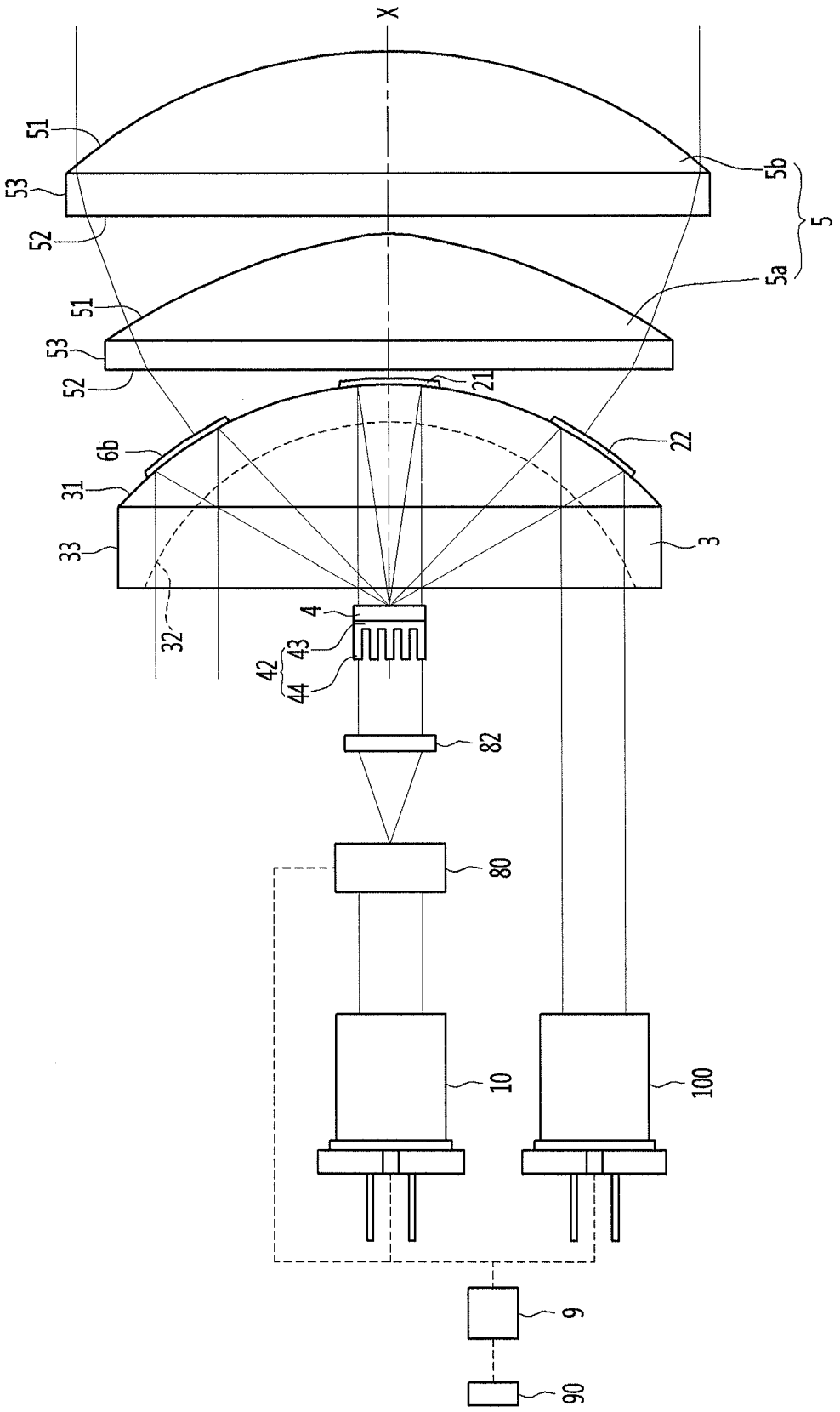

FIG. 11

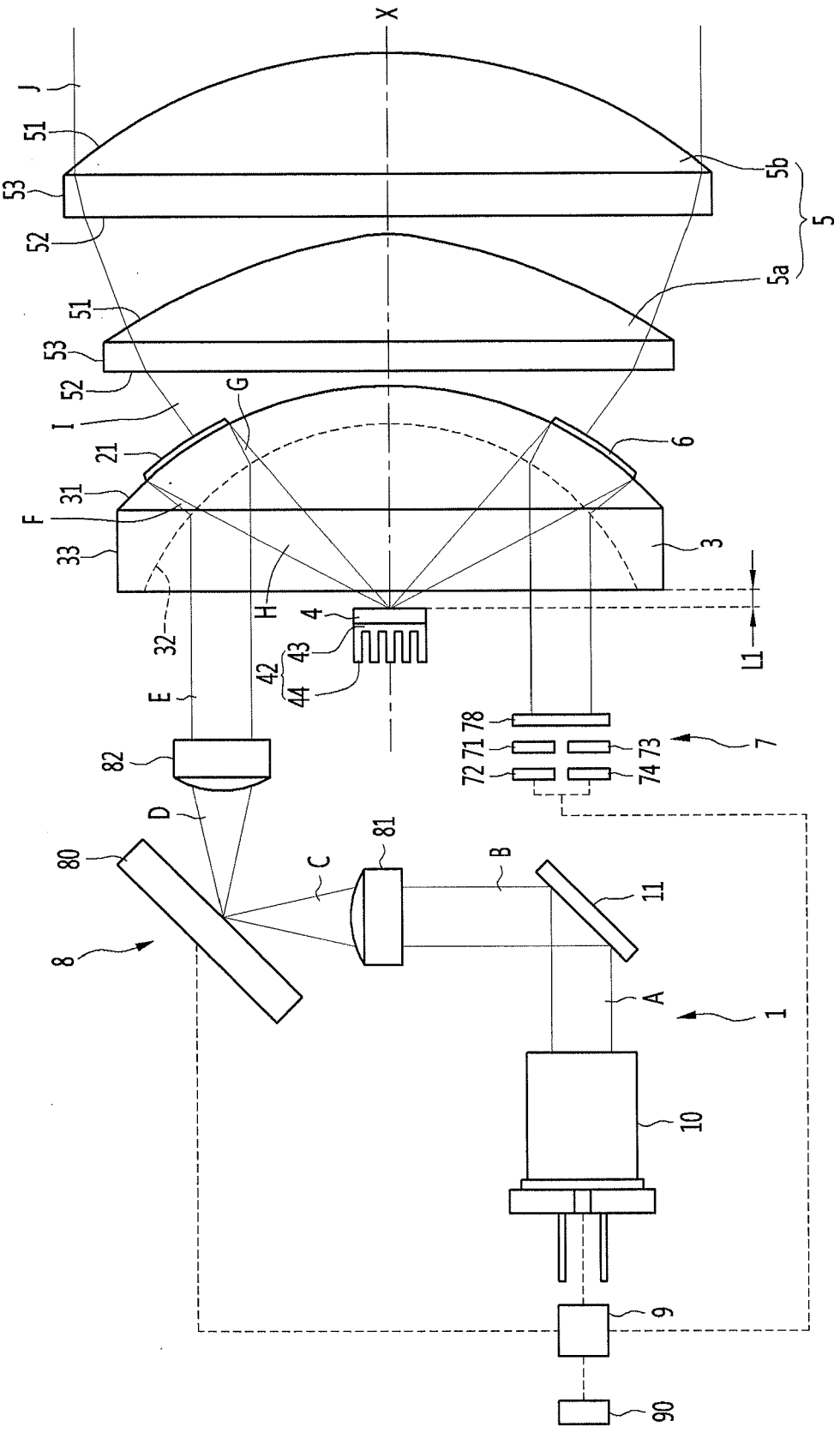
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FIG. 12

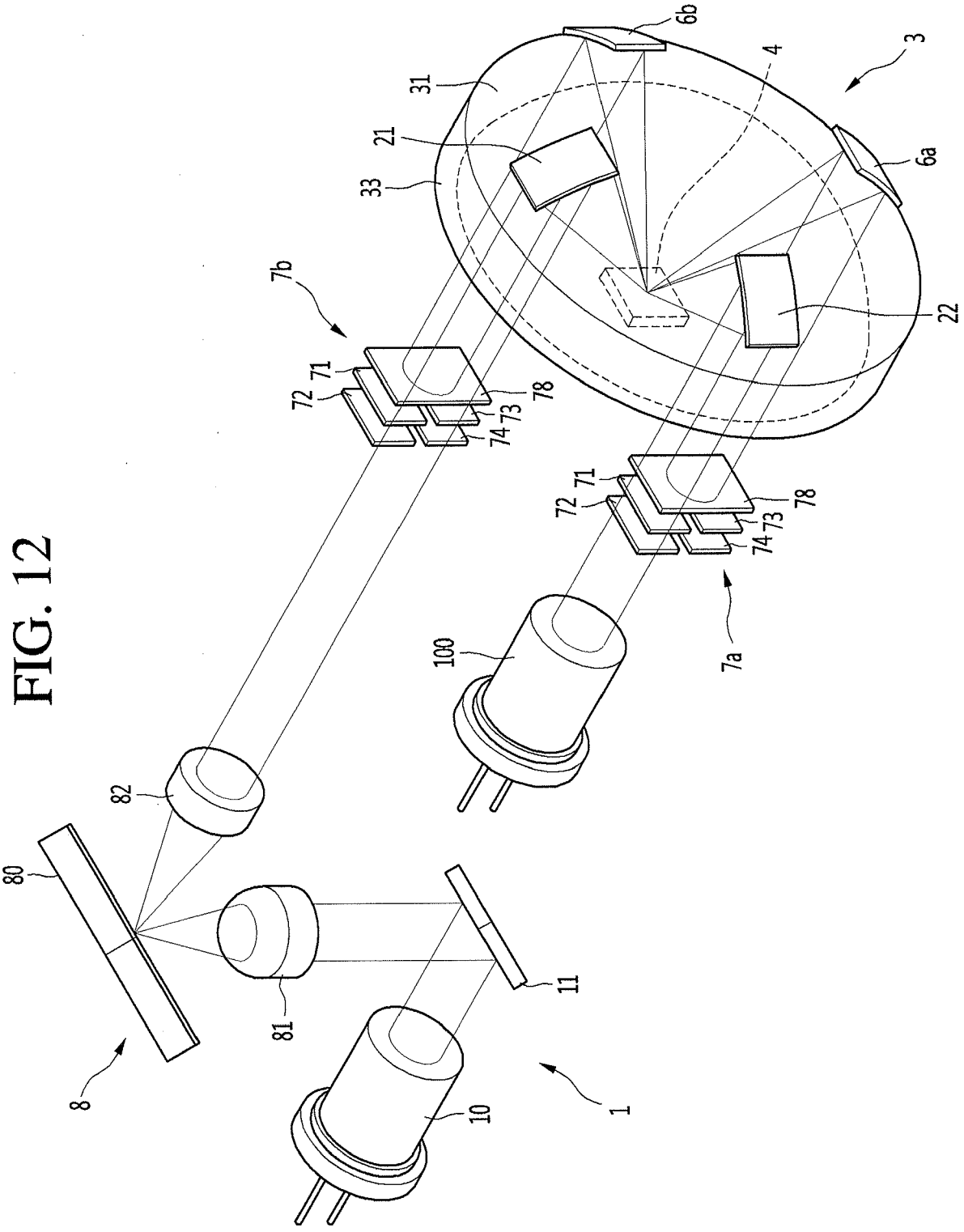
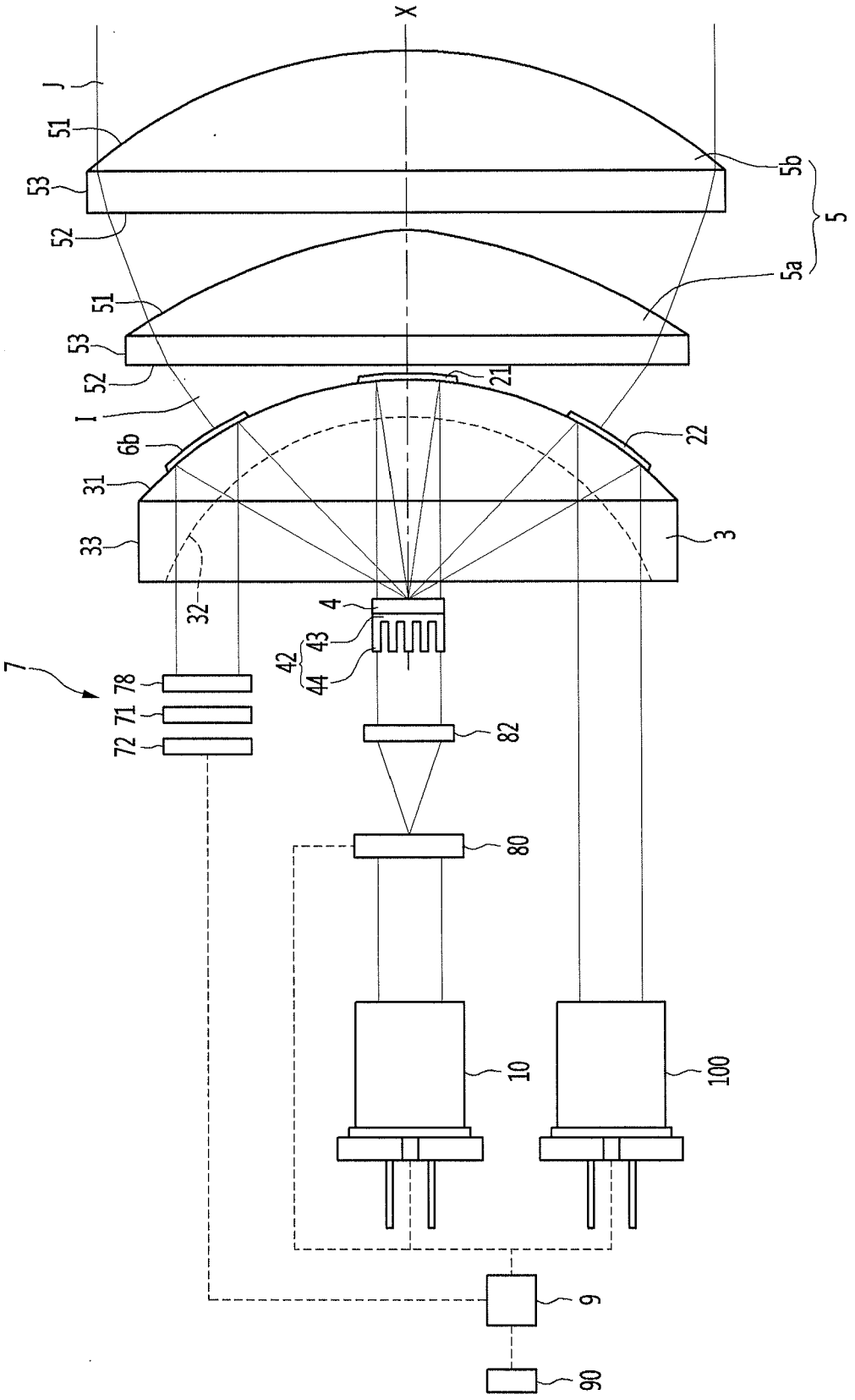


FIG. 13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Application Number
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F21S
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 August 2017	Berthommé, Emmanuel

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