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(54) Illumination apparatus having adjustable luminous distribution

(57) A LED illumination apparatus (100) comprises at least one LED module (11) and a driving module (12). The LED module (11) includes a substrate (111) and a plurality of LED lighting sources (112) arranged on the substrate. The LED lighting sources (112) are electrically connected to the substrate (111). The driving module (12) includes a driver (121) and a shaft (122) connected to the driver. The shaft (122) is positioned in one side surface of the substrate (111). The substrate (111) can be rotated by the driver (121), adjusting the illumination angle of the LED module (11) and change the luminous distribution of the LED illumination apparatus (100).

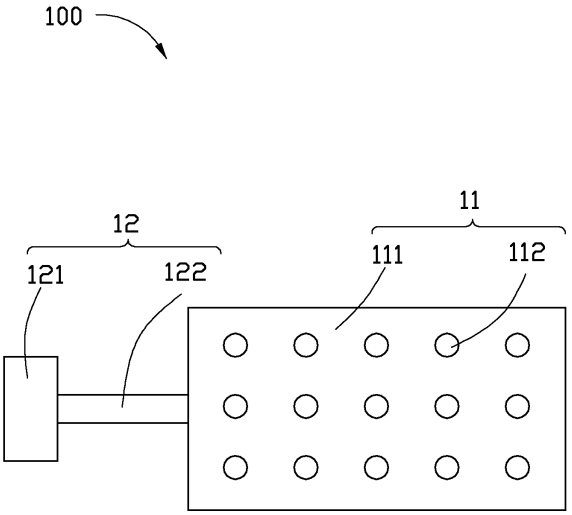

FIG. 1

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Description

BACKGROUND

1. Technical Field

[0001] The disclosure relates to illumination, and particularly to an illumination apparatus that can change its luminous distribution.

2. Description of the Related Art

[0002] Light emitting diodes' (LEDs) many advantages, such as high luminosity, low operational voltage, low power consumption, compatibility with integrated circuits, easy driving, long term reliability, and environmental friendliness have promoted their wide use as a light source. Now, light emitting diodes are commonly applied in environmental lighting.

[0003] The divergence angle of light is larger. LED, as a point lighting source requires revised optical design to change the luminous distribution. The luminous distribution of LED commonly is a Lambertian distribution.

[0004] The Full Width at Half Maximum (FWHM) of the LED is within $\pm 60°$; such that Full Width at Half Maximum is 120°. In secondary optical design, such as an optical lens or reflector, the illumination apparatus using the LED can change the luminous distribution from the Lambertian distribution.

[0005] Nevertheless, when a lens or reflector is fixed, the luminous distribution is correspondingly fixed. Redesign of different lenses or reflectors according to different illumination needs is required, increasing manufacturing costs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Many aspects of the present illumination apparatus can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the present illumination device. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

[0007] FIG. 1 is a schematic view of an illumination apparatus in accordance with a first embodiment.

[0008] FIG. 2 is a schematic view of an illumination apparatus in accordance with a second embodiment.

[0009] FIG. 3 is a schematic view of a first operating state of the illumination apparatus in accordance with the second embodiment.

[0010] FIG. 4 is a schematic view of a second operating state of the illumination apparatus in accordance with the second embodiment.

[0011] FIG. 5 is a schematic view of a third operating state of the illumination apparatus in accordance with the second embodiment.

[0012] FIG. 6 is a schematic view of an illumination apparatus in accordance with a third embodiment.

[0013] FIG. 7 is a lateral view of the illumination apparatus in accordance with the third embodiment.

[0014] FIG. 8 is a schematic view of an illumination apparatus in accordance with a fourth embodiment.

[0015] FIG. 9 is a schematic view of a first operating state of the illumination apparatus in accordance with the fourth embodiment.

[0016] FIG. 10 is a schematic view of a second operating state of the illumination apparatus in accordance with the fourth embodiment.

[0017] FIG. 11 is a schematic view of the first operating state of the illumination apparatus in accordance with the fourth embodiment, in use as a streetlight.

[0018] FIG. 12 is a schematic view of a third operating state of the illumination apparatus in accordance with the fourth embodiment, in use as a streetlight.

[0019] FIG. 13 is a schematic view of an illumination apparatus in accordance with a fifth embodiment.

DETAILED DESCRIPTION

[0020] Embodiments of the illumination apparatus are described in detail here with reference to the drawings.

[0021] Referring to FIG. 1, an illumination apparatus 100 includes a LED lighting source module 11 and a driving module 12.

[0022] The LED lighting source module 11 includes a substrate 111 and a plurality of LED lighting sources 112. The substrate 111 has a circuit. The plurality of LED lighting sources 112 are mounted on the substrate 111. A plurality of electrodes of the LED lighting sources 112 electrically connect to the circuit on the substrate 111. A heat dissipation device (not shown) can be attached to the substrate 111 at a side opposite to the LED lighting sources 112.

[0023] According to individual needs, the LED lighting source module 11 can further include at least one optical element adjusting the luminous distribution of the LED lighting source 112, such as an optical lens or a reflector.

[0024] If the optical element is a lens, the lens is mounted on the light emitting surface of the LED lighting source 112. Light from which is emitted through the lens deflects at a specific angle.

[0025] If the optical element is a reflector, the reflector is mounted on a side of the light emitting surface of the LED lighting source 112, altering the luminous distribution of the LED lighting source module 11.

[0026] The driving module 12 includes a driver 121 and a shaft 122 connecting thereto. The shaft 122 is fixed on the side surface of the substrate 111. The driver 121 rotates the shaft 122, and the substrate 111 accordingly, thus altering the illumination angle of the LED lighting source module 11.

[0027] Preferably, the shaft 122 is at the geometric center axis of the substrate 111 to effectively rotate the substrate 111.

[0028] Understandably, as long as the shaft 122 can effectively rotate the substrate 111, the shaft 122 needs not be limited to the geometric center axis and can be at any location of the side surface of the substrate 111.

[0029] Referring to FIG. 2, an illumination apparatus 200 according to a second embodiment includes four LED lighting source modules 21, 22, 23, and 24, and a driving module 25.

[0030] The structures of the four LED lighting source modules 21, 22, 23, and 24 are the same. The LED lighting source module 21 includes a substrate 211 and a plurality of LED lighting sources 212. The LED lighting sources 212 are mounted on the substrate 211 having a circuit. The electrodes of the LED lighting sources 212 are electrically connecting to the circuit on the substrate 211.

[0031] The driving module 25 includes four drivers 251, 252, 253, 254, and four shafts 255, 256, 257, 258. The four drivers 251, 252, 253, and 254 are respectively connecting to the four shafts 255, 256, 257, and 258, and the four shafts 255, 256, 257, and 258 are respectively connecting to the four LED lighting source modules 21, 22, 23, and 24. With controlling to the drivers 251, 252, 253, and 254, that respectively adjust the rotating angles of the LED lighting source modules 21, 22, 23, and 24, each luminous distribution of the LED lighting source modules 21, 22, 23, and 24 coordinates mutually and provides new luminous distribution of the illumination apparatus 200.

[0032] The illumination apparatus 200 further includes a supporting board 26 to which the driving module 25 and drivers 251, 252, 253, and 254 are fixed, separated by a predetermined distance.

[0033] Referring to FIG. 3, the two outside LED lighting source modules 21 and 24 respectively rotate outwardly at an angle of 30° and the illumination angles of the two middle LED lighting source modules 22 and 23 are fixed, such that the luminous distribution of the illumination apparatus 200 is altered.

[0034] FIG. 4 shows another operating state of the illumination apparatus 200 in this embodiment. The two adjacent interior LED lighting source modules 22 and 23 rotate outwardly at an angle of 30° and the two outside LED lighting source modules 21 and 24 respectively rotate outwardly at an angle of 45°, altering luminous distribution of the illumination apparatus 200.

[0035] Referring to FIG. 5, the illumination apparatus 200 further includes two more LED lighting source modules 26 and 27, with drivers and shafts corresponding thereto (not shown).

[0036] By controlling the driving module 25, the two interior LED lighting source modules 23 and 24 rotate outwardly at an angle of 35°, the middle LED lighting source modules 22 and 26 rotate outwardly at an angle of 55°, and the two outside LED lighting source modules 21 and 27 respectively rotate outwardly at an angle of 70° altering luminous distribution of the illumination apparatus 200.

[0037] Referring to FIG. 6 and FIG. 7, an illumination apparatus 300 of a third embodiment includes two LED lighting source modules 31 and 32, and a driving module 33. The structures of the LED lighting source modules 31 and 32 are the same as the first embodiment.

[0038] The driving module 33 includes a driver 331 and two shafts 332 and 333 respectively connecting to two LED lighting source modules 31 and 32. The shafts 332 and 333 have wheel gears 334 and 335. The wheel gear 334 and the wheel gear 335 engage. When the wheel gear 334 rotates, it drives the other wheel gear 335. The driver 331 connects to the shaft 332, such that one driver 331 can rotate two LED lighting source modules 31 and 32 and change the angle of illumination.

[0039] Understandably, the driver 331 can also be connected to the shaft 333 and rotate the two LED lighting source modules 31 and 32. Moreover, three or more lighting source modules can be deployed, with the number of shafts corresponding thereto. Each shaft has a wheel gear, engaging that of adjacent shafts, such that a single driver can drive all of the lighting source modules.

[0040] The wheel gear of each shaft can be replaced by an annular rubber ring contacting that of adjacent shafts. The driver fixed and driving one of the shafts, by friction force, drives other shafts.

[0041] Referring to FIG. 8, the illumination apparatus 400 in accordance with a fourth embodiment includes two LED lighting source modules 41 and 42, and a driving module 43. The structures of the LED lighting source modules 41 and 42 are the same as those of the first embodiment.

[0042] The driving module 43 includes two drivers (not shown) and two shafts 433 and 434. The two drivers respectively rotate the shafts 433, 434. The driving module 43 further includes two connecting rods 435 and 436, by which the shafts 433 and 434 respectively connect to two LED lighting source modules 41 and 42. Shaft 433 has a C-shaped cross-section and the shape of the shaft 434 has an O-shaped cross-section, wherein the O-shaped shaft 434 is enveloped in the C-shaped shaft 433. The two shafts 433 and 434 can rotate between each other independently The angle of rotation is limited to the opening size of the C-shaped shaft 433. Basically, the opening size of the C-shaped shaft 433 is designed for the O-shaped shaft 434 can not fall off the C-shaped shaft 433.

[0043] Understandably, between the two shafts 433 and 434, ball bearing, Vaseline or lubricating oil can be arranged there, such that the shafts 433 and 434 rotate more easily

[0044] FIG. 9 and FIG. 10 respectively show two operating states of the illumination apparatus 400. FIG. 9 shows the two LED lighting source modules 41 and 42 rotating upwardly FIG.10 shows the two LED lighting source modules 41 and 42 rotating downwardly

[0045] FIG. 11 and FIG. 12 show operating states of the illumination apparatus 400 applied in use as a streetlight. The illumination apparatus 400 further includes a pole 44 supporting the LED lighting source modules 41

and 42, and a driving module 43. Referring to FIG. 11, the illumination angles of the two LED lighting source modules 41 and 42 are as in general use, such as θ1. When a vehicle approaches one end of the area illuminated by LED lighting source modules 42, the driving module 43 drives LED lighting source module 42 on the car end to rotate to an angle of θ2 to avoid glare from the LED lighting source module 42, wherein θ1>θ2. The angle of the LED lighting source module 41 is unchanged, as referring to FIG. 12. Thus, the included angle between the light from the LED lighting source 42 and the front view of the driver decreases.

[0046] Preferably, $\theta 2 \leqq 45°$, helps prevent glare.

[0047] Understandably, the illumination apparatus 400 can further include a detection device detecting the current conditions. By adjusting the illumination angle of the LED lighting source module in accordance with the different environment, luminous distribution can be varied.

[0048] FIG. 13 is a schematic view of a system of an illumination apparatus 500 in accordance with a fifth embodiment. The illumination apparatus 500 includes a detection device 511, a processor 512, a storage unit 513, a driver 514 and a LED lighting source module 515.

[0049] The detection device 511 is employed for detecting current conditions. The detection device 511 outputs the data corresponding to the environment to the processor 512. The detection device 511 can be a heat detection device detecting the heat source of the people, animal or car.

[0050] The processor 512 receives a signal from the detection device 511 detecting situation of the environment. According to the current conditions detected by the detection device 511, the processor 512 chooses a different operation mode from the storage unit 513 and controls the driver 514, thereby altering luminous distribution of the lighting source module.

[0051] The storage unit 513 stores different illumination modes of the LED lighting source module 515. Each of the different illumination modes corresponds to different road conditions. By the processor 512 controlling the driving circuit, an illumination angle of the LED lighting source module 515 can be adjusted in accordance with the different situation of the road surface and luminous distribution can be altered.

[0052] While certain embodiments have been described and exemplified above, various other embodiments from the foregoing disclosure will be apparent to these skilled in the art. The disclosure is not limited to the particular embodiments described and exemplified but is capable of considerable variation and modification without departure from the scope of the appended claims.

Claims

1. An illumination apparatus comprising at least one LED lighting source module and a driving module, the at least one LED lighting source module comprising a substrate and a plurality of LED lighting sources arranged on the substrate and electrically connecting to the substrate, the driving module comprising a driver and a shaft connecting to the driver, the shaft fixed on one side surface of the substrate, the driver rotating the shaft and further the substrate, and then adjusting the illumination angle of the at least one LED lighting source module.

2. The illumination apparatus of claim 1, wherein the driving module includes a driver and a plurality of shafts, each of the shafts comprising a wheel gear, wherein adjacent wheel gears of the shafts engage, and the driver is connected to one of the shafts.

3. The illumination apparatus of claim 1, wherein the driving module includes a driver and a plurality of shafts, on each of which is disposed a rubber ring, each contacts that of the adjacent shaft, and the driver is connected to one of the shafts.

4. The illumination apparatus of any preceding claim, wherein the driving module includes two shafts and two drivers, one shaft having a C-shaped cross section, the other having an O-shaped cross section, the O-shaped shaft seated in the C-shaped shaft, and the two shafts operating independently

5. The illumination apparatus of claim 4, wherein a ball bearing or a lubricant is arranged between the C-shaped shaft and the O-shaped shaft.

6. The illumination apparatus of any preceding claim, further including a heat dissipating device mounted on one surface of the substrate opposite to the LED lighting source.

7. The illumination apparatus of any preceding claim, further including a detection device for detecting current conditions.

8. The illumination apparatus of claim 7, further including a processor and a storage unit employed for saving operating modes of the illumination apparatus in different environments.

9. The illumination apparatus of any preceding claim, further including at least one lens mounted on the light emitting surface of the LED lighting source, through which light from the LED lighting source is emitted.

10. The illumination apparatus of any preceding claim, further including a reflector mounted adjacent to the light emitting surface of the LED lighting source reflecting light from the LED lighting source.

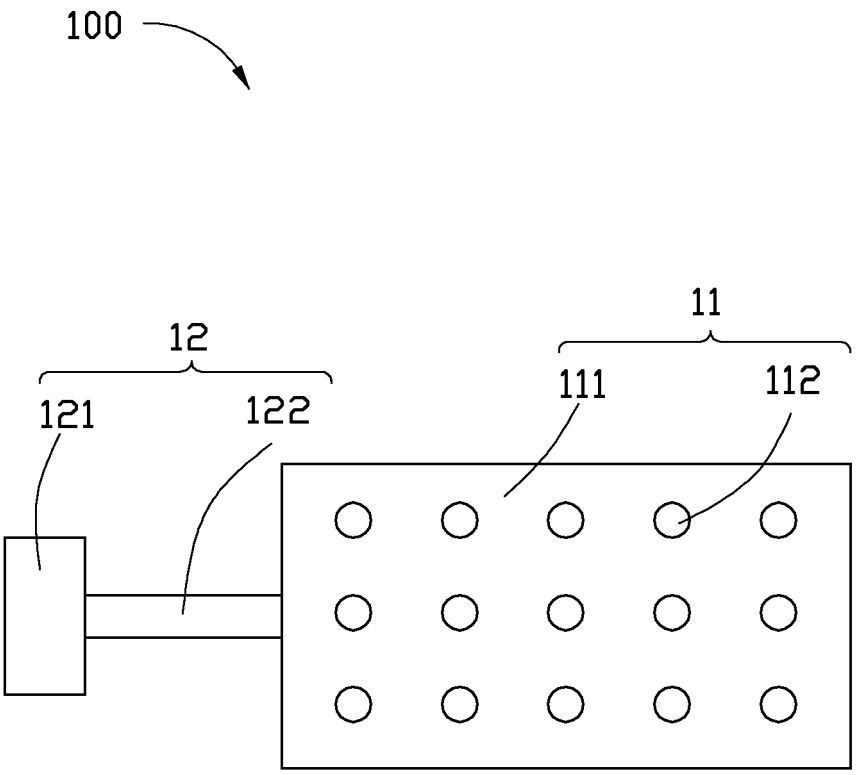

FIG. 1

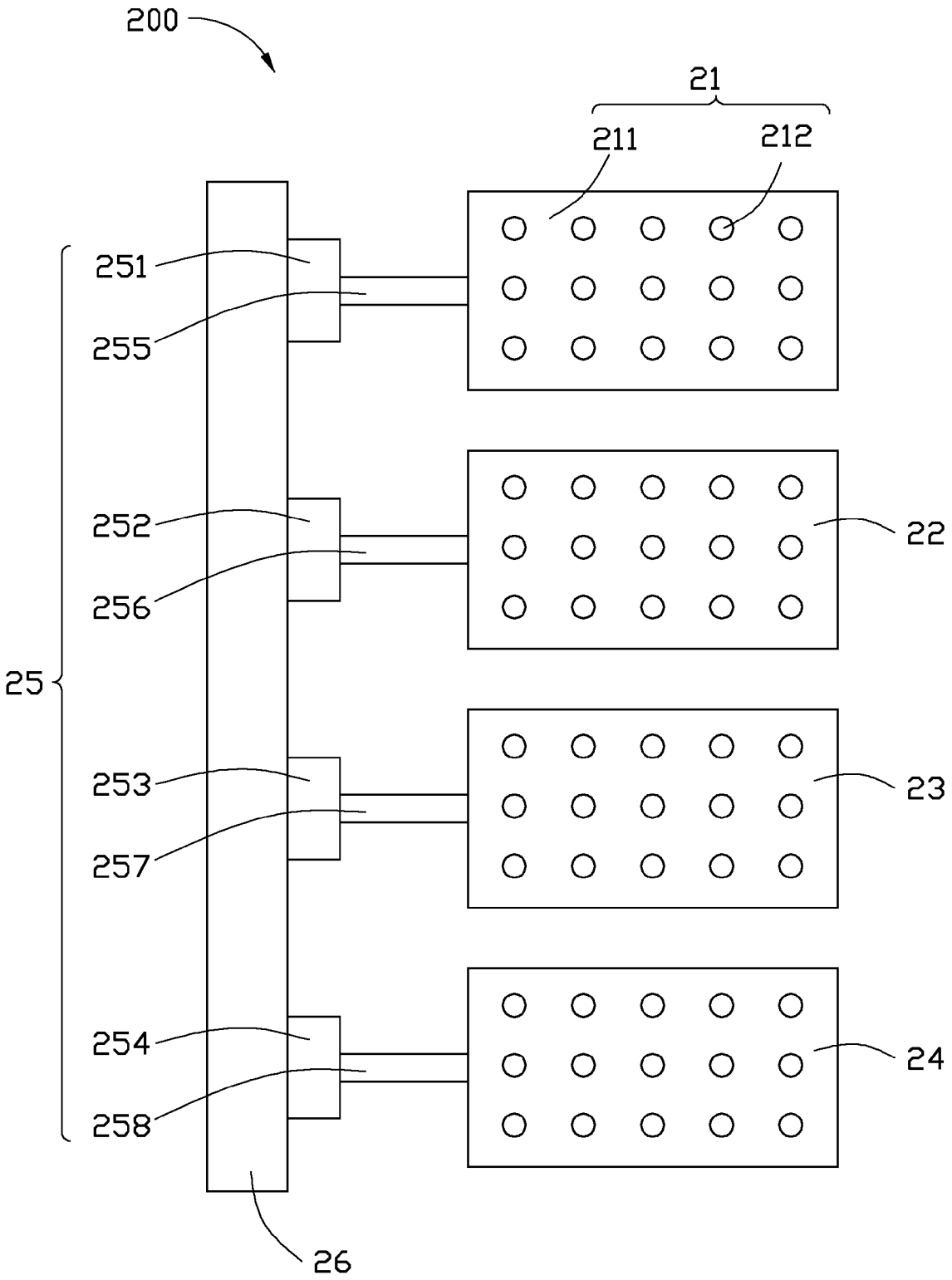

FIG. 2

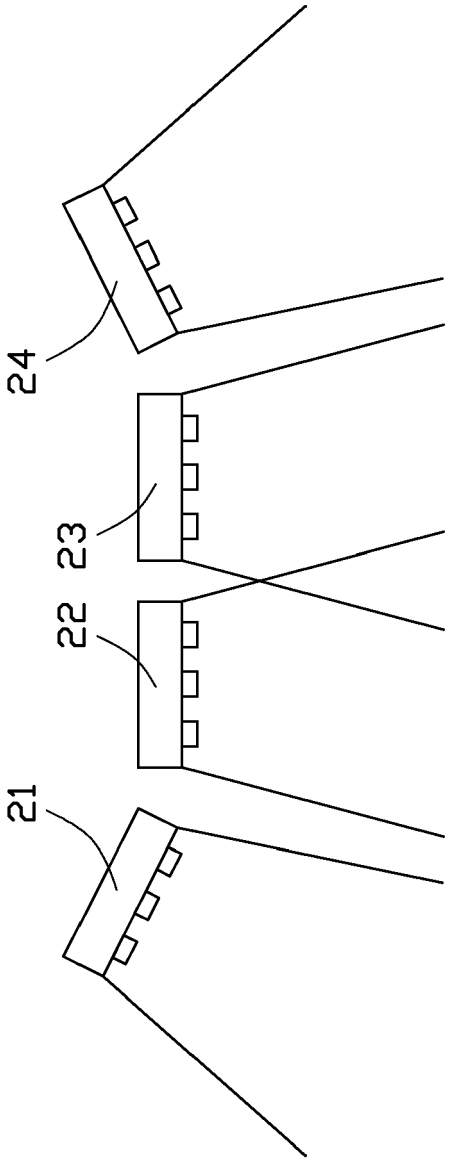

FIG. 3

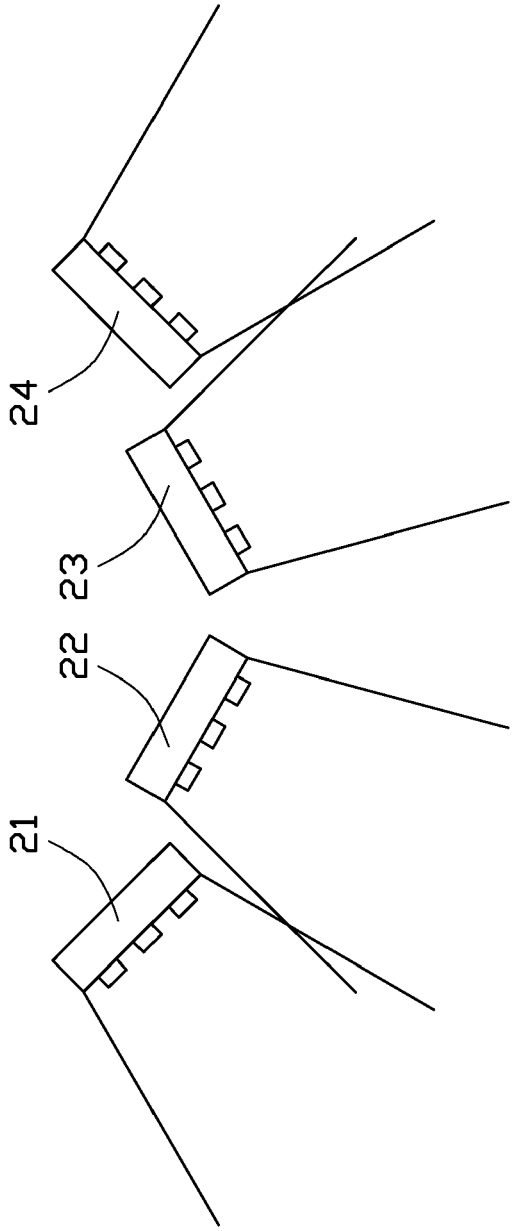

FIG. 4

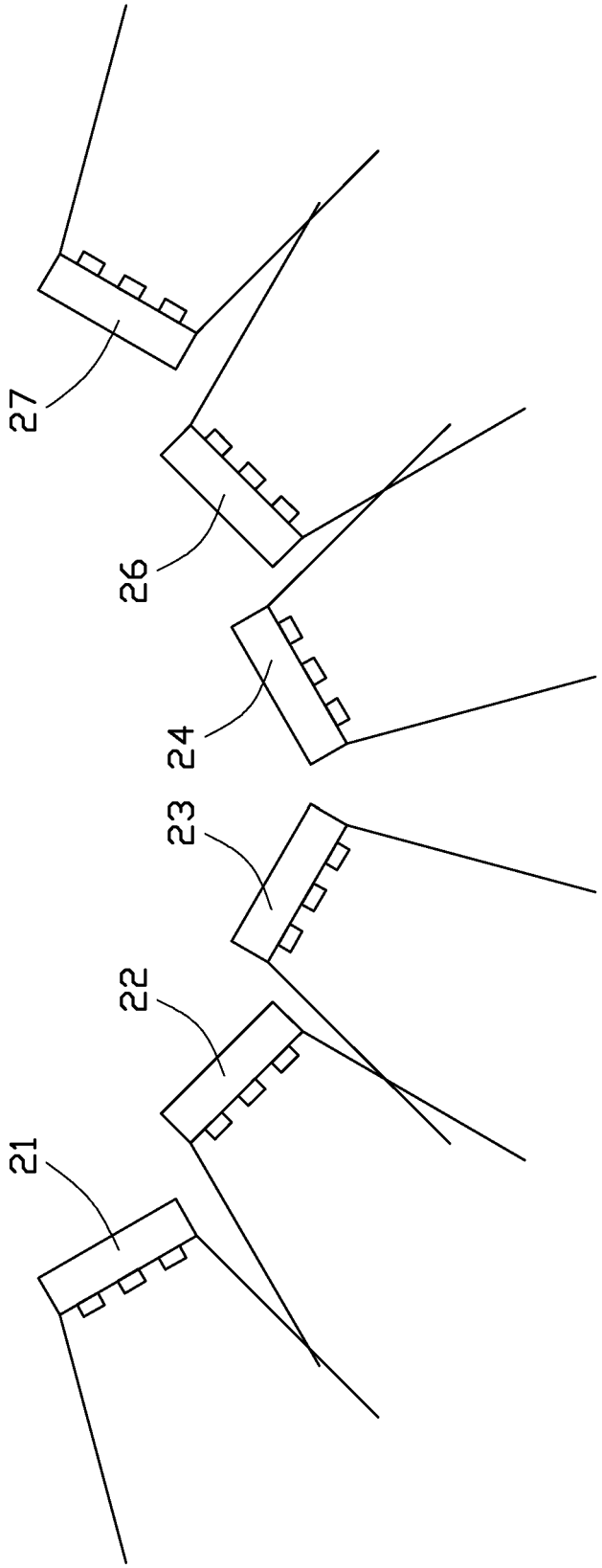

FIG. 5

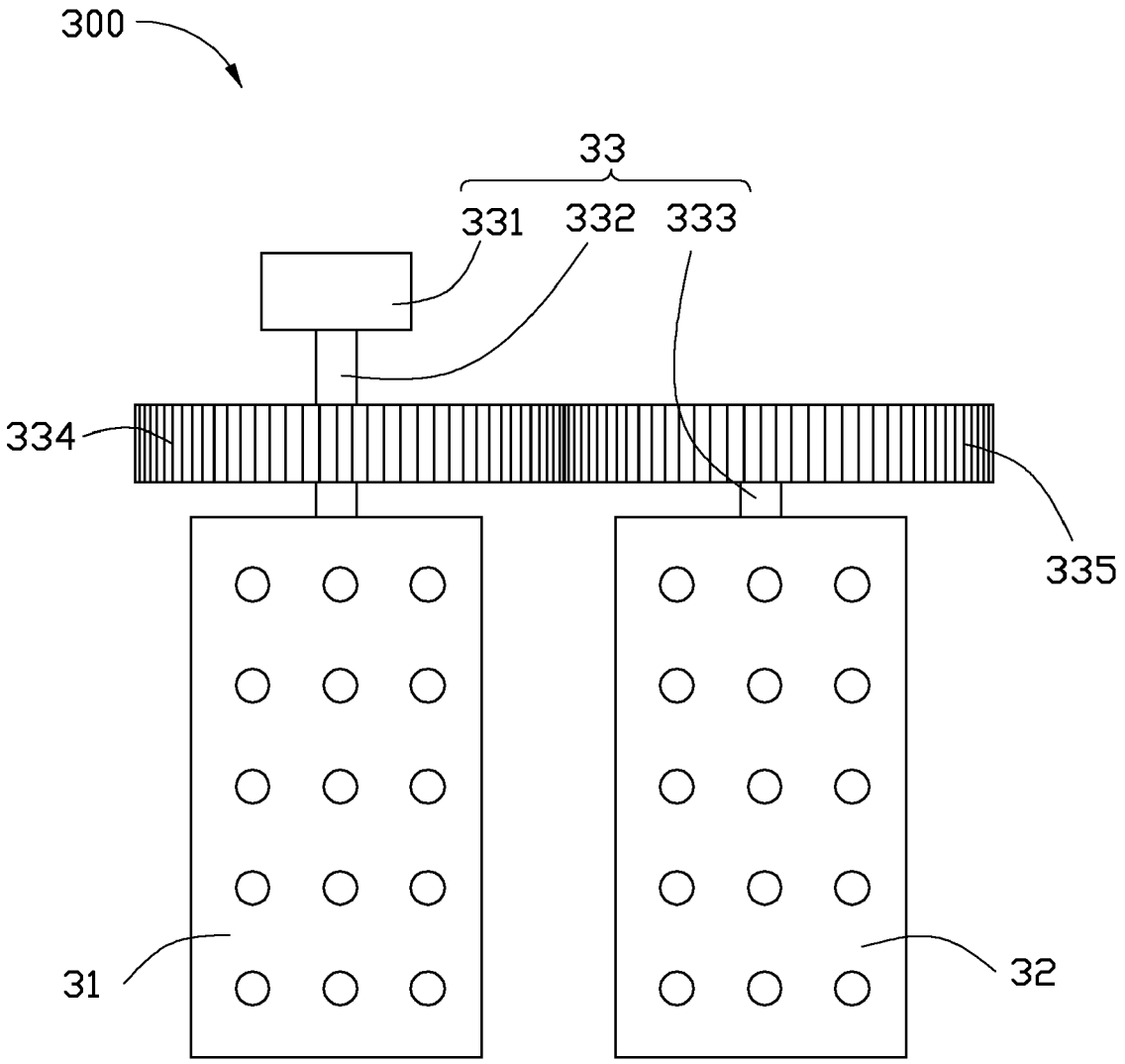

FIG. 6

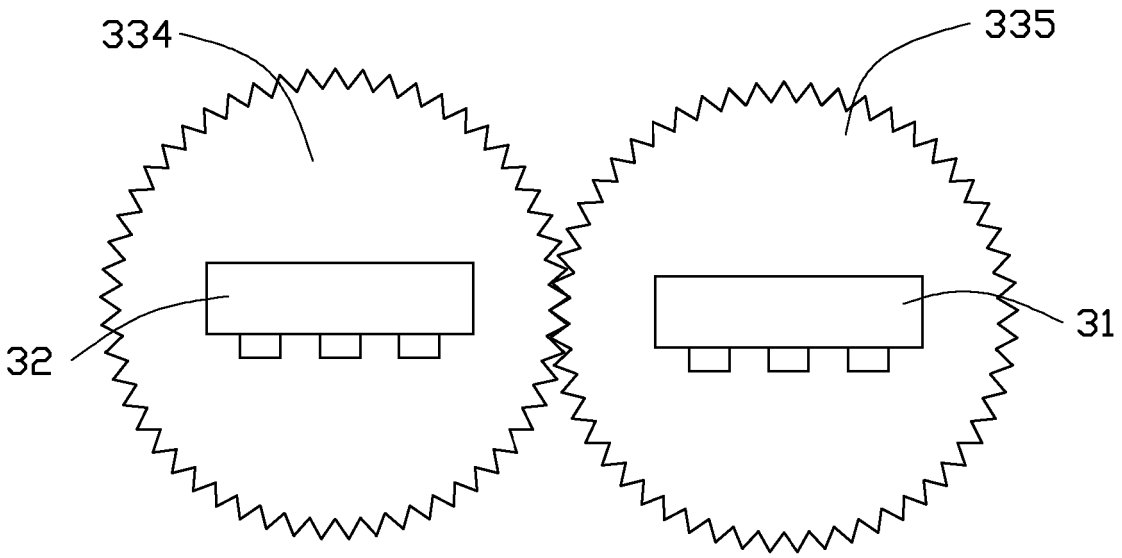

FIG. 7

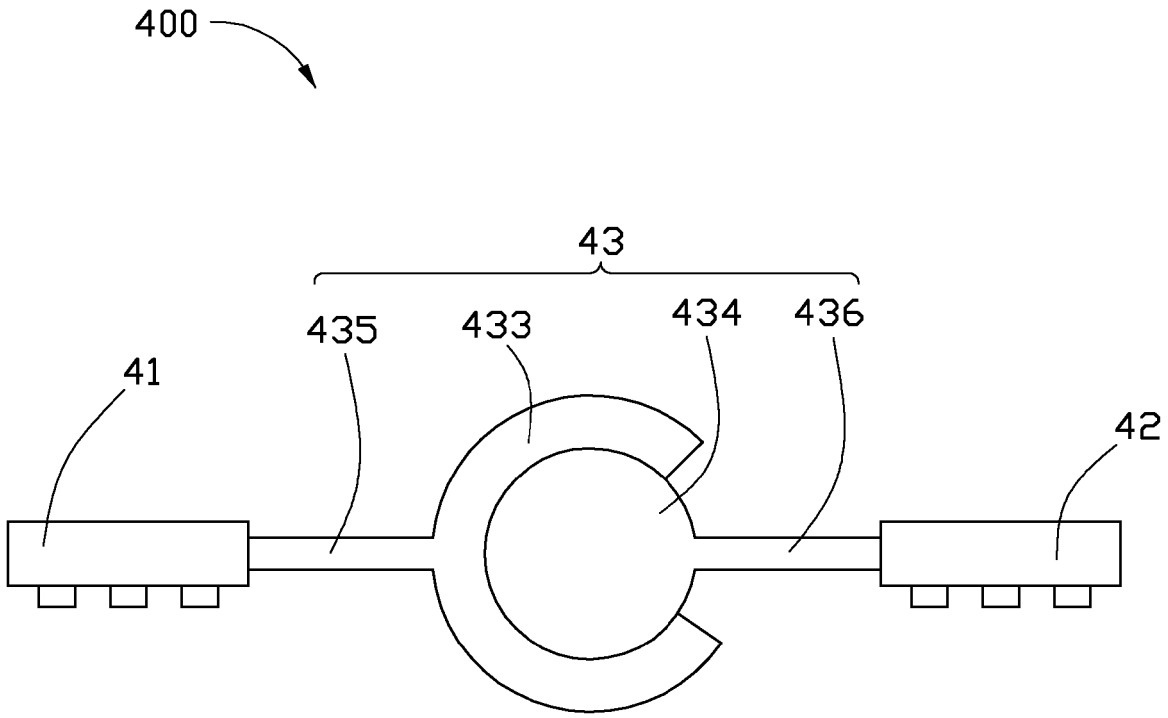

FIG. 8

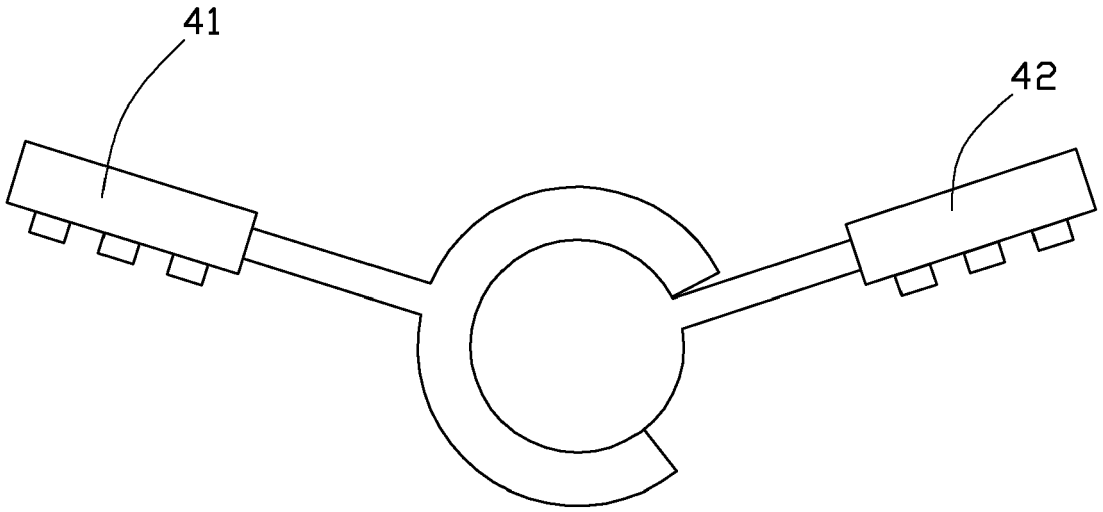

FIG. 9

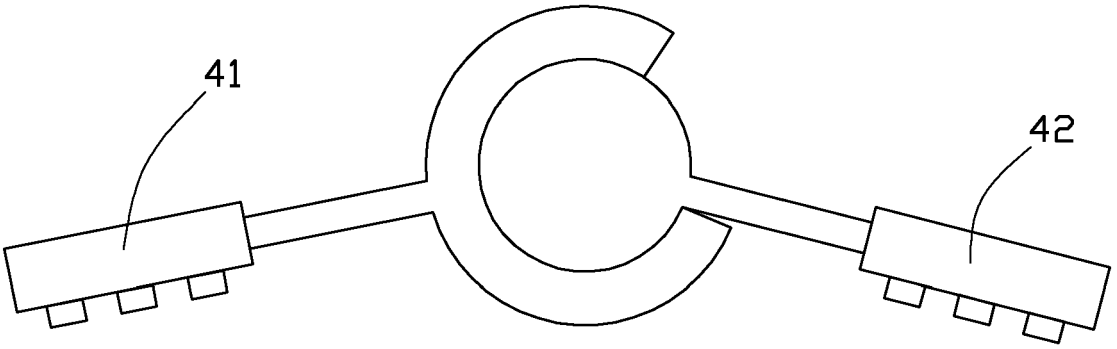

FIG. 10

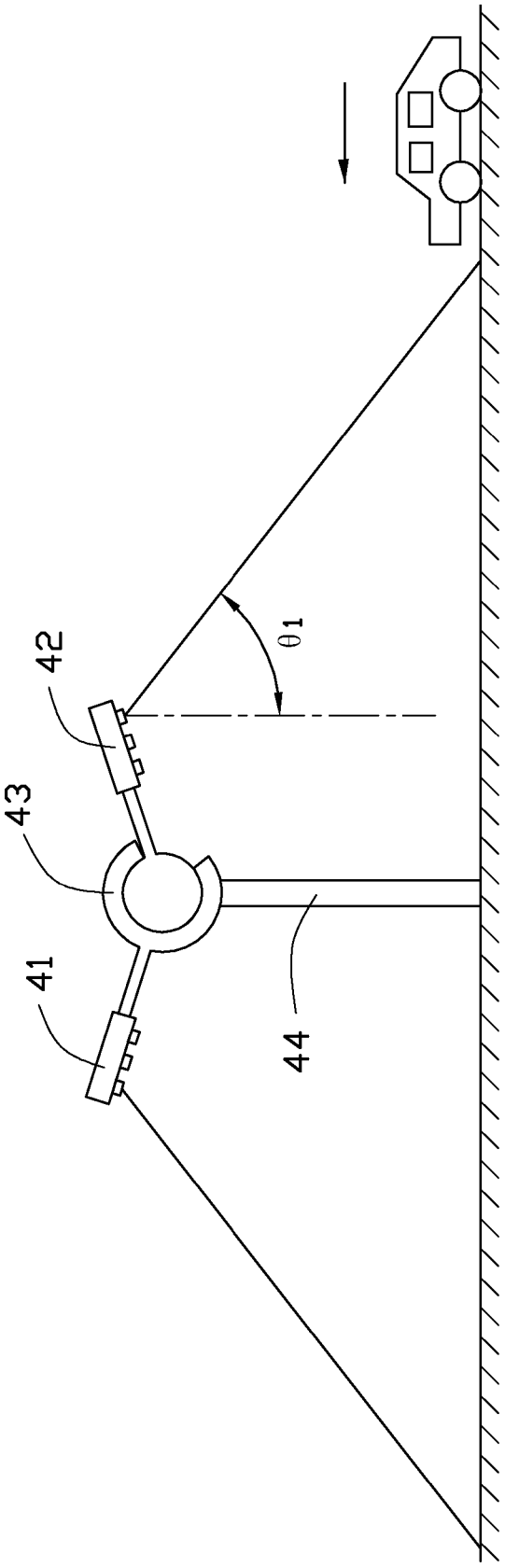

FIG. 11

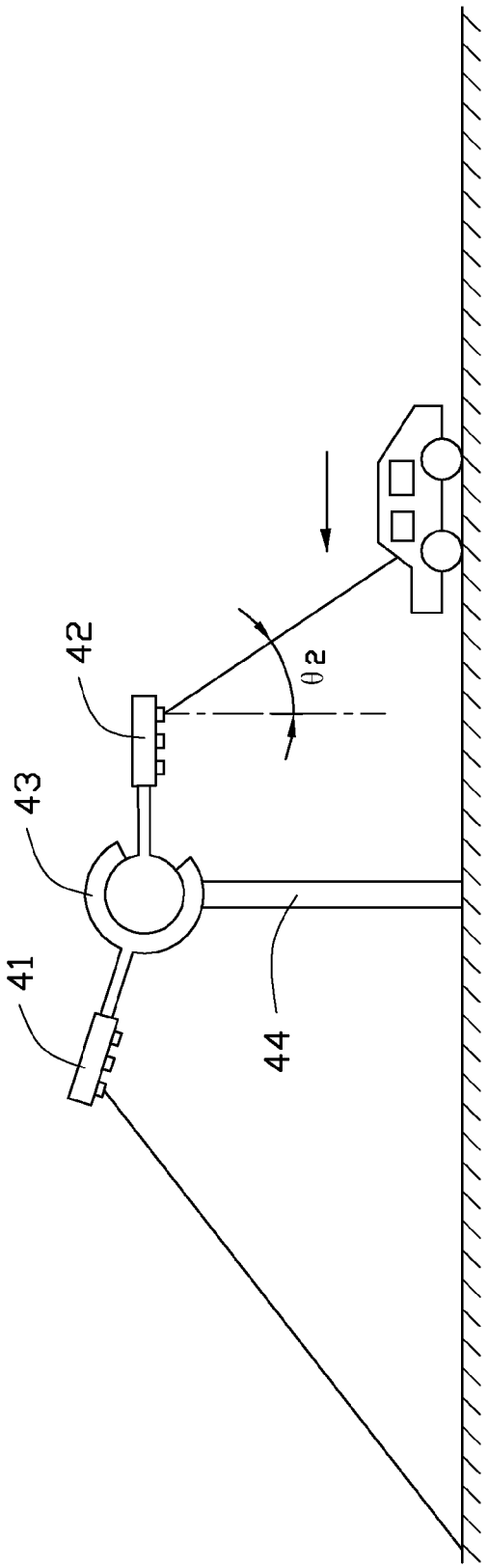

FIG. 12

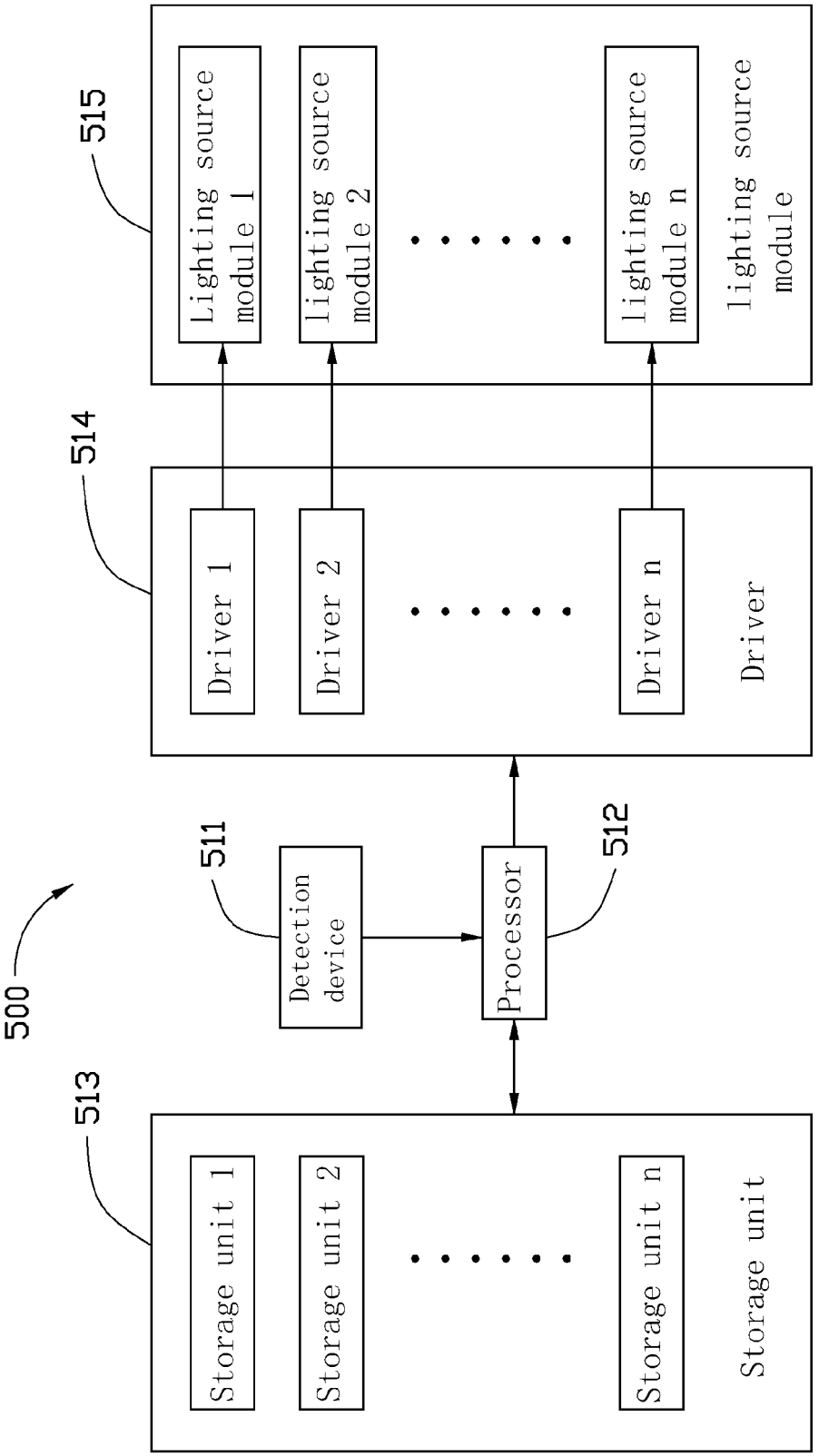
500
513
Storage unit 1
Storage unit 2
Storage unit n
Storage unit
511
Detection device
512
Processor
514
Driver 1
Driver 2
Driver n
Driver
515
Lighting source module 1
lighting source module 2
lighting source module n
lighting source module

FIG. 13