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VEHICLE LAMP

Abstract

A vehicle lamp includes: a light-transmitting cover; a semiconductor light-emitting element, wherein light emitted from the semiconductor light-emitting element passes through the light-transmitting cover; a pair of light-shielding walls disposed on both sides of the semiconductor light-emitting element and blocking a portion of the light emitted by the semiconductor light-emitting element; wherein a space is formed between the pair of light-shielding walls and the light-transmitting cover; the light-transmitting cover is subjected to processing for diffusing the light passing through the light-transmitting cover; and when a portion of the light emitted by the semiconductor light-emitting element is blocked by the pair of light-shielding walls and another portion of the light passes through the light-transmitting cover, a segment emission area including an outer shape defined by the pair of light-shielding walls is formed on the light-transmitting cover.

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Background/Summary

INCORPORATION BY REFERENCE

[0001] This application is based upon and claims the benefit of priority from Japanese patent application No. 2024-22549, filed on Feb. 19, 2024, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

[0002] The present disclosure relates to a vehicle lamp.

[0003] A vehicle lamp is known (for example, see Patent Literature 1) that functions as a communication lamp for the purpose of communication between a vehicle (for example, a vehicle capable of running in an autonomous driving mode) and an object (for example, a pedestrian or another vehicle) by controlling the lighting state of multiple segment emission areas.

[0004] [Patent Literature 1] Japanese Patent No. 7045993

SUMMARY

[0005] However, in the vehicle lamp described in Patent Literature 1, the relationship between the multiple reflectors used to form the multiple segment emission areas and the light-transmitting cover is unclear, and there is a problem in that adjacent segment emission areas may overlap or result in other issues, making it impossible to divide light into the intended segment emission areas and emit light from the divided segment emission areas.

[0006] The present disclosure has been made in order to solve such problem, and it is an object of the present disclosure to provide a vehicle lamp that, without using additional components (e.g., reflectors or resin lenses) and with a simple configuration, can divide light into the intended segment emission areas and emit light from the divided segment emission areas.

[0007] The vehicle lamp according to the present disclosure includes: a light-transmitting cover; a semiconductor light-emitting element, wherein light emitted from the semiconductor light-emitting element passes through the light-transmitting cover; a pair of light-shielding walls disposed on both sides of the semiconductor light-emitting element and blocking a portion of the light emitted by the semiconductor light-emitting element; wherein a space is formed between the pair of light-shielding walls and the light-transmitting cover; the light-transmitting cover is subjected to processing for diffusing the light passing through the light-transmitting cover; and when a portion of the light emitted by the semiconductor light-emitting element is blocked by the pair of light-shielding walls and another portion of the light passes through the light-transmitting cover, a segment emission area including an outer shape defined by the pair of light-shielding walls is formed on the light-transmitting cover.

[0008] With such a configuration, it is possible to divide light into the intended segment emission areas and emit light from the divided segment emission areas without using multiple reflectors and with a simple configuration.

[0009] Also, in the above-described vehicle lamp, the semiconductor light-emitting element may be a light source with a Lambertian luminous intensity distribution, and the height of the pair of light-shielding walls may be set to block light emitted by the semiconductor light-emitting element within an angular range greater than the half-value angle.

[0010] Also, in the above-described vehicle lamp, the distance between the outer shapes of the segment emission area, defined by the pair of light-shielding walls may be longer than the distance between the pair of light-shielding walls.

[0011] Also, in the above-described vehicle lamp, the vehicle lamp may include a plurality of combinations of the semiconductor light-emitting element and the pair of light-shielding walls, wherein the combinations may be disposed in a row in a predetermined direction.
[0012] Also, in the above-described vehicle lamp, the height of the pair of light-shielding walls may be set such that the segment emission areas are formed in a state where they do not overlap each other.
[0013] Also, in the above-described vehicle lamp, the height of the pair of light-shielding walls may be set such that no dark areas are formed between the segment emission areas, which are formed in a state where they are adjacent to each other.
[0014] Also, in the above-described vehicle lamp, the height of the pair of light-shielding walls may be set such that dark areas are formed between the segment emission areas, which are formed in a state where they are adjacent to each other.
[0015] According to the present disclosure, it is possible to provide a vehicle lamp that, without using additional components (e.g., reflectors or resin lenses) and with a simple configuration, can divide light into the intended segment emission areas and emit light from the divided segment emission areas.
[0016] The above and other objects, features and advantages of the present disclosure will become more fully understood from the detailed description given hereinbelow and the accompanying drawings.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0017] FIG. **1**A is a perspective view showing the state in which the vehicle lamp **10** mounted on the vehicle V forms a segment emission area SA;
[0018] FIG. **1**B is a perspective view showing the state in which the vehicle lamp **10** mounted on the vehicle V forms another segment emission area SA;
[0019] FIG. **2** is a perspective view of the vehicle lamp **10**;
[0020] FIG. **3** is a sectional view taken along line III-III in FIG. **2**;
[0021] FIG. **4** is an exploded perspective view of the vehicle lamp **10**;
[0022] FIG. **5** is a perspective view of the housing **30**;
[0023] FIG. **6**A is a sectional view taken along line VIA-VIA in FIG. **2**;
[0024] FIG. **6**B is a view seen in the direction of arrow AR**1** in FIG. **6**A;
[0025] FIG. **7**A shows an example of the segment emission area SA when the height H**1** of the light-shielding walls **32** (**32***a* and **32***b*) is adjusted to 5.37 mm;
[0026] FIG. **7**B shows an example of the segment emission area SA when the height H**1** of the light-shielding walls **32** (**32***a* and **32***b*) is adjusted to 6.07 mm;
[0027] FIG. **8**A is an example of segment emission areas SA (multiple);
[0028] FIG. **8**B is another example of segment emission areas SA (multiple);
[0029] FIG. **9** is a diagram illustrating the lighting modes used in the experiments; and
[0030] FIG. **10** is a table summarizing the experimental results (measured results) for each lighting mode and for each height of the light-shielding walls.
DESCRIPTION OF EMBODIMENTS
[0031] Hereinafter, a vehicle lamp **10** according to an embodiment of the present disclosure is described below with reference to the accompanying drawings. In the drawings, corresponding components are denoted by the same reference numerals, and the repetitive description is omitted.
[0032] FIG. **1**A is a perspective view showing the state in which the vehicle lamp **10** mounted on the vehicle V forms a segment emission area SA. FIG. **1**B is a perspective view showing the state in which the vehicle lamp **10** mounted on the vehicle V forms another segment emission area SA.

FIG. **2** is a perspective view of the vehicle lamp **10**.
[0033] As shown in FIGS. **1**A and **1**B, the vehicle lamp **10** is a communication lamp that informs the state (for example, the driving control state of the vehicle V) of the vehicle V (for example, a vehicle capable of running in an autonomous driving mode) on which the vehicle lamp **10** is mounted to the outside (for example, a pedestrian U) of the vehicle V. This is achieved by forming the segment emission area SA which is selectively turned on and off as appropriate.
[0034] As shown in FIG. **2**, the vehicle lamp **10** is configured to be long and narrow. The vehicle lamp **10** is mounted in a position visible from outside the vehicle V, for example, on the sides (left side and right side) of the vehicle V. At that time, the vehicle lamp **10** is mounted **20** such that its longitudinal direction matches the front-rear direction of the vehicle. The vehicle lamp **10** mounted on the left and right sides are symmetrical in structure. Therefore, the following description will focus on the vehicle lamp **10** mounted on the left side (the left side when facing the front of the vehicle) as a representative.
[0035] FIG. **3** is a sectional view taken along line III-III in FIG. **2**. FIG. **4** is an exploded perspective view of the vehicle lamp **10**.
[0036] As shown in FIGS. **3** and **4**, the vehicle lamp **10** includes an outer **30** lens **20**, a housing **30**, a substrate **40** on which a semiconductor light-emitting element **41** is mounted, a heat dissipation sheet **50**, and a case **60**.
[0037] The outer lens **20** is a long and narrow light-transmitting cover made of transparent resin, such as acrylic or polycarbonate. The outer lens **20** includes a light-transmitting part **21** and a light-non-transmitting part **22**.
[0038] The light-transmitting part **21** is a portion through which light emitted by the semiconductor light-emitting element **41** passes. The light-transmitting part **21** is provided in the range indicated by reference sign A**1** in FIG. **3**. At least one of the front and rear surfaces of the light-transmitting part **21** is subjected to processing for diffusing light transmitting through the light-transmitting part **21**, for example, coating for giving a frosted glass appearance to at least one of the front and rear surfaces. Alternatively, the processing for diffusing light passing through the light-transmitting part **21** may employ texturing, a diffusion sheet, or similar methods instead of the coating.
[0039] The light-non-transmitting part **22** is provided so as to surround the light-transmitting part **21**. The light-non-transmitting part **22** is provided in the ranges indicated by reference signs A**2** and A**3** in FIG. **3**. The light-non-transmitting part **22** is provided to cover and conceal the internal structure of the vehicle lamp **10**, preventing it from being visible from the outside. For example, the light-non-transmitting part **22** is formed by applying a black or other light-non-transmitting color coating to at least one of the front and rear surfaces of the outer lens **20**.
[0040] FIG. **5** is a perspective view of the housing **30**.
[0041] As shown in FIG. **5**, the housing **30** includes a housing body **31** and light-shielding walls **32** (a pair of light-shielding walls **32***a* and **32***b*). The housing body **31** and the light-shielding walls **32** (**32***a* and **32***b*) are integrally molded. Alternatively, the housing **30** may be configured by combining a separately formed housing body **31** and the light-shielding walls **32** (**32***a* and **32***b*). The housing **30** is made, for example, of black synthetic resin (for example, polypropylene containing carbon).
[0042] The housing body **31** is formed to be long and narrow, corresponding to the long and narrow outer lens **20** (see FIG. **4**). A plurality of rectangular through-holes H.sub.31 are formed in a row in the housing body **31** at predetermined intervals along the longitudinal direction of the housing body **31**. The through-holes H.sub.31 penetrate the front and rear surfaces of the housing body **31**. Each semiconductor light-emitting element **41** mounted on the substrate **40** disposed behind the housing body **31** is exposed through the respective through-holes H.sub.31.
[0043] The light-shielding walls **32** (**32***a* and **32***b*) are provided on the front surface of the housing body **31** (see FIG. **5**). Specifically, the light-shielding walls **32** (**32***a* and **32***b*) are plate-like parts with a thickness T**1** (see FIG. **5**) in the longitudinal direction of the housing body **31** and are

provided on both sides of the through-hole H.sub.31 with respect to the longitudinal direction of the housing body **31**. The light-shielding walls **32** (**32***a* and **32***b*) are an example of the pair of light-shielding walls in the present disclosure.

[0044] The combination of the through-hole H.sub.31 and the light-shielding walls **32** (**32***a* and **32***b*), configured as described above, is disposed in a row at predetermined intervals along the longitudinal direction of the housing body **31**.

[0045] FIG. **6**A is a sectional view taken along line VIA-VIA in FIG. **2**.

[0046] As shown in FIG. **6**A, a space S**1** is formed between the outer lens **20** (light-transmitting part **21**) and the light-shielding walls **32** (**32**a and **32***b*). As a result, it is possible to make the distance Ll between the outer shapes of the segment emission area SA, defined by the light-shielding walls **32***a* and **32***b*, longer than the distance L**4** between the light-shielding walls **32***a* and **32***b*.

[0047] The substrate **40** is formed to be long and narrow, corresponding to the long and narrow housing **30** (see FIG. **4**). The substrate **40** is attached to the case **60** in a state where the rear surface, opposite to the front surface on which the semiconductor light-emitting element **41** is mounted, faces the front surface of the metal case **60** (for example, made of aluminum) (see FIG. **3**). The heat dissipation sheet **50** (thermal conductive sheet) is provided between the rear surface of the substrate **40** and the front surface of the case **60** to enhance the adhesion between the substrate and the case and reduce thermal contact resistance. Note that instead of the heat dissipation sheet **50**, other TIMs (Thermal Interface Materials), such as thermal grease or thermal conductive adhesive, may also be used.

[0048] The semiconductor light-emitting element **41** is a light source with a Lambertian luminous intensity distribution, and is, for example, an LED emitting amber light. Note that the emission color of the semiconductor light-emitting element **41** may be other than amber. The semiconductor light-emitting element **41** has a light-emitting surface (for example, a rectangular light-emitting surface of 1 mm square). The semiconductor light-emitting elements **41** are disposed in a row at predetermined intervals along the longitudinal direction of the substrate **40**. The substrate **40** is disposed behind the housing **30** and fixed to the case **60** in a state where each semiconductor light-emitting element **41** is exposed through the respective through-hole H.sub.31, that is, in a state where the semiconductor light-emitting elements **41** (light-emitting surfaces) exposed through the respective through-holes H.sub.31 and the outer lens **20** (light-transmitting part **21**) face each other (see FIG. **3**).

[0049] Next, the segment emission area SA will be described.

[0050] FIG. **6**A is a diagram showing the state where the segment emission area SA is formed on the outer lens **20** (light-transmitting part **21**) by lighting the semiconductor light-emitting element **41**. FIG. **6**B is a view seen in the direction of arrow AR**1** in FIG. **6**A. In FIGS. **6**A and **6**B, the hatched area indicated by reference sign SA represents the segment emission area, and the hatched area indicated by reference sign SB represents the non-emitting dark area. The same applies to other figures.

[0051] When the semiconductor light-emitting element **41** is turned on, a portion of the light emitted by the semiconductor light-emitting element **41** (for example, light within angles θ**1** and θ**2** in FIG. **6**A, which is relatively weaker in intensity) is blocked by the light-shielding walls **32** (**32***a* and **32***b*), while another portion of the light (for example, light within angle θ**3** in FIG. **6**A, which is relatively stronger in intensity) passes through the outer lens **20** (light-transmitting part **21**). At that time, since the outer lens **20** (light-transmitting part **21**) is subjected to processing for diffusing light passing through the light-transmitting part **21**, when another portion of the light (relatively stronger in intensity) passes through the outer lens **20** (light-transmitting part **21**), a segment emission area SA is formed on the outer lens **20** (light-transmitting part **21**).

[0052] As shown in FIG. **6**B, the segment emission area SA is a rectangular area with a length L**1** in the longitudinal direction and a width W**1** in the lateral direction. The outer shape of the segment

emission area SA is a shape defined by the light-shielding walls **32** (**32***a* and **32***b*), which, in this case, includes two straight-line shapes CL.sub.SA1 and CL.sub.SA2 (light-dark boundary lines) extending in the lateral direction. In addition, the outer shape of the segment emission area SA is a shape defined by the light-non-transmitting part **22** which is provided to surround the light-transmitting part **21**, which, in this case, includes two straight-line shapes L.sub.SA1 and L.sub.SA2 extending in the longitudinal direction. In this way, the segment emission area SA is formed as an area (in this case, a rectangular area) enclosed by the two straight-line shapes CL.sub.SA1 and CL.sub.SA2 and the two straight-line shapes L.sub.SA1 and L.sub.SA2.

[0053] The length L**1** of the segment emission area SA in the longitudinal direction can be adjusted by adjusting the height H**1** of the light-shielding walls **32** (**32***a* and **32***b*).

[0054] FIG. **6**A shows an example of the segment emission area SA when the height H**1** of the light-shielding walls **32** (**32***a* and **32***b*) is adjusted to 4.67 mm. FIG. **7**A shows an example of the segment emission area SA when the height H**1** of the light-shielding walls **32** (**32***a* and **32***b*) is adjusted to 5.37 mm. FIG. **7**B shows an example of the segment emission area SA when the height H**1** of the light-shielding walls **32** (**32***a* and **32***b*) is adjusted to 6.07 mm.

[0055] Referring to FIGS. **6**, **7**A, and **7**B, it can be observed that as the height H**2** of the light-shielding walls **32** (**32***a* and **32***b*) increases, the length L**1** of the segment emission area SA in the longitudinal direction decreases.

[0056] FIG. **8**A is an example of segment emission areas SA (multiple), and FIG. **8**B is another example of segment emission areas SA (multiple).

[0057] For example, by adjusting the height H**2** of the light-shielding walls **32** (**32***a* and **32***b*), as shown in FIG. **8**A, it is possible to form multiple segment emission areas SA in a state where they are adjacent to each other without gaps (dark areas SB) and without overlapping each other. Additionally, by adjusting the height H**2** of the light-shielding walls **32** (**32***a* and **32***b*), as shown in FIG. **8**B, it is also possible to form multiple segment emission areas SA in a state where they are adjacent to each other with gaps (dark areas SB) in between.

[0058] The height H**2** of the light-shielding walls **32** (**32***a* and **32***b*) is desirably set to block light emitted by the semiconductor light-emitting element **41** within an angular range greater than the half-value angle (for example, the range of angles θ**1** and θ**2** in FIG. **6**A). In this way, it is possible to form a brighter segment emission area SA.

[0059] Next, the experimental results conducted by the inventors of the present invention will be described.

[0060] FIG. **9** is diagrams illustrating the lighting modes used in the experiments.

[0061] In the experiment, in a darkroom, the luminance and contrast at measurement point pl were measured using a luminance meter **70** each time the semiconductor light-emitting elements **41** disposed at different positions were turned on in the lighting modes shown in FIGS. **9** (*a*) to **9** (*d*). In FIG. **9**, the semiconductor light-emitting elements **41** filled in black indicate that they are turned on, while the semiconductor light-emitting elements **41** filled in white indicate that they are turned off. As shown in FIG. **9** (*a*), measurement point pl is the location where the optical axis AX.sub.41 of a specific semiconductor light-emitting element **41** intersects the outer lens **20** (light-transmitting part **21**). The distance H**2** between the outer lens **20** (light-transmitting part **21**) and the semiconductor light-emitting element **41** is 14.5 mm, and the distance L**2** between the optical axis AX.sub.41 of the semiconductor light-emitting element **41** and the light-shielding walls **32** (**32***a* and **32***b*) is 3 mm. The luminance meter **70** was disposed at a position separated by a distance H**3** in the normal direction from measurement point pl. The distance H**3** is 600 mm.

[0062] FIG. **10** is a table summarizing the experimental results (measured results) for each lighting mode and for each height of the light-shielding walls.

[0063] Referring to FIG. **10**, it can be observed that as the height H**2** of the light-shielding walls **32** (**32***a* and **32***b*) increases, the contrast improves.

[0064] The segment emission area SA may be formed to move from the rear side to the front side

of the vehicle (or in the reverse direction) by controlling the on/off states of each semiconductor light-emitting element **41** (see arrow AR**2** in FIG. **1**A). The segment emission area SA and the dark areas SB may also be formed to alternate continuously (see FIG. **1**B). Furthermore, the segment emission area SA may be formed in various other patterns.

[0065] As described above, according to this embodiment, it is possible to divide light into the intended segment emission areas and emit light from the divided segment emission areas without using additional components (e.g., reflectors or resin lenses) and with a simple configuration (light-shielding walls **32** (**32***a* and **32***b*)). In this case, it is also possible to achieve high efficiency and higher contrast in the segment emission areas SA.

[0066] The numerical values described in the above-described embodiments are all illustrative, and appropriate numerical values different from the numerical values described in the above-described embodiments can be used as a matter of course.

[0067] The above-described embodiments are merely illustrative in all aspects.

[0068] The present disclosure is not limitedly interpreted by the description of the above-described embodiments. The present disclosure can be implemented in other various forms without departing from the spirit or main features of the present disclosure.

Claims

1. A vehicle lamp comprising: a light-transmitting cover; a semiconductor light-emitting element, wherein light emitted from the semiconductor light-emitting element passes through the light-transmitting cover; a pair of light-shielding walls disposed on both sides of the semiconductor light-emitting element and blocking a portion of the light emitted by the semiconductor light-emitting element; wherein a space is formed between the pair of light-shielding walls and the light-transmitting cover; the light-transmitting cover is subjected to processing for diffusing the light passing through the light-transmitting cover; and when a portion of the light emitted by the semiconductor light-emitting element is blocked by the pair of light-shielding walls and another portion of the light passes through the light-transmitting cover, a segment emission area including an outer shape defined by the pair of light-shielding walls is formed on the light-transmitting cover.

2. The vehicle lamp according to claim 1, wherein the semiconductor light-emitting element is a light source with a Lambertian luminous intensity distribution, and the height of the pair of light-shielding walls is set to block light emitted by the semiconductor light-emitting element within an angular range greater than the half-value angle.

3. The vehicle lamp according to claim 1, wherein the distance between the outer shapes of the segment emission area, defined by the pair of light-shielding walls is longer than the distance between the pair of light-shielding walls.

4. The vehicle lamp according to claim 1, further comprising a plurality of combinations of the semiconductor light-emitting element and the pair of light-shielding walls, wherein the combinations are disposed in a row in a predetermined direction.

5. The vehicle lamp according to claim 4, wherein the height of the pair of light-shielding walls is set such that the segment emission areas are formed in a state where they do not overlap each other.

6. The vehicle lamp according to claim 4, wherein the height of the pair of light-shielding walls is set such that no dark areas are formed between the segment emission areas, which are formed in a state where they are adjacent to each other.

7. The vehicle lamp according to claim 4, wherein the height of the pair of light-shielding walls is set such that dark areas are formed between the segment emission areas, which are formed in a state where they are adjacent to each other.