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BACKLIGHT AND DISPLAY DEVICE

Abstract

A backlight includes: a light guide plate a first prism surface, the first prism surface including first grooves, the first grooves being adjacent in a first direction and extending in a second direction, the first direction and the second direction being perpendicular; and a prism sheet overlapping with the light guide plate, the prism sheet including a second prism surface directly facing the first prism surface, and a flat surface on a side opposite to the second prism surface, the second prism surface including second grooves, the second grooves being adjacent in the first direction and extending in the second direction. In light distribution characteristics on a first vertical plane spreading in the first direction and a vertical direction that is perpendicular to both the first direction and the second direction, peaks of luminous intensity are observed in two directions excluding the vertical direction.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority from Japanese patent application JP2024-021937 filed on Feb. 16, 2024, the contents of which are hereby incorporated by reference into this application.

BACKGROUND

1. Field

[0002] This disclosure relates to a backlight and a display device.

2. Description of the Related Art

[0003] A display capable of separating light to the left and right to present different images in two directions is known (JP2008-538154A). To enable such a display, a backlight with a light distribution characteristic featuring luminance peaks in two directions is required.

[0004] In edge-lit backlights, where light enters through the end face of a light guide plate, further improvements in luminance are anticipated.

SUMMARY

[0005] This disclosure aims to improve luminance in two directions.

[0006] A backlight includes: a light source; a light guide plate including an end face that serves as an incident surface of light from the light source, and a first prism surface that serves as an emission surface of the light, the first prism surface including first grooves, the first grooves being adjacent in a first direction and extending in a second direction, the first direction and the second direction being perpendicular; and a prism sheet overlapping with the light guide plate, the prism sheet including a second prism surface directly facing the first prism surface, and a flat surface on a side opposite to the second prism surface, the second prism surface including second grooves, the second grooves being adjacent in the first direction and extending in the second direction, wherein, in light distribution characteristics on a first vertical plane spreading in the first f direction and a vertical direction that is perpendicular to both the first direction and the second direction, peaks of luminous intensity are observed in two directions excluding the vertical direction.

[0007] A display device includes: the backlight, and a display panel in an arrangement that enables incidence of the light emitted from the backlight into a rear.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a plan view of a backlight according to an embodiment.

[0009] FIG. **2** is a sectional view taken along line II-II of the backlight in FIG. **1**.

[0010] FIG. **3** is an enlarged partial view of a light guide plate and a prism sheet.

[0011] FIG. **4** is a sectional view taken along line IV-IV of the backlight in FIG. **1**.

[0012] FIG. **5** is a light distribution characteristic diagram of the backlight according to the embodiment.

[0013] FIG. **6** is a sectional view of a backlight according to related art.

[0014] FIG. **7** is a light distribution characteristic diagram of light emitted from a light guide plate in related art.

[0015] FIG. **8** is a light distribution characteristic diagram of light emitted from a diffusion sheet in related art.

[0016] FIG. **9** is an enlarged partial view of a backlight according to a modification of the embodiment.
[0017] FIG. **10** is a schematic diagram of a display device according to the present embodiment.
DETAILED DESCRIPTION
[0018] Hereinafter, some embodiments will be described with reference to the drawings. Here, the invention can be embodied according to various aspects within the scope of the invention without departing from the gist of the invention and is not construed as being limited to the content described in the embodiments exemplified below.
[0019] The drawings are further schematically illustrated in widths, thickness, shapes, and the like of units than actual forms to further clarify description in some cases but are merely examples and do not limit interpretation of the invention. In the present specification and the drawings, the same reference numerals are given to elements having the same functions described in the previously described drawings, and the repeated description will be omitted.
[0020] Further, in the detailed description, “on” or “under” in definition of positional relations of certain constituents, and other constituents includes not only a case in which a constituent is located just on or just under a certain constituent but also a case in which another constituent is interposed between constituents unless otherwise mentioned.
[0021] FIG. **1** is a plan view of a backlight according to an embodiment. FIG. **2** is a sectional view taken along line II-II of the backlight in FIG. **1**. A backlight **10** includes a light source **12** (e.g., laser). The light source **12** includes a pair of light sources **12**. The light source **12** is configured to emit light. A first group of light sources **12**A are arranged in a first direction D**1**, and a second group of light sources **12**B are arranged in the first direction D**1**. There is a gap in a second direction D**2**, which is perpendicular to the first direction D**1**, between the first group of light sources **12**A and the second group of light sources **12**B.
[0022] The backlight **10** includes a light guide plate **14**. The light guide plate **14** includes an end face **16** that serves as an incident surface of light from the light source **12**. The backlight **10** employs an edge-lit (side-lit) configuration. The light source **12** is adjacent to the light guide plate **14** in the second direction D**2**. A pair of light sources **12** are adjacent to both sides of the light guide plate **14** in the second direction D**2**. This configuration allows light to enter from opposite directions, thereby reducing luminance unevenness caused by differences in distance from the light source **12**. A reflective sheet **20** is provided on the back side of the light guide plate **14** to direct light toward the emission surface.
[0023] The light guide plate **14** includes a first prism surface **26**, which serves as a light emission surface. The first prism surface **26** includes first grooves **28**. The first grooves **28** are adjacent in the first direction D**1** and extend in the second direction D**2**. Each first groove **28** is a V-groove.
[0024] The backlight **10** includes a prism sheet **30**. The prism sheet **30** overlaps with the light guide plate **14**. No diffusion sheet is interposed between the prism sheet **22** and the light guide plate **14**. The prism sheet **30** includes a second prism surface **32** directly facing the first prism surface **26**. The second prism surface **32** includes second grooves **34**. The second grooves **34** are adjacent in the first direction D**1** and extend in the second direction D**2**. Each second groove **34** is a V-groove. The prism sheet **30** includes a flat surface **36** on the side opposite to the second prism surface **32**.
[0025] FIG. **3** is an enlarged partial view of the light guide plate **14** and the prism sheet **30**. Each first groove **28** includes a pair of first inclined surfaces **38**. The pair of first inclined surfaces **38** are of plane-symmetry. The reference plane of the plane-symmetry is a second vertical plane P**2**, which spreads in the vertical direction VD and the second direction D**2**. Each second groove **34** includes a pair of second inclined surfaces **40**. The pair of second inclined surfaces **40** are of plane-symmetry. The reference plane of the plane-symmetry is the second vertical plane P**2**, which spreads in the vertical direction VD and the second direction D**2**. A first external angle α**1** (e.g., 120 degrees) between the pair of first inclined surfaces **38** is equal to or greater than a second external angle α**2** (e.g., 90 degrees) between the pair of second inclined surfaces **40**.

[0026] The first prism surface **26** includes a first ridge portion **42** between an adjacent pair of the first grooves **28**. The first internal angle β**1** of the first ridge portion **42** is equal to the first external angle α**1**. The second prism surface **32** includes a second ridge portion **44** between an adjacent pair of the second grooves **34**. The second internal angle β**2** of the second ridge portion **44** is equal to the second external angle α**2**.
[0027] FIG. **4** is a sectional view taken along line IV-IV of the backlight **10** in FIG. **1**. The backlight **10** includes an optical sheet **46** (e.g., prism sheet). The optical sheet **46** includes a bottom surface **48** directly facing the flat surface **36** of the prism sheet **30**.
[0028] The optical sheet **46** includes a third prism surface **50** on the side opposite to the bottom surface **48**. The third prism surface **50** includes third grooves **52**. The third grooves **52** extend in the first direction D**1** and are adjacent in the second direction D**2**. The backlight **10** includes a dual brightness enhancement film **54** directly facing the third prism surface **50** of the optical sheet **46**.
[0029] FIG. **5** is a light distribution characteristic diagram of the backlight **10** according to the embodiment. In the light distribution characteristics on the first vertical plane P**1** spreading in the vertical direction VD and the first direction D**1** as shown in FIG. **2**, peaks of luminous intensity are observed in two directions excluding the vertical direction VD. The angle in the vertical direction VD is 0 degrees. The angles in the two directions are +30 degrees or more and −30 degrees or less.
[0030] FIG. **6** is a sectional view of a backlight according to related art. The light guide plate **60** includes no first prism surface, but a diffusion sheet **56** is added between the light guide plate **60** and the prism sheet **30**. The other components are the same as those of the embodiment. When the second external angle α**2** of the prism sheet **30** is set to 90 degrees, the backlight of related art achieves the highest luminous intensity peak.
[0031] FIG. **7** is a light distribution characteristic diagram of light emitted from the light guide plate **60** in related art. The luminous intensity of light emitted from the light guide plate **60** is uniform over a range of +30 degrees or more.
[0032] FIG. **8** is a light distribution characteristic diagram of light emitted from a diffusion sheet **56** in related art. The luminous intensity of light emitted from the diffusion sheet **56** is highest near 0 degrees.
[0033] In contrast, the backlight **10** according to the embodiment, where there is no diffusion sheet **56** but the light guide plate **14** includes the first prism surface **26**, achieves peaks of luminous intensity in two directions, as shown in FIG. **5**, improving luminance in the two directions.
[0034] In simulations where the second external angle α**2** was set to 90 degrees and the first external angle α**1** was set to 80, 90, 100, 110, 120, and 130 degrees, the luminous intensities of the embodiment were 1.17, 1.16, 1.15, 1.15, 1.18, and 1.15, respectively, when the luminous intensity was 1.0 in related art.
[0035] FIG. **9** is an enlarged partial view of a backlight according to a modification of the embodiment. The first prism surface **126** of the light guide plate **114** includes a first ridge portion **142** with a rounded apex between an adjacent pair of the first grooves **128**. The rounding is, for example, an arc with a radius of 5 μm.
[0036] In simulations where the second external angle α**2** was set to 90 degrees and the first external angles α**1** were set to 90 and 120 degrees, the luminous intensities of the embodiment were 1.11 and 1.12, respectively, when the luminous intensity was 1.0 in related art.
[0037] FIG. **10** is a schematic diagram of a display device according to the embodiment. The display device includes the backlight **10**. The display device includes a display panel **58** (e.g., liquid crystal display panel) in an arrangement that enables incidence of the light emitted from the backlight **10** into a rear.
Outline of the Embodiment
[0038] (1) A backlight **10** comprising: a light source **12**; a light guide plate **14** including an end face **16** that serves as an incident surface of light from the light source **12**, and a first prism surface **26** that serves as an emission surface of the light, the first prism surface **26** including first grooves **28**,

the first grooves **28** being adjacent in a first direction D**1** and extending in a second direction D**2**, the first direction D**1** and the second direction D**2** being perpendicular; and a prism sheet **30** overlapping with the light guide plate **14**, the prism sheet **30** including a second prism surface **32** directly facing the first prism surface **26**, and a flat surface **36** on a side opposite to the second prism surface **32**, the second prism surface **32** including second grooves **34**, the second grooves **34** being adjacent in the first direction D**1** and extending in the second direction D**2**, wherein, in light distribution characteristics on a first vertical plane P**1** spreading in the first direction D**1** and a vertical direction VD that is perpendicular to both the first direction D**1** and the second direction D**2**, peaks of luminous intensity are observed in two directions excluding the vertical direction VD.
[0039] The first prism surface **26** reduces light in the vertical direction VD and improves luminance in the two directions. [0040] (2) The backlight **10** according to (1), wherein each of the first grooves **28** and the second grooves **34** is a V-groove. [0041] (3) The backlight **10** according to (1), wherein each of the first grooves **28** includes a pair of first inclined surfaces **38**, and each of the second grooves **34** includes a pair of second inclined surfaces **40**. [0042] (4) The backlight **10** according to (3), wherein the pair of first inclined surfaces **38** are of plane-symmetry, the pair of second inclined surfaces **40** are of plane-symmetry, and a reference plane of the plane-symmetry is a second vertical plane P**2** spreading in the vertical direction VD and the second direction D**2**.
[0043] (5) The backlight **10** according to (3), wherein a first external angle α**1** between the pair of first inclined surfaces **38** is equal to or greater than a second external angle α**2** between the pair of second inclined surfaces **40**. [0044] (6) The backlight **10** according to (5), wherein the first external angle α**1** is 90 degrees, and the second external angle α**2** is 120 degrees. [0045] (7) The backlight **10** according to (1), wherein the light source **12** is adjacent to the light guide plate **14** in the second direction D**2**. [0046] (8) The backlight **10** according to (7), wherein the light source **12** includes a pair of light sources **12**, and the pair of light sources **12** are adjacent to both sides of the light guide plate **14** in the second direction D**2**. [0047] (9) The backlight **10** according to (1), further comprising an optical sheet **46**, the optical sheet **46** including a bottom surface **48** directly facing the flat surface **36** of the prism sheet **30**, the optical sheet **46** including a third prism surface **50** on a side opposite to the bottom surface **48**, the third prism surface **50** including third grooves **52**, the third grooves **52** extending in the first direction D**1** and being adjacent in the second direction D**2**.
[0048] (10) The backlight **10** according to (9), further comprising a dual brightness enhancement film **54** directly facing the third prism surface **50** of the optical sheet **46**. [0049] (11) The backlight **10** according to (1), wherein the first prism surface **126** of the light guide plate **114** includes a rounded ridge portion **142** at a peak between an adjacent pair of the first grooves **128**. [0050] (12) The backlight **10** according to (1), wherein an angle in the vertical direction VD is 0 degrees, and angles in the two directions are an angle of +30 degrees or more and an angle of −30 degrees or less. [0051] (13) A display device comprising: the backlight **10** according to any one of (1) to (12), and a display panel **58** in an arrangement that enables incidence of the light emitted from the backlight **10** into a rear.
[0052] The embodiments described above are not limited and different variations are possible. The structures explained in the embodiments may be replaced with substantially the same structures and other structures that can achieve the same effect or the same objective.

Claims

1. A backlight comprising: a light source; a light guide plate including an end face that serves as an incident surface of light from the light source, and a first prism surface that serves as an emission surface of the light, the first prism surface including first grooves, the first grooves being adjacent in a first direction and extending in a second direction, the first direction and the second direction being perpendicular; and a prism sheet overlapping with the light guide plate, the prism sheet including a second prism surface directly facing the first prism surface, and a flat surface on a side

opposite to the second prism surface, the second prism surface including second grooves, the second grooves being adjacent in the first direction and extending in the second direction, wherein, in light distribution characteristics on a first vertical plane spreading in the first direction and a vertical direction that is perpendicular to both the first direction and the second direction, peaks of luminous intensity are observed in two directions excluding the vertical direction.

2. The backlight according to claim 1, wherein each of the first grooves and the second grooves is a V-groove.

3. The backlight according to claim 1, wherein each of the first grooves includes a pair of first inclined surfaces, and each of the second grooves includes a pair of second inclined surfaces.

4. The backlight according to claim 3, wherein the pair of first inclined surfaces are of plane-symmetry, the pair of second inclined surfaces are of plane-symmetry, and a reference plane of the plane-symmetry is a second vertical plane spreading in the vertical direction and the second direction.

5. The backlight according to claim 3, wherein a first external angle between the pair of first inclined surfaces is equal to or greater than a second external angle between the pair of second inclined surfaces.

6. The backlight according to claim 5, wherein the first external angle is 90 degrees, and the second external angle is 120 degrees.

7. The backlight according to claim 1, wherein the light source is adjacent to the light guide plate in the second direction.

8. The backlight according to claim 7, wherein the light source includes a pair of light sources, and the pair of light sources are adjacent to both sides of the light guide plate in the second direction.

9. The backlight according to claim 1, further comprising an optical sheet, the optical sheet including a bottom surface directly facing the flat surface of the prism sheet, the optical sheet including a third prism surface on a side opposite to the bottom surface, the third prism surface including third grooves, the third grooves extending in the first direction and being adjacent in the second direction.

10. The backlight according to claim 9, further comprising a dual brightness enhancement film directly facing the third prism surface of the optical sheet.

11. The backlight according to claim 1, wherein the first prism surface of the light guide plate includes a rounded ridge portion at a peak between an adjacent pair of the first grooves.

12. The backlight according to claim 1, wherein an angle in the vertical direction is 0 degrees, and angles in the two directions are an angle of +30 degrees or more and an angle of −30 degrees or less.

13. A display device comprising: the backlight according to claim 1, and a display panel in an arrangement that enables incidence of the light emitted from the backlight into a rear.