DISPLAY DEVICE, DISPLAY METHOD AND HEAD-UP DISPLAY

A display device, generating light flux containing image information and making the light flux incident to one-eye of an image viewer by controlling an angle of divergence of the light flux, or a display device including: a light flux generation unit configured to generate light flux containing image information; a field of view control unit configured to make the light flux incident to one-eye of an image viewer; and an image formation unit configured to form an image based on the light flux, the image formation unit including an optical element nearest to the one-eye of constituent optical elements, which is placed apart from the one-eye by 21.7 cm or more is provided.
AMENDED CLAIMS
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[1] (Amended) A display device, generating light flux containing image information and making the light flux incident to one-eye of an image viewer by controlling an angle of divergence of the light flux, the device comprising a first lens, a second lens and an angle of divergence control device provided between the first lens and the second lens, the angle of divergence control device being configured to control the angle of divergence of the light flux.

[2] The device according to claim 1, wherein a distance between an optical element nearest to the one-eye of optical elements included in the display device and the one-eye is 21.7 cm or more.

[3] The device according to claim 1, wherein a distance between an optical element nearest to the one-eye of optical elements included in the display device and the one-eye is 25.5 cm or more.

[4] The device according to claim 1, wherein a distance between an optical element nearest to the one-eye of optical elements included in the display device and the one-eye is 63.4 cm or more.

[5] (Amended) A display device comprising:
   a light flux generation unit configured to generate light flux containing image information;
   a field of view control unit configured to make the light flux incident to one-eye of an image viewer; and
   an image formation unit configured to form an image based on the light flux, the image formation unit including an optical element nearest to the one-eye of constituent optical elements, which is placed apart from the one-eye by 21.7 cm or more,
   at least one of the field of view control unit and the image formation unit including a first lens, a second lens and an angle of divergence control device provided between the first lens and the second lens, the angle of divergence control device being configured to control the angle of divergence of the light flux.

[6] The device according to claim 5, wherein the optical element nearest to the one-eye of constituent optical elements of the image formation unit is placed apart from the one-eye by 25.5 cm or more.

[7] The device according to claim 5, wherein the optical element nearest to the one-eye of constituent optical elements of the image formation unit is placed apart from the one-eye by 63.4 cm or more.
[8] The device according to claim 5, wherein the field of view control unit and the image formation unit include at least one selected from a group consisting of an optical structure body including a lens and an aperture, a lenticular plate, a holographic diffuser, a microlens array, a grated index type microlens, a prism sheet, a louver sheet and an optical structure body having a plurality of waveguide shaped like a top truncated triangular pyramid arrayed.

[9] The device according to claim 5, wherein the light flux generation unit includes a light source and any one of an optical element scanning the light flux generated in the light source and a light switch modulating the light flux.
[10] The device according to claim 5, further comprising:
an image pickup unit configured to image the image viewer;
an image judgment unit configured to process the image imaged by the image
pickup unit and to derive a position of the one-eye of the image viewer; and
a control unit configured to control direction of the light flux based on
information about the derived position of the one-eye by the image judgment
unit.

[11] The device according to claim 10, wherein the control unit controls at least any
of a position and an angle of optical elements included in the light flux
generation unit, the field of view control unit and the image formation unit.

[12] (Amended) A display method, generating light flux containing image
information and making the light flux incident to one-eye of an image viewer by
controlling an angle of divergence of the light flux by using a first lens, a
second lens and an angle of divergence control device provided between the first
lens and the second lens, the angle of divergence control device being
configured to control the angle of divergence of the light flux.

[13] The method according to claim 12, wherein
the image viewer is imaged,
the imaged image is processed and a position of the one-eye of the image viewer
is derived, and
the direction of the light flux is further controlled based on information about
the derived position of the one-eye.

[14] (Amended) A display method,
generating light flux containing image information, and
making the light flux incident to the one-eye by placing an optical element
nearest to one-eye of an image viewer apart from the one-eye by 21.7 cm or
more by using a first lens, a second lens and an angle of divergence control
device provided between the first lens and the second lens, the angle of
divergence control device being configured to control the angle of divergence of
the light flux.

[15] The method according to claim 14, wherein the light flux is made incident to
the one-eye by placing the optical element nearest to the one-eye of the image
viewer apart from the one-eye by 25.5 cm or more.

[16] The method according to claim 14, wherein the light flux is made incident to
the one-eye by placing the optical element nearest to the one-eye of the image
viewer apart from the one-eye by 63.4 cm or more.

[17] The method according to claim 14, wherein the display method making the
light flux incident to the one-eye includes a method controlling an angle of
divergence of the light flux using an optical system including at least one selected from a group consisting of an optical structure body including a lens and an aperture, a lenticular plate, a holographic diffuser, a microlens array, a grated index type microlens, a prism sheet, a louver sheet and an optical structure body having a plurality of waveguide shaped like a top truncated triangular pyramid arrayed.

[18] The method according to claim 14, wherein
the image viewer is imaged,
the imaged image is processed and a position of the one-eye of the image viewer is derived, and
the direction of the light flux is further controlled based on the derived position information of the one-eye.

[19] (Amended) A head-up display comprising:

a light flux projection unit configured to output light flux containing image information configured to be incident to one-eye of a driver;
an angle of divergence control mechanism configured to control an angle of divergence of the light flux, the angle of divergence control mechanism including a first lens, a second lens and an angle of divergence control device provided between the first lens and the second lens, the angle of divergence control device being configured to control the angle of divergence of the light flux; and

a transparent plate provided with a reflecting layer having the light flux projected thereon with the angle of divergence controlled by the angle of divergence control mechanism.
Brief Statement under PCT Article 19(1)

Claim 1 is amended to include features “the device comprising a first lens, a second lens and an angle of divergence control device provided between the first lens and the second lens, the angle of divergence control device being configured to control the angle of divergence of the light flux”.

Claim 5 is amended to include features “at least one of the field of view control unit and the image formation unit including a first lens, a second lens and an angle of divergence control device provided between the first lens and the second lens, the angle of divergence control device being configured to control the angle of divergence of the light flux”.

Claim 12 is amended to include features “by using a first lens, a second lens and an angle of divergence control device provided between the first lens and the second lens, the angle of divergence control device being configured to control the angle of divergence of the light flux”.

Claim 14 is amended to include features ”by using a first lens, a second lens and an angle of divergence control device provided between the first lens and the second lens, the angle of divergence control device being configured to control the angle of divergence of the light flux”.

Claim 19 is amended to include features “the angle of divergence control mechanism including a first lens, a second lens and an angle of divergence control device provided between the first lens and the second lens, the angle of divergence control device being configured to control the angle of divergence of the light flux”.