(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
2 April 2015 (02.04.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/045691 A1

(51) International Patent Classification:
B60J 1/20 (2006.01) *B60J 3/04* (2006.01)
B60J 3/02 (2006.01) *G06T 7/00* (2006.01)

(21) International Application Number:
PCT/JP2014/071944

(22) International Filing Date:
15 August 2014 (15.08.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2013-197385 24 September 2013 (24.09.2013) JP

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

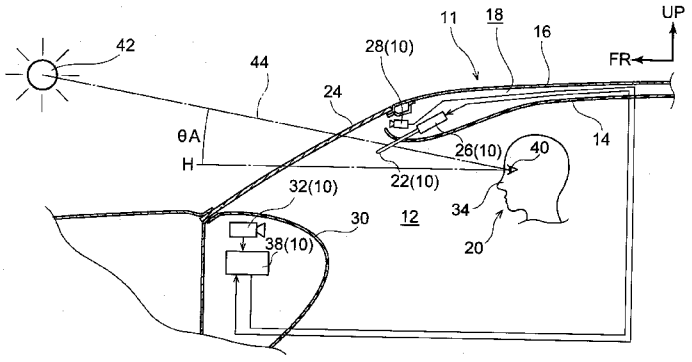
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) **Title**: VEHICLE AUTOMATIC ANTI-GLARE DEVICE

FIG. 1



(57) **Abstract**: A vehicle automatic anti-glare device comprising a light blocking unit, a light source position detection unit that detects the position of a light source ahead of the vehicle, an eye position detection unit that detects the position of eyes of an occupant; and a control unit that identifies the position of the light source and the position of the eyes based on detection results of the light source position detection unit and the eye position detection unit, and in a case in which the eyes are determined to be positioned on a path of light, the control unit closes the light blocking unit such that light is blocked only in a range necessary to prevent light from being incident to the eyes, and the control unit stows the light blocking unit in a case in which the eyes are determined not to be positioned on a path of light.

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DESCRIPTION

VEHICLE AUTOMATIC ANTI-GLARE DEVICE

Field of the Invention

[0001] The present invention relates to a vehicle automatic anti-glare device.

Description of the Related Art

[0002] Japanese Patent Application Laid-Open (JP-A) No. 2008-189253 describes a configuration of an anti-glare control device including a first camera that images to the front, a second camera that images an occupant, a light blocking device provided inside a cabin, and a light blocking device control unit that controls the light blocking device. Specifically, the first camera is provided to the vehicle in a state in which the lens faces ahead of the vehicle. The first camera accordingly images a scene, including the road on which the vehicle is travelling and the sky. When a light source, such as the sun, is present in a region above the horizon in the captured image, this light source is detected as high brightness pixels. The second camera is provided in a state in which the lens faces toward the occupant side. The face of the occupant is imaged, and the position of the eyes of the occupant is detected from the captured image. The light blocking device includes a sun visor and a motor that drives the sun visor, and the sun visor is rotated on receipt of a signal. Based on detection results of the first camera and the second camera, the light blocking device control unit transmits a signal to the light blocking device such that light coming from the light source (referred to below as "light from the light source") is not incident to the occupant.

[0003] According to the above configuration, when a light source is detected by the first camera, based on the detection result, the light blocking device control unit determines that light from the light source is incident to the occupant, and transmits a signal to actuate the light blocking device. The sun visor is moved to a light-blocking position according to this signal. When the second camera detects that the eyes of the occupant are at a position not facing toward the vehicle front, the light blocking device determines, based on this detection result, that the occupant is averting their gaze due to experiencing glare from the light from the light source, and an additional signal to actuate the sun visor again is transmitted to the light blocking device. The sun visor is accordingly moved again.

SUMMARY of the INVENTION

Technical Subject

[0004] However, in the configuration described in JP-A No. 2008-189253, the light blocking

device is actuated on detection of a light source by the first camera. Namely, since the light blocking device is actuated based on detection of the presence or absence of a light source, light is comprehensively blocked over such a range that light is not incident to the eyes of the occupant, rather than blocked only over a range where light from the light source would be incident to the eyes of the occupant. There is also a possibility of the light blocking device being actuated even when light from the light source is not actually incident to the eyes of the occupant. Namely, there is concern of obstructing the field of view of the occupant due to performing unnecessary anti-glare control.

[0005] In consideration of the above circumstances, an object of the present invention is to obtain a vehicle automatic anti-glare device capable of accurately ascertaining the position of a light source, and preventing glare only to necessary portions.

Solution Addressing to the Subject

[0006] A vehicle automatic anti-glare device of a first aspect of the present invention includes: a light blocking unit that is provided at an upper portion side of a windshield glass, or at a cabin side of an upper portion side of a windshield glass, and that blocks light incident from outside a vehicle; a light source position detection unit that is provided at the upper portion side at the cabin side of the windshield glass, and that detects the position of a light source ahead of the vehicle; an eye position detection unit that is provided inside the vehicle cabin further toward the vehicle front than a vehicle seat, and that detects the position of eyes of an occupant; and a control unit that identifies the position of the light source and the position of the eyes of the occupant based on detection results of the light source position detection unit and the eye position detection unit, and in a case in which the eyes of the occupant are determined to be positioned on a path of light from the light source, the control unit closes the light blocking unit such that, out of a light-blockable range of the light blocking unit, light is blocked only in a range necessary to prevent light from the light source from being incident to the eyes of the occupant, and the control unit stows the light blocking unit in a case in which the eyes of the occupant have been determined not to be positioned on a path of light from the light source.

[0007] A vehicle automatic anti-glare device of a second aspect of the present invention is the vehicle automatic anti-glare device of the first aspect, wherein: the control unit identifies the position of the light source from an image captured by a first camera provided to the light source position detection unit so as to face toward the vehicle front side, and identifies the position of the eyes of the occupant from an image captured by a second camera provided to the eye position detection unit so as to face toward the occupant side.

[0008] A vehicle automatic anti-glare device of a third aspect of the present invention is the vehicle automatic anti-glare device of the second aspect, wherein: the first camera is set with plural grid lines in the vehicle up-down direction and the vehicle width direction; and the control unit is input in advance with respective top-bottom angles θA of light from the light source with respect to a substantially horizontal hypothetical line H extending along the vehicle front-rear direction, and with respective left-right angles θB of light from the light source with respect to a substantially horizontal hypothetical line D extending along the vehicle front-rear direction, corresponding to cases in which the light source is positioned at each of the grid lines on an image captured by the first camera, and the control unit identifies the top-bottom angle θA and the left-right angle θB for an incident direction of detected light from the light source by detecting a position of high brightness pixels with respect to the grid lines.

[0009] A vehicle automatic anti-glare device of a fourth aspect of the present invention is the vehicle automatic anti-glare device of any one of the first aspect to the third aspect, wherein the light blocking unit is configured independently as the left and right units in the vehicle width direction, with the left and right units of the light blocking unit capable of independent operation.

[0010] A vehicle automatic anti-glare device of a fifth aspect of the present invention is the vehicle automatic anti-glare device of any one of the first aspect to the fourth aspect, wherein the light blocking unit is a liquid crystal anti-glare device.

[0011] According to the vehicle automatic anti-glare device of the first aspect, the control unit identifies the position of the light source and the position of the eyes of the occupant based on an image of the light source detected by the light source position detection unit, and an image of the face of the occupant detected by the eye position detection unit. In a case in which the eyes of the occupant are determined to be positioned on a path of light from the light source, the control unit computes a range for blocking light incident to the eyes of the occupant out of the light-blockable range of the light blocking unit, and outputs a drive signal to the light blocking unit so as to block light only in a range necessary to prevent light from being incident. The light blocking unit blocks light for the occupant based on this drive signal. In a case in which the eyes of the occupant are determined not to be positioned on an incident direction of the incident light, the control unit outputs a drive signal to the light blocking unit to stow the light blocking unit, and the light blocking unit is stowed in a specific position based on the drive signal.

[0012] According to the vehicle automatic anti-glare device of the second aspect, the first

camera of the light source position detection unit images ahead of the vehicle, and transmits an image of the scene ahead of the vehicle, including the light source, to the control unit. The control unit identifies the position of a light source included in the image. The second camera of the eye position detection unit images the occupant, and transmits an image of the face of the occupant to the control unit. The control unit identifies the position of the eyes of the occupant included in the image. Since the light source position detection unit and the eye position detection unit both employ cameras, stable detection of the positions of target objects is enabled. Moreover, the cost of the light source position detection unit and the eye position detection unit can be suppressed.

[0013] According to the vehicle automatic anti-glare device of the third aspect, the first camera is set with plural grid lines in the vehicle up-down direction and the vehicle width direction, and the control unit is input in advance with respective top-bottom angles θA of light from the light source with respect to a substantially horizontal hypothetical line H extending along the vehicle front-rear direction, and with respective left-right angles θB of light from the light source with respect to a substantially horizontal hypothetical line D extending along the vehicle front-rear direction, corresponding to cases in which the light source is positioned at each of the grid lines on an image captured by the first camera. This enables the control unit to identify the top-bottom angle θA and the left-right angle θB of an incident direction of light from the light source by detecting a position of high brightness pixels with respect to the grid lines.

[0014] According to the vehicle automatic anti-glare device of the fourth aspect, the light blocking unit is configured independently as the left and right units in the vehicle width direction, with the left and right units of the light blocking unit capable of independent operation. This enables light to be blocked only to locations where the occupant experiences glare, without obstructing the field of view of the occupant any more than necessary.

[0015] According to the vehicle automatic anti-glare device of the fifth aspect, the light blocking unit is a liquid crystal anti-glare device. This enables only positions where the occupant experiences glare to be darkened, with other positions adopting a substantially transparent state. This enables light to be reduced or blocked only to locations where the occupant experiences glare, without obstructing the field of view of the occupant any more than necessary.

Advantageous Effects of Invention

[0016] The vehicle automatic anti-glare device of the first aspect exhibits the excellent advantageous effect of obtaining an automatic anti-glare device capable of accurately

ascertaining the position of a light source, and preventing glare only at a necessary portions.

[0017] The vehicle automatic anti-glare device of the second aspect exhibits the excellent advantageous effects of enabling stable detection of the positions of target objects, and suppressing cost.

[0018] The vehicle automatic anti-glare device of the third aspect exhibits the excellent advantageous effect of enabling costs to be suppressed with a simple configuration, and enables easy and fast identification of the top-bottom angle θA and the left-right angle θB with respect to the substantially horizontal hypothetical lines of the light source, due to setting the first camera with the grid lines.

[0019] The vehicle automatic anti-glare device of the fourth aspect exhibits the excellent advantageous effect of enabling light to be blocked only to locations where the occupant experiences glare, without obstructing the field of view of the occupant any more than necessary.

[0020] The vehicle automatic anti-glare device of the fifth aspect exhibits the excellent advantageous effect of enabling only positions where the occupant experiences glare to be darkened, such that light is reduced or blocked.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Fig. 1 is a side view illustrating a vehicle automatic anti-glare device according to a first exemplary embodiment;

Fig. 2 is an example of an image captured by a light source position detection unit of a vehicle automatic anti-glare device according to the first exemplary embodiment;

Fig. 3 is a plan view illustrating a relationship in the vehicle width direction between an incident direction of light from the light source and an occupant;

Fig. 4 is a schematic perspective view illustrating a state in which a light blocking device of a vehicle automatic anti-glare device according to the first exemplary embodiment is provided at the inside of a front windshield glass;

Fig. 5A is a schematic perspective view illustrating an actuated state of a light blocking device according to a second exemplary embodiment;

Fig. 5B is a schematic perspective view illustrating left and right units independently actuated states of a light blocking device according to the second exemplary embodiment;

Fig. 6A is a schematic perspective view illustrating a light blocking device according to the second exemplary embodiment provided at the inside of a front windshield glass, with a sun visor at a vehicle width direction outside of the light blocking device in an extended state;

Fig. 6B is a schematic perspective view illustrating a light blocking device according to the second exemplary embodiment provided at the inside of a front windshield glass, with a sun visor at the vehicle width direction inside of the light blocking device in an extended state; and

Fig. 7 is a schematic perspective view illustrating a state in which a light blocking device according to a third exemplary embodiment is provided at a front windshield glass.

DETAILED DESCRIPTION OF THE INVENTION

[0022] First Exemplary Embodiment

Explanation follows regarding a first exemplary embodiment of a vehicle automatic anti-glare device according to the present invention, with reference to Fig. 1 to Fig. 4. In the drawings, the arrow FR indicates the vehicle front, the arrow OUT indicates the vehicle left (one side in a vehicle width direction), and the arrow UP indicates upwards, as appropriate.

[0023] Fig. 1 illustrates an overall structure of a vehicle automatic anti-glare device 10. A roof lining 14, which is a ceiling interior member, is provided above a cabin 12 of a vehicle 11. A device housing portion 18 is provided at the vehicle front side of the roof lining 14, between the roof lining 14 and a roof panel 16. A sun visor 22, serving as a light blocking unit that blocks light incident to an occupant 20 from the outside of the vehicle, and a sun visor controller 26, that slides the sun visor 22 along a front windshield glass 24 in the vehicle up-down direction, are provided in the device housing portion 18.

[0024] A first camera 28, configuring a light source position detection unit, is provided inside the device housing portion 18. The first camera 28 is attached in a state in which the lens faces toward the vehicle front, and is capable of imaging a scene to the front of the vehicle through the front windshield glass 24.

[0025] An instrument panel 30 is provided at the front side of the cabin 12. A second camera 32, configuring an eye position detection unit, is attached to the instrument panel 30. The second camera 32 is attached in a state in which the lens faces toward the face 34 of the occupant 20, and is capable of imaging the face 34 of the occupant 20.

[0026] As illustrated in Fig. 2, an image captured by the first camera 28 includes, for example, the road on which the vehicle is travelling and the sky. The first camera 28 is pre-set with plural grid lines 36 running in the vehicle up-down direction and the vehicle width direction, and the grid lines 36 are included in the captured image.

[0027] The first camera 28, the second camera 32, and the sun visor controller 26 are each connected to an incident direction computation device 38, serving as a controller, through

wiring, not illustrated in the drawings. An image signal regarding the vehicle front side is transmitted from the first camera 28 to the incident direction computation device 38, and an image signal of the face 34 of the occupant 20 is transmitted from the second camera 32 to the incident direction computation device 38. A drive signal is transmitted from the incident direction computation device 38 to the sun visor controller 26.

[0028] The incident direction computation device 38 is input in advance with respective top-bottom angles θA of light from a light source with respect to a substantially horizontal hypothetical line H extending along the vehicle front-rear direction. The respective top-bottom angles θA correspond to cases in which a light source 42 is positioned at each of the grid lines 36 on the image from the first camera 28. Similarly, the incident direction computation device 38 is input in advance with respective left-right angles θB of light from the light source with respect to a substantially horizontal hypothetical line D extending along the vehicle front-rear direction. The respective left-right angles θB correspond to cases in which a light source 42 is positioned at each of the grid lines 36 on the image from the first camera 28. Accordingly, by detecting the positions of high brightness pixels with respect to the grid lines 36, the incident direction computation device 38 is able to identify the top-bottom angle θA and the left-right angle θB for the incident direction of light from the detected light source.

[0029] The incident direction computation device 38 also detects the eyes 40 of the occupant 20, and can identify the position of the eyes 40 from the image of the face 34 of the occupant 20 imaged by the second camera 32.

[0030] Operation and Advantageous Effects of the First Exemplary Embodiment

Explanation follows regarding operation and advantageous effects of the first exemplary embodiment.

[0031] When the vehicle automatic anti-glare device 10 is in an operational state, the first camera 28 continuously images front side of the vehicle. As illustrated in Fig. 2, the captured images include the grid lines 36, and when the light source 42 is present within the image, the position of the light source 42 is imaged as high brightness pixels in the image. The captured image is transmitted to the incident direction computation device 38.

[0032] Similarly, when the vehicle automatic anti-glare device 10 is in an operational state, the second camera 32 continuously images the occupant 20 side. Images including the face 34 of the occupant 20 are transmitted to the incident direction computation device 38.

[0033] In the incident direction computation device 38, the top-bottom angle θA and the left-right angle θB of the light from the light source detected by the first camera 28 are

identified based on the data, that has been input in advance, of the top-bottom angles θA with respect to the substantially horizontal hypothetical line H extending along the vehicle front-rear direction and the left-right angles θB with respect to the substantially horizontal hypothetical line D extending along the vehicle front-rear direction, corresponding to light from a light source on each of the grid lines 36. Namely, setting the grid lines 36 enables the top-bottom angle θA and the left-right angle θB of the light from the light source to be identified quickly and easily, suppressing costs with a simple configuration.

[0034] The incident direction computation device 38 moreover determines the position of the eyes 40 of the occupant 20 from detection results of the second camera 32. The incident direction computation device 38 then computes a hypothetical line 44 joining between the position of the identified light source 42 and the position of the eyes 40 of the occupant 20. The hypothetical line 44 represents the eyes 40 of the occupant 20 positioned on a path of the light from the light source. In other words, the hypothetical line 44 represents an incident direction of the light from the light source at which the occupant 20 would experience glare. The glare experienced by the occupant 20 can therefore be reduced by blocking the hypothetical line 44. When, based on the detection results of the first camera 28 and the second camera 32, the eyes of the occupant 20 are positioned along the incident path direction of the incident light, namely, when the hypothetical line 44 has been derived joining between the position of the identified light source 42 and the position of the eyes 40 of the occupant 20, the incident direction computation device 38 determines that "light needs to be blocked". The incident direction computation device 38 then identifies a location where the computed hypothetical line 44 overlaps with a movement range of the sun visor 22. The incident direction computation device 38 then transmits an actuation signal to the sun visor controller 26 to actuate the sun visor 22, so as to cover this location using the sun visor 22.

[0035] As illustrated in Fig. 4, the sun visor controller 26 slides the sun visor 22 along the front windshield glass 24 toward the vehicle lower side, according to the signal from the incident direction computation device 38. The sun visor controller 26 stops actuation when the sun visor 22 has slid as far as the location where the hypothetical line 44 overlaps with the movement range of the sun visor 22. Glare can thus be prevented at only locations where the occupant 20 actually experiences glare, while securing the field of view ahead of the occupant 20.

[0036] When, based on the detection results of the first camera 28 and the second camera 32, the incident direction computation device 38 determines that the eyes of the occupant 20 are not positioned along the incident direction of the incident light, namely, when the hypothetical

line 44 joining between the position of the light source 42 with the position of the eyes 40 of the occupant 20 cannot be derived, the incident direction computation device 38 determines that "light does not need to be blocked". The incident direction computation device 38 then transmits a drive signal to the sun visor controller 26 to stow the sun visor 22 inside the roof lining 14.

[0037] The sun visor controller 26 slides the sun visor 22 along the front windshield glass 24 toward the vehicle upper side according to the signal from the incident direction computation device 38, stowing the sun visor 22 inside the roof lining 14. The maximum field of view can accordingly be secured ahead of the occupant 20.

[0038] Accordingly, the vehicle automatic anti-glare device 10 of the present exemplary embodiment enables the position of the light source 42 and the position of the eyes 40 of the occupant 20 to be ascertained, such that based on the position of the light source 42, it is possible to block only the light from the light source that is incident to the eyes 40 of the occupant 20. This enables the position of the light source 42 to be accurately ascertained, and glare to be prevented only at necessary portions.

[0039] The light source position detection unit and the eye position detection unit both employ cameras, enabling stable detection of the positions of target objects, and enabling the cost of the light source position detection unit and the eye position detection unit to be suppressed.

[0040] Second Exemplary Embodiment

Explanation follows regarding a vehicle automatic anti-glare device 78 according to a second exemplary embodiment of the present invention, with reference to Figs. 5A to 6B. Note that configuration portions that are the same as in the first exemplary embodiment described above are allocated the same reference numerals, and explanation thereof is omitted.

[0041] As illustrated in Fig. 5A and Fig. 5B, the vehicle automatic anti-glare device 78 according to the second exemplary embodiment has the same basic configuration as in the first exemplary embodiment, however independent left and right sun visors 46 are employed as the light blocking unit, in place of the sun visor 22.

[0042] As illustrated in Fig. 5A, the independent left and right sun visors 46 are configured by two screen units 48. Specifically, the independent left and right sun visors 46 are configured by disposing the screen units 48 side-by-side in the vehicle width direction, and are capable of being actuated independently of each other.

[0043] The screen units 48 each include a screen 52 that is taken up onto a take-up roller 50 when stowed, extendable arms 54 that are attached at the vehicle front side of the screen 52,

and a moving mechanism 56 that is provided above the take-up roller 50 and that houses an actuator, not illustrated in the drawings. The size along the width direction of one of the screen units 48 is set at approximately half that of the sun visor 22 of the first exemplary embodiment.

[0044] The screen 52 is formed in a substantially rectangular shape using a soft material with light-blocking properties (for example a fabric or vinyl material). One end of the screen 52 is fixed to an outer peripheral face of the take-up roller 50, such that the screen 52 is taken up by rotating the take-up roller 50. A biasing unit (not illustrated in the drawings), that biases the take-up roller 50 so as to rotate in a take-up direction, is attached to the take-up roller 50, and applies a constant take-up bias to the screen 52.

[0045] The other end of the screen 52 is attached to a lateral frame 58 extending in the vehicle width direction. Semicircular shaft attachment tabs 62 are respectively provided in the vicinity of end portions 60 in the vehicle width direction of the lateral frame 58. Shaft attachment holes 64 are provided at the centers of the shaft attachment tabs 62.

[0046] The arms 54 provided at the vehicle front side of the screen 52 are respectively attached to the lateral frame 58 through swivel shafts 66 that pass through the shaft attachment holes 64 of the shaft attachment tabs 62. Joint portions 68, that are capable of flexing along the vehicle width direction, are provided at length direction central portions of the arms 54, and substantially L-shaped bent portions 70 are provided to end portions of the respective arms 54 on the opposite side to the end portions where the swivel shafts 66 are attached. The bent portions 70 are disposed inside the moving mechanism 56 provided at an upper portion of the take-up roller 50, and are connected to the actuator. Rotating the actuator rotates the bent portions 70, and accompanying this action, the arms 54 are able to extend or retract in a pantograph shape along the inside of the front windshield glass 24.

[0047] The screen 52 is pulled out from the take-up roller 50 and deployed toward the vehicle lower side along an inside face of the front windshield glass 24, accompanying the extension of the arms 54 toward the vehicle lower side when the actuator is actuated. Moreover, the screen 52 is gradually taken up onto the take-up roller 50 and stowed under the biasing force of the biasing unit as the arms 54 retract toward the vehicle upper side when the actuator is actuated. Namely, deployment of the screen 52 can be varied as desired by actuation of the actuator.

[0048] Operation and Advantageous Effects of the Second Exemplary Embodiment

Explanation follows regarding operation and advantageous effects of the second exemplary embodiment.

[0049] The vehicle automatic anti-glare device 78 of the present exemplary embodiment obtains the same basic operation and advantageous effects as the first exemplary embodiment due to the provision of the light source position detection unit and the eye position detection unit. Namely, the position of the light source 42 can be accurately ascertained, and glare prevented only at the necessary portions.

[0050] According to the above configuration, the respective screen units 48 of the independent left and right sun visors 46 can be actuated independently of each other, enabling one of the screen units 48 to be placed in a deployed state while the other of the screen units 48 is in a stowed state, as illustrated in Fig. 5B. Accordingly, as illustrated in Fig. 6A, when the light source 42 is on the left hand side with respect to the occupant 20, the hypothetical line 44 joining between the light source 42 and the eyes 40 of the occupant 20 is computed to locate at the left hand side with respect to the occupant 20. When the location where the hypothetical line 44 overlaps with the movement range of the independent left and right sun visors 46 is within the movement range of the left side screen unit 48 out of the independent left and right sun visors 46, only the left side screen unit 48 is deployed toward the vehicle lower side, thereby enabling light to be blocked only at the portions where the occupant 20 experiences glare.

[0051] As illustrated in Fig. 6B, when the light source 42 is on the right hand side with respect to the occupant 20, the hypothetical line 44 joining between the light source 42 and the eyes 40 of the occupant 20 is computed to locate at the right hand side with respect to the occupant 20. When the location where the hypothetical line 44 overlaps with the movement range of the independent left and right sun visors 46 is within the movement range of the right side screen unit 48 out of the independent left and right sun visors 46, only the right side screen unit 48 is deployed toward the vehicle lower side, thereby enabling light to be blocked only at the portions where the occupant 20 experiences glare.

[0052] Out of the independent left and right sun visors 46, actuating only the screen unit 48 on the side overlapping with the hypothetical line 44 enables light to be blocked only at the locations where the occupant 20 experiences glare, without obstructing the field of view of the occupant 20 any more than necessary.

[0053] Third Exemplary Embodiment

Next, explanation follows regarding a vehicle automatic anti-glare device 80 according to a third exemplary embodiment of the present invention, with reference to Fig. 7. Note that configuration portions that are the same as in, for example, the first exemplary embodiment described above are allocated the same reference numerals and explanation thereof is omitted.

[0054] As illustrated in Fig. 7, the vehicle automatic anti-glare device 80 according to the third exemplary embodiment has the same basic configuration as the first exemplary embodiment, however a liquid crystal anti-glare device 72 is employed as the light blocking unit in place of the sun visor 22.

[0055] The liquid crystal anti-glare device 72 includes a liquid crystal filter 74 provided at an upper portion of the front windshield glass 24. The liquid crystal filter 74 is substantially transparent under normal conditions, however darkens on a signal from the incident direction computation device 38. Note that the overall liquid crystal filter 74 is divided into a number of segments, with each of the segments capable of darkening individually.

[0056] Operation and Advantageous Effects of the Third Exemplary Embodiment

Next, explanation follows regarding operation and advantageous effects of the third exemplary embodiment.

[0057] The vehicle automatic anti-glare device 80 of the present exemplary embodiment obtains the same basic operation and advantageous effects as the first exemplary embodiment due to the provision of the light source position detection unit and the eye position detection unit. Namely, the position of the light source 42 can be accurately ascertained, and glare prevented only at the necessary portions.

[0058] According to the above configuration, the liquid crystal anti-glare device 72 is capable of darkening at only positions where the occupant 20 experiences glare, with other positions adopting a substantially transparent state. Accordingly, as illustrated in Fig. 7, the incident direction computation device 38 computes a location where the hypothetical line 44 that joins between the light source 42 and the eyes 40 of the occupant 20 passes through the liquid crystal filter 74. Based on the computation results, the incident direction computation device 38 transmits a signal to the liquid crystal filter 74 such that only the segment 76 corresponding to this location is darkened. According to the signal, only the segment 76 of the liquid crystal filter 74 is darkened, with other positions maintained in a substantially transparent state. This enables light to be reduced or blocked only at the location where the occupant 20 experiences glare, without obstructing the field of view of the occupant 20 any more than necessary.

[0059] Note that in the first exemplary embodiment to the third exemplary embodiment, the light source position detection unit is configured such that the position of the light source 42 is detected based on an image captured by the first camera 28. However, there is no limitation thereto, and configuration may be made with a combination of the first camera 28 and various sensors. Namely, the hypothetical line 44 joining between the light source 42

and the eyes of the occupant 20 may be computed by supplementing the position of the light source 42 detected by the first camera 28 of the incident direction computation device 38 with detection results regarding the state of the vehicle 11 from, for example, a tilt sensor. Such a configuration enables more precise detection of the position of the light source 42.

[0060] In the first exemplary embodiment to the third exemplary embodiment, the first camera 28 configuring the light source position detection unit is configured to capture what is referred to as visible light ahead of the vehicle. However, there is no limitation thereto, and configuration may be made with a camera sensitive to infrared light, or a camera sensitive to ultraviolet light. Namely, distant objects appear sharp in images captured by a camera sensitive to infrared light. Images captured by a camera sensitive to ultraviolet light appear dark with the exception of the light source 42 that emits ultraviolet light. Detection of the position of the light source 42 in the respective images is accordingly made easier.

[0061] Explanation has been given regarding exemplary embodiments of the present invention, however the present invention is not limited to the above, and obviously various modifications may be implemented within a range not departing from the scope of the present invention.

[0062] The disclosure of Japanese Patent Application No. 2013-197385, filed September 24, 2013, is incorporated herein by reference in its entirety.

All publications, patent applications, and technical standards mentioned in this specification are herein incorporated by reference to the same extent as if each individual publication, patent application, or technical standard was specifically and individually indicated to be incorporated by reference.

CLAIMS

1. A vehicle automatic anti-glare device comprising:

a light blocking unit that is provided at an upper portion side of a windshield glass, or at a cabin side of an upper portion side of a windshield glass, and that blocks light incident from outside a vehicle;

a light source position detection unit that is provided at the upper portion side at the cabin side of the windshield glass, and that detects the position of a light source ahead of the vehicle;

an eye position detection unit that is provided inside the vehicle cabin further toward the vehicle front than a vehicle seat, and that detects the position of eyes of an occupant; and

a control unit that identifies the position of the light source and the position of the eyes of the occupant based on detection results of the light source position detection unit and the eye position detection unit, and that, in a case in which the eyes of the occupant are determined to be positioned on a path of light from the light source, closes the light blocking unit such that, out of a light-blockable range of the light blocking unit, light is blocked only in a range necessary to prevent light from the light source from being incident to the eyes of the occupant, and that stows the light blocking unit in a case in which the eyes of the occupant have been determined not to be positioned on a path of light from the light source.

2. The vehicle automatic anti-glare device of claim 1, wherein the control unit identifies the position of the light source from an image captured by a first camera provided to the light source position detection unit so as to face toward the vehicle front side, and identifies the position of the eyes of the occupant from an image captured by a second camera provided to the eye position detection unit so as to face toward the occupant side.

3. The vehicle automatic anti-glare device of claim 2, wherein:

the first camera is set with a plurality of grid lines in the vehicle up-down direction and the vehicle width direction; and

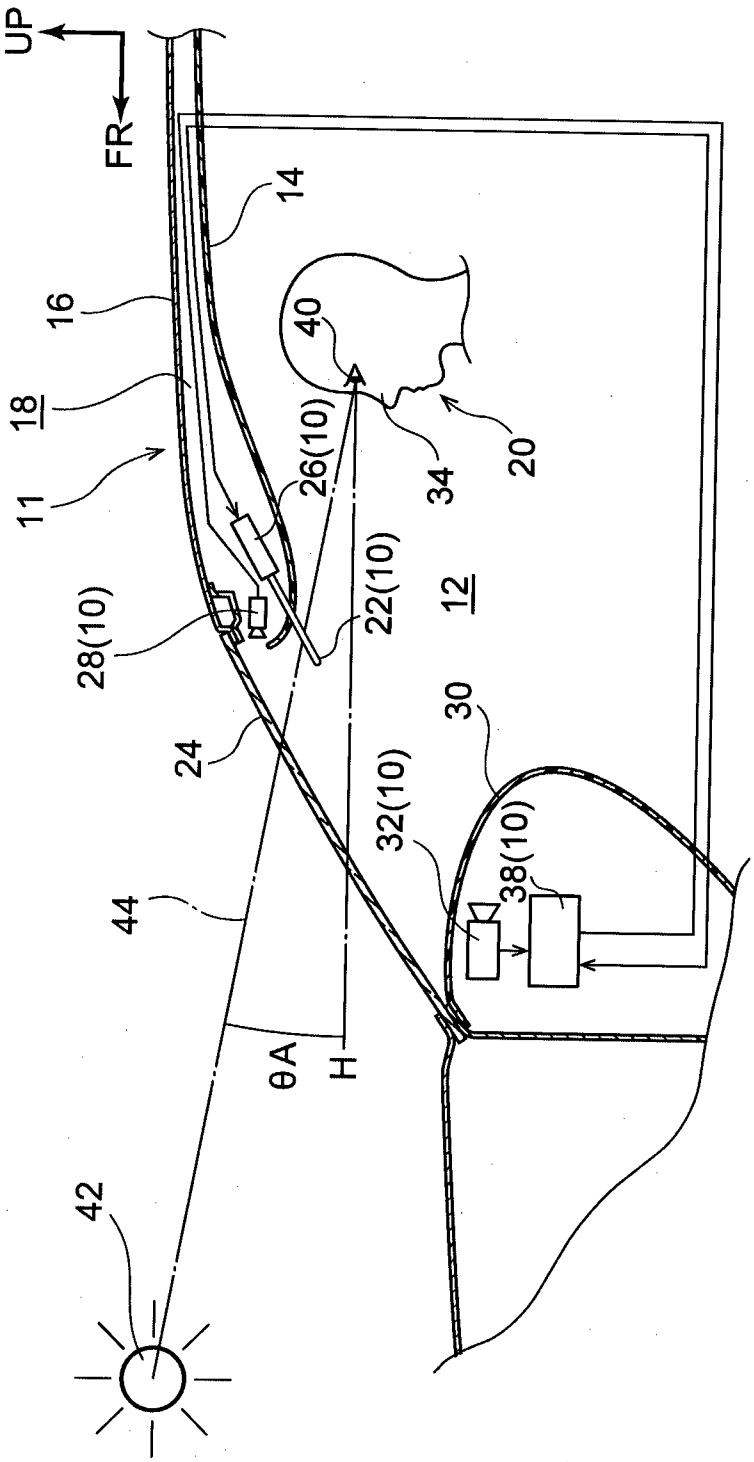
the control unit is input in advance with respective top-bottom angles θA of light from the light source with respect to a substantially horizontal hypothetical line H extending along the vehicle front-rear direction, and with respective left-right angles θB of light from the light source with respect to a substantially horizontal hypothetical line D extending along the vehicle front-rear direction, corresponding to cases in which the light source is positioned

at each of the grid lines on an image captured by the first camera, and the control unit identifies the top-bottom angle θA and the left-right angle θB for an incident direction of detected light from the light source by detecting a position of high brightness pixels with respect to the grid lines.

4. The vehicle automatic anti-glare device of any one of claim 1 to claim 3, wherein the light blocking unit is configured independently as left and right units in the vehicle width direction, with the left and right units of the light blocking unit capable of independent operation.

5. The vehicle automatic anti-glare device of any one of claim 1 to claim 4, wherein the light blocking unit is a liquid crystal anti-glare device.

FIG. 1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H
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FIG. 2

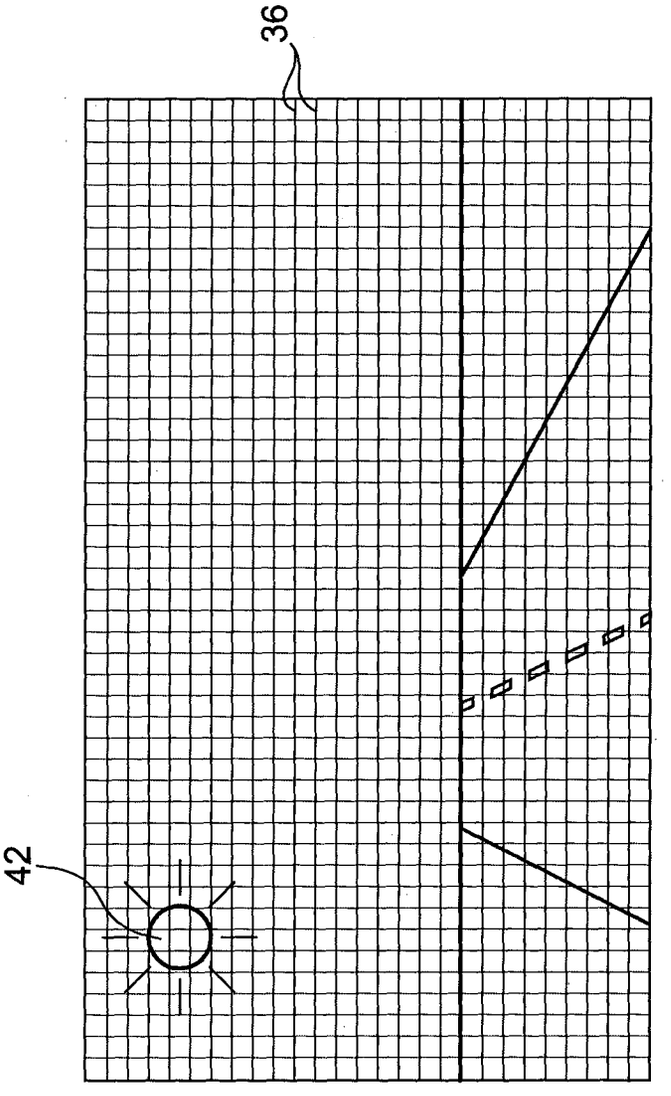

FIG. 3

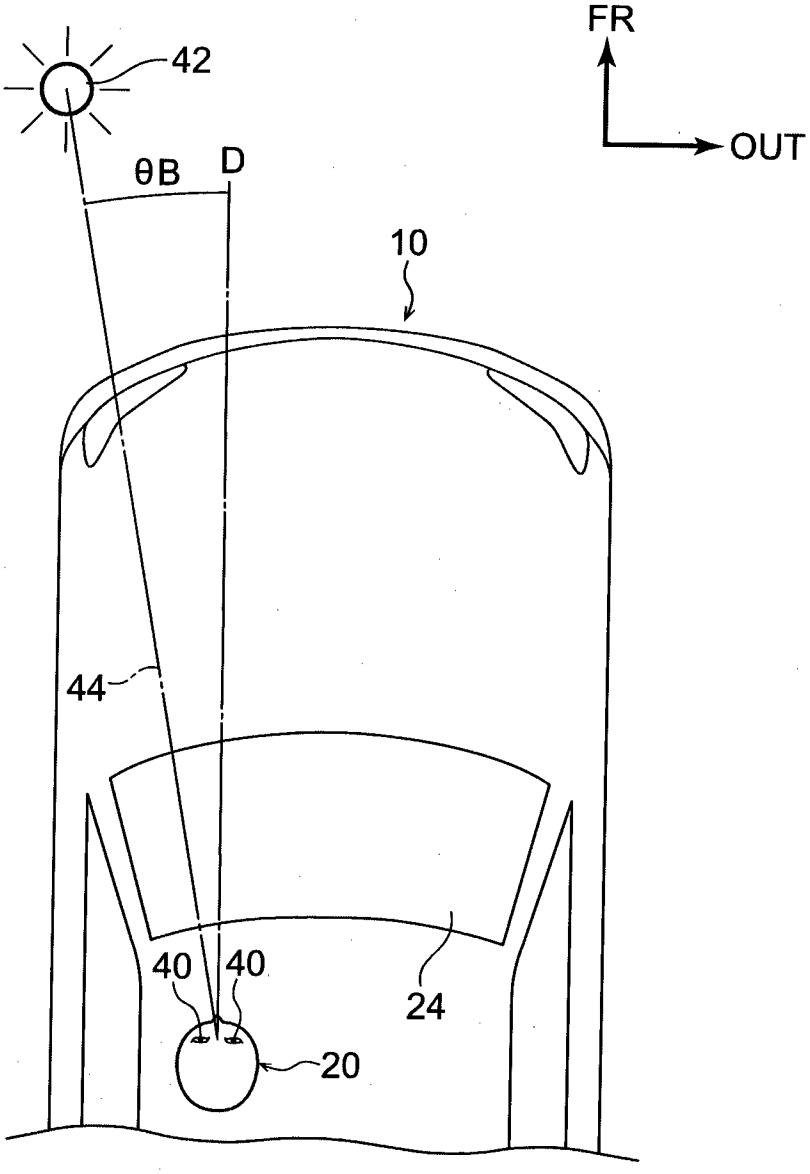

FIG. 4

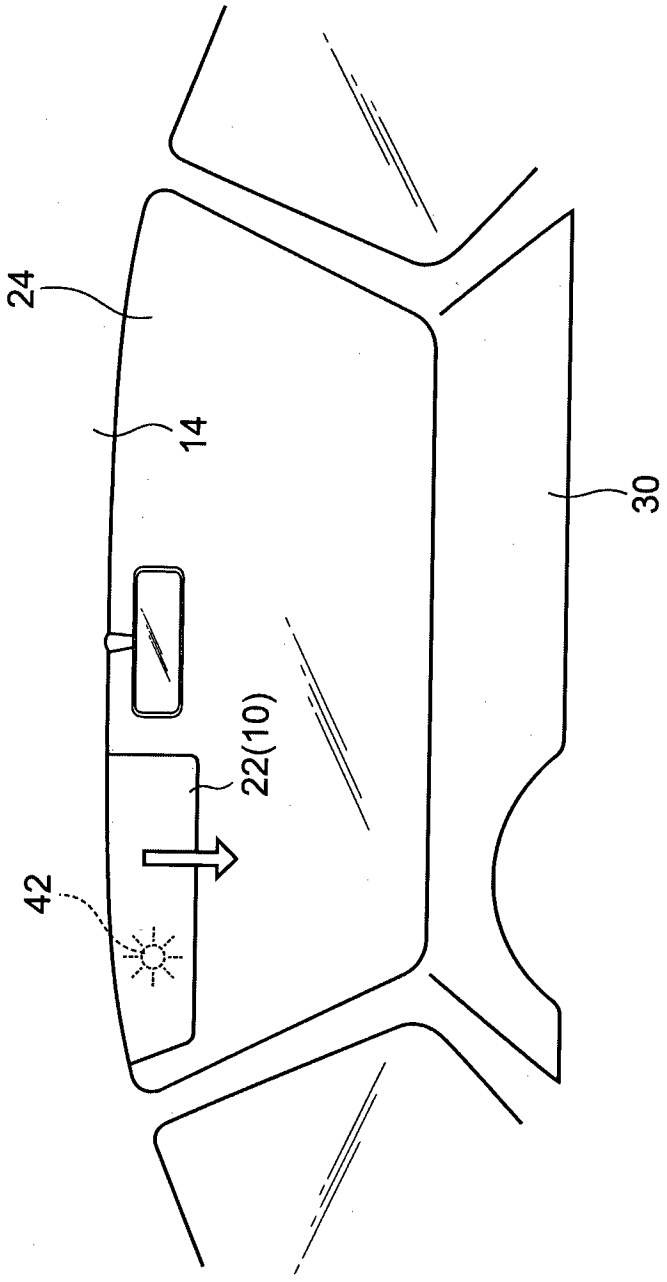

FIG. 5A

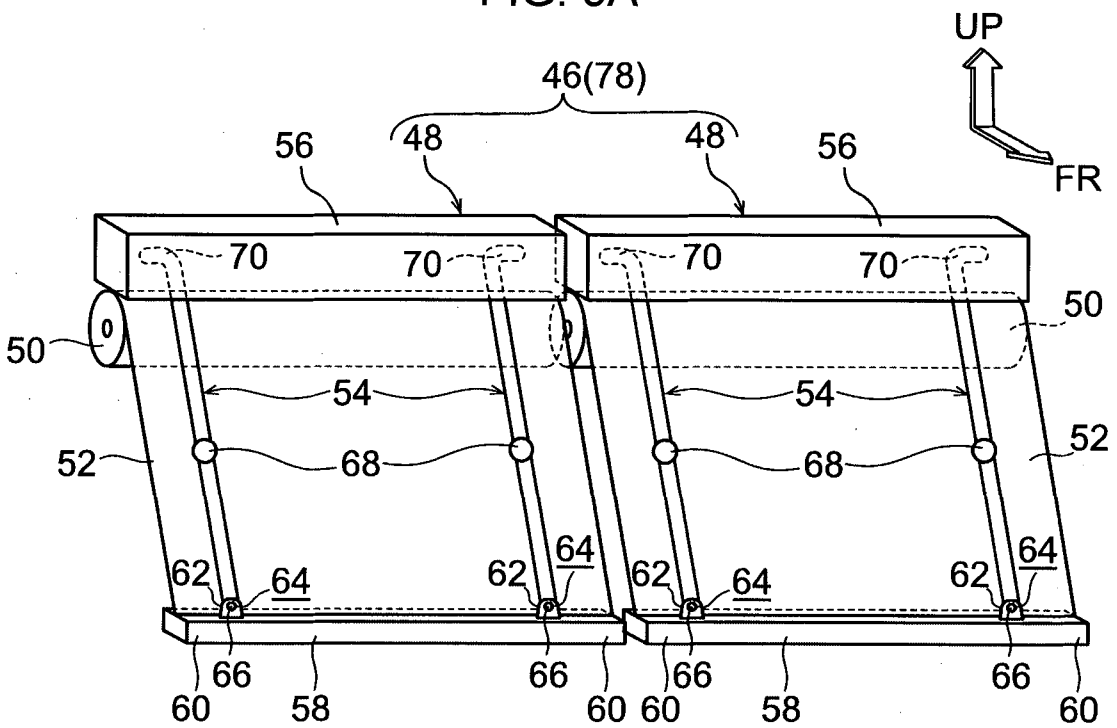
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FIG. 5B

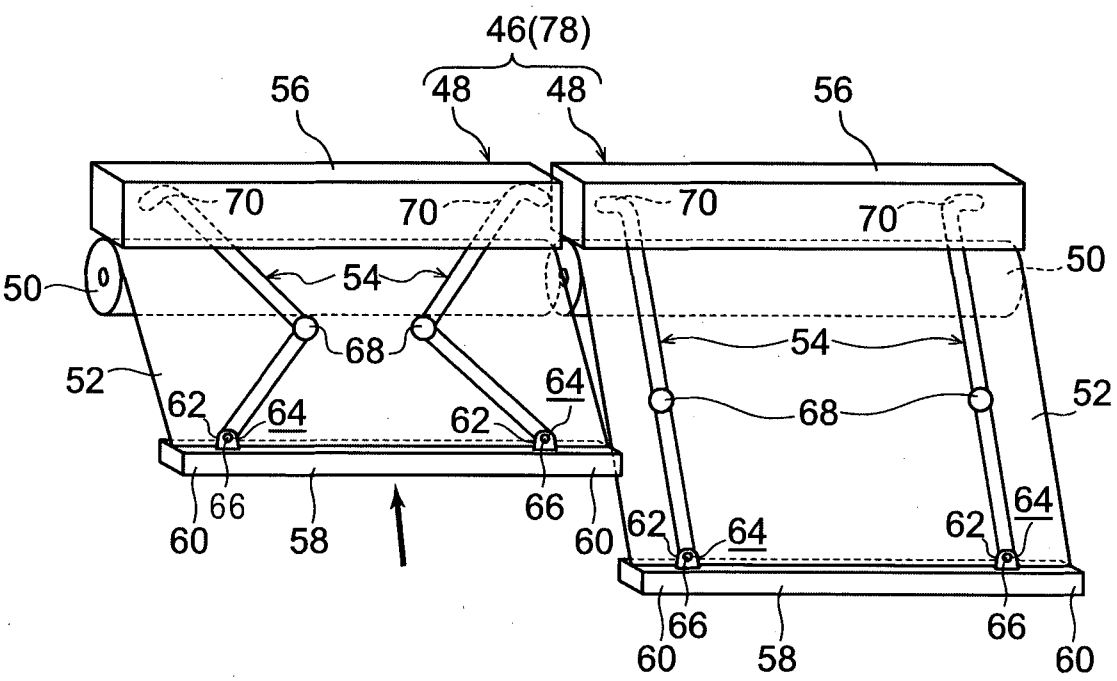
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FIG. 6A

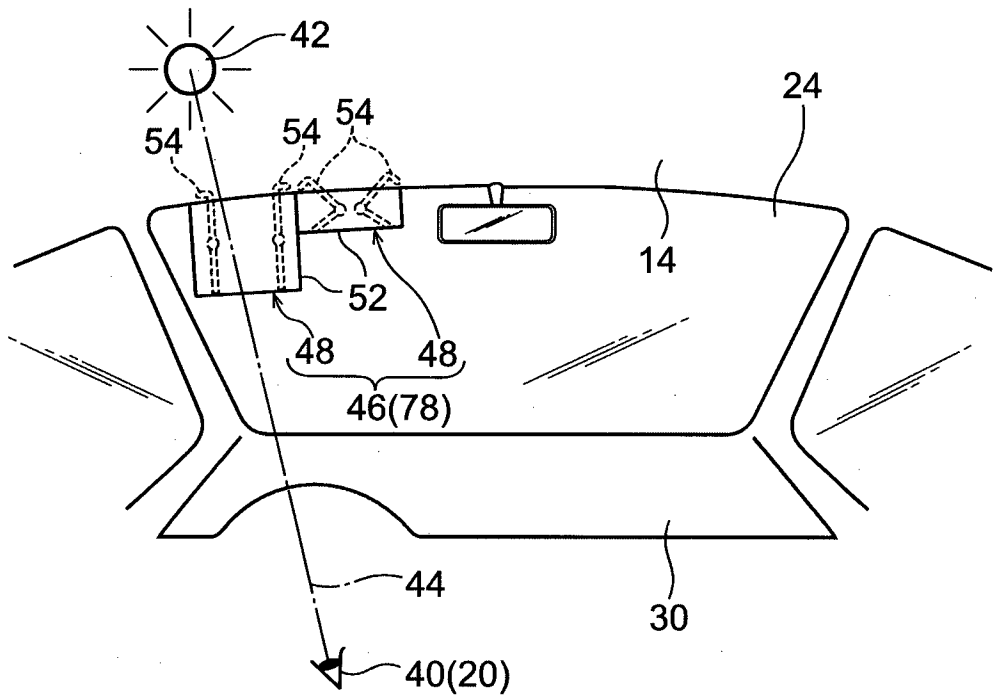
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FIG. 6B

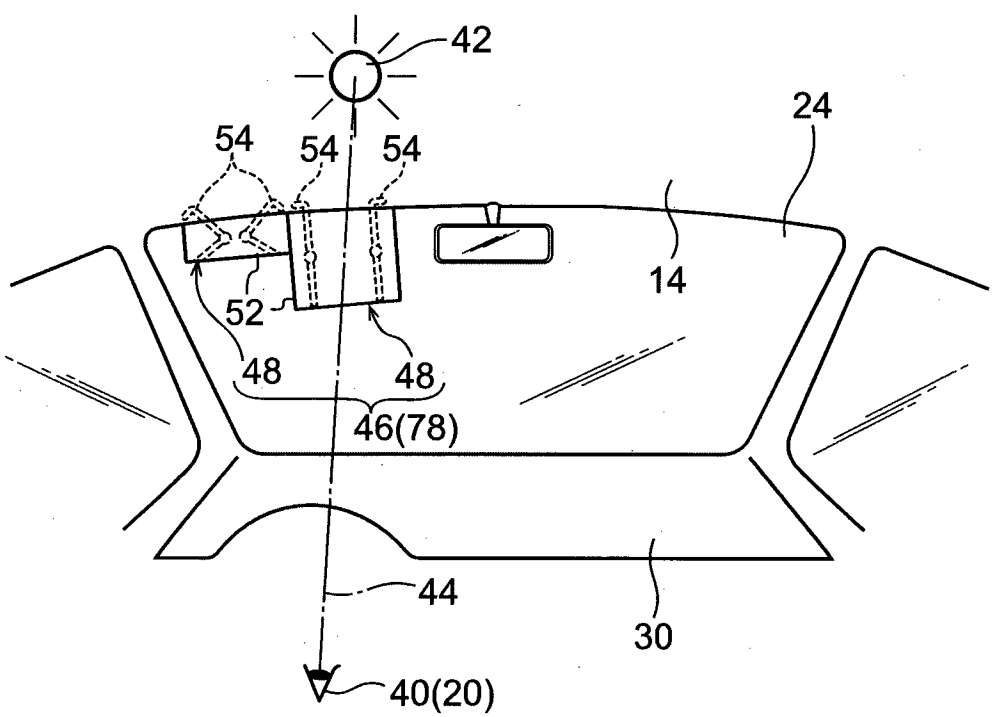
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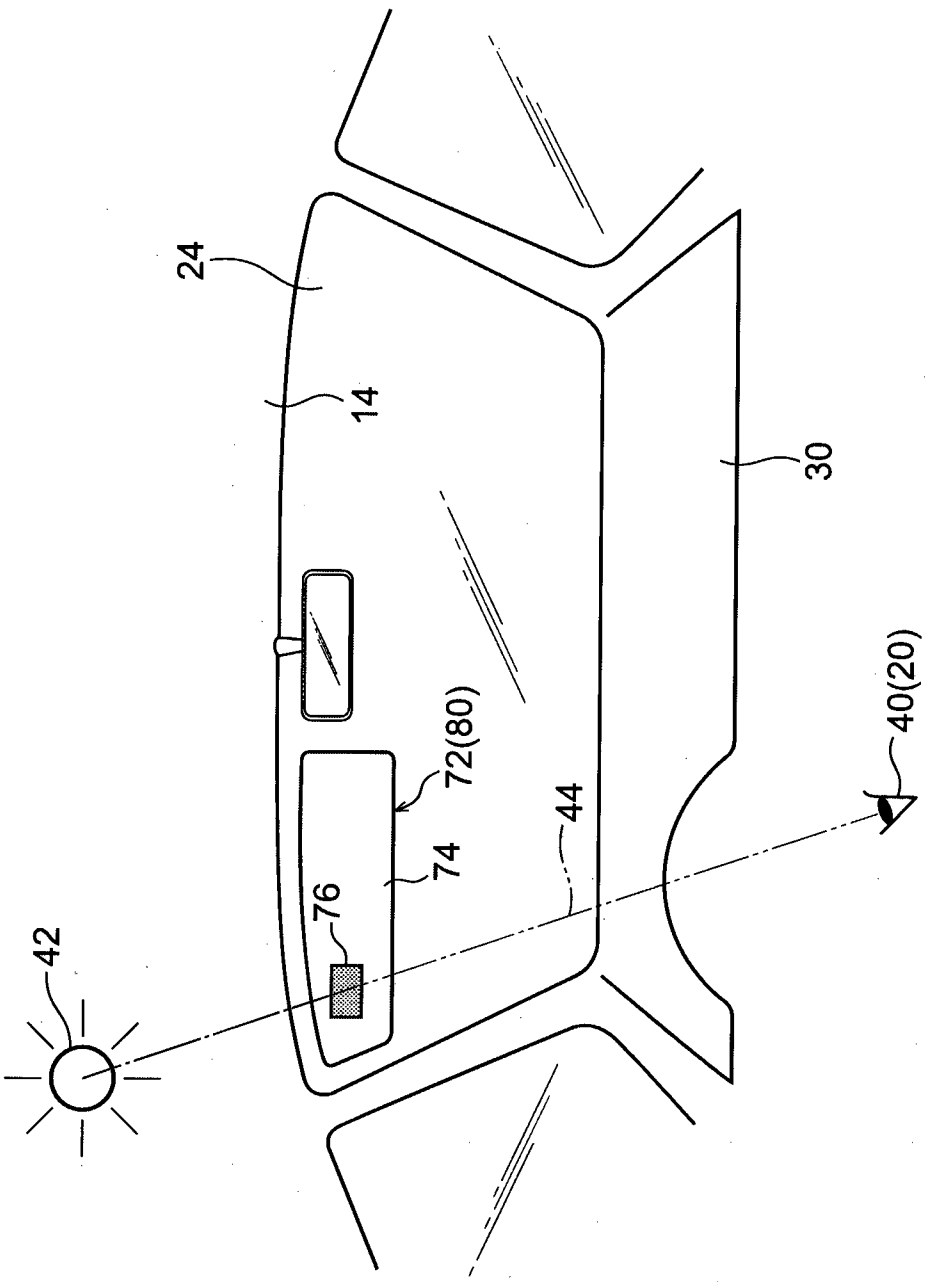
FIG. 7



INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2014/071944

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60J1/20 B60J3/02 B60J3/04 G06T7/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60J G06T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 683 668 A2 (HITACHI LTD [JP]) 26 July 2006 (2006-07-26) abstract paragraphs [0006], [0007], [0021], [0026], [0028] claim 5 figures 3, 5, 6, 11-13	1,2,4,5
X	US 2009/168185 A1 (AUGUSTINE BRUCE A [US]) 2 July 2009 (2009-07-02) abstract paragraphs [0014], [0020], [0023], [0024] claim 1 figures 2, 4	1,2,4,5

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 November 2014	19/11/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Larangeira, F

INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2014/071944

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 199 33 397 A1 (ERTL LOTHAR [DE]) 25 January 2001 (2001-01-25) abstract column 1, line 49 - column 2, line 8 column 3, lines 1-9 claims 1, 3-6, 8, 10 figures 1, 2 -----	1,2,4,5
X	DE 198 14 094 A1 (ECKER RAINER [DE]) 14 October 1999 (1999-10-14) abstract column 2, lines 22-26 column 3, lines 38-48 column 4, line 49 - column 5, line 10 column 6, line 68 - column 7, line 14 figure 1 -----	1,2,4,5

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Information on patent family members

International application No
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