



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.10.2016 Bulletin 2016/43

(51) Int Cl.:
H01H 9/16 (2006.01) **G05G 1/10** (2006.01)
H01H 9/18 (2006.01) **H01H 19/02** (2006.01)
H01H 19/14 (2006.01)

(21) Application number: **16165602.0**

(22) Date of filing: **15.04.2016**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(71) Applicant: **KABUSHIKI KAISHA TOKAI RIKI DENKI SEISAKUSHO**
Niwa-gun,
Aichi 480-0195 (JP)

(72) Inventor: **MORI, Kensuke**
Niwa-gun, Aichi 480-0195 (JP)

(74) Representative: **Betten & Resch**
Patent- und Rechtsanwälte PartGmbB
Maximiliansplatz 14
80333 München (DE)

(30) Priority: **20.04.2015 JP 2015085975**

(54) **ROTATIONAL SWITCHING DEVICE**

(57) An operation device includes a rotational operation portion that is rotationally operated and includes an opening formed in the center of an upper portion and a transmissive region formed at a circumference portion of the opening to allow light to pass through, and an indicator portion that includes an exposed region exposed from the opening of the rotational operation portion, a transmissive-reflective region provided around the exposed region so as to face the transmissive region and indicators formed in the exposed region, the transmissive-reflective region transmitting a portion of artificial light travelling from its back surface and reflecting a portion of natural light incident on its front surface through the transmissive region.

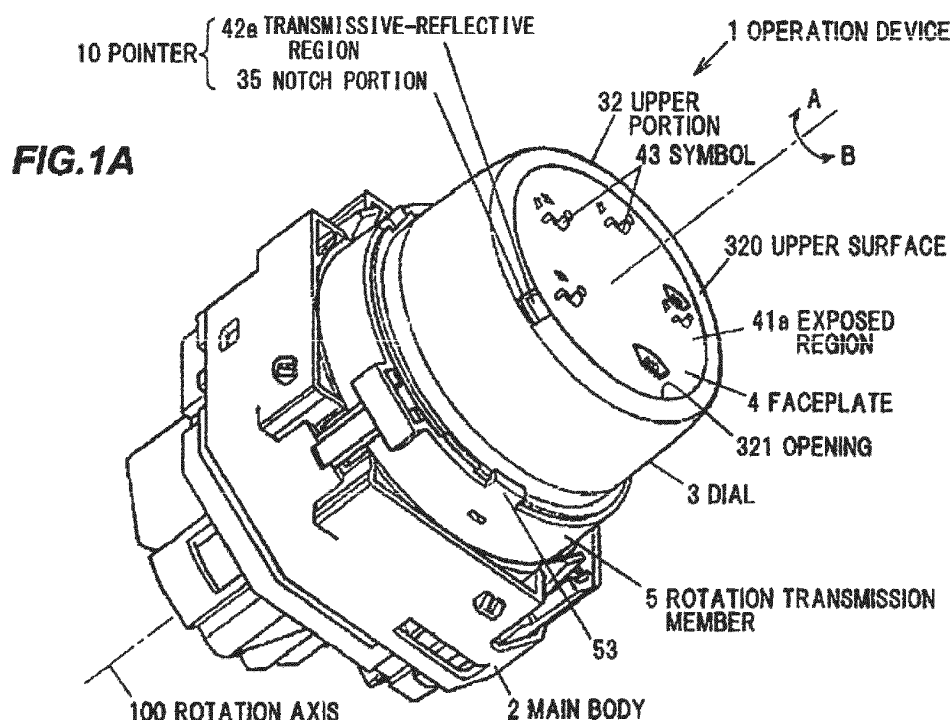
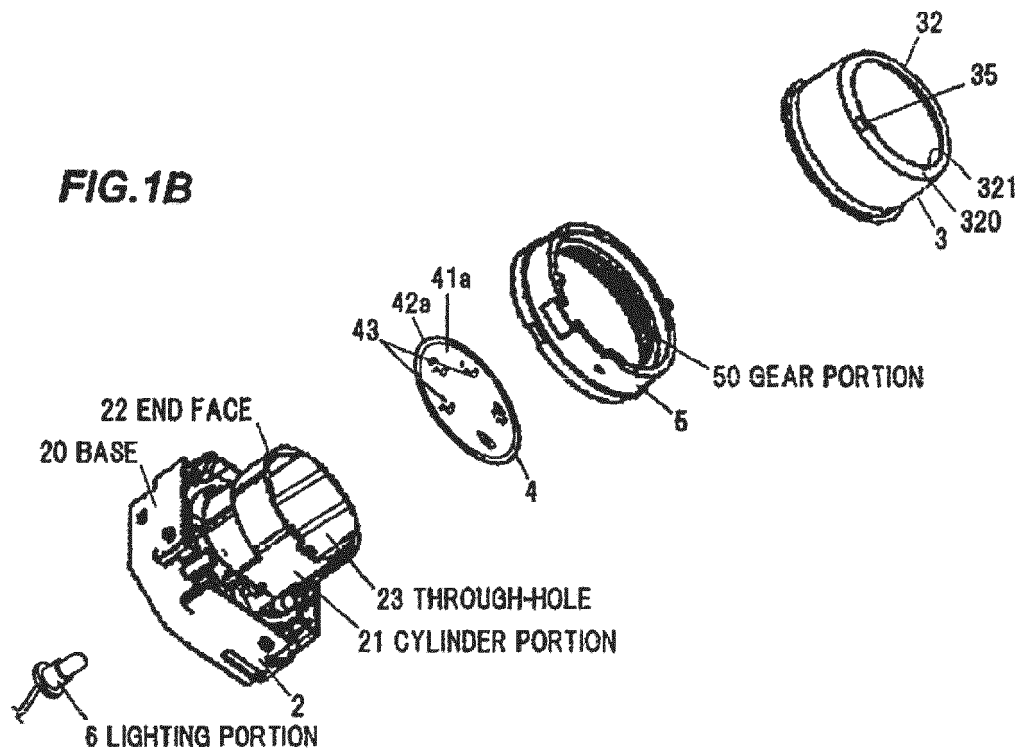


FIG.1B



Description

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0001] The invention relates to an operation device.

2. DESCRIPTION OF THE RELATED ART

[0002] A rotary operation switch is known which is provided with a rotational operation portion and a sing portion. The rotational operation portion has a first translucent portion to show an operating state and is to be turned to change the operating state. The sign portion is arranged behind the rotational operation portion and has an indicator portion composed of plural indicators for indicating the operation state (see, e.g., JP-A-2006-164856).

[0003] In this rotary operation switch, the first translucent portion provided on the rotational operation portion is located in a region close to the circumferential edge, not in the center region. An operator can visually check the indicators indicating the operation state through the first translucent portion.

SUMMARY OF THE INVENTION

[0004] The rotary operation switch, however, is configured to visually check the indicators through the first translucent portion. Thereby, problems may arise that it is necessary to increase the size of the first translucent portion when the size of the indicators is increased to improve visibility and the shape of indicators is limited by the shape of the first translucent portion.

[0005] Thus, it is an object of the invention to provide an operation device that is improved in design freedom of indicator and that allows a pointer for pointing the indicator to be composed by only few components.

[0006] According to an embodiment of the invention, an operation device comprises:

a rotational operation portion that is rotationally operated and comprises an opening formed in the center of an upper portion and a transmissive region formed at a circumference portion of the opening to allow light to pass through; and
an indicator portion that comprises an exposed region exposed from the opening of the rotational operation portion, a transmissive-reflective region provided around the exposed region so as to face the transmissive region and indicators formed in the exposed region, the transmissive-reflective region transmitting a portion of artificial light travelling from its back surface and reflecting a portion of natural light incident on its front surface through the transmissive region.

[0007] According to an embodiment of the invention, an operation device can be provided that is improved in design freedom of indicator and that allows a pointer for pointing the indicator to be composed by only few components.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Next, the present invention will be explained in more detail in conjunction with appended drawings, wherein:

FIG.1A is a perspective view showing an example of an operation device of an embodiment;

FIG.1B is an exploded view showing an example of a portion of the operation device;

FIG.2A is an exemplary top view showing the upper surface of the operation device in the embodiment;

FIG.2B is a top view showing an example of a faceplate of the operating device;

FIG.2C is an exemplary cross sectional view when a cross section taken along a line II(c)-II(c) in **FIG.2B** is viewed in an arrow direction;

FIG.3A is an exemplary cross sectional view showing the operation device in the embodiment when a cross section taken along a line III(a)-III(a) in **FIG.2A** is viewed in an arrow direction; and

FIG.3B is an exemplary cross sectional view showing an operation device in a modification and corresponding to **FIG.3A**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Summary of the embodiments

[0009] An operation device in the embodiment is generally composed of a rotational operation portion that is rotationally operated and comprises an opening formed in the center of an upper portion and a transmissive region formed at a circumference portion of the opening to allow light to pass through, and an indicator portion that comprises an exposed region exposed from the opening of the rotational operation portion, a transmissive-reflective region provided around the exposed region so as to face the transmissive region and indicators formed in the exposed region, the transmissive-reflective region transmitting a portion of artificial light travelling from its back surface and reflecting a portion of natural light incident on its front surface through the transmissive region.

Embodiment

General configuration of operation device 1

[0010] **FIG.1A** is a perspective view showing an example of an operation device of an embodiment and **FIG.1B** is an exploded view showing an example of a portion of

the operation device. **FIG.2A** is an exemplary top view showing the upper surface of the operation device in the embodiment, **FIG.2B** is a top view showing an example of a faceplate of the operating device and **FIG.2C** is an exemplary cross sectional view when a cross section taken along the line II(c)-II(c) in **FIG.2B** is viewed in an arrow direction. Note that, a scale ratio in each drawing of the embodiment may be different from the actual scale ratio.

[0011] The operation device **1** is used to operate, e.g., an air conditioning system in a vehicle. The operation device **1** in the present embodiment is a device capable of selecting air vents for discharging the temperature-regulated air, but is not limited thereto and can be used for temperature setting of air conditioning system, parameter setting of other electronic devices or switching of functions, etc. In addition, a single operation device **1** or plural operation devices **1** can be used as an operating device for an electronic device.

[0012] As shown in **FIG.1A**, the operation device **1** is generally composed of a dial **3** as a rotational operation portion which is rotationally operated and has an opening **321** formed in the center of an upper portion **32** and a transmissive region formed at a circumference portion of the opening **321** to allow light to pass through, and a faceplate **4** as an indicator portion which has an exposed region **41a** exposed from the opening **321** of the dial **3**, a transmissive-reflective region **42a** provided around the exposed region **41a** so as to face the transmissive region and indicators formed in the exposed region **41a**. The transmissive-reflective region **42a** transmits a portion of artificial light travelling from a back surface **4b** and reflects a portion of natural light incident on a front surface **4a** through the transmissive region.

[0013] The transmissive region allowing light to pass through is, e.g., a notch portion **35** formed by cutting out a portion of the upper portion **32**, as shown in **FIG.1A**. The indicators are, e.g., plural symbols **43**.

[0014] The operation device **1** is provided with, e.g., a main body **2**, a rotation transmission member **5** and a lighting portion **6**, as shown in **FIG.1B**.

Configuration of the main body 2

[0015] The main body **2** is formed of, e.g., a resin material such as ABS (acrylonitrile butadiene styrene). The main body **2** has a base **20** having a rectangular box shape and a cylinder portion **21** having a cylindrical shape, as shown in **FIG.1B**.

[0016] The cylinder portion **21** is integrated with the base **20** of the main body **2** and is enclosed by the dial **3**. In other words, the dial **3** is arranged to cover the cylinder portion **21**. The dial **3** rotates on the cylinder portion **21** about a rotation axis **100**.

[0017] The cylinder portion **21** is configured to not be in contact with the dial **3**. In addition, an end face **22** of the cylinder portion **21** is located inside the dial **3** when the dial **3** is attached to the main body **2**. That is, the cylinder portion **21** is not configured to support rotation

of the dial **3**, but is configured so that an artificial light **60** of the lighting portion **6** attached to the main body **2** is guided to the faceplate **4**.

[0018] A gear engaged with a gear portion **50** of the rotation transmission member **5** is provided on the main body **2**. In **FIG.1A**, rotation of the dial **3** in forward and reverse directions is indicated by arrows A and B.

Configuration of the dial 3

[0019] The dial **3** is formed of, e.g., a resin such as ABS or a metal material such as aluminum. The dial **3** has a truncated cone shape having a smaller diameter at the top.

[0020] The upper portion **32** of the dial **3** protrudes along the rotation axis **100** and defines the circular opening **321**. The notch portion **35** is formed by cutting out a portion of the upper portion **32**. The notch portion **35**, together with the transmissive-reflective region **42a** exposed through the notch portion **35**, constitutes a pointer **10** for pointing the symbols **43** on the faceplate **4**. Although the notch portion **35** in **FIG.2A** is connected to the opening **321**, it is not limited thereto.

[0021] Although the upper portion **32** of the dial **3** is integrated, the configuration is not limited thereto. A separate member having the notch portion **35** may be attached to the dial **3**.

Configuration of the faceplate 4

[0022] **FIG.3A** is an exemplary cross sectional view showing the operation device in the embodiment when a cross section taken along the line III(a)-III(a) in **FIG.2A** is viewed in an arrow direction.

[0023] On the faceplate **4**, selectable air vents of an air conditioning system are indicated by the plural symbols **43**. An operator can change the air vents by turning the pointer **10** to point the symbol **43** indicating a desired air vent.

[0024] The faceplate **4** has, e.g., a circular disc shape on which the belt-shaped transmissive-reflective region **42a** is formed along the circumference, as shown in **FIG.2C**. The width of the belt shape does not extend beyond the opening **321** on the top view.

[0025] Meanwhile, the exposed region **41a** located in the center of the faceplate **4** has a circular shape corresponding to the opening **321** of the dial **3**, and the plural symbols **43** are arranged along the circumference. The plural symbols **43** transmit, e.g., the artificial light **60** travelling from the back surface **4b** side of the faceplate **4** and are illuminated by the lighting portion **6**.

[0026] The faceplate **4** is attached to, e.g., the end face **22** of the cylinder portion **21** of the main body **2** by an adhesive. However, the attachment of the faceplate **4** is not limited thereto. The faceplate **4** may be integrally formed with the cylinder portion **21**. Alternatively, the faceplate **4** may be, e.g., fitted to a recess formed on the cylinder portion **21** and thereby attached to the cylinder

portion 21.

[0027] The faceplate 4 has, e.g., a base 40, and first and second printed portions 41 and 42 which are formed on a back surface 40b of the base 40, as shown in FIG.2C. The base 40 has a shape which is convex in the center, as shown in FIGS.2B and 2C. The base 40 is formed of, e.g., a resin material with high light transmission such as polycarbonate. In the present embodiment, the front surface 4a of the faceplate 4 is the front surface of the base 40. As an alternative, the first printed portion 41 and the second printed portion 42 may be formed on the front surface of the base 40.

[0028] The first printed portion 41 and the second printed portion 42 are formed by printing. The exposed region 41a is a region formed of the first printed portion 41. The transmissive-reflective region 42a is a region formed of the second printed portion 42.

[0029] The first printed portion 41 is printed in, e.g., black so that the artificial light 60 is blocked in a region other than the plural symbols 43. The plural symbols 43 are printed in, e.g., white so that a portion of the artificial light 60 can be transmitted therethrough.

[0030] The second printed portion 42 is printed in, e.g., a color other than black so as to transmit a portion of the artificial light 60, and is preferably printed in white so that natural light 7 is reflected easily. In the present embodiment, the second printed portion 42 is printed in white.

[0031] Transmitted light 61, which is transmitted through the second printed portion 42 (the transmissive-reflective region 42a) as shown in FIG.3A, is visible through the notch portion 35 of the dial 3 for an operator who thus visually recognizes as if the notch portion 35 is emitting light, i.e., visually recognizes as light from the pointer 10.

[0032] Meanwhile, the second printed portion 42 also reflects a portion of the natural light 7 which is incident through the notch portion 35 of the dial 3, as shown in FIG.3A. Therefore, even when the faceplate 4 is not illuminated, reflected light 70 which is the natural light 7 reflected by the front surface 4a of the base 40 and by a front surface 420 of the second printed portion 42 is visible for an operator through the notch portion 35 of the dial 3. In other words, the operator can visually check the pointer 10 even when the faceplate 4 is not illuminated.

[0033] The first printed portion 41 may be configured to have a large radius and to be located under the opening 321 within a range capable of providing required visibility of the pointer 10 so that the transmitted light 61 transmitted through the second printed portion 42 does not leak from the opening 321.

[0034] As a modification, the second printed portion 42 may be configured that color changes in a stepwise manner. Alternatively, the second printed portion 42 may be configured that color changes continuously, such as gradation.

Configuration of the lighting portion 6

[0035] The lighting portion 6 illuminates at least the transmissive-reflective region 42a of the faceplate 4 through a through-hole 23 of the cylinder portion 21 of the main body 2. The lighting portion 6 is configured to include, e.g., a light-emitting element such as LED (light emitting diode).

[0036] The lighting portion 6 is arranged, e.g., inside the through-hole 23 of the cylinder portion 21 of the main body 2 and illuminates the faceplate 4 from the back surface 4b through the through-hole 23.

[0037] The lighting portion 6 is lit when, e.g., headlights of a vehicle are lit. Then, the artificial light 60 output from the lighting portion 6 passes through the cylinder portion 21 of the main body 2 and is then incident on the faceplate 4 from the back surface 4b.

[0038] The artificial light 60 which reaches the first printed portion 41 of the faceplate 4 is blocked in the region other than the symbols 43. Then, only the artificial light 60, which reaches the symbols 43 and is transmitted through the base 40, passes through the opening 321 of the dial 3 and is visibly checked by the operator.

[0039] Meanwhile, the artificial light 60, which reaches the second printed portion 42 of the faceplate 4 and is transmitted through the base 40, is blocked by the upper portion 32 of the dial 3 in a region except the region facing the notch portion 35. Then, only the artificial light 60 passing through the notch portion 35 is visibly checked by the operator.

Effects

[0040] The operation device 1 in the embodiment allows a high degree of freedom in design of indicator and also allows the number of components of the pointer for pointing the indicators to be reduced. In detail, in the operation device 1 in which the pointer 10 is arranged on the circumferential portion of the dial 3, the exposed region 41a is larger than when not adopting this configuration, hence, a high degree of freedom in design of indicator. In addition, in the operation device 1, the pointer 10 is formed by a combination of the notch portion 35 of the dial 3 and the transmissive-reflective region 42a (the second printed portion 42) of the faceplate 4. Therefore, unlike a device in which a light guide for guiding light from a lighting portion is arranged on a dial, it is not necessary to provide such a light guide and this reduces the components of the pointer 10 and thereby allows the manufacturing cost to be reduced.

[0041] Since the operation device 1 is configured that the artificial light 60 is output from the notch portion 35 without using a light guide, less artificial light 60 is lost, the symbols 43 are illuminated efficiently and the pointer 10 is also formed, as compared to a device in which light passes through an opening formed on a side surface of the cylinder portion 21 of the main body 2 and is guided to the notch portion 35 by a light guide. In addition, it is

easy to form the main body **2** of the operation device **1** since it is not necessary to form an opening on the cylinder portion **21**. Furthermore, due to high luminous efficacy, the operation device **1** can use a low-output light-emitting element, allowing the manufacturing cost and power consumption to be reduced.

[0042] Since a light guide as described above is not required for the operation device **1**, it is possible to reduce a gap between the dial **3** and the cylinder portion **21** of the main body **2** and thereby to downsize the operation device **1**.

Modification

[0043] **FIG.3B** is an exemplary cross sectional view showing an operation device in a modification and corresponding to **FIG.3A**. The operation device **1** in the modification has a translucent member **8** arranged at the notch portion **35**. The translucent member **8** is formed of a resin material such as polycarbonate or a material with high light transmission such as glass.

[0044] The translucent member **8** may be, e.g., fitted to the notch portion **35** or may be formed together with the dial **3** by co-injection molding.

[0045] In addition, the translucent member **8** may be configured to contain light-scattering particles for the purpose of improving visibility. The translucent member **8** may further have a lens function.

[0046] The artificial light **60**, which reaches the second printed portion **42** of the faceplate **4** and is transmitted through the base **40**, is blocked by the upper portion **32** of the dial **3** in a region except the region facing the notch portion **35**. Then, only the artificial light **60** passing through the translucent member **8** of the notch portion **35** is visibly checked by the operator.

[0047] The second printed portion **42** also reflects a portion of the natural light **7** which is incident through the translucent member **8** of the notch portion **35** of the dial **3**, as shown in **FIG.3B**. Therefore, even when the faceplate **4** is not illuminated, the reflected light **70** which is the natural light **7** reflected by the front surface **4a** of the base **40** and by the front surface **420** of the second printed portion **42** is visible for an operator through the translucent member **8** of the notch portion **35** of the dial **3**. In other words, the operator can visually check the pointer **10** even when the faceplate **4** is not illuminated.

[0048] Although the embodiment and the modification of the invention have been described, the embodiment and the modification are merely an example and the invention according to claims is not to be limited thereto. These new embodiment and modification may be implemented in various other forms, and various omissions, substitutions and changes, etc., can be made without departing from the gist of the invention. In addition, all combinations of the features described in the embodiment and the modification are not necessary to solve the problem of the invention. Further, these embodiment and modification are included within the scope and gist of the

invention and also within the invention described in the claims and the range of equivalency.

5 Claims

1. An operation device, comprising:

a rotational operation portion that is rotationally operated and comprises an opening formed in the center of an upper portion and a transmissive region formed at a circumference portion of the opening to allow light to pass through; and an indicator portion that comprises an exposed region exposed from the opening of the rotational operation portion, a transmissive-reflective region provided around the exposed region so as to face the transmissive region and indicators formed in the exposed region, the transmissive-reflective region transmitting a portion of artificial light travelling from its back surface and reflecting a portion of natural light incident on its front surface through the transmissive region.

25 2. The operation device according to claim 1, wherein the indicator portion is circle-shaped, and the transmissive-reflective region is belt-shaped along a periphery of the circle.

30 3. The operation device according to claim 1 or 2, further comprising:

a main body; and
a cylinder portion that is integrated with the main body and is enclosed by the rotational operation portion,

wherein the indicator portion is arranged on an upper portion of the cylinder portion.

40 4. The operation device according to claim 3, further comprising a lighting portion for illuminating at least the transmissive-reflective region of the indicator portion through a through-hole of the cylinder portion.

45 5. The operation device according to any one of claims 1 to 3, wherein the transmissive region comprises a notch portion formed in the rotational operation portion.

50 6. The operation device according to claim 2 or 3, wherein the transmissive region comprises a notch portion formed in the rotational operation portion, and
55 wherein the notch portion has substantially a same width as the belt-shaped transmissive-reflective region in radial direction of the circle.

7. The operation device according to any one of claims **1 to 3**, wherein no light guide is disposed between the main body and the rotational operation portion.

5

10

15

20

25

30

35

40

45

50

55

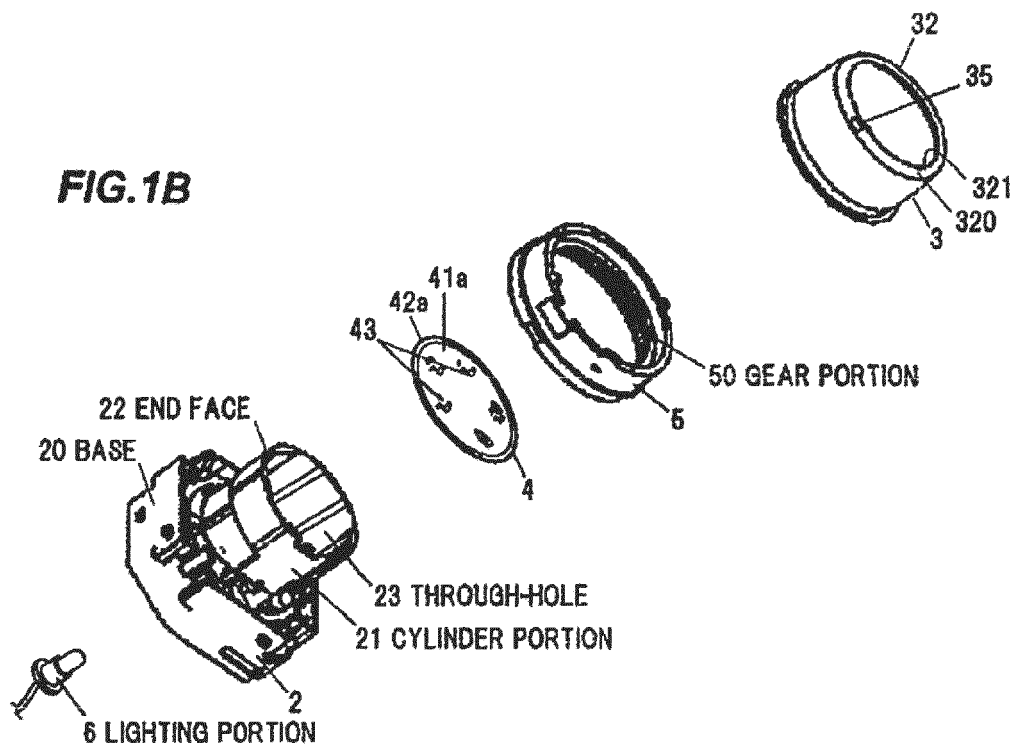
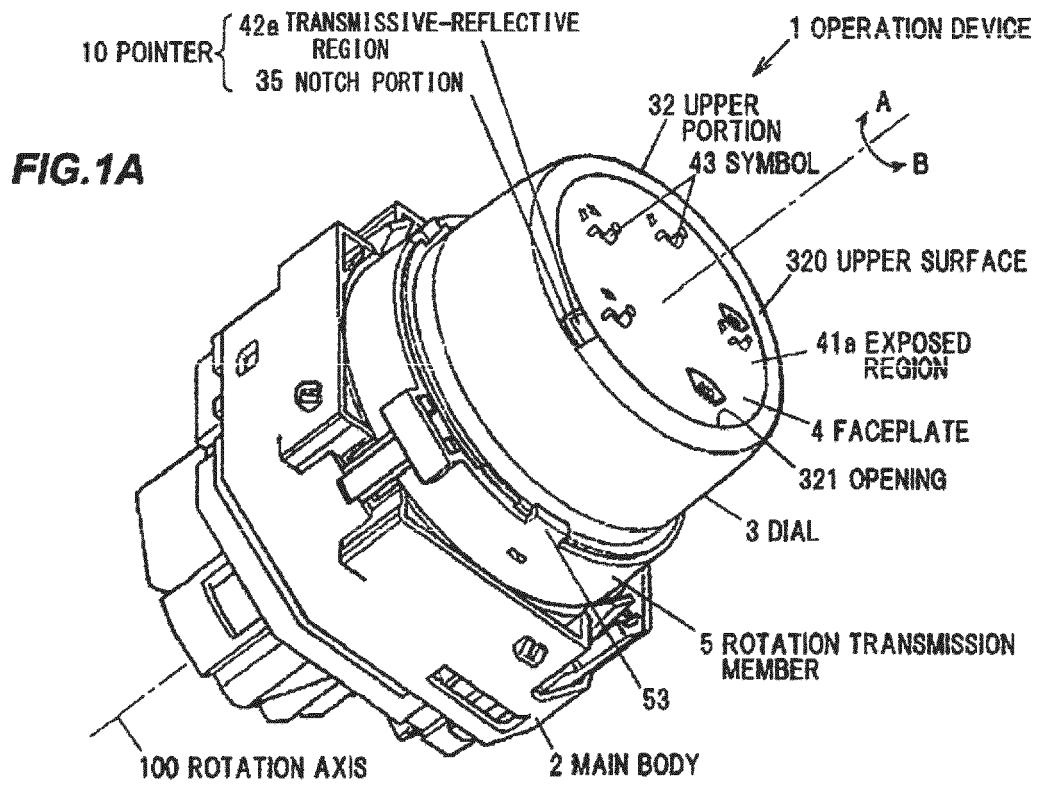


FIG.2A

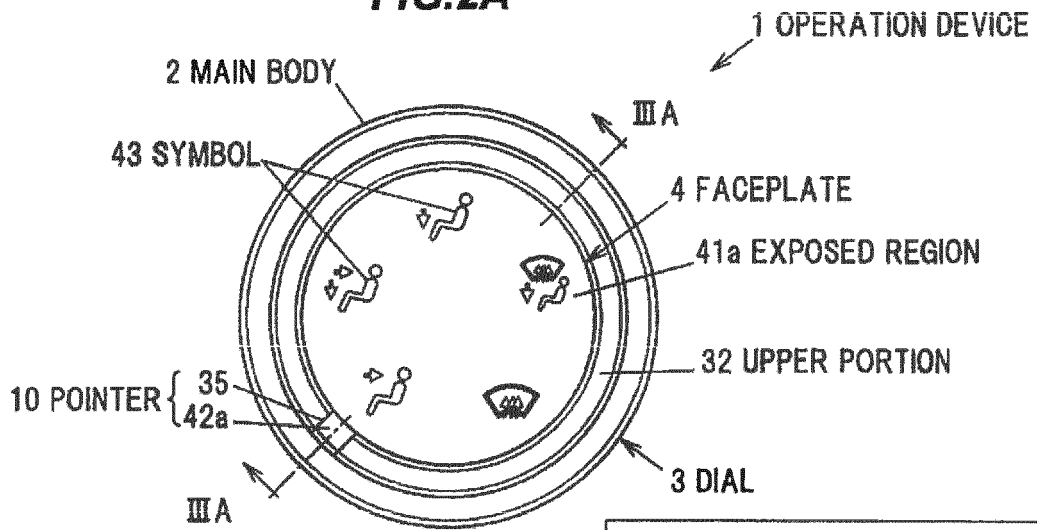


FIG.2B

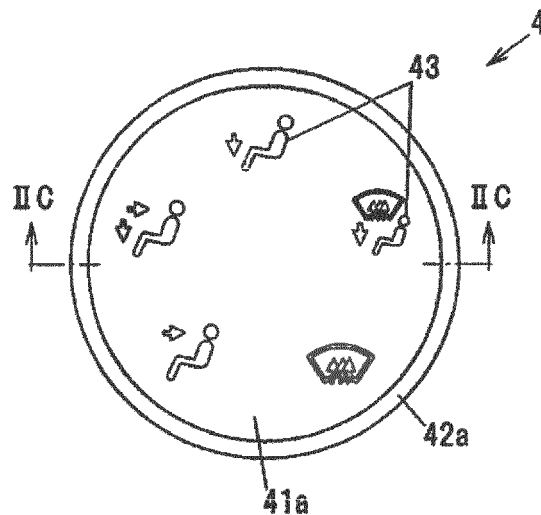


FIG.2C

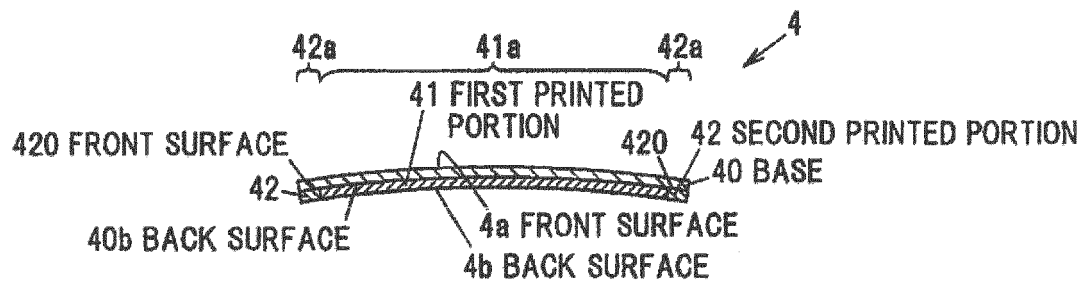


FIG.3A

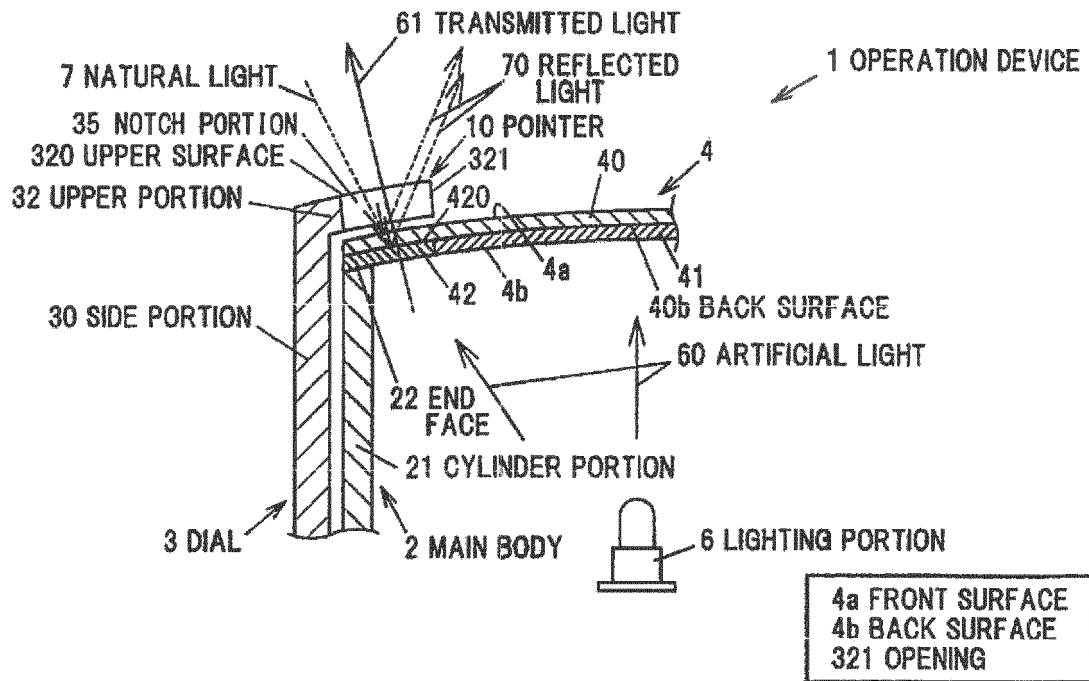
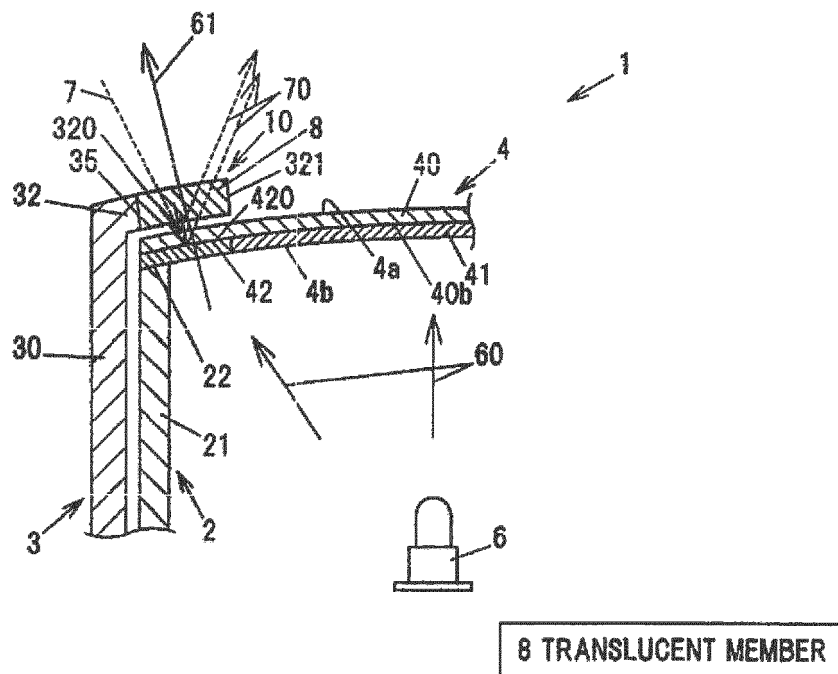


FIG.3B





EUROPEAN SEARCH REPORT

Application Number
EP 16 16 5602

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2013 180737 A (TOKAI RIKI CO LTD) 12 September 2013 (2013-09-12)	1-6	INV. H01H9/16 G05G1/10 H01H9/18 H01H19/02 H01H19/14
A	* figures 1-9 * * paragraph [0015] * * paragraph [0023] *	7	
X	US 2010/101363 A1 (HISADA MASAHI TO [JP] ET AL) 29 April 2010 (2010-04-29) * figures 1,2 *	1-6	
A	US 2007/029181 A1 (OGAWA SATOSHI [JP]) 8 February 2007 (2007-02-08) * figures 1A, 1B * * paragraph [0023] *	1-7	
A	JP 2010 067492 A (TOKAI RIKI CO LTD) 25 March 2010 (2010-03-25) * figure 4 *	1,4	TECHNICAL FIELDS SEARCHED (IPC) H01H G05G
A	US 2013/175147 A1 (HISADA MASAHI TO [JP] ET AL) 11 July 2013 (2013-07-11) * figure 2 *	1	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 25 August 2016	Examiner Bilard, Stéphane
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 16 5602

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25-08-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2013180737 A	12-09-2013	CN 103303095 A	18-09-2013
		JP 5763572 B2	12-08-2015
		JP 2013180737 A	12-09-2013
US 2010101363 A1	29-04-2010	CN 101728109 A	09-06-2010
		JP 5117994 B2	16-01-2013
		JP 2010102558 A	06-05-2010
		US 2010101363 A1	29-04-2010
US 2007029181 A1	08-02-2007	CN 1937128 A	28-03-2007
		CN 200983117 Y	28-11-2007
		EP 1750292 A1	07-02-2007
		JP 4636545 B2	23-02-2011
		JP 2007038801 A	15-02-2007
		US 2007029181 A1	08-02-2007
JP 2010067492 A	25-03-2010	JP 5102161 B2	19-12-2012
		JP 2010067492 A	25-03-2010
US 2013175147 A1	11-07-2013	CN 103197724 A	10-07-2013
		JP 2013141868 A	22-07-2013
		US 2013175147 A1	11-07-2013

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2006164856 A [0002]