(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 418 603 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
12.05.2004 Bulletin 2004/20

(51) Int Cl.[7]: **H01H 21/24**

(21) Application number: **03025671.3**

(22) Date of filing: **10.11.2003**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **11.11.2002 JP 2002327212**

(71) Applicant: **ALPS ELECTRIC CO., LTD.**
Tokyo 145-8501 (JP)

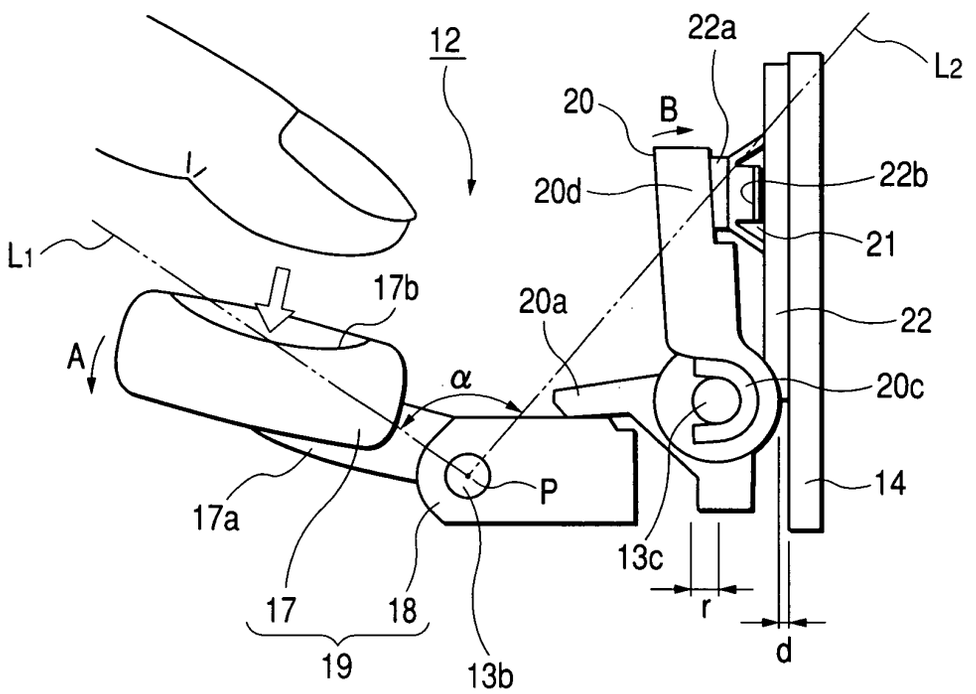
(72) Inventor: **Amano, Toshiaki, Alps Electric Co., Ltd.**
Tokyo 145-8501 (JP)

(74) Representative: **Klunker . Schmitt-Nilson . Hirsch**
Winzererstrasse 106
80797 München (DE)

(54) Switching device

(57) A switching device has an operation member (19) having an operation key (17) which is connected to and rotatably supported by a key holder lever (18); a driving lever (20) engaged with the operation member (19) and rotationally driven when the operation key (17) is pressed; and a switching element (21) press-driven by the rotationally-driven driving lever (20), the operation key (17) with a keyboard operational configuration disposed at a front surface of a front panel (11) being pressed downward. Here, a switching element (21) is mounted on a circuit substrate (14) which is held upright, and a spacing d between the circuit (14) and the driving lever (20) is set to a value smaller than a radius r of a boss (13c) serving as rotation axis of the driving lever (20), thereby preventing the driving lever (20) from being disconnected even when a simple attachment structure is employed.

FIG. 3



EP 1 418 603 A1

Description

[0001] The present invention relates to a switching device wherein a switching element provided at a rear face of a front panel is actuated when an operation key provided at the front panel is pressed and, particularly, to a switching device suitably provided in vehicles.

[0002] Various operation keys and a display unit are arranged on a front panel (control panel) of an on-vehicle electric appliance such as a car air conditioner and a car audio. These operation keys serve to actuate switching elements such as push switches provided at a rear face of the front panel, and, as shown in Fig. 7a, conventional switching device has a structure wherein an operation key 1 having its upper end pivoted is pressed from the front so that a switching element 3 is press-driven via a driving rod 2 (see JP-A-2001-14978 (Fig. 2), for example).

[0003] In the conventional switching device shown in Fig. 7, an axis 1a is provided at the upper end of the operation key 1. Since the axis 1a is pivoted on a holding plate 4a of a supporting case 4, the operation key 1 is supported by the supporting case 4 in such a fashion that it rotates within the range of predetermined angles using the axis 1a as a rotation axis. The front panel 5 has an opening 5a for placing therein the operation key 1, and the operation key 1 moves backward (toward right side in the drawing) in the opening 5a when an operating force indicated by an arrow F is applied to the operation key 1 by pressing. A circuit substrate 6 is provided upright at a region on a rear face of the front panel 4, and a push type switching element 3 is mounted on the circuit substrate 6. The driving rod 2 is provided between a bottom end of the operation key 1 and the switching element 3, and the driving rod 2 moves toward the circuit substrate 6 when the operation key 1 is pressed.

[0004] Accordingly, it is possible to actuate the switching element 3 by pressing the operation key 1 to move the driving rod 2 by a predetermined stroke. Further, by releasing the operation force in such ON state, the operation key 1 is pressed back via the driving rod 2 by way of a self reset force of the switching element 3 returning to the OFF position, so that the operation key 1 automatically returns to the original non-operation position. In addition, a switching device having a structure wherein the front panel 5 rotatably supports the upper end of the operation key 1 in place of the supporting case 4 is known.

[0005] In the case of assembly of the conventional switching device described above, it is necessary to secure in the front panel 5 the opening 5a having a size similar to that of the operation key 1; however, because there has been a tendency toward an increase in size of the display unit and an increase in the number of operation keys in the front panel of the on-vehicle electric appliance due to the recent multifunctionalization, it is becoming difficult to provide the front panel 5 with many openings 5a for the operation keys 1. In the case of downsizing the front panel 5, it will be difficult to secure a sufficient number of openings 5a for the operation keys 1. Of course, it is possible to use small size opening 5a if the operation key is reduced in size, but such downsizing is not preferred since it remarkably deteriorates the operability. In order to deal with the multifunctionalization of electric appliance and the downsizing of front panel, there has recently been a demand for a switching device having a novel structure wherein the openings for the operation keys to be provided in the front panel are downsized.

[0006] The present invention has been accomplished in view of the facts of the conventional technology, and an object thereof is to provide a switching device with good operability, which eliminates the need for securing a large opening for an operation key in the front panel.

[0007] As means for achieving the above object, a switching device according to the invention comprises an operation member having an operation key pressed downward for operation and disposed at a front side (or front face, respectively) of the front panel as being rotatably supported; a driving lever engaged with the operation member and rotationally driven when the operation key is pressed; and a switching element press-driven by the rotationally-driven driving lever.

[0008] In the thus-constituted switching device, the switching element is press-driven by way of the driving lever as the operation key projected frontward from the front panel being pressed downward, thereby enabling to operate the operation key facing upward with the ease of operating a keyboard as well as to eliminate the need for providing the front panel with a large opening for the operation key.

[0009] In the switching device, by adapting an angle formed by a first straight line connecting a point of action of an operation force to the operation member to a center of rotation of the operation member and a second straight line connecting a point of action of an operation force to the switching element to the center of rotation to be increased at the time of operation, it is possible to dispose the operation key at a bottom end of a front face of the front panel at the same time with disposing the switching element at an arbitrary height of a rear face of the front panel; thereby eliminating the risk that the operation key will deteriorate a design and operability of the front panel and making it easier to dispose at a desired position the circuit substrate on which the switching element and the like are mounted.

[0010] For example, when the switching element is mounted on the circuit substrate which is held upright, it is possible to have other electric components which are mounted together with the switching element on an identical plane, such as a light source, faced to the front panel. Further, in this case, by setting a spacing between the driving lever and the circuit substrate to a value smaller than a radius of a rotation axis of the driving lever, even if the rotation axis tends to be disconnected

from a bearing due to an excessive operation force or shock, it is possible to avoid the disconnection owing to the circuit substrate which controls positioning of the driving lever having the bearing. Therefore, improvements in assembly and a reduction in number of components are easily achieved since it is possible to attain sufficient assembly strength even by employing the simple attachment structure of snap-fitting the driving lever to the supporting member.

[0011] Further, in the switching device where the operation key projecting from the front face of the front panel is connected to a key holder supported rotatably as being disposed at the rear side (or rear face, respectively) of the front panel in the operation member and the key holder is engaged with the driving lever, the opening required on the front panel for the operation member can be significantly small since it is possible to connect the operation key to the key holder from the front and the rear of the front panel.

[0012] An embodiment of the invention will be described with reference to the drawings wherein:

Fig. 1 is a sectional view showing a switching unit in which a switching device according to this embodiment is incorporated;
Fig. 2 is a broken perspective view showing the switching unit;
Fig. 3 is a diagram illustrating an operations of the switching device;
Fig. 4 is a sectional view showing the supporting device shown in Figs. 1 and 2;
Fig. 5 is a diagram showing a rear face of the front panel shown in Figs. 1 and 2;
Fig. 6 is a sectional view showing the front panel; and
Fig. 7 shows a prior art switching unit.

[0013] A switching unit 10 shown in Figs. 1 and 2 is a part of an on-vehicle electric appliance and constituted essentially of a front panel 11, a plurality of switching devices 12 including a supporting case 13, a circuit substrate 14 on which a rubber sheet 22 is mounted, a connector 15, and a cover 16. Here, each of the switching devices 12 has an operation member 19 constituted of an operation key 17 and a key holder lever 18 coupled to the operation key 17, a driving lever 20 rotationally driven by the key holder lever 18, a pair of push type switching elements 21 press-driven by the driving lever 20, and the supporting case 13 rotatably supporting the key holder lever 18 and the driving lever 20, and the supporting case 13 is shared among the plurality of switching devices 12. The switching element 21 is a known one which has a movable contact portion 22b provided inside a click rubber 22a having the shape of a dome and projecting from the rubber sheet 22 and a fixed contact portion 14a provided on the circuit substrate 14, wherein the movable contact portion 22b and the fixed contact portion 14a face to each other as being connectable/disconnectable and the movable contact portion 22b is brought to contact with the fixed contact portion 14a when the click rubber 22a is pressed for a predetermined stroke to be buckled.

[0014] The front panel 11 is provided with a plurality of openings 11a in each of which a connecting shaft 17a of each of the operation keys 17 is placed and a plurality of display units 11b illuminated by light from a light emitting diode 23 mounted on the circuit substrate 14. A stiffening rib 11c is projected from the rear face of the front panel 11 as shown in Figs. 5 and,6. The front panel 11 is attached to a front end of the supporting case 13.

[0015] The operation key 17 is disposed at a front face of the front panel 11 with its pressed surface 17b being faced upward and is pressed downward. The connecting shaft 17a of the operation key 17 penetrates through the opening 11a of the front panel 11 to be press-fitted into a fitting hole 18a of the key holder lever 18. The connecting shaft 17a press-fitted into the fitting hole 18a is fixed to the key holder lever 18 with a fixing screw 24. Thus, the operation key 17 and the key holder lever 18 constituting the operation member 19 are connected to each other strongly. A mounting plate 18b is projected from each side of the key holder lever 18, and a hole 18c for inserting thereinto a boss 13b of the holding plate 13a projected from a front portion of the supporting case 13 is formed on each of the mounting plates 18b. Since the holding plate 13a has a flexibility in a direction of plate thickness, it is possible to achieve a state wherein the key holder lever 18 is rotatably supported by the supporting case 13 by thrusting the key holder lever 18 between a pair of the holding plates 13a facing to each other, whereby snapping the bosses 13b serving as rotation axes into the holes 18c at the time of assembly. The front panel 11 is attached to the supporting case 13 after thus snap-fitting the key holder lever 18 to the front portion of the supporting case 13, so that the stiffening rib 11c is disposed at a position controlling the flexibility of the holding plate 13a. A pair of engagement faces 18d on which projection pieces 20a of the driving lever 20 are mounted is provided respectively on shoulders of the key holder lever 18 sandwiching the fitting hole 18a.

[0016] Formed on each side of the driving lever 20 is the hole 20b into which the boss 13c projected from a rear portion of the supporting case 13 is inserted and a bearing 20c engaging with about a half of a periphery of the boss 13c as being adjacent to the hole 20b. It is possible to achieve a state wherein the driving lever 20 is engaged with the key holder lever 18 at the same time with being rotatably supported by the supporting case 13, by snapping the bosses 13c of the supporting case 13 into the holes 20b whereby mounting the projection pieces 20a on the engagement faces 18d of the key holder lever 18. The circuit substrate 14 on which the rubber sheet 22 is mounted is disposed at a position facing to a rear face of the driving lever 20 after thus snap-fitting the driving lever 20 to the rear portion of the sup-

porting case 13, and a spacing d between the driving lever 20 and the circuit substrate 14 is so set as to be smaller than a radius r of the boss 13c serving as the rotation axis of the driving lever 20 as shown in Fig. 3. Thus, even when the driving lever 20 is positioned erroneously due to a large external force, it is possible to prevent such a positioning error that causes the boss 13c to come off from the bearing 20c thanks to the control by the circuit substrate 14. In addition, the upper end of the driving lever 20 serves as a presser 20d which is normally in contact with the top of the click rubber 22a.

[0017] The rear face of the circuit substrate 14 is supported by the cover 16, and the cover 16 is attached to the supporting case 13 as a back cover. The click rubber 22a of the rubber sheet 22 mounted on the circuit substrate 14 is incorporated in the presser 20d of the driving lever 20 with a pretension. The connector 15 is connected to the circuit substrate 14, and a cable 25 led from the connector 15 is extended outward from a rear face of the cover 16.

[0018] In the case of assembly of the thus-constituted switching unit 10, the connecting shaft 17a of the operation key 17 inserted into the opening 11a of the front panel 11 is pressed into the fitting hole 18a of the key holder lever 18, and then the fixing screw 24 is clamped to form the operation member 19 into an integrated body. Next, the boss 13b serving as the rotation axis is snapped into the hole 18c to rotatably attach the operation member 19 to the front portion of the supporting case 13. Then, the front panel 11 is attached to the front end of the supporting case 13. The boss 13c serving as rotation axis is snapped into the hole 20b to rotatably mount the driving lever 20 on the rear portion of the supporting case 13 as well as to mount the projection piece 20a of the driving lever 20 on the engagement face 18d of the key holder lever 18. The connector 15 is connected to the circuit substrate 14 on which the rubber sheet 22 is mounted so that the circuit substrate 14 is provided upright at the rear face of the driving lever 20, and then the cover 16 supporting the circuit substrate 14 and the connector 15 from their rear faces is attached to the supporting case 13 as the back cover, whereby finishing the assembly.

[0019] Hereinafter, an operation of the switching unit 10 will be described. In a non-operation state, the operation member 19 maintains the posture indicated by a solid line in Fig. 1 and the operation key 17 is positioned at the uppermost point within rotation range, since the projection piece 20a of the driving lever 20 presses the engagement face 18d of the key holder lever 18 downward owing to the pretension of the click rubber 22a.

[0020] In this state, when an operator presses the pressed surface 17b of the operation key 17 downward, the key holder lever 18 is rotationally driven via the connecting shaft 17a to rotate the operation member 19 in the anti-clock direction (in a direction of an arrow A in Fig. 3) with the boss 13b being used as the rotation axis, so that the engagement face 18d presses up the projection piece 20a to rotate the driving lever 20 in a direction of an arrow B, whereby the presser 20d presses the click rubber 22a. Then, when the operation key 17 is pressed down to the position indicated by a broken line in Fig. 1, the click rubber 22a is pressed by the presser 20d by the predetermined stroke to buckle, so that the movable contact portion 22b is brought into contact with the fixed contact portion 14a thereby to switch the state of the switching element 21 from OFF to ON.

[0021] More specifically, in the switching device 12 of this embodiment, an angle α formed by a first straight line L1 connecting a point of action of the operation force to the operation member 19 to a center of rotation P of the operation member 19 and a second straight line L2 connecting a point of action of the operation force to the switching element 21 to the center of rotation P is increased at the time of operation as shown in Fig. 3. In contrast, in the conventional switching device shown in Fig. 7, the angle α is reduced at the time of operation. In other words, the switching device 12 of this embodiment has a structure wherein the pressed surface 17b of the operation key 17 moves away from the switching element 21 at the time of operation.

[0022] Further, when the operation force to the operation key 17 is released during the ON state, the shape of the click rubber 22a which has been buckled returns to the original dome shape, so that the movable contact portion 22b moves away from the fixed contact portion 14a to return the switching element 21 to the OFF state and that the projection piece 20a of the driving lever 20 is pressed back by the click rubber to press down the engagement face 18d of the key holder lever 18, thereby rotating the operation member 19 in the reverse direction to be returned automatically to the original non-operation position.

[0023] Thus, in the switching device 12 of this embodiment, since the operation key 17 projected from the front face of the front panel 11 is pressed downward to press-drive the switching element 21 by way of the driving lever 20, it is possible to operate the operation key 17 facing upward with the easiness of operating a keyboard. Further, since it is possible to maintain the size of the opening 11a for the operation member 19 required for the front panel 11 to be as small as to allow the elevation of the connecting shaft 17a, the front panel 11 affords a space to be easily adopted to multifunctionalization of an electric appliance, making it easy to achieve downsizing of the front panel 11 itself.

[0024] Also, since the switching device 12 has a structure wherein the pressed surface 17b of the operation key 17 moves away from the switching element 21 at the time of operation, it is possible to dispose the switching element 21 at an arbitrary height of the circuit substrate 14 provided upright behind the front panel 11 with the operation key 17 being disposed at the bottom end of the front face of the front panel 11. Therefore, the operation key 17 will not damage the design of the front panel 11, and it is possible to mount other electric com-

ponents such as the light emitting diode 23 which is preferred to be disposed opposite to the front panel 11 at desired positions of the circuit substrate 14.

[0025] Further, since the spacing d between the driving lever 20 and the circuit substrate 14 is set to a value smaller than the radius r of the boss 13c which is the rotation axis of the driving lever 20 in this embodiment, even if the boss 13c tends to be disconnected from the bearing 20c due to an excessive operation force or shock, it is possible to avoid the disconnection owing to the circuit substrate 14 which controls positioning of the driving lever 20 having the bearing 20c. Therefore, advantages in improving the assembly and reducing the number of components are derived since it is possible to achieve sufficient assembly strength at the same time with employing the simple attachment structure of snap-fitting the driving lever 20 to the rear portion of the supporting case 13.

[0026] Though the bosses 13b and 13c of the supporting case 13 are separately inserted into the hole 18c of the operation member 19 and the hole 20b of the driving lever 20 to serve as rotation axes in this embodiment, it is possible to provide the operation member 19 and the driving lever 20 with the rotation axes and to provide the supporting case 13 with the bearings. Also, though the switching device 12 in which two switching elements 21 are simultaneously actuated by one operation key 17 is described by way of example, it is possible to make correspondence between one operation key 17 and one or three or more switching elements 21; the structure of the switching element may be selected as required.

[0027] The present invention is carried out by way of the embodiment described above to achieve the following effects.

[0028] Since the operation key projected from the front face of the front panel is pressed downward to rotate the driving lever which press-drive the switching element by way of the driving lever in the switching device, it is possible to operate the operation key facing upward with the easiness of operating a keyboard. Further, there is no need for providing the front panel with a large opening for the operation key, and therefore the front panel 11 affords a space to be easily adopted to multifunctionalization of an electric appliance, making it easy to achieve downsizing of the front panel 11 itself.

[0029] Further, in the case where the spacing d between the driving lever and the circuit substrate is set to a value smaller than the radius r of the rotation axis of the driving lever, it is possible to avoid the rotation axis from being disconnected from the bearing even when the rotation axis tends to be disconnected from the bearing due to an excessive operation force or shock since positioning of the driving lever having the bearing or the rotation axis is controlled by the circuit substrate. Therefore, advantages in improving the assembly and reducing the number of components are readily derived since it is possible to achieve sufficient assembly strength even when the simple attachment structure of snap-fitting the driving lever to the supporting case is employed.

Claims

1. A switching device **characterized by** comprising: an operation member having an operation key pressed downward for operation and disposed at a front side of a front panel as being rotatably supported; a driving lever engaged with the operation member and rotationally driven when the operation key is pressed; and a switching element press-driven by the rotationally-driven driving lever.

2. The switching device according to claim 1, **characterized in that** an angle made by a first straight line connecting a point of action of an operation force to the operation member to a center of rotation of the operation member and a second straight line connecting a point of action of an operation force to the switching element to the center of rotation is increased at the time of operation.

3. The switching device according to claim 1 or 2, **characterized in that** the switching element is mounted on a circuit substrate held upright.

4. The switching device according to claim 2 or 3, **characterized in that** a spacing between the driving lever and the circuit substrate is set to a value smaller than a radius of a rotation axis of the driving lever.

5. The switching device according to any one of claims 1 to 4, **characterized in that** the operation member has a structure wherein the operation key projecting frontward from the front panel is connected to a key holder supported rotatably as being disposed on a rear side of the front panel, the key holder being engaged with the driving lever.

FIG. 1

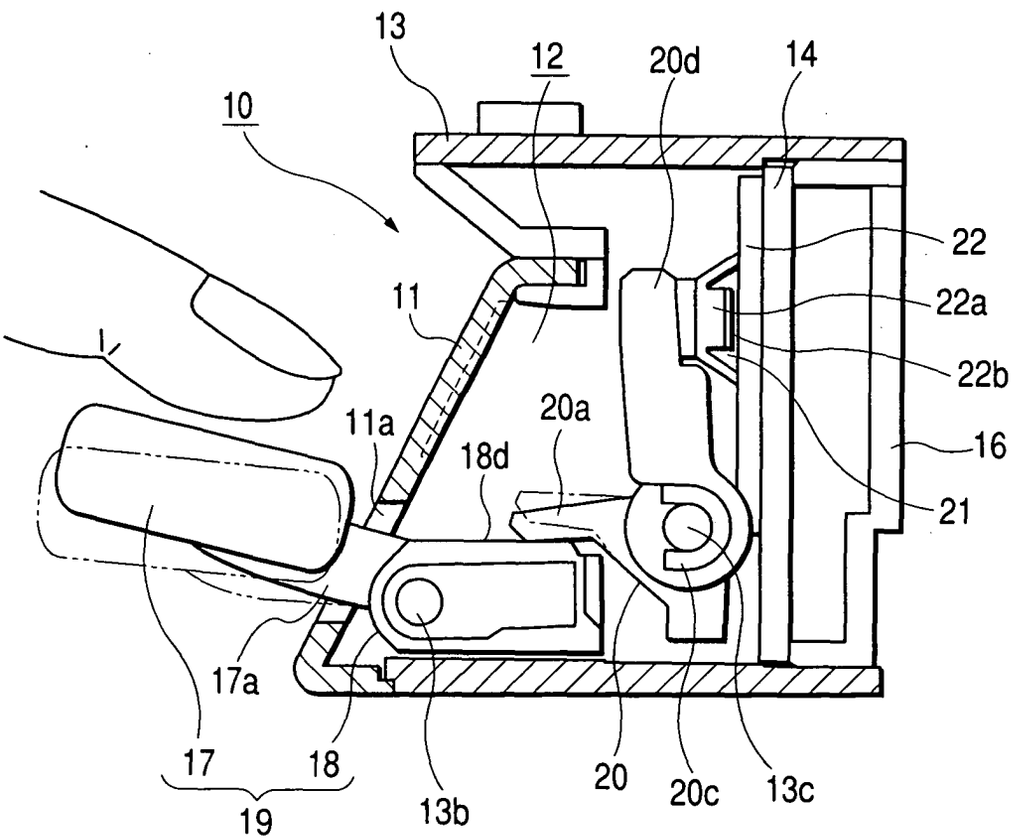

13
12
20d
14
10
22
11
22a
22b
20a
11a
18d
16
21
17a
17
18
19
13b
20
20c
13c

FIG. 2

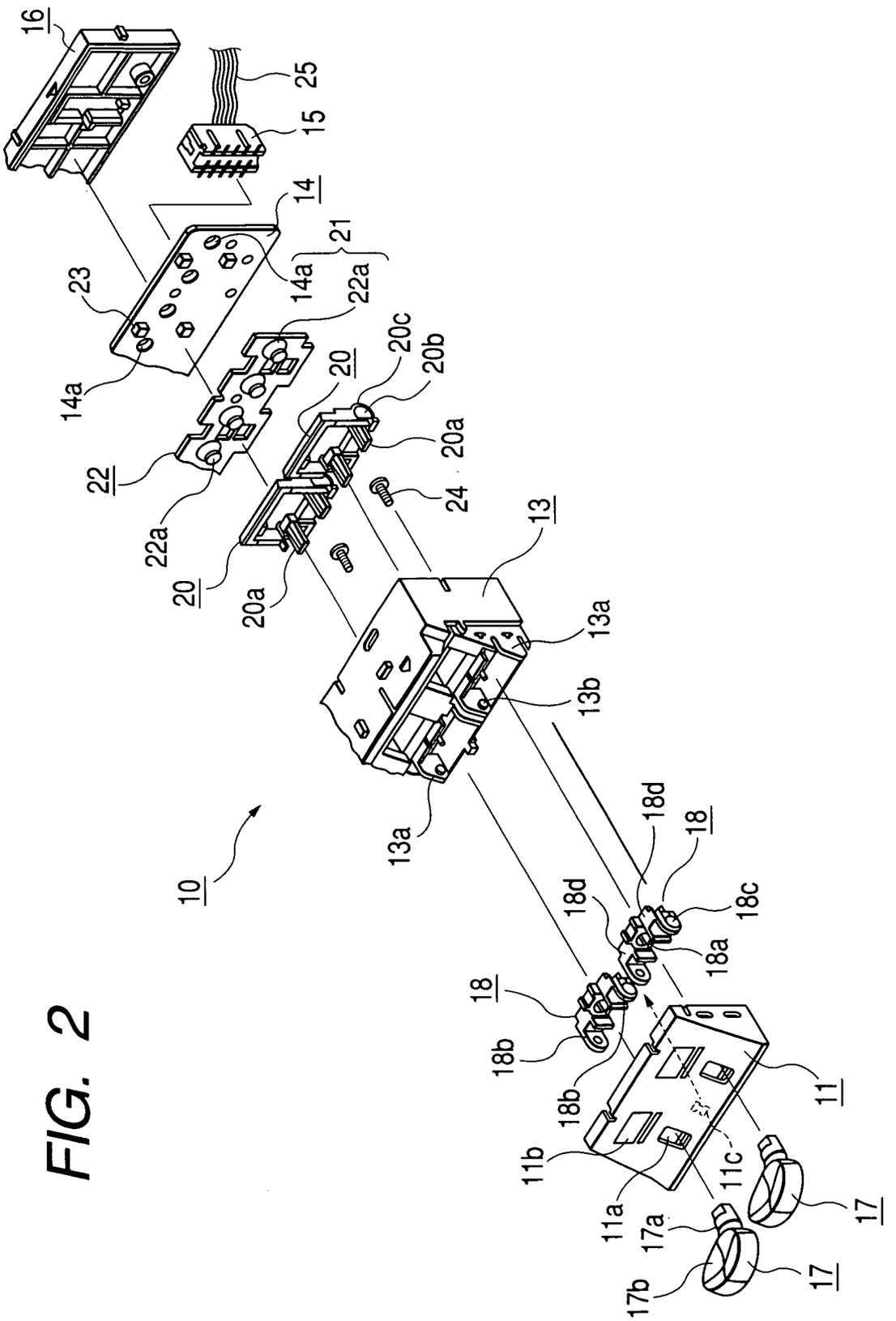

16
25
15
14
21
14a
22a
23
14a
22
20
20c
20b
20a
24
22a
20
20a
13
13a
13b
13a
10
18d
18
18d
18c
18a
18
18b
18b
11
11b
11c
11a
17
17a
17b
17

FIG. 3

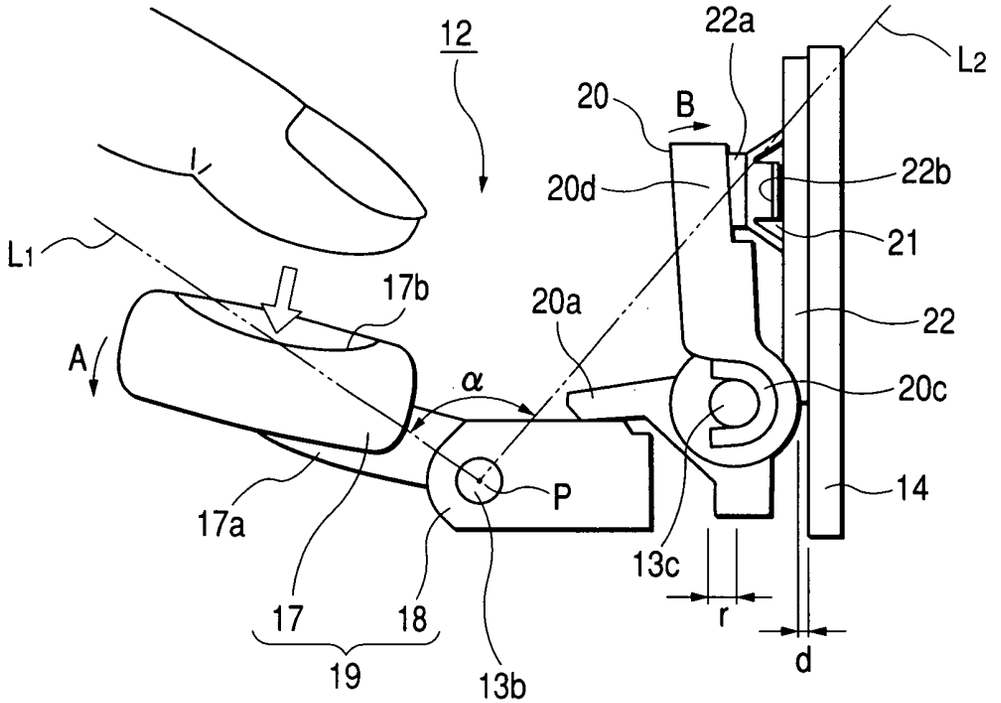

12
22a
L2
20
B
20d
22b
21
L1
17b
20a
22
A
α
20c
P
14
17a
13c
r
17
18
d
19
13b

FIG. 4

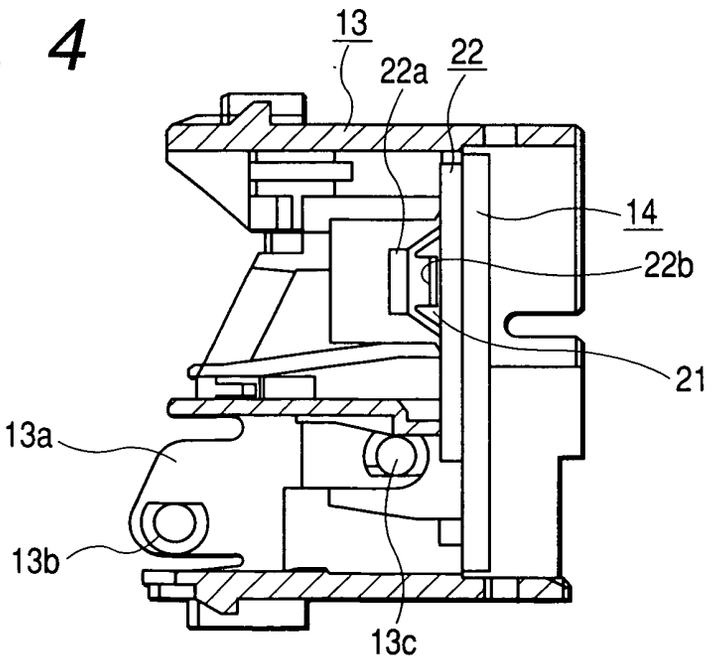

13
22a
22
14
22b
21
13a
13b
13c

FIG. 5

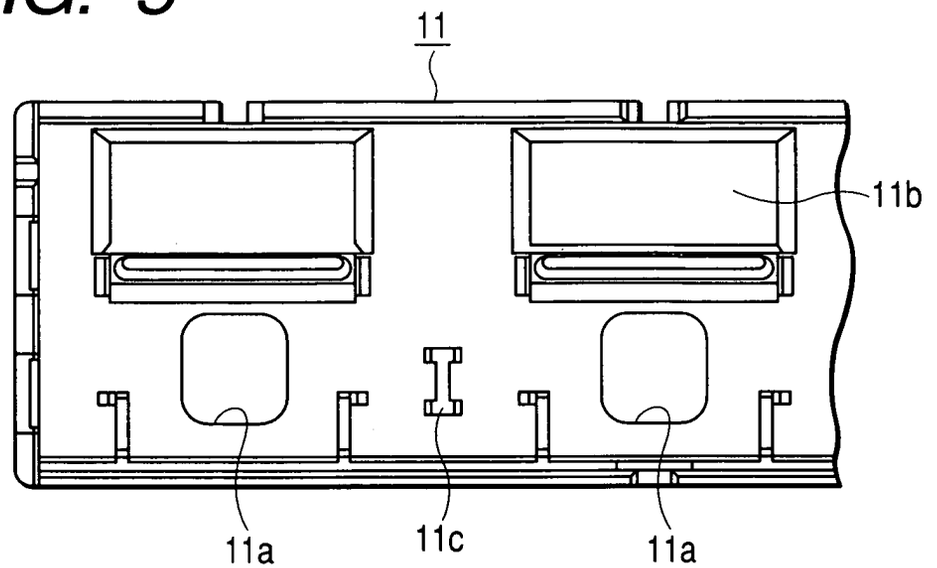


FIG. 6

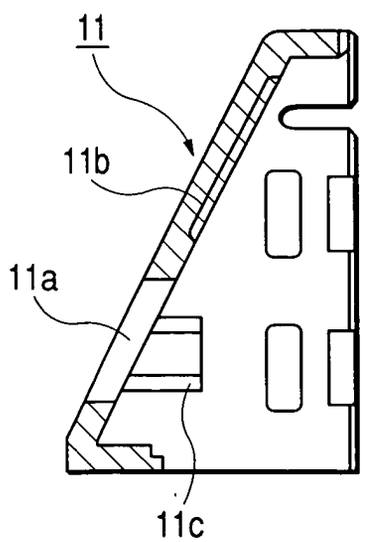
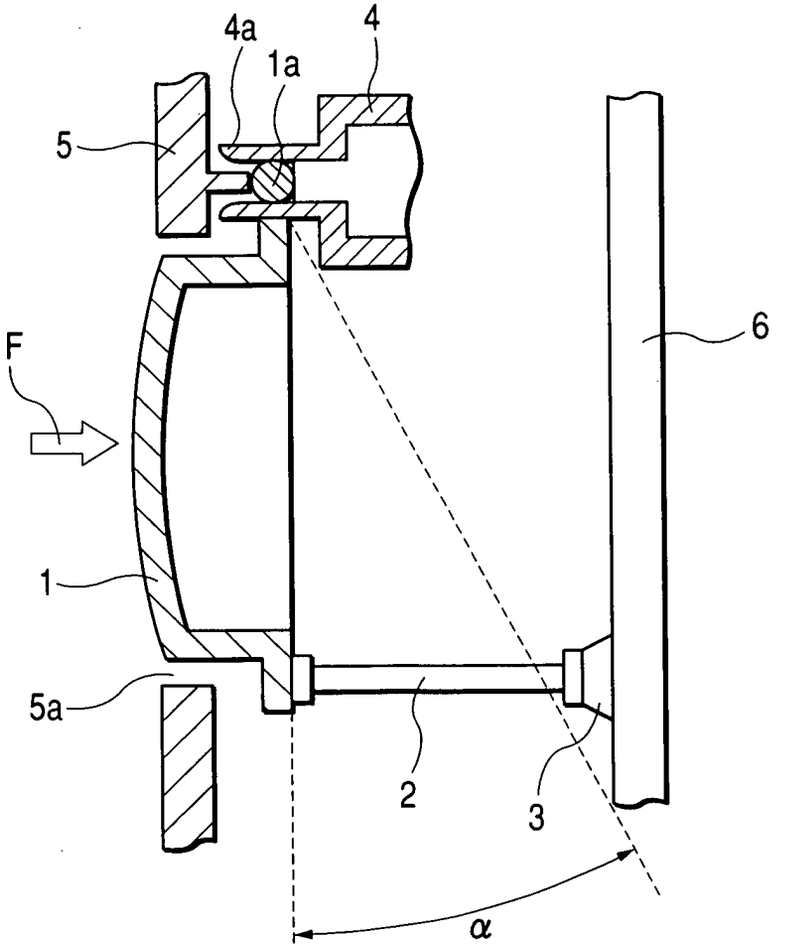


FIG. 7
PRIOR ART



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 02 5671

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	US 4 803 316 A (HAYASHI KAZUTOSHI ET AL) 7 February 1989 (1989-02-07) * column 6, line 11 - column 16, line 18; figures 5A-11 * ---	1-5	H01H21/24
Y	US 2 757 252 A (SPARR ALBERT E ET AL) 31 July 1956 (1956-07-31) * column 2, line 3 - column 4, line 28; figure 3 * ---	1-5	
Y	GB 828 875 A (ALLIED CONTROL COMPANY INC) 24 February 1960 (1960-02-24) * page 1 - page 2; figure 1 * -----	2,5	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	3 December 2003	Nieto, J.M.

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 03 02 5671

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.

03-12-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4803316 A	07-02-1989	CA 1280796 C	26-02-1991
		DE 3670174 D1	10-05-1990
		EP 0224006 A1	03-06-1987
US 2757252 A	31-07-1956	BE 539478 A	
		CH 324062 A	31-08-1957
		DE 1070722 B	
		FR 1126346 A	20-11-1956
		GB 770836 A	27-03-1957
GB 828875 A	24-02-1960	US 2808482 A	01-10-1957

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82