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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- of inventorship (Rule 4.17(iv))

Published:

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(54) Title: SWITCHING ELEMENT WITH TACTILE AND/OR ACOUSTIC FEEDBACK

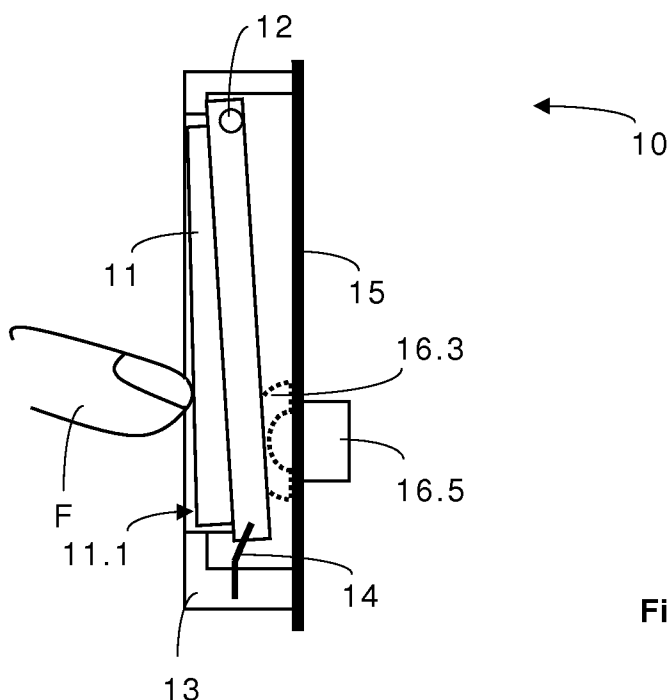


Fig. 7B

(57) Abstract: Switching element (10) comprising interaction means (11) mounted on a mounting part (13) and having an outer surface (11.1) for manual activation causing a movement of it with respect to the mounting part (13), further comprising a converter, which translates said movement into a signal and resetting means (14, 17) for mechanically resetting the interaction means (11). An interrupter (16) is employed as converter. A mechanically contact free interaction occurs between said interaction means (11) and said interrupter (16) when said interaction means (11) is moved with respect to said mounting part (13). The resetting means (14, 17) comprises a spring-like element (14, 17) which provides a resetting force for the resetting of the interaction means (11), said resetting means (14, 17) being situated at said mounting part (13) so as to act on said interaction means (11).

Switching element with tactile and/or acoustic feedback

The present invention relates to switches which, when being activated, provide an acoustic and/or tactile feedback.

5 Switches come currently in many forms and shapes and for very different uses. However, only two main approaches are being followed:

- The first approach is the use of a classical mechanical switch, which needs to be pressed with a defined force. The element
10 pressed by the user directly actuates a mechanical switch or microswitch, which in turn creates the electric contact desired. The mechanical resistance of the mechanical switch intrinsically provides both a mechanical feedback resulting from the resistance of a spring-like element and an acoustic
15 feedback often in the form of a "clicking" sound. However, such mechanical switches are often prone to failure due to the fact that mechanically moving parts that provide for the electrical connection are subject to wear. Other disadvantages are the large mounting depth of these switches, and the fact that these
20 switches are exposed to vandalism.
- A further approach is the use of a sensitive switch. In this case the actuation of the switch does not involve any mechanical movement and the actuation of the switch by the user does not result in any significant movement or deformation of
25 the surface of the switch. Such switches are either based on so called "touch panels" or similar touch sensitive surfaces which in turn translate a touch of the user to an electrical signal. However, even if they are not prone to wear and mechanical failure, these sensitive switches have the major drawback that
30 they do not provide necessarily an intrinsic acoustic or a mechanical feedback confirming the actuation of the switch, causing frustration of the user or repeated activation of the switching element until some result is finally perceptible. If in some cases a feedback is provided with an additional
35 speaker, for instance with an artificially generated feedback sound, the complexity of the switches increases. Such sensitive switches exhibit typically an interrupter comprising an

electrical, electromagnetic or magnetic field and/or an emitter of electromagnetic waves, whereby for example a finger changes the electrical, electromagnetic or magnetic field and/or the electromagnetic waves in the interrupter, in order to obtain a signal. Such sensitive switches can be defined as contactless switches, since a direct mechanical contact between the switch and the finger is not necessary for the activation of the switch. The electromagnetic field of the interrupter is already disturbed when a finger approaches the interrupter without touching it.

EP 1598298 A1 discloses an operating panel for use in elevators. Mechanical push buttons are mounted onto existing touch screen panels in order to modernize or update car operating panels.

The object of the present invention is thus to provide a switch not prone to wear even in extensive use and with a shallow mounting depth that at the same time provides tactile or acoustic feedback letting the user be aware that the switch has been activated.

SUMMARY OF THE INVENTION

The above identified objects are achieved by a switch based on the disturbance of an electromagnetic field with an interaction means, which provides the "feel" of a classical push-button. The interaction means is mechanically separated from the interrupter, which in turn provides an activation signal in response to the activation of the interacting means.

The above-mentioned separation of the interaction means from the interrupter is made possible with the employment of a converter acting as an interrupter, which translates the movement of the interaction means into a signal. According to the present invention said converter is based on the disturbance of an electromagnetic field.

This mechanically separated arrangement allows the switching element to provide both the advantages of a mechanical switch and the advantages of a sensitive switch, but at the same time eliminates the disadvantages of both, i.e. the switching element provides

acoustic and tactile feedback, similar to a mechanical switch, and at the same time offers the reliability of a sensitive switch by achieving the electrical switching by the interrupter, without mechanically moving parts.

5 BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the invention are described in detail by means of the following description and by reference to the drawings, in which:

10 Fig. 1A shows a side view of a first embodiment of the switching element in a resting position;

Fig. 1B shows a side view of the first embodiment of the switching element in an activated position;

15 Fig. 2A shows a side view of a second embodiment of the switching element in a resting position;

Fig. 2B shows a side view of the second embodiment of the switching element in an activated position;

Fig. 3A shows a side view of a third embodiment of the switching element in a resting position;

20 Fig. 3B shows the side view of the third embodiment of the switching element in an activated position;

Fig. 3C shows a side view of a fourth embodiment of the switching element in a resting position;

25 Fig. 3D shows a side view of the fourth embodiment of the switching element in an activated position;

Fig. 4A shows a side view of a fifth embodiment of the switching element in a resting position showing a light emitting device, disturbing means and a light detector;

30 Fig. 4B shows a side view of the fifth embodiment of the switching element in an activated position showing the light beam

between the light emitting device and the light detector being interrupted by the disturbing means;

Fig. 5 shows a front view of an embodiment of an operating panel comprising a multitude of switching elements;

5 Fig. 6A shows a front view of a further embodiment of an operating panel comprising a multitude of switching elements;

Fig. 6B shows a side view of another embodiment of an operating panel comprising a multitude of switching elements;

10 Fig. 7A shows a side view of a further embodiment of the switching element in a resting position;

Fig. 7B shows a side view of a further embodiment of the switching element in an activated position;

DESCRIPTION OF PREFERRED EMBODIMENTS

15 Figure 1A depicts a side view of a first embodiment of the switching element 10 based on the disturbance of an electromagnetic field in a so called resting position. As shown here, the switching element 10 comprises a mounting part 13, a back support 15, an interaction means 11 and resetting means 14 which provides a resetting force for
20 resetting the interaction means 11, after being activated, into the initial resting position. The switching element 10 further comprises a so called converter which translates the movement of the interaction means 11 into a signal. This signal is then interpreted to cause an electrical contact, i.e. to achieve the actual role of
25 the switching element 10. Accordingly, this converter is an interrupter 16 interacting with the interaction means 11 in such a way that a signal is produced when the interaction means 11 is moved with respect to the mounting part 13.

30 Figure 1B shows a side view of a first embodiment of the switching element 10 based on the disturbance of an electromagnetic field in a so called activated position, i.e. the interaction means 11 is moved with respect to the mounting part 13, said movement being caused by

the user who has "activated", i.e. pushed the interaction means 11. This action is perceived by the user exactly as is pushing a classical mechanical button or switch. This perception relates to the tactile feedback, a dislocation of the activated part of the button, and the audible feedback, like a "clicking" sound, that one

can perceive when activating a classical mechanical switch. Accordingly, the user is aware that the switch has been activated/pushed and that the required action is performed in response. With reference, for example, to the call button of an elevator, the user should preferably get some sort of feedback confirming that the button has been pushed and the elevator will respond to the call i.e. an elevator car is coming. Several other situations are

possible where the user needs direct confirmation that a switch has been activated. It is important that the current invention is intended to provide the above mentioned tactile and audible feedback without the employment of any additional devices like a speaker for an audible feedback.

As shown in Figure 1B, the activation of the outer surface 11.1 of the interaction means 11 causes a dislocation of the interaction means 11 with respect to the mounting part 13. This dislocation causes an interaction between the interaction means 11 and the interrupter 16, which will translate this dislocation into a signal. The interrupter 16 thus acts as a converter.

Preferred embodiments of the present invention further comprise a resetting means 14 which is additionally employed in order to provide a resetting force for resetting the interaction means 11 into the resting position shown on Figure 1A, after being activated and thus displaced into the position shown on Figure 1B. The resetting means 14 is preferably a spring-like element 14 which is deformed when the interaction means 11 is dislocated in relation to the mounting part 13. Due to this deformation of the spring-like element 14, a resetting force arises and the interaction means 11 is reset to the original resting position. In the preferred embodiment the resetting means 14 is designed such that when deformed due to the user pressing against the outer surface 11.1 of the interaction means 11, a "clicking sound" is emitted by the spring-like element

14. This provides the acoustic feedback described before. The tactile feedback is provided when the interaction means 11 is reset by the spring-like element 14.

5 Figure 1A and 1B show a first embodiment of the switching element 10 with the interaction means 11 implemented as a lever that tilts around an axis 12. The interaction means 11 is shown as positioned at the two endpoints in Figure 1A and Figure 1B, respectively. The amount of displacement of the interaction means 11 is variable according to the specific needs of the specific area of application
10 and the illustrations are not supposed to limit the subject-matter of the present invention to the tilting lever arrangement.

Figures 2A and 2B show a further embodiment of the switching element 10 where the interaction means 11 is mounted to "float" in the mounting part 13. This is achieved by mounting the interaction means
15 11 using flexible mounting elements 19. The flexible mounting element 19 is made either from a flexible rubber band, a harmonica style membrane or other similar arrangements that allow a smooth lateral movement of the interaction means 11.

By mounting the interaction means 11 with the above mentioned
20 flexible mounting elements 19 symmetrically, the displacement of the interaction means 11 will occur laterally, preferably roughly parallel to the back support 15 of the mounting part 13. Figure 2A shows the interaction means 11 of the switching element 10 in the resting position, whereby Figure 2B shows the interaction means 11
25 in an activated position, when it is laterally displaced in relation to the mounting part 13 as a consequence of the user exercising a pressure against an outer surface 11.1 of the interaction means 11.

Figure 3A to 3D show two further embodiments of the switching element 11 that further comprises a spring 17 serving as resetting
30 means 14. Additionally, this spring 17 can also serve the purpose of providing a mechanical acoustic signal providing a confirmation to the user that the switching element 10 has been activated.

Figure 3A and 3B show an embodiment where the additional spring 17 is a coil spring 17 that provides an additional resetting force on

the interaction means 11. This additional resetting force is preferably perpendicular to the outer surface 11.1 of the interaction means 11. Figure 3A shows the switching element 10 with the coil spring 17 in a resting position and Figure 3B shows the same embodiment in an activated position where the coil spring 17 is compressed due to the dislocation of the interaction means 11 caused by the user pressing against the outer surface 11.1 of the interaction means 11.

Figure 3C and 3D show an alternative embodiment of the switching element 10 with a spring 17. In this embodiment the additional spring 17 is a leaf spring with a fixed end 17.1 and a sliding end 17.2. Figure 3C shows the switching element 10 with the leaf spring 17 in a resting position. In this position the leaf spring 17 is curved inward as observed from the back support 15. When the interaction means 11 is dislocated, as shown in Figure 3D, the leaf spring 17 is deformed, with the sliding end 17.2 sliding outwards, roughly perpendicular to the direction of the dislocation of the interaction means. At the moment when the leaf spring 17 is deformed to an extent where the leaf spring 17 starts to curve outwards, as observed from the back support 15, the acoustic feedback in the form of a "clicking sound" is emitted by the leaf spring as a response to its deformation.

According to the present invention, several approaches are possible to accomplish the interrupter 16. One should note that the specific interrupter 16 used does not affect the inventive concept of the switching element 10, i.e. the mechanical separation of the interrupter 16 and the interaction means 11. For this reason each specific interrupter 16 is suitable to be employed in all embodiments of the switching element 10 presented in previous paragraphs in relation to the figures depicting these embodiments.

One possible approach for the interrupter 16 is an emitter of a light beam which is being disturbed or interrupted when the interaction means 11 is moved with respect to the mounting part 13. In order to achieve this, in a preferred embodiment of the switching element 10, a light emitting device 16.1, for example an LED is used

in connection with a light detector 16.2 as shown in Figure 4A. A disturbing means 16.3 connected to the interaction means 11 is employed to disturb the light beam between the light source 16.1 and the light detector 16.2, as depicted in Figure 4B, when the

5 interaction means 11 is moved with respect to the mounting part 13.

A second approach for the interrupter 16 is an interrupter 16 which emits a magnetic or electric field that is being disturbed when the interaction means 11 is displaced in relation to the mounting part 13 in response to the user exercising pressure on the outer surface 10 11.1 of the interaction means 11.

This can be achieved by fixing a capacitor having two parallel plates on the back support 15 and fixing a dielectric material on the interaction means 11 in such a way that, when the interaction means 11 is dislocated towards the back support 15, the dielectric 15 material is introduced between the plates of the capacitor, thus modifying its capacitance.

A similar solution is the use of an inductor in connection with a permanent magnet attached to the interaction means 11 in such a way that, when the interaction means is dislocated towards the back 20 support 15, the permanent magnet is introduced into the inner part of the inductor, thus inducing electrical current in it. This specific embodiment allows the detection of the exact amount of dislocation of the interaction means 11 or even the speed of this dislocation by measuring the amount of induced current in the 25 inductor. This can be advantageous when a potentiometer or the like is to be constructed instead of an on/off switch.

Figure 5 shows an operating panel 20 comprising a multitude of switching elements 10. The particular operating panel 20 depicted on this figure is intended to be used e.g. in an elevator cabin. Such 30 panels 20 may comprise a display 3 among other elements.

A further variation of an operating panel 20 comprising a multitude of switching elements 10 according to the present invention is depicted in Figures 6A and 6B. The operating panel 20 presented in these figures is suitable to be operated by visually impaired people

due to the fact that the outer surface 11.1 of the interaction means 11 of each switching element 10 is fitted with Braille codes besides other engravings. Figure 6A shows a front view of this further embodiment of the operating panel 20.

5 Figure 6B shows a side view of an operating panel 20. One can observe that the switching elements 10 protrude from the surface of the operating panel 20, providing an exactly similar appearance as a classical mechanical switch.

10 In Figures 7A and 7B, a further embodiment of the present invention is shown. The interrupter comprises an interrupter emitter and sensor 16.4 and an interrupter field 16.5. The interrupter emitter and sensor 16.4 is mounted on the back panel 15. The interrupter emitter and sensor 16.4 is located on the opposite side of the back panel 15 than the interaction means 11. This ensures that electronic
15 components in the interrupter emitter and sensor 16.4 are shielded by the back panel from vandalism or harmful environmental influences such as water or dust.

The interrupter emitter and sensor 16.4 emits a field 16.5, which extends across the back panel 15 and towards the interaction means
20 11. When the interaction means 11 is moved from a passive state (Figure 7A) to an active state (Figure 7B), the interaction means 11 interferes with the interrupter field 16.5. A change in the interrupter field 16.5 caused by said interference is sensed by the interrupter emitter and sensor 16.4 and converted into a signal
25 representative of the activation state (active state as shown in Figure 7A or passive state as shown in Figure 7B) of the switching element 10.

One should note that these figures are merely exemplifications of particular uses of the switching element 10 and that the use of the
30 present invention is not limited to the examples presented herein.

Claims

1. Switching element (10) comprising

- a mounting part (13) mounted on a back panel (15),
- 5 - interaction means (11) mounted on said mounting part (13) for manual activation, said activation causing a mechanical movement of said interaction means (11) with respect to said mounting part (13),
- 10 - an interrupter (16) mounted on said back panel (15) whereas said interrupter (16) and said interaction means (11) are mechanically separated,
- 15 - an electrical field or a magnetic field or an electromagnetic field or a plurality of electromagnetic waves is emitted by said interrupter (16), whereas said interaction means (11) is adapted to change said field or waves when displaced from a passive state to an active state or vice versa,
- 20 - said interrupter (16) is configured to translate said change of said field or waves into a signal representative of the activation state of said interaction means (11).

2. Switching element (10) according to claim 1, characterized in that the switching element (10) comprises resetting means (14, 17) for mechanically resetting the interaction means (11) and said resetting means (14, 17) comprise at least one spring-like element (14, 17) which provides a resetting force for the resetting of said interaction means (11), said resetting means (14, 17) being situated at said mounting part (13) or at said back panel (15) so as to act on said interaction means (11).

3. Switching element (10) according to claim 2, characterized in that said resetting means (14, 17) are designed so as to

mechanically cause an acoustic signal and/or tactile feedback when said interaction means (11) are manually activated.

5 4. Switching element (10) according to one of the claims 1 to 3, characterized in that said interaction means (11) has the shape of a button, lever or switch.

10 5. Switching element (10) according to one of the claims 1 to 3, characterized in that said interaction means (11) has an axis (12) fixed at said mounting part (13), and wherein said movement of said interaction means (11) is a tilting movement.

15 6. Switching element (10) according to one of the claims 1 to 3, characterized in that said interaction means (11) is mounted with respect to said mounting part (13) by using flexible mounting elements (19) so that it floats, and wherein said movement of said interaction means (11) is a lateral movement.

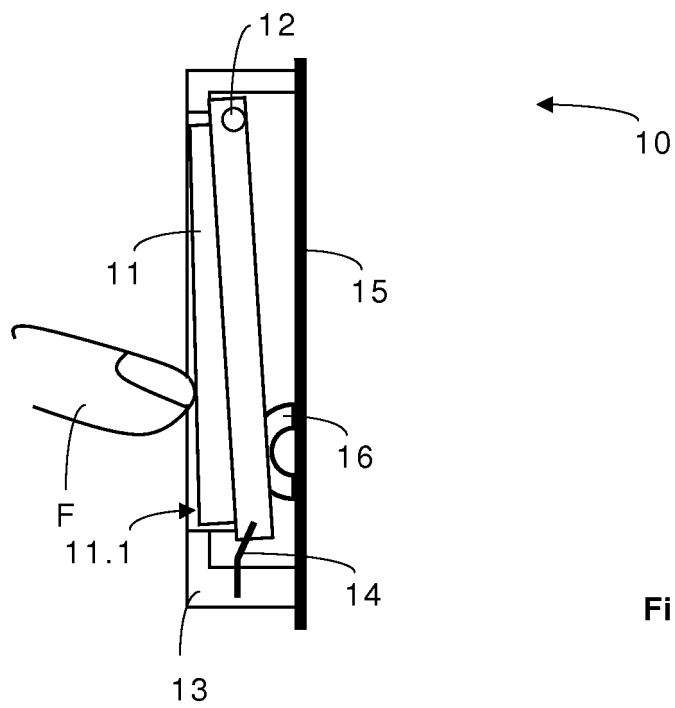
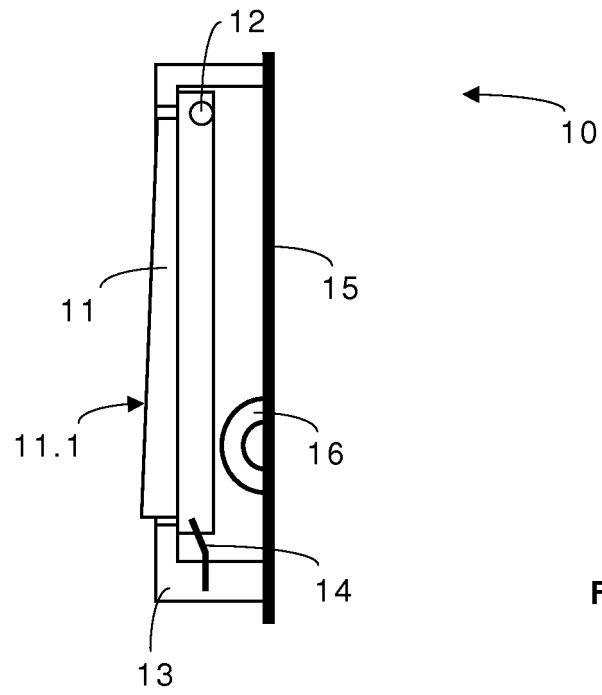
20 7. Switching element (10) according to one of the claims 1 to 6, characterized in that said interrupter (16) comprises an interrupter emitter and sensor (16.4) configured to emit a predetermined interrupter field (16.5), whereas the interrupter emitter and sensor (16.4) is adapted to sense a change in said interrupter field (16.5) caused by a
25 displacement of the interaction means (11).

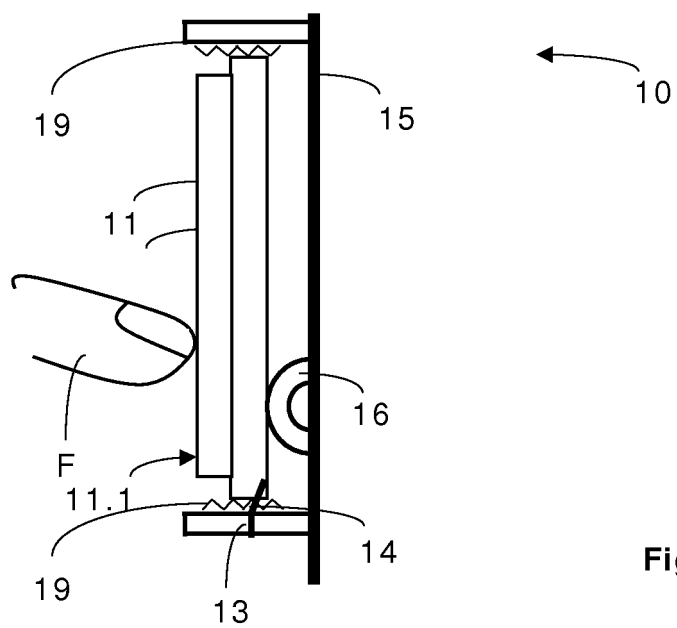
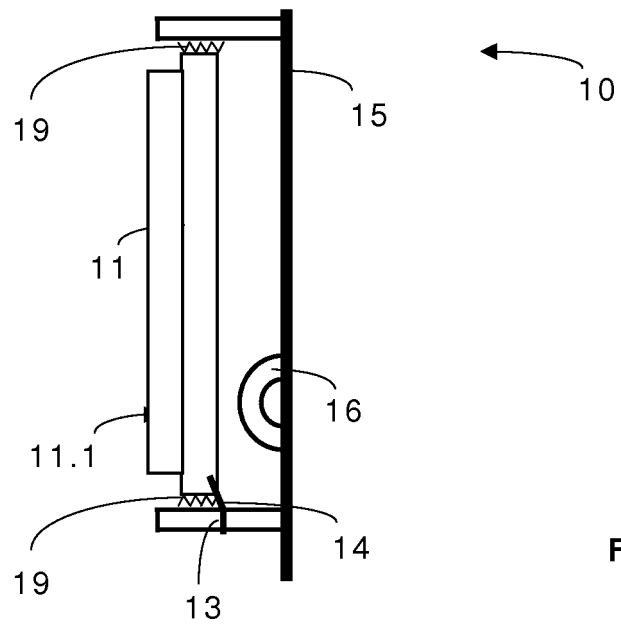
30 8. Switching element (10) according to claim 7, characterized in that the interrupter emitter and sensor (16.4) is mounted to the back panel (15) on an opposite side than the mounting part (13), whereas the interrupter field (16.5) extends across the back panel (15) and towards the interaction means (11).

9. Switching element (10) according to one of the claims 1
through 6, characterized in that said interrupter (16) emits
light which is being disturbed or interrupted when said
5 interaction means (11) is moved with respect to said mounting
part (13).

10. Switching element (10) according to claim 9, characterized in
that said interrupter (16) comprises a light emitting device
10 (16.1) and a light detector (16.2).

11. Operating panel (20) comprising a multitude of switching
elements (10) according to one of the previous claims 1- 10.





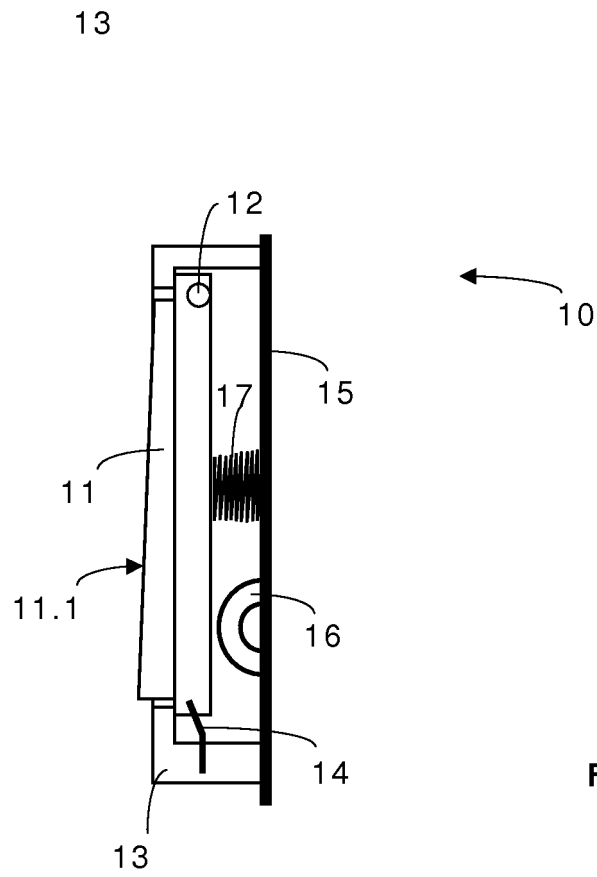


Fig. 3A

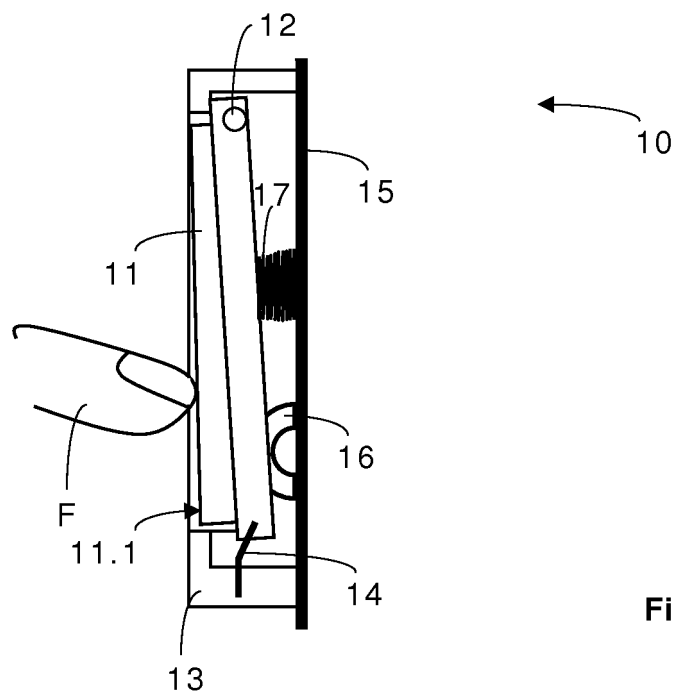


Fig. 3B

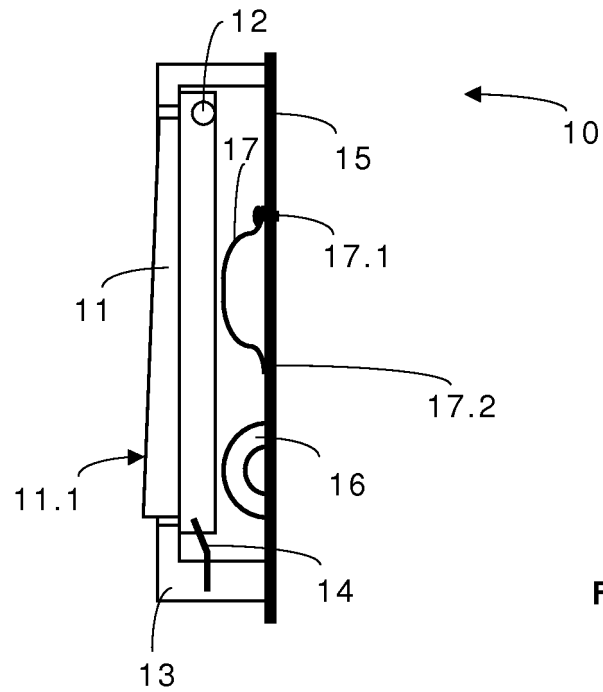


Fig.3C

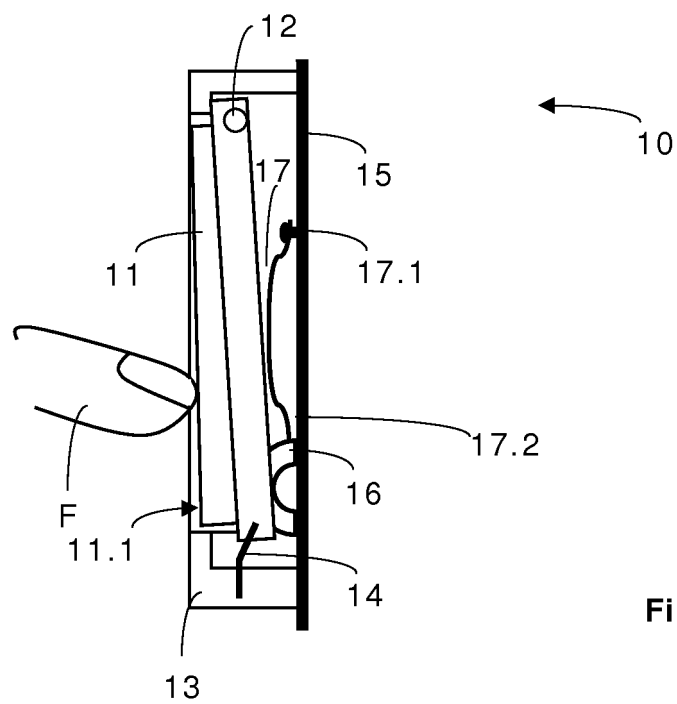
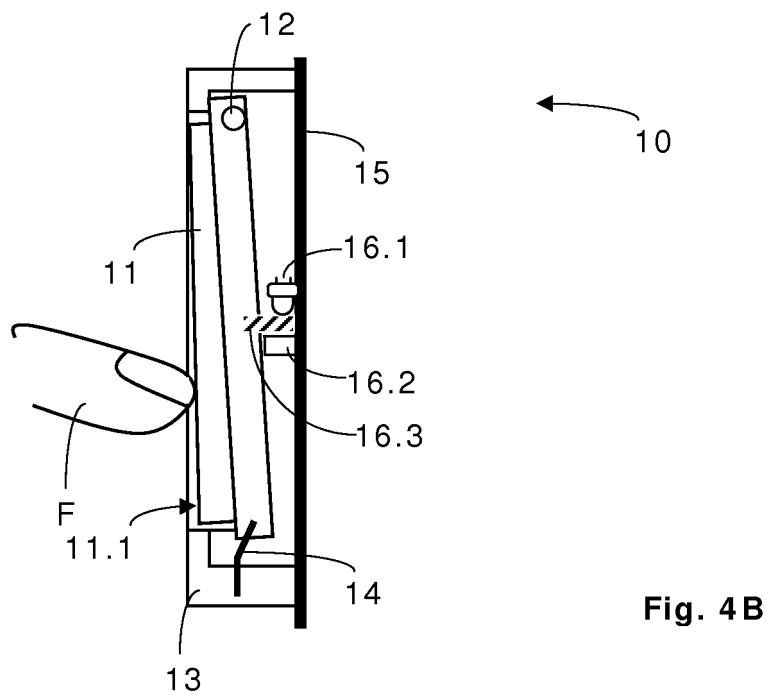
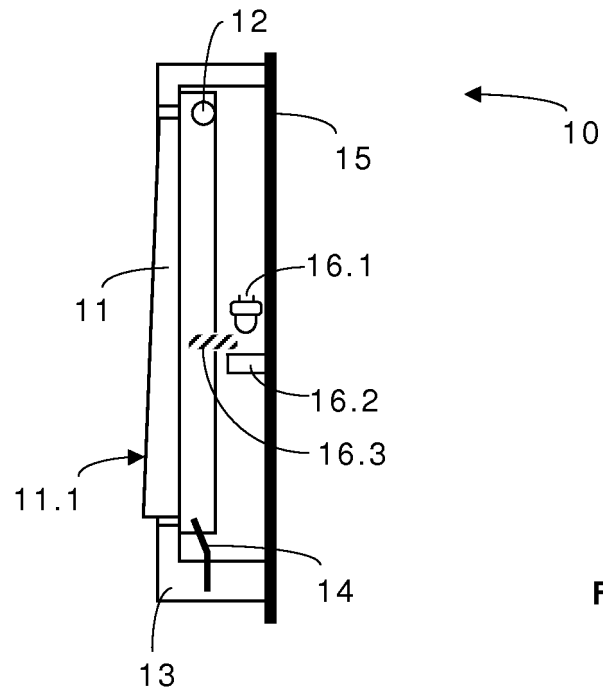


Fig. 3D



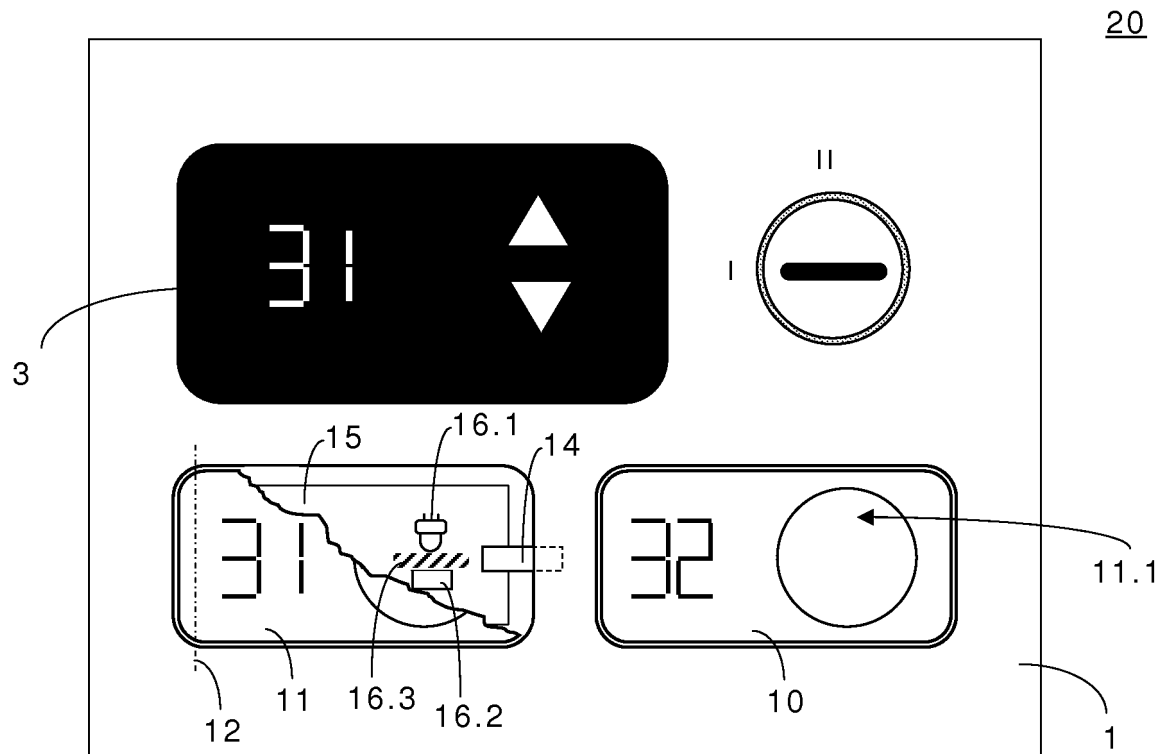


Fig. 5

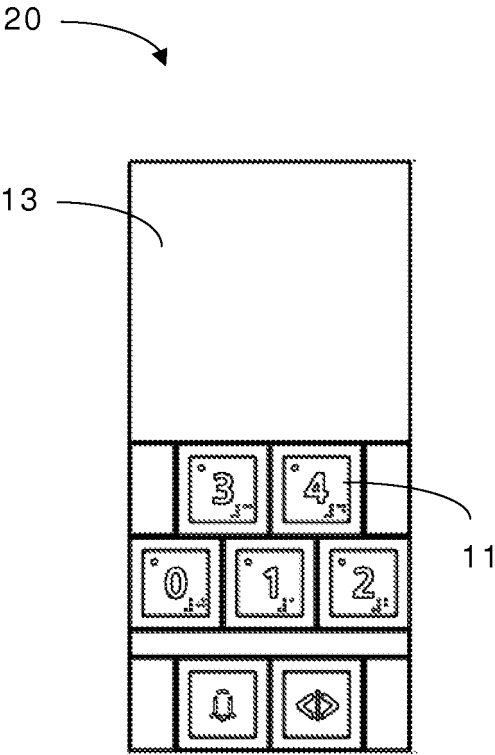


Fig. 6A

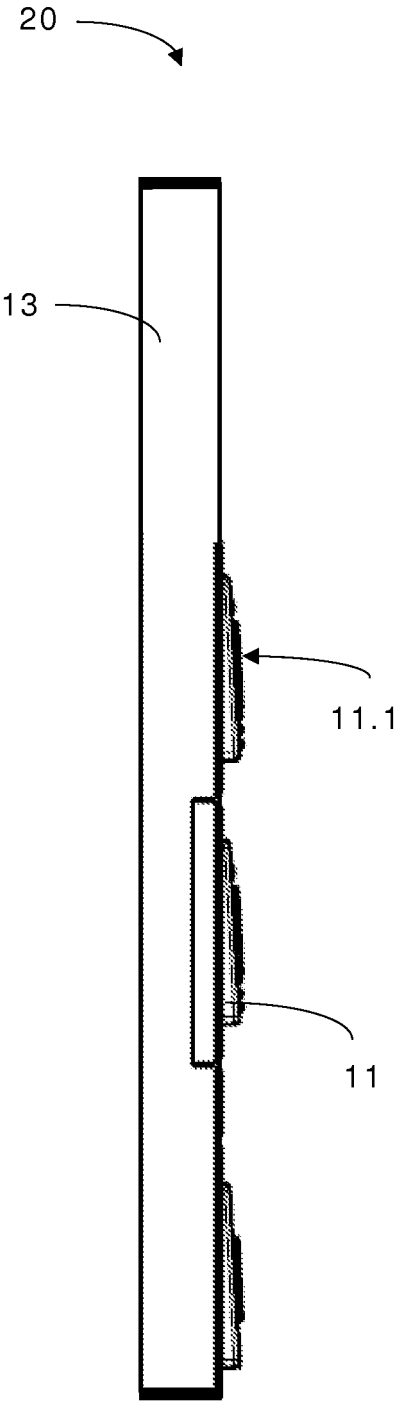
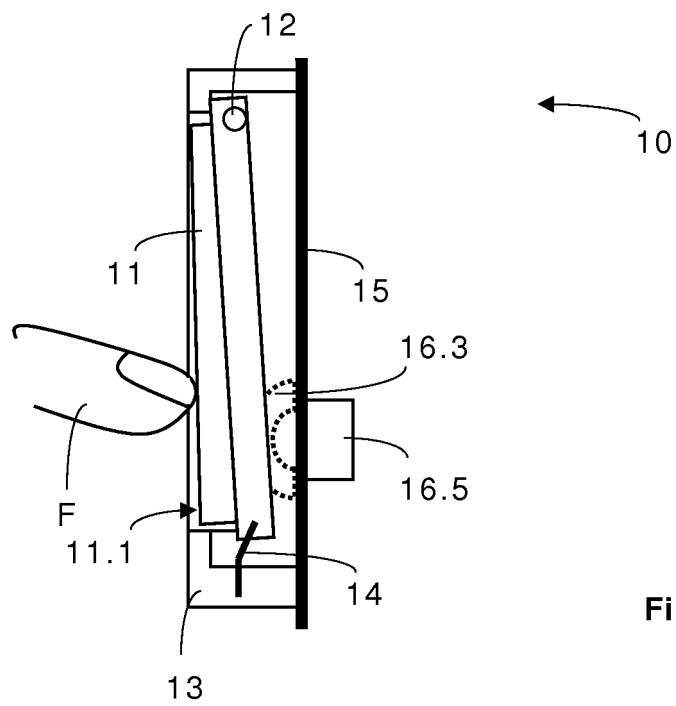
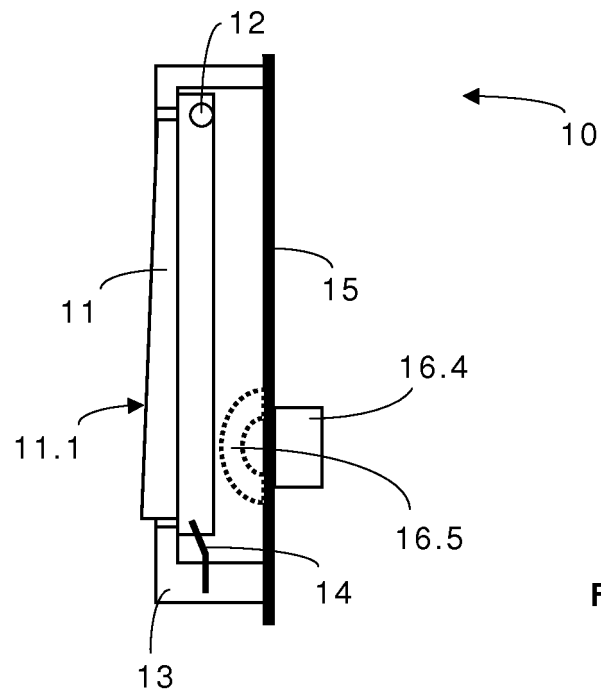


Fig. 6B



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2008/067608

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01H21/24 H03K17/94

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)

H01H H03K

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 20 2006 010973 U1 (HARTING AUTOMOTIVE GMBH & CO [DE]) 12 October 2006 (2006-10-12) abstract; figure 2	1,2,4,7, 8,11
Y	-----	3
X	WO 01/45125 A (H O VUOLAS OY [FI]; VUOLAS HEIKKI [FI]; KORTELAJINEN PETRI [FI]) 21 June 2001 (2001-06-21) abstract; figure 1	1,7
Y	page 3, line 4 -----	3



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

A document defining the general state of the art which is not considered to be of particular relevance

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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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Date of the actual completion of the international search

3 April 2009

Date of mailing of the international search report

15/04/2009

Name and mailing address of the ISA/

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Fax: (+31-70) 340-3016

Authorized officer

Simonini, Stefano

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2008/067608

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 4,6,8,9
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 4,6,8,9

The initial phase of the search revealed a very large number of documents relevant to the issue of novelty. So many documents were retrieved that it is impossible to determine which parts of the claims may be said to define subject-matter for which protection might legitimately be sought (Article 6 PCT). For these reasons, a meaningful search of the whole claimed subject matter could not be carried out (PCT Guidelines, 15.29). The extent of the search was consequently limited.

There are four possible alternatives in claim 1, namely the switch may be electric, electromagnetic, magnetic, or based on the emission of a plurality of electromagnetic waves. The last option cannot be understood at all: what is meant by a plurality of electromagnetic waves? Different frequencies? It seems that this combination is not even supported by the rest of the application. The last option is therefore excluded from the search.

Each of these alternatives leads to a very broad claim and to a case of "novelty overflow".

The search of claims 1-3,5,7,11 was restricted to the case of a "magnetic" switch.

Claims 4 and 6 were not searched as they cannot be understood: what is the "shape of a switch" (claim 4)? What is a "lateral movement" (claim 6)?

Claims 9 and 10 are dependent on an unsearched alternative of claim 1, and are therefore excluded from search.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2)PCT declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2008/067608

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 202006010973 U1	12-10-2006	NONE	
WO 0145125 A	21-06-2001	AU 2376901 A TW 476081 B	25-06-2001 11-02-2002