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

(11) **EP 2 299 463 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
26.12.2012 Bulletin 2012/52

(51) Int Cl.:
H01H 13/807 *(2006.01)*

(21) Application number: **10176579.0**

(22) Date of filing: **14.09.2010**

(54) **Press-to-operate input device**

Auf Knopfdruck betriebene Eingabevorrichtung

Dispositif d'entrée de bouton-poussoir

(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 SE SI SK SM TR

(30) Priority: **18.09.2009 JP 2009217229**

(43) Date of publication of application:
23.03.2011 Bulletin 2011/12

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(56) References cited:
WO-A2-2008/014110
DE-A1- 4 104 572
JP-U- H0 576 856
US-A1- 2001 003 539

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a press-to-operate input device in which a plurality of push switches allowing depressions to two levels are arranged in a line and any of the push switches is selectively operable.

2. Description of the Related Art

[0002] Recently-commercialized press-to-operate input devices including a plurality of push switches intended for operation of vehicle-mounted control devices such as car air conditioners and car audio devices are equipped with touch sensors having a sensor function of detecting whether or not a finger of a user is touching an operation key corresponding to any of the push switches on the basis of changes in capacitance. Such an input device is connected to a display device installed at a position easily viewable from the user who is driving. Which operation key the user's finger is touching is displayed on the display device in real time. Therefore, in pressing a push switch, the user can find on which operation key his/her finger is currently placed by viewing the screen of the display device, instead of carefully looking at his/her hand. This enables the user to correctly press an intended push switch even during driving, without neglecting to look ahead. Consequently, increased safety is expected.

[0003] Employing a touch sensor operating on the basis of changes in capacitance, however, leads to a problem that the input device costs high with additional microprocessors and so forth. Moreover, if the user is wearing gloves, correct sensing may not be performed, resulting in poor usability.

[0004] To solve such problems, a sensor function similar to that of a touch sensor may be realized by employing push switches according to a known technique allowing depressions to two levels of shallow and deep and by mechanically detecting whether or not any push switch is depressed to a shallow level. Specifically, the input device may be designed such that an operation key corresponding to any of such push switches is easily depressed to the shallow level in response to the placement of a user's finger onto that operation key. Since the user can find on which of a plurality of operation keys arranged in a line his/her finger is placed by viewing the screen of the display device, the user can correctly press the intended push switch to a deep level without carefully looking at his/her hand. Thus, an inexpensive input device having a sensor function similar to that of a touch sensor can be obtained.

[0005] To enable the push switches to detect shallow depression, however, a specific operation load needs to be applied thereto. Therefore, in a case where a plurality of operation keys arranged in a line are successively depressed to the shallow level with the user's finger being placed only on those operation keys, the operability is not good, and operation only by the feel is very difficult. Specifically, to successively depress operation keys to the shallow level, the user needs to apply an exact operation load to the operation keys and simultaneously to slide his/her finger along the line of operation keys. To enable the user to assuredly perform such a series of operations only by the feel, some kind of guide mechanism that supports and guides the finger in an intended direction needs to be provided. If no such guide mechanism is provided, the user cannot stably move his/her finger when the user who is driving attempts to successively depress operation keys to the shallow level.

[0006] There is a known technique of improving the operability of an input device by providing a guide for supporting fingers of the user on an instrument panel of an automobile on which operation keys corresponding to a plurality of push switches are arranged (see Japanese Unexamined Utility Model Registration Application Publication No. 5-76856, for example). In the known technique, a ledge-like guide extending laterally is provided below a console box so as to receive fingers of the user other than the one used for pressing an intended operation key. With reference to the guide, the user can easily feel and find the positions of individual operation keys. Therefore, the user can relatively easily place his/her finger onto an intended operation key even during driving. Furthermore, with some fingers being supported by the guide, the operation load to be applied to the operation keys can be adjusted easily, facilitating the operation of push switches allowing depressions to two levels of shallow and deep.

[0007] In the technique disclosed in Japanese Unexamined Utility Model Registration Application Publication No. 5-76856, however, the guide is provided relatively far from the operation keys of the push switches. In addition, the technique is contrived on the premise that the fingers to be placed on the guide are other than the finger used for pressing an operation key. Therefore, when the user attempts to slide his/her finger placed on the line of operation keys in a specific direction by a specific length with reference to the guide, mispositioning often occurs. Accordingly, when the user attempts to press an intended operation key during driving, for example, by sliding his/her finger with reference to the guide without looking at his/her hand, misoperation occurs with a high possibility. Another example of such an operation key is known from US 2001/003539.

[0008] To realize a sensor function similar to that of a touch sensor by allowing successive shallow depressions performed on a plurality of operation keys, the operation keys need to be capable of being extremely easily depressed to the shallow level by the user. If the user who is attempting to select any of the operation keys arranged in a line needs to sequentially depress those operation keys to the shallow level, the operation be-

comes complicated with repetition of the depressing action to the shallow level, leading to very poor operability. To avoid this, it is desirable that shallow depression be substantially automatically performed when the user merely place his/her finger onto an operation key even if the user is not conscious of pressing the operation key, and that, if the user slides that finger along a guide, the user be able to smoothly perform successive shallow depressions on a plurality of operation keys.

SUMMARY OF THE INVENTION

[0009] In light of such circumstances in the known art, it is an object of the present invention to provide a press-to-operate input device including a plurality of push switches arranged in a line and having a sensor function similar to that of a touch sensor, thereby realizing high operability with low cost.

[0010] To achieve the above object, according to an aspect of the present invention, a press-to-operate input device has a plurality of push switches allowing depressions to two levels of shallow and deep performed on operation keys included in the push switches, the operation keys being arranged in a line and exposed in an opening provided in an operation panel. The device includes a strip-like guide surface provided on the operation panel and extending in a direction in which the operation keys are arranged and along one-side ends of the operation keys, the strip-like guide surface allowing a finger placed thereon to depress any of the operation keys. Each of the push switches is in a shallowly depressed state when at least part of a top surface (front surface) of the one-side end of a corresponding one of the operation keys is flush with or projects relative to the strip-like guide surface, and is in a deeply depressed state when the top surface of the one-side end of the operation key is below the strip-like guide surface.

[0011] In the press-to-operate input device configured as above, when the user places his/her finger onto a specific region of the strip-like guide surface, the one-side end of any operation key that the user's finger is touching is automatically depressed to a level about the same as the level of the strip-like guide surface. Therefore, the user can change the state of the push switch corresponding to the operation key to the shallowly depressed state without being conscious of performing a depressing action. Furthermore, when the user slides that finger in the longitudinal direction of the strip-like guide surface, the operation keys arranged in a line are sequentially depressed to the shallow level. Therefore, on which of the operation keys the user's finger is placed can be detected in a manner similar to that in a touch sensor, providing good operability. Moreover, since whether or not shallow depression is performed only needs to be detected mechanically, a sensor function is provided with an extremely low cost, compared to a touch sensor operating on the basis of changes in capacitance. In addition, even if the user is wearing gloves, the sensor function is not adversely affected, maintaining good operability. Furthermore, each of the push switches does not become the deeply depressed state unless the corresponding operation key is depressed to a level below the strip-like guide surface. Therefore, deep depression is not realized unless the user intentionally perform a depressing action. Accordingly, there is little chance of misoperation of unintentional deep depression while the user is sliding his/her finger along the strip-like guide surface. Thus, an inexpensive input device having a sensor function similar to that of a touch sensor and good operability can be provided.

[0012] In the above configuration, it is preferable that an amount by which the at least part of the top surface of the one-side end of each operation key that is unoperated projects relative to the strip-like guide surface be at the maximum a depression depth of the operation key required for realizing the shallowly depressed state of the push switch. Thus, the push switch corresponding to the operation key assuredly becomes the shallowly depressed state when the user presses the one-side end of the operation key with the finger to a level about the same as the level of the strip-like guide surface.

[0013] Furthermore, in the above configuration, it is preferable that a ridge extending in the direction in which the operation keys are arranged be provided on the operation panel and that a top surface (front surface) of the ridge form the strip-like guide surface. Thus, the user can easily place his/her finger onto the strip-like guide surface only by the feel.

[0014] Furthermore, in the above configuration, it is preferable that the strip-like guide surface have a concave shape curving toward the opening, that the top surface of the one-side end of each operation key have a concave shape curving toward the strip-like guide surface, and that the top surface of the one-side end of the operation key in the shallowly depressed state substantially coincide with a concave curved plane obtained by extending the strip-like guide surface. Thus, when the user places his/her finger onto the strip-like guide surface, the user can extremely easily perform shallow depression on any operation key that the user's finger is touching. Accordingly, the push switches of the input device can be operated with a feeling substantially the same as that provided by push switches equipped with touch sensors. The strip-like guide surface, however, may have a tapered side-view shape inclining linearly, for example.

[0015] Furthermore, in the above configuration, it is preferable that the line of the operation keys extend in a lateral direction, and that the strip-like guide surface extend linearly in the lateral direction. Thus, a sensing operation similar to that of a touch sensor can be realized when the user merely slides his/her finger linearly along the strip-like guide surface. Accordingly, the input device can be easily operated by the feel. The operation keys, however, may be provided in another arrangement, for example, in an annular arrangement.

[0016] Furthermore, in the above configuration, it is

preferable that the push switches each include a contact rubber that is to be pressed through the corresponding operation key. Thus, the push switch allowing depressions to two levels of shallow and deep can be provided with fewer components, facilitating the reduction of the component cost and the assembly cost. The push switch, however, may be a push switch not including the contact rubber. Instead, a push switch allowing depressions to two levels may be configured by employing, for example, a coil spring, a leaf spring, or the like.

[0017] Furthermore, in the above configuration, it is preferable that the strip-like guide surface have projections projecting relative to the top surfaces of the operation keys that are unoperated, the projections being positioned in correspondence with gaps between adjacent ones of the operation keys. Thus, when the user attempts to slide his/her finger in the longitudinal direction of the strip-like guide surface, the user's finger is prevented from being caught by edges of the top surfaces of the operation keys. Moreover, since the user can easily place his/her finger onto a region between the projections without looking at his/her hand carefully, the user can assuredly depress a single operation key to the shallow level with his/her finger. Accordingly, the input device provides very good operability. In this case, it is preferable that the strip-like guide surface have round recesses between adjacent ones of the projections thereof in such a manner as to form a wavy shape in the longitudinal direction thereof. Thus, the user can extremely easily place his/her finger onto any of the recesses without looking at his/her hand carefully and can smoothly slide that finger in the longitudinal direction of the strip-like guide surface. Accordingly, further improvement of operability is expected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

Fig. 1 is a perspective view showing an operated part of an input device according to a first embodiment of the present invention;
Fig. 2 is a diagram of the input device shown in Fig. 1 seen from above in Fig. 1;
Fig. 3 is a top view of the input device shown in Fig. 1;
Fig. 4 is a side view of any operation key shown in Fig. 1 when not operated and relevant parts provided therearound;
Fig. 5 is a cross-sectional view of a push switch when not operated, corresponding to Fig. 4;
Fig. 6 is a side view of the operation key shown in Fig. 4 in a shallowly depressed state and the relevant parts;
Fig. 7 is a cross-sectional view of the push switch in the shallowly depressed state, corresponding to Fig. 6;
Fig. 8 is a side view of the operation key shown in Fig. 4 in a deeply depressed state and the relevant parts;
Fig. 9 is a cross-sectional view of the push switch in the deeply depressed state, corresponding to Fig. 8;
Fig. 10 shows a characteristic curve representing the relationship between the pressing load and the depression depth with and by which the push switch is depressed;
Fig. 11 is a block diagram of a control system including the input device shown in Fig. 1;
Fig. 12 is an explanatory diagram illustrating the level difference between a strip-like guide surface and operation keys included in an input device according to a second embodiment of the present invention;
Fig. 13 is an explanatory diagram illustrating the level difference between a strip-like guide surface and operation keys included in an input device according to a third embodiment of the present invention;
Fig. 14 is a side view of an input device according to a fourth embodiment of the present invention, showing relevant parts thereof; and
Fig. 15 is a top view of an input device according to a fifth embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] A first embodiment of the present invention will now be described with reference to Figs. 1 to 11. Referring to Figs. 1 to 3, in a press-to-operate input device 10 according to the first embodiment, operation keys 2 corresponding to a plurality of push switches 1 are arranged in a line, and a ridge 8c is provided on a top panel (operation panel) 8a in such a manner as to extend along one-side ends 2a of the operation keys 2. Figs. 4 to 10 are diagrams for describing the configuration and behavior of a single push switch 1. As shown in Fig. 11, the input device 10 is connected to a vehicle-mounted control device 40 and a display device 50.

[0020] The input device 10 is intended for operation of the vehicle-mounted control device 40, such as a car air conditioner or a car audio device. When a user presses the operation key 2 corresponding to any push switch 1 provided in the input device 10 to a specific depth, a control signal for performing an intended operation is output to the vehicle-mounted control device 40. The input device 10 is connected to the display device 50 installed at a position easily viewable from the user. Information of on which operation key 2 a finger F of the user is currently placed, operations (functions) assigned to the individual operation keys 2, and the like are displayed on a screen of the display device 50. The display device 50 is connected to the vehicle-mounted control device 40, thereby being capable of displaying on the screen thereof the control operation currently performed by the vehicle-mounted control device 40, and so forth. The vehicle-mounted control device 40, the display device 50, and the input device 10 may be housed in a single casing.

[0021] The operation keys 2 of the respective push switches 1 included in the input device 10 are arranged in a lateral line. The push switches 1 all have identical

configurations. Specifically, the push switches 1 each include a contact rubber 3 and the operation key 2 mounted on the contact rubber 3. The contact rubber 3 is a part of a molded rubber member made of light-transmissive silicone rubber or the like mounted on a substrate (printed circuit board) 7. The contact rubber 3 has first and second movable contacts 4a and 4b made of a conductive carbon material and provided thereon by printing, bonding, or the like. The first and second movable contacts 4a and 4b are movable toward and away from first and second fixed contacts 5a and 5b, respectively, provided on the substrate 7. The fixed contacts 5a and 5b are made of a conductive carbon material. The plurality of push switches 1 are housed in a casing including an upper case 8 and a lower case 9 assembled together. The operation keys 2 are arranged in an opening 8b provided in the top panel (operation panel) 8a of the upper case 8 and are movable up and down (forward and backward). The operation keys 2 each have the top surface (front surface) thereof projecting relative to the top panel 8a so as to be capable of being pressed. The ridge 8c integrally provided on the top panel 8a of the upper case 8 extends linearly in a direction in which the operation keys 2 are lined. The ridge 8c is provided along the one-side ends 2a (the left-side ends in Figs. 4 to 9) of the operation keys 2. The top surface (front surface) of the ridge 8c forms a strip-like guide surface 8d on which the finger F of the user is to be placed. The ridge 8c may be formed as a separate body from the upper case 8 and subsequently be bonded to the top panel 8a.

[0022] The configuration of a single push switch 1 will now be described in detail. Referring to Fig. 5, the operation key 2 when not operated is pressed at a flange thereof provided at the lower end thereof against an inner surface of the upper case 8 with the elastic restoring force of the contact rubber 3. Such a pretension prevents the operation key 2 from wobbling. The operation key 2 is made of a light-transmissive synthetic resin and has on the top surface thereof an illuminated region (not shown) that is to be illuminated by a light-emitting diode (LED) 6 mounted on the substrate 7. The LED 6 on the substrate 7 is surrounded by the first fixed contact 5a, and the first fixed contact 5a is surrounded by the second fixed contact 5b. As shown in Fig. 5, when the operation key 2 is not operated, the first and second movable contacts 4a and 4b provided on the contact rubber 3 are positioned exactly above the first and second fixed contacts 5a and 5b, respectively, with clearances interposed therebetween. The substrate 7 of the push switch 1 carries a first switch circuit that is turned on when the first movable contact 4a comes into contact with the first fixed contact 5a and a second switch circuit that is turned on when the second movable contact 4b comes into contact with the second fixed contact 5b.

[0023] The contact rubber 3 includes the following elements that are formed as an integral body: an annular base 3a provided on the substrate 7 in such a manner as to surround the second fixed contact 5b, a mover cylindrical portion 3b and a follower cylindrical portion 3c arranged concentrically, a clicking-sensation-producing wall 3d extending round and connecting the inner periphery of the mover cylindrical portion 3b and the outer periphery of the follower cylindrical portion 3c to each other, and a flexibly deformable wall 3e extending round and connecting the outer periphery of the mover cylindrical portion 3b and the base 3a to each other. The base 3a supports the mover cylindrical portion 3b with the flexibly deformable wall 3e interposed therebetween. The top surface of the mover cylindrical portion 3b resides at the highest end of the contact rubber 3. Accordingly, the operation key 2 is mounted on the mover cylindrical portion 3b, and a pressing load to be applied to the operation key 2 is received by the top surface of the mover cylindrical portion 3b. The mover cylindrical portion 3b supports the follower cylindrical portion 3c with the clicking-sensation-producing wall 3d interposed therebetween. Therefore, when the mover cylindrical portion 3b moves downward (backward) in response to the application of a pressing load to the operation key 2, the follower cylindrical portion 3c moves downward together with the mover cylindrical portion 3b. The bottom surface of the follower cylindrical portion 3c resides nearer to the substrate 7 than the bottom surface of the mover cylindrical portion 3b. The first movable contact 4a is provided on the bottom surface of the follower cylindrical portion 3c by printing, bonding, or the like. The bottom surface of the mover cylindrical portion 3b resides farther from the substrate 7 than the bottom surface of the follower cylindrical portion 3c. The second movable contact 4b is provided on the bottom surface of the mover cylindrical portion 3b by printing, bonding, or the like. The clicking-sensation-producing wall 3d has a shape of a skirt that is turned upside down, with a cross-sectional shape extending linearly and obliquely upward from the outer periphery of the follower cylindrical portion 3c to the inner periphery of the mover cylindrical portion 3b. The clicking-sensation-producing wall 3d is capable of undergoing buckling deformation in response to the pressing of the operation key 2 and produces a tactile clicking sensation when buckled. The flexibly deformable wall 3e is thinner than the clicking-sensation-producing wall 3d and has a cross-sectional shape continuously curving in one direction with no linear part so as to start to bend with a small pressing load. In the first embodiment, the cross section of the flexibly deformable wall 3e substantially forms an arc of about 90 degrees between the top surface of the base 3a and the outer periphery of the mover cylindrical portion 3b. The flexibly deformable wall 3e bends gradually, without buckling, in response to the pressing of the operation key 2. The cross-sectional shape of the flexibly deformable wall 3e is not limited to such a curved shape having no linear part, and may be, for example, a substantially curved shape including very small continuous linear parts, i.e., any shape that enables bending without buckling when the operation key 2 is pressed. Nevertheless, to prevent the occurrence of an abrupt change in

the pressing load due to the cross-sectional shape of the flexibly deformable wall 3e in the entire depression range of the operation key 2 described below, the flexibly deformable wall 3e preferably has a cross-sectional shape continuously curving in one direction with no linear part, as described above.

[0024] The push switch 1 including the contact rubber 3 configured as above allows an operation of shallow depression in which the operation key 2 is depressed to a shallow level with a small operating force, whereby the first switch circuit is turned on, and an operation of deep depression in which the operation key 2 is depressed to a deep level with a relatively large operating force, whereby the second switch circuit is turned on.

[0025] The operation of depressing the push switch 1 to two levels according to the first embodiment will now be described with reference to the feeling curve shown in Fig. 10. Fig. 10 shows the relationship between the pressing load and the depression depth with and by which the operation key 2 is depressed. As shown in Fig. 10, in the push switch 1 according to the first embodiment, the contact rubber 3 is pressed to bend when a pressing load of 0.2 N (about 20 g weight) or larger is applied to the operation key 2. This is because the operation key 2 when not operated is subjected to a pretension of about 0.2 N (about 20 g weight) applied by the contact rubber 3. The pretension prevents the operation key 2 from wobbling and from being accidentally depressed to the shallow level because of external vibration or the like. The contact rubber 3 in the push switch 1 when not operated has the cross-sectional shape shown in Fig. 5, in which the first and second movable contacts 4a and 4b are positioned exactly above the first and second fixed contacts 5a and 5b, respectively.

[0026] When a pressing load of 0.2 N or larger is applied to the operation key 2, the flexibly deformable wall 3e of the contact rubber 3 first gradually starts to bend, accompanied by the lowering (backward movement) of the mover cylindrical portion 3b and the follower cylindrical portion 3c. The clearance between the follower cylindrical portion 3c and the substrate 7 is very small. Therefore, when the depression depth reaches S1 (about 0.22 mm), the push switch 1 becomes the state shown in Fig. 7, in which the lowering of the follower cylindrical portion 3c is stopped by the substrate 7, with the first movable contact 4a being in contact with the first fixed contact 5a. That is, at the depression depth S1 as small as below 0.5 mm, the first switch circuit is turned on. The pressing load required for realizing the depression depth S1 is extremely small, specifically, 0.32 N (about 33 g weight). Therefore, the user can perform shallow depression of the push switch 1 by merely placing his/her finger F onto the operation key 2 without being conscious of performing such a depressing action.

[0027] When the operation key 2 that has been depressed to the shallow level is further depressed, the mover cylindrical portion 3b is further lowered while the lowering of the follower cylindrical portion 3c is stopped. Consequently, while the flexibly deformable wall 3e continues bending, the clicking-sensation-producing wall 3d also starts to bend. Therefore, the inclination of the feeling curve suddenly becomes steep after the depression depth S1, as shown in Fig. 10. With a pressing load of 3.17 N (about 324 g weight), the depression depth is increased to S2 (about 1.12 mm). When the depression depth becomes larger than S2, the pressing load is rapidly reduced because the clicking-sensation-producing wall 3d undergoes elastic buckling, and the depression depth rapidly increases to S3 (about 1.63 mm), whereby a tactile clicking sensation is produced. Consequently, the lowering of the mover cylindrical portion 3b is stopped by the substrate 7 as shown in Fig. 9, with the second movable contact 4b being in contact with the second fixed contact 5b. Thus, in the first embodiment, the user can turn the second switch circuit on by applying a pressing load of 3.17 N or larger to the operation key 2 and causing the operation key 2 to be depressed by 1.6 mm or larger.

[0028] The values of the pressing load and the depression depth provided above are only exemplary and may be changeable appropriately, of course, in accordance with the size, weight, and so forth of the operation key 2. Nevertheless, to enable the user to perform shallow depression of the push switch 1 by merely placing the finger F onto the operation key 2 without being conscious of performing a depressing action, the depression depth S1 shown in Fig. 10 corresponding to the shallow level is preferably 0.5 mm or smaller, and the pressing load required for realizing the depression depth S1 is preferably 0.48 N (50 g weight) or smaller.

[0029] The level of the strip-like guide surface 8d, i.e., the top surface (front surface) of the ridge 8c provided on the top panel (operation panel) 8a, is set to be the same or lower than the level of the top surface (front surface) of the one-side end 2a of the operation key 2 in a shallowly depressed state (the state where the first switch circuit is on) and to be sufficiently higher than the level of the top surface (front surface) of the one-side end 2a of the operation key 2 in a deeply depressed state (the state where the second switch circuit is on). That is, the one-side end 2a of each of the operation keys 2 slightly projects upward (frontward) relative to the strip-like guide surface 8d of the ridge 8c when the operation key 2 is not operated, is flush with or is slightly depressed downward (backward) relative to the strip-like guide surface 8d when the operation key 2 is depressed to the shallow level, and is significantly depressed downward (backward) relative to the strip-like guide surface 8d when the operation key 2 is depressed to the deep level.

[0030] The relationship between the level of the operation key 2 and the level of the strip-like guide surface 8d will now be described more specifically. Referring to Fig. 4, when the operation key 2 is not operated, the top surface (front surface) of the one-side end 2a of the operation key 2 projects upward (frontward) relative to the strip-like guide surface 8d by a very small amount A (0.3 to 0.5 mm). The depression depth S1 required for real-

izing shallow depression of the operation key 2 is set to be equal to or much smaller (about 0.22 mm) than the very small amount A. Therefore, referring now to Fig. 6, when the user presses the one-side end 2a of the operation key 2 with the finger F to a level about the same as the level of the strip-like guide surface 8d, the push switch 1 corresponding to the operation key 2 assuredly becomes the shallowly depressed state (the state where the first switch circuit is on). Moreover, the pressing load required for realizing the depression depth S1 in the first embodiment is smaller than 0.48 N (50 g weight), specifically, as extremely small as 0.32 N. Therefore, only with a light touch of the user's finger F on the strip-like guide surface 8d, the operation key 2 that the tip of the finger F is touching is automatically depressed to become the state shown in Fig. 6. Thus, the user can extremely easily perform shallow depression of the operation key 2 without being conscious of such a depressing action. Moreover, the depression depth S3 required for realizing deep depression of the operation key 2 is set to be sufficiently larger (about 1.63 mm) than the very small amount A. Therefore, the user cannot change the state of the push switch 1 corresponding to the operation key 2 to the deeply depressed state (the state where the second switch circuit is on) unless the user deeply presses the operation key 2 with the tip of the finger F placed on the strip-like guide surface 8d. Fig. 8 shows the state where the operation key 2 is depressed to the deep level with the tip of the finger F.

[0031] The operation key 2 may be designed such that the positional relationship between the strip-like guide surface 8d and the top surface (front surface) of the one-side end 2a also applies to the positional relationship between the strip-like guide surface 8d and the top surface of an end (the right-side end in Figs. 4 to 9) of the operation key 2 opposite the one-side end 2a or the entirety of the top surface of the operation key 2. The level and shape of the top surface of the operation key 2 may be changed arbitrary in a region thereof that is out of reach of the tip of the user's finger F placed on the strip-like guide surface 8d.

[0032] In the press-to-operate input device 10 in which a plurality of the push switches 1 described above are arranged in a line, when the user lightly presses his/her finger F onto the strip-like guide surface 8d, any operation key 2 that is in contact with the tip of the finger F is substantially automatically depressed to the shallow level. Moreover, if the finger F is slid along the strip-like guide surface 8d in the longitudinal direction of the strip-like guide surface 8d, a plurality of the operation keys 2 arranged in a line can be sequentially depressed to the shallow level. Thus, the user can find on which operation key 2 his/her finger F is currently placed only by viewing the screen of the display device 50 installed at a position easily viewable from the user, without carefully looking at his/her hand. Therefore, the user can correctly select an intended operation key 2 while sliding his/her finger F along the strip-like guide surface 8d and can press the intended operation key 2 to the deep level. Consequently, a control signal for performing the operation (function) assigned to the operation key 2 that has been depressed to the deep level is output from the input device 10 to the vehicle-mounted control device 40.

[0033] To summarize, in the press-to-operate input device 10 according to the first embodiment, when the user lightly presses his/her finger F onto a specific region of the strip-like guide surface 8d, the one-side end 2a of the operation key 2 that the tip of the user's finger F is touching is automatically depressed to a level about the same as the level of the strip-like guide surface 8d. Therefore, the user can extremely easily depress the operation key 2 to the shallow level without being conscious of such a depressing action. Furthermore, when the user slides the finger F along the strip-like guide surface 8d in the longitudinal direction of the strip-like guide surface 8d, the operation keys 2 arranged in a line are sequentially depressed to the shallow level. Therefore, on which of the operation keys 2 the user's finger F is placed can be detected in a manner similar to that in a touch sensor, providing good operability. Moreover, since whether or not the operation of shallow depression is performed only needs to be detected mechanically on the basis of contact between the first movable contact 4a and the first fixed contact 5a, a sensor function is provided with an extremely low cost, compared to a touch sensor operating on the basis of changes in capacitance. In addition, even if the user is wearing gloves, the sensor function is not adversely affected, maintaining good operability. Furthermore, the push switch 1 does not become the deeply depressed state unless the operation key 2 is depressed to a level below the strip-like guide surface 8d. Therefore, deep depression is not realized unless the user intentionally perform a depressing action. Accordingly, there is little chance of misoperation of unintentional deep depression while the user is sliding his/her finger F along the strip-like guide surface 8d.

[0034] In the press-to-operate input device 10 according to the first embodiment, the ridge 8c extending in the direction of the line of the operation keys 2 is provided on the top panel (operation panel) 8a of the upper case 8, and the top surface (front surface) of the ridge 8c forms the strip-like guide surface 8d. Therefore, the user can easily place his/her finger F onto the strip-like guide surface 8d only by the feel. Moreover, in the first embodiment, the line of the operation keys 2 extends in the lateral direction, and the strip-like guide surface 8d extends linearly in the lateral direction. Therefore, a sensing operation similar to that of a touch sensor can be realized when the user merely slides his/her finger F linearly along the strip-like guide surface 8d. Accordingly, the input device 10 can be easily operated by the feel, preventing the user who is driving from neglecting to look ahead.

[0035] In the press-to-operate input device 10 according to the first embodiment, the push switches 1 each include the contact rubber 3 that is to be depressed in response to the pressing of the operation key 2. There-

fore, the push switch 1 allowing depressions to two levels of shallow and deep can be provided with fewer components, facilitating the reduction of the component cost and assembly cost. The push switch 1 may be a push switch not including the contact rubber 3. Instead, a push switch allowing depressions to two levels may be configured by employing, for example, a coil spring, a leaf spring, or the like.

[0036] Fig. 12 is an explanatory diagram illustrating the level difference between the strip-like guide surface 8d and the operation keys 2 included in a press-to-operate input device 11 according to a second embodiment of the present invention, showing the positional relationship between the strip-like guide surface 8d and the operation keys 2 when the input device 11 is seen from the left side in, for example, Fig. 4 (from the bottom).

[0037] In the press-to-operate input device 11 shown in Fig. 12, the strip-like guide surface 8d has a plurality of projections 8d1 having round tops. The projections 8d1 are provided at positions corresponding to the positions of the gaps B between adjacent ones of the operation keys 2. The level of the top of each projection 8d1 is designed so as to be higher than the level of the top surface of the operation key 2 that is not operated by about 0.3 mm and be higher than the level of the remaining regions of the strip-like guide surface 8d by about 0.5 mm.

[0038] With the projections 8d1 provided on the strip-like guide surface 8d, when the user attempts to slide his/her finger F along the strip-like guide surface 8d in the longitudinal direction of the strip-like guide surface 8d, the user's finger F is prevented from being caught by edges of the top surfaces of the operation keys 2. Moreover, since the user can easily place his/her finger F onto a region between the projections 8d1 without looking at his/her hand carefully, the user can assuredly depress a single operation key 2 to the shallow level with his/her finger tip. Thus, the press-to-operate input device 11 provides very good operability.

[0039] Fig. 13 is an explanatory diagram illustrating the level difference between the strip-like guide surface 8d and the operation keys 2 included in a press-to-operate input device 12 according to a third embodiment of the present invention. The elements corresponding to those shown in Fig. 12 are denoted by the same reference numerals, respectively.

[0040] In the press-to-operate input device 12 shown in Fig. 13, the strip-like guide surface 8d has round recesses 8d2 between the projections 8d1, thereby having a wavy shape in the longitudinal direction thereof. That is, the press-to-operate input device 12 is a variation in which substantially flat parts of the strip-like guide surface 8d in the second embodiment are changed to the recesses 8d2 that are smoothly continuous from and to the projections 8d1. Thus, the user can extremely easily place his/her finger F onto any of the recesses 8d2 without looking at his/her hand carefully and can smoothly slide that finger F in the longitudinal direction of the strip-like guide surface 8d. Accordingly, further improvement of operability is expected.

[0041] As is obvious from the press-to-operate input devices 11 and 12 shown in Figs. 12 and 13, the present invention is not necessarily have such a configuration that the entirety of the top surface (front surface) of the one-side end 2a of the operation key 2 that is not operated projects upward (frontward) relative to the strip-like guide surface 8d. That is, it is sufficient that at least part of the top surface (front surface) of the one-side end 2a of the operation key 2, preferably, a central part of the top surface of the one-side end 2a, projects upward (forward) relative to the strip-like guide surface 8d (the recess 8d2) by the very small amount A (0.3 to 0.5 mm). Thus, the operation key 2 can be depressed to the shallow level in response to the user's light pressing of his/her finger F onto a specific region of the strip-like guide surface 8d.

[0042] Fig. 14 is a side view showing a press-to-operate input device 13 according to a fourth embodiment of the present invention, showing relevant parts thereof. Elements corresponding to those shown in Fig. 6 are denoted by the same reference numerals, respectively.

[0043] The operation keys 2 of the press-to-operate input device 13 shown in Fig. 14 are almost sunk in the opening 8b of the top panel (operation panel) 8a. Therefore, the ridge 8c described in the first embodiment is not provided. Instead, the strip-like guide surface 8d is provided in a region of the top panel 8a facing the opening 8b and has a concave shape curving toward the opening 8b. Furthermore, the top surfaces of the operation keys 2 each have a concave shape curving toward the strip-like guide surface 8d, As shown by double-dashed chain line in Fig. 14, the top surface of the one-side end 2a of the operation key 2 that is not operated projects slightly upward (forward) relative to the strip-like guide surface 8d. When the user lightly presses his/her finger F onto a specific region of the strip-like guide surface 8d and changes the state of any operation key 2 to the shallowly depressed state with the tip of the finger F, the top surface of the one-side end 2a of the operation key 2 becomes continuous with the strip-like guide surface 8d, along a common concave curved plane.

[0044] In a case where the operation keys 2 on the top panel (operation panel) 8a are provided at relatively retracted positions as in the press-to-operate input device 13, misoperation due to accidental pressing of the operation keys 2 when part of the user's body or any object comes into contact with the operation keys 2 can be avoided easily. In the press-to-operate input device 13, the top surface of any operation key 2 that is in the shallowly depressed state substantially coincides with the concave curved plane obtained by extending the strip-like guide surface 8d. Therefore, when the user places his/her finger F onto the strip-like guide surface 8d, the user can extremely easily perform shallow depression of the operation key 2 with the tip of that finger F. Thus, the push switches 1 of the input device 13 can be operated with a feeling substantially the same as that provided by

push switches equipped with touch sensors.

[0045] The strip-like guide surface 8d shown in Fig. 14 may have a tapered side-view shape inclining linearly toward the opening 8b. Alternatively, the strip-like guide surface 8d of the ridge 8c shown in Figs. 1 to 9 may form a concave surface curving toward the opening 8b and the top surface of the one-side end 2a of each operation key 2 may form a concave surface curving toward the strip-like guide surface 8d of the ridge 8c, whereby the top surface of the one-side end 2a of any operation key 2 in the shallowly depressed state may be made to substantially coincides with a concave curved plane obtained by extending the strip-like guide surface 8d.

[0046] Fig. 15 is a top view (front view) of a press-to-operate input device 14 according to a fifth embodiment of the present invention. Elements corresponding to those shown in Fig. 3 are denoted by the same reference numerals, respectively.

[0047] In the press-to-operate input device 14 shown in Fig. 15, the operation keys 2 are provided in an annular arrangement, and the top surface (front surface) of the ridge 8c having an annular shape surrounding the operation keys 2 forms the strip-like guide surface 8d on which the user's finger F is to be placed. The relationship between the level of the one-side end (outer periphery) 2a of each operation key 2 and the level of the strip-like guide surface 8d is the same as that in the first embodiment (see Figs. 5 to 9). Therefore, the user can extremely easily depress the operation keys 2 sequentially to the shallow level by sliding his/her finger F along the annular strip-like guide surface 8d. Thus, a sensing operation similar to that of a touch sensor can be realized.

[0048] While the above embodiments each concern a case where the press-to-operate input device is used in combination with the vehicle-mounted control device 40, the present invention is not limited to a vehicle-mounted input device, and may be of course applied to input devices of any other electronic apparatuses intended for home use, industrial use, and so forth.

Claims

1. A press-to-operate input device (10) having a plurality of push switches (1) allowing depressions to two levels comprising a shallow and a deep level performed on a respective operation key (2) included in the push switches (1), the operation keys (2) being arranged in a line and exposed in an opening (8b) provided in an operation panel (8a), the device (10) comprising:

   a strip-like guide surface (8d) provided on the operation panel (8a) and extending in a direction in which the operation keys (2) are arranged and along one-side ends (2a) of the operation keys (2), the strip-like guide surface (8d) allowing a finger (F) placed thereon to depress any of the operation keys (2), **characterised in that** each of the push switches (1) is in a shallowly depressed state when at least part of a top surface of the one-side end (2a) of a corresponding one of the operation keys (2) is flush with or projects relative to the strip-like guide surface (8d), and is in a deeply depressed state when the top surface of the one-side end (2a) of the operation key (2) is below the strip-like guide surface (8d).

2. The press-to-operate input device (10) according to Claim 1, wherein an amount by which the at least part of the top surface of the one-side end (2a) of each operation key (2) that is unoperated projects relative to the strip-like guide surface (8d) is at a maximum depression depth of the operation key (2) required for realizing the shallowly depressed state of the push switch (1).

3. The press-to-operate input device (10) according to Claim 1 or 2, further comprising:

   a ridge (8c) provided on the operation panel (8a) and extending in the direction in which the operation keys (2) are arranged,
   wherein a top surface of the ridge (8c) forms the strip-like guide surface (8d).

4. The press-to-operate input device (10) according to any of Claims 1 to 3, wherein the strip-like guide surface (8d) has a concave shape curving toward the opening (8b),
   wherein the top surface of the one-side end (2a) of each operation key (2) has a concave shape curving toward the strip-like guide surface (8d), and
   wherein the top surface of the one-side end (2a) of the operation key (2) in the shallowly depressed state substantially coincides with a concave curved plane obtained by extending the strip-like guide surface (8d).

5. The press-to-operate input device (10) according to any of Claims 1 to 4,
   wherein the line of the operation keys (2) extends in a lateral direction, and
   wherein the strip-like guide surface (8d) extends linearly in the lateral direction.

6. The press-to-operate input device (10) according to any of Claims 1 to 5, wherein the strip-like guide surface (8d) has projections (8d1) projecting relative to the top surfaces of the operation keys (2) that are unoperated, the projections (8d1) being positioned in correspondence with gaps (B) between adjacent ones of the operation keys (2).

7. The press-to-operate input device (10) according to

Claim 6, wherein the strip-like guide surface (8d) has round recesses (8d2) between adjacent ones of the projections (8d1) thereof in such a manner as to form a wavy shape in a longitudinal direction thereof.

8. The press-to-operate input device (10) according to any of Claims 1 to 7, wherein the push switches (1) each include a contact rubber (3) that is to be pressed through the corresponding operation key (2).

9. The press-to-operate input device (10) according to Claim 8,
wherein the push switches (1) each include a substrate (7) provided with first and second fixed contacts (5a, 5b), and
wherein the contact rubber (3) is provided with first and second movable contacts (4a, 4b) that are movable toward and away from the first and second fixed contacts (5a, 5b), respectively.

Patentansprüche

1. Auf Knopfdruck betriebene Eingabevorrichtung (10) mit einer Mehrzahl von Drückschaltern (1), welche ein Niederdrücken auf zwei Niveaus mit einem flachen und einem tiefen Niveau ermöglichen, welche auf einer jeweiligen Betriebstaste (2) durchgeführt werden, die in dem Drückschalter (1) enthalten sind, wobei die Betriebstasten (2) in einer Linie angeordnet sind und in einer Öffnung (8b), die in einer Bedienungsplatte (8a) vorgesehen ist, offenliegen, wobei die Vorrichtung (10) aufweist:

eine streifenähnliche Führungsoberfläche (8d), die auf der Bedienungsplatte (8a) vorgesehen ist und sich in einer Richtung erstreckt, in welcher die Betriebstasten (2) angeordnet sind, und entlang auf einer Seite befindlicher Enden (2a) der Betriebstasten (2), wobei die streifenähnliche Führungsoberfläche (8d) einem Finger (F), der darauf platziert ist, ein Niederdrücken einer der Betriebstasten (2) ermöglicht, **dadurch gekennzeichnet, dass**
jeder der Drückschalter (1) in einem flach niedergedrückten Stadium ist, wenn wenigstens ein Teil einer oberen Oberfläche des auf einer Seite befindlichen Endes (2a) einer Entsprechenden der Betriebstasten (2) bündig ist mit oder relativ zu der streifenähnlichen Führungsoberfläche (8d) hervorsteht, und in einem tief niedergedrückten Stadium ist, wenn die obere Oberfläche des auf einer Seite befindlichen Endes (2a) der Betriebstaste (2) unterhalb der streifenähnlichen Führungsoberfläche (8d) ist.

2. Auf Knopfdruck betriebene Eingabevorrichtung (10) nach Anspruch 1, wobei eine Höhe, durch welche der wenigstens eine Teil der oberen Oberfläche des auf einer Seite befindlichen Endes (2a) einer jeden Betriebstaste (2), die nicht betätigt ist, relativ zu der streifenähnlichen Führungsoberfläche (8d) hervorsteht, einer maximalen Niederdrücktiefe der Betriebstaste (2) entspricht, die notwendig ist, um das flach niedergedrückte Stadium des Drückschaiters (1) zu realisieren.

3. Auf Knopfdruck betriebene Eingabevorrichtung (10) nach Anspruch 1 oder 2, weiterhin aufweisend:

einen Formgrat (8c) auf der Bedienungsplatte (8a), welcher sich in die Richtung erstreckt, in welcher die Betriebstasten (2) angeordnet sind, wobei eine obere Oberfläche des Formgrats (8c) die streifenähnliche Führungsoberfläche (8d) bildet.

4. Auf Knopfdruck betriebene Eingabevorrichtung (10) nach einem der Ansprüche 1 bis 3,
wobei die streifenähnliche Führungsoberfläche (8d) eine konkave Form aufweist, die sich in Richtung der Öffnung (8b) krümmt,
wobei die obere Oberfläche des auf einer Seite befindlichen Endes (2a) einer jeden Betriebstaste (2) eine konkave Form aufweist, die sich in Richtung der streifenähnlichen Führungsoberfläche (8d) krümmt, und
wobei die obere Oberfläche des auf einer Seite befindlichen Endes (2a) der Betriebstaste (2) in dem flach niedergedrückten Stadium im Wesentlichen übereinstimmt mit einer konkav gekrümmten Ebene, die man erhält durch Ausdehnung der streifenähnlichen Führungsoberfläche (8d).

5. Auf Knopfdruck betriebene Eingabevorrichtung (10) nach einem der Ansprüche 1 bis 4,
wobei die Linie der Betriebstasten (2) sich in einer seitlichen Richtung erstreckt, und
wobei die streifenähnliche Führungsoberfläche (8d) sich linear in die seitliche Richtung erstreckt.

6. Auf Knopfdruck betriebene Eingabevorrichtung (10) nach einem der Ansprüche 1 bis 5, wobei die streifenähnliche Führungsoberfläche (8d) Erhebungen (8d1) aufweist, die sich relativ zu den oberen Oberflächen der Bedienungstasten (2), welche nicht benutzt werden, erheben, wobei die Erhebungen (8d1) in Entsprechung mit Lücken (B) zwischen benachbarten der Betriebstasten (2) positioniert sind.

7. Auf Knopfdruck betriebene Eingabevorrichtung (10) nach Anspruch 6, wobei die streifenähnliche Führungsoberfläche (8d) rundförmige Vertiefungen (8d2) zwischen Benachbarten der Erhebungen (8d1) derart aufweist, dass eine wellenförmige Form in einer Längsrichtung davon geformt wird.

8. Auf Knopfdruck betriebene Eingabevorrichtung (10) nach einem der Ansprüche 1 bis 7, wobei die Drückschalter (1) jeweils einen Kontaktgummi (3) beinhalten, der durch die entsprechende Betriebstaste (2) zu drücken ist.

9. Auf Knopfdruck betriebene Eingabevorrichtung (10) nach Anspruch 8,
wobei die Drückschalter (1) jeweils ein Substrat (7) beinhalten, welches mit ersten und zweiten festen Kontakten (5a, 5b) vorgesehen ist, und
wobei der Kontaktgummi (3) mit ersten und zweiten beweglichen Kontakten (4a, 4b) vorgesehen ist, die in Richtung der ersten und zweiten festen Kontakte (5a, 5b) bzw. davon weg beweglich sind.

Revendications

1. Dispositif d'entrée par pression (10) comportant une pluralité de boutons-poussoirs (1) permettant des enfoncements à deux niveaux comprenant un niveau peu profond et un niveau profond réalisés sur une touche de fonction respective (2) comprise dans les boutons-poussoirs (1), les touches de fonction (2) étant agencées en ligne et exposées dans une ouverture (8b) prévue dans un panneau de fonction (8a), le dispositif (10) comprenant :

   une surface de guidage du type bande (8d) placée sur le panneau de fonction (8a) et s'étendant dans une direction dans laquelle les touches de fonction (2) sont disposées et le long d'extrémités d'un côté (2a) des touches de fonction (2), la surface de guidage du type bande (8d) permettant à un doigt (F) placé sur celle-ci d'enfoncer n'importe laquelle des touches de fonction (2), **caractérisé en ce que** chacun des boutons-poussoirs (1) est dans un état peu enfoncé quand au moins une partie d'une surface supérieure de l'extrémité d'un côté (2a) d'une touche de fonction (2) correspondante est de niveau avec ou fait saillie par rapport à la surface de guidage du type bande (8d), et est dans un étant profondément enfoncé quand la surface supérieure de l'extrémité d'un côté (2a) de la touche de fonction (2) se trouve sous la surface de guidage du type bande (8d).

2. Dispositif d'entrée par pression (10) selon la revendication 1, dans lequel la quantité avec laquelle ladite au moins une partie de la surface supérieure de l'extrémité d'un côté (2a) de chaque touche de fonction (2) qui n'est pas actionnée fait saillie par rapport à la surface de guidage du type bande (8d) est à une profondeur d'enfoncement maximale de la touche de fonction (2) nécessaire pour réaliser l'état faiblement enfoncé du bouton-poussoir (1).

3. Dispositif d'entrée par pression (10) selon la revendication 1 ou 2, comprenant en outre :

   une arête (8c) placée sur le panneau de fonction (8a) et s'étendant dans la direction dans laquelle les touches de fonction (2) sont disposées,
   dans lequel une surface supérieure de l'arête (8c) forme la surface de guidage du type bande (8d).

4. Dispositif d'entrée par pression (10) selon l'une quelconque des revendications 1 à 3,
dans lequel la surface de guidage du type bande (8d) a une surface concave courbée vers l'ouverture (8b),
dans lequel la surface supérieure de l'extrémité d'un côté (2a) de chaque touche de fonction (2) a une forme concave courbée vers la surface de guidage du type bande (8d), et
dans lequel la surface supérieure de l'extrémité d'un côté (2a) de la touche de fonction (2) dans l'état faiblement enfoncé coïncide substantiellement avec un plan courbé concave obtenu en étendant la surface de guidage du type bande (8d).

5. Dispositif d'entrée par pression (10) selon l'une quelconque des revendications 1 à 4,
dans lequel la ligne des touches de fonction (2) s'étend dans une direction latérale, et
dans lequel la surface de guidage du type bande (8d) s'étend linéairement dans la direction latérale.

6. Dispositif d'entrée par pression (10) selon l'une quelconque des revendications 1 à 5, dans lequel la surface de guidage du type bande (8d) comporte des protubérances (8d1) faisant saillie par rapport aux surfaces supérieures des touches de fonction (2) qui ne sont pas actionnées, les protubérances (8d1) étant positionnées en correspondance avec des espaces (B) situés entre les touches de fonction (2) adjacentes.

7. Dispositif d'entrée par pression (10) selon la revendication 6, dans lequel la surface de guidage du type bande (8d) comporte des évidements ronds (8d2) entre les protubérances (8d1) adjacentes de celle-ci de manière à former une forme ondulée dans une direction longitudinale de celle-ci.

8. Dispositif d'entrée par pression (10) selon l'une quelconque des revendications 1 à 7, dans lequel les boutons-poussoirs (1) comprennent chacun un caoutchouc de contact (3) qui est destiné à être pressé par l'intermédiaire de la touche de fonction (2) correspondante.

9. Dispositif d'entrée par pression (10) selon la revendication 8,

dans lequel les boutons-poussoirs (1) comprennent chacun un substrat (7) pourvu d'un premier et d'un deuxième contact fixe (5a, 5b), et
dans lequel le caoutchouc de contact (3) est pourvu d'un premier et d'un deuxième contact mobile (4a, 4b) qui sont mobiles respectivement vers et depuis les premier et deuxième contacts fixes (5a, 5b).

FIG. 1

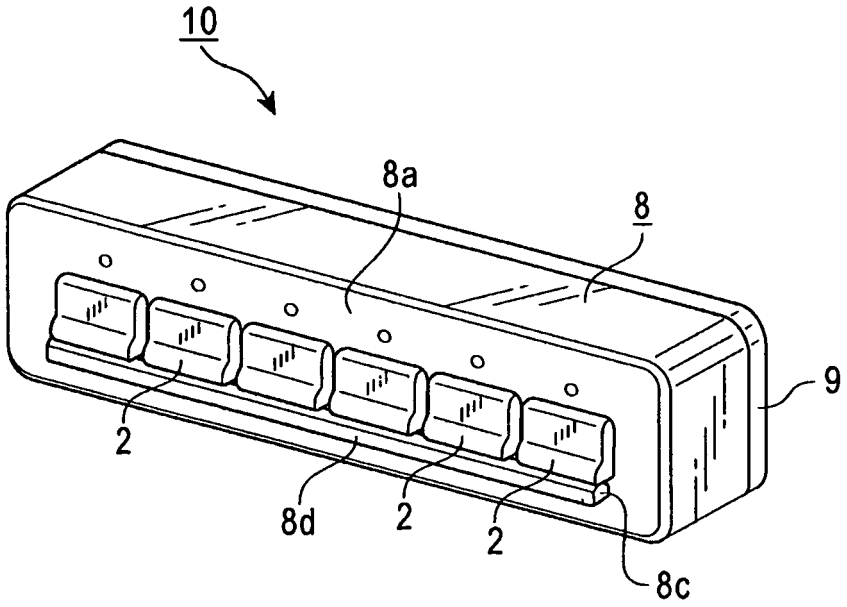


FIG. 2

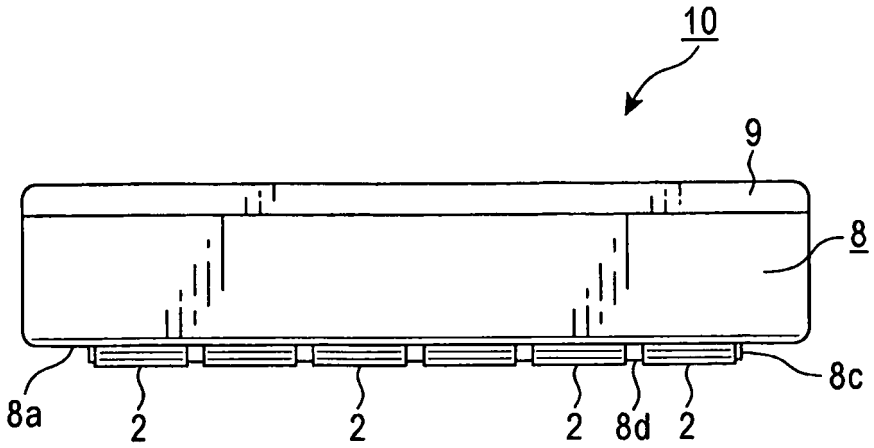


FIG. 3

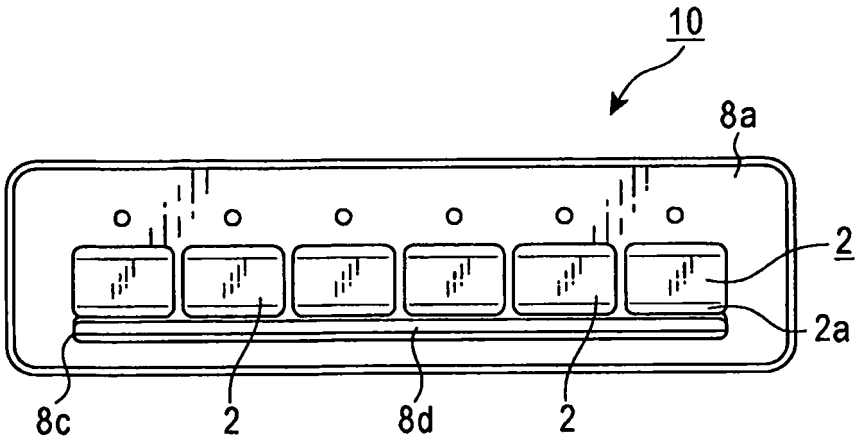


FIG. 4

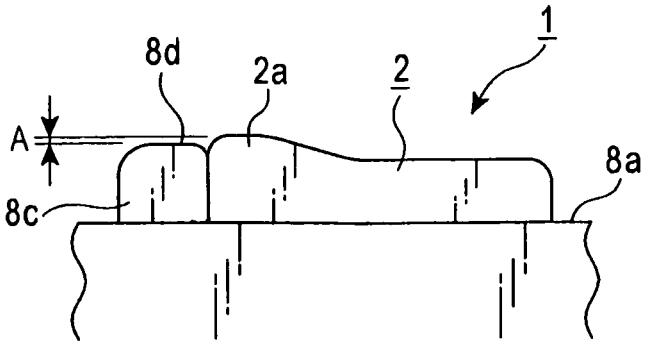


FIG. 5

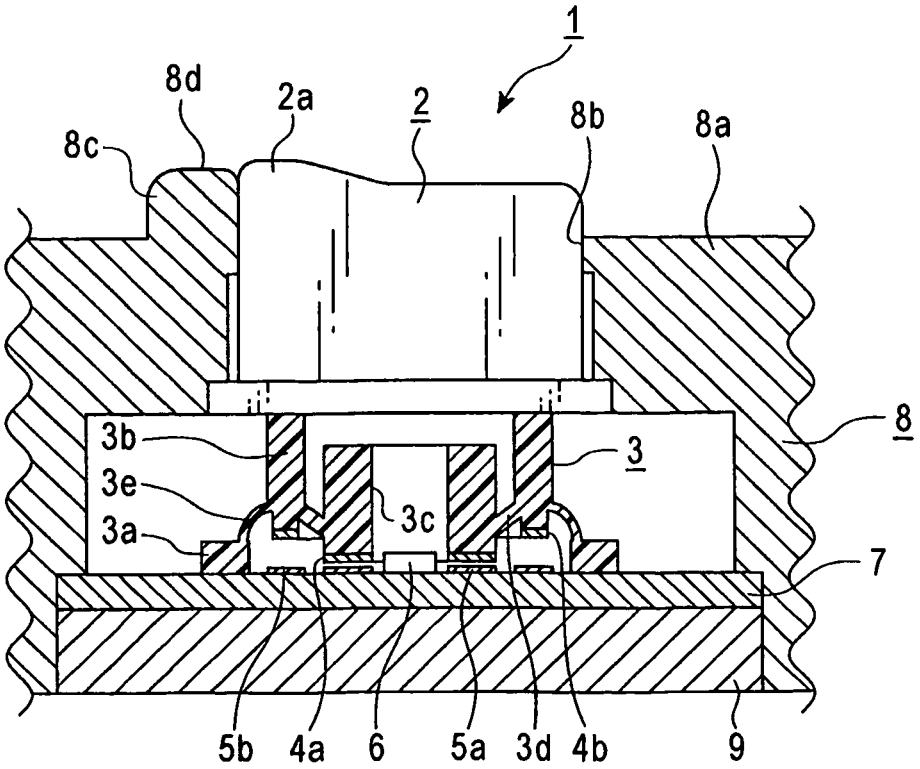


FIG. 6

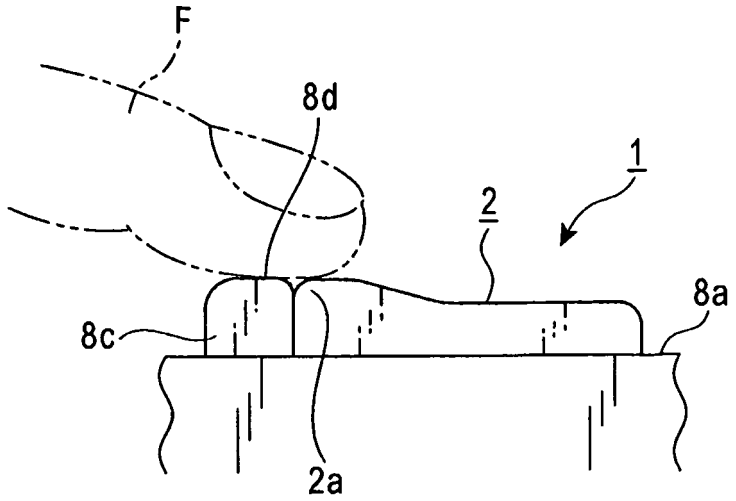


FIG. 7

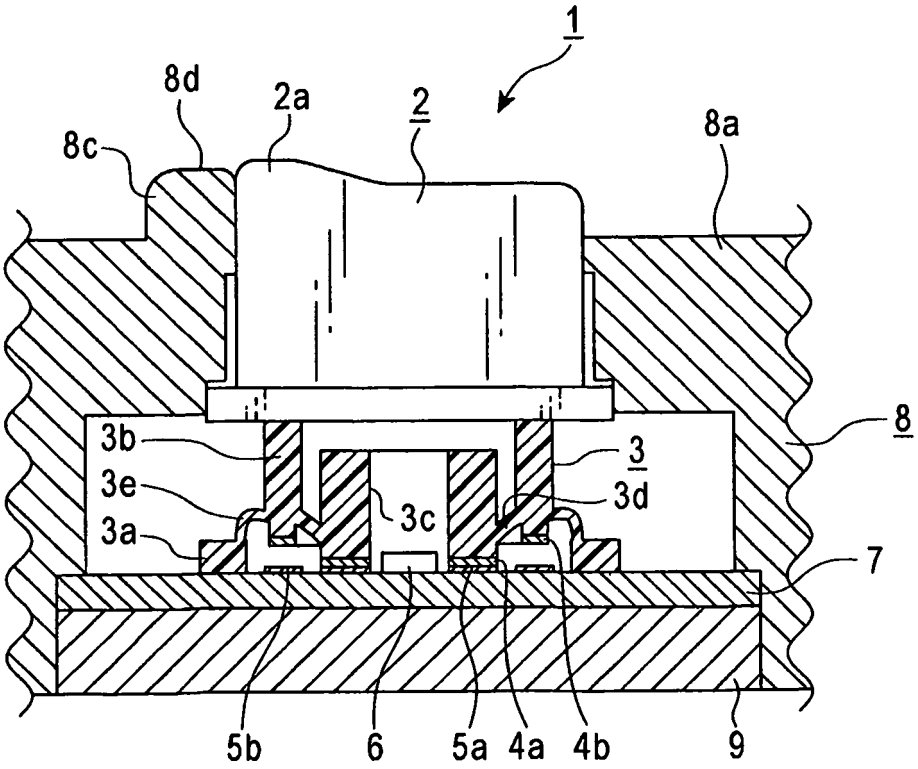


FIG. 8

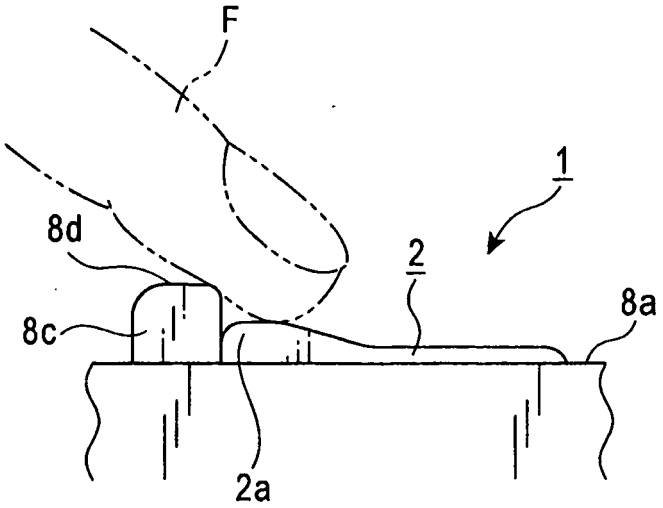


FIG. 9

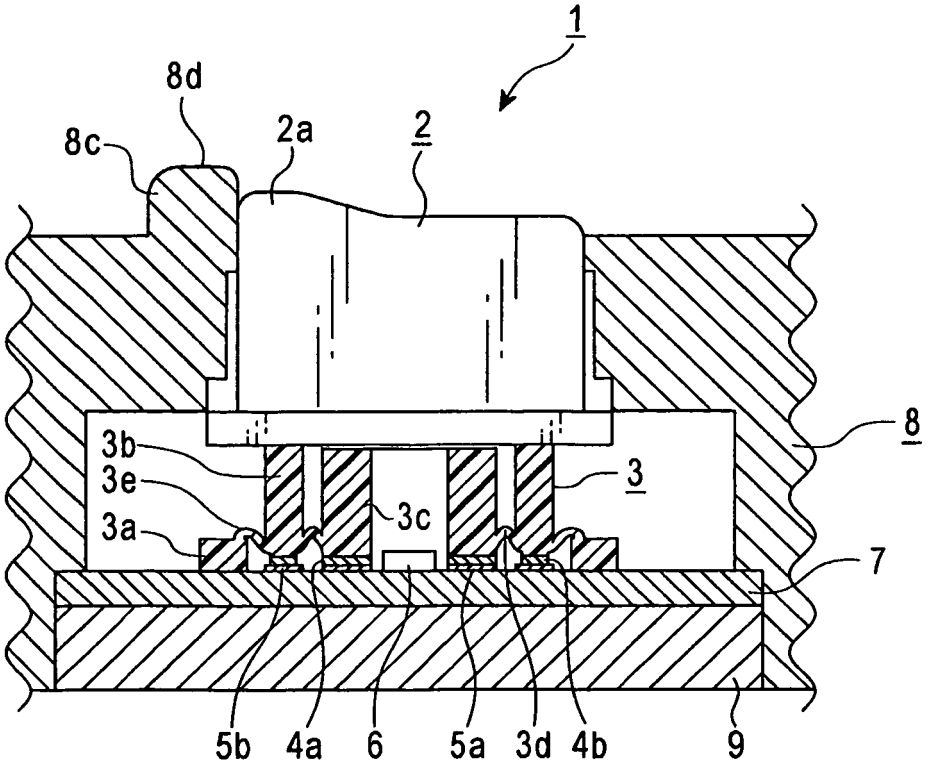


FIG. 10

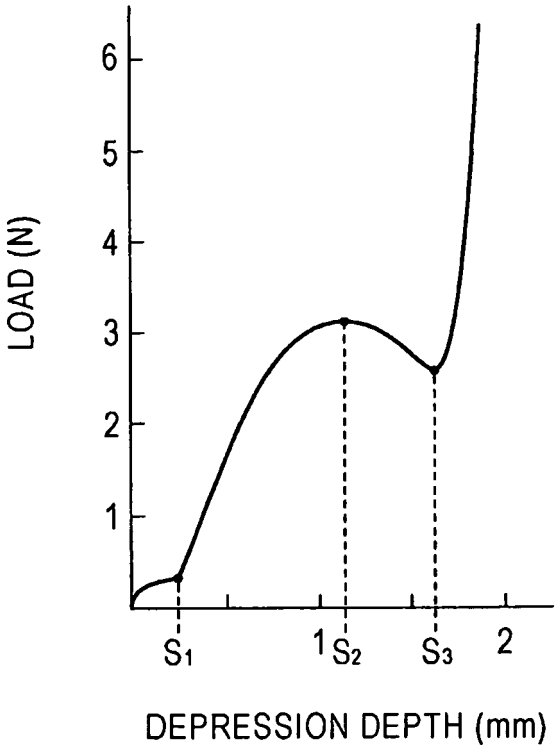

LOAD (N)
6
5
4
3
2
1
S1
1
S2
S3
2
DEPRESSION DEPTH (mm)

FIG. 11

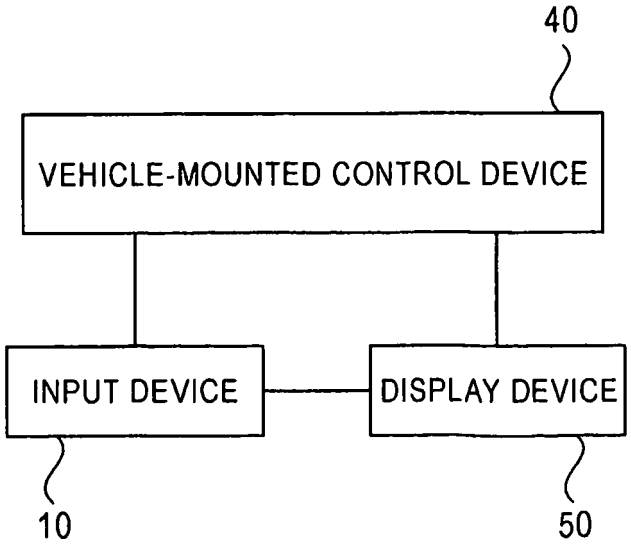

40
VEHICLE-MOUNTED CONTROL DEVICE
INPUT DEVICE
DISPLAY DEVICE
10
50

FIG. 12

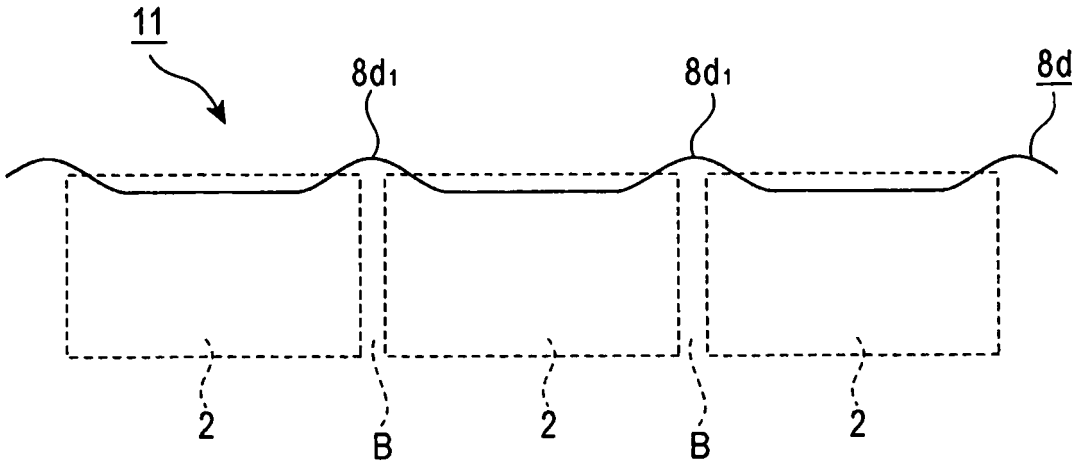


FIG. 13

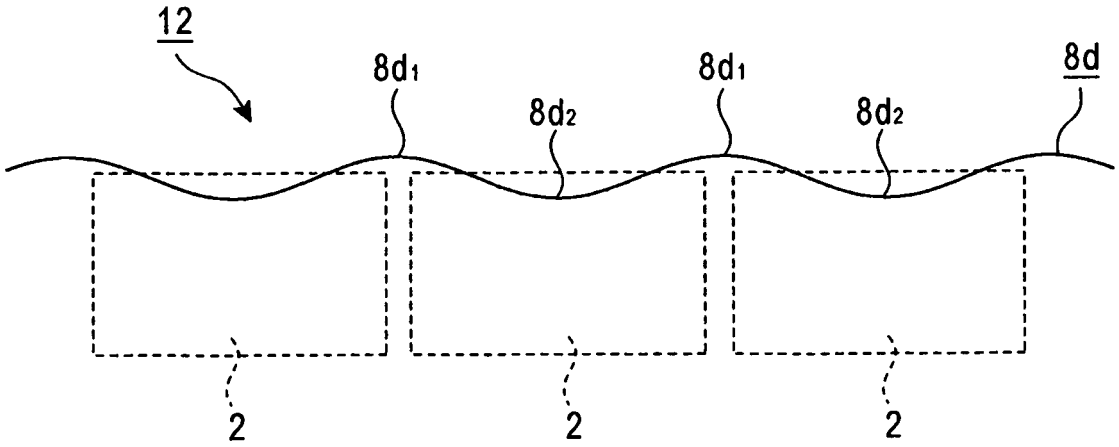


FIG. 14

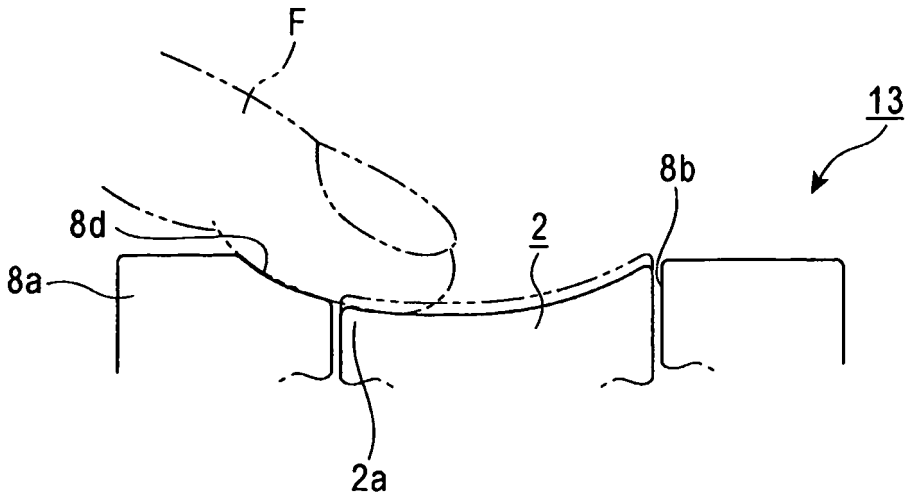
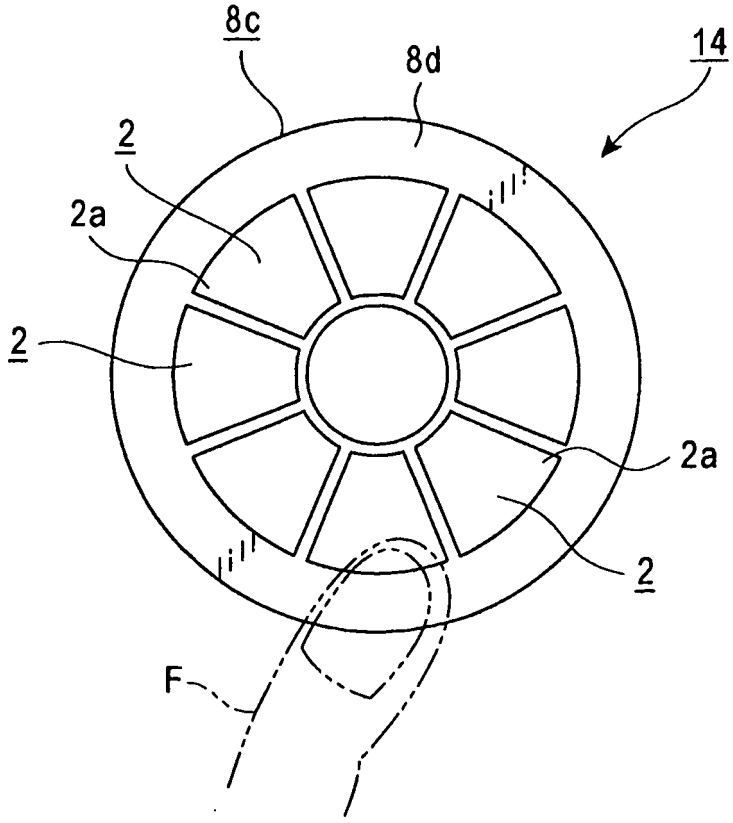


FIG. 15



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 5076856 A **[0006] [0007]**
- US 2001003539 A **[0007]**