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

(11) EP 2 759 380 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
30.07.2014 Bulletin 2014/31

(21) Application number: **12880607.2**

(22) Date of filing: **02.08.2012**

(51) Int Cl.:
B25F 5/00 *(2006.01)* ***H01H 15/10*** *(2006.01)*

(86) International application number:
PCT/IB2012/001483

(87) International publication number:
WO 2014/006438 (09.01.2014 Gazette 2014/02)

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

(30) Priority: **20.09.2011 JP 2011204995**

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(54) **SLIDE SWITCH FOR ELECTRIC TOOL**

(57) A slide switch for an electric tool is provided with a pair of rails (2) and a slide part (3) for sliding sandwiched between said rails, and said rails (2) are provided with a positioning region for determining the position in the sliding direction of the slide part. The positioning region, comprising a plurality of concave parts (23) formed in a line on the slide part side, has at least three positioning units formed so as to be centered around one of the concave parts (23). The angle of inclination (α) of an ascending inclined face (27) of the positioning unit which is two units or more in front of the positioning unit which is in the final position at the tip end in the sliding direction is smaller than the angle of inclination (β) of an ascending inclined face (25) of the positioning unit adjacent to said positioning unit in the tip end direction.

FIG. 1A

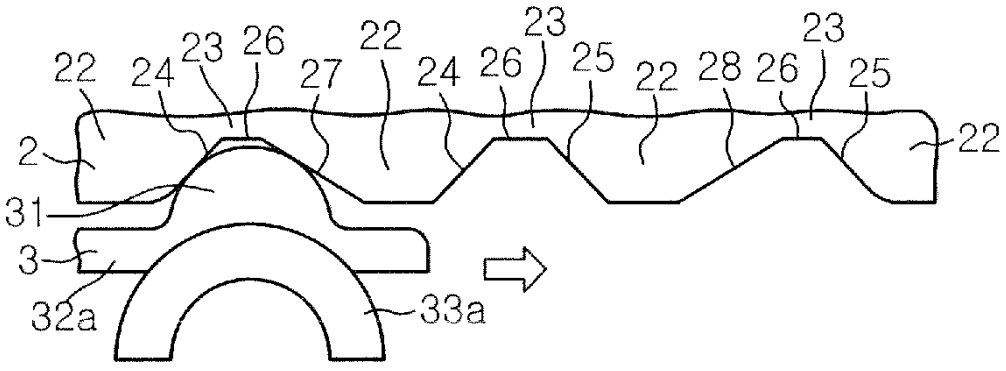

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FIG. 1B

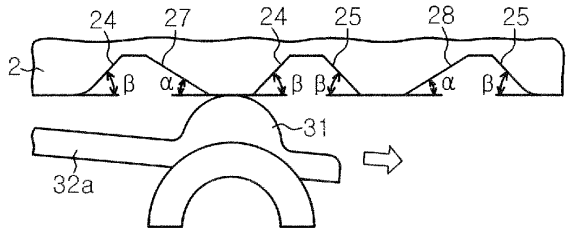


FIG. 1C

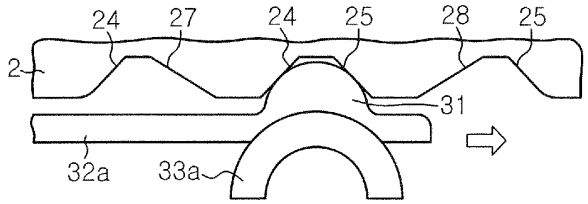


FIG. 1D

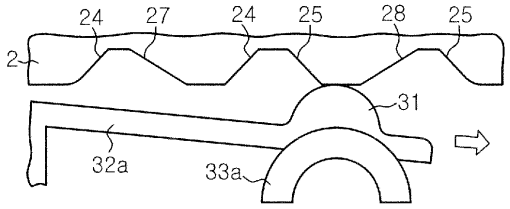
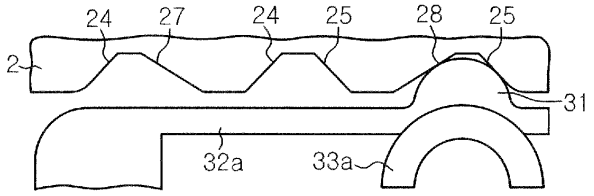


FIG. 1E



Description

Field of the Invention

[0001] The present invention relates to a slide switch for an electric power tool.

Background of the Invention

[0002] Among electric power tools having a built-in transmission mechanism, there is available an electric power tool that employs a slide switch for switching the speed level of the electric power tool. One example of a positioning mechanism of the slide switch used for this purpose is illustrated in Fig. 2. Elastic arm portions 32a and 32b are provided to a slider 3 disposed between a pair of rails 2. Projections 31 are provided on the outer surfaces of the tip ends of the arm portions 32a and 32b. In Fig. 2, reference symbol 33 designates a spring for bringing spring pieces 33a and 33b formed in the opposite end portions thereof into contact with the arm portions 32a and 32b and biasing the respective projections 31 toward the rails 2.

[0003] On the surface of each of the rails 2 which faces the slider 3, protrusions 22 and recesses 23 are alternately formed along the longitudinal direction of each of the rails 2 (i.e., the sliding direction of the slider 3). When sliding the slider 3, each of the projections 31 moves from one recess 23 to the next recess 23 by climbing over the protrusion 22. The slider 3 is positioned in place as the projections 31 are located within the recesses 23.

[0004] In the conventional case, the respective recesses 23 of the rails 2 are identical in shape with one another. In other words, as shown in Figs. 5A and 5B, each of the recesses 23 includes a bottom surface 26 and slant surfaces 24 and 25 extending from the bottom surface 26 toward the corresponding protrusions 22. The recesses 23 provided in plural numbers are identical in shape with one another.

[0005] Patent Document 1: Japanese Patent Application Publication No. H07-335073

[0006] In case of a slide switch in which three or more recesses 23 are arranged to enable the slide switch to be switched between three or more stages, it is often the case that, during a sliding operation, a trouble occurs in the movement of the slider 3 as described below in detail.

[0007] In order for the projection 31 to move from one recess 23 to the neighboring recess 23, the projection 31 has to climb over the protrusion 22. At this time, it is necessary to apply a force which depends on the inclination angle of the slant surfaces 24 and 25. When the slider 3 is slid in a direction indicated by an arrow in Fig. 5A, due to the presence of the slant surface 25, it is necessary to apply a force for moving the projection 31 against the elasticity of the arm portion 32a and the elasticity of the spring piece 33a. However, there is a case that the force thus applied becomes too large. In this case, the projection 31 may not stop in the neighboring recess 23 to climb over the next protrusion 22 or may move to the next neighboring recess 23.

Summary of the Invention

[0008] In view of the aforementioned problem, the present invention provides a slide switch for an electric power tool capable of being sequentially switched step by step.

[0009] In accordance with an embodiment of the present invention, there is provided a slide switch for an electric power tool including: a pair of rails; and a slider configured to slide between the rails, wherein the rails include a positioning region for positioning the slider in a sliding direction, and the slider includes a projection biased toward the corresponding rail to make contact with the positioning region. The positioning region includes a plurality of protrusions protruding toward the slider, which is arranged along the sliding direction, and a plurality of recesses is formed between the neighboring protrusions. A descending slant surface descending from the protrusion to the recess and an ascending slant surface ascending from the recess to the neighboring protrusion next to the protrusion in the sliding direction form a positioning unit, and the positioning region includes at least three positioning units. An inclination angle of the ascending slant surface of the positioning unit, which is located two or more units before the final positioning unit located at the front end position in the sliding direction is smaller than an inclination angle of the ascending slant surface of the neighboring positioning unit next to the positioning unit located two or more units before the final positioning units.

[0010] The sliding operation for moving the projection from the recess of the positioning unit, which is located two units before the final positioning unit, to the recess of the positioning unit, which is located one unit before the final positioning unit, can be performed by a smaller force than the sliding operation for moving the projection from the recess of the positioning unit, which is located one unit before the final positioning unit, to the recess of the final positioning unit.

Effect of the Invention

[0011] In accordance with the present invention, even if a larger force is applied to move the slider, a failure to adjust steps is less likely to occur. Therefore, the slide switch can be sequentially switched step by step.

Brief Description of the Drawings

[0012] The objects and features of the present invention will become more apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings.

Figs. 1A to 1E are partially enlarged views illustrating

the operation of a slide switch according to one embodiment of the present invention.

Fig. 2 is a perspective view of the slide switch according to the embodiment of the present invention.

Fig. 3 is a perspective view showing an electric power tool provided with the slide switch according to the embodiment of the present invention.

Fig. 4 is a partially enlarged view illustrating the operation of a slide switch according to a modified example of the embodiment of the present invention.

Figs. 5A and 5B are partially enlarged views showing a conventional example.

Detailed Description of the Embodiments

[0013] An embodiment of the present invention will now be described with reference to Figs. 1A to 3. Throughout the drawings, like reference numerals will be given to the like parts having substantially the same function and configuration, and a redundant description thereof will be omitted.

[0014] A slide switch 1 for an electric power tool in accordance with the present embodiment includes a pair of rails 2 and a slider 3 sliding between the rails 2. Each of the rails 2 includes a positioning region for positioning the slider 3 in a sliding direction. The slider 3 includes projections 31, each of which is biased toward each of the rails 2 to make contact with the positioning region. The positioning region includes a plurality of recesses 23 arranged side by side on the surface of each of the rails 2 facing the slider 3. A section around each one of the recesses 23 defines a positioning unit, and the positioning region includes at least three positioning units. In each of the recesses 23, an ascending slant surface is positioned at the front end in the sliding direction and a descending slant surface is positioned at the rear end in the sliding direction. Each of the positioning units includes the ascending slant surface and the descending slant surface. The inclination angle α of the ascending slant surface 27 of a positioning unit, which is located two or more units before the final positioning unit positioned at the front end position in the sliding direction, is smaller than the inclination angle β of the ascending slant surface 25 of a neighboring positioning unit which adjoins the corresponding positioning unit at its front side in the sliding direction.

[0015] Fig. 2 shows the overall configuration of the slide switch 1. The slide switch 1 includes the pair of rails 2 and the slider 3 sliding between the rails 2.

[0016] Each of the rails 2 guides the movement of the slider 3 to allow the slider 3 to be reciprocated in the direction along the rails 2 while determining the positioning of the slider 3 in the sliding direction. The two rails 2 are connected to each other by a member (not shown) (e.g., by a housing of the electric power tool).

[0017] Each of the rails 2 disposed parallel to each other includes a positioning region for positioning the slider 3 in the sliding direction. In the positioning region, four protrusions 22 protruding toward the slider 3 are formed in each of the rails 2 along the sliding direction of the slider 3. Recesses 23 are formed between the neighboring protrusions 22. That is to say, in the positioning region, a plurality of recesses 23 facing toward the slider 3 is formed side by side along the sliding direction of the slider 3. Thus, in the illustrated example, there are three recesses 23 in total.

[0018] The slider 3 includes a pair of arm portions 32a and 32b extending substantially parallel to each other along the sliding direction of the slider 3 (along the longitudinal direction of the rails 2). Each of the arm portions 32a and 32b includes a projection 31 provided at the outer surface of the tip end thereof facing the corresponding rail 2. The positioning of the slider 3 in the sliding direction is performed by fitting the projection 31 to one of the recesses 23 of the rails 2. In Fig. 2, reference symbol 33 designates a spring for bringing spring pieces 33a and 33b formed in the opposite end portions thereof into contact with the arm portions 32a and 32b and biasing the respective arm portions 32a and 32b toward the rails 2. For that reason, the projections 31 are fitted to the recesses 23 in a state that they are biased by the elasticity of the arm portions 32a and 32b and the elasticity of the spring 33.

[0019] A section around each one of the recesses 23 defines a positioning unit and the positioning region includes at least three positioning units. Referring to the recess in which the slider 3 is fitted as shown in Fig. 1A, the recess 23 of the positioning unit includes a descending slant surface 24 descending from the end protrusion 22 to a bottom surface 26 of the recess 23 along the sliding direction of the slider 3 and an ascending slant surface 27 ascending from the bottom surface 26 of the recess 23 to the neighboring protrusion 22 next to the end protrusion 22 in the sliding direction.

[0020] In this regard, the ascending slant surface and the descending slant surface are named depending on the sliding direction. The aforementioned positioning unit includes a front end wall (ascending slant surface) and a rear end wall (descending slant surface) of the recess 23 in the sliding direction.

[0021] Referring to the recess in which the slider 3 is fitted as shown in Fig. 1C in the sliding direction of the slider 3, the positioning unit includes a descending slant surface 24 and an ascending slant surface 25. Referring to the recess in which the slider 3 is fitted as shown in Fig. 1E, the positioning unit includes a descending slant surface 28 and an ascending slant surface 25.

[0022] That is to say, one positioning unit includes an ascending slant surface and a descending slant surface positioned at the front end and the rear end in one recess 23 in the sliding direction, respectively.

[0023] In the present embodiment, the inclination angle α of the ascending slant surface 27 of the positioning unit, which is located two or more units before the final positioning unit located at the front end position in the sliding direction is set smaller than the inclination angle

β of the ascending slant surface 25 of the neighboring positioning unit which adjoins the corresponding positioning unit at its front side in the sliding direction.

[0024] In other words, in the recesses 23 positioned at the longitudinal opposite ends of each of the rails 2 so that another recess 23 is located only at one side thereof, one slant surface 27 (or the slant surface 28) adjoining another recess 23 through the protrusion 22 differs in inclination angle from the other slant surface 25 (or the slant surface 24). In the recess 23 at the opposite sides of which other recesses 23 are located, i.e., in the centrally positioned recess 23, the slant surfaces 24 and 25 of the opposite side walls thereof have the same inclination angle. Among the slant surfaces 24, 25, 27 and 28, the inclination angle α of the slant surface 27 (the slant surface 28) joined to the central recess 23 through the protrusion 22 is set smaller than the inclination angle β of other slant surfaces 24 and 25. In the Fig. 1A, reference symbol 26 designates the bottom surface of the recess 23 as mentioned above. However, the recess 23 may not have the bottom surface 26.

[0025] If the projection 31 is moved to the central recess 23 by sliding the slider 3 in a direction indicated by an arrow from the state in which the projection 31 is fitted to the recess 23 located at one end of the corresponding rail 2 as shown in Fig. 1A, the projection 31 moves along the slant surface 27 whose inclination angle α is gentle. At this time, the projection 31 climbs over the protrusion while moving inwardly against the biasing force of the spring. Thereafter, the projection 31 is fitted to the central recess 23. If the inclination angle α is assumed to be 30 degrees and if the inclination angle β is assumed to be 45 degrees, the force required at this time may be about 70% of the force required in moving the projection 31 along the slant surfaces 24 and 25 having the inclination angle β.

[0026] For that reason, even if the force applied when the projection 31 moves along the slant surface 27 is a little strong, there is no possibility that, after the projection 31 is fitted to the central recess 23 by climbing over the protrusion 22, the projection 31 further moves along the slant surface 25 (or the slant surface 24) to climb over the next protrusion 22. Thus, the projection 31 is positioned and held in the central recess 23.

[0027] In case where the projection 31 fitted to the central recess 23 is moved to one of the recesses 23 positioned at the longitudinal opposite ends of the corresponding rail 2, the projection 31 can be fitted to one of the opposite end recesses 23 although the inclination angle β of the slant surfaces 24 and 25 is large. This is because the slide stroke of the slider 3 is separately restricted.

[0028] Next, a modified example of the present embodiment will be described with reference to Fig. 4. The modified example of the present embodiment differs from the embodiment shown in Fig. 1 only in terms of the number of recesses. Therefore, description on the parts other than the recesses will be omitted.

[0029] Each of the rails 2 includes a positioning region for positioning the slider 3 in the sliding direction. The positioning region of each of the rails 2 shown in Fig. 4 includes six positioning units. First to six recesses 23a to 23f are provided in each of the rails 2.

[0030] In this regard, the inclination angle of the ascending slant surface of the fourth positioning unit (the fourth recess 23d), which is located two units before the sixth positioning unit (the sixth recess 23f) located at the front end position in the sliding direction of the slider 3 (the left-to-right direction in Fig. 4), is α4. The inclination angle of the ascending slant surface of the fifth positioning unit (the fifth recess 23e), which adjoins the fourth positioning unit (the fourth recess 23d) at the front side of the fourth positioning unit in the sliding direction, is β. In this case, the inclination angle α4 is smaller than the inclination angle β.

[0031] The inclination angle of the ascending slant surface of the third positioning unit (the third recess 23c), which is located three units before the sixth positioning unit (the sixth recess 23f) located at the front end position in the sliding direction, is α3. The inclination angle of the ascending slant surface of the fourth positioning unit (the fourth recess 23d), which adjoins the third positioning unit (the third recess 23c) at the front side of the third positioning unit in the sliding direction, is α4. In this case, the inclination angle α3 is smaller than the inclination angle α4.

[0032] The inclination angle of the ascending slant surface of the second positioning unit (the second recess 23b), which is located four units before the sixth positioning unit (the sixth recess 23f) located at the front end position in the sliding direction, is α2. The inclination angle of the ascending slant surface of the third positioning unit (the third recess 23c), which adjoins the second positioning unit (the second recess 23b) at the front side of the second positioning unit in the sliding direction, is α3. In this case, the inclination angle α2 is smaller than the inclination angle α3.

[0033] Subsequently, the inclination angle of the ascending slant surface of the first positioning unit (the first recess 23a), which is located five units before the sixth positioning unit (the sixth recess 23f) located at the front end position in the sliding direction, is α1. The inclination angle of the ascending slant surface of the second positioning unit (the second recess 23b), which adjoins the first positioning unit (the first recess 23a) at the front side of the first positioning unit in the sliding direction, is α2. In this case, the inclination angle α1 is smaller than the inclination angle α2.

[0034] In other words, the inclination angles of the ascending slant surfaces of the first to fifth recesses 23a to 23e are α1, α2, α3, α4 and β, respectively, and have a relationship of $\alpha 1<\alpha 2<\alpha 3<\alpha 4<\beta$. Accordingly, if the inclination angles α1, α2, α3, α4 and β are assumed to be 30°, 35°, 40°, 45° and 50°, respectively, the force required in moving the slider 3 from the first recess 23a to the second recess 23b is smaller than the force required in

moving the slider 3 from the second recess 23b to the third recess 23c. Furthermore, the force required in moving the slider 3 from the second recess 23b to the third recess 23c is smaller than the force required in moving the slider 3 from the third recess 23c to the fourth recess 23d. Likewise, the force required in moving the slider 3 from the third recess 23c to the fourth recess 23d is smaller than the force required in moving the slider 3 from the fourth recess 23d to the fifth recess 23e. Thus, even if the force applied to move the slider 3 is a little strong, a climb-over problem is less likely to occur. Therefore, the slide switch can be sequentially switched step by step.

[0035] In addition, the inclination angle of the ascending slant surface of the third positioning unit (the third recess 23c), which is located two units before the first positioning unit (the first recess 23a) located at the front end position in the reverse sliding direction of the slider 3 (the right-to-left direction in Fig. 4), is $\alpha 4$. The inclination angle of the ascending slant surface of the second positioning unit (the second recess 23b), which adjoins the third positioning unit (the third recess 23c) at the front side of the third positioning unit in the reverse sliding direction, is β. In this case, the inclination angle $\alpha 4$ is smaller than the inclination angle β. The operation in the reverse sliding direction is similar to the operation in the forward sliding direction. Therefore, description on the operation in the reverse sliding direction will be omitted.

[0036] In the recesses 23 located at the opposite ends of each of the rails 2, the side wall not adjoining another recess 23 may not be formed into a slant surface but may be formed into a right-angled wall.

[0037] Fig. 3 shows an electric power tool provided with the aforementioned slide switch 1. The slide switch 1 disposed on the upper surface of the electric power tool is used as a switch for switching speed reduction ratios in the electric power tool.

[0038] While the invention has been shown and described with respect to the embodiments, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

Claims

1. A slide switch for an electric power tool comprising:

a pair of rails; and
a slider configured to slide between the rails,
wherein the rails include a positioning region for positioning the slider in a sliding direction, and the slider includes a projection biased toward the corresponding rail to make contact with the positioning region;
wherein the positioning region includes a plurality of recesses arranged side by side on a surface of the corresponding rail facing the slider;
wherein a section around each of the recesses defines a positioning unit, and the positioning region includes at least three positioning units;
wherein in each of the recesses, the positioning unit includes an ascending slant surface positioned at a front end in the sliding direction and a descending slant surface positioned at a rear end in the sliding direction; and
wherein an inclination angle of the ascending slant surface of one of the positioning units, which is located two or more units before the final one of the positioning units located at the front end position in the sliding direction is smaller than an inclination angle of the ascending slant surface of another one of the positioning units, which adjoins the positioning unit located two or more units before the final one of the positioning units, at the front side in the sliding direction.

FIG. 1A

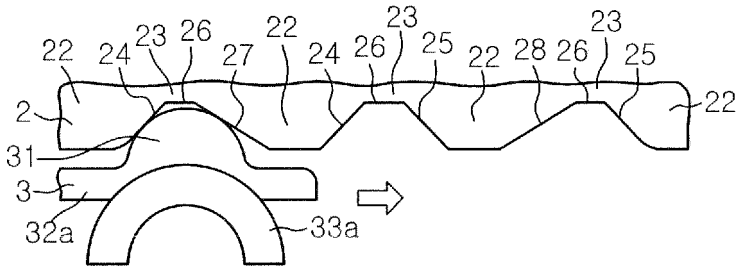


FIG. 1B

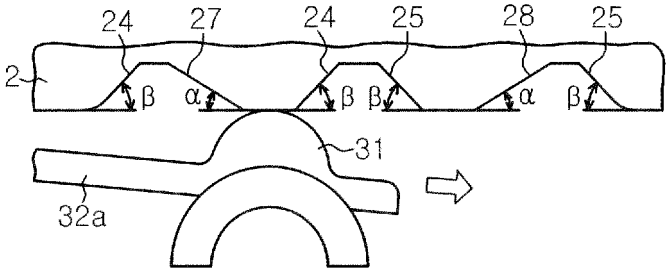


FIG. 1C

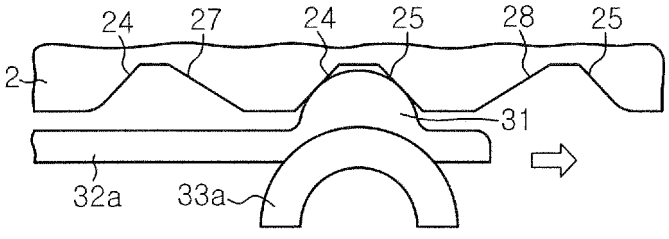


FIG. 1D

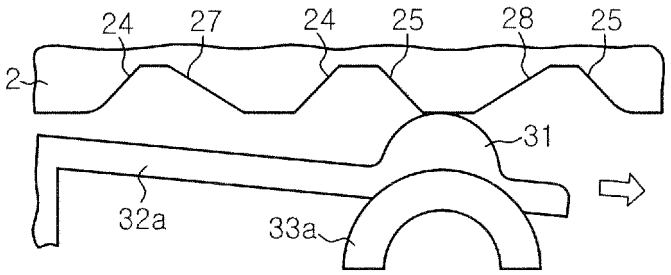


FIG. 1E

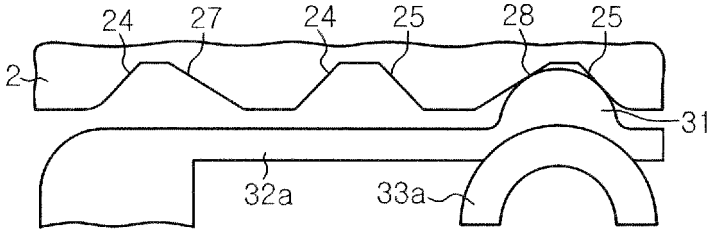


FIG. 2

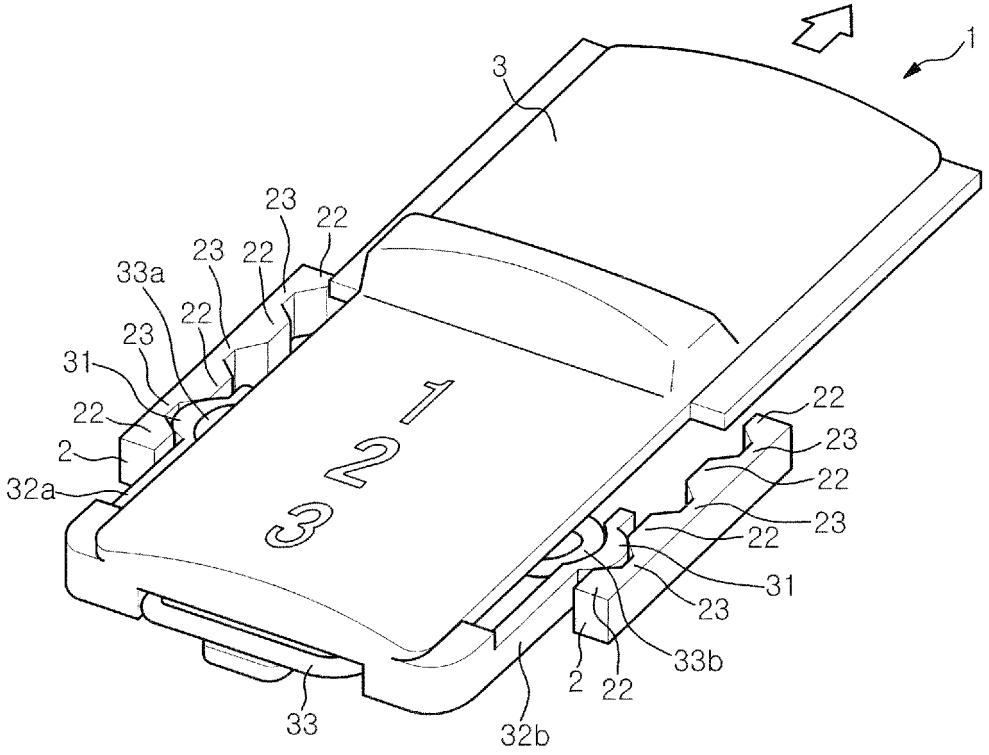

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FIG. 3

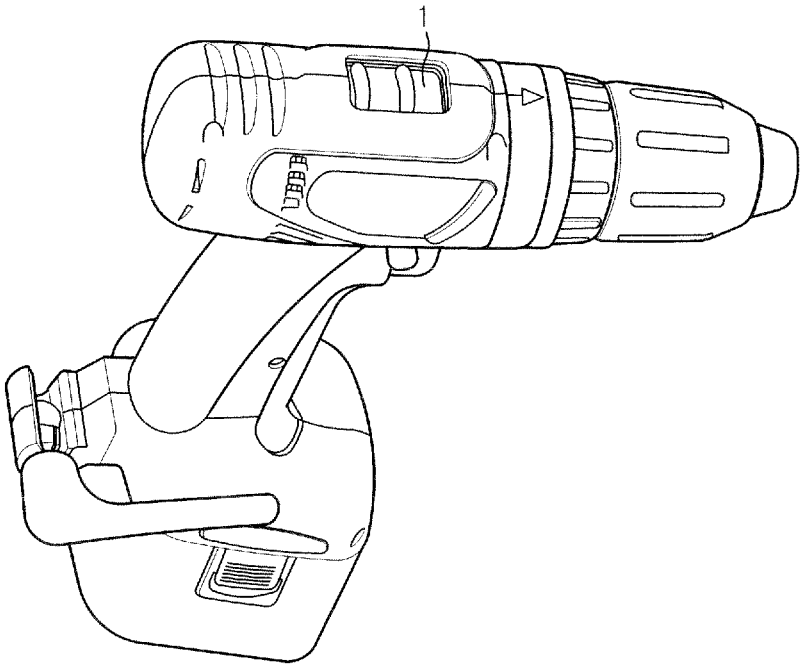

FIG. 4

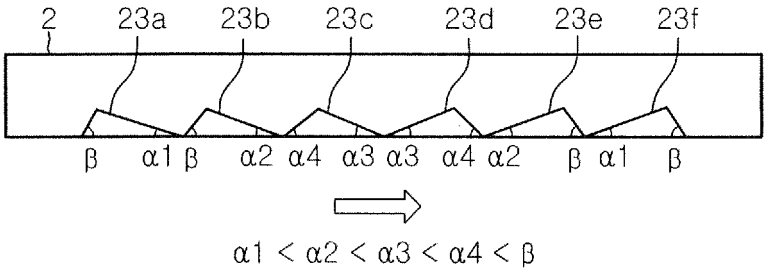

FIG. 5A

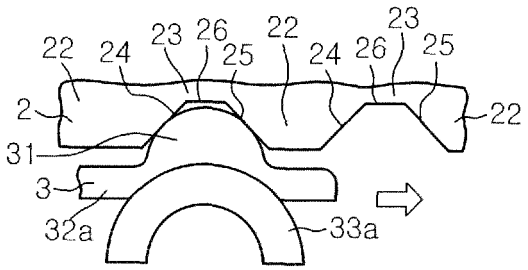
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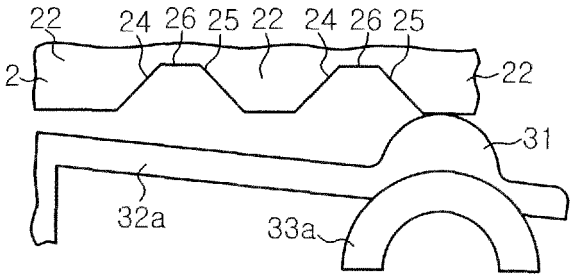
FIG. 5B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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2012/001483

A. CLASSIFICATION OF SUBJECT MATTER
B25F5/00(2006.01)i, *H01H15/10*(2006.01)i

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)
B25F1/00-5/02, H01H15/00-15/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012
Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2004-299047 A (Hilti AG.), 28 October 2004 (28.10.2004), paragraphs [0016] to [0023]; fig. 1 to 3 & US 2004/0188233 A1 & DE 203005224 U1	1
Y	JP 2011-113931 A (Yazaki Corp.), 09 June 2011 (09.06.2011), paragraph [0039]; fig. 2, 10, 12 (Family: none)	1
Y	JP 2004-164936 A (Alps Electric Co., Ltd.), 10 June 2004 (10.06.2004), paragraph [0001]; fig. 5 to 7 (Family: none)	1

☒ 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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Date of the actual completion of the international search	Date of mailing of the international search report
16 October, 2012 (16.10.12)	30 October, 2012 (30.10.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2012/001483

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 5-217464 A (Shinmei Electric Co., Ltd.), 27 August 1993 (27.08.1993), paragraph [0001]; fig. 1, 3 (Family: none)	1
Y	JP 9-245569 A (Kabushiki Kaisha T an T), 19 September 1997 (19.09.1997), paragraph [0001]; fig. 3 to 5 & US 5824977 A & GB 2310957 A & DE 19708609 A1 & CN 1174389 A	1

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H07335073 B **[0005]**