



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.05.2018 Bulletin 2018/22

(51) Int Cl.:
B25F 5/02 (2006.01)

(21) Application number: **16200989.8**

(22) Date of filing: **28.11.2016**

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

(72) Inventor: **Valentini, Guido**
20122 Milano (IT)

(74) Representative: **Herrmann, Jochen**
Herrmann
Patentanwälte
Königstrasse 30
70173 Stuttgart (DE)

(71) Applicant: **Valentini, Guido**
20122 Milano (IT)

(54) **POWER TOOL**

(57) The invention relates to a power tool (10) comprising a mechanical device (50) for setting a working parameter of said power tool (10) via a potentiometer (56) that is adjustable via the mechanical device for setting the working parameter, the power tool (10) further comprising a printed circuit board (44) and an illumination

device (64), in particular an LED (70), with electrical contacts (72), the illumination device (64) being adapted for illuminating the mechanical device (50) for setting the working parameter. The electrical contacts (72) of the illumination device (64) are indirectly connected to the printed circuit board (44) via flexible wires (74).

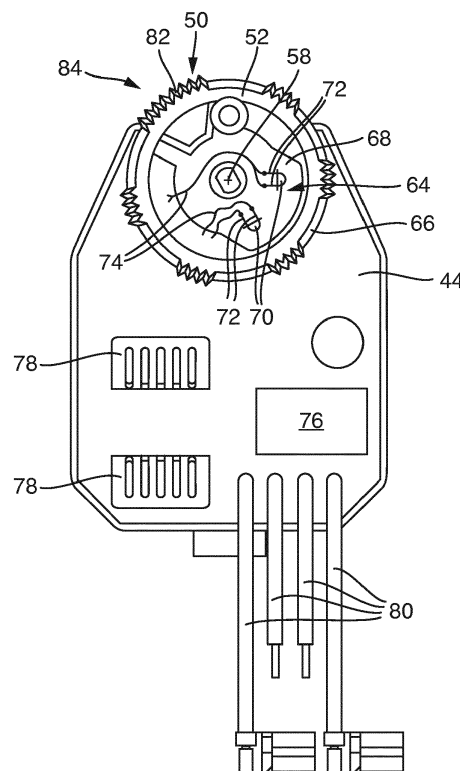


Fig. 2

Description

[0001] The present invention regards a power tool according to the preamble of claim 1. That is a power tool comprising a mechanical device for setting a working parameter of said power tool, at least part of the mechanical device being visible and accessible from outside of the power tool by a user of the power tool, the power tool further comprising a printed circuit board and an illumination device with electrical contacts, the illumination device being adapted for illuminating at least that part of the mechanical device being visible from outside of the power tool. In the context of the present invention it is preferred if the illumination device comprises at least one LED, preferably two LEDs. However, the present invention is not limited to illumination devices comprising an LED.

[0002] The expression power tool in the context of the present invention is referring to a tool that is powered by a non-manual energy source. The power tool in the context of the present invention can be stationary or handheld. Examples of such power tools would be a sander, a polisher, a drill or a saw.

[0003] From power tools available on the market it is known to attach the illumination device rigidly and unmovably to the circuit board, like it is described in detail in DE 10 2010 013 783 A1. In particular, in the known power tools the LEDs are mounted to the circuit board directly with their contact ends, for example by soldering. In consequence, the position of the illumination device in the power tool is limited by its position on the circuit board and by the circuit board's position in the housing of the power tool. This requires that the mechanical device for setting the working parameter, which is supposed to be illuminated by the illumination device, has to be installed in the vicinity to or directly attached to the circuit board. This significantly limits the possibilities for arranging said mechanical device on the power tool and/or implies strong restrictions regarding the design and position of the circuit board and of the mechanical device located thereon. If the mechanical device is supposed to be installed at a position in the power tool where there is little space for accommodating the circuit board, either this installation position is not possible or the circuit board has to be designed with rather small dimensions fitting into the small available space. Imposing such a limitation on the circuit board in turn might limit its functionality or limit the space for cooling fins or other components requiring rather large amounts of space. If there is not enough space near the circuit board for adequately sized cooling fins, then the reliability of the power tool is reduced and/or its power consumption has to be limited.

[0004] Therefore the object of the present invention is to create a power tool that is reliably operating and in which the position for accommodating the illumination device and the mechanical device for setting the working parameter are highly variable.

[0005] This problem is solved by a power tool accord-

ing to the present invention. The power tool according to the present invention is characterized in that the electrical contacts of the illumination device are indirectly connected to the printed circuit board via flexible wires. In the prior art, especially when the illumination device is constituted by an LED, the electrical contacts in the form of rigid wires extending from the LED are directly attached to the circuit board, e.g. by soldering. These rigid wires then form an electrical connection between the circuit board and the LED as well as a mechanical mounting device for the LED. The rigid wires extending from the LED are therefore used for electrical connection and fastening or fixing of the LED on the circuit board at the same time. However, as described above, this limits the possibilities for arranging the LED. When using the teaching of the current invention due to the flexible wires it is possible to arrange the LED at basically any desired position within the housing of the power tool, irrespective of the position of the printed circuit board. Therefore the arrangement of the mechanical device for setting the working parameter which is supposed to be illuminated by the illumination device, e.g. the LED, can be placed on the power tool as desired.

[0006] Preferably, the flexible wires of the illumination device are connected to the printed circuit board by means of a connector or by soldering. In the case of a connector, the printed circuit board is equipped with an appropriate socket for receiving the connector. In that way a damaged illumination device can be easily replaced by a properly functioning illumination device. Furthermore, the flexible wires allow a movement of the illumination device, e.g. together with a movable part of the mechanical device for setting the working parameter of the power tool. In particular, the working element may comprise a turn-switch rotatable about an axis of rotation, and the illumination device can be rotated together with the turn-switch in order to provide for a constant illumination of the turn-switch.

[0007] A further advantage of the present invention is the easier and faster mounting of the illumination device on the printed circuit board and assembly of the power tool. To start with the illumination device can be electrically contacted with the printed circuit board. Then the electrically connected illumination device can be positioned within the desired part of the mechanical device to be illuminated in a desired position. Thereafter, the entire mechanical device can be easily positioned, mechanically fixed and electrically connected to the printed circuit board together with the illumination device, which has been previously electrically connected to the printed circuit board and positioned in respect to the mechanical device.

[0008] In a preferred embodiment the mechanical device comprises a potentiometer for setting the working parameter of the power tool and a turn-switch adapted to adjust a resistance value of the potentiometer and being located in the power tool such that it is visible and accessible from outside of the power tool by the user of

the power tool. This constitutes an advantageous embodiment of the mechanical device.

[0009] Preferably the illumination device is adapted for illuminating the turn-switch. The illumination device is in particular located within the turn-switch such that at least that part of the turn-switch visible and accessible from outside of the power tool is illuminated. This makes the power tool particularly easy to manage since the position and orientation of the turn-switch is always visible.

[0010] It is furthermore advantageous, if the illumination device comprises at least one light emitting diode (LED). By this the illumination device can be designed particularly compact and on top of this is especially energy efficient.

[0011] According to a preferred embodiment of the current invention the flexible wires are stranded or braided wires. This gives enhanced durability and flexibility to the wires while electrical conductivity of the wires is also affected positively. Therefore a reliable and stable flexible electrical connection between the printed circuit board and the illumination device (e.g. one or more LEDs) is realized by the wires formed by stranded or braided wires.

[0012] A further preferred embodiment of the current invention is characterized in that the mechanical device comprises a potentiometer, wherein the potentiometer comprises electrical contacts that are indirectly connected to the printed circuit board via flexible wires, preferably wherein the flexible wires are stranded or braided wires. This preferred embodiment not only allows a very flexible placement of the illumination device but also of the potentiometer. By this the flexibility of the arrangement of the mechanical device for setting the working parameter is increased even further.

[0013] In a further preferred embodiment of the current invention part of the mechanical device being visible from outside of the power tool, in particular the turn-switch, is at least partially made of a translucent material allowing translucence of light emitted by the illumination device located inside the mechanical device. This allows that even in bad lighting conditions the position and alignment of the mechanical device for setting the working parameter on the power tool is easily recognized by an operator of the tool.

[0014] Preferably the translucent material of that part of the mechanical device being visible from outside of the power tool, in particular of the turn-switch, resembles numbers referring to certain values of the working parameters of the power tool if the mechanical device is set to these numbers. This embodiment allows for easy recognition of the currently set operating parameter even in bad lighting conditions.

[0015] It is also preferred when the mechanical device comprises a turn-switch, wherein the turn-switch is rotatable around an axis of rotation and the illumination device is accommodated within the turn-switch and preferably offset to the axis of rotation. By this arrangement the turn-switch is not limited in its motion by the illumination device and the risk of damaging the illumination device when

the turn-switch is rotated is also eliminated.

[0016] It is furthermore preferred, if the turn-switch has a contour which is substantially in the shape of a truncated cone. It is in this embodiment especially preferred, if the small end face side of the truncated cone is formed by a transparent material. The shaping of the turn-switch as a truncated cone makes it easily operable for example with the thumb of the operator of the power tool even in difficult conditions.

[0017] It is furthermore preferred, when the turn-switch comprises protrusions on its circumferential outer surface constituting a knurling structure. These protrusions provide enhanced grip to the operator of the power tool, when turning the turn-switch.

[0018] It is preferred when the working parameter of said power tool is a driving speed of the power tool, i.e. the driving speed of the power tool can be adjusted via the mechanical device for setting the working parameter and preferably the turn-switch. Even more preferred is when the power tool has a rotating tool and the working parameter is the speed of rotation of this tool.

[0019] It is also preferred when the power tool is pneumatically or electrically powered and preferably hand-held or hand-guided. Especially for the described devices the installation of the illumination device, according to the described embodiments before, offers significant advantages since especially hand-held devices are usually miniaturized and the smaller and more lightweight the device is the better. Therefore the arrangement of the illumination device according to the present invention allows further miniaturization of such a device.

[0020] Further preferably, the power tool is one of a polisher and a sander, preferably an orbital polisher or sander, in particular a random orbital or a roto-orbital polisher or sander. An orbital sander is a sander in which the attachment for the sanding material is rotated in an orbit and a random orbital sander is such a type of sander in which the orbital motion of the sanding attachment is random, i.e. the advancement of the sanding attachment in each step is not prescribed. Rather the advancement of the sanding attachment is influenced by the amount of pressure with which the sanding attachment is pressed onto the surface to be sanded and the angle in which the power tool is held towards the surface to be sanded.

[0021] Further features, applications and advantages of the invention are explained and revealed in the subsequent description of embodiments of the invention that is explicated on the basis of the drawing, wherein the features can be important to the invention by themselves as well as in their varying combinations, without the importance of a single feature or a combination of features being explicitly pointed out.

Figure 1 shows a power tool according to the present invention in an exploded view;

figure 2 shows a mechanical device for setting the working parameter of a such a power tool in

- a top view;
- figure 3 shows the mechanical device for setting the working parameter of figure 2 in an perspective view; and
- figure 4 a cover as part of the mechanical device according to figures 2 and 3.

[0022] In figure 1 a power tool 10 according to the present invention is shown in an exploded view. The power tool is embodied as a sander, but could be embodied as any other type of power tool, too, e.g. as a polisher. The sander 10 comprises a housing 12 preferably made of a rigid material, such as plastic. The housing 12 comprises a bottom part 12a and a top part 12b detachably fixed to the bottom part 12a by means of a latching connection and/or screws 14. In its front part, the bottom part 12a of the housing 12 comprises a palm pad 16, which is adapted to be gripped by a user with one hand when operating the power tool 10. The palm pad 16 preferably comprises an insert and is preferably made of resilient material such as an elastomer or rubber. The rear part of the housing 12 forms a grip section which can be gripped by the user with his other hand. The housing further comprises a lower section 18 below the palm pad 16 with an enlarged diameter. The lower section 18 is adapted for receiving a working element (backing pad with a sanding paper or in the case of a polisher with a polishing pad) for working the surface of a workpiece, such as the body of a vehicle or the hull of a boat. A suction bonnet 20 preferably made of resilient material can be connected to the lower section 18 of the housing 12. The suction bonnet 20 has an annular shape and comprises a suction nozzle 22 located circumferentially and directed radially towards the outside. The suction nozzle 22 can be connected to a suction spout 24 adapted for being releasably fixed to the bottom of the housing 12, e.g. by means of a screw 24a. At its distal end the spout 24 comprises a hose adapter 26 for connecting the spout 24 and hence the entire suction elements 20, 22 to the hose of a vacuum cleaner for aspirating dust or other fine particles occurring during working the work piece. This has the advantage that the working area is free of dust and other particles during operation of the power tool 10 and can be clearly monitored by the user. Furthermore, health risks for the user of the power tool 10 due to the fine particles in the air surrounding the working area can be avoided.

[0023] An electric motor (not shown) of the tool 10 is located in the housing 12, preferably within or under the palm pad 16. The motor serves for making the working element of the tool 10 perform an actuating movement, which may be e.g. a purely rotary, a roto-orbital or a random-orbital actuating movement. If necessary, one or more gear mechanisms (not shown) can be located functionally between the motor shaft and the working element, in order to translate the rotational movement of the

motor shaft into the desired actuating movement of the working element. The electric motor is powered with electricity provided to the power tool 10 by means of a power cord 28 comprising three wires 30. The power cord 28 is introduced into the housing 12 from the rear end by means of a sealing grommet 32, preferably made of a resilient material and clamped between the two parts 12a and 12b of the housing 12 when fixed together. Immediately after the grommet 32 a strain-relief element 34 is located in the housing 12, which is releasably fixed to the housing 12 by means of screws 34a.

[0024] The upper part 12a of the housing 12 comprises an on/off switch 36 and an actuating lever 38 pivotably fixed to the upper part 12a. The lever 38 is pivotable about an axis defined by a turning shaft 40 against the force of a spring element 42. With the power tool 10 turned on (switch 36 in the on-position), the actuating lever 38 serves for starting and stopping operation of the working element and for controlling the speed of the working element's actuating movement. The lever 38 can be pressed down by the user with the same hand which also rests on the palm pad 16.

[0025] In the housing 12, more specifically between the lower part 12a and the upper part 12b of the housing 12, a printed circuit board (PCB) 44 is accommodated. The PCB 44 comprises a control unit 46 for the power tool 10. The control unit 46 may comprise a microprocessor. The PCB 44 further comprises several circuit paths and a plurality of electronic components for realizing the control unit's functionality. For example, a surface mounted switching element 48 is located on the PCB 44, which is in connection with the on/off switch 36, when the power tool 10 is assembled. Furthermore, the PCB 44 comprises electric sockets to which the wires 30 of the power cable 28 are connected for providing the tool 10, its control unit 46 and the electric motor with electric energy.

[0026] The power tool 10 also comprises a mechanical device 50 for setting a working parameter of the power tool. The working parameter can be, e.g. a maximum speed of the working element, if the actuating lever 38 is completely pressed down during operation of the tool 10. The mechanical device 50 comprises a turn-switch 52 being visible and accessible from outside of the power tool 10. In particular, when the power tool 10 is assembled, the turn-switch 52 protrudes through an opening 54 in the bottom part 12a of the housing 12. Of course, the visible part of the mechanical device 50 could be visible and accessible at any other position of the housing 12, too. The turn-switch 52 is connected to a potentiometer 56. By actuating the turn-switch 52, in particular by rotating it about an axis 58 of rotation, the resistance of the potentiometer 56 can be adjusted to a desired value corresponding to or representative of the desired value the working parameter.

[0027] The potentiometer 56 is connected to the printed circuit board 44 via three flexible wires 60. In the present embodiment the flexible wires 60 are stranded

wires. In the assembled state of the power tool 10 the potentiometer 56 is covered by a cover 62 having a through hole 62a in order to allow the turning movement of the turn-switch 52 to be transferred to the potentiometer 56. The cover 62 is shown in more detail in figure 4.

[0028] The power tool 10 further comprises an illumination device 64, that is symbolically shown in figure 1. Of course, the tool 10 could also comprise more than one illumination device 64. In the assembled state of the tool 10 according to the described embodiment the illumination device 64 is accommodated within the turn-switch 52 and is placed offset to the axis of rotation 58. In particular, the cover 62 comprises a receiving hole 62b located offset to the axis 58 near the outside of the cover 62. During assembly of the power tool 10 the illumination device 50 is located inside the receiving hole 62b. The illumination device 50 serves for illuminating the turn-switch 52 from the inside. The turn-switch 52 comprises transparent sections 65 allowing transluence of the light emitted by the illumination device 64. As shown in more detail in figure 3, the transparent sections 65 are made of translucent material preferably resembling numbers referring to certain values of the working parameters of the power tool 10 if the mechanical device 50 is set to these numbers. The illumination device 64 is, just as the potentiometer 56, connected to the printed circuit board 44 via flexible wires that are preferably stranded wires and are not separately shown in figure 1.

[0029] In figure 2 an alternative embodiment of the mechanical device 50 for setting the working parameter is shown. The turn-switch 52 is substantially in the shape of a truncated cone (see figure 3). A circumferential wall 66 of the turn-switch 52 is constructed of untransparent (opaque) material while the transparent sections 65 are made of translucent material. Further translucent sections 65 could also be provided in the turn-switch 52, e. g. a bottom face 68.

[0030] In the embodiment of figure 2 the illumination device 64 comprises two LEDs 70. Both of the LEDs 70 are accommodated within the turn-switch 52, preferably within appropriate receiving holes 62b of a cover 62, and arranged offset to the axis of rotation 58 of the turn-switch 52. When the illumination device 64 emits light, then this light is blocked off by the untransparent circumferential walls 66, but can pass the translucent sections 65 of the turn-switch 52. Both LEDs 70 comprise electrical contacts 72. The electrical contacts 72 are solid wires extending out of the LEDs 70 and forming part of the LEDs 70. The LEDs 70 are indirectly connected to the printed circuit board 44 by flexible wires 74, i.e. the flexible wires 74 connect the electrical contacts 72 to the printed circuit board 44. An electric and/or electronic component 76 as well as two heat sinks 78 are directly connected to the printed circuit board 44.

[0031] Electrical connections of the printed circuit board 44 are implemented by wires 80, which are preferably rigid wires, each containing a single conducting strand.

[0032] The turn-switch 52 comprises protrusions 82 on its circumferential outer surface 66 constituting a knurling structure, for an enhanced grip and an easier actuation of the turn-switch 52 by a user. The protrusions 82 are arranged in groups 84 wherein in the individual groups 84 of protrusions 82 are separated by smoothed sections of the circumferential surface 66, where the transparent sections 65 are realized.

[0033] Figure 3 shows the mechanical device 50 of figure 2 in a perspective view. It is well visible that the printed circuit board 44 has a frame 86 around its circumferential edge and attached to that frame are connecting feet 88, which allow for easy installation of the printed circuit board 44 in the housing 12 of the power tool 10.

Claims

1. Power tool (10) comprising a mechanical device (50) for setting a working parameter of said power tool (10), at least part of the mechanical device (50) being visible and accessible from outside of the power tool (10) by a user of the power tool (10), the power tool (10) further comprising a printed circuit board (44) and an illumination device (64) with electrical contacts (72), the illumination device (64) being adapted for illuminating at least that part of the mechanical device (50) being visible from outside of the power tool (10), **characterized in that** the electrical contacts (72) of the illumination device (64) are indirectly connected to the printed circuit board (44) via flexible wires (74).
2. Power tool (10) according to claim 1, **characterized in that** the mechanical device (50) comprises a potentiometer (56) for setting the working parameter of the power tool (10) and a turn-switch (52) adapted to adjust a resistance value of the potentiometer (56) and being located in the power tool (10) such that it is visible and accessible from outside of the power tool (10) by the user of the power tool (10).
3. Power tool (10) according to claim 1 or 2, **characterized in that** the illumination device (64) is adapted for illuminating the turn-switch (52).
4. Power tool (10) according to one of the preceding claims, **characterized in that** the illumination device (64) comprises at least one light emitting diode (70).
5. Power tool (10) according to one of the preceding claims, **characterized in that** the flexible wires (74) are stranded or braided wires.
6. Power tool (10) according to one of the preceding claims, **characterized in that** the mechanical device (50) comprises a potentiometer (56), wherein the potentiometer (56) comprises electrical contacts that

are indirectly connected to the printed circuit board (44) via flexible wires (60), preferably wherein the flexible wires (60) are stranded or braided wires.

7. Power tool (10) according to one of the preceding claims, **characterized in that** at least part of the mechanical device (50) being visible from outside of the power tool (10), in particular the turn-switch (52), is at least partially made of a translucent material (65) allowing translucence of light emitted by the illumination device (64) located inside the mechanical device (50). 5 10
8. Power tool (10) according to claim 7, **characterized in that** that the translucent material (65) of part of the mechanical device (50) being visible from outside of the power tool (10), in particular of the turn-switch (52), resembles numbers referring to certain values of the working parameters of the power tool (10) if the mechanical device (50) is set to these numbers. 15 20
9. Power tool (10) according to one of the preceding claims, **characterized in that** the mechanical device (50) comprises a turn-switch (52), wherein the turn-switch (52) is rotatable around an axis of rotation (58) and the illumination device (64) is accommodated within the turn-switch (52) and preferably offset to the axis of rotation (58). 25
10. Power tool (10) according to one of the preceding claims, **characterized in that** the mechanical device (50) comprises a turn-switch (52), wherein the turn-switch (52) has a contour which is substantially in the shape of a truncated cone. 30 35
11. Power tool (10) according to one of the preceding claims, **characterized in that** the mechanical device (50) comprises a turn-switch (52), wherein the turn-switch (52) comprises protrusions (82) on its circumferential outer surface (66) constituting a knurling structure. 40
12. Power tool (10) according to one of the preceding claims, **characterized in that** the working parameter of said power tool (10) set by the mechanical device (50) is a driving speed of the power tool (10). 45
13. Power tool (10) according to one of the preceding claims, **characterized in that** the power tool (10) is electrically powered and hand-held or hand-guided. 50
14. Power tool (10) according to one of the preceding claims, **characterized in that** the power tool (10) is one of a polisher and a sander, preferably an orbital polisher or sander, in particular a random orbital or a roto-orbital polisher or sander. 55

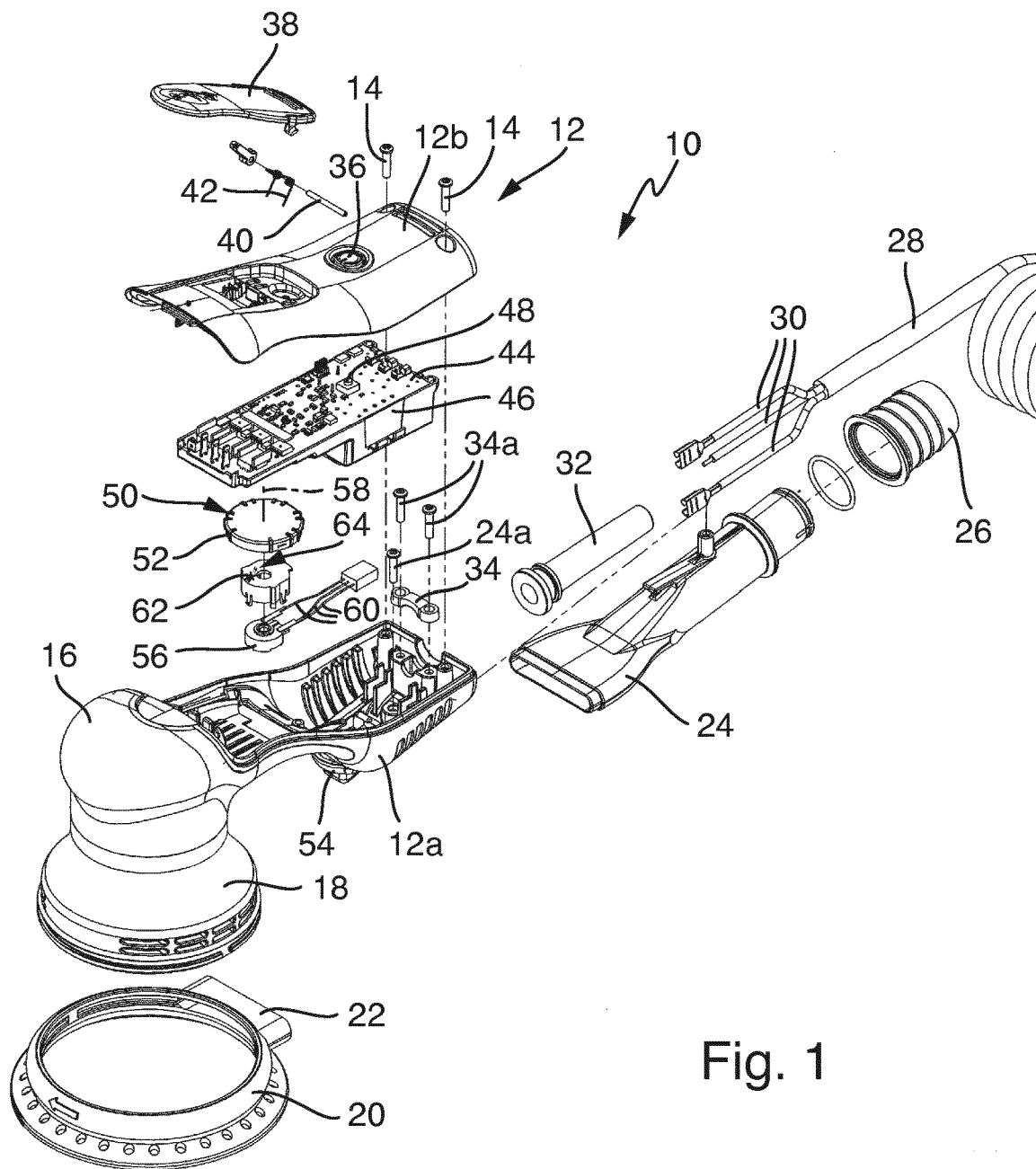


Fig. 1

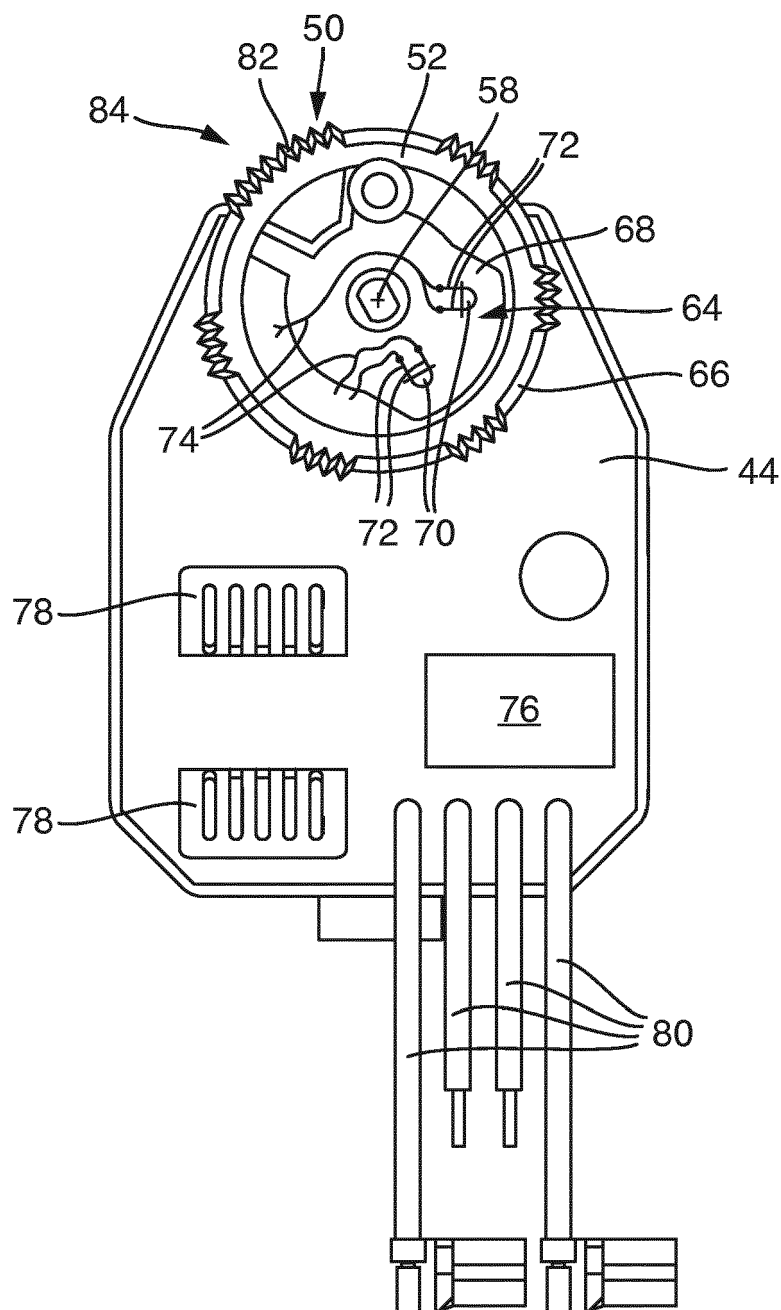


Fig. 2

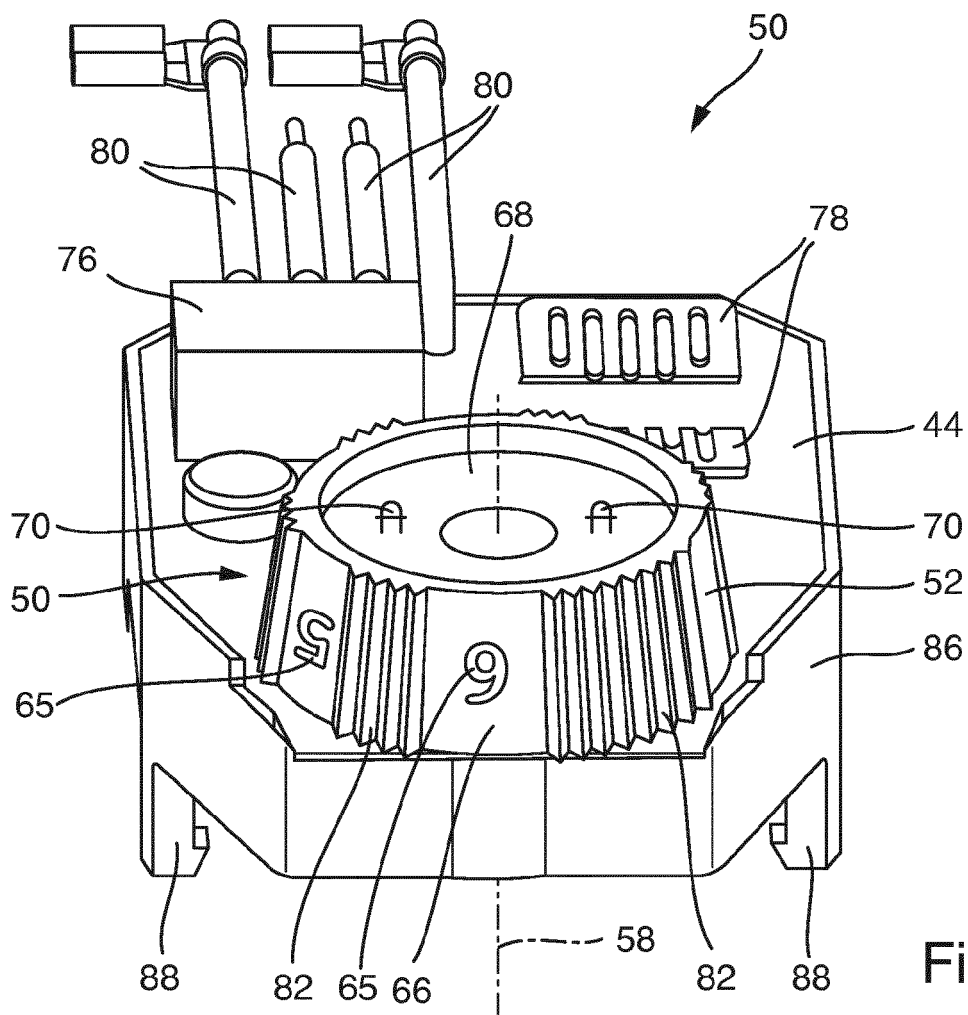


Fig. 3

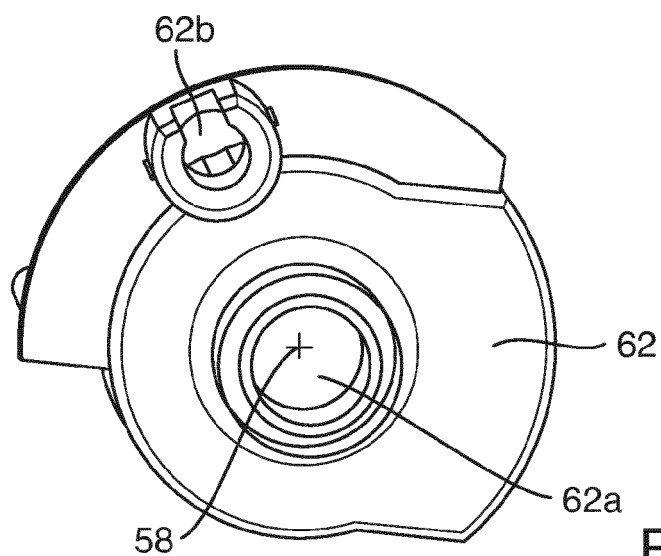


Fig. 4



EUROPEAN SEARCH REPORT

 Application Number
EP 16 20 0989

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	WO 2008/133339 A1 (HITACHI KOKI KK [JP]; UEDA TAKASHI [JP]; ARADACHI TAKAO [JP]; TOUKAIRI) 6 November 2008 (2008-11-06) * pages 3,4,8,9 * * pages 11,12 * * page 14 - page 19; figures *	1-14	INV. B25F5/02
Y	US 2013/292147 A1 (MERGENER MATTHEW J [US] ET AL) 7 November 2013 (2013-11-07) * paragraphs [0018], [0019], [0023] - [0029], [0036], [0037]; claims; figures *	1-14	
Y	EP 1 787 760 A1 (HILTI AG [LI]) 23 May 2007 (2007-05-23) * paragraphs [0004] - [0009], [0012], [0014] - [0021]; figures *	1-14	
Y	US 2014/284070 A1 (NG WONG KUN [US] ET AL) 25 September 2014 (2014-09-25) * paragraphs [0007] - [0009], [0049] - [0072]; figures *	2,6,8,11,12	TECHNICAL FIELDS SEARCHED (IPC)
Y	JP 2015 153626 A (OMRON TATEISI ELECTRONICS CO) 24 August 2015 (2015-08-24) * paragraphs [0008] - [0015], [0042] - [0048]; figures * & EP 3 107 110 A1 (OMRON TATEISI ELECTRONICS CO [JP]) 21 December 2016 (2016-12-21)	2,6	B25F B24B
A	US 2008/074865 A1 (LUTZ MANFRED [DE] ET AL) 27 March 2008 (2008-03-27) * paragraphs [0011] - [0022]; figures *	1-14	
		-/--	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 7 June 2017	Examiner David, Radu
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)



EUROPEAN SEARCH REPORT

Application Number
EP 16 20 0989

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2014/361645 A1 (BEYERL ANDREW T [US]) 11 December 2014 (2014-12-11) * paragraphs [0029], [0034], [0038], [0046] - [0049]; figures * -----	1-14	
A	DE 20 2006 004934 U1 (BOSCH GMBH ROBERT [DE]) 2 August 2007 (2007-08-02) * paragraphs [0030] - [0034]; figures * -----	1-14	
A	EP 2 002 931 A1 (BLACK & DECKER INC [US]) 17 December 2008 (2008-12-17) * paragraphs [0028] - [0032]; figures * -----	1-14	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
Place of search The Hague		Date of completion of the search 7 June 2017	Examiner David, Radu
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

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

EP 16 20 0989

5

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

07-06-2017

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008133339 A1	06-11-2008	US 2010038103 A1 WO 2008133339 A1	18-02-2010 06-11-2008
US 2013292147 A1	07-11-2013	CN 204487506 U US 2013292147 A1 WO 2013166226 A1	22-07-2015 07-11-2013 07-11-2013
EP 1787760 A1	23-05-2007	CN 1970241 A DE 102005000161 A1 EP 1787760 A1 JP 2007136664 A US 2007114051 A1	30-05-2007 24-05-2007 23-05-2007 07-06-2007 24-05-2007
US 2014284070 A1	25-09-2014	NONE	
JP 2015153626 A	24-08-2015	CN 105378882 A EP 3107110 A1 JP 5773001 B2 JP 2015153626 A US 2016365202 A1 WO 2015122035 A1	02-03-2016 21-12-2016 02-09-2015 24-08-2015 15-12-2016 20-08-2015
US 2008074865 A1	27-03-2008	DE 102006045157 A1 JP 2008080484 A US 2008074865 A1 US 2010328929 A1	03-04-2008 10-04-2008 27-03-2008 30-12-2010
US 2014361645 A1	11-12-2014	NONE	
DE 202006004934 U1	02-08-2007	NONE	
EP 2002931 A1	17-12-2008	AT 477081 T CN 201366648 Y EP 2002931 A1 US 2008311832 A1	15-08-2010 23-12-2009 17-12-2008 18-12-2008

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- DE 102010013783 A1 [0003]