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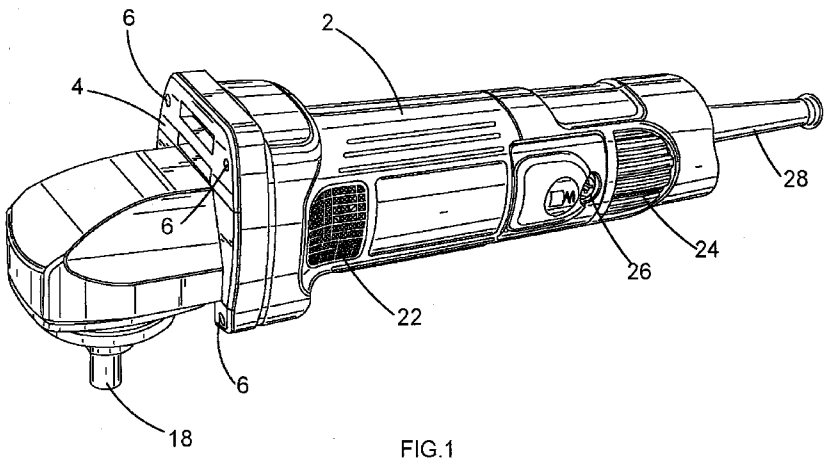


FIG.1

(57) Abstract: A power tool comprises: a housing (2); an electric motor (14) mounted within the housing; an insulated wire (46, 47) which is electrically connected to the motor and is capable of providing an electric current to the motor; and an electric switch (30) connected in series with the insulated wire, the electric switch comprising a body (32) and at least one electrical terminal plate (34) extending from the body. An exposed end of the insulated wire is electrically connected to the end of the terminal plate. The exposed end of the wire and the end of the terminal plate are enclosed within an insulating sleeve (50). A resilient insulating tube (52) is mounted on and surrounds the terminal plate, the resilient insulating tube being positioned on the terminal plate between the insulating sleeve and the body of the switch to enclose the part of the terminal plate located between the body and the insulating sleeve.

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POWER TOOL

The present invention relates to a power tool, in particular to an angle grinder, and more in particular, to a toggle switch for an angle grinder.

Figures 1 to 3 which discloses a prior art design of angle grinder, the angle grinder comprises a plastic rear motor housing 2 which is connected to a metal gear housing 4 via bolts (not shown) located within threaded passageways 6 formed in the two housings. The rear motor housing comprises two clam shells 8, 10 which are attached to each other with bolts (not shown) along a vertical plane 12 as best seen in Figure 3.

An electric motor (generally indicated by the dashed lines 14 in Figure 2) is mounted within the motor housing 2. A motor spindle (generally indicated by the dashed lines 16 in Figure 2) of the motor 14 rotationally drives an output spindle 18 of the grinder via a gear box (generally indicated by the dashed lines 20 in Figure 2). The gear box 20 is mounted within the gear housing 4 and typically comprises a bevel gear. The gear box 20 alters the rotational speed of the output spindle 18 versus the motor spindle 16, as well as allowing the axis of rotation of the output spindle 18 to be located pe endicularly relative to the axis of rotation of the motor spindle 16.

Fo ard vents 22 are formed in the side of the motor housing 2 adjacent the front end of the motor 14 to allow a fan (generally indicated by the dashed lines 60 in Figure 2), mounted on the motor spindle 16, to draw air into the motor housing and then force it to ow over the motor 14 to cool it. Rear vents 24 are formed in the motor housing 2 to allow the warm air to be expelled from the motor housing after it has passed over the motor 14.

Removable access caps 26 are formed the side of the motor housing adjacent each of the brushes (not shown) of the motor 14 to enable the brushes to be replaced without dismantling the angle grinder.

The electric motor 14 is powered by a mains electricity supply which is provided to the grinder via an electric cable 28 which enter the motor housing 2 of the grinder at the rear. The electric cable comprises electrically insulted wires, 46, 47, 48 which form a circuit. The electric cable 28 connects to the motor 14 via a toggle switch 30 which enables the operator to switch the motor 14 on and off.

An example of such a toggle switch is 30 shown at Figure 4.

The toggle switch 30 comprises body 32, extending from which are two metal plates 34 which act as electric terminals for the switch 30. The toggle switch 30 is connected in series with the wires 46, 47 of the electric circuit 36 of the motor 14 as shown in Figure . The plates 34 are connected by being soldered to exposed ends of the wires 46, 47. Alternatively, the ends of the wires may comprise female connectors which receive the plates 34 within them in an electrically conductive manner, and which may then be crimped. A pivotal toggle 38 extends from the body 32 which can be pivoted between

two positions, a first position 40 shown in figures 4 and 5 by solid lines and a second position 40' shown in Figures 4 and 5 by the dashed lines. When the toggle is in its first position, an electrical connection is made between the two plates 34 allowing the motor 14 to run. hen the toggle 38 is in its second position, the electrical connection between the plates 34 is broken and the flow of electrical current through the switch is prevented. As such, the motor 14 is switched off. A rubber boot 42 connects between the toggle 38 and the body 32 to prevent the ingress of dirt into the body of the switch via the opening in the body 32 through which the toggle 38 projects.

During use, a grinding or cutting disks is rigidly attached to the output spindle 18. The motor is then activated using the toggle switch 30 and the operator manually manipulates angle grinder to use the grinding or cutting disk to grind or cut a work piece. ften the work piece is made from metal such as a metal girder.

owever, a problem has been found with the operation of existing designs grinder. During use, metal filings generated by the cutting action of the grinder are drawn inside of the housing 2 via the vent 22 of the grinder due to the air flow generated by the fan 0. Whilst a proportion of these will be subse uently expelled om the housing, a residual amount will collect on internal components located inside of the motor housing 2. This includes the body 32 and metal plates 34 of the toggle switch 30. In existing designs of grinder, parts or all of the plates 34 remain exposed. As such, when a sufficient amount of metal filings has congregated on the body 32 and plates 34 of the toggle switch, a short circuit is formed directly between the plates 34. When electric power is provided to the grinder, the electrical power short circuits the toggle switch by being able to conduct between the plates 34 via the metal filings. This is dangerous for two reasons. Firstly, as soon as elec ical power is connected to angle grinder, it will immediately commence to operate with the operator unable to stop its operation without removing the power supply. econdly, the short circuit can lead to the switch setting fire which, as the motor housing is made of plastic, results in the housing setting on fire.

The object of the present invention is to provide an improved design which overcomes or at least reduces the problems associated with existing designs.

According there is provided a power tool comprising:
a housing;
an electric motor mounted within the housing;
an insulated electric wire electrically connected to the motor and which is capable of providing an electric current to the motor;
an electric switch connected in series with the wire, the electrical switch comprising a body and at least one electrical terminal plate extending from the body wherein an exposed end of the insulated electric wire is electrically connected to the end of the terminal plate, the exposed end of the wire and the end of the terminal plate being enclosed within an insulating sleeve characteri ed in that a resilient insulating tube is mounted on and surrounds the terminal plate, the resilient insulating tube being positioned on the terminal plate between the insulating sleeve and the body of the switch

to enclose the part of the terminal plate located between the body and the insulating sleeve.

se of an insulating sleeve in isolation has resulted in small parts of the plate between the insulating sleeve and body of the switch remaining exposed due to manufacturing processes and tolerances in component parts. Therefore, the use of an insulating resilient tube in addition to an insulating sleeve ensures that whole of the plate is enclosed. The resilient nature of the tube ensures that any exposed part is enclosed as it expands to fill the gaps.

Figure 1 shows a perspective view of an existing design of angle grinder;
Figure 2 shows a side view of the angle grinder of Figure 1;
Figure 3 shows a rear view of the angle grinder of Figure 1;
Figure 4 shows a side view of a toggle switch;
Figure 5 show the electric circuit of the motor;
Figure 6 shows a side view of a toggle switch in accordance with an embodiment of the present invention;
Figure 7 shows a block of the resilient polyurethane flame retardant sponge material with aperture for a plate;
Figure shows a block of the resilient polyurethane flame retardant sponge material mounted on a plate of the toggle switch; and
Figure 9 shows the plate with the block of the resilient polyurethane flame retardant sponge material attached to an electric wire.

An embodiment of the invention will now be described with reference to Figures 6 to 9.

The toggle switch 30 of the embodiment is mounted within the housing 2 and located within the circuit 36 in the same manner as that described previously. owever, the electrical connection between each of the plates 34 of the toggle switch and the exposed ends of the electrical wires 46, 47 are encapsulated within an insulating sleeve 50 and an insulating resilient tube 52.

The insulating sleeve 50 is a commercially available sleeve which is used to enclosed exposed parts of electric wires and the ends of the plates 34 to which they are connected. The sheaf can be made of plastic material. uch sheaths may be capable of being shrink fitted by being heated, causing the diameter of the sleeve to reduce thereby causing it to encapsulate the exposed part of the electric wire and sleeve. Alte atively, the sleeve may be a bber sleeve which may be held in place by being tight fitted over the exposed part of the electric wire.

The resilient insulating tube 52 is shown in Figure 7 and comprises a block of polyurethane flame retardant sponge material. An aperture 54 is formed through the length of the block to enable the plate 34 of the switch to pass through it.

en the toggle switch is being assembled in side the motor housing 2, each of the plates 34 is inserted into a resilient insulating tube 54 which is slid up against the body 32

of the switch, exposing the end of the plate 34 as shown in Figure . The exposed end of the corresponding electric wire 46, 47 (and female connector if such a type connection is being used) is passed through an insulating sleeve 50 and then electrically and mechanically connected to the exposed end the plate 34. The insulating sleeve 50 is then located to enclose the end of the plate 34 and the exposed end of the wire 46, 47 and then fixed in place (for example by being shrin wrapped). ue to the resilient nature of the resilient insulating bes 52, the resilient insulating tubes 52 enclose the each of the plates 34 between the body 32 of the switch and the insulating sleeve 50 as shown in Figure . s such, the whole of the plates are enclosed. Therefore, any metal filings can not provide a sho circuit between the plates 34.

ilst the present embodiment has been described in relation to an angle grinder, it will be appreciated that the invention could be utili ed on any type of power tool.

Claims

1 A power tool comprising:
a housing (2);
an electric motor (14) mounted within the housing (2);
an insulated electric wire (46, 47) electrically connected to the motor and which is capable of providing an electric current to the motor;
an electric switch (30) connected in series with the wire (46, 47), the electrical switch comprising a body (32) and at least one electrical terminal plate (32) extending from the body (32) wherein an exposed end of the insulated electric wire is electrically connected to the end of the terminal plate 34, the exposed end of the wire (46, 47) and the end of the terminal plate (34) being enclosed within an insulating sleeve (50) characteri ed in that a resilient insulating be (52) is mounted on and surrounds the terminal plate (34), the resilient insulating tube (52) being positioned on the terminal plate (34) between the insulating sleeve (50) and the body (32) of the switch to enclose the part of the terminal plate (34) located be een the body (32) and the insulating sleeve (50).

2 A power tool as claimed in claim 1 wherein the resilient insulating tube (52) is made om pol rethane.

3 A power tool as claimed in either of claims 1 or 2 wherein the resilient insulating tube (52) is made from a ame retardant material.

4 A power tool as claimed in any one of the previous claims wherein the resilient insulating tube (52) is made from a sponge material.

5 A power tool as claimed in any one of the previous claims wherein the electrical switch is a toggle switch.

6 A power tool as claimed in any one of the previous claims wherein the electrical switch is an O OFF switch for activating and deactivating the motor (14).

7 A power tool as claimed in any one of the previous claims wherein there is further provide a fan (60) rotatably mounted within the housing (2), for drawing air through the housing (2), wherein the body (32) of the electric switch (30) and the at least one electrical terminal plate (34) of the switch are both positioned within the housing,

A power tool as claimed in claim 7 wherein the fan is rotably driven by the motor.

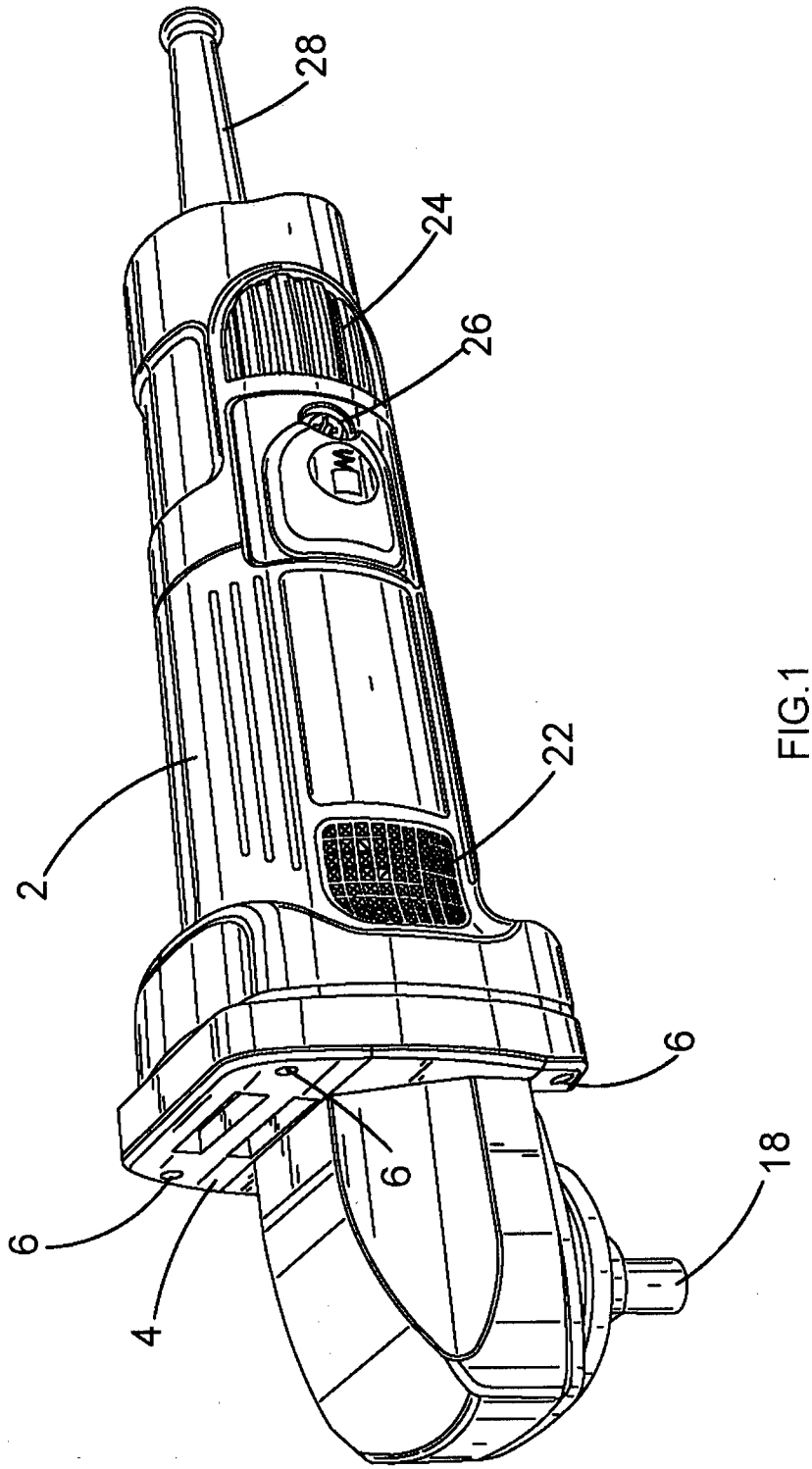


FIG.1

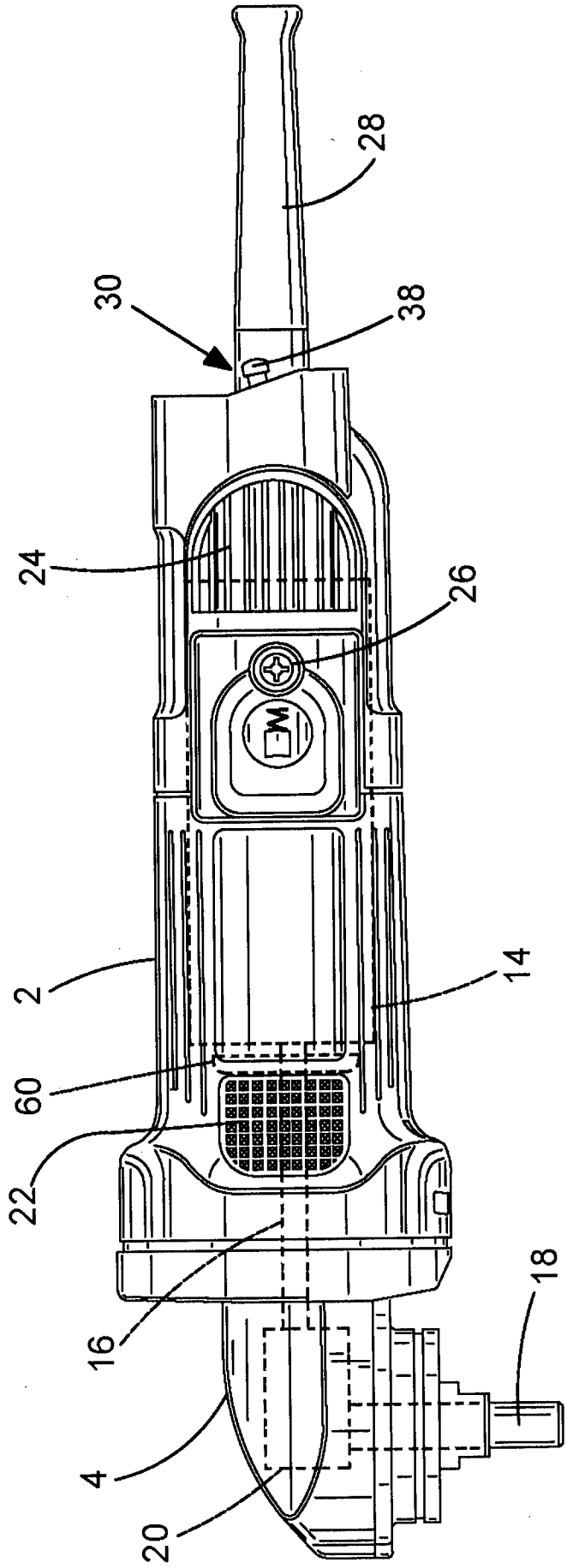


FIG.2

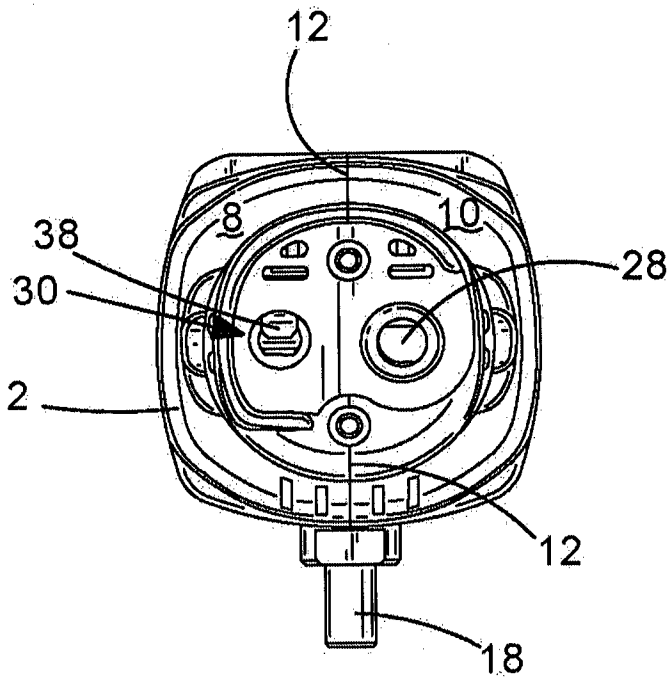

12
8
10
38
28
30
2
12
18

FIG.3

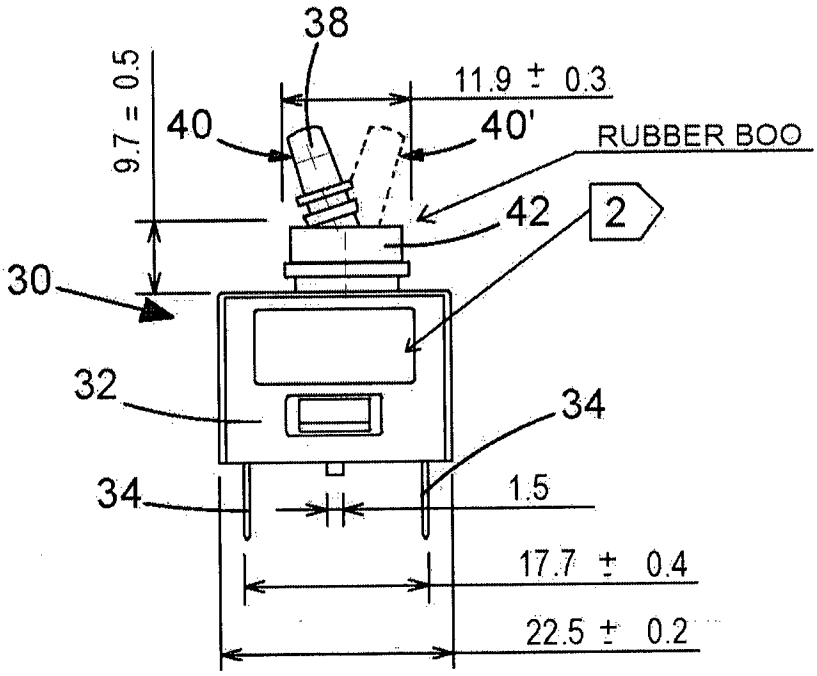

38
11.9 ± 0.3
9.7 = 0.5
40
40'
RUBBER BOO
42
2
30
32
34
34
1.5
17.7 ± 0.4
22.5 ± 0.2

FIG.4

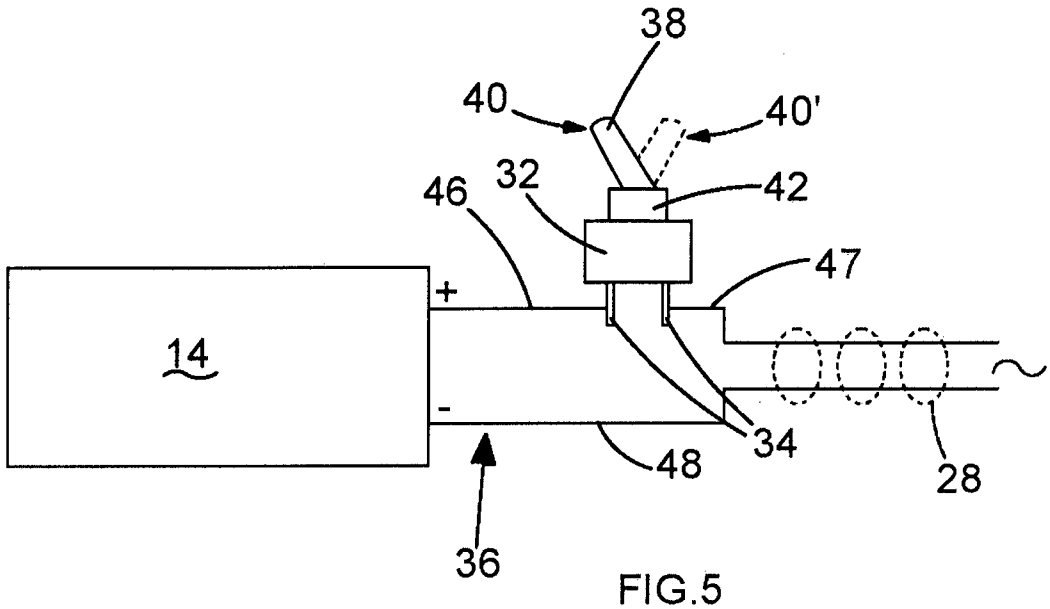


FIG.5

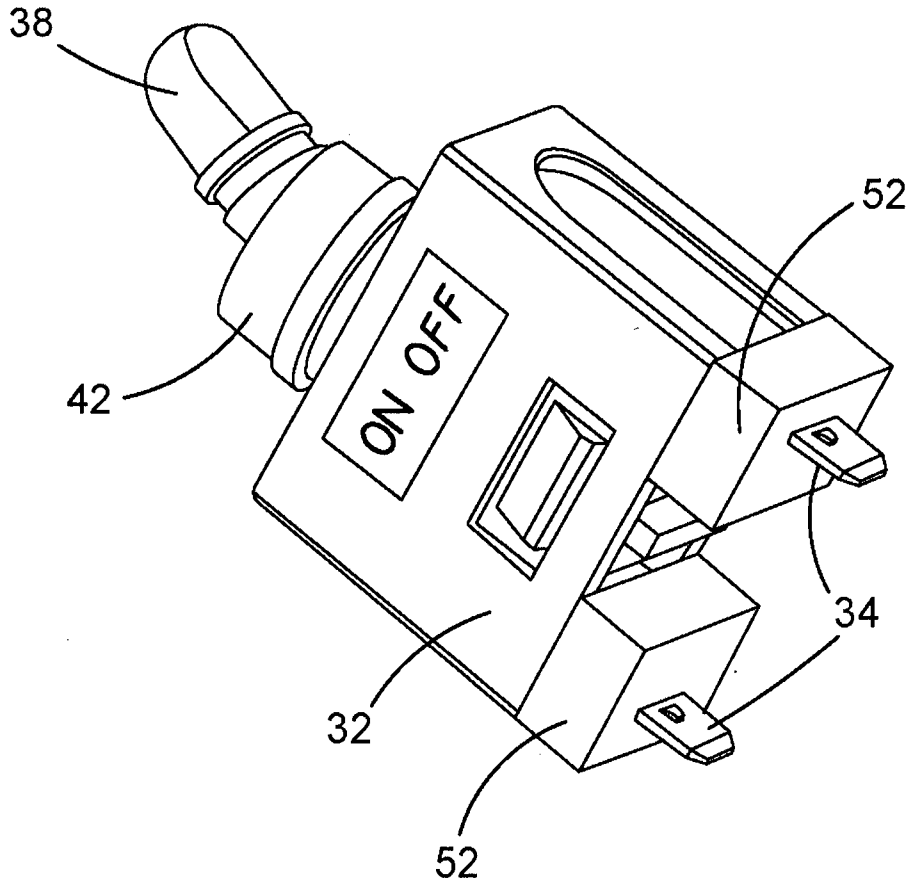


FIG.6

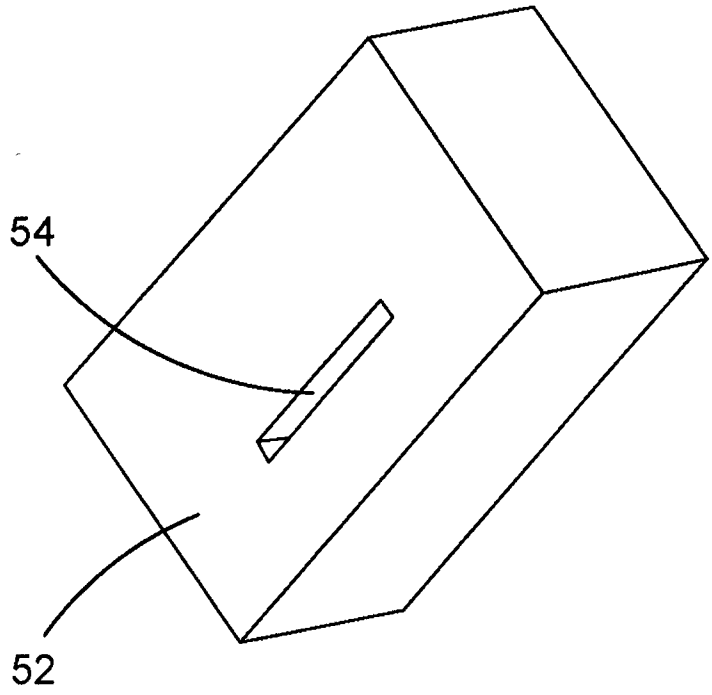


FIG.7

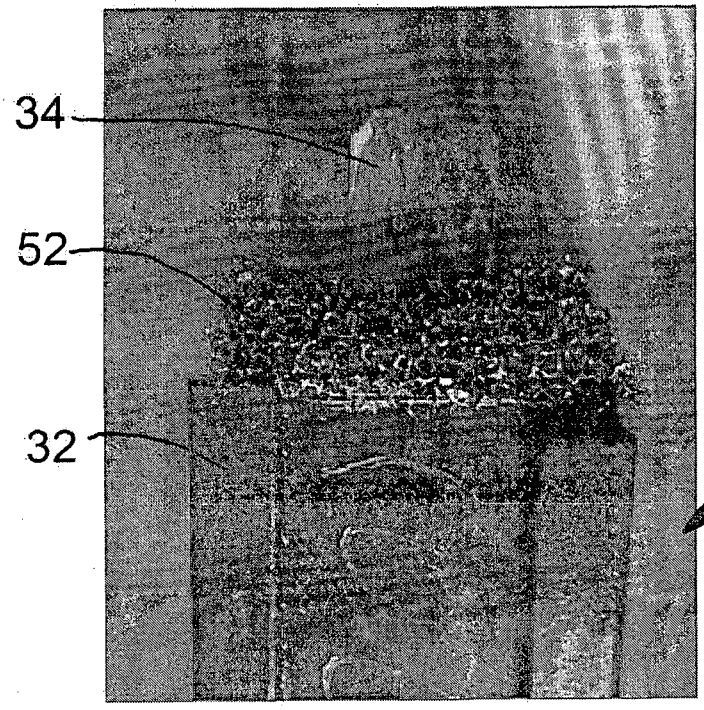


FIG.8

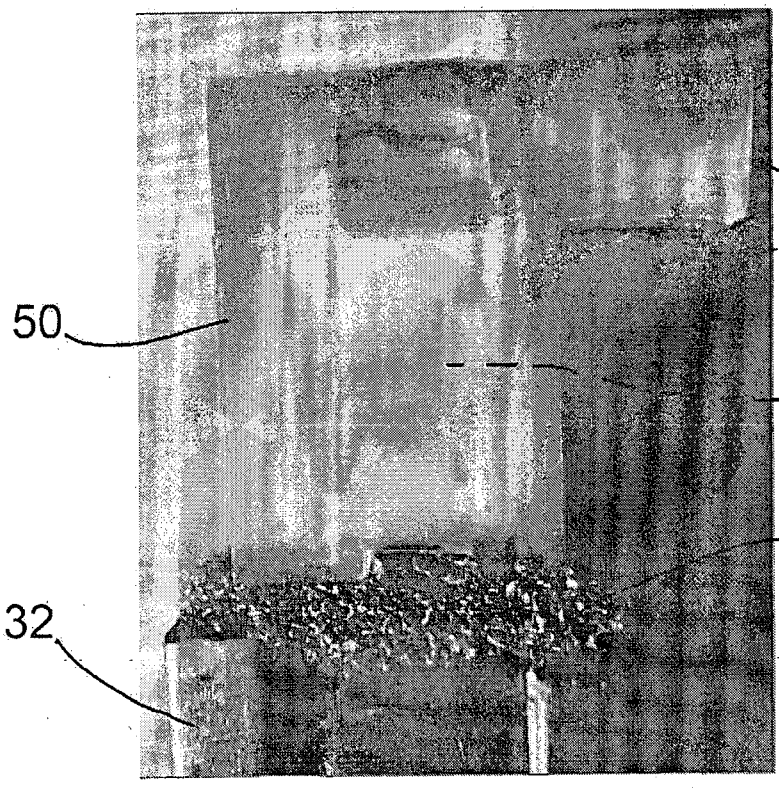


FIG.9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/078178

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC: B24B, H01H;

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

WPI ; EPODOC ; CNPAT ; CNKI: grinder, motor, tool, wire, switch, terminal, dust, dirt, seal, sleeve, tube;

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN202045549U (HENAN DIBANG ABRASIVE TOOL CO LTD) 23 Nov. 2011(23.11.2011) the whole document	1-7
A	CN202006412U (CIXI HONGGUAN POWER TOOL CO LTD) 12 Oct. 2011(12.10.2011) the whole document	1-7
A	CN102076467A (BOSCH GMBH ROBERT) 25 May 2011(25.05.2011) the whole document	1-7
A	CN101379578A (MARQUARDT GMBH) 04 Mar. 2009(04.03.2009) the whole document	1-7

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 Mar.2013(28.03.2013)	**11 Apr. 2013 (11.04.2013)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer RAN, Chunyan Telephone No. (86-10)62411745

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/078178

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN202045549U	23.11.2011	None	
CN202006412U	12.10.2011	None	
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		WO2007090382A3	20.09.2007
		CN101379578B	18.07.2012

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

B24B 23/00 (2006.01) i

B24B 55/10 (2006.01) i