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(71) Applicant: **Positec Power Tools (Suzhou) Co., Ltd.**
Suzhou 215006 (CN)

(72) Inventor: **SANG, Shuhua**
Suzhou, Jiangsu 215006 (CN)

(74) Representative: **Jeannet, Olivier**
Cabinet Jeannet
40 rue Raulin
69007 Lyon (FR)

(54) ELECTRICAL WOOD-MILLING MACHINE

(57) A router (20) is provided with a digital display device (5). The route has a depth rod (4) that includes a first sensor element (10) movable with respect to a second sensor element (11) that is mounted on a motor housing (2). The sensor elements transmit a position signal to the digital display device for reading of the displacement of the depth rod relative to the motor housing. This helps to reduce human error of incorrect reading.

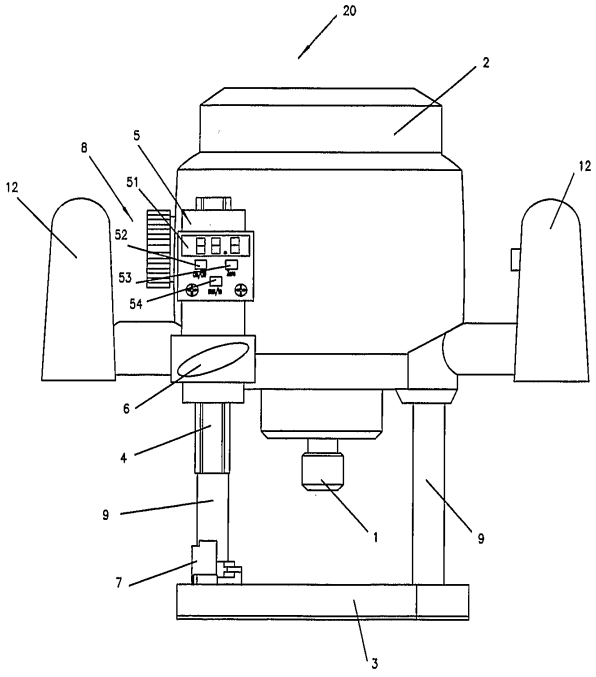

Fig.1

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Description

[0001] The present invention generally relates to a router, and in particular to a router with a digital display device.

[0002] Recently, routers are often provided with a mechanism, such as adjustable rods and scales with indicators, for setting and/or adjusting the cutting depth of a router bit. For example, US Patent No. 4,272,821 discloses a router comprising a position encoding device coupled to a depth adjustment device. The encoding device provides displacement information of a router bit that moves with a motor housing relative to a router base to a microprocessor, and a digital display device, which is coupled to the microprocessor, displays a precise digital reading of cutting depth of router bit that is obtained from the relative displacement of the router bit. However, the router lacks of a locking device such that the router must be adjusted to obtain the desired cutting depth before routing operation. Further, the router bit extends beyond the router base such that the router is incapable of plunge routing operation. US Patent No. 5,191,921 discloses a plunge router, which comprises a depth rod which can be set to a desired cutting depth. An operator of the plunge route may apply a downward force on a motor housing of the plunge router against the biasing force of an elastic element to drive a bit of the plunge route to a predetermined depth set by the depth rod. The router comprises a moving member that follows a scale arranged in the motor housing to indicate the cutting depth. The operators can read the figures or indexes on the scale in performing a routing operation; however human error may occur in reading the scale, which makes it difficult to obtain very high precision machining result.

[0003] In order to overcome the above-mentioned problems, the present invention provides a router which is capable of plunge routing operation in which cutting depth of a route bit is precisely read by a digital display device.

[0004] Thus, the present invention provides a router, which comprises a router bit driven by a motor, a motor housing enclosing the motor, a base coupled to the motor housing, and a depth rod attached to the motor housing and movable in a direction substantially perpendicular to the base. The depth rod comprises a first sensor element and the motor housing carries a second sensor element opposing the first sensor element. The router further comprises a digital display device connected to one of the first and second sensor elements. The router further comprises a depth adjusting mechanism for moving the depth rod and the depth adjusting mechanism comprises an operation knob, a gear mounted to the operation knob, a rack connected to the depth rod and mating and driven by the gear. The router comprises a locking bolt disposed in the motor housing for selectively securing the depth rod at a selected position.

[0005] As compared to the conventional devices, the router in accordance with the present invention is advantageous in that a depth rod is moveably connected to the motor housing and a sensor element transmits a position signal to a digital display device, which provides a direct visual display of positional data so that the router is capable of a plunge routing operation on the basis of precise positioning effected with the depth rod. As a consequence, human error in data reading is eliminated and high precision machining is realized.

[0006] The present invention will be described in greater detail hereinafter in connection with an embodiment, reference being hand to the drawings, in which:

Figure 1 is a front view of a preferred embodiment of the router of the present invention;

Figure 2 is a left side view of the router shown in Figure 1, with portions removed to illustrate the internal construction of the router; and

Figure 3 is an enlarged view of a portion of the router shown in Figure 2.

[0007] Referring to Figure 1, a preferred embodiment to which the present invention is applied comprises a router, which is indicated with reference numeral 20. The router 20 comprises a router bit 1 driven by a motor (not shown), a motor housing 2 enclosing the motor, a base 3 vertically spaced from the motor housing 2 and coupled to the motor housing 2 by a pair of parallel plunge rods 9, a pair of handles 12 preferably integrally formed with the motor housing 2, a depth rod 4, a stop member 7, an adjustable mechanism 8, and a digital display device 5. The stop member 7 is mounted on a surface of the base 3 facing the depth rod 4. The digital display device 5 comprises a display element 51, an on/off switch 52, a reset switch 53 that is positioned below the display element 51 for resetting the reading of the display element 51 to zero, a mode switch 54 that is positioned below the display element 51 for switching between for example English and Metric unit read-outs.

[0008] Referring to Figures 2 and 3, the depth adjustable mechanism 8 of the router 20 is provided in the motor housing 2 and includes an operation knob 13. The operation knob 13 is connected to a gear 14 that engages a rack 15 coupled to the depth rod 4. When the operation knob 13 is rotated, the gear 14 rotates and causes the rack 15 to move in a direction perpendicular to the base 3 so as to adjust the position of the depth rod 4 relative to the stop member 7 mounted on the base 3. Apparently, the depth adjustable mechanism 8 can be embodied in various forms, such as those comprising a worm gear and a worm or a threaded rod and a nut, as substitutes for the gear and rack arrangement. The rack 15 is secured to the depth rod 4, and a first sensor element 10 is attached to and movable in unison with the depth rod 4 in the direction perpendicular to the base 3. The digital display device 5 is mounted to the motor housing 2 in such a way that the digital display device 5 and the motor

housing 2 form a space therebetween in which the depth rod 4 is moveably accommodated. It is obvious that the digital display device 5 can be mounted to any suitable location on the motor housing 2, which allows for easy reading of the display device 5.

[0009] The digital display device 5 is connected to the first sensor element 10, or the digital display device 5 can be alternatively connected to a second sensor element 11. In the embodiment illustrated, the first sensor element 10 moves relative to the second sensor element 11 in order to generate a position signal which is transmitted to the digital display device 5 to be displayed on the display element 51. The second sensor element 11 is mounted to the motor housing 2 and opposes to the first sensor element 10. In the preferred embodiment, the second sensor element 11 is arranged at the side of the digital display device 5 that faces the depth rod 4. A locking bolt 6 is provided in the motor housing 2 and can be rotated to engage and thus secure the depth rod 4 at a predetermined position. A locking knob 16 is provided in the motor housing 2 and can be rotated to secure the motor housing 2 to the base 3 at a predetermined position. The first sensor element 10 and the second sensor element 11 can be a capacitance transducer, or alternatively a potentiometer based sensor or an optical sensor known in the art.

[0010] To operate the router, the router is first positioned on a work piece and the operator applies a downward force on the motor housing 2 against the biasing force of an elastic element, generally by pressing the handles 12 to thereby move the router bit 1 downward into contact with the work piece and the locking knob 16 is then applied to lock and secure the motor housing 2 in such a position. The operator then rotates the operation knob 13 to rotate the gear 14 and thus moving the rack 15 with respect to the motor housing. The rack 15 is coupled to the depth rod 4 and thus the depth rod 4 is moved with the rack 15 with respect to the motor housing 2 until the depth rod 4 is brought into contact with the stop member 7 of the base 3. The operator then unlocks the locking knob 16 and releases the handles 12. The motor housing 2, being biased by the elastic element, automatically moves upward back to into the original position. The operator actuates the on/off switch 52 to turn the digital display device 5 on, and then depresses the reset switch 53 to zero the display element 51. After the above process is done, the operator adjusts the depth adjustable mechanism 8 and again rotates the operation knob 13 to move the depth rod 4 relative to the motor housing 2 while observing the digital display device 5 until a desired depth is indicated on the display device 5, whereupon the operator tightens the locking bolt 6 to secure the depth rod 4 in place with respect to the motor housing 2. The operator operates the handles 12 again to depress the motor housing 2 towards the base 3 until the depth rod 4 gets into contact with the stop member 7. At this time, the router bit 1, which is coupled to the motor housing 2, reaches the desired cutting depth. In case a stepped groove is to be machined with respect to the initial cutting depth, the operator can depress the reset switch 53 to zero the display element 51, and then directly adjusts the operation knob 13 until a desired height of the stepped groove is indicated on the display element 51 of the display device 5 and thereafter, a plunge routing operation can be initiated. Alternatively, with no zeroing operation being performed, the operator can directly adjust the operation knob 13 until an increase of height or depth, which is indicated on the display element 51, equals to the desired height of the groove, and thereafter, the operator begins the plunge routing operation.

Claims

1. A router (20) comprising a router bit (1) driven by a motor, a motor housing (2) enclosing the motor, a base (3) coupled to the motor housing (2), and a depth rod (4) disposed in the motor housing (2) and movable in a direction perpendicular to the base (3), **characterized in that** a first sensor element (10) is attached to the depth rod (4) and a second sensor element (11) is mounted to the motor housing (2) and opposes the first sensor element (10), the router (20) further comprising a digital display device (5) connected to one of the fist sensor element (10) and the second sensor element (11).

2. A router according to Claim **1, characterized in that** the router (20) comprises a depth adjustable mechanism (8) for moving the depth rod (4).

3. A router according to Claim **2, characterized in that** the depth adjustable mechanism (8) comprises an operation knob(13), a gear (14) coupled to the operation knob (13), a rack (15) mounted to the depth rod (4) and mating and driven by the gear (14).

4. A router according to Claim **1, characterized in that** the router (20) comprises a locking bolt (6) disposed in the motor housing (2) for securing the depth rod (4) at a selected position.

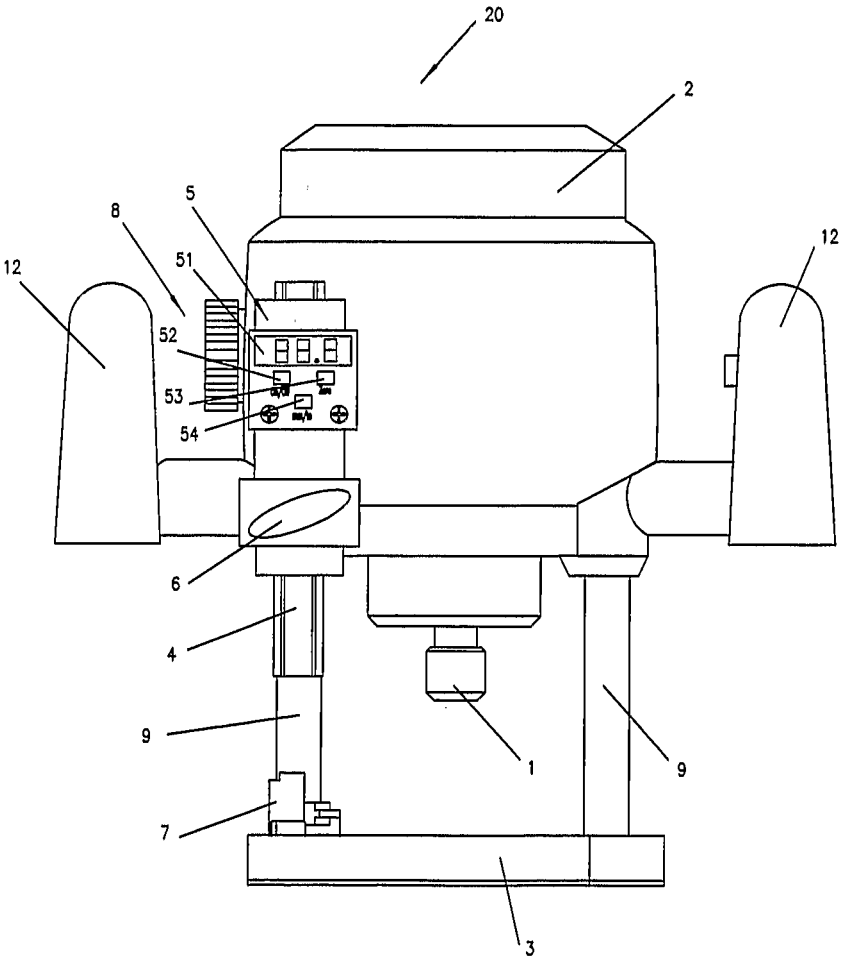

Fig.1

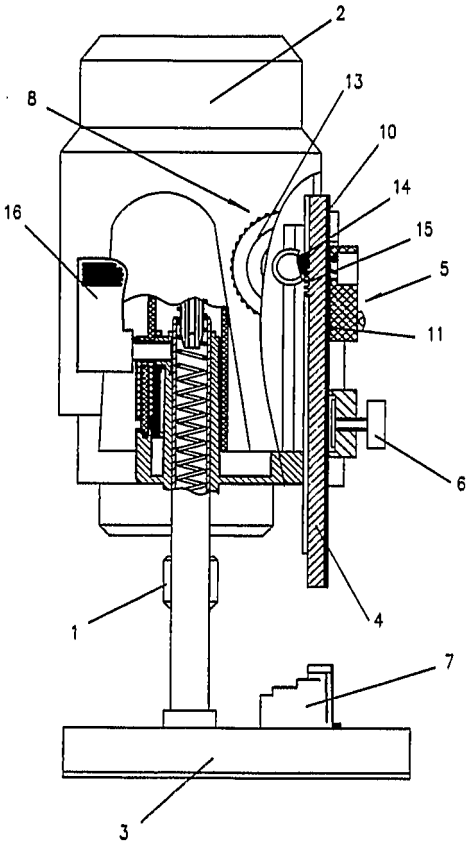

Fig.2

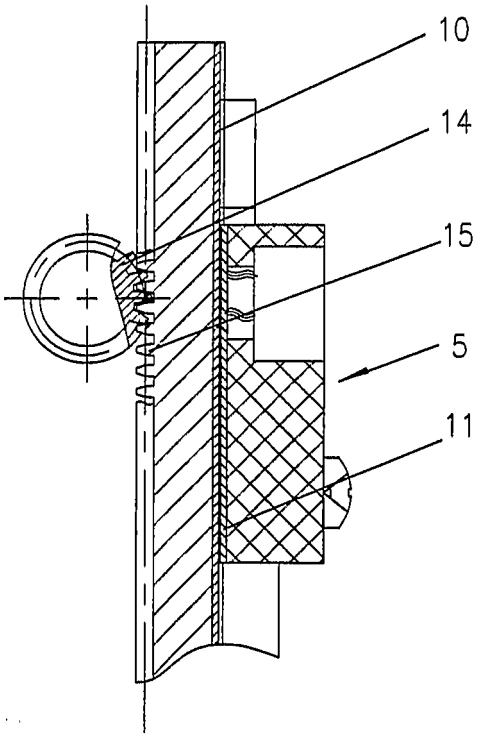

Fig.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2005/001680

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[8] B23C1/20, 1/12, 1/06, 1/00, 1/02, 1/025, 1/027, B23B45/00, B27B5/20, 5/16, 5/18, 5/00, B27C1/00, 1/14, 1/10, 3/00, 3/02, G01B5/18, 5/00, G01B7/26, 7/00

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

Chinese Invention 1985-2006, Chinese Utility Models 1985-2006

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

WPI EPODOC PAJ : drill, drilling, depth, deepness, displacement, position, adjust, display, digital, gear, worm, nut, bolt, ruler, rule, scale

CNPAT: drill, display, digital, ruler, gear, worm, nut, depth, height, distance, position

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN, Y, 2598720 (QINGDAO D & D HARDWARE & TOOLS CO LTD) 14 Jan. 2004 (14.01.2004), see the whole document	1-4
A	CN, A, 1495000 (TECHTRONIC IND CO LTD) 12 May. 2004 (12.05.2004), see the whole document	1-4
A	US, A, 4566830 (FESTO-MASCHFAB STOLL et. al) 28 Jan. 1986 (28.01.1986), see the whole document	1-4
A	US, A, 5662440(RYOBI NORTH AMERICA) 2 Sep. 1997(02.09.1997), see the whole document	1-4
A	US, A, 6139229 (PORTER-CABLE CORP) 31 Oct. 2000 (31.10.2000), see the whole document	1-4
A	US, B1, 6474378 (SB POWER TOOL CORP et. al) 5 Nov. 2002 (05.11.2002), see the whole	1-4

☐ 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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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
10 Jan 2006 (10.01.2006)	26 · JAN 2006 (26 · 01 · 2006)
Name and mailing address of the ISA/ 6 Xitucheng Rd., Jimen Bridge, Haidian District, 100088 Beijing, China Facsimile No. 86-10-62019451	Authorized officer XU, Zhiqing Telephone No. 86-10-62085454

Form PCT/ISA /210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2005/001680

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		DE3314419 C	31 Oct. 1984 (31.10.1984)
		DE3347764 C	14 Aug. 1986 (14.08.1986)
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		EP0123155 B	17 Dec. 1986 (17.12.1986)
US5662440 A	2 Sep. 1997 (02.09.1997)	None	
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		GB2375320 A	13 Nov. 2002 (13.11.2002)
		DE10215736 A1	31 Jul. 2003 (31.07.2003)

Form PCT/ISA /210 (patent family annex) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2005/001680

CLASSIFICATION OF SUBJECT MATTER

B23C 1/20 (2006.01) i
B27B 5/20 (2006.01) i
B27C 1/00, 3/00 (2006.01) i
G01B 5/18 (2006.01) n
G01B 7/26 (2006.01) n

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4272821 A **[0002]**
- US 5191921 A **[0002]**