



(11) **EP 4 298 952 A1**

(12) **EUROPEAN PATENT APPLICATION**

- (43) Date of publication:
03.01.2024 Bulletin 2024/01

(21) Application number: **23182182.8**

(22) Date of filing: **28.06.2023**
- (51) International Patent Classification (IPC):
A45D 29/00 *(2006.01)* **A45D 29/05** *(2006.01)*
A45D 29/17 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
A45D 29/05; A45D 29/007; A45D 29/17

(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 ME MK MT NL NO PL PT RO RS SE SI SK SM TR Designated Extension States: BA Designated Validation States: KH MA MD TN (30) Priority: 29.06.2022 US 202263356958 P	(71) Applicant: Fashion Biotech Corporation New Taipei City 244 (TW) (72) Inventor: SU, YUEH CHIH 244 New Taipei City (TW) (74) Representative: 2K Patentanwälte Blasberg Kewitz & Reichel Partnerschaft mbB Schumannstrasse 27 60325 Frankfurt am Main (DE)
--	---

(54) **NAIL GRINDING PEN AND NAIL GRINDING HOST MACHINE**

(57) The present invention discloses a nail grinding pen, which comprises a pen barrel, a motor, and an inner body. The inner side of the pen barrel has a receiving space, and an opening connected to the receiving space provided on one side of the pen barrel. The motor is arranged in the receiving space, and driven by electric power

to rotate the rotating shaft. The inner body is connected to the rotating shaft, and one end of the inner body facing the opening has a gripper for fixing a grinding head, so that the motor is able to drive the grinding head into rotation by rotating the gripper.

Description

BACKGROUND OF THE INVENTION

1. Technical Field

[0001] The present invention relates to a nail grinding pen and a nail grinding host machine. More particularly, the invention relates to a nail grinding pen and a nail grinding host machine for the beauty treatment of finger-nails.

2. Description of Related Art

[0002] Hand gestures are frequently used in interpersonal communications to help accentuate the ideas being communicated. This explains why a person's hands are often the focus of attention in addition to the person's face, and why a woman's hands are also referred to as her second face. With the development of technology, the market has been supplied with a great variety of nail beautifying devices such that meticulously beautified nails have gradually become a manifestation of modern women's fashion and an important feature of a woman's overall appearance.

[0003] During a nail beautifying process, nail files or emery boards are typically used to wear down the residues of gel nails or dip powder nails after such artificial nails are removed, or to shape acrylic nails by trimming the edges of or shortening such artificial nails. The conventional nail files or emery boards, however, are subject to limitations imposed by their shapes and sizes and therefore have problem doing their work in relatively small areas. Furthermore, the relatively large movements of nail filing tend to cause dispersion of the resulting nail filings, or nail dust, which ends up suspended in the air and is likely to harm an inhaler's health.

BRIEF SUMMARY OF THE INVENTION

[0004] Compared with its prior art counterparts, the nail grinding pen of the present invention is more versatile in use, is effectively enhanced in its nail grinding effect and operability, and can reduce the dispersion of nail dust in the air.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0005]

Fig. 1 is a perspective view of a nail grinding pen according to the present invention;
 Fig. 2 is an exploded view of the structure of the nail grinding pen in Fig. 1;
 Fig. 3 is another exploded view of the structure of the nail grinding pen in Fig. 1;
 Fig. 4(a) shows how the gripper of a nail grinding

pen according to the invention is opened by operating a push switch;

Fig. 4(b) shows how the gripper in Fig. 4(a) is closed by operating the push switch;

Fig. 5(a) shows how the gripper of a nail grinding pen according to the invention is opened by operating a rotary switch;

Fig. 5(b) shows how the gripper in Fig. 5(a) is closed by operating the rotary switch;

Fig. 6 is a sectional view of the nail grinding pen in Fig. 1 to Fig. 3;

Fig. 7 shows various rotating shaft designs for the motor in the invention;

Fig. 8 is a partial sectional view of the nail grinding pen in Fig. 1 to Fig. 3;

Fig. 9 is another partial sectional view of the nail grinding pen in Fig. 1 to Fig. 3;

Fig. 10 is still another partial sectional view of the nail grinding pen in Fig. 1 to Fig. 3;

Fig. 11 shows how the rolling ball in the invention moves when the rotating ring is rotated;

Fig. 12 shows various electrical connection port designs for the motor in the invention;

Fig. 13 is partial sectional views of two nail grinding pens according to the invention;

Fig. 14 is a partial sectional view of another nail grinding pen according to the invention;

Fig. 15 is another partial sectional view of the nail grinding pen in Fig. 1 to Fig. 3;

Fig. 16 is still another partial sectional view of the nail grinding pen in Fig. 1 to Fig. 3;

Fig. 17 shows two nail grinding pens according to the invention, each incorporating a fan;

Fig. 18 is a partial perspective view of a nail grinding pen according to the invention;

Fig. 19 shows two nail grinding pens according to the invention, each incorporating an auxiliary light;

Fig. 20 shows the exterior of a nail grinding host machine according to the invention;

Fig. 21 shows the devices in the nail grinding host machine in Fig. 20;

Fig. 22 is a block diagram of the nail grinding host machine in Fig. 20 and Fig. 21;

Fig. 23A-23E are block diagrams of some alternative nail grinding host machines according to the invention;

Fig. 24(a)-24(c) are block diagrams of some more alternative nail grinding host machines according to the invention;

Fig. 25(a)-25(e) show the receiving mechanisms of different nail grinding host machines according to the invention;

Fig. 26 is a block diagram of another nail grinding host machine according to the invention;

Fig. 27 shows an angle between a nail grinding pen according to the invention and a horizontal plane; and

Fig. 28 is a block diagram of yet another nail grinding

host machine according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0006] As is conventionally done, the features and elements shown in the accompanying drawings are not drawn to scale but are drawn to best illustrate specific features and elements that are related to the present invention. In addition, identical or similar reference numerals are used throughout the drawings to indicate similar elements or parts.

[0007] The embodiments described below are not intended to impose excessive limitations on the present invention. A person of ordinary skill in the art may modify or change the embodiments discussed herein without departing from the spirit or scope of the invention, and all such modifications and changes shall be viewed as falling within the scope of the invention.

[0008] As used herein, terms such as "comprise," "include," "have," and "contain" are inclusive or open-ended unless otherwise stated and therefore do not exclude elements or steps that are not specified. The terms "a" and "said" may be construed as referring to a single referent or plural referents. The term "one or a plurality of" means "at least one" and therefore may be used to identify a single feature or a mixture/combination of features. Moreover, unless otherwise stated, the term "provided on an article" as used in this specification and the appended claims may be construed as being directly or indirectly attached to a surface of the article or as contacting the surface of the article in other ways, wherein the definition of the surface should be determined according to the context and common knowledge in the art.

[0009] Each "equipment," "device," "apparatus," or "module" used in the present invention, or its function, may be implemented by a single chip or by a plurality of chips that work together; the invention has no limitation on the number of such chips. The aforesaid chips may be, but are not limited to, processors, central processing units (CPUs), microprocessors, digital signal processors (DSPs), application-specific integrated circuits (ASICs), programmable logic devices (PLDs), or a combination of the above; the invention has no limitation in this regard.

[0010] One embodiment of the present invention is described below with reference to Fig. 1, Fig. 2, and Fig. 3, which are a perspective view of a nail grinding pen according to the invention and two exploded views of the structure of the nail grinding pen. This embodiment discloses a nail grinding pen 100 that includes a nail grinding pen barrel 10, a motor 20, and an inner body 30. The nail grinding pen barrel 10 has a receiving space SP therein. One end of the nail grinding pen barrel 10 has an opening OP in communication with the receiving space SP. The motor 20 is provided in the receiving space SP and has a rotating shaft 21 to be driven to rotate by electricity. The inner body 30 is connected to the rotating shaft 21 of the motor 20. The rotating shaft 21 protrudes from the motor housing 22 by a length less than 15 mm, such as

but not limited to 1 mm, 2 mm, 3 mm, 4 mm, 5 mm, 6 mm, 7 mm, 8 mm, 9 mm, 10 mm, 11 mm, 12 mm, 13 mm, 14 mm; the invention has no limitation in this regard. The end of the inner body 30 that faces the opening OP is provided with a gripper 31. The gripper 31 is configured to secure a grinding head GH so that by rotating the gripper 31, the motor 20 can drive the grinding head GH into rotation.

[0011] The gripper 31 can be opened and closed by operating each of the following two types of switches. Please refer to Fig. 4(a) and Fig. 4(b), which show how the gripper of a nail grinding pen according to the present invention is opened and closed by operating a push switch. In the embodiment shown in the drawings, the nail grinding pen barrel 10 is provided with a push switch 11A coupled to the gripper 31. The push switch 11A can be pushed forward and pulled rearward to switch the gripper 31 between an opened state and a closed state. In Fig. 4(a) for example, the push switch 11A is pushed forward (or leftward as shown in the drawing) and thereby moved slightly forward such that the gripper 31 is expanded by an internal linkage mechanism and thus releases the grinding head GH. In Fig. 4(b), the push switch 11A is pulled rearward (or rightward as shown in the drawing) and thereby moved back to its position in Fig. 4(a) such that the gripper 31 is radially constricted by the internal linkage mechanism and thus grips the grinding head GH. The linkage mechanism of the push switch 11A can be implemented in many ways and can be any suitable mechanism, and the techniques by which to implement the linkage mechanism of the push switch 11A are conventional. As the design of the linkage mechanism of the push switch 11A is not a feature for which patent protection is sought by the applicant, the working principle of the linkage mechanism will not be detailed herein.

[0012] Another embodiment of the switch for opening and closing the gripper 31 is illustrated in Fig. 5(a) and Fig. 5(b), which show how the gripper of a nail grinding pen according to the present invention is opened and closed by operating a rotary switch. In the embodiment shown in the drawings, the nail grinding pen barrel 10 is provided with a rotary switch 11B coupled to the gripper 31. The rotary switch 11B can be rotated to switch the gripper 31 between an opened state and a closed state. In Fig. 5(a) for example, the rotary switch 11B is rotated clockwise (as indicated by the arrow A1 in the drawing) such that the gripper 31 is expanded by an internal linkage mechanism and thus releases the grinding head GH. In Fig. 5(b), the rotary switch 11B is rotated counterclockwise (as indicated by the arrow A2 in the drawing) such that the gripper 31 is radially constricted by the internal linkage mechanism and thus grips the grinding head GH.

[0013] Please refer to Fig. 6 for a sectional view of the nail grinding pen in Fig. 1 to Fig. 3. As shown in Fig. 6, the inner body 30 in this embodiment essentially includes a pushing post 32; the gripper 31, which is provided at the front end of the pushing post 32; a position-limiting barrel 33 surrounding the gripper 31; and a shaft sleeve

34 provided at the rear end of the pushing post 32 and attached to the rotating shaft 21 so that the motor 20 can drive the pushing post 32, the gripper 31, and the position-limiting barrel 33 into rotation. In one embodiment, the shaft sleeve 34 is made of plastic or metal. In a preferred embodiment, the material of the shaft sleeve 34 is plastic to enhance self-lubrication of the rotation mechanism; the present invention, however, has no limitation on the material of the shaft sleeve 34. In one embodiment, bearings 35A and 35B are respectively provided between the two ends of the position-limiting barrel 33 and the wall of the receiving space SP. The bearings 35A and 35B are provided to prevent friction between the position-limiting barrel 33 and the inner wall of the nail grinding pen barrel 10 when the position-limiting barrel 33 is rotated by the motor 20 along with the pushing post 32 and the gripper 31. The bearings 35A and 35B also define the concentricity of the position-limiting barrel 33. In another embodiment, the connecting elements (e.g., fixing plates and washers) connected to the bearings 35A and 35B are made of copper or gold, or any metal coated with polytetrafluoroethylene (PTFE), hard chrome-plated, nickel-plated, or lubricated, or they can be thrust bearings; the invention, however, has no limitation on the material of those connecting elements.

[0014] For the design of the rotating shaft of the motor, please refer to Fig. 7, which shows various rotating shaft designs for the motor in the present invention. In the embodiments shown in Fig. 7, the rotating shafts are respectively designed as a shaft 21A with a circular cross section (see Fig. 7(a)), a shaft 21B with a cross-shaped cross section (see Fig. 7(b)), a shaft 21C with a D-shaped cross section (see Fig. 7(c)), and shafts 21D and 21E with a polygonal cross section (see Fig. 7(d) for a quadrilateral cross section and Fig. 7(e) for a pentagonal cross section). In fact, the rotating shaft of the motor may have any other cross-sectional shape without limitation. In another embodiment, an additional sleeve 211 is attached to and mounted around the rotating shaft 21 of the motor in the invention (see Fig. 7(f)), and the shaft sleeve 34 is fixed to the rotating shaft 21 via the additional sleeve 211. The invention has no limitation on the shape of the additional sleeve 211.

[0015] Please refer to Fig. 8 for a partial sectional view of the nail grinding pen in Fig. 1 to Fig. 3. As shown in Fig. 8, the gripper 31 includes a sleeve 311 connected to the pushing post 32, an accommodating groove 312 provided at one end of the sleeve 311 and facing the opening OP, and a plurality of claw units 313 provided along the periphery of the accommodating groove 312. The accommodating groove 312 is configured to accommodate the grinding head GH. A gap SG is formed between each two adjacent claw units 313 so that the claw units 313 can constrict radially to grip the grinding head GH or can expand radially to release the grinding head GH.

[0016] In one embodiment, the gripper 31 includes three claw units 313. In other embodiments, the number

of the claw units 313 may be four, five, six, or a greater number. Changes in the number of the claw units 313 shall be viewed as falling within the scope of the present invention. To provide an appropriate gripping force and prevent the grinding head GH from separating from the gripper 31, one embodiment is so designed that when the claw units 313 are closed, the gap between each two adjacent claw units 313 is smaller than 0.7 mm, such as but not limited to 0.10 mm, 0.15 mm, 0.20 mm, 0.25 mm, 0.30 mm, 0.35 mm, 0.40 mm, 0.45 mm, 0.50 mm, 0.55 mm, 0.60 mm, or 0.65 mm; the invention has no limitation in this regard. In one embodiment, the depth of the accommodating groove 312 is between 20 mm and 38 mm, such as but not limited to 20 mm, 21 mm, 22 mm, 23 mm, 24 mm, 25 mm, 26 mm, 27 mm, 28 mm, 29 mm, 30 mm, 31 mm, 32 mm, 33 mm, 34 mm, 35 mm, 36 mm, 37 mm, or 38 mm; the invention has no limitation in this regard either.

[0017] In order for the gripper 31 to be switchable between an opened state and a closed state, one embodiment is so designed that the gripper 31 is restricted between a front position and a rear position, can be moved forward in order to be switched to the opened state, and can be moved rearward in order to be switched to the closed state. Please refer to Fig. 9 for another partial sectional view of the nail grinding pen in Fig. 1 to Fig. 3. As shown in Fig. 9, the rotary switch 11B includes a rotating ring 111B, a position-limiting track 112B disposed on the nail grinding pen barrel 10 and surrounded by the rotating ring 111B, a connecting ring 113B provided on the inner side of the position-limiting track 112B, and a rolling ball 114B provided on the connecting ring 113B and confined in the position-limiting track 112B. The outer periphery of the connecting ring 113B is provided with an annular track AT for interfering with the rolling ball 114B. By rotating the rotating ring 111B, the rolling ball 114B can be moved in and along the position-limiting track 112B between a first axial position and a second axial position such that the connecting ring 113B is moved in the axial direction due to interference and limitation by the position-limiting track 112B and thereby pushes the gripper 31 forward or rearward. In one embodiment, the rolling ball 114B can be locked at a first end P1 or a second end P2 of the position-limiting track 112B, wherein the first end P1 is the end of the position-limiting track 112B that faces the first axial position while the second end P2 is the end of the position-limiting track 112B that faces the second axial position. As to the locking method, one embodiment is so designed that a spring 115B is provided on one side of the connecting ring 113B to apply an elastic force to the connecting ring 113B in the axial direction, thereby applying an auxiliary force to the connecting ring 113B to secure the rolling ball 114B either in the first position-limiting groove P11 at the first end P1 of the position-limiting track 112B or in the second position-limiting groove P21 at the second end P2 of the position-limiting track 112B. In order for the rolling ball 114B to be able to roll along with the rotating ring 111B

and move in the axial direction, the inner side of the rotating ring 111B is provided with a confining track LT that extends in the axial direction, and the rolling ball 114B is located in the confining track LT.

[0018] The "first axial position" in the present invention is a position in the nail grinding pen 100 that is relatively close to the rear end (or a rear cover 12, as defined further below) of the nail grinding pen 100 in the axial direction (i.e., relatively close to the right side of Fig. 9), whereas the "second axial position" is a position in the nail grinding pen 100 that is relatively close to the front end (or the opening OP) of the nail grinding pen 100 in the axial direction (i.e., relatively close to the left side of Fig. 9).

[0019] Please refer to Fig. 10 for still another partial sectional view of the nail grinding pen in Fig. 1 to Fig. 3. As shown in Fig. 10, the gripper 31 includes a constricting unit 314. The constricting unit 314 is provided inside the position-limiting barrel 33, is mounted around the sleeve 311, and constricts the claw units 313 in normal circumstances. The inner side of the position-limiting barrel 33 is provided with an inner wall 332 facing one end of the constricting unit 314, and the pushing post 32 is provided with a front wall 321 facing the other end of the constricting unit 314. When the connecting ring 113B pushes the gripper 31 via the pushing post 32, the constricting unit 314 is compressed in two opposing directions and therefore expands radially to reduce the constricting force of the claw units 313, thereby allowing the grinding head GH to be replaced. In one embodiment, the constricting unit 314 is, for example but not limited to, a spring or a leaf spring; the invention has no limitation in this regard.

[0020] Please refer to Fig. 11, which shows how the rolling ball in the present invention moves when the rotating ring is rotated. As shown in the drawing, the foregoing structural configurations are such that the moving path of the rolling ball 114B is essentially limited by interference of the position-limiting track 112B on the nail grinding pen barrel 10, by interference of the annular track AT on the outer periphery of the connecting ring 113B, and by interference of the confining track LT on the inner side of the rotating ring 111B. Referring to Fig. 11(a), Fig. 11(b), and Fig. 11(c), when the rotating ring 111B is rotated (e.g., clockwise), the rolling ball 114B is moved from the first end P1 toward the second end P2 of the position-limiting track 112B by the rotating ring 111B, as indicated by the arrow A3 in Fig. 11(a). With the rolling ball 114B moving from the first end P1 to the second end P2, the connecting ring 113B, which is located on the inner side of the rolling ball 114B, is pushed by the rolling ball 114B and thus moved from the first axial position toward the second axial direction, as indicated by the arrow A4 in Fig. 11(b). The connecting ring 113B, in turn, pushes and moves the pushing post 32 and the gripper 31 such that the constricting unit 314 is compressed from both ends by the front wall 321 of the pushing post 32 and the inner wall 332 on the inner side of the position-limiting barrel 33. As a result, the constricting unit 314 is radially expanded (see Fig. 11(c)), and

the inclined walls 3131 at the distal ends of the claw units 313 are moved away from the bell-shaped opening of the position-limiting barrel 33 to allow removal of the grinding head GH. To mount the grinding head GH, referring to Fig. 11(d), Fig. 11(e), and Fig. 11(f), the rotating ring 111B is rotated in the opposite direction (e.g., counterclockwise), thereby moving the rolling ball 114B from the second end P2 toward the first end P1 of the position-limiting track 112B, as indicated by the arrow A5 in Fig. 11(d). With the rolling ball 114B moving from the second end P2 to the first end P1, the connecting ring 113B, which is located on the inner side of the rolling ball 114B, is pushed by the rolling ball 114B and thus moved from the second axial position toward the first axial direction, as indicated by the arrow A6 in Fig. 11(e). Once the connecting ring 113B is moved, the forces applied respectively to the two ends of the constricting unit 314 are removed such that the constricting unit 314 constricts radially and restores its original position (see Fig. 11(f)) as the distance between the front wall 321 of the pushing post 32 and the inner wall 332 on the inner side of the position-limiting barrel 33 is increased. Consequently, the inclined walls 3131 at the distal ends of the claw units 313 are brought back into the bell-shaped opening of the position-limiting barrel 33 to secure the grinding head GH.

[0021] The motor 20 may be a brushless motor or a brushed motor; the present invention has no limitation in this regard. In one embodiment, the motor 20 has a rotation speed lower than 40000 RPM. More specifically, the rotation speed of the motor 20 may be, but is not limited to, 5000 RPM, 6000 RPM, 7000 RPM, 8000 RPM, 9000 RPM, 10000 RPM, 11000 RPM, 12000 RPM, 13000 RPM, 14000 RPM, 15000 RPM, 16000 RPM, 17000 RPM, 18000 RPM, 19000 RPM, 20000 RPM, 21000 RPM, 22000 RPM, 23000 RPM, 24000 RPM, 25000 RPM, 26000 RPM, 27000 RPM, 28000 RPM, 29000 RPM, 30000 RPM, 31000 RPM, 32000 RPM, 33000 RPM, 34000 RPM, 35000 RPM, 36000 RPM, 37000 RPM, 38000 RPM, or 39000 RPM; the invention has no limitation in this regard. In one embodiment, the drive voltage for driving the motor 20 to rotate at the highest speed is higher than 4 V. More specifically, the drive voltage of the motor 20 may be, but is not limited to, 5 V, 6 V, 7 V, 8 V, 9 V, 10 V, 11 V, 12 V, 13 V, 14 V, 15 V, 16 V, 17 V, 18 V, 19 V, 20 V, 21 V, 22 V, 23 V, 24 V, or 25 V; the invention has no limitation in this regard.

[0022] Please refer to Fig. 12 for various electrical connection port designs for the motor in the present invention. In one embodiment, the electrical connection ports of the motor 20 are in the form of a plurality of electrical sockets 23A, as shown in Fig. 12(a). When the electrical connection ports are designed as the electrical sockets 23A, the power cord to be connected to the electrical connection ports may have a plug corresponding to the electrical sockets 23A so that electrical connection can be established by connecting the plug of the power cord to the electrical sockets 23A of the motor 20. In another

embodiment, the electrical connection ports of the motor 20 are in the form of terminals 23B, as shown in Fig. 12(b), and when the electrical connection ports are designed as the terminals 23B, the power cord to be connected to the electrical connection ports may have a socket corresponding to the terminals 23B so that electrical connection can be established by inserting the terminals 23B of the motor 20 into the socket of the power cord. In yet another embodiment, the electrical connection ports of the motor 20 are in the form of soldered wires 23C, as shown in Fig. 12(c), and when the electrical connection ports are designed as the soldered wires 23C, the power cord to be connected to the electrical connection ports may have wires or solder pads corresponding to the soldered wires 23C so that electrical connection can be established by soldering the soldered wires 23C of the motor 20 to the wires or solder pads of the power cord. Changes in design of the electrical connection ports of the motor 20 shall be viewed as falling within the scope of the invention.

[0023] Please refer to Fig. 13 for partial sectional views of two nail grinding pens according to the present invention. As shown in the drawing, the nail grinding pen barrel 10 in the invention is provided with a rear cover 12 at the rear end, and the rear cover 12 is configured to close the receiving space SP from the rear side. In the embodiment shown in Fig. 13(a), the rear side of the rear cover 12 is provided with an electrical wire having a protective sleeve 121 through which a power cord can pass, and which can protect the power cord from damage by being bent. When the electrical connection ports of the motor 20 are designed as soldered wires, the inner side of the rear cover 12 will be provided with a pliable wire-surrounding member 122 for enclosing the soldered wires, and once the rear cover 12 is locked to the nail grinding pen barrel 10, the rear cover 12 and the motor 20 press tightly on the pliable wire-surrounding member 122 from two opposite sides thereof to secure and seal the pliable wire-surrounding member 122. In one embodiment, the pliable wire-surrounding member 122 is made of flexible polyvinyl chloride (PVC), rubber, or silicone rubber; the invention, however, has no limitation on the material of the pliable wire-surrounding member 122. In the embodiment shown in Fig. 13(b), the electrical connection ports of the motor 20 are designed as a plurality of electrical sockets or a plurality of terminals, a power cord is inserted into the rear cover 12 from the outer side thereof and then soldered to the electrical ports inside a pliable terminal-surrounding member 122, and the electrical ports and the electrical sockets or terminals are electrically connected through the pliable terminal-surrounding member 122. Once the rear cover 12 is locked to the nail grinding pen barrel 10, the rear cover 12 and the motor 20 press tightly on the pliable terminal-surrounding member 122 from two opposite sides thereof to secure and seal the pliable terminal-surrounding member 122.

[0024] In another embodiment as shown in Fig. 14, which shows a partial sectional view of a nail grinding

pen according to the present invention, the rear cover 12 is dispensed with. As shown in the drawing, the rear end of the nail grinding pen barrel 10 has a rear opening 15, and the rear opening 15 is provided with a position-limiting portion 151. The position-limiting portion 151 is located on the outer side of a pliable wire-surrounding member 16 with respect to the rear opening 15 so as to prevent the pliable wire-surrounding member 16 from leaving the rear opening 15 from inside the receiving space SP, wherein the pliable wire-surrounding member 16 closes the receiving space SP by closing the rear opening 15. In one embodiment, the position-limiting portion 151 is, for example, a protruding ring provided on the inner periphery of the rear opening 15 to prevent the pliable wire-surrounding member 16 from separating from the rear opening 15. In another embodiment, the position-limiting portion 151 is formed by gradually reducing the receiving space SP toward the rear opening 15 such that the inner diameter of the tapered end of the receiving space SP is smaller than the outer diameter of the pliable wire-surrounding member 16, causing interference between the rear opening 15 and the pliable wire-surrounding member 16 and thereby preventing the pliable wire-surrounding member 16 from separating from the rear opening 15.

[0025] In one embodiment, the material of the pliable wire-surrounding member is, for example but not limited to, flexible PVC, rubber, or silicone rubber; the present invention has no limitation in this regard.

[0026] Please refer to Fig. 15 for another partial sectional view of the nail grinding pen in Fig. 1 to Fig. 3. As shown in Fig. 15, the nail grinding pen barrel 10 is provided with a grip portion 13 to facilitate operation of the nail grinding pen 100. The grip portion 13 has an ergonomic design in terms of its thickness so that the nail grinding pen 100 can be easily held by the grip portion 13. In one embodiment, the greatest gripping comfort can be achieved by providing the nail grinding pen barrel 10 with a width less than 32 mm, such as but not limited to 8 mm, 9 mm, 10 mm, 11 mm, 12 mm, 13 mm, 14 mm, 15 mm, 16 mm, 17 mm, 18 mm, 19 mm, 20 mm, 21 mm, 22 mm, 23 mm, 24 mm, 25 mm, 26 mm, 27 mm, 28 mm, 29 mm, 30 mm, or 31 mm; the invention has no limitation in this regard. In one embodiment, the grip portion 13 is provided with a cool-feeling material, and the cool-feeling material may be, but is not limited to, a gel, silicone, or polyester fiber; the invention has no limitation in this regard. In one embodiment, the grip portion 13 is provided with a cushioning material corresponding to the inner side or the outer side of the nail grinding pen barrel 10. When corresponding to the outer side of the nail grinding pen barrel 10, the cushioning material may cover the grip portion 13 and an area extending from the grip portion 13. When corresponding to the inner side of the nail grinding pen barrel 10, the cushioning material may cover the contact surfaces between the position-limiting barrel 33 and the bearings 35A and 35B, or cover the contact surfaces between the bearings 35A and 35B and the nail grinding

pen barrel 10, or lie between the position-limiting barrel 33 and the nail grinding pen barrel 10, in order to absorb the vibrations generated by the motor 20 rotating the inner body 30. To protect the nail grinding pen barrel 10 from damage by solvents, the nail grinding pen barrel 10 in one embodiment is made of an acetone-resistant material or has a coating, the nail grinding pen barrel 10 in another embodiment has a surface with a polyurethane (PU) paint layer or a UV-resistant paint layer, the nail grinding pen barrel 10 in still another embodiment has a surface with a metal coating layer, and the nail grinding pen barrel 10 in yet another embodiment has a surface with a layer formed by water electroplating; the invention has no limitation on such a protective material or coating.

[0027] Please refer to Fig. 16 for still another partial sectional view of the nail grinding pen in Fig. 1 to Fig. 3. In the embodiment shown in Fig. 16, the nail grinding pen barrel 10 includes a dust cover 14 attached to the gap between the wall of the opening OP of the nail grinding pen barrel 10 and the position-limiting barrel 33 to prevent the nail dust generated by nail grinding from entering the interior of the nail grinding pen barrel 10 through the opening OP (or more particularly through the aforesaid gap) and hence from making the electromechanical devices inside the nail grinding pen barrel 10 malfunction.

[0028] Please refer to Fig. 17 for two nail grinding pens according to the present invention, each incorporating a fan. In the embodiments shown in the drawing, the nail grinding pen 10 is further provided with a fan to dissipate heat from the electromechanical parts (e.g., the motor 20) inside the nail grinding pen barrel 10. In the embodiment shown in Fig. 17(a), a fan FF1 is provided inside the nail grinding pen barrel 10 by way of example and is supplied with electricity through internal wires inside the nail grinding pen barrel 10 (e.g., by way of the pliable wire-surrounding member 16). In the embodiment shown in Fig. 17(b), a fan FF2 is mounted directly around the nail grinding pen barrel 10 by way of example, is configured to dissipate the heat of the nail grinding pen barrel 10 from the outside and thereby dissipate heat from the electromechanical parts inside the nail grinding pen barrel 10, and is driven by electricity supplied either through external wires or by an independent power source. Changes in the mounting method and power supply circuitry of the fan shall be viewed as falling within the scope of the invention.

[0029] Please refer to Fig. 18 for a partial perspective view of a nail grinding pen according to the present invention. As shown in the drawing, a front end portion of the nail grinding pen barrel 10 is peripherally provided with heat dissipation slots 16 to enhance heat dissipation efficiency. The term "front end portion" refers to a peripheral wall portion of the nail grinding pen barrel 10 that is adjacent to the opening OP. The slots 16 allow the heat generated by operation of, or friction between, the electromechanical parts inside the nail grinding pen barrel 10 to be dissipated effectively. To satisfy practical nail grinding needs, the grinding head GH in one embodiment has

a diameter preferably ranging from 2.2 mm to 3.2 mm, such as but not limited to 2.2 mm, 2.3 mm, 2.4 mm, 2.5 mm, 2.6 mm, 2.7 mm, 2.8 mm, 2.9 mm, 3.0 mm, 3.1 mm, or 3.2 mm; the invention has no limitation in this regard.

[0030] Please refer to Fig. 19, which shows two nail grinding pens according to the present invention, each incorporating an auxiliary light. In order to provide proper lighting during the nail grinding process and thereby allow the operator to better see the nail grinding effects and details, the nail grinding pen barrel 10 in each embodiment in Fig. 19 is provided with an auxiliary light. In one embodiment, the auxiliary light may be, for example but not limited to, a LED, an annular light, a homogeneous light, or an optical fiber; the invention has no limitation in this regard. In the embodiment shown in Fig. 19(a), an auxiliary light 17A is incorporated into the nail grinding pen barrel 10 and obtains electricity through internal wires inside the nail grinding pen barrel 10 (e.g., is electrically connected to the pliable wire-surrounding member 16 through internal wires). In the embodiment shown in Fig. 19(b), an auxiliary light 17B is mounted on the outer side of the nail grinding pen barrel 10 and is driven by electricity supplied either through external wires outside the nail grinding pen barrel 10 or by an independent power source. Changes in the mounting method and power supply circuitry of the auxiliary light shall be viewed as falling within the scope of the invention.

[0031] The present invention further provides a nail grinding host machine 200 for use with the nail grinding pen 100, as described below with reference to the embodiment illustrated in Fig. 20, Fig. 21, and Fig. 22, which show the exterior, the internal devices, and a block diagram of a nail grinding host machine according to the invention, respectively. The nail grinding host machine 200 according to the embodiment shown in the drawings is connected to the foregoing nail grinding pen 100 in order to control the operating mode of the motor 20 in the nail grinding pen 100.

[0032] The nail grinding host machine 200 includes a host machine body 40 and a main board 50. The host machine body 40 is provided with at least one man-machine interface 41. The main board 50 is provided in the host machine body 40, is connected to the man-machine interface 41, and is configured to receive instructions from and send instructions to the man-machine interface 41. The main board 50 includes a power module 51, at least one driver 52, and a microcontroller C1 connected or coupled to the man-machine interface 41 and the driver 52. The main board 50 is connected through wires, or is coupled, to the motor 20 of the nail grinding pen 100 in order to transmit control instructions and driving power to the motor 20 and thereby control the operation of the motor 20. In one embodiment, the microcontroller C1 and the driver 52 may be co-constructed as a single chip or implemented as different chips; the present invention has no limitation in this regard.

[0033] The main board 50 is not necessarily a single circuit board. More specifically, the main board 50 may

be composed of a plurality of circuit boards to meet the requirements in function, circuit design, or mechanism layout. For example, the main board 50 may be composed of a plurality of sub-functional circuit boards due to the fact that, in practice, the product corresponding to each function of the main board 50 may be provided with an independent circuit board by its manufacturer. Changes in the number of such circuit boards shall be viewed as falling within the scope of the present invention.

[0034] When the motor 20 is a brushless motor, the driver 52 in this embodiment may be, for example but not limited to, a three-phase inverter, a buck converter, a boost converter, a pulse-amplitude modulator (PAM), a pulse-width modulator (PWM), a pulse-position modulator (PPM), a variable-frequency drive (VFD), or other similar devices that can drive a brushless motor with a square wave, a six-step square wave, or a sine wave, or by field-oriented control (FOC). When the motor 20 is a brushed motor instead, the driver 52 may, apart from being any of the aforesaid drivers, include a converter, switch, metal-oxide-semiconductor (MOS) device, voltage stabilizer, or relay that can provide a voltage to and thereby drive a brushed motor. In one embodiment, the MOS device 522 of the brushless or brushed motor driver 52 may be externally connected to a chip including the driver 52 or be a built-in element of the chip; the present invention has no limitation in this regard. In an embodiment where the motor 20 is a brushed motor, forward and reverse rotation of the motor 20 is switched by a switching device; the invention, however, has no limitation in this regard. In one embodiment, the switching device may be, but is not limited to, an H-bridge, a MOS device, or a relay; the invention has no limitation in this regard either.

[0035] In one embodiment, the man-machine interface 41 may be, for example but not limited to, a rotating knob, a pushbutton, a liquid crystal display screen, a touchpad, a touch-controlled button, a touch screen, LED, LED display, slide switch, rocker switch, or a combination of the above; the present invention has no limitation in this regard. In one embodiment, the man-machine interface 41 includes a motor speed regulator 411, and the motor speed regulator 411 includes a varistor or an encoder. The motor speed regulator 411 comprises a varistor or an encoder, which is used by the driver 52 to control the rotation speed of the motor 20 accordingly, wherein the driver 52 is driven by either the voltage level or a PWM signal.

[0036] Please refer to Fig. 23A to Fig. 23E for block diagrams of some alternative nail grinding host machines according to the present invention. In the embodiment shown in Fig. 23A, the main board 50 includes a rotation speed detector 53 connected or coupled to the driver 52 and the motor 20. The rotation speed detector 53 is configured to detect the rotation speed of the motor 20 and provide feedback to the driver 52 in order to modify the output of the driver 52. In another embodiment, the rotation speed detector 53 detects the rotation speed of the motor 20 by detecting the induced voltage generated by

rotation of the motor 20, with the term "induced voltage" referring to the voltage generated in a rotating magnetic field. In the embodiment shown in Fig. 23B, the motor 20 includes a built-in Hall sensor H1, and the rotation speed detector 53 detects the rotation speed of the motor 20 via the built-in Hall sensor H1 of the motor 20. In the embodiment shown in Fig. 23C, the rotation speed detector 53 detects the rotation speed of the motor 20 via a Hall sensor H2 that is externally connected to the motor 20, and such a change in the connection method of the Hall sensor shall be viewed as falling within the scope of the invention. In the embodiment shown in Fig. 23D, and by way of example only, the rotation speed detector 53 detects the rotation speed of the motor 20 via a direct-current tachometer H3 that is externally connected to the motor 20. In the embodiment shown in Fig. 23E, and by way of example only, the rotation speed detector 53 detects the rotation speed of the motor 20 via a rotary transformer H4 that is externally connected to the motor 20.

[0037] When contacting the surface of a nail, the grinding head GH of the nail grinding pen 100 may be subjected to different levels of resistance such that the rotation speed of the motor 20 (equivalent to the force applied to the nail by the nail grinding pen 100) is changed and becomes inconsistent. In order to maintain the rotation speed of the grinding head GH (or the motor 20), the microcontroller C1 detects the rotation speed of the motor 20 via the rotation speed detector 53 and, when the rotation speed of the motor 20 is reduced, increases the output of the motor 20 to compensate for the reduced rotation speed. More specifically, the microcontroller C1 may set a rotation speed threshold according to the current rotation speed and, when the rotation speed threshold has yet to be reached, increase the rotation speed of the motor 20 either at once or gradually until the rotation speed threshold is reached. In another embodiment, the rotation speed threshold includes a lower limit Threshold 1 and an upper limit Threshold 2 higher than the lower limit Threshold 1. When the rotation speed value fed back to the microcontroller C1 is lower than the lower limit Threshold 1, the microcontroller C1 increases the rotation speed of the motor 20 until it is higher than the lower limit Threshold 1. When the rotation speed value fed back to the microcontroller C1 is higher than the upper limit Threshold 2, the microcontroller C1 reduces the rotation speed of the motor 20 until it is lower than the upper limit Threshold 2. The foregoing design helps prevent the motor 20 from rotating too fast when the grinding head GH leaves the surface of a nail. In an embodiment where the microcontroller C1 is dispensed with, the driver 52 detects the rotation speed of the motor 20 via the rotation speed detector 53 and, when the rotation speed of the motor 20 is reduced, increases the output of the motor 20 to compensate for the reduced rotation speed. In another embodiment, the microcontroller C1 or the driver 52 may increase the switching speed of a MOS device, adjust a duty ratio or voltage, or perform self-adaptive I×R compensation in order to control the output of the

driver 52 and thereby carry out rotation speed compensation.

[0038] Please refer to Fig. 24(a)-24(c) for block diagrams of some more alternative nail grinding host machines according to the present invention. In the embodiment shown in Fig. 24(a), the driver 52 includes a comparator 521 for detecting whether or not a feedback voltage V1 (or current) has reached a setting value TH. If the setting value is reached, the output power to the motor 20 will be maintained; otherwise, compensation for the output will continue until the feedback voltage or current reaches the setting value. In the embodiment shown in Fig. 24(b), the microcontroller C1 carries out self-adaptive regulation by receiving a feedback parameter V2 of the motor 20, calculating the corresponding compensation value from the feedback parameter, and controlling the output of a MOS device or the driver 52 according to the compensation value. In the embodiment shown in Fig. 24(c), the microcontroller C1 performs self-adaptive regulation by receiving a feedback parameter of the motor 20, finding the corresponding compensation value in a lookup table, and controlling the output of a MOS device or a voltage stabilizer according to the compensation value.

[0039] Please refer to Fig. 25(a)-25(e) for the receiving mechanisms of different nail grinding host machines according to the present invention. In one embodiment, the host machine body 40 is provided with a receiving mechanism for receiving the grinding head GH. In the embodiments shown in Fig. 25(a)-25(c), the receiving mechanisms include a receiving box 42A for receiving the grinding head GH (see Fig. 25(a)); a plurality of receiving blocks 42B so that the grinding head GH can be engaged in any of the gaps 421B between the receiving blocks 42B (see Fig. 25(b)); and a receiving groove 42C sunken into the host machine body 40 so that the grinding head GH can be engaged and received in the engaging groove 42C (see Fig. 25(c)). In another embodiment, the receiving mechanism 42 is provided with one or a plurality of magnetic units 421 for magnetically attracting and thereby retaining the grinding head GH (see Fig. 25(d)). In yet another embodiment, the receiving mechanism 42 is provided with one or a plurality of engaging units 422 so that the grinding head GH can be engaged and secured in the one or plurality of engaging units 422 (see Fig. 25(e)).

[0040] In one embodiment, the nail grinding host machine 200 includes a replaceable or rechargeable battery connected to the power module 51. In embodiments that use a rechargeable battery, the power module 51 may include, for example, a recharging module, and the recharging module may or may not support a rapid-charging function for increasing the efficiency with which a rechargeable battery can be recharged. In one embodiment, the charging current ranges from 0.3c to 1c, the unit "c" refers to the charging rate in relation to the battery capacity. In one embodiment, the power module 51 includes an electrical socket located on the host machine body 40, and the electrical socket may be exposed from

the host machine body 40 or include a dust cover or dust shield that can cover the electrical socket to ward off dust and water or repel water. In one embodiment, this electrical socket may be, for example but not limited to, a USB Type-C socket. Changes in configuration of the electrical socket shall be viewed as falling within the scope of the present invention.

[0041] Please refer to Fig. 26 for a block diagram of another nail grinding host machine according to the present invention. As shown in the drawing, the main board 50 includes an over-current protection module M1, an over-voltage protection module M2, and an over-temperature protection module M3, each connected to the microcontroller C1. The over-current protection module M1 may include, for example but not limited to, a current detector. The over-current protection module M1 produces decision information upon detecting that the input current on the secondary side (corresponding to the input into the motor 20) exceeds a safe value. The over-voltage protection module M2 may include, for example but not limited to, a voltage detector. The over-voltage protection module M2 produces decision information upon detecting that the voltage exceeds a safe value. In one embodiment, the over-voltage protection module M2 is provided on the driver 52 and is configured to track the input of the motor 20. In other embodiments, the over-voltage protection module M2 may be provided anywhere in the circuit on the secondary side of the power module 51 in order to detect the voltage across an arbitrary node. The invention has no limitation on the location of the over-voltage protection module. The over-temperature protection module M3 may include, for example but not limited to, a temperature sensor or a thermistor. The over-temperature protection module M3 produces decision information upon detecting that the temperature of the motor 20 exceeds a safe value. In one embodiment, the decision information may be, but is not limited to, a power-off instruction, circuit-breaking instruction, or warning instruction to the microcontroller C1; the invention has no limitation in this regard. In another embodiment, the decision information may be sent directly to the power module 51. The invention has no limitation on whether the decision information is sent to the power module 51 directly or otherwise.

[0042] In order to provide enhanced operability and safety, the nail grinding host machine of the present invention can be paused according to a pause instruction triggered by a user instruction or by a predetermined operation state. In one embodiment, the microcontroller C1 stops the motor 20 upon detecting that the pause instruction is triggered via the man-machine interface 41. In another embodiment, the microcontroller C1 stops the motor 20 when the pause instruction is triggered by the degree of inclination of the nail grinding pen 100 as is detected by the inclinometer of the nail grinding pen 100. More specifically, the inclinometer of the nail grinding pen 100 is connected or coupled to the main board 50 or the microcontroller C1. When the inclinometer detects that

the nail grinding pen 100 is placed horizontally, the microcontroller C1 determines that the user has stopped operating the nail grinding pen 100, and in consequence, the microcontroller C1 triggers the pause instruction to pause the motor 20. As the angle value detected by the inclinometer will vary with the inclination angle at which the inclinometer is mounted in/on the nail grinding pen 100, the invention has no limitation on the angle detected by the inclinometer. Please refer to Fig. 27, which shows an angle between a nail grinding pen according to the invention and a horizontal plane, or more particularly the angle $\theta 1$ between the pen body of the nail grinding pen 100 and a horizontal plane in the world coordinate system. The angle $\theta 1$ that will trigger the pause instruction preferably ranges from -10° to 10° and may be, but is not limited to, -10° , -9° , -8° , -7° , -6° , -5° , -4° , -3° , -2° , -1° , 0° , 1° , 2° , 3° , 4° , 5° , 6° , 7° , 8° , 9° , or 10° ; the invention has no limitation in this regard. In one embodiment, the microcontroller C1 stops the motor 20 when the pause instruction is triggered by the motion sensor of the nail grinding pen 100 detecting that the nail grinding pen 100 has been still for a predetermined amount of time. In another embodiment, the main board 50 or the microcontroller C1 includes a timer that will trigger a shut-down instruction when the nail grinding pen 100 has been still for a predetermined amount of time. The time-related pause in the last two embodiments can prevent unnecessary power consumption and eliminate safety concerns while the nail grinding pen 100 is not in operation. In one embodiment, the microcontroller C1 controls the power of the motor 20 at a stable wattage lower than 13 W when the motor 20 is idling; thus, by limiting the driving power of the motor 20, safety issues associated with damage and/or too high a rotation speed of the motor 20 are prevented. The stable wattage may be set at, for example, 5 W, 6 W, 7 W, 8 W, 9 W, 10 W, 11 W, or 12 W; the invention has no limitation in this regard.

[0043] The present invention may dispense with the microcontroller and use only the driver to drive the motor. Please refer to Fig. 28 for a block diagram of yet another nail grinding host machine according to the invention. In the embodiment shown in the drawing, the nail grinding host machine 300 essentially includes a host machine body 40 and a main board 50. The host machine body 40 is provided with at least one man-machine interface 41. The main board 50 is provided in the host machine body 40, is connected to the man-machine interface 41, and is configured to receive instructions from and send instructions to the man-machine interface 41. The main board 50 includes a power module 51. The main board 50 is connected through wires, or is coupled, to the motor 20 of the nail grinding pen 100 in order to transmit control instructions and driving power to the motor 20. The motor 20 is a brushed motor, and the man-machine interface 41 is connected to the driver 54 of the brushed motor. The driver 54 serves to provide a voltage output for the brushed motor.

[0044] In contrast to its brushless counterpart in the

previous embodiments, the motor in this embodiment is a brushed motor and can be implemented without using the microcontroller C1. All that is needed to control the activation, deactivation, and rotation speed of the brushed motor is for the driver 54 to provide, or stop providing, stable direct-current power to the brushed motor. This embodiment is different from the previous ones only in the type of the motor and the lack of the microcontroller C1. The remaining parts of this embodiment are identical to their respective counterparts in the previous embodiments and therefore will not be described repeatedly.

[0045] In one embodiment, the driver 54 may include, for example but not limited to, a converter, a switch, a MOS device, a relay, or other devices that can provide electric power. In another embodiment, the driver 54 may include, for example but not limited to, a buck converter or a boost converter.

Claims

1. A nail grinding pen (100), comprising:

a nail grinding pen barrel (10), wherein the nail grinding pen barrel (10) has a receiving space (SP) therein, and the nail grinding pen barrel (10) has an end with an opening (OP) in communication with the receiving space (SP);

a motor (20) provided in the receiving space (SP) and having a rotating shaft (21) to be driven to rotate by electricity; and

an inner body (30) connected to the rotating shaft (21), wherein the inner body (30) has an end facing the opening (OP) and provided with a gripper (31), and the gripper (31) is configured to secure a grinding head (GH) so that the motor (20) is able to drive the grinding head (GH) into rotation by rotating the gripper (31).

2. The nail grinding pen (100) of claim 1, wherein the nail grinding pen barrel (10) is provided with a rotary switch (11B) coupled to the gripper (31), and the rotary switch (11B) is configured to be rotated in order to switch the gripper (31) between an opened state and a closed state, the gripper (31) is restricted between a front position and a rear position and is movable forward and rearward in order to be switched between the opened state and the closed state.

3. The nail grinding pen (100) of claim 1, wherein the nail grinding pen barrel (10) is provided with a rotary switch (11B) coupled to the gripper (31), and the rotary switch (11B) is configured to be rotated in order to switch the gripper (31) between an opened state and a closed state, and the inner body (30) comprises: a pushing post (32); the gripper (31), which is provided at a front end of the pushing post (32); a position-limiting barrel (33) surrounding the gripper

(31); and a shaft sleeve (34) provided at a rear end of the pushing post (32) and attached to the rotating shaft (21) so that the motor (20) is able to drive the pushing post (32) and the gripper (31) into rotation.

4. The nail grinding pen (100) of claim 3, wherein the gripper (31) comprises: a sleeve (311) connected to the pushing post (32); an accommodating groove (312) provided at an end of the sleeve (311), facing the opening (OP), and configured to accommodate the grinding head (GH); and a plurality of claw units (313) provided along a periphery of the accommodating groove (312); wherein there is a gap (SG) between each two adjacent said claw units (313) so that the claw units (313) are able to constrict radially to grip the grinding head (GH) or are able to expand radially to release the grinding head (GH), and the gripper (31) comprises three said claw units (313).
5. The nail grinding pen (100) of claim 4, wherein there is a gap smaller than 0.7 mm between each two adjacent said claw units (313) when the claw units (313) are closed, and the accommodating groove (312) has a depth ranging from 20 mm to 38 mm.
6. The nail grinding pen (100) of claim 4, wherein the rotary switch (11B) comprises: a rotating ring (111B); a position-limiting track (112B) disposed on the nail grinding pen barrel (10) and surrounded by the rotating ring (111B); a connecting ring (113B) provided on an inner side of the position-limiting track (112B); and a rolling ball (114B) provided on the connecting ring (113B) and confined in the position-limiting track (112B), wherein the connecting ring (113B) has an outer periphery provided with an annular track (AT) for interfering with the rolling ball (114B), and by rotating the rotating ring (111B), the rolling ball (114B) is movable in and along the position-limiting track (112B) between a first axial position and a second axial position such that the connecting ring (113B) is moved in an axial direction due to interference and limitation by the position-limiting track (112B) and thereby pushes the gripper (31) forward or rearward, the rolling ball (114B) is able to be locked at a first end (P1) or a second end (P2) of the position-limiting track (112B), and a spring (115B) is provided on a side of the connecting ring (113B) to apply an elastic force to the connecting ring (113B) in the axial direction, thereby applying an auxiliary force to the connecting ring (113B) to secure the rolling ball (114B) in a first position-limiting groove (P11) at the first end (P1) of the position-limiting track (112B), the rotating ring (111B) has an inner side provided with a confining track (LT), and the confining track (LT) extends in the axial direction.
7. The nail grinding pen (100) of claim 6, wherein the gripper (31) comprises a constricting unit (314), and

the constricting unit (314) is provided inside the position-limiting barrel (33), is mounted around the sleeve (311), and constricts the claw units (313) in normal circumstances; and wherein the position-limiting barrel (33) has an inner side provided with an inner wall (332) facing an end of the constricting unit (314), and the pushing post (32) is provided with a front wall (321) facing an opposite end of the constricting unit (314) so that when the connecting ring (113B) pushes the gripper (31) via the pushing post (32), the constricting unit (314) is compressed in two opposing directions and therefore expands radially to reduce a constricting force of the claw units (313), thereby allowing replacement of the grinding head (GH).

8. The nail grinding pen (100) of claim 3, wherein a bearing (35A) is provided between an end of the position-limiting barrel (33) and a wall of the receiving space (SP), and another bearing (35B) is provided between an opposite end of the position-limiting barrel (33) and the wall of the receiving space (SP).
9. The nail grinding pen (100) of claim 1, wherein the rotating shaft (21) has a circular, cross-shaped, D-shaped, or polygonal cross section, or an additional sleeve (211) is attached to the rotating shaft (21), and/or the rotating shaft (21) protrudes from the motor housing (22) by a length less than 15 mm, the motor (20) is a brushless motor or a brushed motor, and/or the motor (20) has electrical connection ports configured as a plurality of electrical sockets, a plurality of terminals, or a plurality of soldered wires.
10. The nail grinding pen (100) of claim 9, wherein a rear side of the nail grinding pen barrel (10) is provided with an electrical wire having a protective sleeve (121) which is configured to prevent a power cord passing through the protective sleeve (121) from damage by being bent.
11. The nail grinding pen (100) of claim 9, wherein the motor (20) has electrical connection ports configured as a plurality of soldered wires, the rear cover (12) has an inner side provided with a pliable wire-surrounding member (122) for enclosing the soldered wires, and once the rear cover (12) is locked to the nail grinding pen barrel (10), the rear cover (12) and the motor (20) press tightly on the pliable wire-surrounding member (122) from two opposite sides thereof to secure and seal the pliable wire-surrounding member (122); or wherein the electrical connection ports of the motor (20) are configured as a plurality of electrical sockets or a plurality of terminals, a power cord is inserted into the rear cover (12) from an outer side thereof and then soldered to electrical ports inside a pliable terminal-surrounding member (122), the electrical ports and the electrical sockets

or the terminals are electrically connected through the pliable terminal-surrounding member (122), and once the rear cover (12) is locked to the nail grinding pen barrel (10), the rear cover (12) and the motor (20) press on the pliable terminal-surrounding member (122) from two opposite sides thereof to secure and seal the pliable terminal-surrounding member (122); or

the nail grinding pen barrel (10) has a rear end with a rear opening (15), the rear opening (15) is provided with a position-limiting portion (151), and the position-limiting portion (151) is located on an outer side of a pliable wire-surrounding member (16) with respect to the rear opening (15) so as to prevent the pliable wire-surrounding member (16) from leaving the rear opening (15) from inside the receiving space (SP), wherein the pliable wire-surrounding member (16) closes the receiving space (SP) by closing the rear opening (15).

12. The nail grinding pen (100) of claim 1, wherein the nail grinding pen barrel (10) is provided with a grip portion (13), and the grip portion (13) is provided with a cool-feeling material, and/or the nail grinding pen barrel (10) is provided with a grip portion (13), and the grip portion (13) is provided with a cushioning material corresponding to an inner side or an outer side of the nail grinding pen barrel (10).
13. The nail grinding pen (100) of claim 1, wherein the nail grinding pen barrel (10) is made of an acetone-resistant material or has a coating, or has a surface comprising a polyurethane (PU) paint layer, a UV-resistant paint layer, a metal coating layer, or a layer formed by water electroplating.
14. The nail grinding pen (100) of claim 1, wherein the nail grinding pen barrel (10) is provided with an auxiliary light (17), and the auxiliary light (17) is a LED, an annular light, a homogeneous light, or an optical fiber.
15. A nail grinding host machine (200), connected to the nail grinding pen (100) in claim 1 to control operating mode of the motor (20) in the nail grinding pen (100), the nail grinding host machine (200) comprising:

a host machine body (40), wherein the host machine body (40) is provided with at least one man-machine interface (41), wherein the man-machine interface (41) comprises a rotating knob, a pushbutton, a liquid crystal display screen, a touchpad, a touch-controlled button, a touch screen, LED, LED display, slide switch, rocker switch, or a combination of the above, and/or the man-machine interface (41) comprises a motor speed regulator (411), the motor speed regulator (411) comprises a varistor or an

encoder, which is used by the driver (52) to control the rotation speed of the motor (20) accordingly; and

a main board (50) provided in the host machine body (40) and connected to the man-machine interface (41) in order to receive instructions from and send instructions to the man-machine interface (41), wherein the main board (50) comprises a power module (51) and at least one driver (52), and the main board (50) is connected through wires, or is coupled, to the motor (20) of the nail grinding pen (100) in order to transmit control instructions and driving power to the motor (20), wherein the main board (50) controls power of the motor (20) at a stable wattage lower than 13 W when the motor (20) is idling.

100

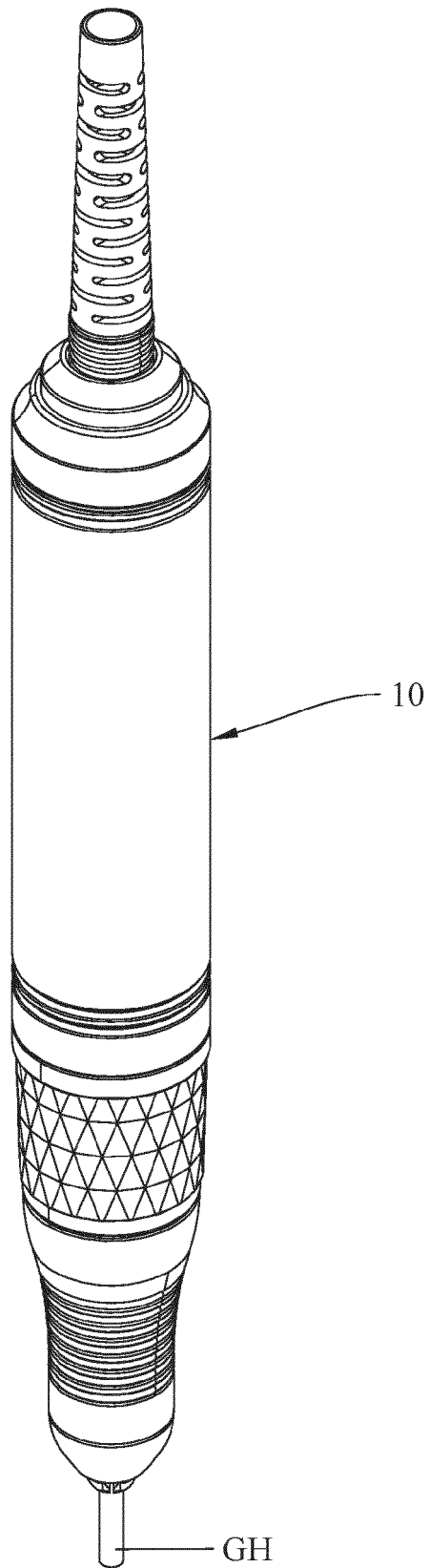
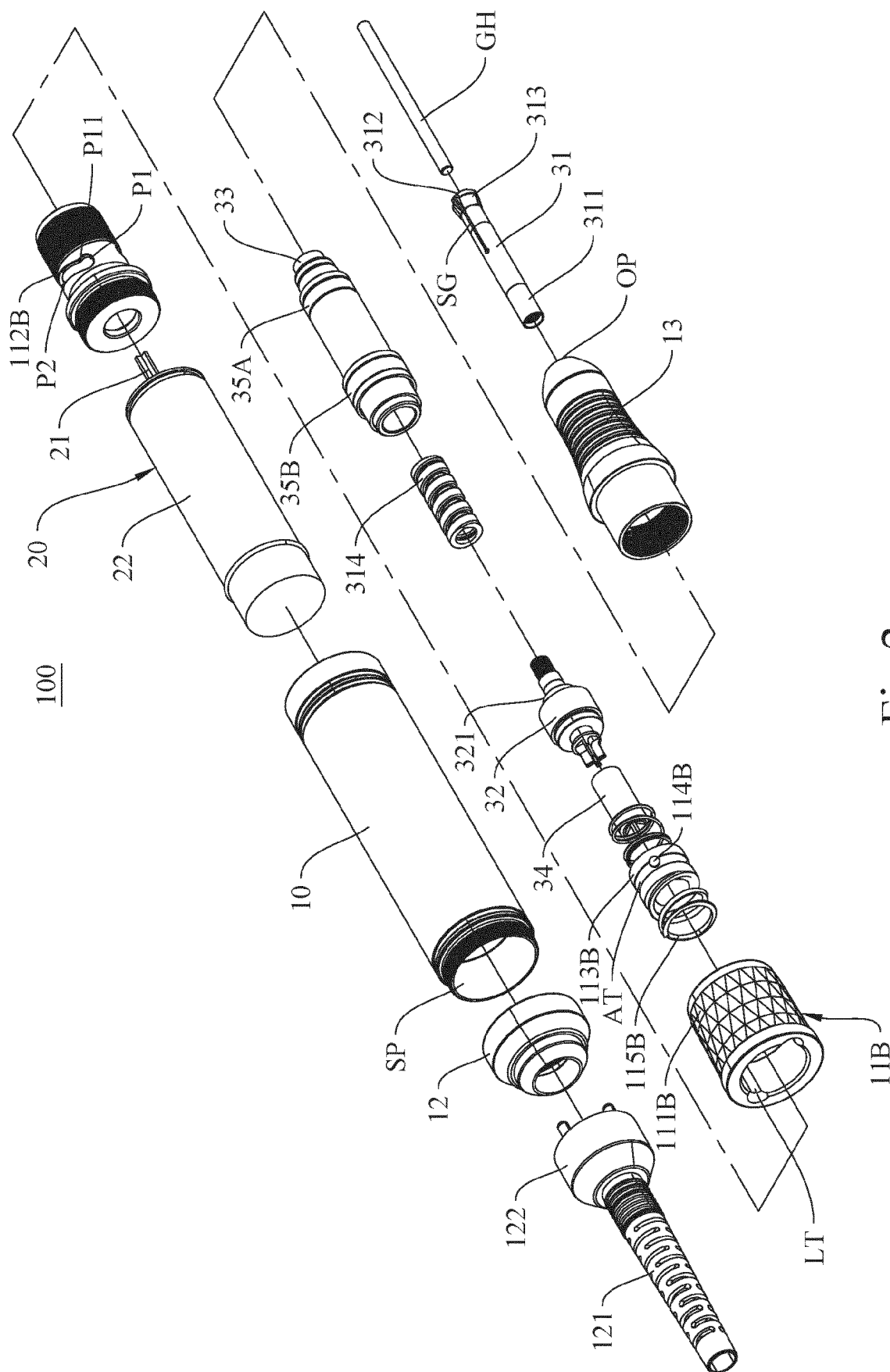


Fig.1



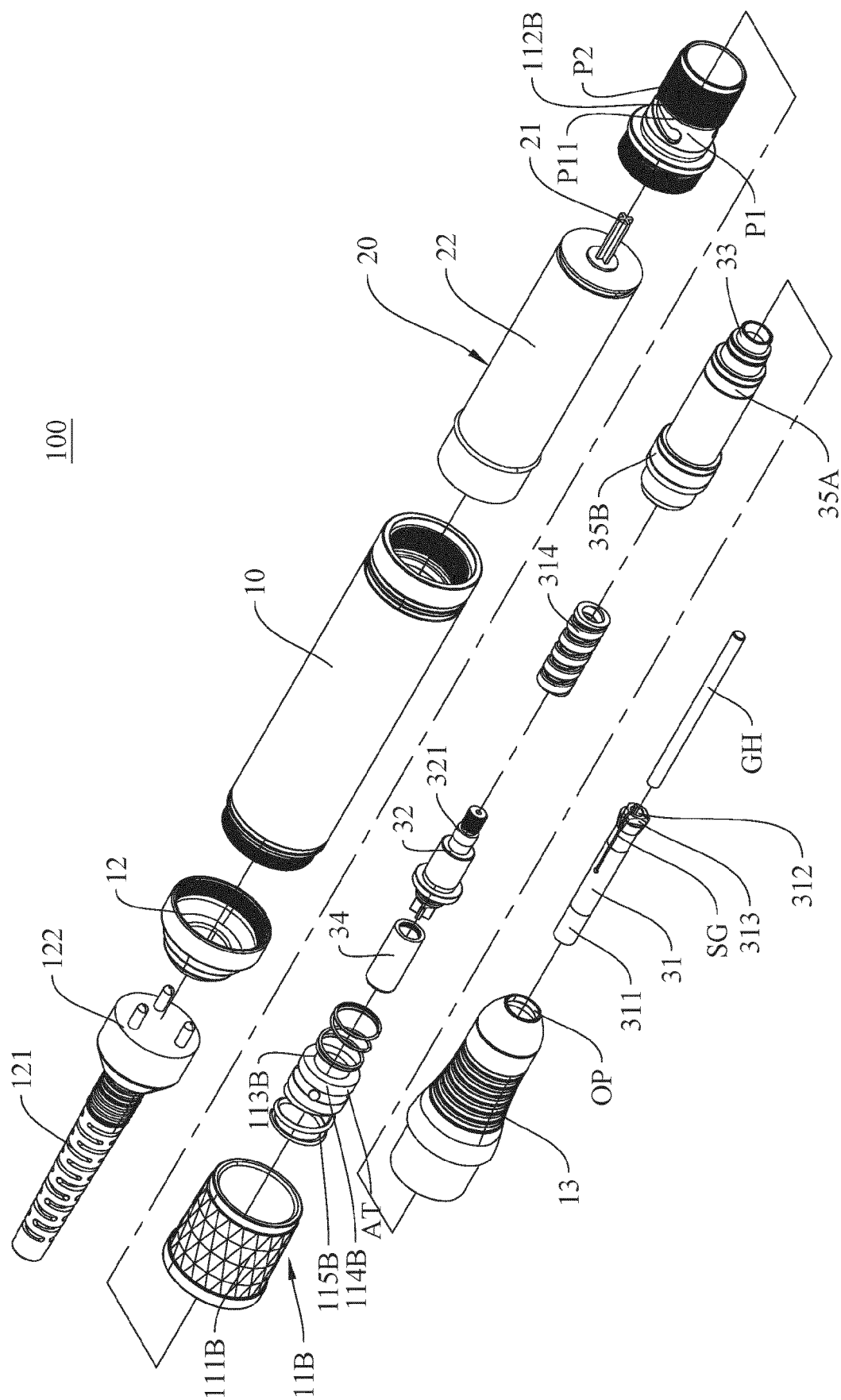
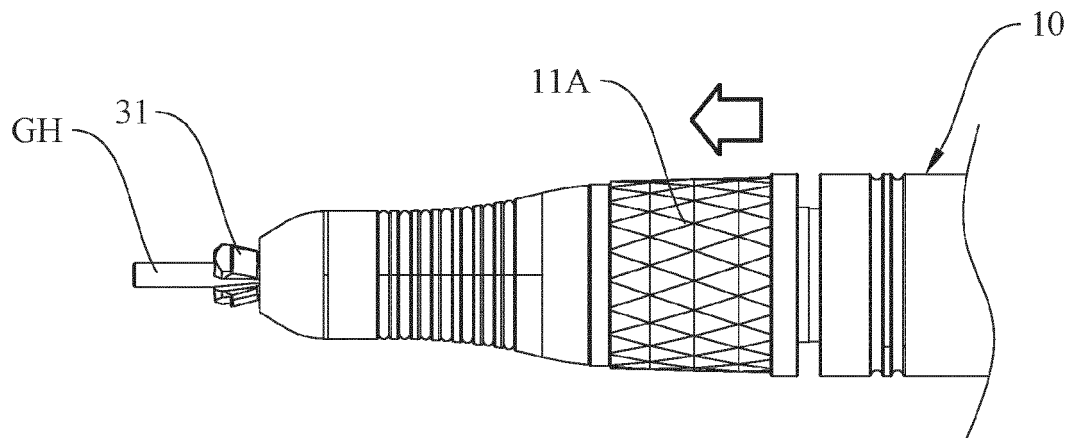


Fig.3

(a)



(b)

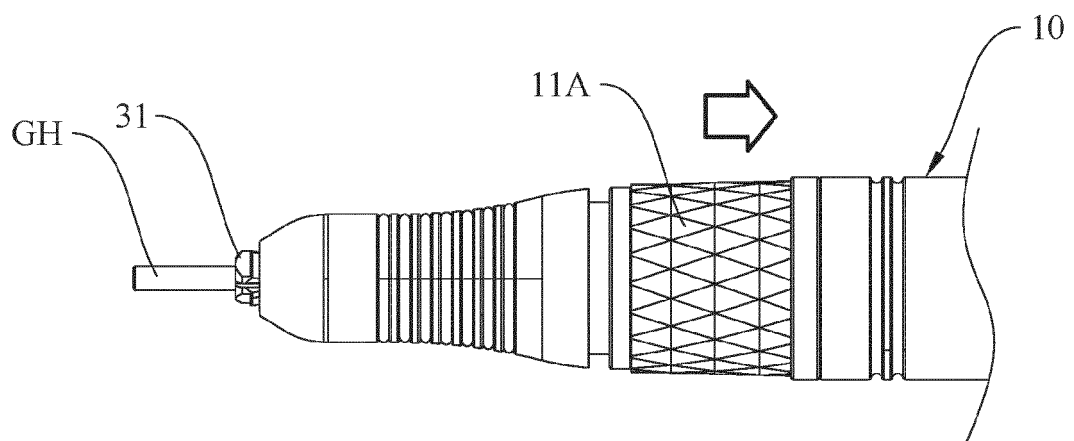
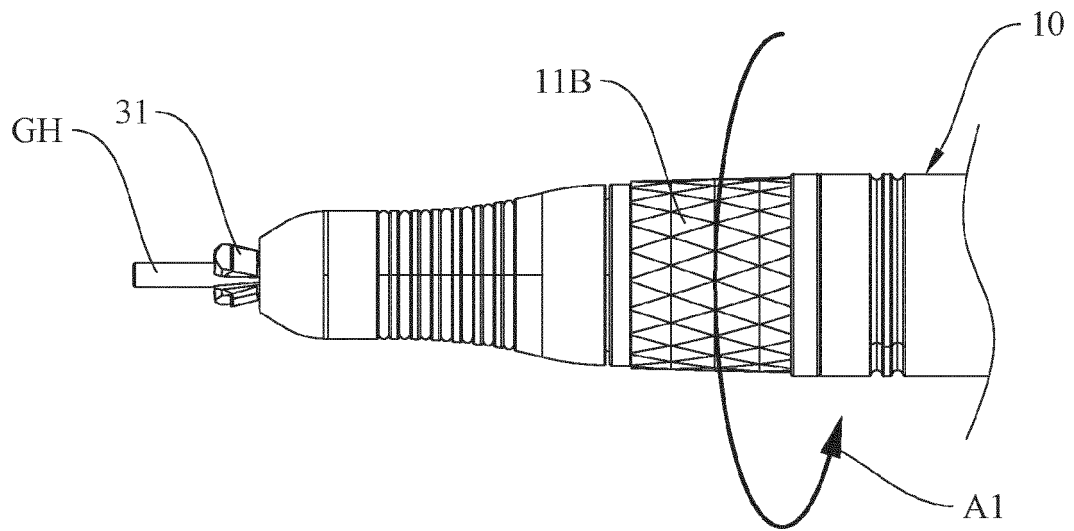


Fig.4

(a)



(b)

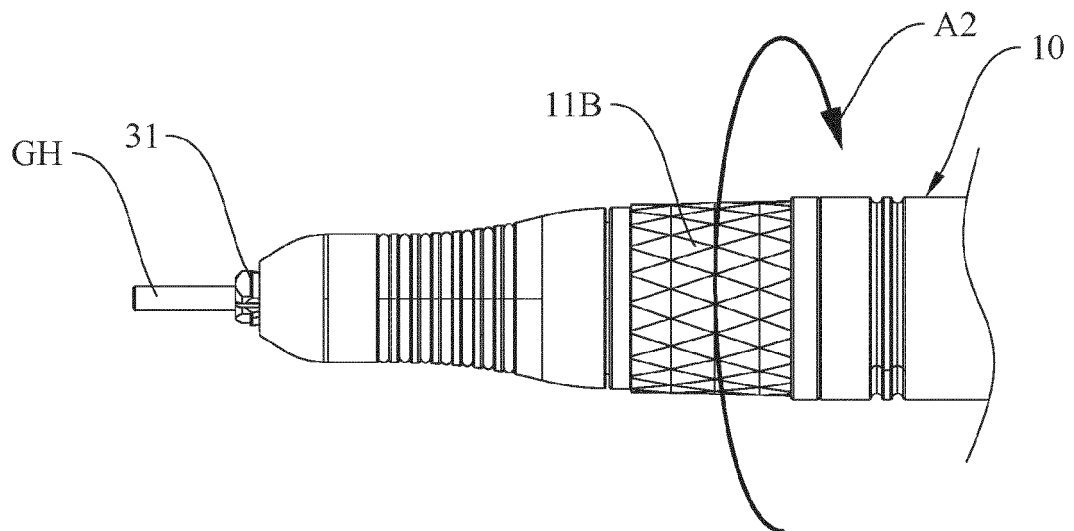


Fig.5

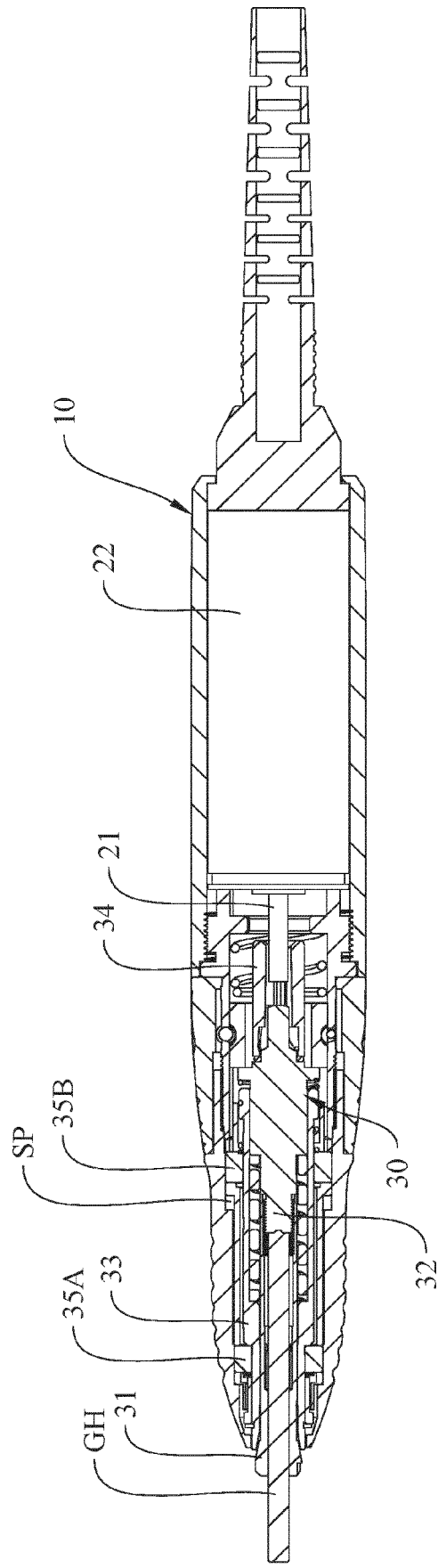


Fig.6

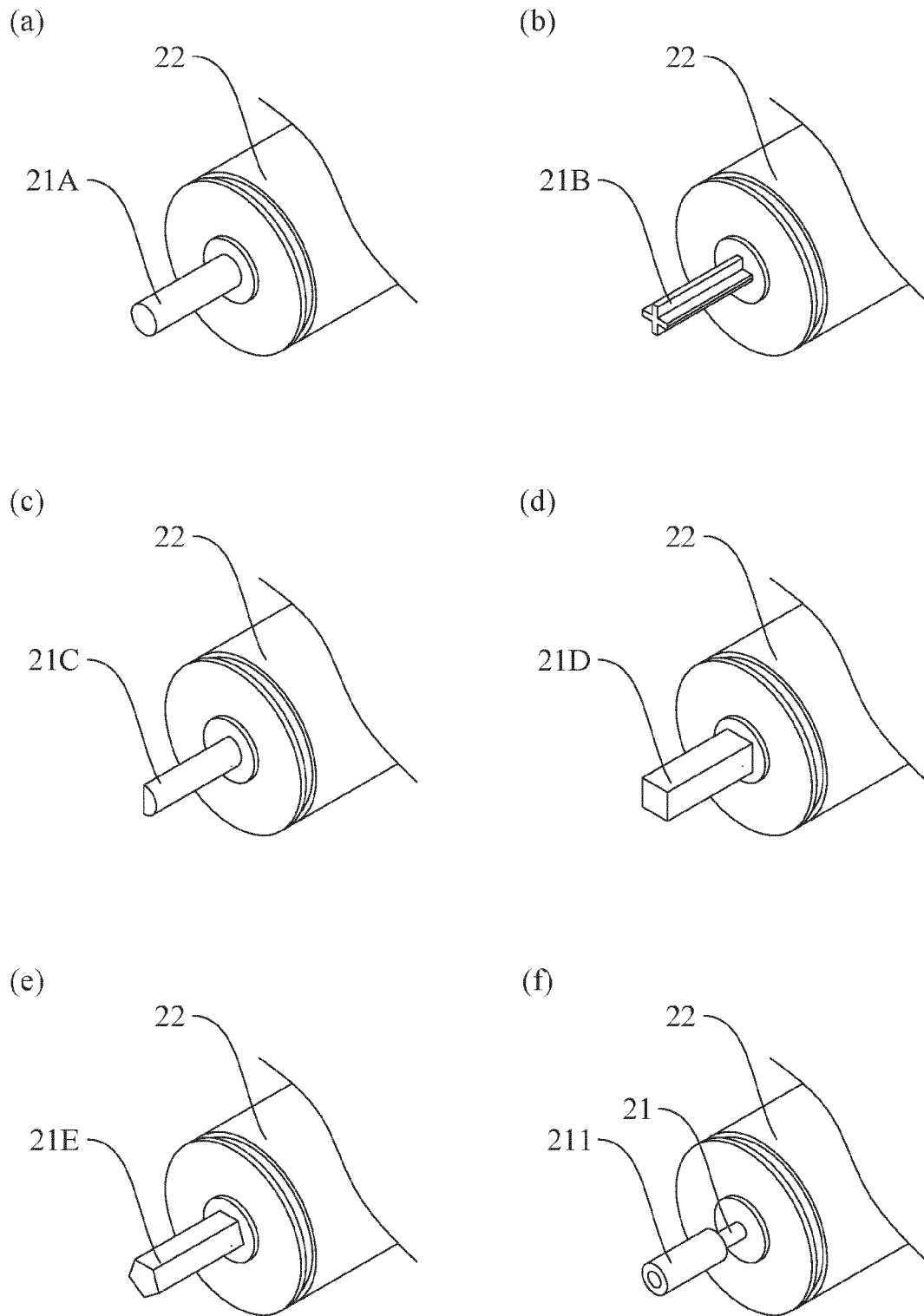


Fig.7

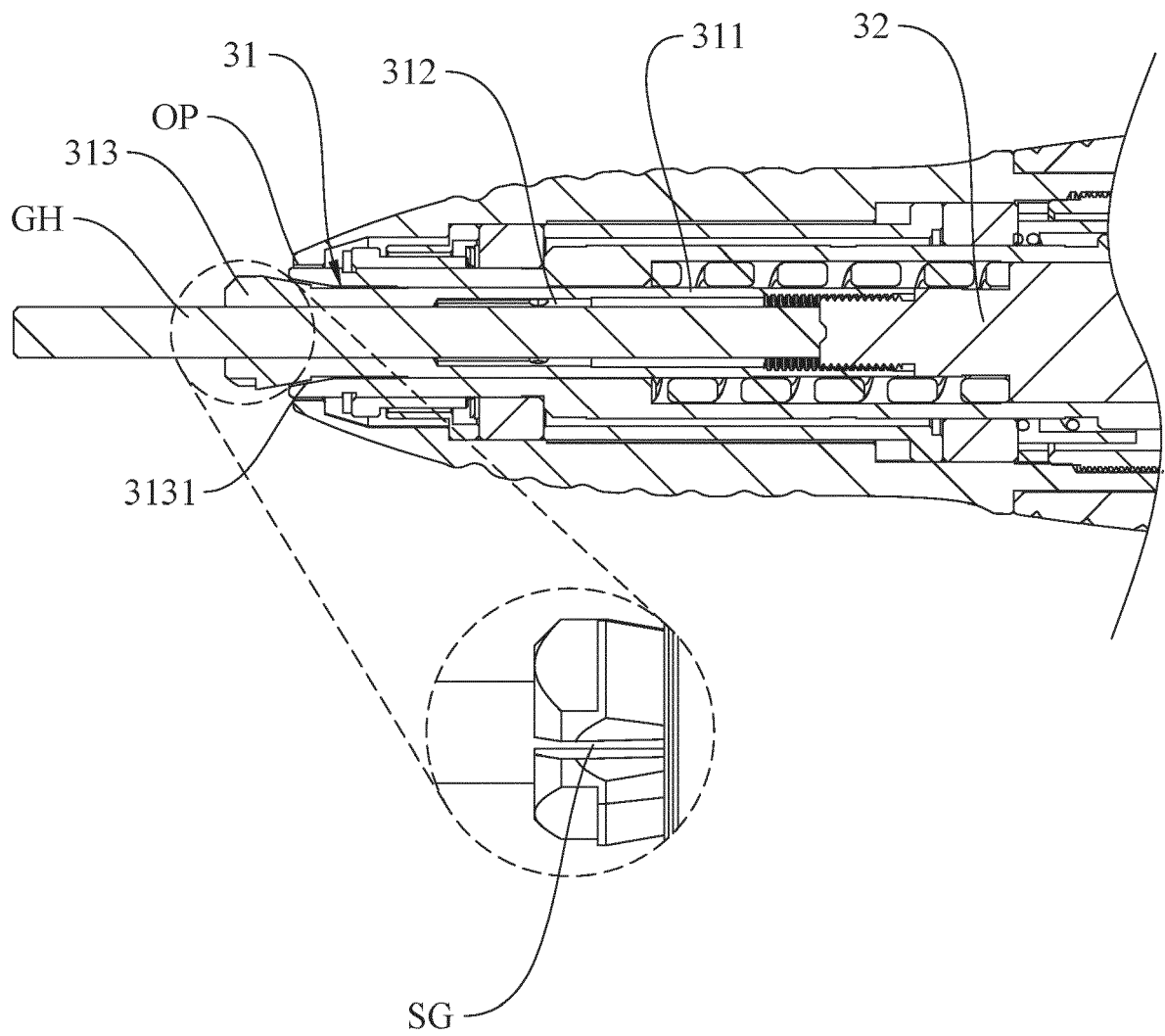


Fig.8

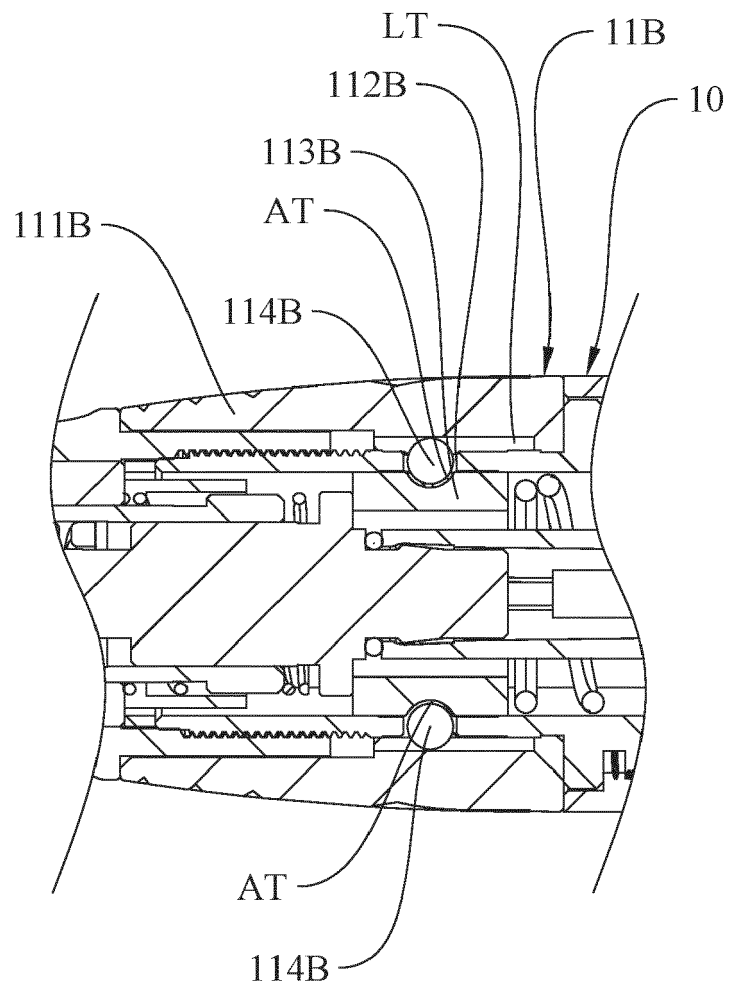


Fig.9

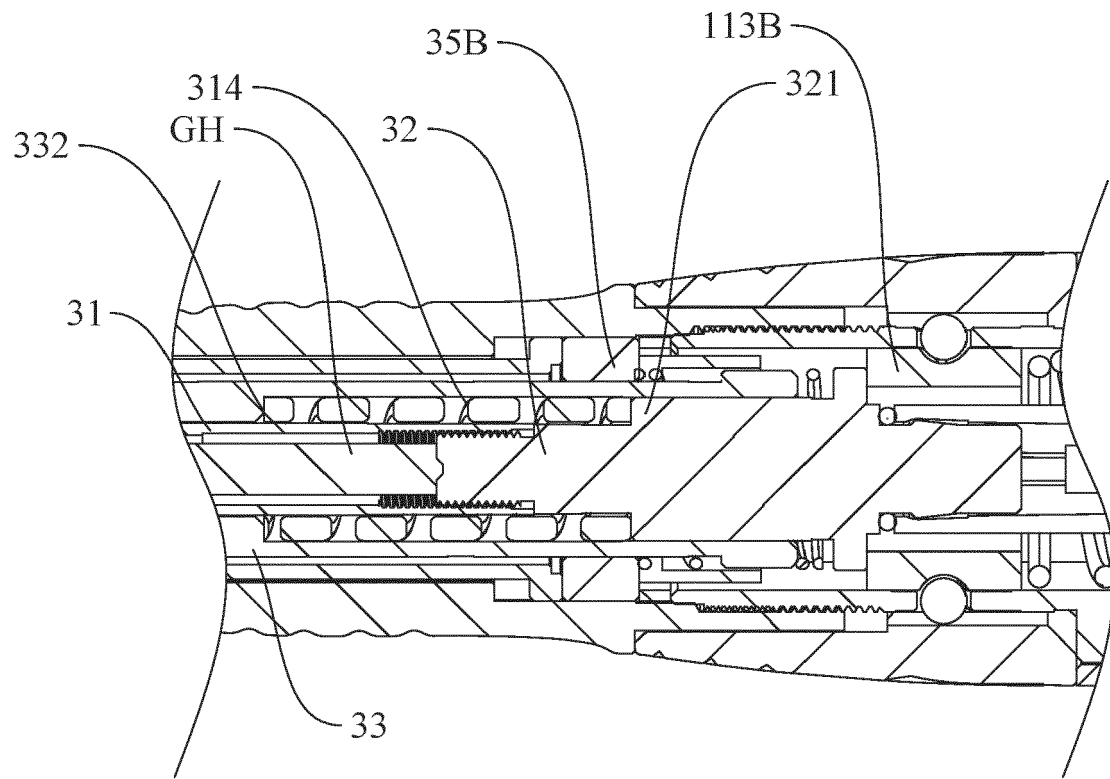


Fig.10

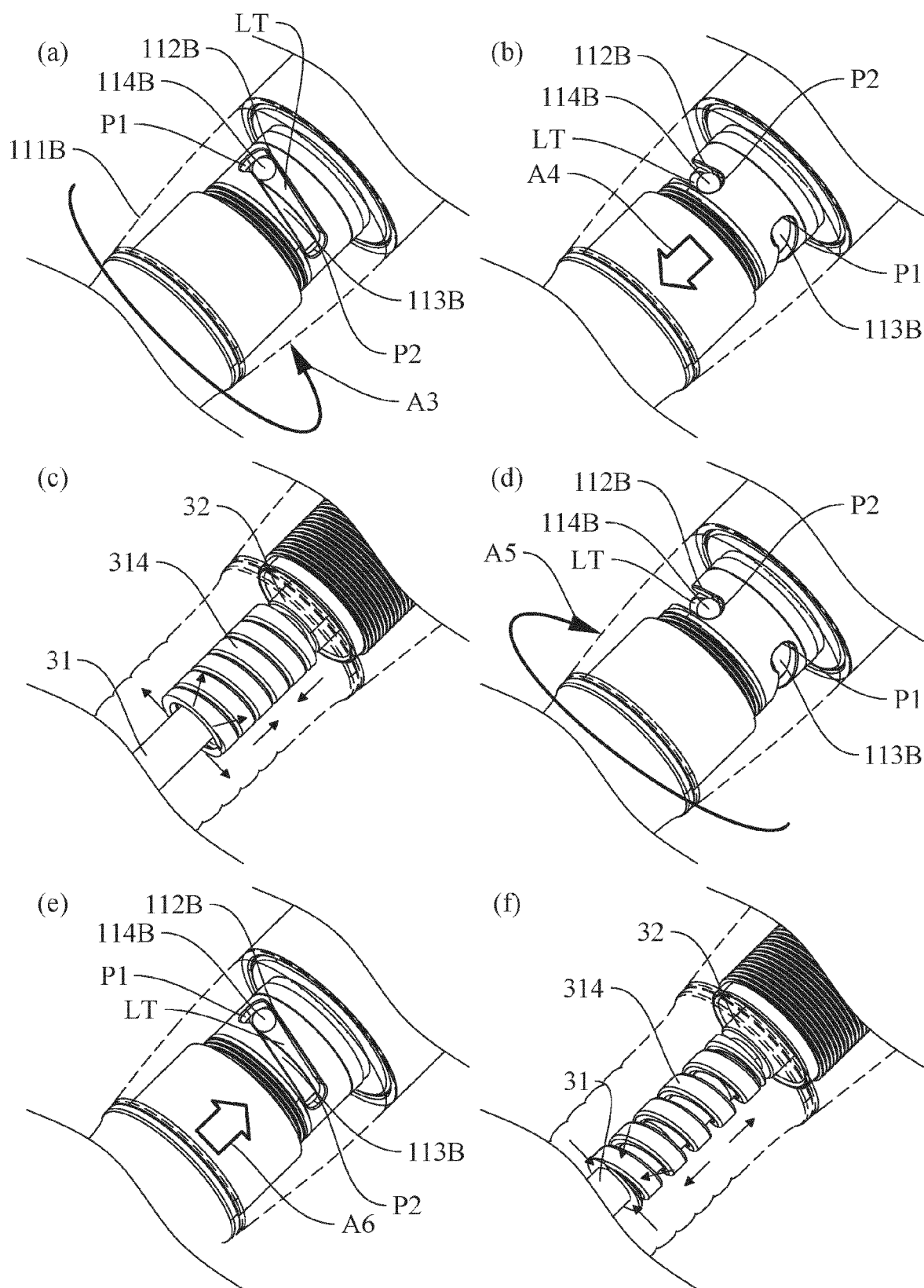
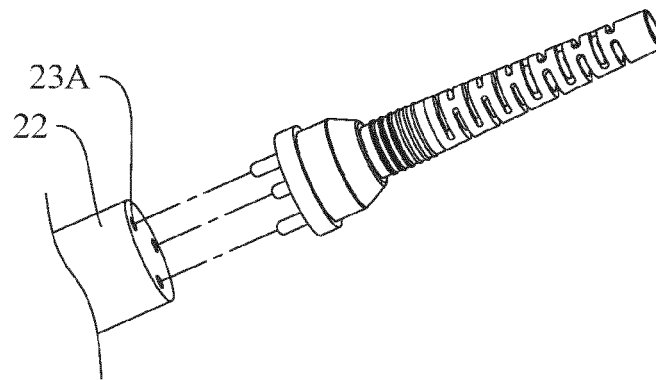
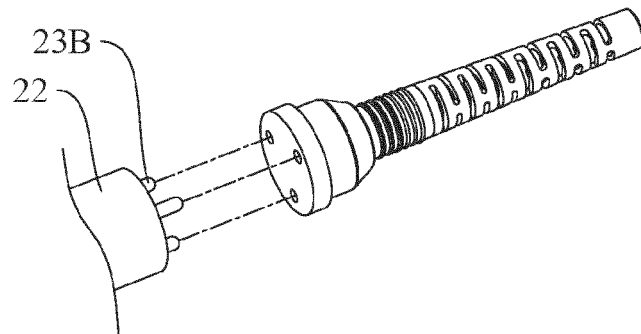


Fig.11

(a)



(b)



(c)

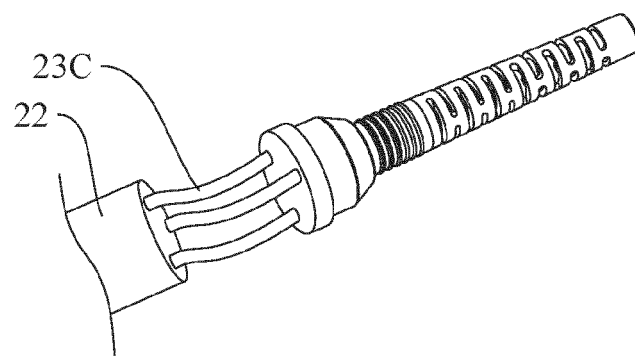
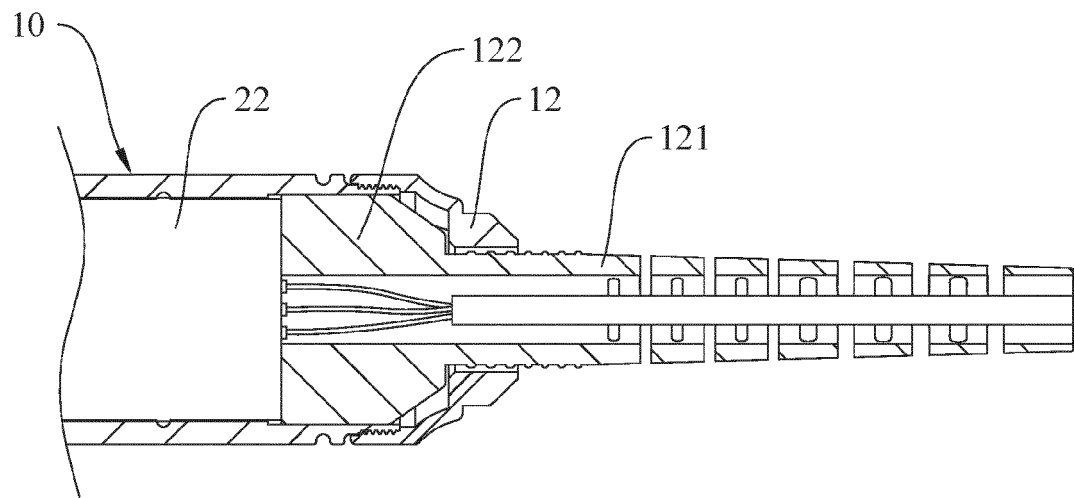


Fig.12

(a)



(b)

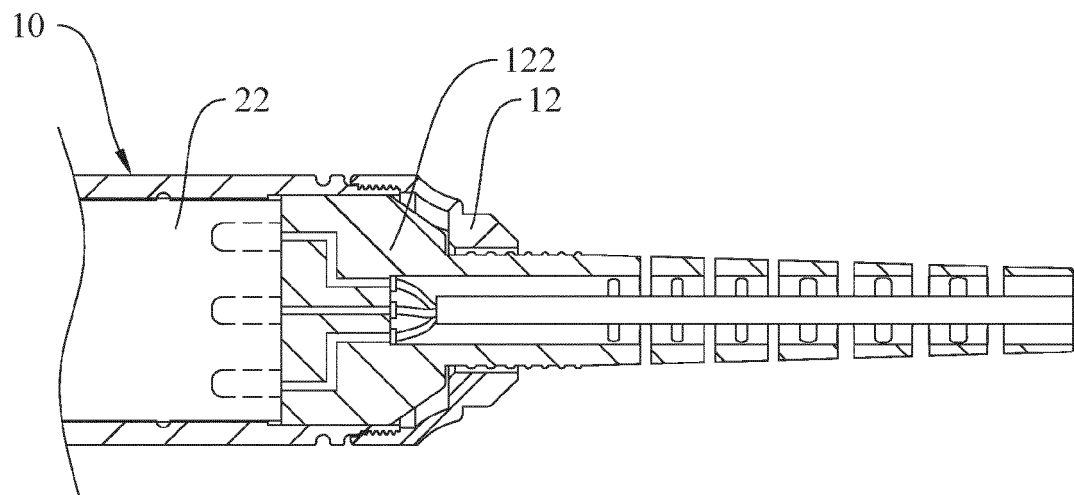


Fig.13

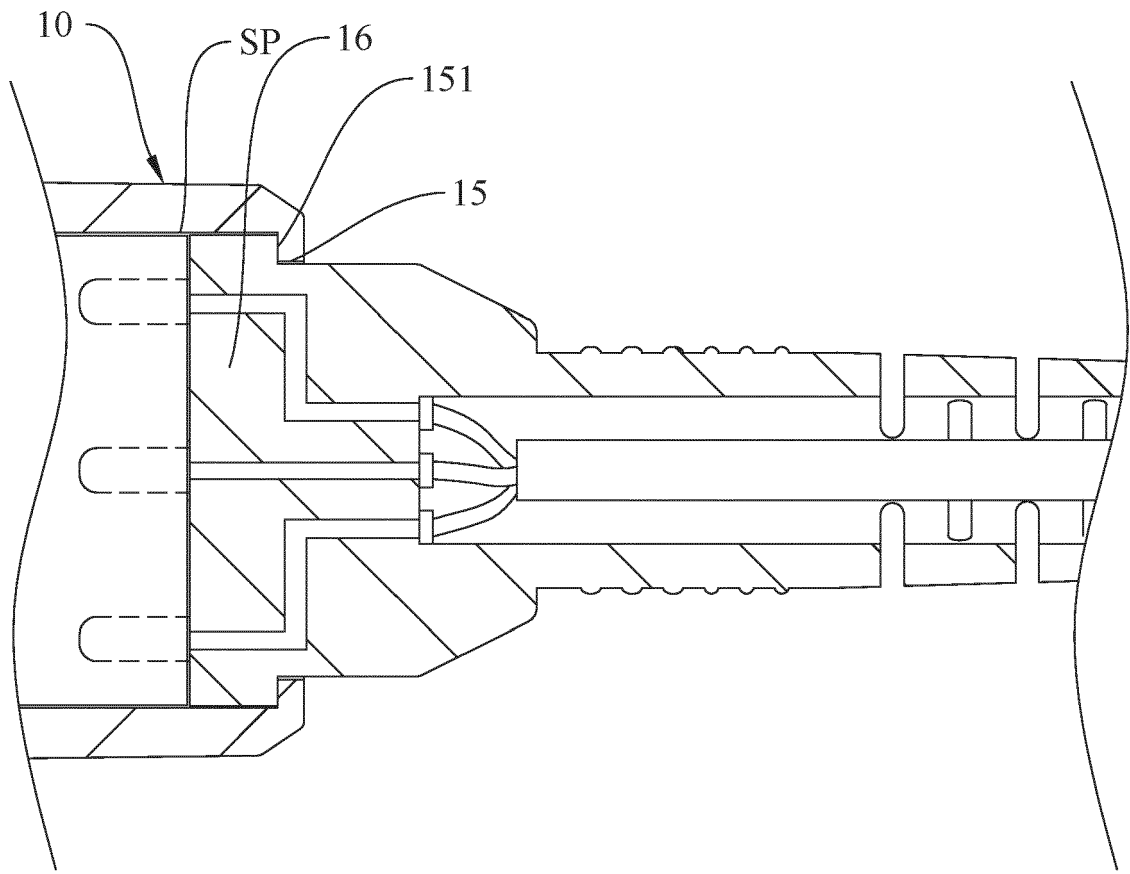


Fig.14

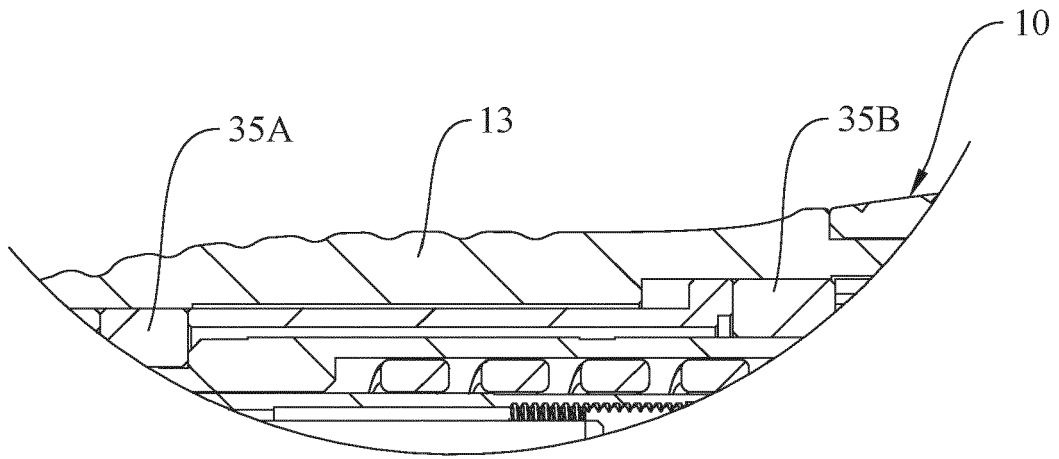


Fig.15

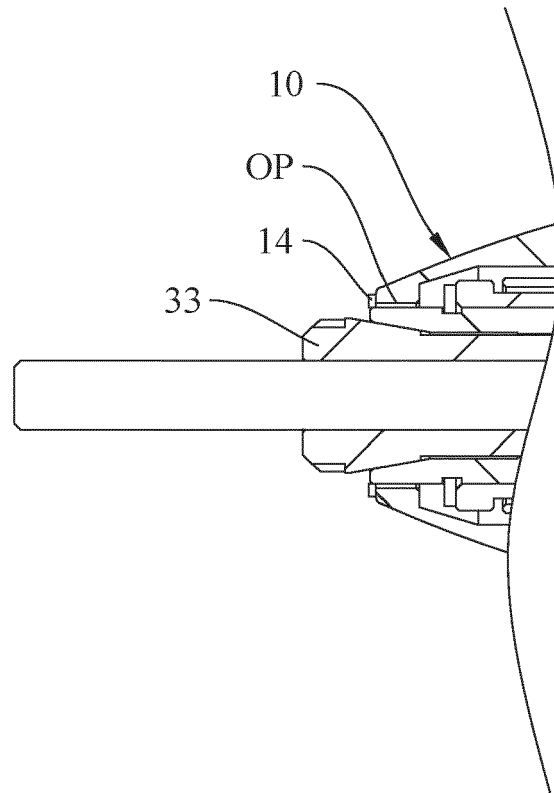
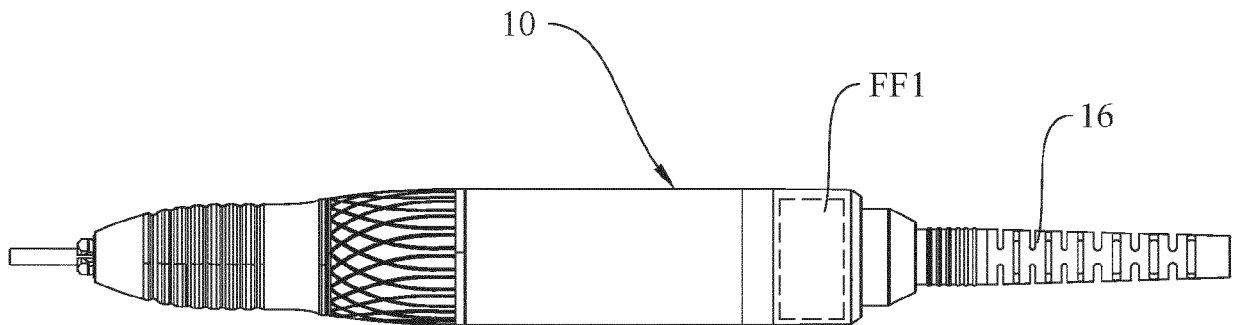


Fig.16

(a)



(b)

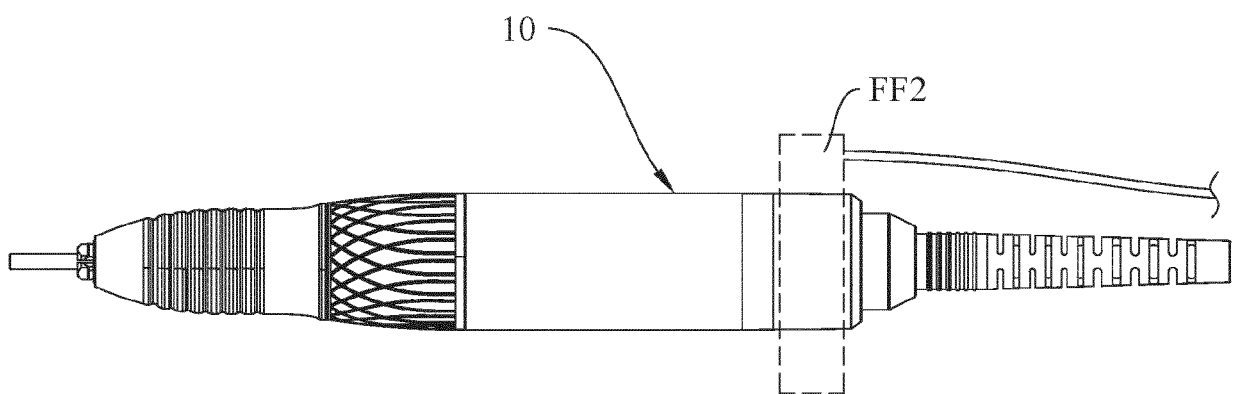


Fig.17

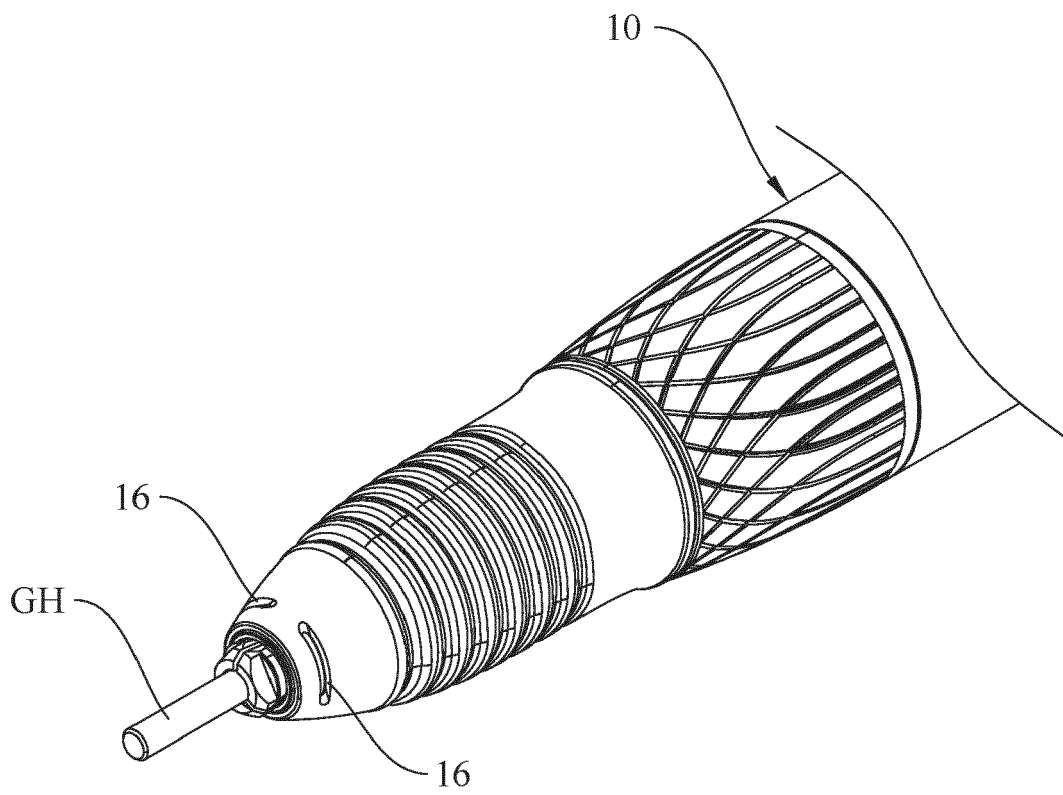
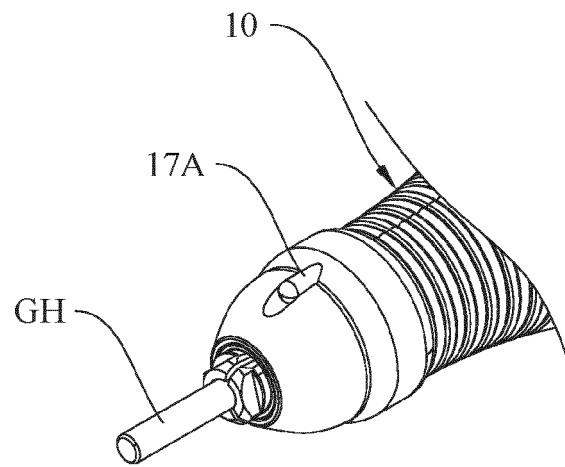


Fig.18

(a)



(b)

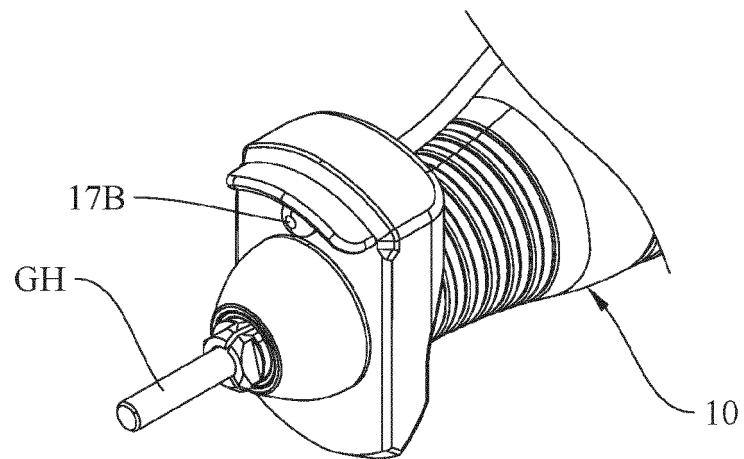


Fig.19

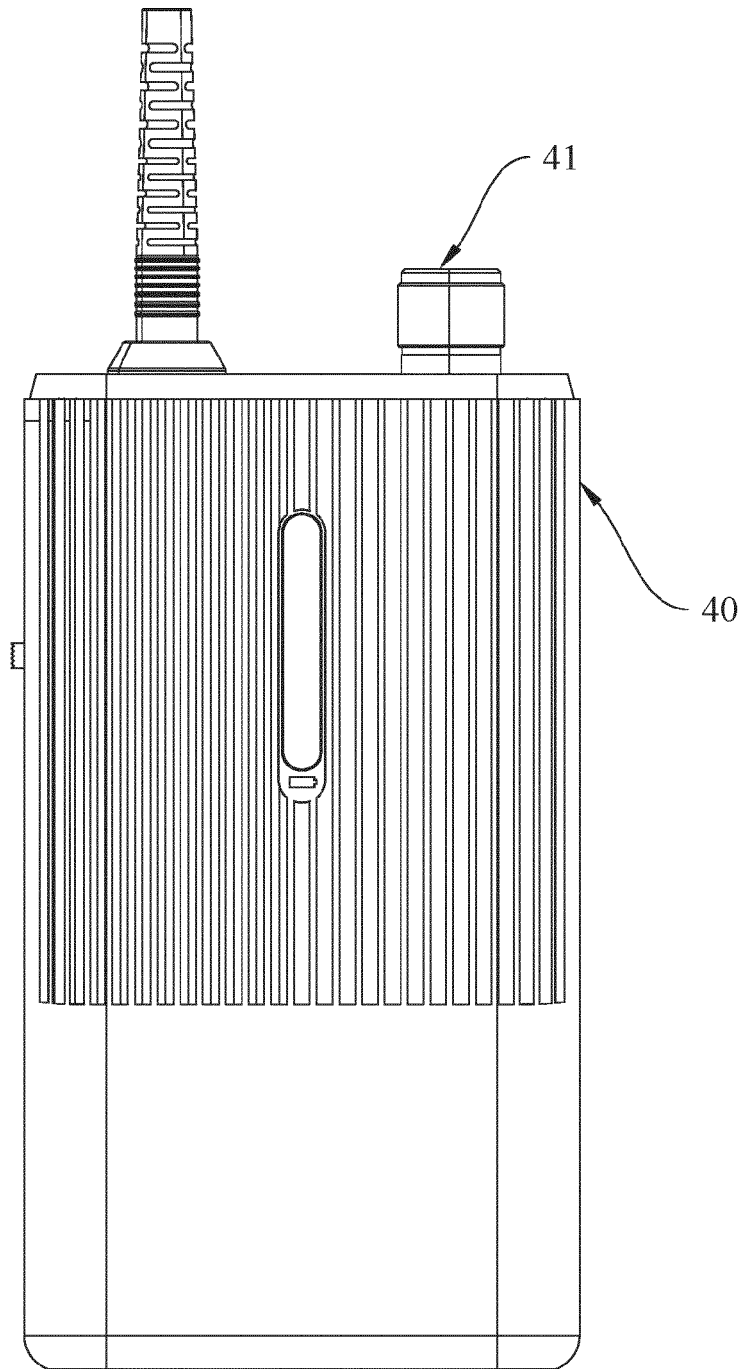


Fig.20

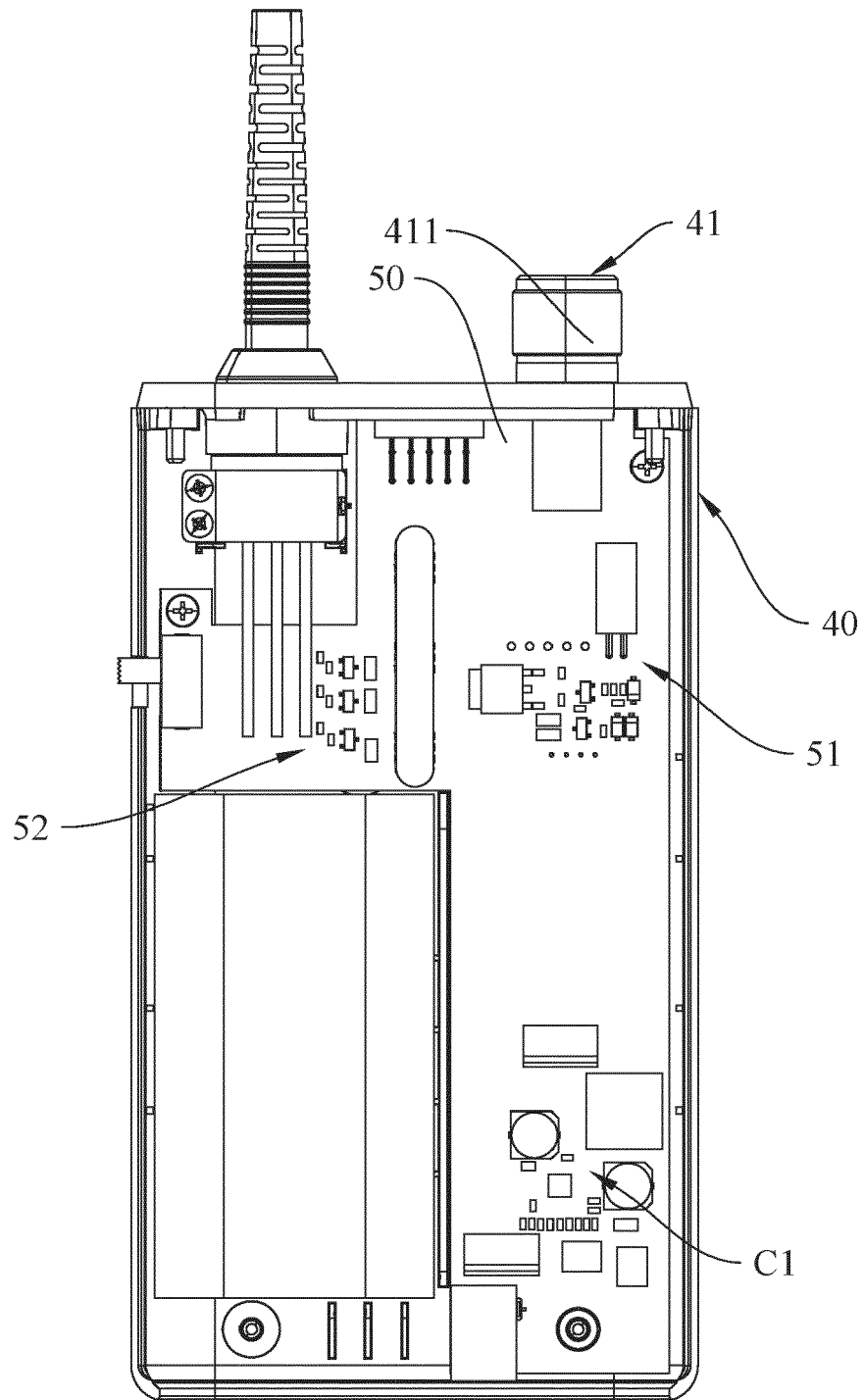


Fig.21

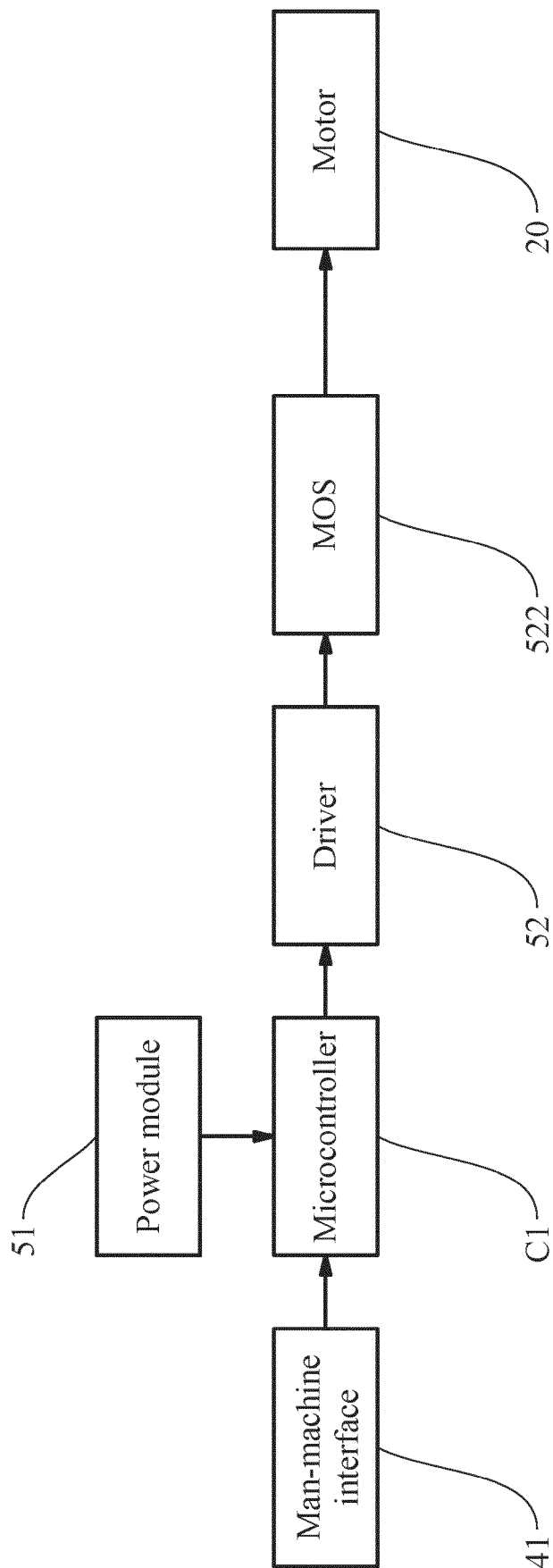


Fig.22

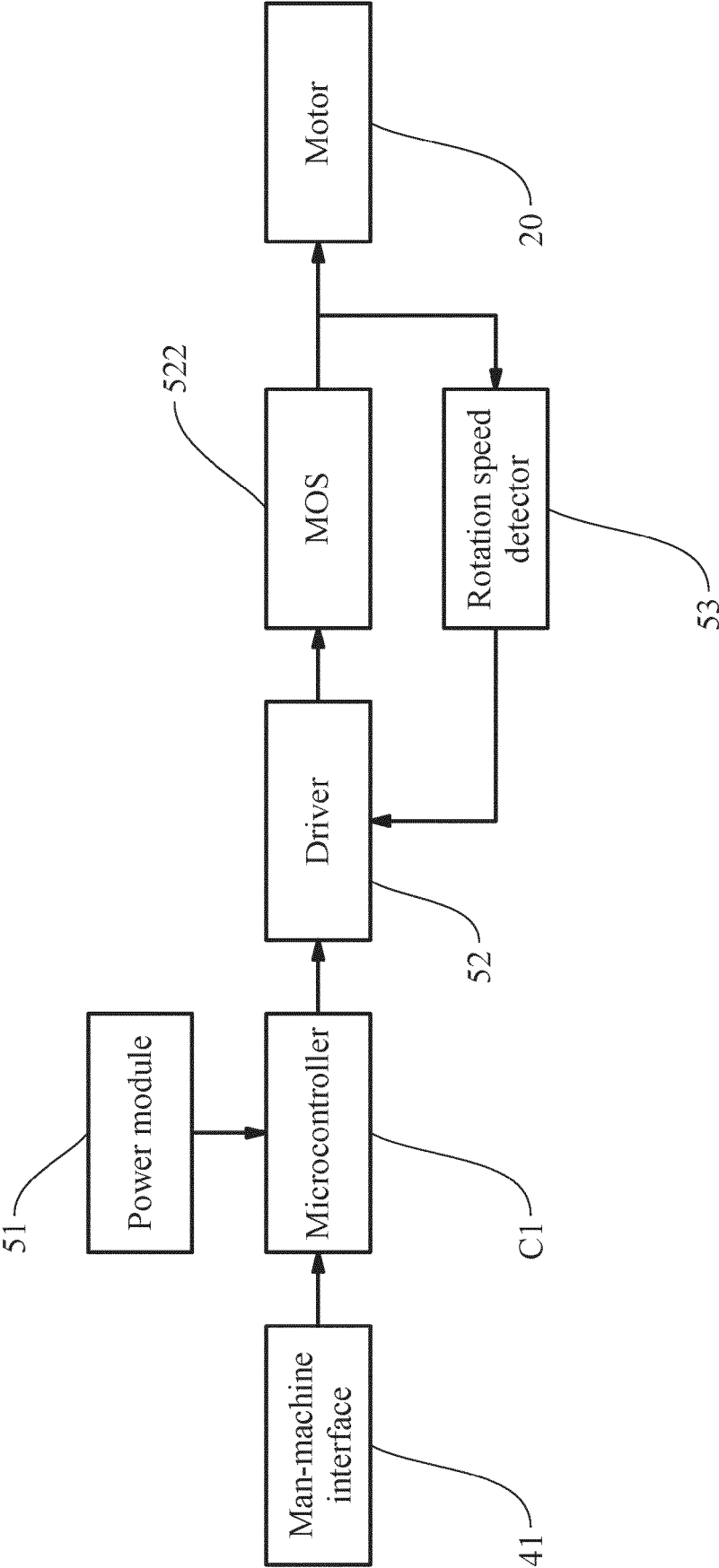


Fig.23A

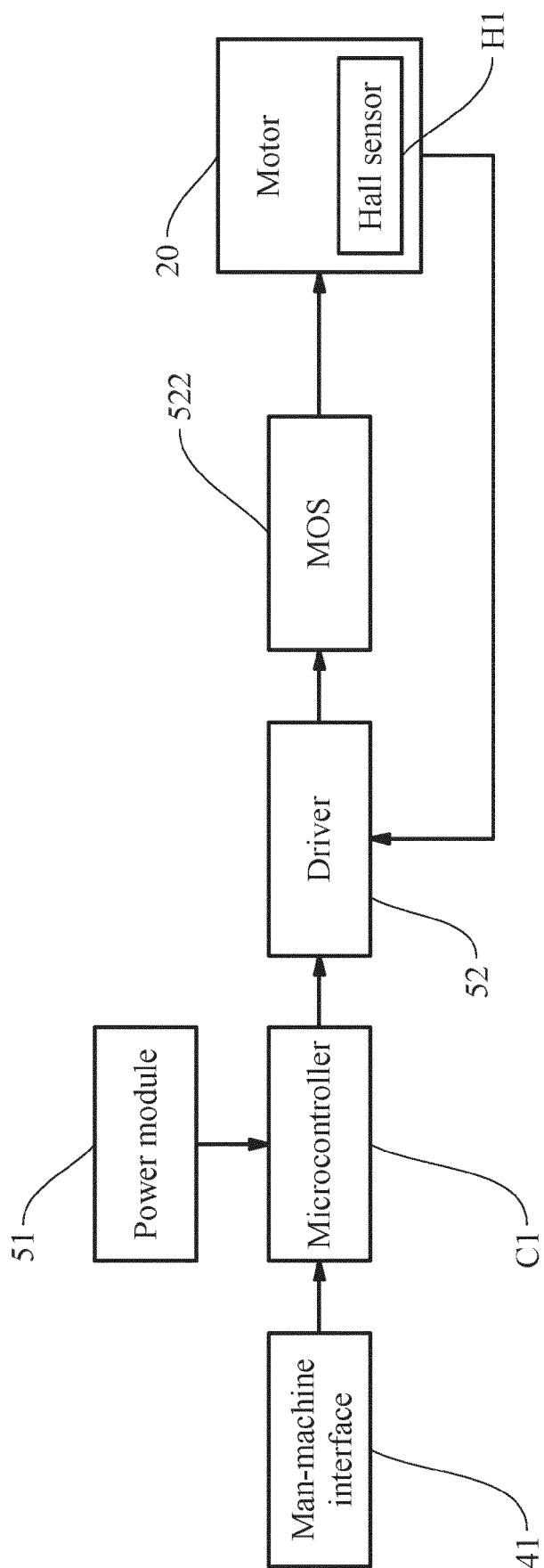


Fig.23B

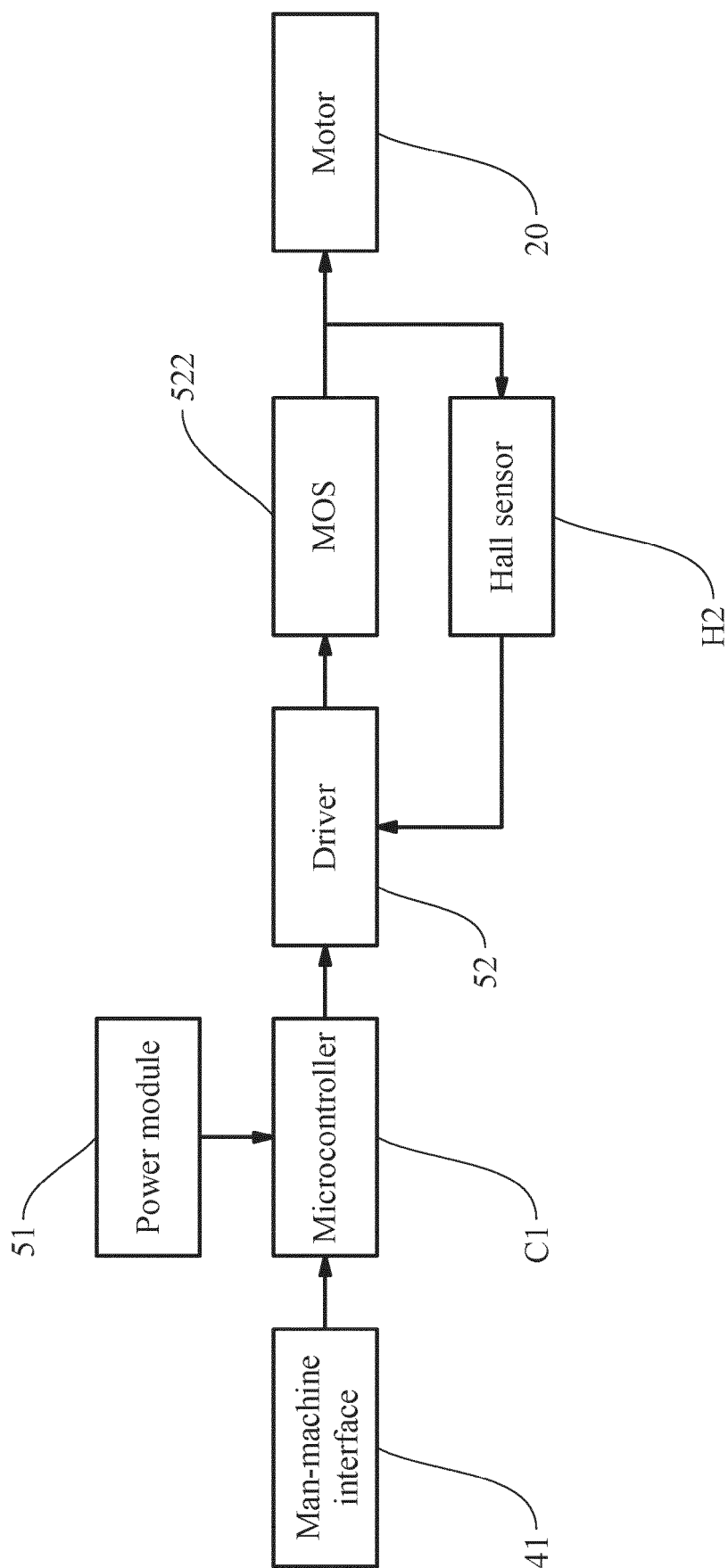


Fig.23C

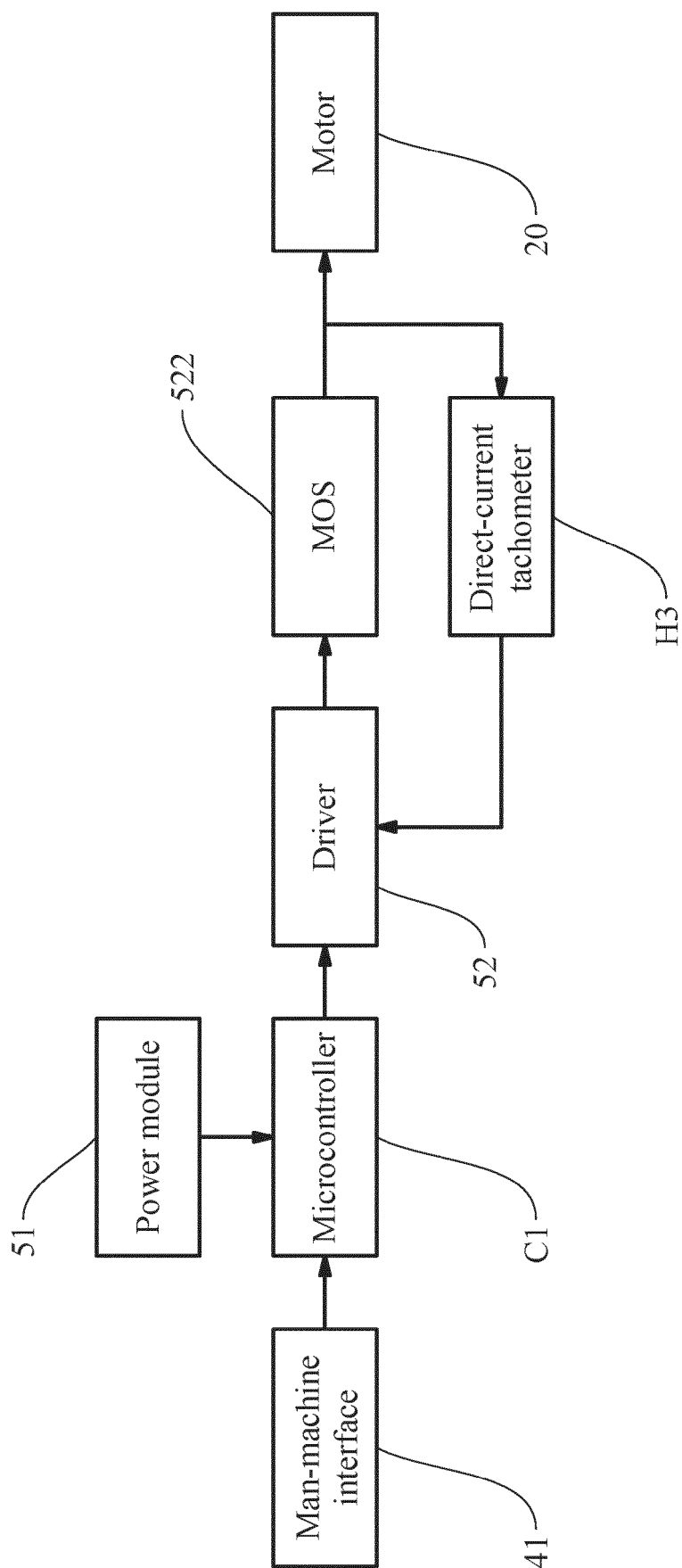


Fig.23D

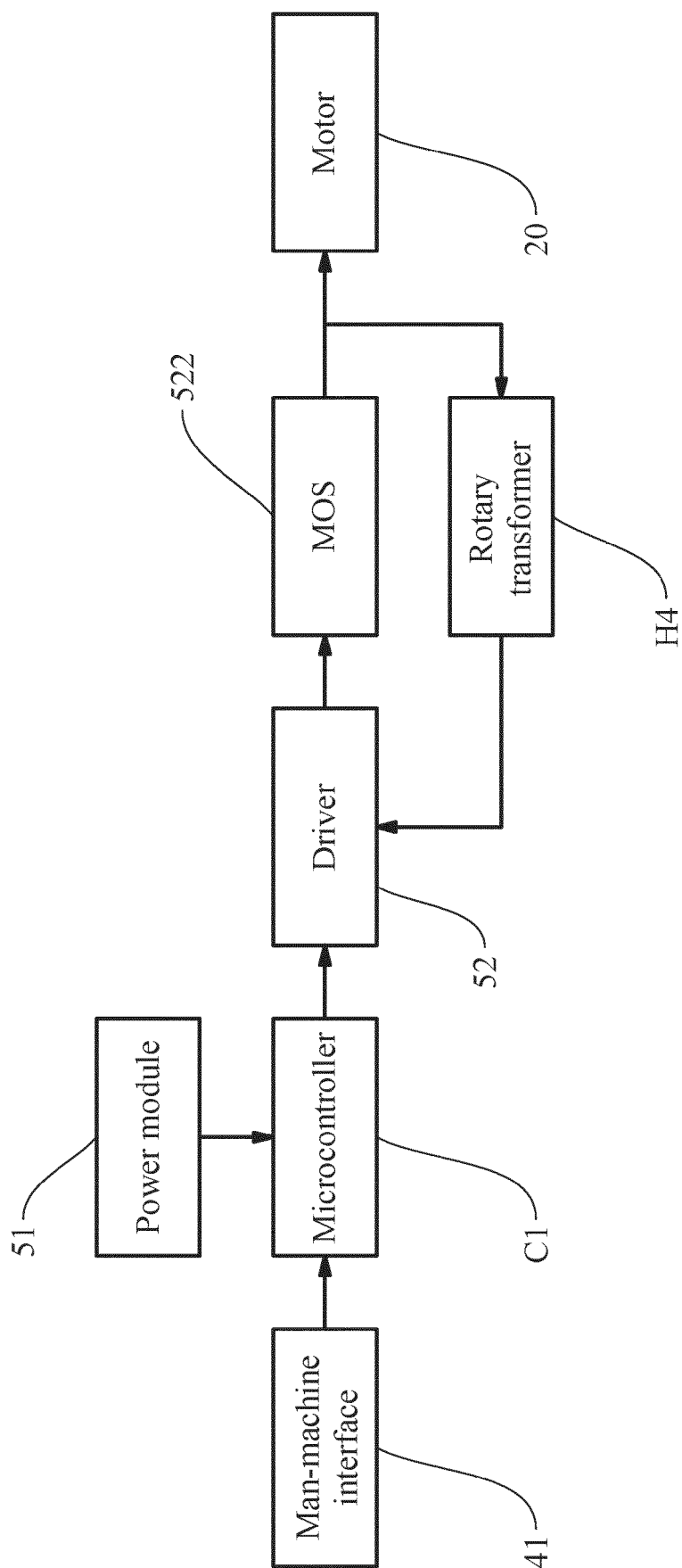


Fig.23E

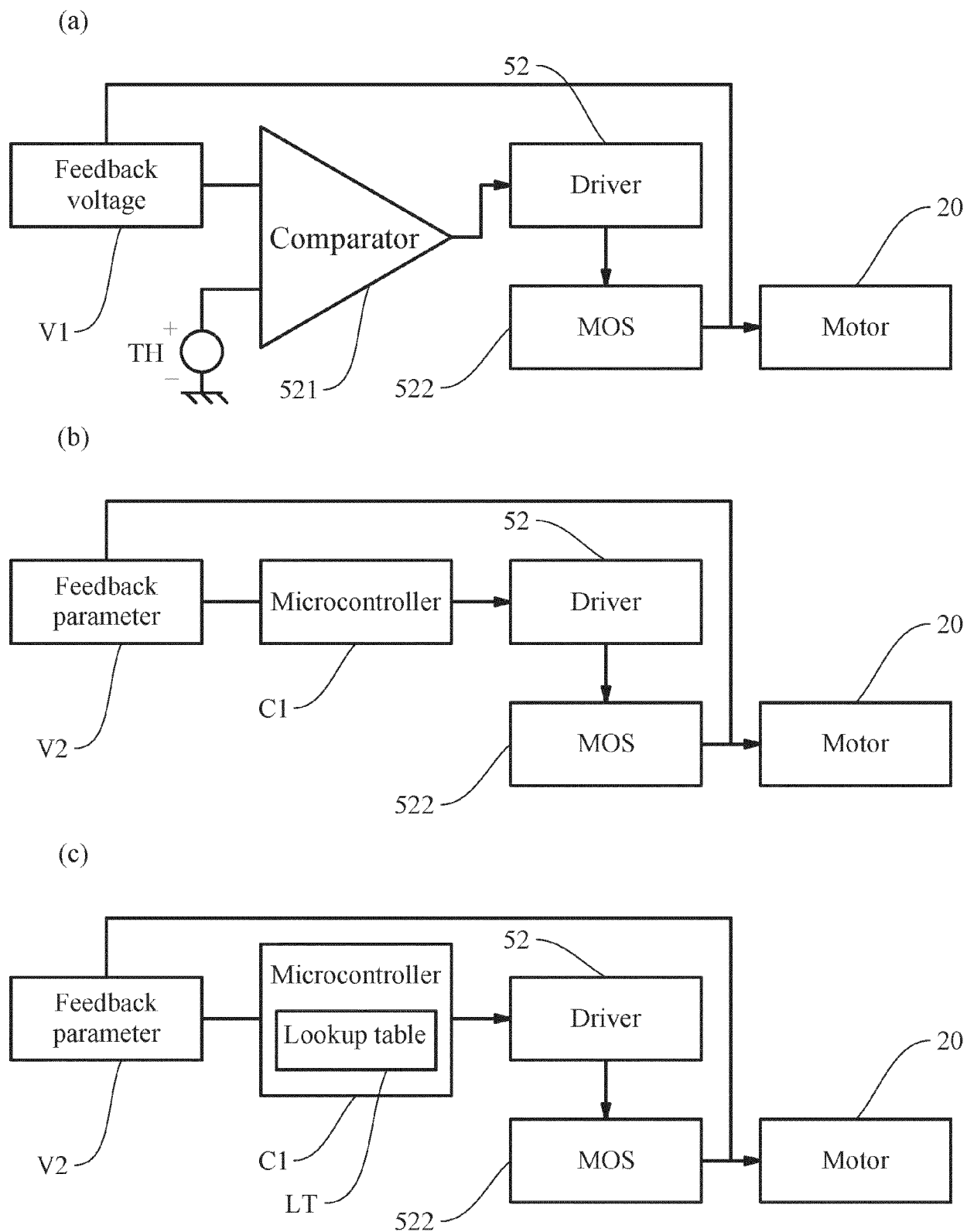


Fig.24

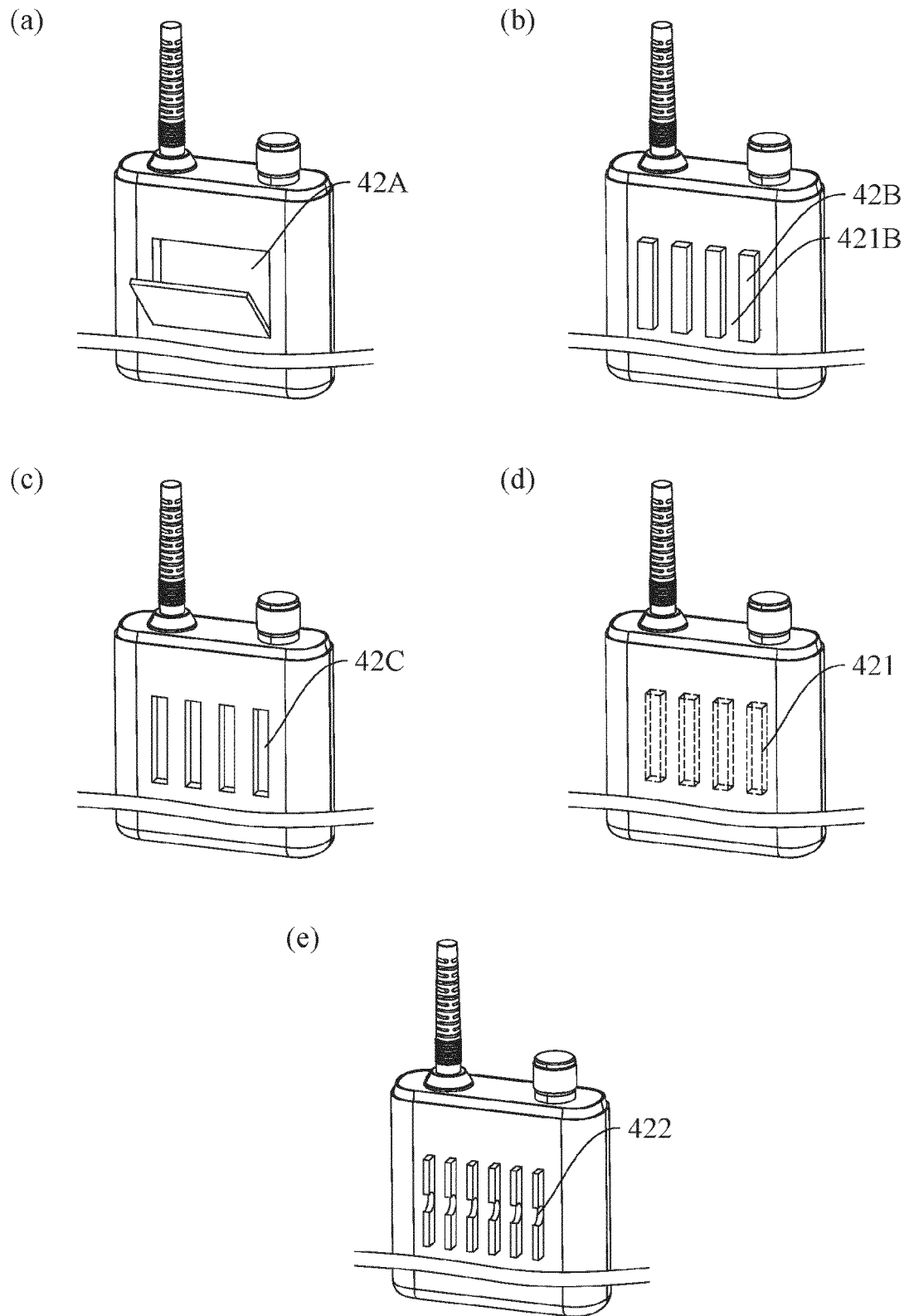


Fig.25

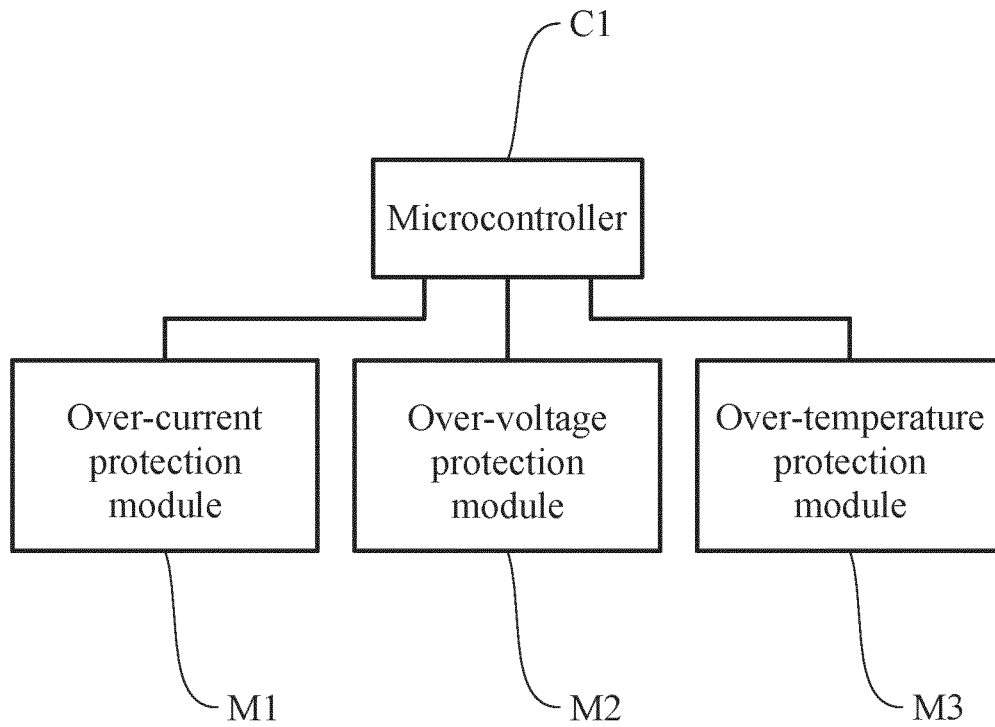


Fig.26

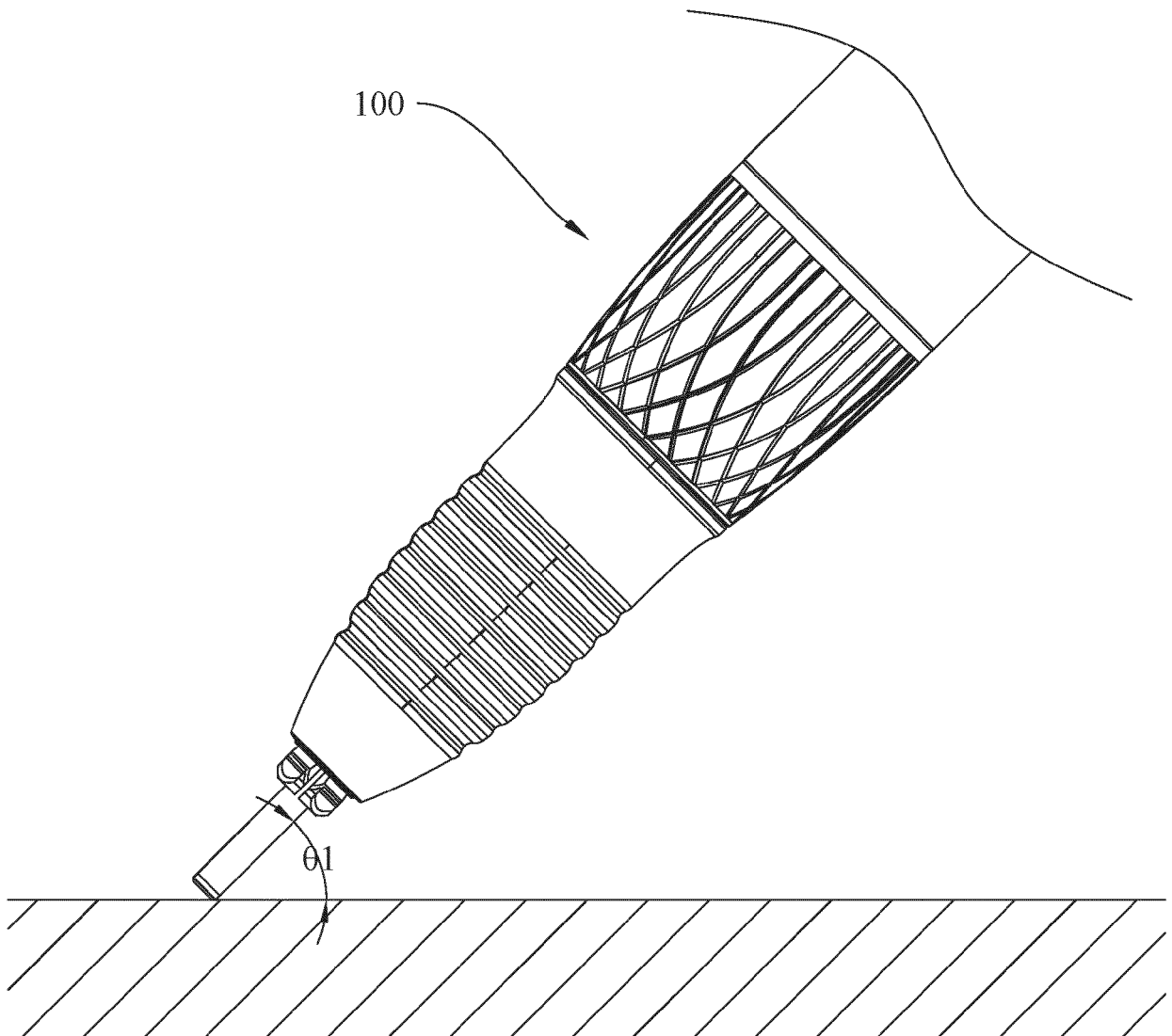


Fig.27

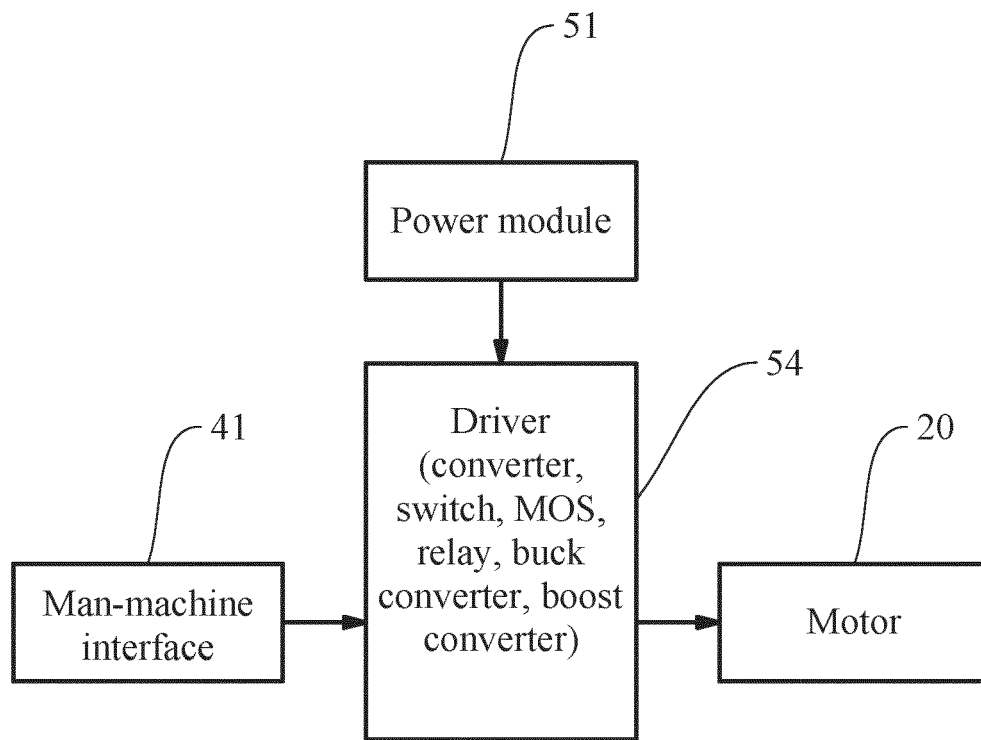


Fig.28



EUROPEAN SEARCH REPORT

Application Number

EP 23 18 2182

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2021/100332 A1 (HSIEH WAN-CHIEH [TW] ET AL) 8 April 2021 (2021-04-08)	1, 2, 9-15	INV.
A	* paragraphs [0060] - [0083]; figures 1-9 *	3-8	A45D29/00 A45D29/05 A45D29/17

X	US 2015/150353 A1 (YIU WAI WAH [HK]) 4 June 2015 (2015-06-04)	1	
	* paragraphs [0050] - [0052], [0058], [0031]; figures 1, 3, 9, 10 *		

The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			A45D
Place of search		Date of completion of the search	Examiner
The Hague		20 November 2023	Fidalgo Marron, B
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			

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

EP 23 18 2182

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.

20-11-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2021100332 A1	08-04-2021	TW M589483 U	21-01-2020
		US 2021100332 A1	08-04-2021

US 2015150353 A1	04-06-2015	CN 104665209 A	03-06-2015
		CN 204169260 U	25-02-2015
		DE 202014007228 U1	13-04-2015
		EP 3021708 A1	25-05-2016
		HK 1210921 A1	13-05-2016
		US 2015150352 A1	04-06-2015
		US 2015150353 A1	04-06-2015
		WO 2015082995 A1	11-06-2015
