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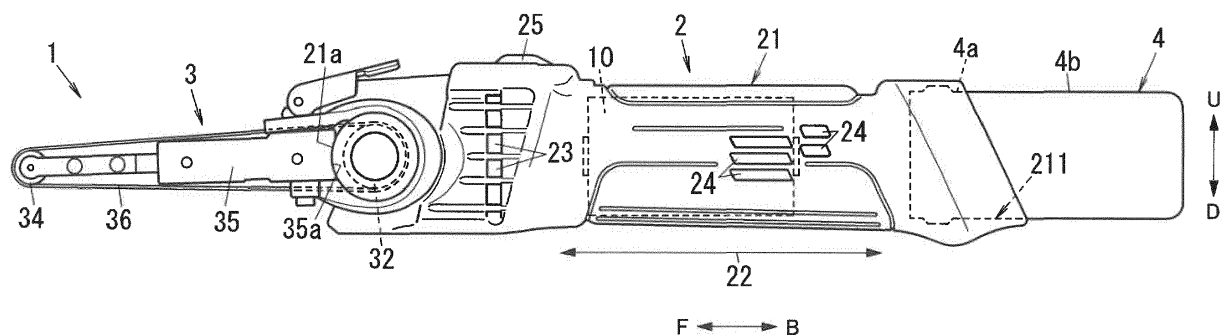
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(54) **ELECTRIC TOOL**

(57) Electric tool that enables user to easily suppress vibration of motor with hand and that is usable even in narrow spaces and outdoors. Electric tool (1) of the present disclosure includes sanding mechanism (3), motor (10), battery pack (4) and housing (21). Motor (10) is configured to drive sanding mechanism (3). Battery pack (4) is configured to supply motor (10) with electric power. Sanding mechanism (3), motor (10) and battery pack (4)

are fixed to housing (21). Motor (10) possesses rotary shaft (101) configured to transmit rotary drive power to sanding mechanism (3). Housing (21) possesses handle (22) that allows user to hold. Sanding mechanism (3), motor (10), battery pack (4) and handle (22) are arranged in one direction. Rotary shaft (101) of motor (10) is elongated in the one direction.

FIG. 1A



Description

Technical Field

[0001] The present disclosure relates generally to electric tools and, more particularly, to an electric tool equipped with an electric motor.

Background Art

[0002] Document 1 (JP 2002-233942 A) discloses a belt sander as an example of an electric tool equipped with an electric motor. The belt sander described in Document 1 is equipped with a handle, an electric motor, a driving roller, an arm, a driven roller and a sanding belt. The handle allows a user to hold. The electric motor is provided at a front end part of the handle. The electric motor has a motor shaft perpendicular to a lengthwise direction of the handle. The driving roller is fixed to the motor shaft of the electric motor. The handle is provided with the arm protruding forward from the driving roller. The driven roller is provided at a front end part of the arm so that it is allowed to rotate with the driven roller being apart from the driving roller. The sanding belt is looped around the driving roller and the driven roller.

[0003] With the belt sander, the electric motor rotates the driving roller, thereby causing the sanding belt to circulate around the driving roller and the driven roller. The sanding belt circulating in this way is made contact with a target object, thereby sanding the target object.

[0004] In the belt sander, the motor shaft of the electric motor is elongated in a direction perpendicular to the lengthwise direction of the handle. The electric motor generates vibration mainly along radial directions perpendicular to the motor shaft. Therefore, when the belt sander is activated, the vibration of the electric motor causes the handle to vibrate mainly along the lengthwise direction of the handle. That is, the handle causes user's hand holding the handle to vibrate in a direction parallel with the palm thereof. It is consequently difficult to suppress such vibration of the handle with hand holding the handle.

[0005] Moreover, with the belt sander, since the motor shaft of the electric motor is perpendicular to the lengthwise direction of the handle, the electric motor protrudes in a widthwise (or transverse) direction of the handle. This makes it difficult to use the belt sander in a narrow space such as the inside of pipes in plumbing (e.g., electricity conduits or water pipes) because the electric motor becomes an obstacle.

[0006] Furthermore, the belt sander may be used outdoor such a site where the system of pipes such as electricity conduits and/or water pipes is installed. In this case, the belt sander is preferably provided with, as a power supply thereof, not an AC power supply but a battery.

Summary of Invention

[0007] The present disclosure has been achieved in view of the above circumstances, and an object thereof is to provide an electric tool that enables a user to easily suppress vibration of a motor with user's hand and that is usable even in narrow spaces and outdoors.

[0008] An electric tool according to an aspect of the present disclosure includes a sanding mechanism, a motor, a battery pack and a housing. The sanding mechanism is configured to sand a target object. The motor is configured to drive the sanding mechanism. The battery pack is configured to supply the motor with electric power. The sanding mechanism, the motor and the battery pack are fixed to the housing. The motor includes a rotary shaft configured to transmit rotary drive power to the sanding mechanism. The housing includes a handle that allows a user to hold. The sanding mechanism, the motor, the battery pack and the handle are arranged in one direction. The rotary shaft of the motor is elongated in the one direction.

[0009] The electric tool according to the present disclosure enables a user to easily suppress vibration of an electric motor with user's hand, and is usable even in narrow spaces and outdoors.

Brief Description of Drawings

[0010]

FIG. 1A is a side view of an electric tool according to an embodiment of the present disclosure;
FIG. 1B is a plan view of the electric tool as seen from above;
FIG. 2A is a sectional view of the electric tool with a battery pack attached to an electric tool body thereof; and
FIG. 2B is a sectional view of the electric tool with the battery pack removed from the electric tool body.

Description of Embodiments

[0011] An embodiment of the present disclosure will hereinafter be explained. The embodiment below is merely an example of various embodiments of the present disclosure. Various modifications in the embodiment below are possible in light of general arrangement and the like as long as an object of the present disclosure is achieved. For convenience of explanation, forward (F), backward (B), leftward (L), rightward (R), upward (U) and downward (D) directions in the explanation below are used. It is however not intended to define the usage directions of an electric tool according to the embodiment.

(Embodiment)

[0012] An electric tool (or power tool) 1 according to the present embodiment will be explained with reference

to FIGS. 1A to 2B.

[0013] As shown in FIGS. 1A and 1B, the electric tool 1 is composed as, for example a handheld belt sander. Such a belt sander is a tool for sanding a target object by a polishing surface of an endless belt rotated in a circulatory manner at a high speed. The electric tool 1 enables a user to easily suppress vibration of an electric motor 10 with user's hand holding the electric tool 1, and has a rod or bar shape as a whole, thereby improving usability in narrow spaces and being usable even in out-doors.

[0014] The electric tool 1 includes an electric tool body 2, a sanding mechanism 3 and a battery pack 4.

[0015] The electric tool body 2 is configured to receive electric power supplied from the battery pack 4 to perform drive control of the sanding mechanism 3. The electric tool body 2 also has a rod or bar shape with a thickness or cross section that allows a user to hold in hand, and also functions as a handle 22 to be held in a user's hand. The electric tool body 2 includes a housing 21 that houses components for driving the sanding mechanism 3.

[0016] The housing 21 is in the shape of a cylinder. For example, the housing 21 may be shaped like a circular cylinder with a thickness or cross section that allows a user to hold in hand. The housing 21 may be long narrow and have an appropriate length. As a specific example, the housing 21 is shaped like a circular cylinder that is 40 to 60 millimeters (mm) in diameter and 150 to 200 mm in length.

[0017] An approximately center part of a peripheral face of the housing 21 in a lengthwise direction thereof (i.e., a fore-aft direction) functions as the handle 22. The sanding mechanism 3 is provided at a front end part of the housing 21 in the lengthwise direction. The battery pack 4 is detachably attached to or inserted into a back end part of the housing 21 in the lengthwise direction. The handle 22 is therefore disposed between the sanding mechanism 3 and the battery pack 4 (i.e., near sanding mechanism 3). Thus, the handle 22 is disposed near the sanding mechanism 3, thereby enabling an improvement in sanding mechanism's (3) operational performance.

[0018] The housing 21 is provided with an attached part 211 in the back end part of the housing 21 in the lengthwise direction. The attached part 211 allows the battery pack 4 to be detachably attached to or inserted into.

[0019] Intake holes 24 and exhaust holes 23 are provided in the peripheral face of the housing 21. The intake holes 24 allow outside (or ambient) air to enter the electric tool body 2 therethrough. The ambient air serves as cooling air for the electric motor 10. Two or more (e.g., five) intake holes 24 are provided in each region on both left and right sides of the peripheral face of the electric tool body 2 with the intake holes 24 being near a back end of the electric motor 10 (e.g., each of side faces of the handle 22). The exhaust holes 23 allow inside air of the electric tool body 2 to exit therethrough. Two or more (e.g., five) exhaust holes 23 are provided in each region

on both left and right sides of the peripheral face of the electric tool body 2 with the exhaust holes 23 being near a front end of the electric motor 10 (e.g., around a front part of the handle 22).

[0020] A power switch 25 is provided on the peripheral face of the housing 21. The power switch 25 is configured to turn on and off a power supply of the electric tool 1. For example, the power switch 25 is a slide switch with a slider to be slid from side to side in the fore-aft direction. The power switch 25 is provided in front of the handle 22 on an upper region of the peripheral face of the housing 21 (e.g., at a location within the reach of the thumb of a hand holding the handle 22).

[0021] The sanding mechanism 3 is of an endless belt type and includes a part for sanding a target object. In an example, the sanding mechanism 3 is provided at the front end part of the housing 21, and includes a rod or bar shape protruding forward from the housing 21 in a horizontal posture. The sanding mechanism 3 includes a driven shaft 30, a driven side bevel gear 31, a driving pulley 32, a driven pulley 34, an arm 35 and a sanding belt 36.

[0022] The driven shaft 30 is a rotary shaft to which the driven side bevel gear 31 and the driving pulley 32 are fixed. The driven shaft 30 is housed inside a front part of the housing 21. The driven shaft 30 is elongated in a left-right direction of the housing 21 and both end parts thereof are supported by the housing 21 so that the driven shaft 30 is allowed to rotate. A right end of the driven shaft 30 protrudes outward from a right side face of the housing 21, and the driving pulley 32 is fixed to a right end part of the driven shaft 30 as described later.

[0023] The driven side bevel gear 31 is a gear to be driven to rotate by the electric motor 10. The driven side bevel gear 31 is housed inside the front part of the housing 21. The driven side bevel gear 31 is fixed to the driven shaft 30 in a concentric manner. The driven side bevel gear 31 is therefore to rotate integrally with the driven shaft 30. The driven side bevel gear 31 is engaged with a driving side bevel gear 102 fixed to a rotary shaft 101 of the electric motor 10. Here, the driving side bevel gear 102 will be described later.

[0024] The driving pulley 32 and the driven pulley 34 support the sanding belt 36 so as to allow the sanding belt 36 to circularly rotate. The driving pulley 32 is fixed to the right end part of the driven shaft 30 in a concentric manner. The driving pulley 32 is disposed on the outer right side face of the housing 21. The driving pulley 32 is to rotate integrally with the driven side bevel gear 31 via the driven shaft 30.

[0025] The driven pulley 34 is supported by the arm 35 so that it is allowed to rotate. The arm 35 is elongated in the fore-aft direction of the housing 21. A back end part of the arm 35 is attached to the front end part of the housing 21, and a front end part of the arm 35 protrudes forward from the housing 21.

[0026] Specifically, a front half of the arm 35 is shaped like a rod or bar elongated in the fore-aft direction. A back

half of the arm 35 is shaped like a crank. The back half is bent leftward and further bent backward. A connection hole 35a is provided in a back end part of the back half of the arm 35. The connection hole 35a is a hole for connection with the housing 21. The connection hole 35a is cylindrical and pierced in the left-right direction. A coupling member 21a is provided on the left side face of the front part of the housing 21. The coupling member 21a is a cylindrical protrusion protruding leftward from the housing 21 and linked with the connection hole 35a of the arm 35 so that it is allowed to rotate.

[0027] The coupling member 21a of the housing 21 is engaged with (i.e., linked with) the connection hole 35a of the arm 35 so that it is allowed to rotate. The arm 35 is accordingly linked with the housing 21 so that it is allowed to rotate in a predetermined angle range relative thereto in an up-down direction. That is, this enables an adjustment for the angle about the back part of the arm 35 relative to the housing 21 in the up-down direction.

[0028] The back half of the arm 35 (i.e., the crank-shaped part) is disposed adjacent to a front end face and a left side face of the front part of the housing 21. The front half of the arm 35 protrudes forward with the front half shifted to the right side of the housing 21. The driven pulley 34 is provided at the front end part of the arm 35 so that it is allowed to rotate. A rotary shaft of the driven pulley 34 is disposed in the left-right direction of the housing 21. The driven pulley 34 is disposed in front of the driving pulley 32.

[0029] The sanding belt 36 is formed as the endless belt. An outside surface of the sanding belt 36 is a sandpaper. The sanding belt 36 is looped around the driving pulley 32 and the driven pulley 34.

[0030] With the sanding mechanism 3, the driving pulley 32 rotates according to the rotation of the driven side bevel gear 31. In this case, the sanding belt 36 rotates to circulate around the driving pulley 32 and the driven pulley 34. Thus, the sanding mechanism 3 is driven to rotate.

[0031] The battery pack 4 is a direct-current (DC) power supply configured to supply electric power to the electric motor 10 inside the housing 21. The battery pack 4 has a substantially columnar shape (e.g., rectangular columnar shape) and is the same as or slightly narrower than the housing 21 in thickness. A front end part 4a of the battery pack 4 (i.e., one end thereof) is detachably attached to (i.e., linked with) the attached part 211 of the housing 21 (i.e., the back end part of the housing 21). Examples of configuration of the battery pack 4 include a configuration in which a storage battery such as lithium-ion battery is housed in a case, and the like.

[0032] A remaining part 4b of the battery pack 4 other than the front end part 4a protrudes straight backward from the back end part of the housing 21. Such protrusion enables the battery pack 4 to function as a supplementary handle of the electric tool 1. That is, it is possible for a user to employ a portion from the handle 22 to the battery pack 4 as a handle.

[0033] Internal structure of the electric tool body 2 and structure of the battery pack 4 will hereinafter be described in detail with reference to FIGS. 2A and 2B.

[0034] The housing 21 possesses therein an interior space S1. The interior space S1 is formed along the lengthwise direction of the housing 21 (fore-aft direction). A part of the sanding mechanism 3 (driven shaft 30 and driven side bevel gear 31), the electric motor 10 and a control circuit 11 are housed in the interior space S1 of the housing 21.

[0035] The part of the sanding mechanism 3 (i.e., driven shaft 30 and driven side bevel gear 31) is housed in a front part of the interior space S1 of the housing 21. The control circuit 11 is housed in a back part of the interior space S1 of the housing 21. The electric motor 10 is housed in a center part of the housing 21 in the lengthwise direction (i.e., next to sanding mechanism 3).

[0036] Specifically, the driven shaft 30 is in the front part of the interior space S1 of the housing 21, and is elongated in the left-right direction of the housing 21-i.e., a direction perpendicular to the rotary shaft 101 to be described later of the electric motor 10. The driven shaft 30 is supported by the housing 21 so that it is allowed to rotate. The driven side bevel gear 31 is fixed to the driven shaft 30 in a concentric manner in the front part of the interior space S1 of the housing 21.

[0037] The electric motor 10 is configured to receive electric power supplied from the battery pack 4 to drive the sanding mechanism 3. The electric motor 10 includes a motor body 100, the rotary shaft 101, the driving side bevel gear 102 and a cooling fan 103.

[0038] The motor body 100 is composed of a rotor and a stator, and configured to convert the electric power from the battery pack 4 into rotary drive power. The rotary shaft 101 passes through an inside of the motor body 100 and protrudes from both front and back sides of the motor body 100, and is configured to provide an outside with the rotary drive power converted by the motor body 100. The electric motor 10 is housed in the interior space S1 of the housing 21 so that the rotary shaft 101 is parallel to the lengthwise direction of the housing 21. Front and back parts of the rotary shaft 101 are supported by the housing 21 so that the rotary shaft 101 is allowed to rotate.

[0039] As stated above, the rotary shaft 101 is parallel to the lengthwise direction of the housing 21. As described below, the rotary shaft 101 is elongated along a direction in which the sanding mechanism 3 in the horizontal posture (hereinafter simply referred to as the "sanding mechanism 3"), the electric motor 10 inside the handle 22, and the battery pack 4 are arranged side by side.

[0040] The driving side bevel gear 102 is fixed to a front end part of the rotary shaft 101 in a concentric manner, and engaged with the driven side bevel gear 31. The cooling fan 103 is configured to generate cooling air for cooling the motor body 100. The cooling fan 103 is disposed in front of the motor body 100, and fixed to the front part of the rotary shaft 101 in a concentric manner.

Thus, the cooling fan 103 is to rotate according to the rotation of the rotary shaft 101 to generate cooling air toward the motor body 100, thereby cooling the motor body 100.

[0041] Note that the driven shaft 30, the driven side bevel gear 31 and the driving side bevel gear 102 constitute a transmission mechanism configured to transmit rotary drive power by the electric motor 10 to remaining components (mainly sanding belt 36) of the sanding mechanism 3. That is, when the electric motor 10 is activated, rotary drive power by the electric motor 10 is transmitted in order of the rotary shaft 101, the driving side bevel gear 102 and the driven side bevel gear 31 (i.e., sanding mechanism 3). In the transmission mechanism, the driven shaft 30 is disposed in a direction perpendicular to the rotary shaft 101. A transmission direction of the rotary drive power by the electric motor 10 is therefore converted into the direction perpendicular to the rotary shaft 101.

[0042] The control circuit 11 is configured to perform drive control of the electric motor 10. The circuit 11 is composed of a printed circuit board and various electrical components mounted on the printed circuit board. The control circuit 11 is configured to receive electric power supplied from the battery pack 4 and ON or OFF information from the power switch 25. The control circuit 11 is also configured to supply electric power to the electric motor 10 or stop the supply of the electric power to the electric motor 10 according to an ON or OFF state of the power switch 25, respectively.

[0043] Note that an output level of the electric motor 10 may be adjusted according to a position of the slider of the power switch 25. In this case, the control circuit 11 is configured to acquire information on the position of the slider (or slide amount) from the power switch 25 to adjust the electric power to be supplied to the electric motor 10 based on the acquired information. When the electric motor 10 is a DC motor, the control circuit 11 may supply DC power from the battery pack 4 to the electric motor 10. When the electric motor 10 is an alternating-current (AC) motor, the control circuit 11 may convert DC power from the battery pack 4 into AC power to be supplied to the electric motor 10.

[0044] The attached part 211 of the housing 21 includes an engagement recess 211a provided in a back end face of the housing 21, and power input terminals 211b. In the present embodiment, although the back end face of the housing 21 is inclined relative to the lengthwise direction of the housing 21 (see FIG. 2B), the back end face may be perpendicular to the lengthwise direction of the housing 21.

[0045] The engagement recess 211a allows a front part of the battery pack 4 to be detachably fitted in (i.e., to be connected to). The engagement recess 211a is lower than a peripheral edge of the back end face of the housing 21 along the lengthwise direction. Thus, in a state where the front part of the battery pack 4 is fitted in the engagement recess 211a, a remaining part of the

battery pack 4 other than the front part protrudes straight backward from the back end part of the housing 21.

[0046] Engagement hollows 211c are provided in an inner peripheral face of the engagement recess 211a.

Two engagement hollows 211c are provided on both upper and lower sides in the engagement recess 211a. Note that the engagement hollows 211c may be arranged at arbitrary positions and the number of the engagement hollows 211c may be one or more. Note that when two or more engagement hollows 211c are provided, the engagement hollows 211c are preferably arranged at regular intervals in the inner peripheral face of the engagement recess 211a along a peripheral direction thereof.

[0047] The power input terminals 211b allows power output terminals to be described later of the battery pack 4 to be electrically connected to. The power input terminals 211b allows electric power from the battery pack 4 to pass therethrough to be provided to the control circuit 11. The power input terminals 211b includes a positive input terminal and a negative input terminal. The power input terminals 211b are provided on a bottom of the engagement recess 211a. Respective tip parts of the power input terminals 211b are inside the engagement recess 211a, and protrude vertically from the bottom of the engagement recess 211a (i.e., along the fore-aft direction). Respective base parts of the power input terminals 211b are electrically connected to the control circuit 11.

[0048] The battery pack 4 is provided with the power output terminals 41 and engagement projections 42.

[0049] The power output terminals 41 allow the power input terminals 211b of the attached part 211 to be electrically connected with. The power output terminals 41 also allow electric power stored in the battery pack 4 to pass therethrough to be provided to the power input terminals 211b. For example, two power output terminals 41 (positive and negative output terminals) are provided. Note that the positive and negative output terminals are to be connected to the positive and negative input terminals, respectively. Two terminal insertion holes 43 are provided in a front face of the battery pack 4. The power output terminals 41 are to be disposed in the terminal insertion holes 43.

[0050] The engagement projections 42 are allowed to be engaged with (or fit in) the engagement hollows 211c of the attached part 211. Each of the engagement projections 42 has, for example a trapezoid or trapezium shape whose front and back side faces are inclined as seen from the side. For example, two engagement projections 42 whose number is the same as that of the engagement hollows 211c are provided on an outer peripheral face of the front part of the battery pack 4 with respective positions thereof corresponding to those of the engagement hollows 211c. Thus, the two engagement projections 42 correspond to the two engagement hollows 211c.

[0051] In the present embodiment, the attached part 211 is formed with the engagement hollows 211c, while the battery pack 4 is formed with the engagement pro-

jections 42. However, the attached part 211 may be formed with engagement projections, while the battery pack 4 may be formed with engagement hollows.

[0052] When the battery pack 4 is attached to the attached part 211 of the electric tool body 2, the front part of the battery pack 4 is inserted into the engagement recess 211a of the attached part 211. As a result, the front part of the battery pack 4 is engaged with the engagement recess 211a. In this engagement state, the power input terminals 211b of the attached part 211 are inserted into the terminal insertion holes 43 to be electrically connected to the power output terminals 41. This enables the supply of electric power stored in the battery pack 4 to the electric tool body 2 via the power output terminals 41 and the power input terminals 211b.

[0053] In the engagement state, the engagement projections 42 are engaged with the engagement hollows 211c. This prevents the battery pack 4 from falling off from the attached part 211 unless the battery pack 4 is pulled with prescribed force or more. In other words, detaching the battery pack 4 from the attached part 211 requires pulling the battery pack 4 from the attached part 211 with prescribed force or more. In this case, the engagement projections 42 are disengaged from the engagement hollows 211c and the battery pack 4 is detached from the attached part 211.

[0054] In a state where the battery pack 4 is attached to the attached part 211 of the electric tool body 2, the battery pack 4 protrudes from the back end part of the housing 21 along the lengthwise direction of the housing 21.

[0055] As can be seen from the internal structure of the electric tool body 2, a part of the sanding mechanism 3 (driven shaft 30 and driven side bevel gear 31), the electric motor 10 and the control circuit 11 are arranged side by side in one direction (i.e., fore-aft direction). Specifically, a part of the sanding mechanism 3 except the driven shaft 30 and the driven side bevel gear 31 is rotated around the driven shaft 30. It is accordingly possible to arrange the housing 21 in a line relative to the housing 21. Therefore, it can be considered that not only the part of the sanding mechanism 3 but also all the sanding mechanism 3 are arranged in one direction along with the electric motor 10 and the control circuit 11.

[0056] The handle 22 is disposed so as to overlap the electric motor 10 and the control circuit 11 as seen from, for example the side of the electric tool 1. However, considering all of the handle 22, the sanding mechanism 3, the electric motor 10 and the control circuit 11, the sanding mechanism 3 in the horizontal posture and both of the electric motor 10 and the control circuit 11 inside the handle 22 are arranged in a straight line. Therefore, in the present embodiment, the handle 22 is regarded as being arranged in one direction along with the sanding mechanism 3, the electric motor 10 and the control circuit 11. That is, in the present embodiment, even if some components overlap or do not overlap, all of components in question are regarded as being arranged in one direc-

tion as long as all of the components in question are arranged like a straight line. Hence, the handle 22 is arranged in one direction along with the sanding mechanism 3, the electric motor 10 and the control circuit 11. Therefore, even if the handle 22 is added to a group of the sanding mechanism 3, the electric motor 10 and the control circuit 11, these components (i.e., sanding mechanism 3, electric motor 10, control circuit 11 and handle 22) are arranged in one direction.

[0057] In a state where the battery pack 4 is attached to the attached part 211, the battery pack 4 is also arranged in one direction along with the sanding mechanism 3, the electric motor 10, the control circuit 11 and the handle 22. Even except for the control circuit 11, the sanding mechanism 3, the electric motor 10, the battery pack 4 and the handle 22 are arranged in one direction. The arrangement of the sanding mechanism 3, the handle 22, the electric motor 10 and the battery pack 4 in one direction enables the electric tool 1 to have a rod or bar shape. Note that the control circuit 11 may be disposed in any space inside the housing 21, and therefore the arrangement of the control circuit 11 hardly affects an overall shape of the electric tool 1. Of the sanding mechanism 3, the electric motor 10, the battery pack 4 and the handle 22, the battery pack 4 is disposed at the very end in one direction. Thus, the relatively heavy battery pack 4 is disposed at a back end part in the arrangement. That is, a heavy component such as the battery pack 4 is not at a center but an outside of the electric tool 1. This enables an improvement in stability of the electric tool 1 with respect to vibration of the electric motor 10.

[0058] The rotary shaft 101 of the electric motor 10 is elongated along one direction-i.e., an arrangement direction of the sanding mechanism 3, the electric motor 10, the battery pack 4 and the handle 22. The electric motor 10 is disposed next to the driven side bevel gear 31-i.e., next to the sanding mechanism 3. This renders an interval between the electric motor 10 and the sanding mechanism 3 short and enables efficient transmission of rotary drive power by the electric motor 10 to the sanding mechanism 3 with a transmission loss suppressed.

(Modified examples)

(2-1) Modified example 1

[0059] In the abovementioned embodiment, the sanding mechanism 3 includes the endless belt, but the present disclosure is not limited to this. For example, in the present modified example, the sanding mechanism 3 may include a disc-shaped sanding part. With this disc-shaped sanding part, the sanding mechanism 3 includes a disc in place of the driving pulley 32, the driven pulley 34, the arm 35 and the sanding belt 36. The disc is fixed to a driven shaft 30 in a concentric manner. An outer surface as a main side of the disc is a sandpaper. The disc is to be rotated by an electric motor 10, and the main side of the rotating disc (sandpaper) is brought into con-

tact with a target object, thereby sanding the target object.

(2-2) Modified example 2

[0060] In the abovementioned embodiment, the electric motor 10 is disposed next to the sanding mechanism 3-i.e., at or near a center part of the housing 21 in the lengthwise direction. In the present modified example, an electric motor 10 may be disposed at an arbitrary position in an interior space S1 of a housing 21. For example, the electric motor 10 may be disposed behind a sanding mechanism 3-i.e., at the very back in the interior space S1 of the housing 21. In this case, a rotary shaft 101 is elongated to a front part of the housing 21. A driving side bevel gear 102 is fixed to a front end part of the rotary shaft 101 and engaged with a driven side bevel gear 31. Thus, the electric motor 10 is disposed behind the sanding mechanism 3, thereby making it possible to narrow a handle 22 because the electric motor 10 is not disposed inside a central part of the housing 21, namely the handle 22. Note that in this case, a control circuit 11 may be disposed in a free space between the driven side bevel gear 31, namely the sanding mechanism 3 and the electric motor 10.

(2-3) Modified example 3

[0061] In the abovementioned embodiment, the battery pack 4 is configured to be inserted into the attached part 211 of the housing 21. In the present modified example, a battery pack 4 may be configured to be inserted into an attached part 211 of a housing 21 and then rotated in a peripheral direction thereof. In this case, the battery pack 4 is circular cylindrical, and an engagement recess 211a of the attached part 211 is a hollow that is circular cylindrical as well.

[0062] Each of engagement hollows 211c is shaped like an L composed of a longitudinal hollow and a lateral hollow. The longitudinal hollow is formed in an inner peripheral face of the attached part 211 from an opening to a bottom side of the attached part 211 along a lengthwise direction (fore-aft direction) of the housing 21. The lateral hollow is curved in a peripheral direction of the attached part 211 from an end of the longitudinal hollow on the bottom side. That is, the battery pack 4 is inserted into the attached part 211 and thereby each of the engagement projections 42 is guided to the bottom of a corresponding longitudinal hollow. The battery pack 4 is then rotated and thereby each of the engagement projections 42 is guided in a corresponding lateral hollow. The engagement projections 42 are engaged with respective lateral hollows, thereby preventing the battery pack 4 from falling off from the attached part 211 even if the battery pack 4 is pulled behind the housing 21.

[0063] In this case, each opening of terminal insertion holes 43 of the battery pack 4 is a circular arc in shape. When the battery pack 4 is inserted into the engagement recess 211a and then rotated, power input terminals

211b are moved in a circular arc direction of respective openings of the terminal insertion holes 43 with the power input terminals 211b inserted into the terminal insertion holes 43. As a result, the power input terminals 211b are electrically connected to respective power output terminals 41.

(3) Advantages

[0064] As can be seen from the embodiment and the modified examples described above, an electric tool 1 according to a first aspect includes a sanding mechanism 3, a motor 10, a battery pack 4 and a housing 21. The sanding mechanism 3 is configured to sand a target object. The motor 10 is configured to drive the sanding mechanism 3. The battery pack 4 is configured to supply the motor 10 with electric power. The sanding mechanism 3, the motor 10 and the battery pack 4 are fixed to the housing 21. The motor 10 possesses a rotary shaft 101. The rotary shaft 101 is configured to transmit rotary drive power to the sanding mechanism 3. The housing 21 possesses a handle 22 that allows a user to hold. The sanding mechanism 3, the motor 10, the battery pack 4 and the handle 22 are arranged in one direction. The rotary shaft 101 of the motor 10 is elongated in the one direction.

[0065] This configuration enables the user to easily suppress vibration of the motor 10 with hand. It is moreover possible to render the motor 10 usable or available in narrow spaces and outdoors.

[0066] Specifically, the rotary shaft 101 of the motor 10 is elongated along the one direction, and therefore parallel to a lengthwise direction of the handle 22. The vibration of the motor 10 in operation mainly contains vibration components in a direction perpendicular to the rotary shaft 101 in particular. The vibration of the motor 10 in operation therefore mainly contains vibration components in a direction perpendicular to the lengthwise direction of the handle 22. This consequently enables the user to receive the vibration with the palm of user's hand holding the handle 22, thereby easily suppressing the vibration with hand.

[0067] In addition, the sanding mechanism 3, the motor 10, the battery pack 4 and the handle 22 are arranged in the one direction, and it is therefore possible to form an overall shape of the electric tool 1 into a rod or bar shape. This consequently enables the user to insert the electric tool 1 to be used into a narrow space such the inside of pipes in plumbing (e.g., water pipes or electricity conduits).

[0068] The electric tool 1 includes the battery pack 4, thereby enabling outdoor use of the electric tool 1.

[0069] In an electric tool 1 according to a second aspect turning on the first aspect, the motor 10 is disposed next to the sanding mechanism 3.

[0070] This configuration makes it possible to shorten an interval between the motor 10 and the sanding mechanism 3. It is consequently possible to miniaturize or sim-

plify a transmission mechanism configured to transmit the rotary drive power by the motor 10 to the sanding mechanism 3, thereby rendering the electric tool 1 small or less costly.

[0071] In an electric tool 1 according to a third aspect turning on a first or second aspect, of the sanding mechanism 3, the motor 10, the battery pack 4 and the handle 22, the battery pack 4 is disposed at a farthest end in the one direction.

[0072] This configuration enables an improvement in stability of the electric tool 1 with respect to the vibration of the motor 10. It is consequently possible to suppress the vibration of the motor 10 in operation.

[0073] In an electric tool 1 according to a fourth aspect turning on any one of the first to third aspects, the handle 22 is disposed between the sanding mechanism 3 and the battery pack 4.

[0074] This configuration enables the handle 22 to be disposed near the sanding mechanism 3. It is consequently possible to improve operational performance with respect to the sanding mechanism 3-e.g., adjustment precision of increase or decrease in force to be added to the sanding mechanism 3 and adjustment precision of increase or decrease in movement length when the sanding mechanism 3 is moved.

[0075] In an electric tool 1 according to a fifth aspect turning on any one of the first to fourth aspects, the battery pack 4 possesses a first end part 4a and a remaining part 4b other than the first end part 4a. When the battery pack 4 is attached to the housing 21, the first end part 4a of the battery pack 4 is linked with the housing 21. When the battery pack 4 is attached to the housing 21, the remaining part 4b of the battery pack 4 protrudes from the housing 21.

[0076] This configuration enables the user to easily hold the battery pack 4, thereby causing the battery pack 4 to function as a supplementary handle.

Reference Signs List

[0077]

- 1 Electric tool
- 3 Sanding mechanism
- 4 Battery pack
- 10 Electric tool
- 21 Housing
- 22 Handle
- 101 Rotary shaft

Claims

1. An electric tool, comprising
 - a sanding mechanism configured to sand a target object,
 - a motor configured to drive the sanding mechanism,
 - a battery pack configured to supply the motor with

electric power, and

a housing to which the sanding mechanism, the motor and the battery pack are fixed, wherein the motor includes a rotary shaft configured to transmit rotary drive power to the sanding mechanism, the housing includes a handle that allows a user to hold, the sanding mechanism, the motor, the battery pack and the handle are arranged in one direction, and the rotary shaft of the motor is elongated in the one direction.

2. The electric tool of claim 1, wherein the motor is disposed next to the sanding mechanism.
3. An electric tool of claim 1 or 2, wherein of the sanding mechanism, the motor, the battery pack and the handle, the battery pack is disposed at a farthest end in the one direction.
4. An electric tool of any one of claims 1 to 3, wherein the handle is disposed between the sanding mechanism and the battery pack.
5. An electric tool of any one of claims 1 to 4, wherein the battery pack includes a first end part and a remaining part other than the first end part, the first end part of the battery pack is linked with the housing when the battery pack is attached to the housing, and the remaining part of the battery pack protrudes from the housing when the battery pack is attached to the housing.

FIG. 1A

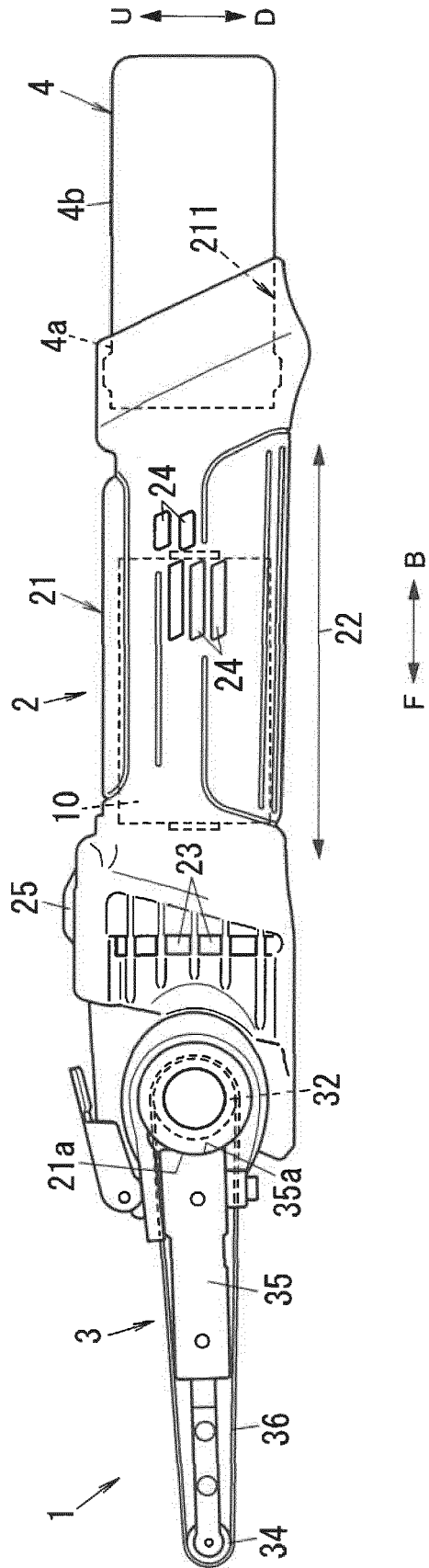
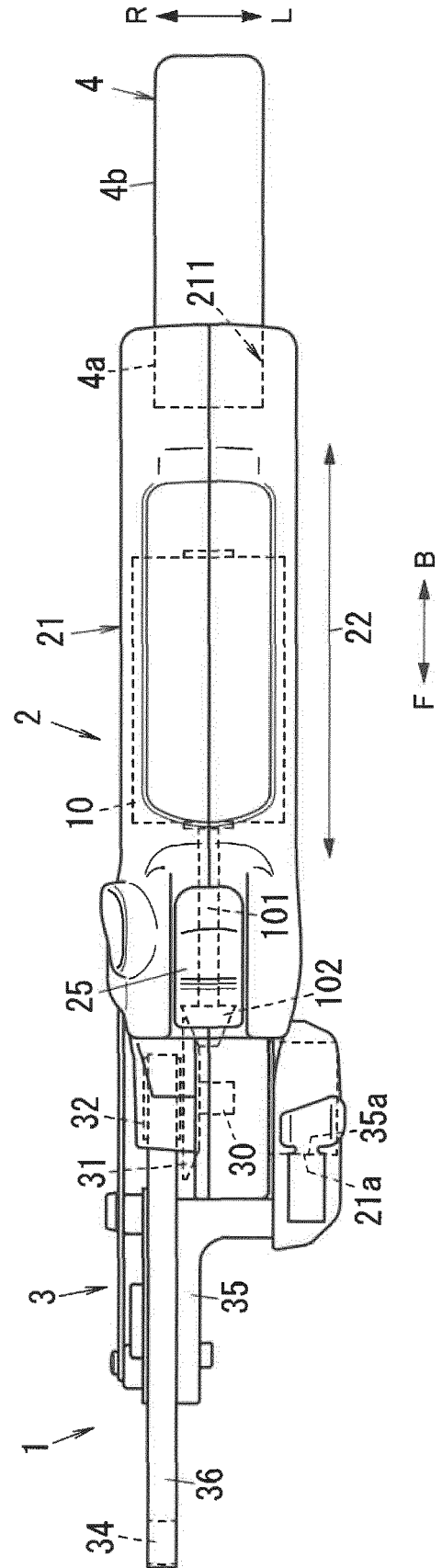
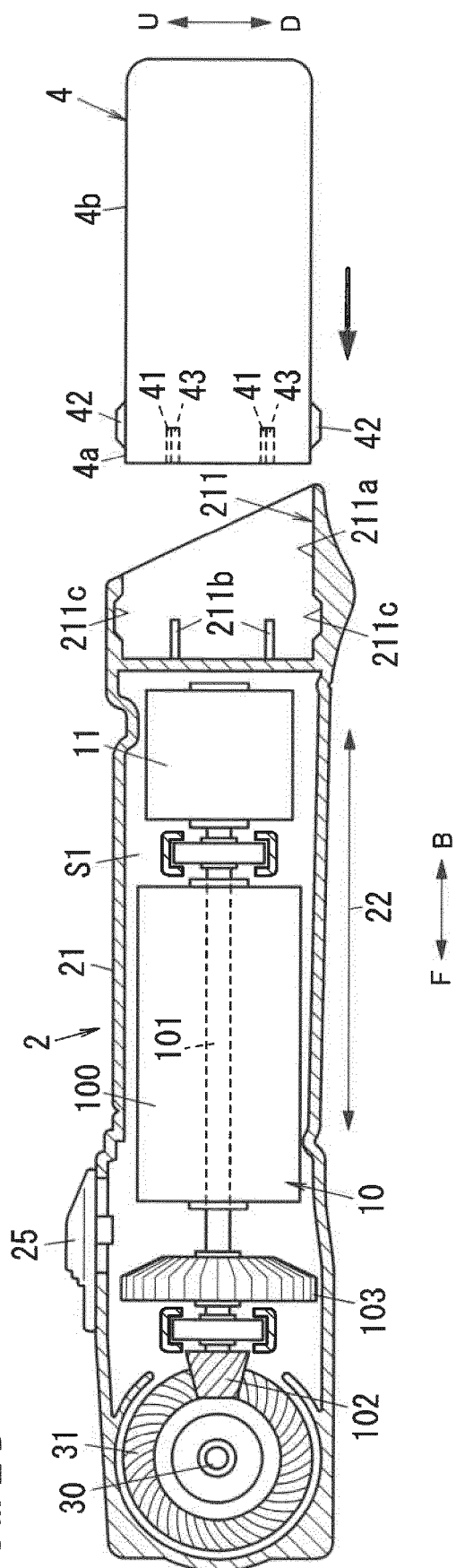
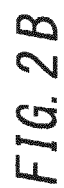
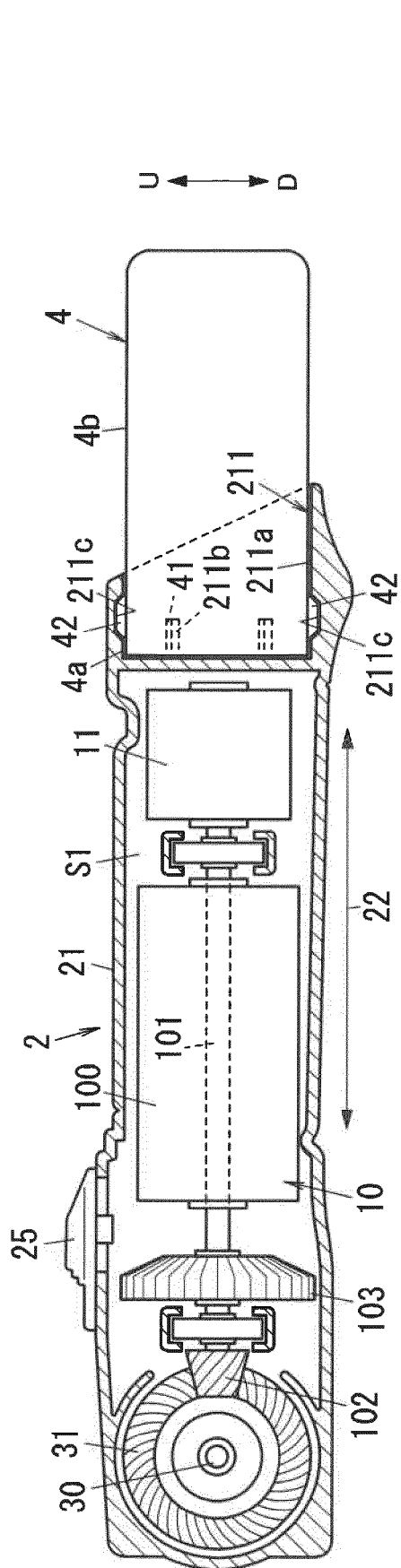


FIG. 1B







EUROPEAN SEARCH REPORT

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Place of search The Hague		Date of completion of the search 12 July 2019	Examiner Bonnin, David
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