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(54) ROLLING BRUSH ASSEMBLY FOR ROBOT VACUUM CLEANER AND ROBOT VACUUM CLEANER

(57) The present application relates to a rolling brush assembly for a robot vacuum cleaner and a robot vacuum cleaner. On the basis of the application, the rolling brush assembly comprises a rotating main shaft, a cutting mechanism and a clutch mechanism; the cutting mechanism comprises a fixed tooth row component and a movable tooth row component which are stacked and arranged; and the clutch mechanism is able to change a clutch state in response to a change of the rotating direction of the rotating main shaft, such that the movable tooth row component executes reciprocating cutting motion relative to the fixed tooth row component only in response to the rotation of the rotating main shaft in a first rotating direction, and stops the reciprocating cutting motion when the rotating main shaft rotates in a second rotating direction. Therefore, starting or stopping the reciprocating cutting motion of the movable tooth row component relative to the fixed tooth row component can be controlled by means of switching the rotating direction of the rotating main shaft, such that by means of selectively controlling stopping of the reciprocating cutting motion, friction noises and ineffective power consumption generated by the cutting mechanism are reduced.

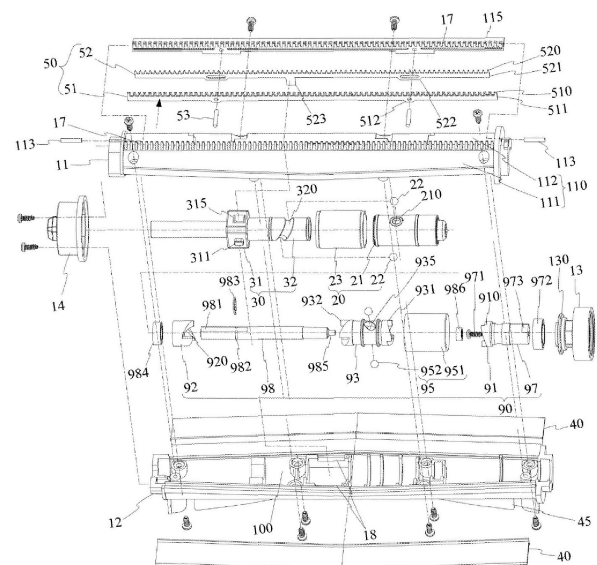


Fig. 2

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Description

[0001] The present application claims priority to a Chinese patent application No. 202311120321.0 filed with the China National Intellectual Property Administration on August 31, 2023 and entitled "rolling brush assembly for robot vacuum cleaner and robot vacuum cleaner" and a Chinese patent application No. 202322363513.6 filed with the China National Intellectual Property Administration on August 31, 2023 and entitled "rolling brush assembly for robot vacuum cleaner and robot vacuum cleaner", which are incorporated herein by reference in its entirety.

Technical Field

[0002] The present application relates to the field of intelligent cleaning, and particularly to a rolling brush assembly for a sweeping robot, and a sweeping robot.

Background

[0003] A sweeping robot includes a mobile chassis, a rolling brush assembly, a suction member, and a dust collection member (such as a rigid dust collection box or a flexible dust collection bag), wherein the rolling brush assembly can perform a sweeping operation on an area below the mobile chassis using a cleaning brush extending radially from a rotating main shaft.

[0004] Discrete dirt such as dust and food crumbs can be swept into the interior of the sweeping robot by the cleaning brush and conveyed into the dust collection member by a suction airflow generated by the suction member in the interior of the sweeping robot. However, filament-shaped dirt such as hair may wind around the rolling brush assembly, making it impossible for the filament-shaped dirt to be conveyed into the dust collection member by the suction airflow generated by the suction member.

[0005] To facilitate cleaning the filament-shaped dirt wound around the rolling brush assembly, the rolling brush assembly may be provided with a cutting mechanism. This cutting mechanism includes a fixed tooth row member and a movable tooth row member which are in stack arrangement, wherein the movable tooth row member can continuously perform a reciprocating cutting motion relative to the fixed tooth row member during rotation of the rolling brush assembly, to cut the filament-shaped dirt into dirt in a discrete state that can be conveyed into the dust collection member by the suction airflow.

[0006] However, cutting of the filament-shaped dirt only requires instantaneous reciprocating cutting motion. Continuously performing the reciprocating cutting motion during the rotation of the rotating rolling brush causes ineffective power consumption of the sweeping robot. Moreover, friction noises generated between the movable tooth row member and the fixed tooth row member

during the reciprocating cutting motion also continuously occur during the power-on period of the sweeping robot.

[0007] Thus, how to reduce the friction noises and ineffective power consumption generated by the cutting mechanism becomes a technical problem to be solved in the prior art.

Summary

[0008] In the embodiments of the present application, a rolling brush assembly for a sweeping robot and a sweeping robot are provided, which facilitates reducing the friction noises and ineffective power consumption generated by the cutting mechanism.

[0009] One embodiment of the present application provides a rolling brush assembly for a sweeping robot, including:

a rotating main shaft, the rotating main shaft being provided with a cleaning brush extending radially from an outer shaft wall;

a cutting mechanism, the cutting mechanism including a fixed tooth row member and a movable tooth row member installed at the outer shaft wall along an axial direction of the rotating main shaft;

an axial movement mechanism, the axial movement mechanism being movably installed along the axial direction within a hollow shaft cavity of the rotating main shaft surrounded by the outer shaft wall, and the axial movement mechanism and the rotating main shaft forming a bidirectional synchronization constraint in a first rotating direction and a second rotating direction that are opposite to each other;

a guiding mechanism, the guiding mechanism being in transmission cooperation with the axial movement mechanism within the hollow shaft cavity, an axial position of the guiding mechanism within the hollow shaft cavity being fixed, and the guiding mechanism being switchable between a rotation-locking state and a rotation-following state;

a clutch mechanism, the clutch mechanism being in transmission cooperation with the guiding mechanism within the hollow shaft cavity, wherein:

when the axial movement mechanism rotates along the first rotating direction following the rotating main shaft, the clutch mechanism is in a first clutch state where the guiding mechanism is kept in the rotation-locking state, the axial movement mechanism is guided by the guiding mechanism in the rotation-locking state to perform reciprocating axial movement along the axial direction, and the reciprocating axial movement triggers reciprocating cutting motion of the

movable tooth row member relative to the fixed tooth row member;

when the axial movement mechanism rotates along the second rotating direction following the rotating main shaft, the clutch mechanism is in a second clutch state where the guiding mechanism is kept in the rotation-following state, and the guiding mechanism in the rotation-following state cancels guidance on the axial movement mechanism by rotating along the second rotating direction following the axial movement mechanism.

[0010] In the embodiments of the present application, a rolling brush assembly for a sweeping robot and a sweeping robot are provided, which facilitates reducing the friction noises and ineffective power consumption generated by the cutting mechanism.

[0011] One embodiment of the present application provides a rolling brush assembly for a sweeping robot, including:

a rotating main shaft, the rotating main shaft being provided with a cleaning brush extending radially from an outer shaft wall;

a cutting mechanism, the cutting mechanism including a fixed tooth row member and a movable tooth row member installed at the outer shaft wall along an axial direction of the rotating main shaft;

an axial movement mechanism, the axial movement mechanism being movably installed along the axial direction within a hollow shaft cavity of the rotating main shaft surrounded by the outer shaft wall, the axial movement mechanism and the rotating main shaft forming a bidirectional synchronization constraint in a first rotating direction and a second rotating direction that are opposite to each other;

a guiding mechanism, the guiding mechanism being in transmission cooperation with the axial movement mechanism within the hollow shaft cavity, an axial position of the guiding mechanism within the hollow shaft cavity being fixed, and the guiding mechanism being switchable between a rotation-locking state and a rotation-following state;

a clutch mechanism, the clutch mechanism being in transmission cooperation with the guiding mechanism within the hollow shaft cavity, wherein:

when the axial movement mechanism rotates along the first rotating direction following the rotating main shaft, the clutch mechanism is in a first clutch state where the guiding mechanism is kept in the rotation-locking state, the axial

movement mechanism is guided by the guiding mechanism in the rotation-locking state to perform reciprocating axial movement along the axial direction, and the reciprocating axial movement triggers reciprocating cutting motion of the movable tooth row member relative to the fixed tooth row member;

when the axial movement mechanism rotates along the second rotating direction following the rotating main shaft, the clutch mechanism is in a second clutch state where the guiding mechanism is kept in the rotation-following state, and the guiding mechanism in the rotation-following state cancels the guidance on the axial movement mechanism by rotating along the second rotating direction following the axial movement mechanism.

[0012] In some examples, optionally, a first shaft end of the rotating main shaft is provided with a drive end cover, and a second shaft end of the rotating main shaft is provided with a static end cover, wherein the drive end cover forms a bidirectional synchronization constraint with the rotating main shaft in the first rotating direction and the second rotating direction, the drive end cover is configured to be in transmission cooperation with a power motor, and the rotating main shaft is in rotational cooperation with the static end cover; the clutch mechanism is located between the guiding mechanism and the static end cover, wherein the clutch mechanism axially limits the guiding mechanism, to enable a relative axial position between the guiding mechanism and the static end cover to be fixed, and: when the clutch mechanism is in the first clutch state, the clutch mechanism forms a rotation-locking constraint between the guiding mechanism and the static end cover that prevents the guiding mechanism from rotating relative to the static end cover along the first rotating direction, to constrain the guiding mechanism in the rotation-locking state; when the clutch mechanism is in the second clutch state, the guiding mechanism is in the rotation-following state where it can freely rotate relative to the static end cover under driving of the axial movement mechanism.

[0013] In some examples, optionally, the clutch mechanism includes a clutch sliding sleeve movable in the axial direction, wherein: when the clutch mechanism is located at a first axial position, the clutch sliding sleeve is in the first clutch state; when the clutch sliding sleeve is located at a second axial position, the clutch mechanism is in the second clutch state; the clutch sliding sleeve is configured to switch between the first axial position and the second axial position in response to switching between the first rotating direction and the second rotating direction.

[0014] In some examples, optionally, the clutch mechanism further includes a fixed tooth ring and a transmission tooth ring, wherein the fixed tooth ring is fixedly

connected to the static end cover, the transmission tooth ring is fixedly connected to the guiding mechanism, an end of the fixed tooth ring facing the clutch sliding sleeve has a clutch convex tooth groove, and an end of the transmission tooth ring facing the clutch sliding sleeve has a transmission tooth groove; the clutch sliding sleeve is movably installed between the fixed tooth ring and the transmission tooth ring, wherein a first annular opening end of the clutch sliding sleeve facing the fixed tooth ring has a clutch convex tooth, and a second annular opening end of the clutch sliding sleeve facing the transmission tooth ring has a transmission convex tooth, wherein: when the clutch sliding sleeve is located at the first axial position, the clutch convex tooth and the clutch convex tooth groove form a first limiting engagement that prevents the clutch sliding sleeve from rotating relative to the static end cover along the first rotating direction, the transmission convex tooth and the transmission tooth groove form a second limiting engagement that prevents the guiding mechanism from rotating relative to the clutch sliding sleeve along the first rotating direction, and the rotation-locking constraint is applied to the guiding mechanism through cascade cooperation of the first limiting engagement and the second limiting engagement; when the clutch sliding sleeve is located at the second axial position, the clutch convex tooth disengage from the clutch convex tooth groove, and the first limiting engagement and the second limiting engagement are released in response to disengagement of the clutch convex tooth from the clutch convex tooth groove.

[0015] In some examples, optionally, the clutch mechanism further includes a fixed shaft base coaxially fixedly connected to the static end cover, and a transmission shaft rod coaxially fixedly connected to the guiding mechanism; the fixed shaft base and the transmission shaft rod form an axial limiting that enables the relative axial position between the guiding mechanism and the static end cover to be fixed; the fixed tooth ring is integrated on an end face of the fixed shaft base facing the clutch sliding sleeve, and the transmission tooth ring is fixedly sleeved on the transmission shaft rod, and the clutch sliding sleeve is movably sleeved on the transmission shaft rod.

[0016] In some examples, optionally, when the clutch sliding sleeve is located at the second axial position, the first limiting engagement and the second limiting engagement also generate a first axial retaining force that prevents the clutch sliding sleeve from leaving the first axial position; when the clutch sliding sleeve is located at the second axial position, the transmission convex tooth and the transmission tooth groove also form a synchronous drive engagement that causes the clutch sliding sleeve to rotate along the second rotating direction together with the guiding mechanism under driving of the axial movement mechanism, and the synchronous drive engagement generates a second axial retaining force that causes the clutch sliding sleeve to prevent the clutch sliding sleeve from leaving the second axial position.

[0017] In some examples, optionally, the clutch convex tooth groove has a rotation-locking limiting groove wall parallel to a longitudinal section of the rotating main shaft on a first phase side opposite to the first rotating direction, and the clutch convex tooth groove has a first arc-surfaced groove wall on a second phase side in the first rotating direction; the clutch convex tooth has a rotation-locking limiting tooth wall parallel to the longitudinal section of the rotating main shaft on the second phase side, and the clutch convex tooth has a first arc-surfaced tooth wall matching with the first arc-surfaced groove wall on the first phase side; the transmission tooth groove has a second arc-surfaced groove wall on the second phase side, and the transmission tooth groove has a synchronous engagement groove wall parallel to the longitudinal section of the rotating main shaft on the first phase side; the transmission convex tooth has a second arc-surfaced tooth wall matching with the second arc-surfaced groove wall on the first phase side, and the transmission convex tooth has a synchronous engagement tooth wall parallel to the longitudinal section of the rotating main shaft on the second phase side; when the clutch sliding sleeve is at the first axial position, the rotation-locking limiting tooth wall and the rotation-locking limiting groove wall opposite to each other form the first limiting engagement through planar-surface contact, and the second arc-surfaced tooth wall and the second arc-surfaced groove wall opposite to each other form the second limiting engagement through arc-surface contact; when the clutch sliding sleeve is at the second axial position, the synchronous engagement groove wall and the synchronous engagement tooth wall opposite to each other form the synchronous drive engagement through planar-surface contact; during position switching between the first axial position and the second axial position, sliding cooperation for guiding the position switching is generated between the first arc-surfaced groove wall and the first arc-surfaced tooth wall opposite to each other, and between the second arc-surfaced tooth wall and the second arc-surfaced groove wall opposite to each other.

[0018] In some examples, optionally, the clutch mechanism further includes a switching mechanism, wherein: when the axial movement mechanism switches from the second rotating direction to the first rotating direction to rotate following a rotating direction of the rotating main shaft, the switching mechanism generates, in response to a first phase offset of the guiding mechanism in the first rotating direction following the axial movement mechanism, a first axial driving force that drives the clutch sliding sleeve to move from the second axial position to the first axial position; when the axial movement mechanism switches from the first rotating direction to the second rotating direction to rotate following the rotating direction of the rotating main shaft, the switching mechanism generates, in response to a second phase offset of the guiding mechanism in the second rotating direction following the axial movement mechanism, a second axial driving force that drives the clutch sliding sleeve to move

from the first axial position to the second axial position.

[0019] In some examples, optionally, the clutch mechanism further includes a transmission shaft rod coaxially fixedly connected to the guiding mechanism, wherein the transmission tooth ring is fixedly sleeved on the transmission shaft rod, and the clutch sliding sleeve is movably sleeved on the transmission shaft rod; the clutch sliding sleeve has an inclined guide groove inclined at a preset angle relative to the axial direction; the switching mechanism includes a fixed outer cylinder and a reversing ball, wherein: the fixed outer cylinder is sleeved on outer periphery of the clutch sliding sleeve, the fixed outer cylinder covers the inclined guide groove, and the fixed outer cylinder is constrained to be stationary relative to the static end cover; the reversing ball is movably accommodated in the inclined guide groove, and the reversing ball is in rolling cooperation with the transmission shaft rod and the fixed outer cylinder; a first groove end of the inclined guide groove is inclined toward the first axial position, and a second groove end of the inclined guide groove is inclined toward the second axial position; when the axial movement mechanism switches from the second rotating direction to the first rotating direction to rotate following the rotating direction of the rotating main shaft, the guiding mechanism drives, during occurrence of the first phase offset, the reversing ball through the transmission shaft rod to produce a first planetary motion in the first rotating direction on an inner surface of the fixed outer cylinder, and the first planetary motion causes a relative position change of the reversing ball in the inclined guide groove from the second groove end to the first groove end, enabling the reversing ball to generate the first axial driving force on the inclined guide groove; when the axial movement mechanism switches from the first rotating direction to the second rotating direction to rotate following the rotating direction of the rotating main shaft, the guiding mechanism drives, during occurrence of the second phase offset, the reversing ball through the transmission shaft rod to produce a second planetary motion in the second rotating direction on the inner surface of the fixed outer cylinder, and the second planetary motion causes a relative position change of the reversing ball in the inclined guide groove from the first groove end to the second groove end, enabling the reversing ball to generate the second axial driving force on the inclined guide groove.

[0020] Another embodiment of the present application provides a sweeping robot, including a mobile chassis, an integrated cavity shell carried on the mobile chassis, and the rolling brush assembly according to the foregoing embodiments, the rolling brush assembly being installed in the integrated cavity shell, wherein: the mobile chassis has a chassis opening; the integrated cavity shell has a sweeping window exposed at the chassis opening, and a suction window for communicating with a dust collection mechanism, wherein an installation position of the rolling brush assembly in the integrated cavity shell causes the cleaning brush to extend outside the sweeping window

during the rotation to perform a sweeping operation; the integrated cavity shell is fixedly provided with a power motor, wherein a first shaft end of the rotating main shaft is in transmission cooperation with the power motor, the power motor drives the rotating main shaft to rotate along the first rotating direction when the sweeping robot is in a self-cleaning mode where the mobile chassis stops moving, and the power motor drives the rotating main shaft to rotate along the second rotating direction when the sweeping robot is in an operating mode where the mobile chassis moves; when the clutch mechanism is in the first clutch state, the clutch mechanism is configured to keep the guiding mechanism in the rotation-locking state by using a rotation-locking constraint applied by the integrated cavity shell on a second shaft end of the rotating main shaft opposite to the first shaft end.

[0021] Based on the above embodiments, the rolling brush assembly includes the rotating main shaft, the cutting mechanism, and the clutch mechanism. The cutting mechanism includes the fixed tooth row member and the movable tooth row member installed along the axial direction of the rotating main shaft. The clutch mechanism can change its clutch state in response to change in the rotating direction of the rotating main shaft, so that the movable tooth row member performs reciprocating cutting motion relative to the fixed tooth row member only in response to rotation of the rotating main shaft along the first rotating direction, and stops the reciprocating cutting motion when the rotating main shaft rotates along the second rotating direction. Therefore, the start or stop of the reciprocating cutting motion of the movable tooth row member relative to the fixed tooth row member can be controlled by switching the rotating direction of the rotating main shaft, thereby enabling to reduce the friction noises and ineffective power consumption generated by the cutting mechanism by selectively controlling the stop of the reciprocating cutting motion.

Brief Description of the Drawings

[0022] The drawings described herein are provided for further understanding of the present application and constitute a part of the present application. The schematic embodiments and descriptions of the present application are used to explain the present application and do not constitute an improper limitation on the present application.

Fig. 1a is a schematic structural diagram of a rolling brush assembly for a sweeping robot in an assembled state according to an embodiment of the present application;

Fig. 1b is a schematic structural diagram of the rolling brush assembly shown in Fig. 1a without a cutting mechanism being installed;

Fig. 2 is a schematic structural diagram of a rolling

brush assembly for a sweeping robot in a disassembled state according to an embodiment of the present application;

Fig. 3 is a schematic diagram of operating principle of the cutting mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application;

Fig. 4 is a cross-sectional view of a clutch mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application;

Fig. 5 is a schematic partial structure diagram of the clutch mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application;

Fig. 6 is a schematic diagram of operating principle of the clutch mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application;

Fig. 7 is a schematic diagram of a state switching process of the clutch mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application;

Fig. 8 is an schematic exploded structure diagram of the rolling brush assembly for a sweeping robot further including a preload mechanism according to an embodiment of the present application;

Fig. 9 is a schematic partial hierarchical structure diagram of a first example of the preload mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application;

Fig. 10 is a cross-sectional view of the first example of the preload mechanism shown in Fig. 9;

Fig. 11 is a schematic partial hierarchical structure diagram of a second example of the preload mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application;

Fig. 12 is a cross-sectional view of the second example of the preload mechanism shown in Fig. 11;

Fig. 13 is a schematic partial hierarchical structure diagram of a third example of the preload mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application;

Fig. 14 is a cross-sectional view of the third example of the preload mechanism shown in Fig. 13;

Fig. 15 is a schematic partial structure diagram of a sweeping robot according to an embodiment of the present application;

Fig. 16 is a schematic structure diagram of an integrated cavity shell of the sweeping robot according to an embodiment of the present application;

Fig. 17 is a schematic diagram of a docking structure between the integrated cavity shell shown in Fig. 16 and the dust collection member.

Description of Reference Numbers

[0023]

10 rotating main shaft; 100 hollow shaft cavity; 11 first semi-cylindrical shell; 110 semi-shell main body; 111 arc-surfaced portion; 112 circular segment portion; 113 assembly positioning pin; 115 arc-surfaced splicing piece; 12 second semi-cylindrical shell; 13 follower sleeve ring; 130 static end cover; 14 drive end cover; 15 mounting slit; 151 side wall groove; 152 side wall blind hole; 153 side wall convex rib; 17 guide comb tooth; 18 sliding keyway;

20 guiding mechanism; 21 inner sleeve; 210 ball-constraining through hole; 22 guiding ball; 23 outer sleeve;

30 axial movement mechanism; 31 transmission slider; 311 radial convex key; 315 retaining groove; 32 guide rotating shaft; 320 inclined annular groove;

40 cleaning brush; 45 adhesive tape;

50 cutting mechanism; 51 fixed tooth row member; 510 fixed tooth; 511 fixed tooth installation strip; 512 fixed tooth installation lug; 52 movable tooth row member; 520 movable tooth; 521 movable tooth installation strip; 522 movable tooth installation lug; 523 movable tooth transmission arm; 53 stack positioning pin;

60 integrated cavity shell; 600 rolling brush cavity; 61 sweeping window; 62 suction window; 63 support shaft base; 64 power shaft base; 65 rotation-locking notch; 66 channel assembly;

70 mobile chassis; 700 chassis opening; 71 power motor; 72 speed reduction mechanism;

80 preload mechanism; 81 first preload mechanism; 82 second preload mechanism; 821 preload spring; 822 floating ball;

90 clutch mechanism; 91 fixed tooth ring; 910 clutch convex tooth groove; 910a rotation-locking limiting groove wall; 910b first arc-surfaced groove wall; 92 transmission tooth ring; 920 transmission tooth groove; 920a second arc-surfaced groove wall; 920b synchronous engagement groove wall; 93 clutch sliding sleeve; 931 clutch convex tooth; 931a rotation-locking limiting tooth wall; 931b first arc-surfaced tooth wall; 932 transmission convex tooth; 932a second arc-surfaced tooth wall; 932b synchronous engagement tooth wall; 935 inclined guide groove; 935a first groove end; 935b second groove end; 95 switching mechanism; 951 fixed outer cylinder; 952 reversing ball; 97 fixed shaft base; 971 axial screw; 972 shaft base bearing; 973 rotation-locking keyway; 98 transmission shaft rod; 981 synchronization keyway; 982 positioning annular groove; 983 synchronization snap ring; 984 end bearing; 985 embedded shaft end; 986 embedded bearing.

Detailed Description of the Embodiments

[0024] To make the objectives, technical solutions, and advantages of the present invention clearer, the present application will be described in more detail below with reference to the accompanying drawings and embodiments. Obviously, the described embodiments are only some, and not all, of the embodiments of the present application. All other embodiments obtained based on the embodiments of the present application by those skilled in the art fall into the scope of protection of the present application.

[0025] Fig. 1a is a schematic structural diagram of a rolling brush assembly for a sweeping robot in an assembled state according to an embodiment of the present application. Fig. 1b is a schematic structural diagram of the rolling brush assembly shown in Fig. 1a without a cutting mechanism being installed. Fig. 2 is a schematic structural diagram of a rolling brush assembly for a sweeping robot in a disassembled state according to an embodiment of the present application (dashed lines in the figures indicate the corresponding assembly position of a certain component). Fig. 3 is a schematic diagram of operating principle of the cutting mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application. Referring to Fig. 1a to Fig. 3, in the embodiments of the present application, the rolling brush assembly for a sweeping robot may include a rotating main shaft 10, a cutting mechanism 50, an axial movement mechanism 30, a guiding mechanism 20, and a clutch mechanism.

[0026] The rotating main shaft 10 may be provided with a cleaning brush 40 extending radially from an outer shaft wall.

[0027] As shown in Fig. 1a, Fig. 1b, and Fig. 2, the cutting mechanism 50 includes a fixed tooth row member 51 and a movable tooth row member 52 installed at the

outer shaft wall along an axial direction of the rotating main shaft 10. As shown in Fig. 2 and Fig. 3, the axial movement mechanism 30 is movably installed along the axial direction within a hollow shaft cavity 100 of the rotating main shaft 10 surrounded by the outer shaft wall. The axial movement mechanism 30 forms a bidirectional synchronization constraint with the rotating main shaft 10 in a first rotating direction and a second rotating direction that are opposite to each other. As shown in Fig. 2 and Fig. 3, the guiding mechanism 20 is in transmission cooperation with the axial movement mechanism 30 within the hollow shaft cavity 100. An axial position of the guiding mechanism 20 within the hollow shaft cavity 100 is fixed, and the guiding mechanism 20 can be configured to switch between a rotation-locking state and a rotation-following state.

[0028] As shown in Fig. 2, a clutch mechanism 90 is in transmission cooperation with the guiding mechanism 20 within the hollow shaft cavity 100, wherein:

20 When the axial movement mechanism 30 rotates along the first rotating direction following rotation of the rotating main shaft 10, the clutch mechanism 90 is in a first clutch state where the guiding mechanism 20 is kept in the rotation-locking state. The axial movement mechanism 30 is guided by the guiding mechanism 20 in the rotation-locking state to perform reciprocating axial movement along the axial direction. The reciprocating axial movement triggers reciprocating cutting motion of the movable tooth row member 52 relative to the fixed tooth row member 51.

[0029] When the axial movement mechanism 30 rotates along the second rotating direction following the rotating main shaft 10, the clutch mechanism 90 is in a second clutch state where the guiding mechanism 20 is kept in the rotation-following state. The guiding mechanism 20 in the rotation-following state cancels the guidance on the axial movement mechanism 30 by rotating along the second rotating direction following the axial movement mechanism 30.

[0030] As can be seen from the embodiments shown in Fig. 1a to Fig. 3, by applying the embodiments of the present application, the clutch mechanism 90 can change its clutch state in response to the change in the rotating direction of the rotating main shaft 10, so that the movable tooth row member 52 performs reciprocating cutting motion relative to the fixed tooth row member 51 only in response to rotation of the rotating main shaft 10 along the first rotating direction, and stops the reciprocating cutting motion when the rotating main shaft 10 rotates along the second rotating direction. Therefore, the start or stop of the reciprocating cutting motion of the movable tooth row member 52 relative to the fixed tooth row member 51 can be controlled by switching the rotating direction of the rotating main shaft 10, thereby enabling to reduce the friction noises and ineffective power consumption generated by the cutting mechanism by selectively controlling the stop of the reciprocating cutting motion.

[0031] In the embodiments shown in the figures of the present application, as shown in Fig. 1a to Fig. 3, taking the rotating main shaft 10 including a first semi-cylindrical shell 11 and a second semi-cylindrical shell 12 as an example, the cylindrical surfaces of the first semi-cylindrical shell 11 and the second semi-cylindrical shell 12 are complementary, and the first semi-cylindrical shell 11 and the second semi-cylindrical shell 12 are spliced together by snap-fit engagement. After the first semi-cylindrical shell 11 and the second semi-cylindrical shell 12 are spliced, they can form the hollow shaft cavity 100. In Fig. 2, only the portion of the hollow shaft cavity 100 in the second semi-cylindrical shell 12 is shown. For example, the splicing by snap-fit engagement of the first semi-cylindrical shell 11 and the second semi-cylindrical shell 12 can be achieved through snap-fit engagement at edges of the cylindrical surfaces, and/or screw locking fixation as shown in the figure. In this case, as shown in Fig. 2, a pair of the cleaning brush 40 can be fixedly clamped by a pair of seams between the first semi-cylindrical shell 11 and the second semi-cylindrical shell 12 respectively. As can be seen from the figures of the embodiments of the present application, the seams between the first semi-cylindrical shell 11 and the second semi-cylindrical shell 12 are not limited to a straight line shape, but can be set to a polyline shape, so that the cleaning brush 40 in an elongated strip shape is constrained into a bent shape by the polyline-shaped seams between the first semi-cylindrical body 11 and the second semi-cylindrical body 12. Such a bent shape can facilitate discrete dirt swept by the cleaning brush 40 to converge toward the central area of the elongated strip shape during the rotation of the rotating main shaft 10.

[0032] In the embodiments of the present application, the cutting mechanism 50 can be installed at the outer shaft wall of the rotating main shaft 10, and the installation position of the cutting mechanism 50 and the installation position of the cleaning brush 40 at the outer shaft wall of the rotating main shaft 10 are staggered. For example, the cutting mechanism 50 can be installed at the first semi-cylindrical shell 11. As shown in Fig. 1a to Fig. 3, the cutting mechanism 50 can be installed on the outer wall of the first semi-cylindrical shell 11. Moreover, the second semi-cylindrical shell 12 can be provided with an adhesive tape 45 that is configured to avoid the cleaning brush 40 and the cutting mechanism 50. This adhesive tape 45 can adhere to the swept dirt. As shown in Fig. 1a to Fig. 3, the adhesive tape 45 can be installed on the outer wall of the second semi-cylindrical shell 12. It can be understood that the adhesive tape 45 is not an essential component for the rotating rolling brush, and the cutting mechanism 50 can also be arranged in pairs like the cleaning brush 40 and installed at the first semi-cylindrical shell 11 and the second semi-cylindrical shell 12 respectively.

[0033] As shown in Fig. 1a to Fig. 3, the cutting mechanism 50 may specifically include a fixed tooth row member 51 and a movable tooth row member 52 stacked and inserted into the outer shaft wall of the rotating main

shaft 10. That is, the fixed tooth row member 51 can be fixedly inserted into the outer shaft wall of the rotating main shaft 10, the movable tooth row member 52 can be movably inserted into the outer shaft wall of the rotating main shaft 10 along the axial direction of the rotating main shaft 10, and the movable tooth row member 52 can perform reciprocating cutting motion relative to the fixed tooth row member 51 in response to the rotation of the rotating main shaft 10.

[0034] In the embodiments of the present application, to facilitate the insertion of the cutting mechanism 50 into the outer shaft wall of the rotating main shaft 10, as shown in Fig. 1a and Fig. 1b, the outer shaft wall of the rotating main shaft 10 may have a mounting slit 15 extending along the axial direction of the rotating main shaft 10. The fixed tooth row member 51 of the cutting mechanism 50 is fixedly inserted into the mounting slit 15, and the movable tooth row member 52 of the cutting mechanism 50 is movably inserted into the mounting slit 15 along the axial direction. As shown in Fig. 2, in this case, the fixed tooth row member 51 may include a fixed tooth installation strip 511 fixed within the mounting slit 15, and multiple fixed teeth 510 protruding from the fixed tooth installation strip 511 beyond the outer shaft wall of the rotating main shaft 10. The movable tooth row member 52 may include a movable tooth installation strip 521 movably installed within the mounting slit 15, and multiple movable teeth 520 protruding from the movable tooth installation strip 521 beyond the outer shaft wall of the rotating main shaft 10. Moreover, the reciprocating cutting motion of the movable tooth row member 52 relative to the fixed tooth row member 51 can cause the movable teeth 520 to reciprocally offset relative to the fixed teeth 510 in the axial direction.

[0035] In the embodiments of the present application, taking the mounting slit 15 located at the first semi-cylindrical shell 11 as an example, as shown in Fig. 2 and Fig. 3, the first semi-cylindrical shell 11 may include a semi-shell main body 110. The semi-shell main body 110 has an arc-surfaced portion 111 that smoothly splices with an outer shaft wall of the second semi-cylindrical shell 12, and a circular segment portion 112 adjacent to the arc-surfaced portion 111. The first semi-cylindrical shell 11 may further include an arc-surfaced splicing piece 115. The arc-surfaced splicing piece 115 is detachably installed (for example, by using screws) at the circular segment portion 112. That is, a half outer shaft wall provided by the first semi-cylindrical shell 11 for the rotating main shaft 10 includes outer arc surfaces of the arc-surfaced portion 111 and the arc-surfaced splicing piece 115, and the mounting slit 15 is located between the arc-surfaced portion 111 and the arc-surfaced splicing piece 115.

[0036] Based on the split structure of the first semi-cylindrical shell 11 including the semi-shell main body 110 and the arc-surfaced splicing piece 115, the stacked installation of the fixed tooth row member 51 and the movable tooth row member 52 is more convenient. That

is, during assembly:

referring to Fig. 2, first, the stacked fixed tooth row member 51 and movable tooth row member 52 can be stacked on the surface of the arc-surfaced splicing piece 115 facing the arc-surfaced portion 111 of the semi-shell main body 110 of the first semi-cylindrical shell 11. For example, the fixed tooth row member 51 may further include fixed tooth installation lugs 512 protruding from the fixed tooth installation strip 511, and the movable tooth row member 52 may further include movable tooth installation lugs 522 protruding from the movable tooth installation strip 521. Moreover, the fixed tooth row member 51 and the movable tooth row member 52 can be stacked on the surface of the arc-surfaced splicing piece 115 using stack positioning pins 53 that pass through the fixed tooth installation lugs 512 and the movable tooth installation lugs 522 and are inserted into the arc-surfaced splicing piece 115;

then, with the fixed tooth row member 51 and the movable tooth row member 52 being oriented toward the arc-surfaced portion 111 of the semi-shell main body 110 of the first semi-cylindrical shell 11, the arc-surfaced splicing piece 115 as well as the stacked fixed tooth row member 51 and movable tooth row member 52 are together installed into the circular segment portion 112 of the semi-shell main body 110 of the first semi-cylindrical shell 11;

finally, the arc-surfaced splicing piece 115 is locked in the circular segment portion 112 of the semi-shell main body 110 of the first semi-cylindrical shell 11 using assembly positioning pins 113 along the axial direction of the rotating main shaft 10.

[0037] It can be understood that, if the cutting mechanism 50 is also arranged in pairs like the cleaning brush 40 and installed on the first semi-cylindrical shell 11 and the second semi-cylindrical shell 12 respectively, then the second semi-cylindrical shell 12 can adopt a structure basically the same as that of the first semi-cylindrical shell 11. That is, the second semi-cylindrical shell 12 can also have a mounting slit 15.

[0038] In the embodiments of the present application, as shown in Fig. 1a, Fig. 1b, and Fig. 2, the rotating main shaft 10 may further include multiple guide comb teeth 17 distributed and spaced apart on the outer shaft wall along the axial direction, to form a guide channel spanning the mounting slit 15 between every two adjacent guide comb teeth 17. For example, the guide comb teeth 17 can be distributed and spaced apart at slit edges on opposite sides of the mounting slit 15 in a slit width direction, that is, the guide comb teeth 17 can be provided at both an edge of the arc-surfaced portion 111 and an edge of the arc-surfaced splicing piece 115 that face each other. As shown in Fig. 1a, Fig. 1b, and Fig. 2, the mounting slit

15 is located between the guide comb teeth 17 at the arc-surfaced portion 111 and the guide comb teeth 17 at the splicing piece 115.

[0039] Specifically, as shown in Fig. 1a, Fig. 1b, and Fig. 2, the first semi-cylindrical shell 11 has two parts: a first part including the arc-surfaced portion 111 and the circular segment portion 112 adjacent to the arc-surfaced portion 111, and a second part including the arc-surfaced splicing piece 115. The top of the arc-surfaced portion 111 has the guide comb teeth 17, and a surface of the arc-surfaced portion 111 facing the arc-surfaced splicing piece 115 is formed with a notch with an L-shaped cross-section, i.e., the circular segment portion 112. The arc-surfaced splicing piece 115 is installed on the bottom surface of the L-shaped notch, and a surface of the arc-surfaced splicing piece 115 provided with the guide comb teeth 17 is opposite to and spaced from a vertical surface of the L-shaped notch, so that the mounting slit 15 is formed between the vertical surface of the L-shaped notch and the surface of the arc-surfaced splicing piece 115 provided with the guide comb teeth 17.

[0040] In this case, positions of the fixed teeth 510 and the guide comb teeth 17 in the axial direction are aligned with each other, to avoid the fixed teeth 510 blocking the guide channel. For example, the guide comb teeth 17 can have comb tooth side walls that are flush with the slit edges. The fixed teeth 510 can be positioned against and abut the comb tooth side walls of the guide comb teeth 17 at a slit edge on one side, and the movable teeth 520 can be in sliding cooperation with the comb tooth side walls of the guide comb teeth 17 at a slit edge on the other side.

[0041] In this embodiment, a reciprocal offset motion stroke of the movable teeth 520 relative to the fixed teeth 510 can be greater than a channel width of the guide channel in the axial direction of the rotating main shaft 10. Preferably, this motion stroke can be greater than a sum of the comb tooth width of the guide comb teeth 17 in the axial direction of the rotating main shaft 10 and the channel widths of two guide channels.

[0042] Based on the guide channels formed by the guide comb teeth 17, filament-shaped dirt can span the mounting slit 15 in an orientation perpendicular or approximately perpendicular to the mounting slit 15, making it easier for the filament-shaped dirt to be cut by the movable teeth 520 performing cutting motion along the mounting slit 15, thereby improving the cutting efficiency of the rolling brush assembly in autonomously and actively cutting filament-shaped dirt wound around the outer shaft wall of the rotating main shaft 10.

[0043] In the embodiment of the present application, the reciprocating cutting motion of the movable tooth row member 52 relative to the fixed tooth row member 51 can be driven by the cooperation of the axial movement mechanism 30 and the guiding mechanism 20. For example, based on the cooperative driving of the axial movement mechanism 30 and the guiding mechanism 20, the movable tooth row member 52 can perform one reciprocating cutting motion relative to the fixed tooth row

member 51 in response to each 360-degree rotation of the rotating main shaft 10.

[0044] The axial movement mechanism 30 can be movably installed along the axial direction of the rotating main shaft 10 within the hollow shaft cavity 100 of the rotating main shaft 10 surrounded by the outer shaft wall. The axial movement mechanism 30 can form a bidirectional synchronization constraint with the rotating main shaft 10 in the first rotating direction and the second rotating direction that are opposite to each other, and the axial movement mechanism 30 can also be in transmission cooperation with the movable tooth row member 52.

[0045] For example, as shown in Fig. 3, the axial movement mechanism 30 may include a transmission slider 31. The transmission slider 31 can reciprocate in the axial direction of the rotating main shaft 10, and the transmission slider 31 can form a bidirectional synchronization constraint with the rotating main shaft 10 in the first rotating direction and the second rotating direction that are opposite to each other.

[0046] Specifically, the transmission slider 31 of the axial movement mechanism 30 may include a radial convex key 311. As shown in Fig. 2, the rotating main shaft 10 may include a sliding keyway 18 located within the hollow shaft cavity 100, and the radial convex key 311 can be inserted into the sliding keyway 18, thereby utilizing a limiting cooperation of the radial convex key 311 and the sliding keyway 18 in the first rotating direction and the second rotating direction to enable the transmission slider 31 to form a bidirectional synchronization constraint with the rotating main shaft 10 in the first rotating direction and second rotating direction that are opposite to each other, and also utilizing the clearance cooperation between the radial convex key 311 and the sliding keyway 18 in the axial direction of the rotating main shaft 10 to enable the axial movement mechanism 30 to reciprocate in the axial direction of the rotating main shaft 10.

[0047] Moreover, as shown in Fig. 3, the transmission slider 31 of the axial movement mechanism 30 may further include a retaining groove 315, the movable tooth row member 52 may further include a movable tooth transmission arm 523 extending from the movable tooth installation strip 521 into the hollow shaft cavity 100, and the movable tooth transmission arm 523 can be inserted into the retaining groove 315, thereby utilizing a limiting cooperation of the movable tooth transmission arm 523 and the retaining groove 315 in the axial direction of the rotating main shaft 10 to enable the movable tooth row member 52 to perform reciprocating cutting motion relative to the fixed tooth row member 51 following the reciprocating movement of the axial movement mechanism 30 in the axial direction of the rotating main shaft 10. In this case, the mounting slit 15 can extend through the outer shaft wall of the rotating main shaft 10 into the hollow shaft cavity 100 (i.e., the arc-surfaced portion 111 and the circular segment portion 112 have communication slits that enables the mounting slit 15 to extend

into the hollow shaft cavity 100), to allow the movable tooth transmission arm 523 of the movable tooth row member 52 to extend into the hollow shaft cavity 100 through the mounting slit 15.

[0048] In this embodiment, the guiding mechanism 20 is in transmission cooperation with the axial movement mechanism 30 within the hollow shaft cavity 100 of the rotating main shaft 10. When the guiding mechanism 20 is in the rotation-locking state under a rotation-locking constraint, this transmission cooperation can cause the axial movement mechanism 30 to undergo reciprocating axial movement during following the rotation of the rotating main shaft 10.

[0049] In the embodiments of the present application, as shown in Fig. 1a, Fig. 1b, and Fig. 2, a first shaft end of the rotating main shaft 10 can be provided with a drive end cover 14, and a second shaft end of the rotating main shaft 10 can be provided with a follower sleeve ring 13. The drive end cover 14 and the follower sleeve ring 13 each form a bidirectional synchronization constraint with the rotating main shaft 10 in the first rotating direction and the second rotating direction, and the drive end cover 14 is configured to be in transmission cooperation with a power motor. Moreover, the second shaft end of the rotating main shaft 10 also has a static end cover 130 that is in rotational cooperation with the follower sleeve ring 13. For example, the static end cover 130 can be rotatably fitted through the follower sleeve ring 13. Therefore, when the rotating main shaft 10 is driven to rotate by the power motor through the drive end cover 14, the follower sleeve ring 13 will also rotate following rotation of the rotating main shaft 10. Moreover, the static end cover 130 can still remain in a stationary state without following the rotation of the rotating main shaft, and the rotation-locking constraint on the guiding mechanism 20 can be from the second shaft end of the rotating main shaft 10 (i.e., the static end cover 130). Additionally, the static end cover 130 can be axially limited at the second shaft end of the rotating main shaft 10 by the follower sleeve ring 13 fixedly connected to the rotating main shaft 10.

[0050] Specifically, the transmission cooperation between the guiding mechanism 20 and the axial movement mechanism 30 within the hollow shaft cavity 100 of the rotating main shaft 10 can adopt a screwing cooperation. The screwing axis of this screwing cooperation is inclined relative to the axial direction of the rotating main shaft 10. That is, the transmission cooperation between the guiding mechanism 20 and the axial movement mechanism 30 can be achieved through the screwing cooperation. In this case, as shown in Fig. 3, the axial movement mechanism 30 may further include a guide rotating shaft 32 coaxially connected to the axial movement slider 31. The guide rotating shaft 32 can have an inclined annular groove 320. The guiding mechanism 20 may include an inner sleeve 21, a guiding ball 22 and an outer sleeve 23, and the rotation-locking state of the guiding mechanism 20 under the rotation-locking con-

straint means that the inner sleeve 21 and the outer sleeve 23 do not rotate following the rotation of the rotating main shaft 10.

[0051] The inner sleeve 21 is sleeved on the outer periphery of the guide rotating shaft 32 and covers the inclined annular groove 320 of the guide rotating shaft 32. The central axis of the inclined annular groove 320 is inclined relative to the axial direction of the rotating main shaft 10, and the screwing axis of the aforementioned screwing cooperation coincides with the central axis of the inclined annular groove 320. The inner sleeve 21 is provided with ball-accommodating through hole 210 penetrating a wall of the sleeve. The guiding ball 22 is rollably accommodated in the ball-constraining through hole 210 and are in spherical matching with the inclined annular groove 320 covered by the inner sleeve 21. The outer sleeve 23 is sleeved on the outside of the inner sleeve 21 and covers the guiding ball 22, to prevent the guiding ball 22 from falling off from the inclined annular groove 320 and the ball-accommodating through hole 210. Thus, when the axial movement mechanism 30 rotates following the rotating main shaft 10, the guide rotating shaft 32 can drive the guiding ball 22 to rotate through the spherical match between the inclined annular groove 320 and the guiding ball 22, and both the phase position in the rotating direction and the axial position in the axial direction of the guiding ball 22 are fixed by the inner sleeve 21. Therefore, the rotation of the guiding ball 22 will cause the change in the spherical match position between the guiding ball 22 and the inclined annular groove 320.

[0052] Since the spherical match position between the inclined annular groove 320 and the guiding ball 22 changes reciprocally in the axial direction during the rotation process, the change in the spherical match position between the guiding ball 22 and the inclined annular groove 320 can cause the axial movement mechanism 30 to undergo reciprocating axial movement during following the rotation of the rotating main shaft 10.

[0053] That is to say, the spherical match between the guiding ball 22 and the inclined annular groove 320 is configured to guide the screwing of the axial movement mechanism 30 relative to the guiding mechanism 20, and the axial movement mechanism 30 can generate reciprocating axial movement in response to the change in the spherical match position between the guiding ball 22 and the inclined annular groove 320.

[0054] In the embodiments of the present application, the guiding mechanism 20 can selectively receive the rotation-locking constraint from the second shaft end (i.e., the static end cover 130) of the rotating main shaft 10. That is, the guiding mechanism 20 is switchable between a rotation-locking state and a rotation-following state where it rotates following the axial movement mechanism 30, and the switching of the guiding mechanism 20 between the rotation-locking state and the rotation-following state is controlled by the clutch mechanism 90.

[0055] Referring to Fig. 2, the clutch mechanism 90 is

in transmission cooperation with the guiding mechanism 20 within the hollow shaft cavity 100 of the rotating main shaft 10, and the clutch mechanism 90 can be configured to switch between a first clutch state and a second clutch state in response to the rotating direction state of the rotating main shaft 10 and the axial movement mechanism 30, wherein:

when the axial movement mechanism 30 rotates along the first rotating direction following the rotating main shaft 10, for example, when the power motor drives the rotating main shaft 10 to rotate along the first rotating direction through the drive end cover 14 while the sweeping robot is in a self-cleaning mode in a stationary state, the clutch mechanism 90 is in the first clutch state where the guiding mechanism 20 is kept in the aforementioned rotation-locking state. Moreover, as described earlier, the axial movement mechanism 30 rotating along the first rotating direction following the rotating main shaft 10 can be guided by the guiding mechanism 20 in the rotation-locking state to perform reciprocating axial movement along the axial direction. The reciprocating axial movement of the axial movement mechanism 30 can trigger reciprocating cutting motion of the movable tooth row member 52 relative to the fixed tooth row member 51;

when the axial movement mechanism 30 rotates along the second rotating direction following the rotating main shaft 10, for example, when the power motor drives the rotating main shaft 10 to rotate along the second rotating direction while the sweeping robot is in an operating mode in a moving state, the clutch mechanism 90 is in the second clutch state where the guiding mechanism 20 is kept in the aforementioned rotation-following state. The guiding mechanism 20 in the rotation-following state can cancel the guidance on the axial movement mechanism 30 by rotating along the second rotating direction following the axial movement mechanism 30. The first rotating direction and the second rotating direction are opposite to each other, for example, may be a clockwise direction and a counterclockwise direction respectively. Of course, the first rotating direction and the second rotating direction can also be counterclockwise direction and clockwise direction respectively, which is not limited in the solution of the present application.

[0056] Based on the above embodiments, the rolling brush assembly includes the rotating main shaft 10, the cutting mechanism 50, and the clutch mechanism 90. The cutting mechanism 50 includes the fixed tooth row member 51 and the movable tooth row member 52 which are in stack arrangement. The clutch mechanism 90 can change its clutch state in response to the change in the rotating direction of the rotating main shaft 10, so that the

movable tooth row member 52 performs reciprocating cutting motion relative to the fixed tooth row member 51 in response to rotation of the rotating main shaft 10 along the first rotating direction, and stops the reciprocating cutting motion when the rotating main shaft 10 rotates along the second rotating direction. Therefore, by switching the rotating direction of the rotating main shaft 10, the start or stop of the reciprocating cutting motion of the movable tooth row member 52 relative to the fixed tooth row member 51 can be controlled, thereby reducing the friction noises and ineffective power consumption generated by the cutting mechanism by selectively controlling the stop of the reciprocating cutting motion.

[0057] Fig. 4 is a cross-sectional view of the clutch mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application. Referring to Fig. 4, as described earlier, the first shaft end of the rotating main shaft 10 is provided with the drive end cover 14, and the second shaft end of the rotating main shaft 10 is provided with the static end cover 130. The drive end cover 14 forms a bidirectional synchronization constraint with the rotating main shaft 10 in the first rotating direction and the second rotating direction. The drive end cover 14 is configured to be in transmission cooperation with the power motor, and the rotating main shaft 10 is in rotational cooperation with the static end cover 130. In this case, the clutch mechanism 90 is located between the guiding mechanism 20 and the static end cover 130, wherein the clutch mechanism 90 can axially limit the guiding mechanism 20, to enable the relative axial position between the guiding mechanism 20 and the static end cover 130 to be fixed, and:

when the clutch mechanism 90 is in the first clutch state, the clutch mechanism 90 forms a rotation-locking constraint between the guiding mechanism 20 and the static end cover 130 that prevents the guiding mechanism 20 from rotating relative to the static end cover 130 along the first rotating direction, to constrain the guiding mechanism 20 in the rotation-locking state;

when the clutch mechanism 90 is in the second clutch state, the guiding mechanism 20 is in the rotation-following state where it can freely rotate relative to the static end cover 130 under the driving of the axial movement mechanism 30.

[0058] Fig. 5 is a schematic partial structure diagram of the clutch mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application. Fig. 6 is a schematic diagram of the operating principle of the clutch mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application. Referring to Fig. 5 and Fig. 6, and referring back to Fig. 2 and Fig. 4, in the embodiments of the present application, the clutch mechanism 90 may include a clutch sliding sleeve 93 mo-

vable in the axial direction of the rotating main shaft 10, wherein:

when the clutch sliding sleeve 93 is located at a first axial position, the clutch mechanism 90 is in the aforementioned first clutch state;

when the clutch sliding sleeve 93 is located at a second axial position, the clutch mechanism 90 is in the aforementioned second clutch state;

the clutch sliding sleeve 93 is configured to switch between the first axial position and the second axial position in response to switching between the first rotating direction and the second rotating direction, to achieve state switching of the clutch mechanism 90 between the aforementioned first clutch state and second clutch state.

[0059] Moreover, the clutch mechanism 90 may further include a fixed tooth ring 91 and a transmission tooth ring 92.

[0060] The fixed tooth ring 91 is fixedly connected to the static end cover 130. For example, the clutch mechanism 90 may further include a fixed shaft base 97 coaxially fixedly connected to the static end cover 130, and the fixed tooth ring 91 is integrated on an end face of the fixed shaft base 97 facing the clutch sliding sleeve 93. As shown in Fig. 2 and Fig. 5, in the embodiment of the present application, the fixed shaft base 97 can be coaxially fixedly connected to the static end cover 130 through an axial screw 971; the fixed shaft base 97 can also be sleeved with a shaft base bearing 972 to maintain the coaxiality between the fixed shaft base 97 and the static end cover 130 using the shaft base bearing 972; and the fixed shaft base 97 can also be in plug-in fit with the static end cover 130, and has a rotation-locking keyway 973 in a portion of the fixed shaft base 97 inserted into the static end cover 130, to maintain a rotation-locking limit with the static end cover 130 in the first rotating direction and the second rotating direction by using the rotation-lock keyway 973.

[0061] In this embodiment, the transmission tooth ring 92 is fixedly connected to the guiding mechanism 20. For example, as shown in Fig. 2 and Fig. 6, the clutch mechanism 90 may further include a transmission shaft rod 98 coaxially fixedly connected to the guiding mechanism 20 (for example, the inner sleeve 21), and the transmission tooth ring 92 can be fixedly sleeved on the transmission shaft rod 98. The fixed sleeving of the transmission tooth ring 92 on the transmission shaft rod 98 means that the transmission tooth ring 92 is fixed relative to the transmission shaft rod 98 in the axial direction of the rotating main shaft 10 as well as in the first rotating direction and the second rotating direction. For example, the transmission shaft rod 98 can have a synchronization keyway 981, and the transmission tooth ring 92 can achieve limiting cooperation with the transmission shaft

rod 98 in the first rotating direction and the second rotating direction by using the synchronization keyway 981. For another example, the transmission shaft rod 98 can also have a positioning annular groove 982, and the transmission tooth ring 92 can be axially limited by a synchronization snap ring 983 snap-fitted into the positioning annular groove 982, to be fixed relative to the transmission shaft rod 98 in the axial direction of the rotating main shaft 10.

[0062] Moreover, as shown in Fig. 2, Fig. 4 to Fig. 6, one end of the transmission shaft rod 98 facing the transmission mechanism 20 can be coaxially fixedly connected to the guiding mechanism 20 (for example, the inner sleeve 21) through a screw, and the end of the transmission shaft rod 98 fixedly connected to the transmission mechanism 20 can be sleeved with an end bearing 984; an end of the transmission shaft rod 98 facing the fixed shaft base 97 has an embedded shaft end 985, wherein the embedded shaft end 985 can be inserted into the fixed shaft base 97, and can achieve coaxial rotational cooperation with the fixed shaft base 97 through an embedded bearing 986 embedded in the fixed shaft base 97. Thus, the transmission shaft rod 98 form an axial support between the guiding mechanism 20 and the static end cover 130, i.e., form an axial limiting that enables the relative axial position between the guiding mechanism 20 and the static end cover 130 to be fixed.

[0063] In this embodiment, the clutch sliding sleeve 93 is movably installed between the fixed tooth ring 91 and the transmission tooth ring 92. For example, the clutch sliding sleeve 93 can be movably sleeved on the transmission shaft rod 98 along the axial direction.

[0064] When the clutch mechanism 90 includes both the fixed tooth ring 91 and the transmission tooth ring 92 as well as the clutch sliding sleeve 93:

as shown in Fig. 2, Fig. 4 to Fig. 6, an end of the fixed tooth ring 91 facing the clutch sliding sleeve 93 can have a clutch convex tooth groove 910, and an end of the transmission tooth ring 92 facing the clutch sliding sleeve 93 has a transmission tooth groove 920;

[0065] The first annular opening end of the clutch sliding sleeve 93 facing the fixed tooth ring 91 has a clutch convex tooth 931, and the second annular opening end of the clutch sliding sleeve 93 facing the transmission tooth ring 92 has a transmission convex tooth 932.

Based on the above structure:

[0066] As shown in the upper enlarged view of Fig. 6, when the clutch sliding sleeve 93 is located at the first axial position where the clutch mechanism 90 is caused to be in the first clutch state, the clutch convex tooth 931 and the clutch convex tooth groove 910 form a first limiting engagement that prevents the clutch sliding sleeve 93 from rotating relative to the static end cover 130 along the first rotating direction; the transmission convex tooth 932 and the transmission tooth groove 920 form a second limiting engagement that prevents the guiding mechanism 20 from rotating relative to the clutch sliding sleeve 93 along the first rotating direction, and the aforementioned rotation-locking constraint is applied to the guiding mechanism 20 through the cascade cooperation of the first limiting engagement and the second limiting engagement; wherein the first limiting engagement can be a tight engagement, and the second limiting engagement can be a partial engagement. That is, in the first clutch state, the clutch convex tooth 931 is tightly engaged with the clutch convex tooth groove 910; the transmission convex tooth 932 is partially engaged with the transmission tooth groove 920.

[0067] As shown in the lower enlarged view of Fig. 6, when the clutch sliding sleeve 93 is located at the second axial position where the clutch mechanism 90 is caused to be in the second clutch state, the clutch convex tooth 931 disengage from the clutch convex tooth groove 910, and the first limiting engagement and the second limiting engagement formed when the clutch sliding sleeve 93 is at the first axial position, are released in response to the disengagement of the clutch convex tooth 931 from the clutch convex tooth groove 910. The transmission convex tooth 932 and the transmission tooth groove 920 form a tight engagement that prevents the guiding mechanism 20 from rotating relative to the clutch sliding sleeve 93 along the first rotating direction, to form the aforementioned synchronous drive engagement.

[0068] Specifically, please pay special attention to Fig. 5:

the clutch convex tooth groove 910 has a rotation-locking limiting groove wall 910a parallel to a longitudinal section of the rotating main shaft 10 on a first phase side opposite to the first rotating direction, and the clutch convex tooth groove 910 has a first arc-surfaced groove wall 910b on a second phase side in the first rotating direction;

the clutch convex tooth 931 has a rotation-locking limiting tooth wall 931a parallel to the longitudinal section of the rotating main shaft 10 on the second phase side in the first rotating direction, and the clutch convex tooth 931 has a first arc-surfaced tooth wall 931b matching with the first arc-surfaced groove wall 910b on the first phase side opposite to the first rotating direction;

the transmission tooth groove 920 has a second arc-surfaced groove wall 920a on the second phase side in the first rotating direction, and the transmission tooth groove 920 has a synchronous engagement groove wall 920b parallel to the longitudinal section of the rotating main shaft 10 on the first phase side;

the transmission convex tooth 932 has a second arc-surfaced tooth wall 932a matching with the second arc-surfaced groove wall 920a on the first phase side opposite to the first rotating direction, and the trans-

mission convex tooth 932 has a synchronous engagement tooth wall 932b parallel to the longitudinal section of the rotating main shaft 10 on the second phase side in the first rotating direction.

[0069] Thus, as shown in Fig. 6:

when the clutch sliding sleeve 93 is at the first axial position where the clutch mechanism 90 is caused to be in the first clutch state, the rotation-locking limiting tooth wall 931a and rotation-locking limiting groove wall 910a opposite to each other form the aforementioned first limiting engagement through planar-surface contact, and the second arc-surfaced tooth wall 932a and the second arc-surfaced groove wall 920a opposite to each other form the aforementioned second limiting engagement through arc-surface contact;

when the clutch sliding sleeve 93 is at the second axial position where the clutch mechanism 90 is caused to be in the second clutch state, the synchronous engagement groove wall 920b and the synchronous engagement tooth wall 932b opposite to each other form the aforementioned synchronous drive engagement through planar-surface contact.

when the clutch sliding sleeve 93 is located at the second axial position, the first limiting engagement and the second limiting engagement formed when the clutch sliding sleeve 93 is at the first axial position also generate a first axial retaining force that prevents the clutch sliding sleeve 93 from leaving the first axial position. For example, the first axial retaining force can include the sum of the surface contact friction between the rotation-locking limiting tooth wall 931a and the rotation-locking limiting groove wall 910a, and the axial component of an arc-surface contact pressure between the second arc-surfaced tooth wall 932a and the second arc-surfaced groove wall 920a;

when the clutch sliding sleeve 93 is located at the second axial position, the transmission convex tooth 932 and the transmission tooth groove 920 also form a synchronous drive engagement that causes the clutch sliding sleeve 93 to rotate along the second rotating direction together with the guiding mechanism 20 under the driving of the axial movement mechanism 30, and the synchronous drive engagement generates a second axial retaining force that causes the clutch sliding sleeve 93 to prevent the clutch sliding sleeve 93 from leaving the second axial position. For example, the second axial retaining force can include the surface contact friction between the synchronous engagement groove wall 920b and the synchronous engagement tooth wall 932b.

[0070] Moreover, during the position switching of the clutch sliding sleeve 93 between the first axial position and the second axial position, sliding cooperation for guiding the position switching is generated between the first arc-surfaced groove wall 910b and first arc-surfaced tooth wall 931b opposite to each other, and between the second arc-surfaced tooth wall 932a and the second arc-surfaced groove wall 920a opposite to each other.

[0071] Fig. 7 is a schematic diagram of the state switching process of the clutch mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application. Referring to Fig. 7, in the embodiment of the present application, the clutch mechanism 90 of the rolling brush assembly may further include a switching mechanism 95, wherein:

as shown in the upper enlarged view of Fig. 7, when the axial movement mechanism 30 switches from the second rotating direction to the first rotating direction to rotate following the rotating direction of the rotating main shaft 10, the switching mechanism 95 generates, in response to a first phase offset of the guiding mechanism 20 in the first rotating direction following the axial movement mechanism 30, a first axial driving force that drives the clutch sliding sleeve 93 to move from the second axial position to the first axial position;

as shown in the lower enlarged view of Fig. 7, when the axial movement mechanism 30 switches from the first rotating direction to the second rotating direction to rotate following the rotating direction of the rotating main shaft 10, the switching mechanism 95 generates, in response to a second phase offset of the guiding mechanism 20 in the second rotating direction following the axial movement mechanism 30, a second axial driving force that drives the clutch sliding sleeve 93 to move from the first axial position to the second axial position.

[0072] Specifically, the clutch sliding sleeve 93 has an inclined guide groove 935 inclined at a preset angle (for example, 45°) relative to the axial direction of the rotating main shaft 10. The first groove end 935a of the inclined guide groove 935 is inclined toward the first axial position, and the second groove end 935b of the inclined guide groove 935 is inclined toward the second axial position.

[0073] Moreover, as shown in Fig. 7, the switching mechanism 95 includes a fixed outer cylinder 951 and a reversing ball 952. The fixed outer cylinder 951 is sleeved on the outer periphery of the clutch sliding sleeve 93, the fixed outer cylinder 951 covers the inclined guide groove 935, and the fixed outer cylinder 951 is constrained to be stationary relative to the static end cover 130. For example, the fixed outer cylinder 951 and the fixed tooth ring 91 both can be integrated on the end face of the fixed shaft base 97 facing the clutch sliding sleeve 93, or the fixed outer cylinder 951 can be a component

independent of the fixed shaft base 97 and be coaxially fixedly connected to the fixed shaft base 97; the reversing ball 952 is movably accommodated in the inclined guide groove 935. The fixed outer cylinder 951 drives the reversing ball 952 to rotate in the inclined guide groove 935. The inclined guide groove 935 provides a leftward decomposition force during forward rotation to stabilize the tight engagement between the transmission convex tooth 932 and the transmission tooth groove 920, and provides a rightward decomposition force during reverse rotation to stabilize the tight engagement between the clutch convex tooth 931 and the clutch tooth groove 910. Moreover, the inclined guide groove 935 can be set between two convex ribs.

[0074] As described earlier, the clutch mechanism 90 may further include the transmission shaft rod 98 coaxially fixedly connected to the guiding mechanism 20, and the transmission tooth ring 92 is fixedly sleeved on the transmission shaft rod 98, and the clutch sliding sleeve 93 is movably sleeved on the transmission shaft rod 98. In this case, the reversing ball 952 accommodated in the inclined guide groove 935 can be confined between the transmission shaft rod 98 and the fixed outer cylinder 951, and is in rolling cooperation with the transmission shaft rod 98 and the fixed outer cylinder 951.

Based on the above structure:

[0075]

as shown in the upper enlarged view of Fig. 7, when the axial movement mechanism 30 switches from the second rotating direction to the first rotating direction to rotate following the rotating direction of the rotating main shaft 10, the guiding mechanism 20 can drive, during the occurrence of the aforementioned first phase offset, the reversing ball 952 through the transmission shaft rod 98 to produce a first planetary motion in the first rotating direction on the inner surface of the fixed outer cylinder 951. The first planetary motion of the reversing ball 952 causes a relative position change of the reversing ball 952 in the inclined guide groove 935 from the second groove end 935b to the first groove end 935a, and the first planetary motion of the reversing ball 952 has an offset component toward the first axial position, thereby enabling the reversing ball 952 to generate the aforementioned first axial driving force on the inclined guide groove 935;

as shown in the lower enlarged view of Fig. 7, when the axial movement mechanism 30 switches from the first rotating direction to the second rotating direction following the rotating direction of the rotating main shaft 10, the guiding mechanism 20 can drive, during the occurrence of the aforementioned second phase offset, the reversing ball 952 through the transmission shaft rod 98 to produce a second

planetary motion in the second rotating direction on the inner surface of the fixed outer cylinder 951. The second planetary motion of the reversing ball 952 causes a relative position change of the reversing ball 952 in the inclined guide groove 935 from the first groove end 935a to the second groove end 935b, and the second planetary motion of the reversing ball 952 has an offset component toward the second axial position, thereby causing the reversing ball 952 to generate the aforementioned second axial driving force on the inclined guide groove 935.

[0076] In the embodiment of the present application, to avoid rigid interference between the movable tooth row member 52 and the side walls of the mounting slit 15 when the movable tooth row member 52 performs reciprocating cutting motion relative to the fixed tooth row member 51, the slit width of the mounting slit 15 can be set to be greater than the thickness of the stack of the fixed tooth row member 51 and the movable tooth row member 52 of the cutting mechanism 50. In this case, there may be a gap between the fixed tooth row member 51 and the movable tooth row member 52 in the stacking direction.

[0077] Fig. 8 is an exploded structure diagram of the rolling brush assembly for a sweeping robot further including a preload mechanism according to an embodiment of the present application. Referring to Fig. 8, to suppress the aforementioned gap, in the embodiment of the present application, the rolling brush assembly may further include a preload mechanism 80.

[0078] The preload mechanism 80 can apply an elastic preload force to the cutting mechanism 50 in the stacking direction of the fixed tooth row member 51 and the movable tooth row member 52, and the preload force applied by the preload mechanism 80 to the cutting mechanism 50 can suppress the gap between the fixed tooth row member 51 and the movable tooth row member 52 in the stacking direction during the reciprocating cutting motion of the movable tooth row member 52 along the axial direction relative to the fixed tooth row member 51.

[0079] For example, the preload mechanism 80 can be installed in the mounting slit 15, and the preload mechanism 80 can generate the aforementioned elastic preload force on the cutting mechanism 50 in the stacking area of the fixed tooth installation strip 511 and the movable tooth installation strip 521.

[0080] Thus, during the reciprocating cutting motion of the movable tooth row member 52 relative to the fixed tooth row member 51, the gap between the fixed tooth row member 51 and the movable tooth row member 52 in the stacking direction can be suppressed or even completely eliminated, to facilitate reducing the failure probability of cutting achieved by the reciprocating cutting motion, thereby facilitating improvement of the cutting efficiency of the cutting mechanism for filament-shaped dirt.

[0081] In the embodiment of the present application, the fixed tooth installation strip 511 is close to a first side wall of the mounting slit 15 in the slit width direction (for example, a surface of the arc-surfaced portion 111 facing the arc-surfaced splicing piece 115), and the movable tooth installation strip 521 is close to a second side wall of the mounting slit 15 in the slit width direction (for example, a surface of the arc-surfaced splicing piece 115 facing the arc-surfaced portion 111). In this case, as shown in Fig. 8, the preload mechanism 80 may include a first preload mechanism 81 and/or a second preload mechanism 82.

[0082] The first preload mechanism 81 is installed at the first side wall of the mounting slit 15, the first preload mechanism 81 is in surface contact with the fixed tooth installation strip 511, and the elastic preload force generated by the preload mechanism 80 on the cutting mechanism 50 includes a first elastic preload force generated by the first preload mechanism 81 through surface contact with the fixed tooth installation strip 511.

[0083] The second preload mechanism 82 is installed at the second side wall of the mounting slit 15, the second preload mechanism 82 is in point contact with the movable tooth installation strip 521. Preferably, the second preload mechanism 82 can be in sliding and rolling cooperation with the movable tooth installation strip 521 at the point contact position to reduce friction between the second preload mechanism 82 and the movable tooth installation strip 521, and the elastic preload force produced by the preload mechanism 80 on the cutting mechanism 50 includes a second elastic preload force generated by the second preload mechanism 82 through point contact with the movable tooth installation strip 521.

[0084] Fig. 9 is a schematic partial hierarchical structure diagram of a first example of the preload mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application. Fig. 10 is a cross-sectional view of the first example of the preload mechanism shown in Fig. 9. In the first example shown in Fig. 9 and Fig. 10, the preload mechanism 80 may include the first preload mechanism 81 and does not include the second preload mechanism 82. In this case, to reduce friction between the movable tooth row member 52 (i.e., the movable tooth installation strip 521) and the second side wall of the mounting slit 15, the second side wall of the mounting slit 15 may have a side wall convex rib 153, and the side wall convex rib 153 can be in line contact with the movable tooth installation strip 521. Compared with the surface contact friction between the movable tooth row member 52 (i.e., the movable tooth installation strip 521) and the second side wall of the mounting slit 15, the line contact friction between the side wall convex rib 153 and the movable tooth installation strip 521 is smaller.

[0085] Fig. 11 is a schematic partial hierarchical structure diagram of a second example of the preload mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application. Fig. 12 is a cross-sectional view of the second

example of the preload mechanism shown in Fig. 11. In the second example shown in Fig. 11 and Fig. 12, the preload mechanism 80 may include the second preload mechanism 82 and does not include the first preload mechanism 81. Since the fixed tooth row member 51 does not move axially, the contact manner between the fixed tooth row member 51 and the first side wall of the mounting slit 15 is not limited, and the fixed tooth row member 51 is preferably in surface contact with the first side wall of the mounting slit 15.

[0086] Fig. 13 is a schematic partial hierarchical structure diagram of a third example of the preload mechanism of the rolling brush assembly for a sweeping robot according to an embodiment of the present application. Fig. 14 is a cross-sectional view of the third example of the preload mechanism shown in Fig. 13. In the third example shown in Fig. 13 and Fig. 14, the preload mechanism 80 may include both the first preload mechanism 81 and the second preload mechanism 82.

[0087] As can be seen from Fig. 9 and Fig. 10 as well as Fig. 13 and Fig. 14, the first preload mechanism 81 includes a strip-shaped elastic body. For example, the first preload mechanism 81 may include multiple strip-shaped elastic body segments arranged in segments to avoid the stack positioning pins 53. The first preload mechanism 81 (i.e., the strip-shaped elastic body) can be fixedly installed in a side wall groove 151 of the first side wall 511, and the first preload mechanism 81 (i.e., the strip-shaped elastic body) is compressed to deform by the fixed tooth installation strip 511 in the stacking direction of the fixed tooth row member 51 and the movable tooth row member 52. For example, the normal thickness of the strip-shaped elastic body in the stacking direction of the fixed tooth row member 51 and the movable tooth row member 52 is greater than a depth of the side wall groove 151 in this stacking direction, and a portion of the strip-shaped elastic body is accommodated in the side wall groove 151 while another portion of the strip-shaped elastic body protrudes from the side wall groove 151 into the mounting slit 15 to be in surface contact with the fixed tooth installation strip 511. Thus, the first elastic preload force generated by the first preload mechanism 81 can include a regional elastic force generated by the first preload mechanism 81 (i.e., the strip-shaped elastic body) due to compressive deformation in a region where the first preload mechanism 81 is in surface contact with the fixed tooth row member 51.

[0088] As can be seen from Fig. 11 to Fig. 14, the second preload mechanism 82 may include a preload spring 821 and a floating ball 822. The preload spring 821 is inserted inside a side wall blind hole 152 of the second side wall of the mounting slit 15. The floating ball 822 is in point contact with the movable tooth installation strip 521 through sliding and rolling cooperation with the movable tooth installation strip 521 at the opening of the side wall blind hole 152. The preload spring 821 is compressed to deform by the movable tooth installation strip 521 through the floating ball 822, and the second elastic preload force

generated by the second preload mechanism 82 includes the discrete elastic force generated by the preload spring 821 due to compressive deformation through the floating ball 822 in a sliding and rolling manner at the point contact position.

[0089] The above is a detailed description of the rolling brush assembly in the embodiments of the present application. In another embodiment of the present application, a sweeping robot employing the rolling brush assembly is also provided.

[0090] Fig. 15 is a schematic partial structure diagram of a sweeping robot according to an embodiment of the present application. Fig. 16 is a schematic structural diagram of the integrated cavity shell of the sweeping robot according to an embodiment of the present application. Referring to Fig. 15 and Fig. 16, the sweeping robot in the embodiment of the present application may include a mobile chassis 70 (only the chassis panel of the mobile chassis 70 is exemplarily shown in the figure), an integrated cavity shell 60 carried on the mobile chassis 70, and the rolling brush assembly described in the foregoing embodiments.

[0091] The mobile chassis 70 has a chassis opening 700, the integrated cavity shell 60 has a sweeping window 61 exposed at the chassis opening 700, the rolling brush assembly is installed in the integrated cavity shell 60, and the installation position of the rolling brush assembly in the integrated cavity shell 60 causes the cleaning brush 40 to extend outside the sweeping window 61 during the rotation process of the rotating main shaft 10 relative to the guiding mechanism 20, to perform a sweeping operation.

[0092] The integrated cavity shell 60 is also fixedly provided with a power motor 71, the first shaft end of the rotating main shaft 10 (for example, the drive end cover 14 installed at the first shaft end) can be in transmission cooperation with the power motor 71 (for example, transmission cooperation with the power motor 71 through a speed reduction mechanism 72). The power motor 71 can drive the rotating main shaft 10 to rotate along the first rotating direction when the sweeping robot is in a self-cleaning mode where the mobile chassis 70 stops moving, and the power motor 71 can drive the rotating main shaft 10 to rotate along the second rotating direction when the sweeping robot is in an operating mode where the mobile chassis 70 moves.

[0093] The integrated cavity shell 60 can have a rolling brush cavity 600 for accommodating the rolling brush assembly, the sweeping window 61 is communicated with this rolling brush cavity 600, and cavity walls of the rolling brush cavity 600 on two opposite side have a support shaft base 63 and a power shaft base 64 respectively, wherein:

the first shaft end of the rotating main shaft 10 (for example, the drive end cover 14) can be installed in the power shaft base 64, the input shaft of the speed reduction mechanism 72 is connected to the power

motor 71, the output shaft of the speed reduction mechanism 72 is located at the power shaft base 64, and the first shaft end of the rotating main shaft 10 (for example, the drive end cover 14) can be coaxially connected with the output shaft of the speed reduction mechanism 72 at the power shaft base 64;

the second shaft end of the rotating main shaft 10 (for example, the static end cover 130) can be installed at the support shaft base 63, the support shaft base 63 has a rotation-locking notch 65 that is in limiting cooperation with the static end cover 130, and the static end cover 130 can be rotationally locked at the support shaft base 63 by the rotation-locking notch 65. Thus, when the clutch mechanism 90 is in the first clutch state, the clutch mechanism 90 is configured to keep the guiding mechanism 20 in the rotation-locking state by using the rotation-locking constraint applied by the integrated cavity shell 60 on the second shaft end of the rotating main shaft 10 opposite to the first shaft end.

[0094] Fig. 17 is a schematic diagram of the docking structure between the integrated cavity shell shown in Fig. 16 and the dust collection member. Referring to Fig. 17 and simultaneously referring back to Fig. 16, in the embodiment of the present application, the integrated cavity shell 60 can also have a suction window 62 for communicating with a dust collection mechanism. For example, this suction window 62 can be communicated with the rolling brush cavity 600, and this suction window 62 can be provided with a channel assembly 66 for docking with the dust collection member.

[0095] The sweeping robot in the embodiment of the present application adopting the aforementioned rolling brush assembly, can reduce the friction noises and ineffective power consumption generated by the cutting mechanism.

[0096] The above are only preferred embodiments of the present invention and are not intended to limit the present invention. Any modifications, equivalent replacements, improvements, etc., made within the spirit and principles of the present invention shall be included within the protection scope of the present invention.

Claims

1. A rolling brush assembly for a sweeping robot comprising:

a rotating main shaft (10), the rotating main shaft (10) being provided with a cleaning brush (40) extending radially from an outer shaft wall;
a cutting mechanism (50), the cutting mechanism (50) comprising a fixed tooth row member (51) and a movable tooth row member (52) installed at the outer shaft wall along an axial

direction of the rotating main shaft (10);
 an axial movement mechanism (30), the axial
 movement mechanism (30) being movably in-
 stalled along the axial direction within a hollow
 shaft cavity (100) of the rotating main shaft (10) 5
 surrounded by the outer shaft wall, and the axial
 movement mechanism (30) and the rotating
 main shaft (10) forming a bidirectional synchro-
 nization constraint in a first rotating direction and
 a second rotating direction that are opposite to 10
 each other;
 a guiding mechanism (20), the guiding mechan-
 ism (20) being in transmission cooperation with
 the axial movement mechanism (30) within the
 hollow shaft cavity (100), an axial position of the
 guiding mechanism (20) within the hollow shaft
 cavity (100) being fixed, and the guiding me- 15
 chanism (20) being switchable between a rota-
 tion-locking state and a rotation-following state;
 a clutch mechanism (90), the clutch mechanism
 (90) being in transmission cooperation with the
 guiding mechanism (20) within the hollow shaft
 cavity (100), wherein: 20

when the axial movement mechanism (30) 25
 rotates along the first rotating direction fol-
 lowing the rotating main shaft (10), the
 clutch mechanism (90) is in a first clutch
 state where the guiding mechanism (20)
 is kept in the rotation-locking state, the axial 30
 movement mechanism (30) is guided by the
 guiding mechanism (20) in the rotation-
 locking state to perform reciprocating axial
 movement along the axial direction, and the
 reciprocating axial movement triggers reci- 35
 procating cutting motion of the movable
 tooth row member (52) relative to the fixed
 tooth row member (51);
 when the axial movement mechanism (30)
 rotates along the second rotating direction 40
 following the rotating main shaft (10), the
 clutch mechanism (90) is in a second clutch
 state where the guiding mechanism (20) is
 kept in the rotation-following state, and the
 guiding mechanism (20) in the rotation-fol- 45
 lowing state cancels guidance on the axial
 movement mechanism (30) by rotating
 along the second rotating direction follow-
 ing the axial movement mechanism (30). 50

2. The rolling brush assembly according to claim 1,
 wherein,

a first shaft end of the rotating main shaft (10) is
 provided with a drive end cover (14), and a 55
 second shaft end of the rotating main shaft
 (10) is provided with a static end cover (130),
 wherein the drive end cover (14) forms a bidir-

irectional synchronization constraint with the ro-
 tating main shaft (10) in the first rotating direction
 and the second rotating direction, the drive end
 cover (14) is configured to be in transmission
 cooperation with a power motor (71), and the
 rotating main shaft (10) is in rotational coopera-
 tion with the static end cover (130);
 the clutch mechanism (90) is located between
 the guiding mechanism (20) and the static end
 cover (130), wherein the clutch mechanism (90)
 axially limits the guiding mechanism (20), to
 enable a relative axial position between the
 guiding mechanism (20) and the static end cover
 (130) to be fixed, and:

when the clutch mechanism (90) is in the
 first clutch state, the clutch mechanism (90)
 forms a rotation-locking constraint between
 the guiding mechanism (20) and the static
 end cover (130) that prevents the guiding
 mechanism (20) from rotating relative to the
 static end cover (130) along the first rotating
 direction, to constrain the guiding mechan-
 ism (20) in the rotation-locking state;
 when the clutch mechanism (90) is in the
 second clutch state, the guiding mechanism
 (20) is in the rotation-following state where it
 can freely rotate relative to the static end
 cover (130) under driving of the axial move-
 ment mechanism (30).

3. The rolling brush assembly according to claim 2,
 wherein,
 the clutch mechanism (90) comprises a clutch sliding
 sleeve (93) movable in the axial direction, wherein: 35

when the clutch mechanism (90) is located at a
 first axial position, the clutch sliding sleeve (93)
 is in the first clutch state;
 when the clutch sliding sleeve (93) is located at a
 second axial position, the clutch mechanism
 (90) is in the second clutch state;
 the clutch sliding sleeve (93) is configured to
 switch between the first axial position and the
 second axial position in response to switching
 between the first rotating direction and the sec-
 ond rotating direction.

4. The rolling brush assembly according to claim 3,
 wherein,

the clutch mechanism (90) further comprises a
 fixed tooth ring (91) and a transmission tooth
 ring (92), wherein the fixed tooth ring (91) is
 fixedly connected to the static end cover
 (130), the transmission tooth ring (92) is fixedly
 connected to the guiding mechanism (20), an
 end of the fixed tooth ring (91) facing the clutch

sliding sleeve (93) has a clutch convex tooth groove (910), and an end of the transmission tooth ring (92) facing the clutch sliding sleeve (93) has a transmission tooth groove (920); the clutch sliding sleeve (93) is movably installed between the fixed tooth ring (91) and the transmission tooth ring (92), wherein a first annular opening end of the clutch sliding sleeve (93) facing the fixed tooth ring (91) has a clutch convex tooth (931), and a second annular opening end of the clutch sliding sleeve (93) facing the transmission tooth ring (92) has a transmission convex tooth (932), wherein:

when the clutch sliding sleeve (93) is located at the first axial position, the clutch convex tooth (931) and the clutch convex tooth groove (910) form a first limiting engagement that prevents the clutch sliding sleeve (93) from rotating relative to the static end cover (130) along the first rotating direction, the transmission convex tooth (932) and the transmission tooth groove (920) form a second limiting engagement that prevents the guiding mechanism (20) from rotating relative to the clutch sliding sleeve (93) along the first rotating direction, and the rotation-locking constraint is applied to the guiding mechanism (20) through cascade cooperation of the first limiting engagement and the second limiting engagement;

when the clutch sliding sleeve (93) is located at the second axial position, the clutch convex tooth (931) disengage from the clutch convex tooth groove (910), and the first limiting engagement and the second limiting engagement are released in response to disengagement of the clutch convex tooth (931) from the clutch convex tooth groove (910).

5. The rolling brush assembly according to claim 4, wherein,

the clutch mechanism (90) further comprises a fixed shaft base (97) coaxially fixedly connected to the static end cover (130), and a transmission shaft rod (98) coaxially fixedly connected to the guiding mechanism (20);

the fixed shaft base (97) and the transmission shaft rod (98) form an axial limiting that enables the relative axial position between the guiding mechanism (20) and the static end cover (130) to be fixed;

the fixed tooth ring (91) is integrated on an end face of the fixed shaft base (97) facing the clutch sliding sleeve (93), and the transmission tooth

ring (92) is fixedly sleeved on the transmission shaft rod (98), and the clutch sliding sleeve (93) is movably sleeved on the transmission shaft rod (98).

6. The rolling brush assembly according to claim 5, wherein,

when the clutch sliding sleeve (93) is located at the second axial position, the first limiting engagement and the second limiting engagement also generate a first axial retaining force that prevents the clutch sliding sleeve (93) from leaving the first axial position;

when the clutch sliding sleeve (93) is located at the second axial position, the transmission convex tooth (932) and the transmission tooth groove (920) also form a synchronous drive engagement that causes the clutch sliding sleeve (93) to rotate along the second rotating direction together with the guiding mechanism (20) under driving of the axial movement mechanism (30), and the synchronous drive engagement generates a second axial retaining force that causes the clutch sliding sleeve (93) to prevent the clutch sliding sleeve (93) from leaving the second axial position.

7. The rolling brush assembly according to claim 6, wherein,

the clutch convex tooth groove (910) has a rotation-locking limiting groove wall (910a) parallel to a longitudinal section of the rotating main shaft (10) on a first phase side opposite to the first rotating direction, and the clutch convex tooth groove (910) has a first arc-surfaced groove wall (910b) on a second phase side in the first rotating direction;

the clutch convex tooth (931) has a rotation-locking limiting tooth wall (931a) parallel to the longitudinal section of the rotating main shaft (10) on the second phase side, and the clutch convex tooth (931) has a first arc-surfaced tooth wall (931b) matching with the first arc-surfaced groove wall (910b) on the first phase side;

the transmission tooth groove (920) has a second arc-surfaced groove wall (920a) on the second phase side, and the transmission tooth groove (920) has a synchronous engagement groove wall (920b) parallel to the longitudinal section of the rotating main shaft (10) on the first phase side;

the transmission convex tooth (932) has a second arc-surfaced tooth wall (932a) matching with the second arc-surfaced groove wall (920a) on the first phase side, and the transmission convex tooth (932) has a synchronous en-

gement tooth wall (932b) parallel to the longitudinal section of the rotating main shaft (10) on the second phase side;

when the clutch sliding sleeve (93) is at the first axial position, the rotation-locking limiting tooth wall (931a) and the rotation-locking limiting groove wall (910a) opposite to each other form the first limiting engagement through planar-surface contact, and the second arc-surfaced tooth wall (932a) and the second arc-surfaced groove wall (920a) opposite to each other form the second limiting engagement through arc-surface contact;

when the clutch sliding sleeve (93) is at the second axial position, the synchronous engagement groove wall (920b) and the synchronous engagement tooth wall (932b) opposite to each other form the synchronous drive engagement through planar-surface contact;

during position switching between the first axial position and the second axial position, sliding cooperation for guiding the position switching is generated between the first arc-surfaced groove wall (910b) and the first arc-surfaced tooth wall (931b) opposite to each other, and between the second arc-surfaced tooth wall (932a) and the second arc-surfaced groove wall (920a) opposite to each other.

8. The rolling brush assembly according to claim 3, wherein,
the clutch mechanism (90) further comprises a switching mechanism (95), wherein:

when the axial movement mechanism (30) switches from the second rotating direction to the first rotating direction to rotate following a rotating direction of the rotating main shaft (10), the switching mechanism (95) generates, in response to a first phase offset of the guiding mechanism (20) in the first rotating direction following the axial movement mechanism (30), a first axial driving force that drives the clutch sliding sleeve (93) to move from the second axial position to the first axial position;

when the axial movement mechanism (30) switches from the first rotating direction to the second rotating direction to rotate following the rotating direction of the rotating main shaft (10), the switching mechanism (95) generates, in response to a second phase offset of the guiding mechanism (20) in the second rotating direction following the axial movement mechanism (30), a second axial driving force that drives the clutch sliding sleeve (93) to move from the first axial position to the second axial position.

9. The rolling brush assembly according to claim 8,

wherein,

the clutch mechanism (90) further comprises a transmission shaft rod (98) coaxially fixedly connected to the guiding mechanism (20), wherein the transmission tooth ring (92) is fixedly sleeved on the transmission shaft rod (98), and the clutch sliding sleeve (93) is movably sleeved on the transmission shaft rod (98); the clutch sliding sleeve (93) has an inclined guide groove (935) inclined at a preset angle relative to the axial direction; the switching mechanism (95) comprises a fixed outer cylinder (951) and a reversing ball (952), wherein:

the fixed outer cylinder (951) is sleeved on outer periphery of the clutch sliding sleeve (93), the fixed outer cylinder (951) covers the inclined guide groove (935), and the fixed outer cylinder (951) is constrained to be stationary relative to the static end cover (130);

the reversing ball (952) is movably accommodated in the inclined guide groove (935), and the reversing ball (952) is in rolling cooperation with the transmission shaft rod (98) and the fixed outer cylinder (951); a first groove end (935a) of the inclined guide groove (935) is inclined toward the first axial position, and a second groove end (935b) of the inclined guide groove (935) is inclined toward the second axial position; when the axial movement mechanism (30) switches from the second rotating direction to the first rotating direction to rotate following the rotating direction of the rotating main shaft (10), the guiding mechanism (20) drives, during occurrence of the first phase offset, the reversing ball (952) through the transmission shaft rod (98) to produce a first planetary motion in the first rotating direction on an inner surface of the fixed outer cylinder (951), and the first planetary motion causes a relative position change of the reversing ball (952) in the inclined guide groove (935) from the second groove end (935b) to the first groove end (935a), enabling the reversing ball (952) to generate the first axial driving force on the inclined guide groove (935);

when the axial movement mechanism (30) switches from the first rotating direction to the second rotating direction to rotate following the rotating direction of the rotating main shaft (10), the guiding mechanism (20) drives, during occurrence of the second phase offset, the reversing ball (952)

through the transmission shaft rod (98) to produce a second planetary motion in the second rotating direction on the inner surface of the fixed outer cylinder (951), and the second planetary motion causes a relative position change of the reversing ball (952) in the inclined guide groove (935) from the first groove end (935a) to the second groove end (935b), enabling the reversing ball (952) to generate the second axial driving force on the inclined guide groove (935).

10. A sweeping robot comprising a mobile chassis (70), an integrated cavity shell (60) carried on the mobile chassis (70), and the rolling brush assembly according to any one of claims 1 to 9, the rolling brush assembly being installed in the integrated cavity shell (60), wherein:

the mobile chassis (70) has a chassis opening (700); the integrated cavity shell (60) has a sweeping window (61) exposed at the chassis opening (700), and a suction window (62) for communicating with a dust collection mechanism, wherein an installation position of the rolling brush assembly in the integrated cavity shell (60) causes the cleaning brush (40) to extend outside the sweeping window (61) during the rotation to perform a sweeping operation; the integrated cavity shell (60) is fixedly provided with a power motor (71), wherein a first shaft end of the rotating main shaft (10) is in transmission cooperation with the power motor (71), the power motor (71) drives the rotating main shaft (10) to rotate along the first rotating direction when the sweeping robot is in a self-cleaning mode where the mobile chassis (70) stops moving, and the power motor (71) drives the rotating main shaft (10) to rotate along the second rotating direction when the sweeping robot is in an operating mode where the mobile chassis (70) moves; when the clutch mechanism (90) is in the first clutch state, the clutch mechanism (90) is configured to keep the guiding mechanism (20) in the rotation-locking state by using a rotation-locking constraint applied by the integrated cavity shell (60) on a second shaft end of the rotating main shaft (10) opposite to the first shaft end.

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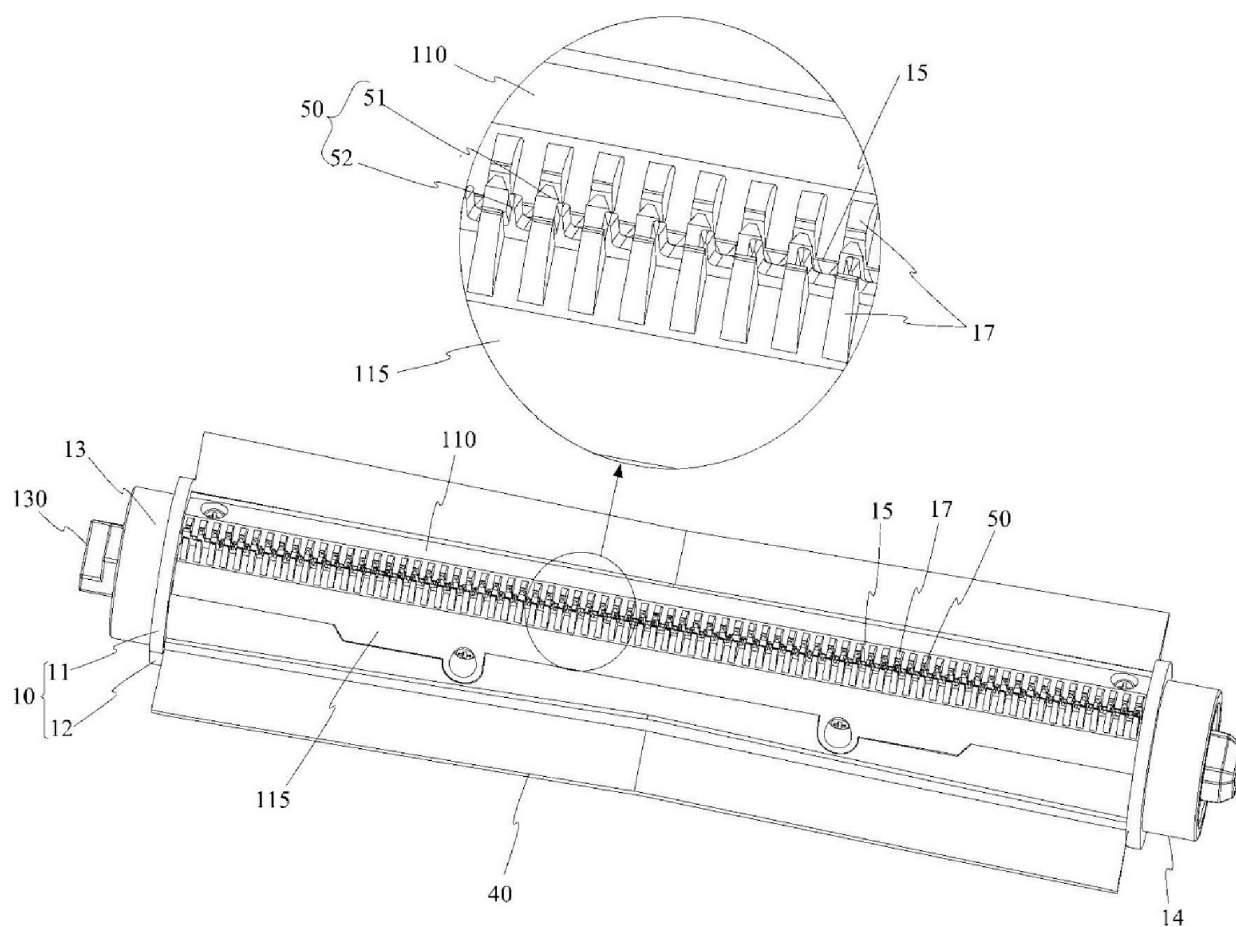


Fig. 1a

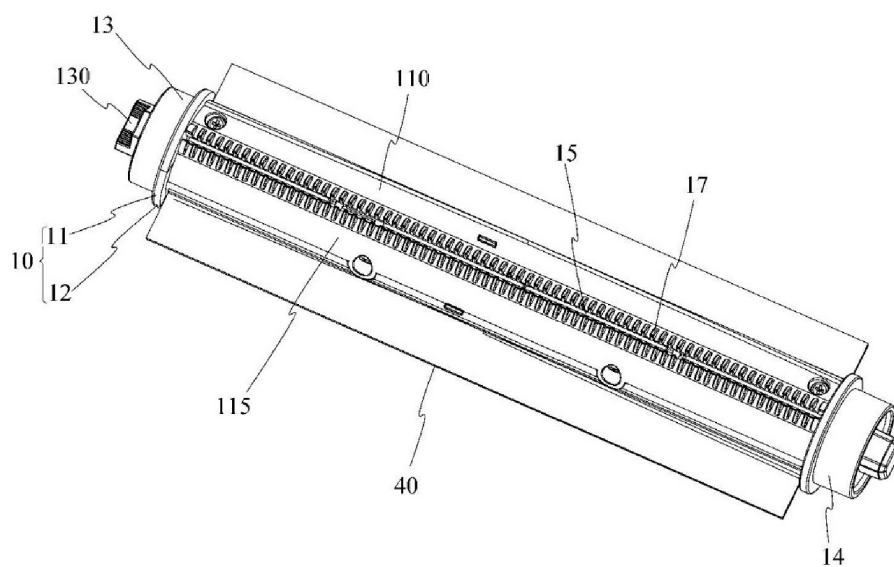


Fig. 1b

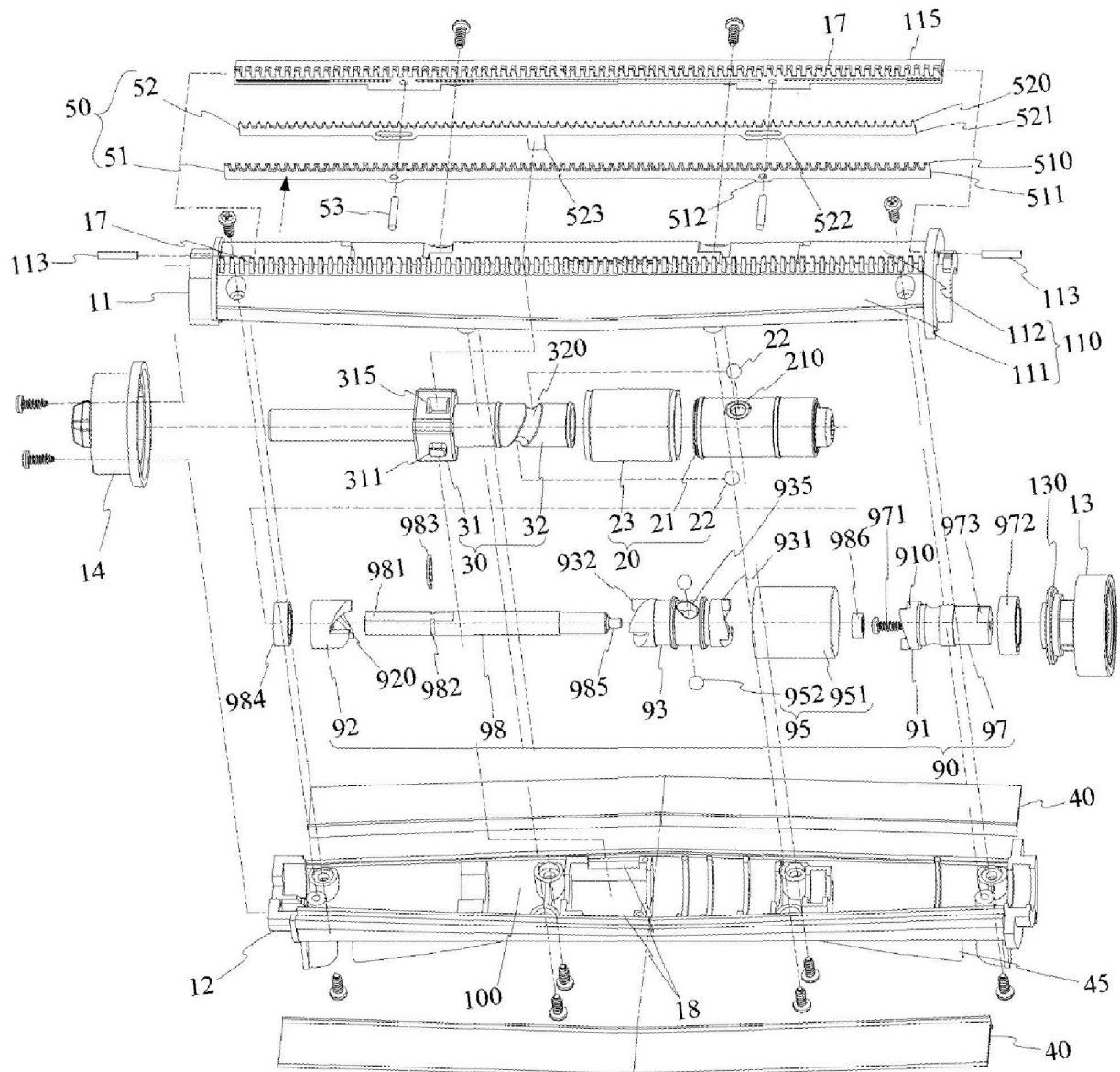


Fig. 2

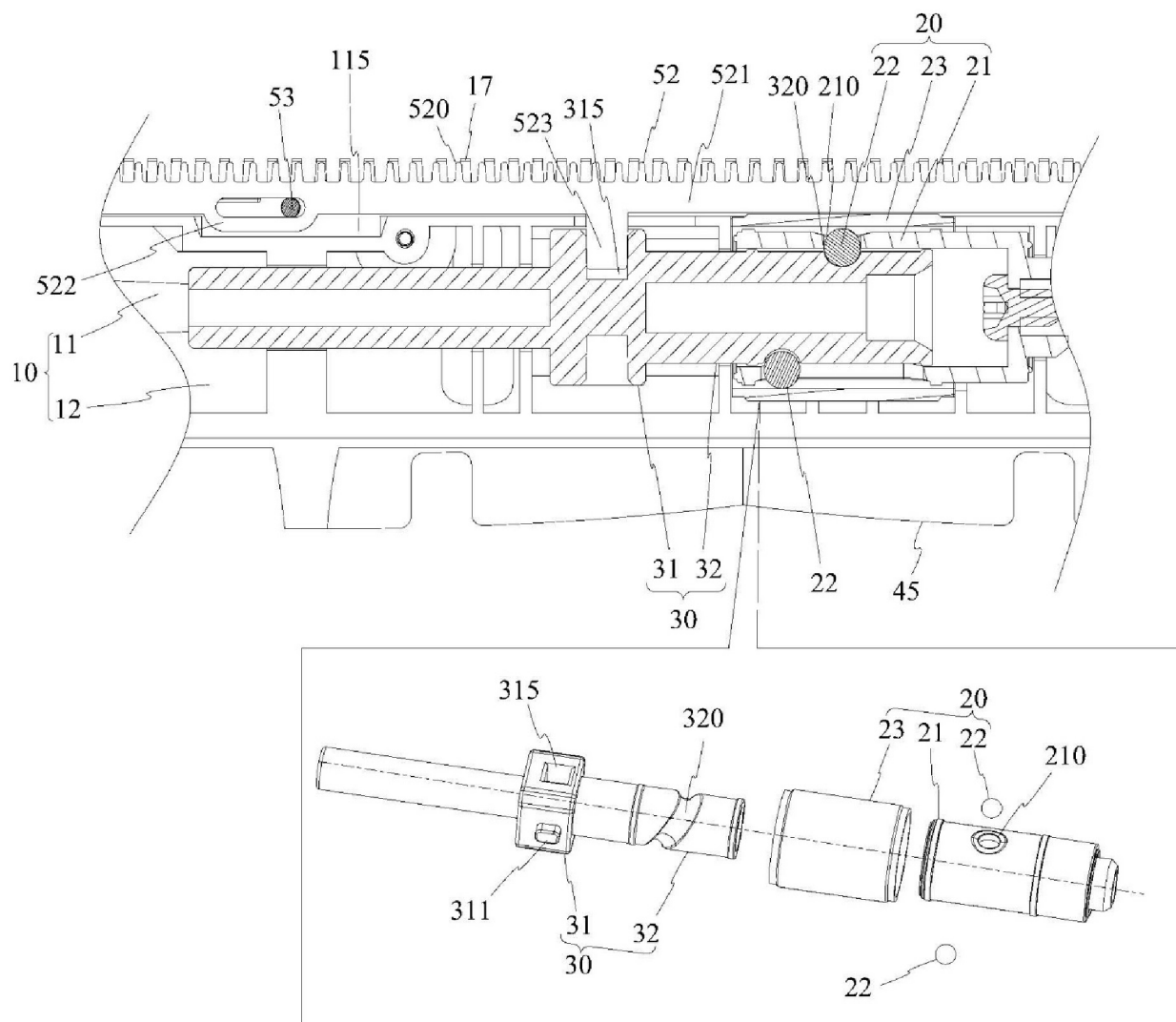


Fig. 3

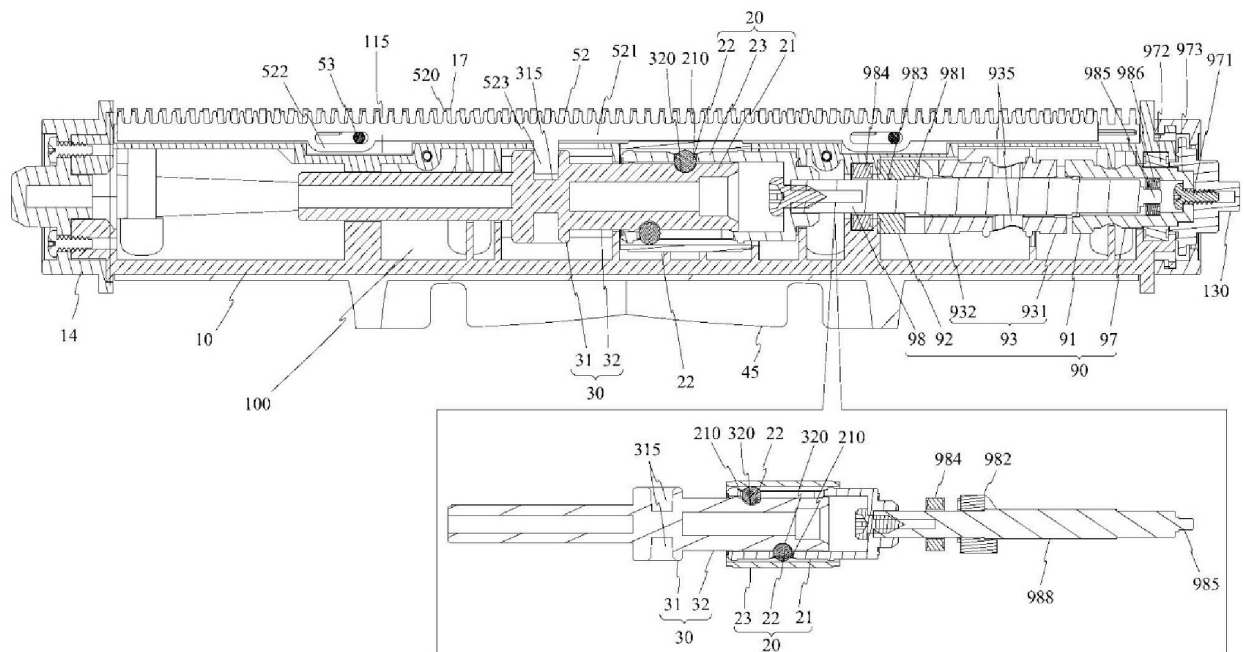


Fig. 4

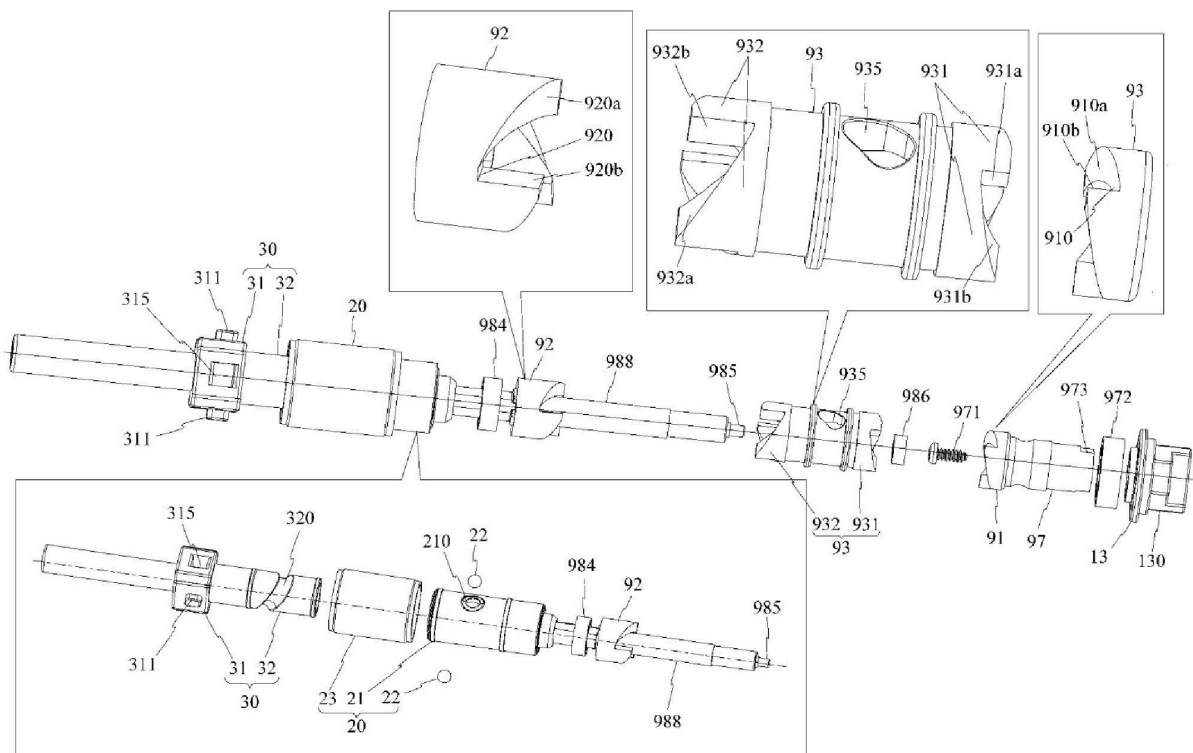


Fig. 5

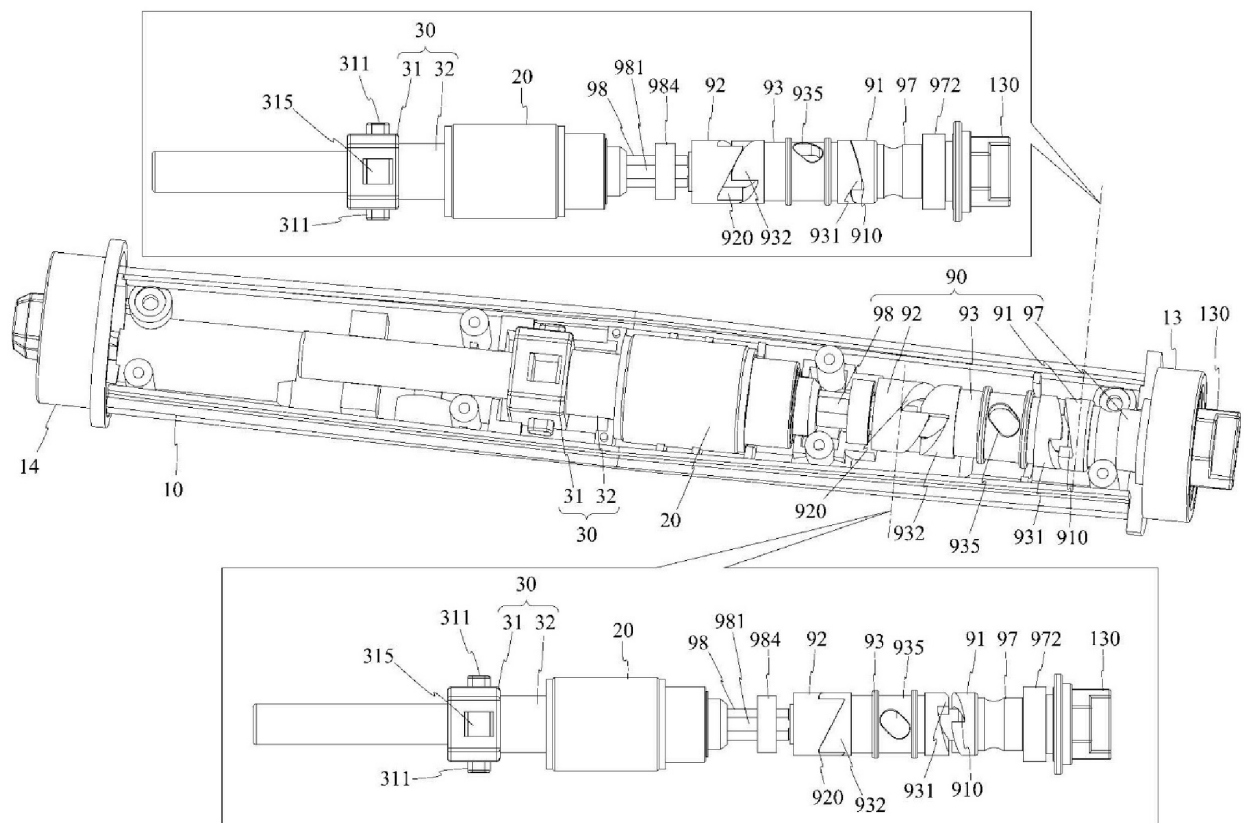


Fig. 6

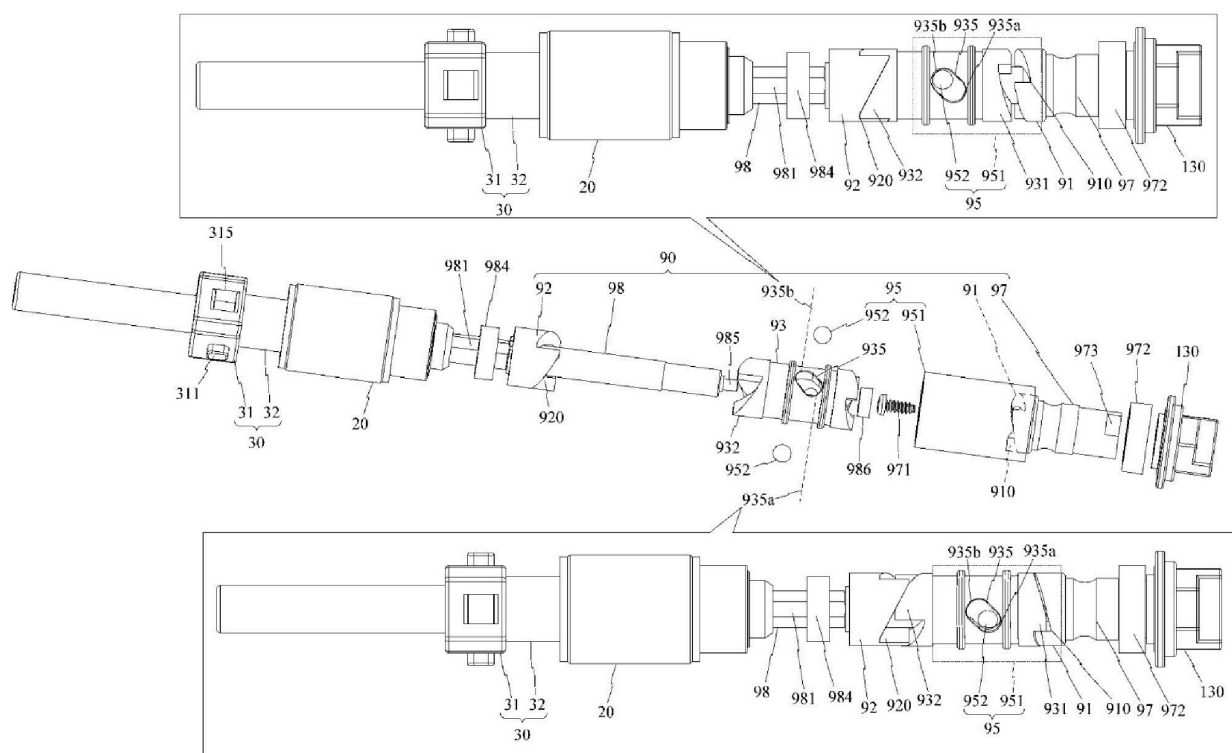


Fig. 7

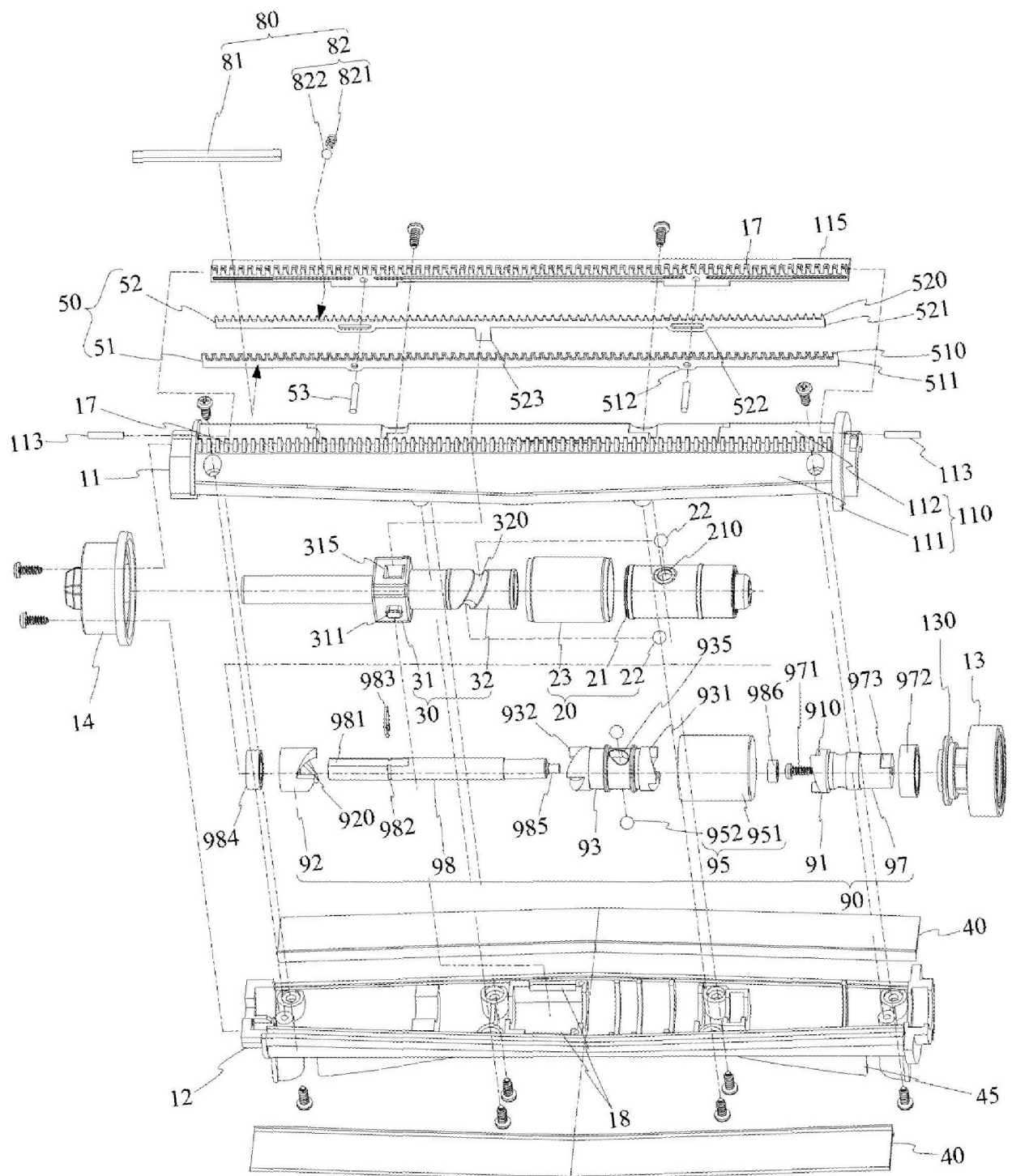


Fig. 8

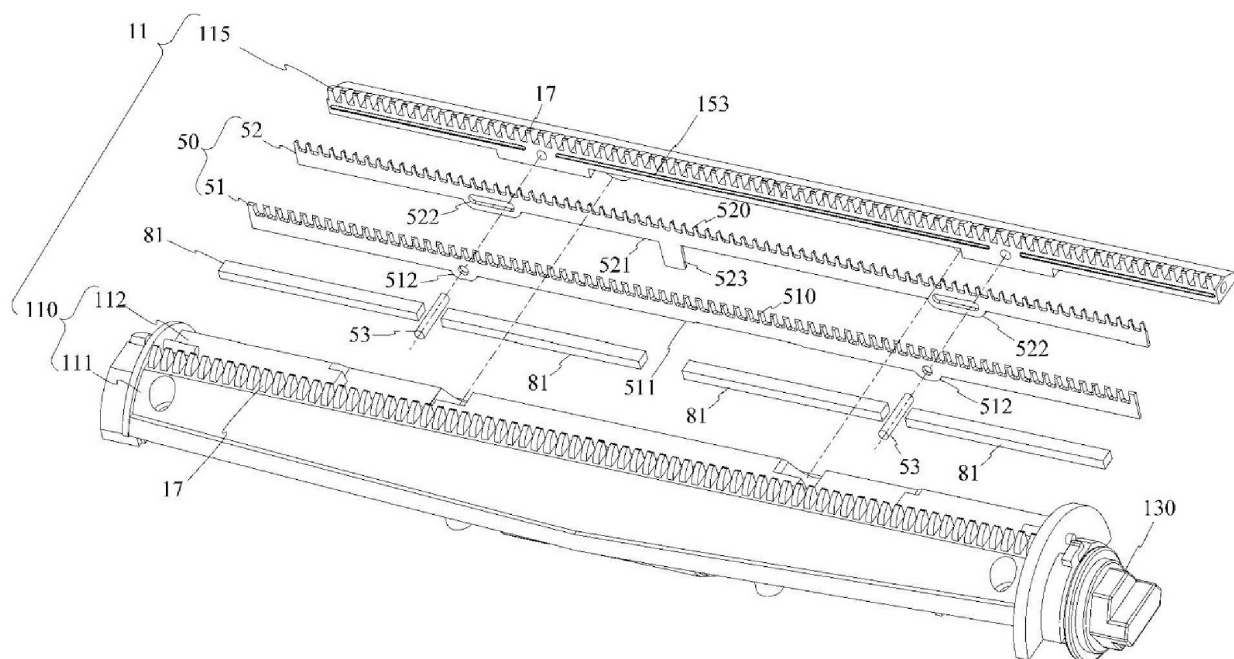


Fig. 9

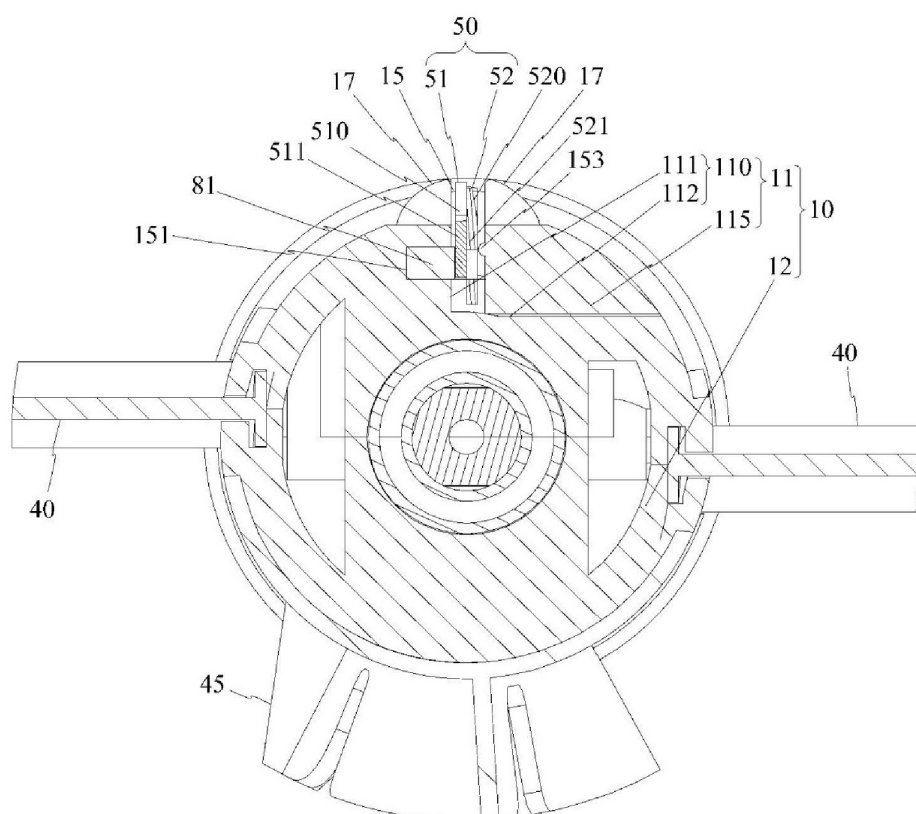


Fig. 10

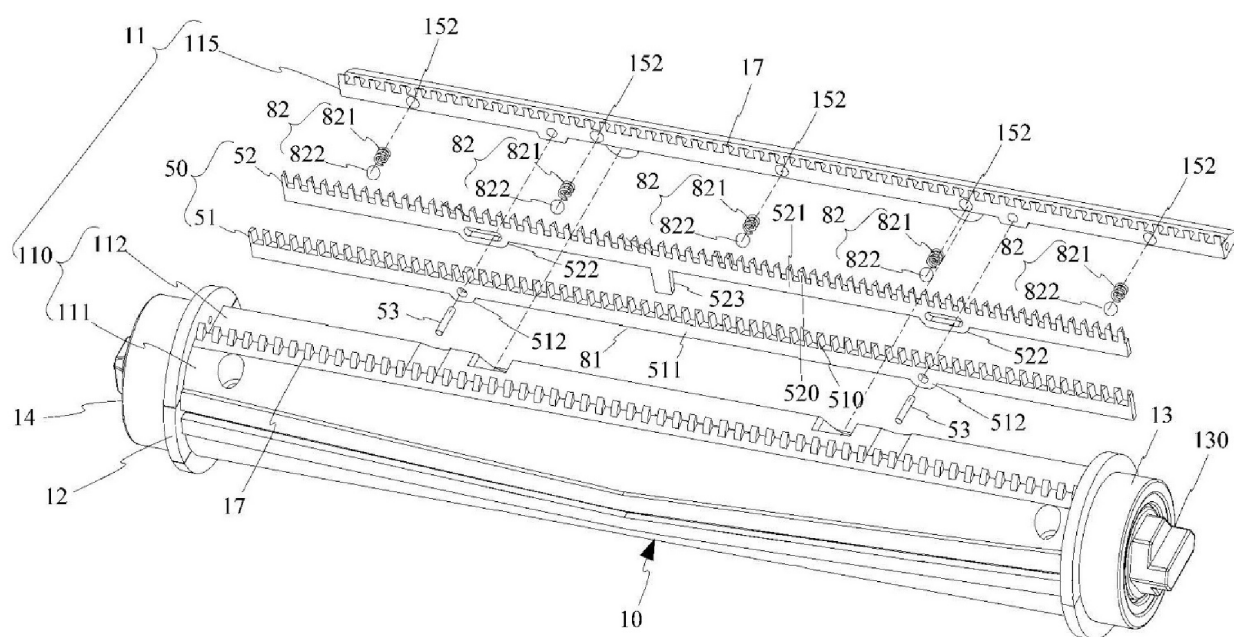


Fig. 11

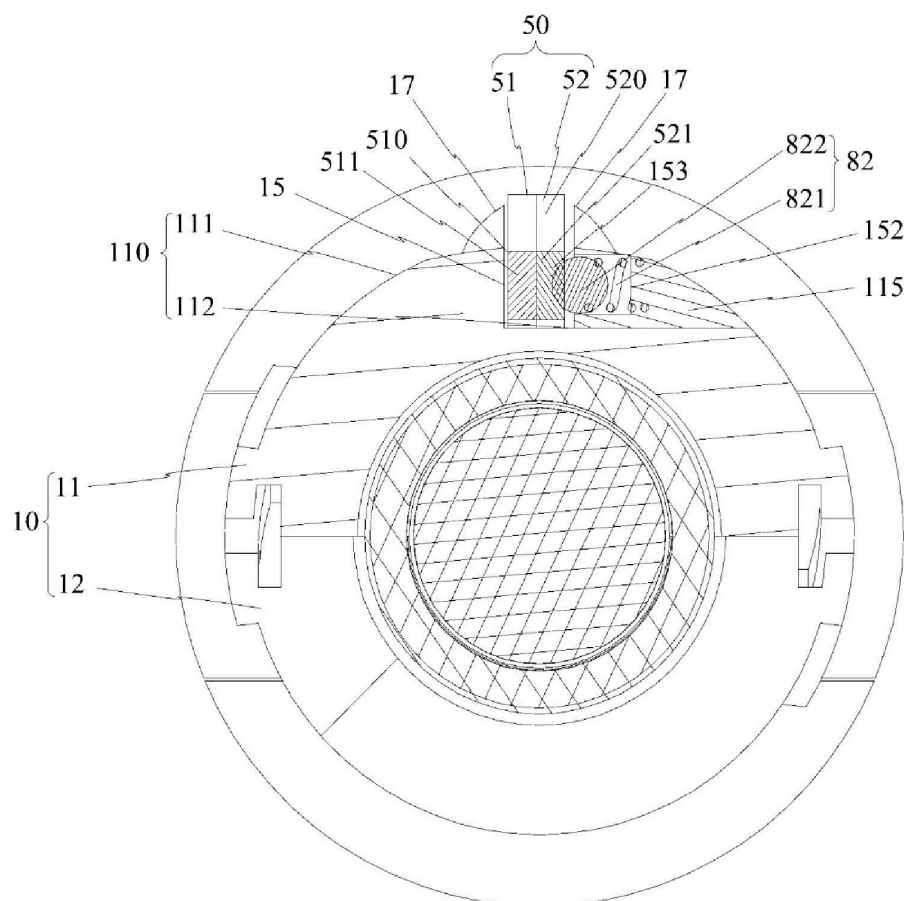


Fig. 12

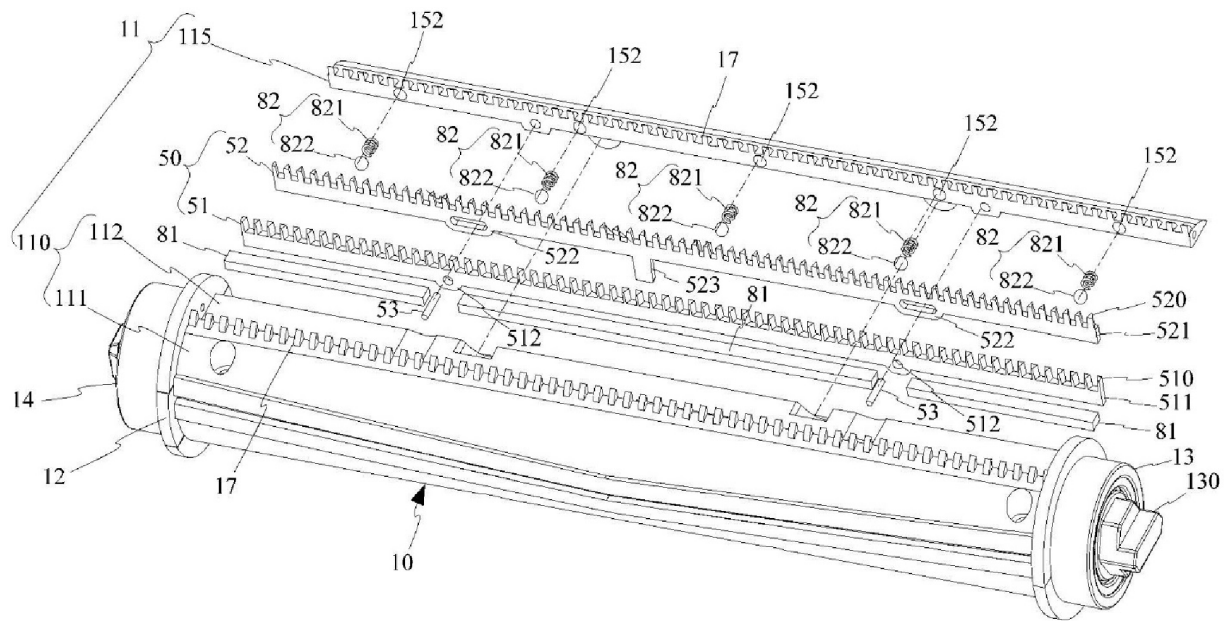


Fig. 13

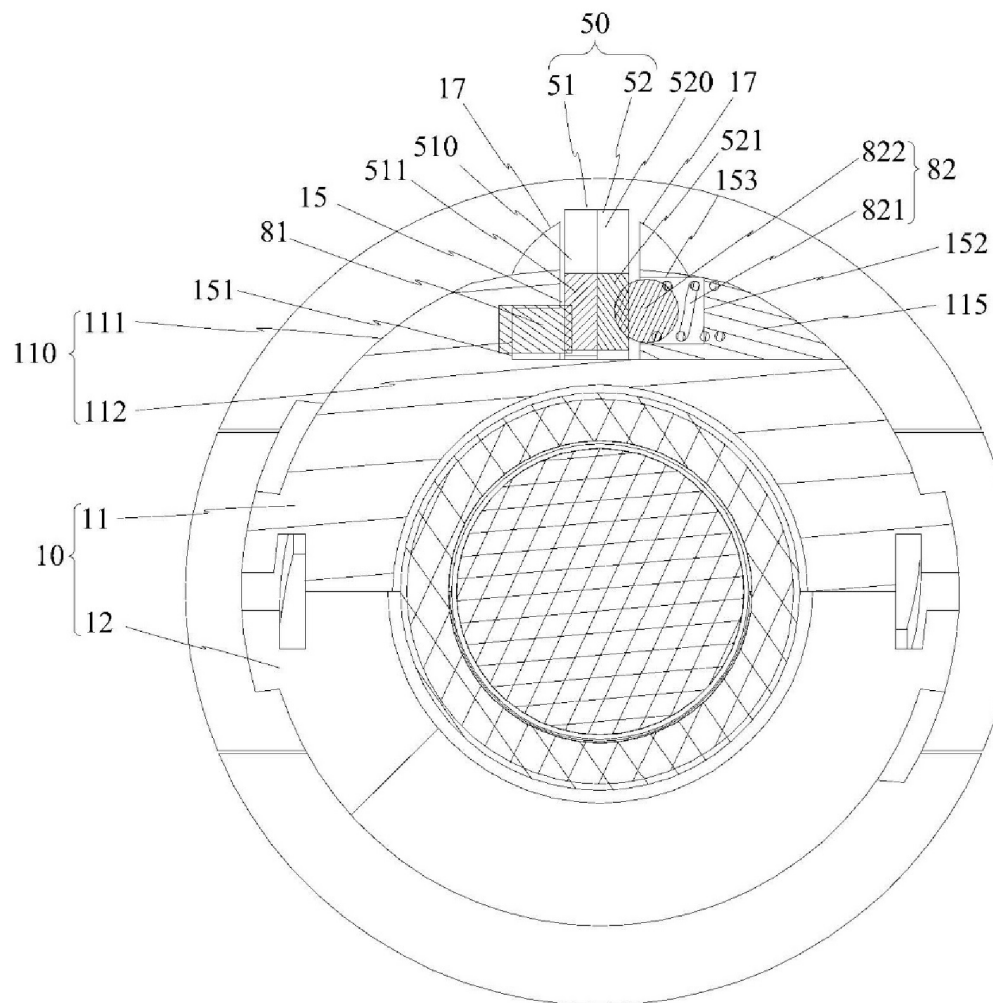


Fig. 14

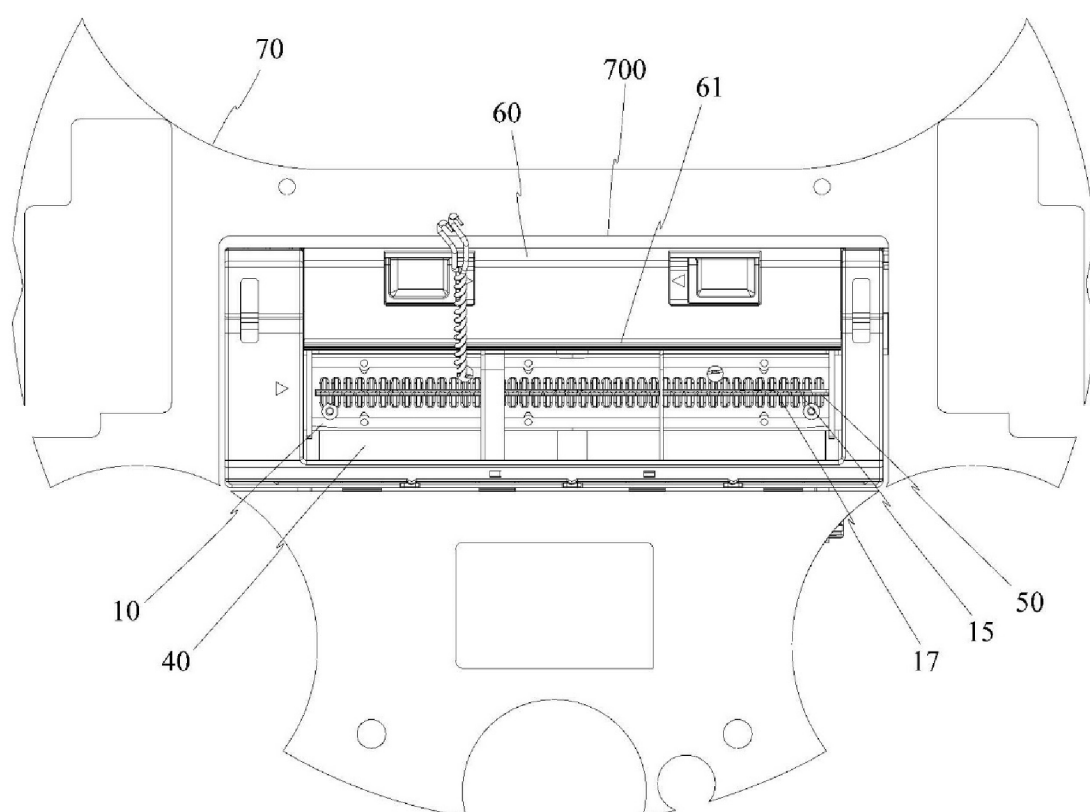


Fig. 15

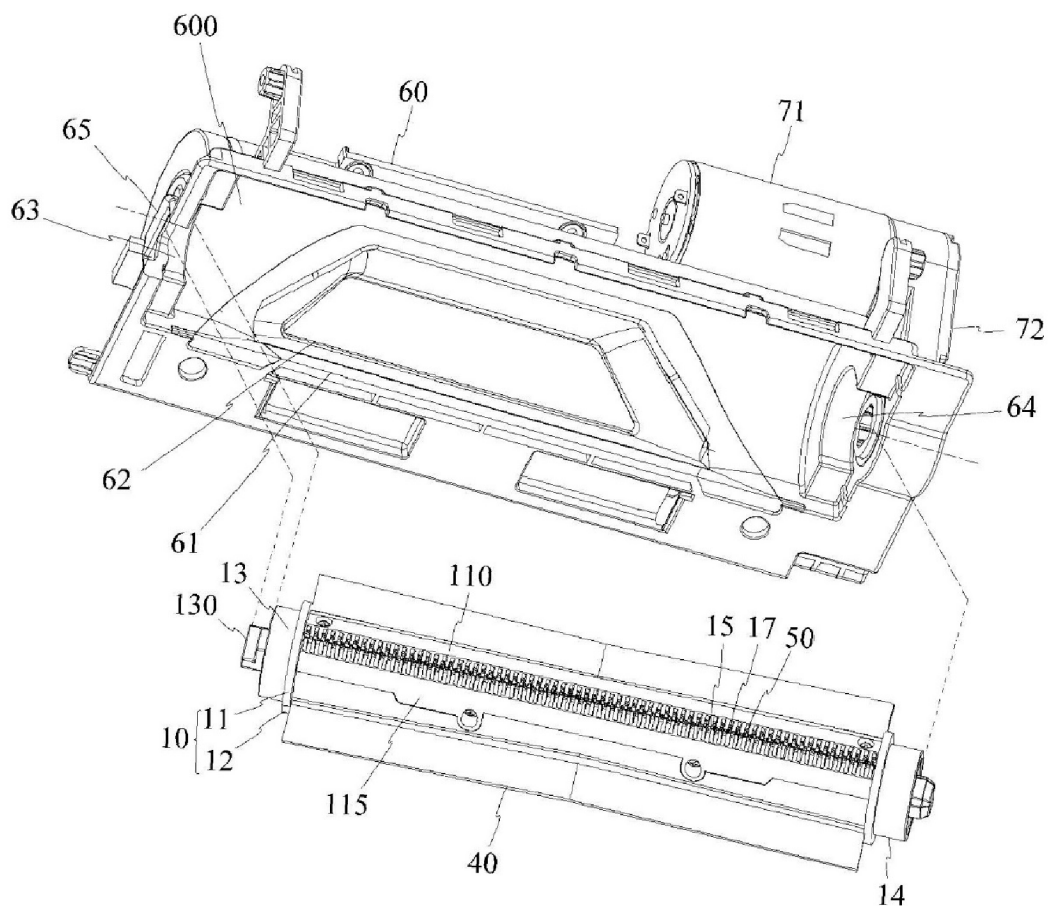


Fig. 16

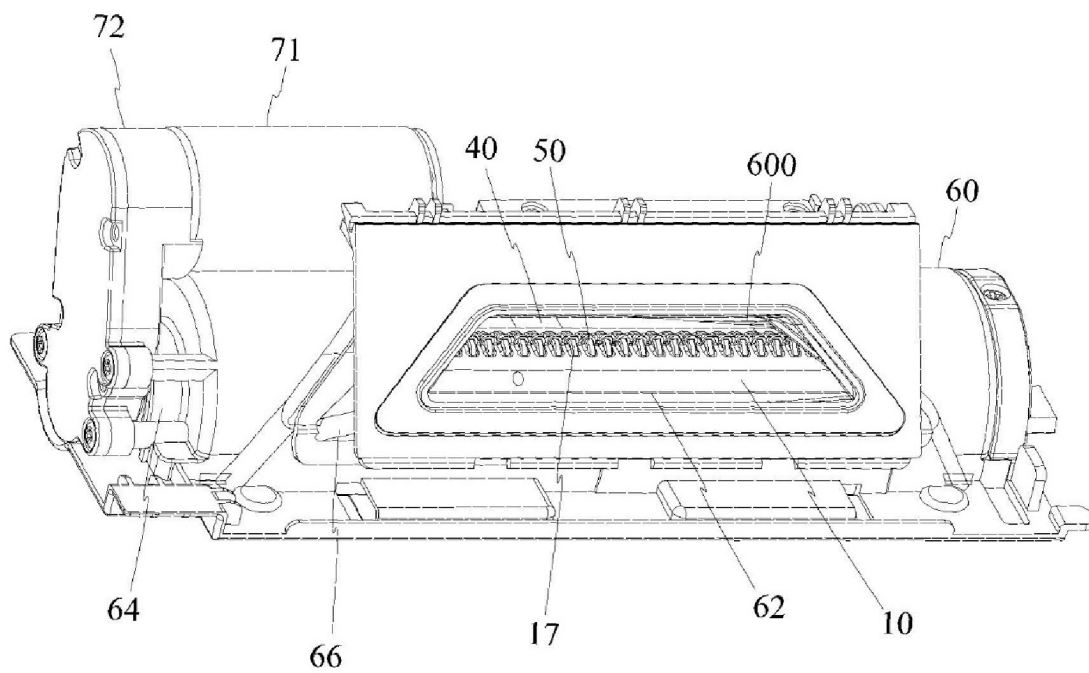


Fig. 17

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/085891

A. CLASSIFICATION OF SUBJECT MATTER

A47L11/40(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC:A47L

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

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

CNTXT, ENTXTC, WPABSC, CNKI, ENTXT: 杭州萤石, 张乐乐, 滚刷, 辊, 搅拌器, 筒, 第二, 第一, 反, 割, 切, 正, 往复, 轴向, 离合, brushroll, rotating agitator, blade, actuator, shuttle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 116919272 A (HANGZHOU EZVIZ SOFTWARE CO., LTD.) 24 October 2023 (2023-10-24) claims 1-10, and description, paragraphs 0138-0226	1-10
Y	CN 219089105 U (DREAME INNOVATION TECHNOLOGY (SUZHOU) CO., LTD.) 30 May 2023 (2023-05-30) description, paragraphs 0054-0096, and figures 1-9	1, 10
Y	CN 218792068 U (GUANGDONG XINBAO ELECTRICAL APPLIANCES HOLDINGS CO., LTD.) 07 April 2023 (2023-04-07) description, paragraphs 0031-0063, and figures 1-8	1, 10
A	CN 112674642 A (TINECO INTELLIGENT TECHNOLOGY CO., LTD.) 20 April 2021 (2021-04-20) entire document	1-10
A	CN 114403742 A (SUZHOU CITY AMBITIOUS ELECTRICAL APPLIANCE CO., LTD.) 29 April 2022 (2022-04-29) entire document	1-10

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"E" earlier application or patent but published on or after the international filing date	"&" document member of the same patent family
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 17 June 2024	Date of mailing of the international search report 24 June 2024
Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088	Authorized officer Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/085891

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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 6539575 B1 (ORECK HOLDINGS L.L.C.) 01 April 2003 (2003-04-01) entire document	1-10

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2024/085891

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CN 219089105 U	30 May 2023	None	
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REFERENCES CITED IN THE DESCRIPTION

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