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(54) **AUTOMATIC CLEANING APPARATUS**

(57) An automatic cleaning apparatus, comprising: a moving platform (100) configured to automatically move on an operation surface; and a cleaning module (150) arranged on the moving platform (100), wherein the cleaning module comprises: a wet cleaning module (400) configured to clean at least a part of the operation surface by using a wet cleaning mode; a lifting structure (500) connected to the wet cleaning module (400) and config-

ured to enable the wet cleaning module (400) to move up and down relative to the moving platform (100); and a drive assembly (900) connected to the lifting structure (500) and configured to be capable of providing power for the lifting and lowering of the lifting structure (500) and/or providing a cleaning solution for the wet cleaning module (400).

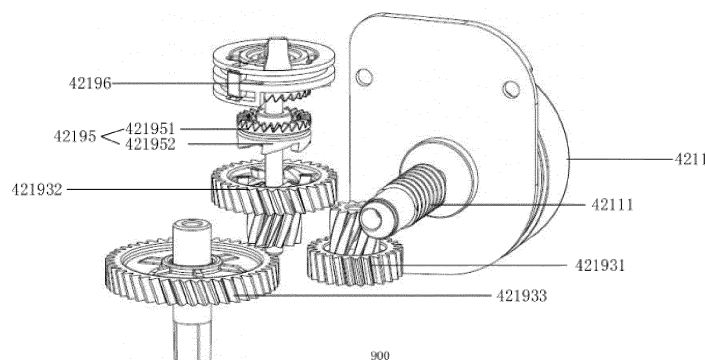


FIG. 26

Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Chinese Patent Applications No. 202110188182.X, filed on February 10, 2021, which is incorporated herein by reference in its entirety as a part of the present application.

TECHNICAL FIELD

[0002] The present disclosure relates to the field of cleaning robot technologies, and more particularly to an autonomous cleaning device.

BACKGROUND ART

[0003] At present, cleaning robots mainly include sweeping robots and mopping robots. Functions of the sweeping robots and the mopping robots are relatively simple. The sweeping robots can only sweep a floor, while the mopping robots can only mop a floor. If it is desirable to perform sweeping and mopping at the same time, two devices are required, which doubles the occupied space.

[0004] In the prior art, there is also a combination of a sweeping robot and a mopping robot, and a mop is added at the end of the robot to achieve the integrated sweeping and mopping. However, the mopping function is achieved in the integrated cleaning process only by moving the mop on the floor. A single mopping operation is being performed in a moving trajectory of the cleaning robot with movement of the mop, and a function of repeatedly mopping the floor in a vibrating manner cannot be performed. In addition, heights of cleaning components of the sweeping device cannot be adjusted, and are tightly attached to a surface to be cleaned all the time. Thus, it is difficult for the cleaning device to move freely on the surface to be cleaned or to move with large resistance when it is not performing cleaning operation. Therefore, the existing sweeping robot cannot realize effective control of mopping the floor, water discharge, lifting and lowering, vibration, etc.

SUMMARY OF THE INVENTION

[0005] An objective of the present disclosure is to provide an autonomous cleaning device, which can solve the technical problems of controlling a height and mopping of a wet cleaning module. The specific solutions are described below.

[0006] According to embodiments of the present disclosure, the present disclosure provides an autonomous cleaning device, including:

a mobile platform 100 configured to move autonomously on an operation surface; and
a cleaning module 150 disposed on the mobile plat-

form 100, including:

a wet cleaning module 400 configured to clean at least part of the operation surface using a wet cleaning mode;

a lifting structure 500 connected to the wet cleaning module 400, configured to enable the wet cleaning module 400 to move upwards or downwards relative to the mobile platform 100; and

a driving assembly 900 connected to the lifting structure 500, configured to provide power for lifting of the lifting structure 500, and/or, to provide a cleaning liquid for the wet cleaning module 400.

[0007] In some embodiments of the present disclosure, the driving assembly 900 includes:

a motor 4211 configured to provide a driving force for forward rotation and reverse rotation; and

a gear set 42193 connected to an output shaft of the motor 4211, configured to output the driving force for the forward rotation and the reverse rotation of the motor 4211.

[0008] In some embodiments of the present disclosure, the driving assembly 900 further includes a clutch 42195 meshed with the gear set 42193, to provide the driving force when the clutch 42195 is in reverse engagement with the gear set 42193, and not to provide the driving force when the clutch 42195 is in forward non-engagement with the gear set 42193.

[0009] In some embodiments of the present disclosure, the clutch 42195 includes a first clutch gear 421951 and a second clutch gear 421952 oppositely disposed, and the second clutch gear 421952 has teeth arranged at an oblique angle in a counterclockwise direction, to provide the driving force when the second clutch gear 421952 is in reverse engagement with the gear set 42193, and not to provide the driving force when the second clutch gear 421952 is in forward non-engagement with the gear set 42193.

[0010] In some embodiments of the present disclosure, the driving assembly 900 further includes a cable gear 42196 meshed with the first clutch gear 421951 to be driven by the first clutch gear 421951 to rotate.

[0011] In some embodiments of the present disclosure, the lifting assembly 500 further includes a cable 42194 with one end wound around the cable gear 42196 and the other end connected to the lifting structure 500, to be driven by the gear set 42193 to pull the lifting structure 500 up or down.

[0012] In some embodiments of the present disclosure, the driving assembly 900 further includes a clean liquid pump 4219 meshed with the gear set 42193 to be driven by the gear set 42193 to provide the cleaning liquid to the wet cleaning module 400.

[0013] In some embodiments of the present disclosure, the gear set 42193 further includes:

a first-stage transmission gear 421931 connected to the output shaft of the motor 4211, configured to output the driving force from the motor;
 a second-stage transmission gear 421932 meshed with the first-stage transmission gear 421931, configured to output the driving force from the motor to the cable gear 42196; and
 a third-stage transmission gear 421933 meshed with the second-stage transmission gear 421932, configured to output the driving force from the motor to the clean liquid pump 4219.

[0014] In some embodiments of the present disclosure, the output shaft of the motor 4211 includes an output gear 42111 meshed with the first-stage transmission gear 421931 to output the driving force from the motor.

[0015] In some embodiments of the present disclosure, the driving assembly 900 further includes:

a driving wheel 4212 connected to the output shaft of the motor, having an asymmetric structure; and
 a vibration member 4213 connected to the driving wheel 4212 to reciprocate under asymmetric rotation of the driving wheel 4212.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The accompanying drawings here, which are incorporated in the Description and constitute a part of the Description, show embodiments conforming to the present disclosure, and are used to explain the principles of the present disclosure together with the Description. Apparently, the accompanying drawings in the following description are only some embodiments of the present disclosure, and for those of ordinary skills in the art, other drawings may also be obtained from these accompanying drawings without creative efforts. In the accompanying drawings:

FIG. 1 is an oblique view of an autonomous cleaning device according to an embodiment of the present disclosure;

FIG. 2 is a schematic structural diagram of a bottom part of an autonomous cleaning device according to an embodiment of the present disclosure;

FIG. 3 is an oblique view of a side driving wheel assembly according to an embodiment of the present disclosure;

FIG. 4 is a front view of a side driving wheel assembly according to an embodiment of the present disclosure;

FIG. 5 is an oblique view of a dust box according to an embodiment of the present disclosure;

FIG. 6 is an oblique view of a fan according to an embodiment of the present disclosure;

FIG. 7 is a schematic diagram of a dust box in an open state according to an embodiment of the present disclosure;

FIG. 8 is a schematic diagram of a dust box and a fan in an assembled state according to an embodiment of the present disclosure;

FIG. 9 is an exploded view of an autonomous cleaning device according to an embodiment of the present disclosure;

FIG. 10 is a structural diagram of a support platform of an autonomous cleaning device according to an embodiment of the present disclosure;

FIG. 11 is a structural diagram of a vibration member of an autonomous cleaning device according to an embodiment of the present disclosure;

FIG. 12 is a schematic diagram of a cleaning head driving mechanism based on a crank-slider mechanism according to another embodiment of the present disclosure;

FIG. 13 is a schematic diagram of a cleaning head driving mechanism based on a double-crank mechanism according to another embodiment of the present disclosure;

FIG. 14 is a schematic diagram of a cleaning head driving mechanism based on a crank mechanism according to another embodiment of the present disclosure;

FIG. 15 is a structural diagram of a vibration member according to an embodiment of the present disclosure;

FIG. 16 is a schematic structural diagram of a cleaning base plate in an assembled state according to an embodiment of the present disclosure;

FIG. 17 is a structural diagram of a motor-driven clean liquid pump according to an embodiment of the present disclosure;

FIG. 18 is a structural diagram of a motor-driven lifting module according to an embodiment of the present disclosure;

FIG. 19 is a schematic diagram of an autonomous cleaning device in a raised state according to an embodiment of the present disclosure;

FIG. 20 is a schematic diagram of an autonomous cleaning device in a lowered state according to an embodiment of the present disclosure;

FIG. 21 is a schematic diagram of a four-linkage lifting structure in a raised state according to an embodiment of the present disclosure;

FIG. 22 is a schematic diagram of a four-linkage lifting structure in a lowered state according to an embodiment of the present disclosure;

FIG. 23 is a schematic structural diagram of a second end of a four-linkage lifting structure according to an embodiment of the present disclosure;

FIG. 24 is a schematic structural diagram of a dry cleaning module in a lowered state according to an embodiment of the present disclosure;

FIG. 25 is a schematic structural diagram of a dry cleaning module in a raised state according to an embodiment of the present disclosure; and

FIG. 26 is a schematic structural diagram of a driving

assembly according to an embodiment of the present disclosure.

List of Reference Numerals:

[0017] mobile platform 100, rear part 110, front part 111, sensing system 120, location determination device 121, buffer 122, cliff sensor 123, control system 130, driving system 140, driving wheel assembly 141, steering assembly 142, elastic element 143, driving motor 146, cleaning module 150, dry cleaning module 151, dust box 152, filter 153, dust suction port 154, air outlet 155, fan 156, power system 160, human-computer interaction system 170, wet cleaning module 400, cleaning head 410, driving unit 420, driving platform 421, support platform 422, motor 4211, driving wheel 4212, vibration member 4213, connection rod 4214, vibration buffer device 4215, claw 4216, clean liquid pump tube 4218, clean liquid pump 4219, cleaning base plate 4221, elastic detachment button 4229, fitting section 4224, buckle position 4225, first sliding groove 4222, second sliding groove 4223, first slider 525, second slider 528, swinging end 512 (4227), sliding end 514 (4226), first pivot 516 (624), second pivot 518 (626), driving mechanism 800 (600, 700), four-linkage lifting structure 500, first connection end 501, second connection end 502, first holder 5011, first pair of connection rods 5012, first connection rod 50121, second connection rod 50122, cable assembly 5013, terminal of cable at a motor 50131, terminal of cable at a holder 50132, transverse beam 50111, sliding groove 50112, buckle hole 50113, first longitudinal beam 50114, second longitudinal beam 50115, second holder 5021, second pair of connection rods 5022, third connection rod 50221, fourth connection rod 50222

DETAILED DESCRIPTION

[0018] To make the objectives, technical solutions and advantages of the present disclosure clearer, the present disclosure will be further described in detail below with reference to the accompanying drawings. It is obvious that the described embodiments are only some, but not all of the embodiments of the present disclosure. All other embodiments obtained by those of ordinary skills in the art without creative efforts based on the embodiments in the present disclosure are within the protection scope of the present disclosure.

[0019] The terms used in the embodiments of the present disclosure are for the purpose of describing particular embodiments only and are not intended to limit the present disclosure. The singular forms "a/an", "said" and "the" used in the embodiments of the present disclosure and the appended claims are intended to include the plural forms as well, unless otherwise indicated clearly in the context. The term "a plurality of" generally includes at least two.

[0020] It is to be understood that, the term "and/or" used herein only describes an association relationship

between associated objects, and indicates that there may be three kinds of relationships. For example, A and/or B may indicate three cases: A exists alone, A and B exist at the same time, and B exists alone. In addition, the character "/" herein generally indicates an "or" relationship between the contextual objects.

[0021] It is to be understood that, although the terms first, second, third, etc. may be used to describe in the embodiments of the present disclosure, these should not be limited to these terms. These terms are only used to distinguish. For example, "first" ... may also be referred to as "second" without departing from the scope of the embodiments of the present disclosure. Similarly, "second" ... may also be referred to as "first".

[0022] It is also to be noted that, the terms "including", "containing", or any other variants are intended to cover the nonexclusive inclusion, such that a commodity or device including a series of elements includes not only those elements, but also other elements not listed explicitly or elements inherent to such a commodity or device. Without more limitations, the element defined by the phrase "including a ..." does not exclude the existence of other same elements in the commodity or device including the element. In a sweeping and mopping integrated cleaning device according to the present disclosure, a driving assembly is connected to a lifting structure. By means of cooperation of a clutch and a gear set, when a motor rotates forward, the motor drives a vibration output shaft to rotate. By means of transmission of the gear set, a peristaltic pump discharges water synchronously. At this time, clutch teeth are in a slipping state and cannot perform transmission, and the lifting mechanism cannot be raised. When the motor rotates in a reverse direction, the clutch teeth are in an operating state to drive a lifting turn table to rise. When the lifting turn table is raised in position, the motor stops due to the limit. At this time, the vibration output and the peristaltic pump stop operation. Therefore, the cleaning device can coordinately control the discharge of the peristaltic pump, the lifting of the lifting mechanism and the vibration of the vibration member.

[0023] Embodiments of the present disclosure are described in detail below with reference to the accompanying drawings.

[0024] FIGS. 1 to 2 illustrate schematic structural view of an autonomous cleaning device according to an embodiment of the present disclosure. As illustrated in FIGS. 1 to 2, the autonomous cleaning device may be a vacuum suction robot, a mopping/brushing robot, or a window cleaning robot, etc. The autonomous cleaning device may include a mobile platform 100, a sensing system 120, a control system 130, a driving system 140, a cleaning module 150, a power system 160, and a human-computer interaction system 170.

[0025] The mobile platform 100 may be configured to autonomously move in a target direction on an operation surface. The operation surface may be a surface to be cleaned by the autonomous cleaning device. In some

embodiments of the present disclosure, the autonomous cleaning device may be a mopping robot, and the autonomous cleaning device operates on a floor, i.e., the floor being the operation surface. The autonomous cleaning device may further be a window cleaning robot, where the autonomous cleaning device operates on an outer glass surface of a building, and the glass is the operation surface. The autonomous cleaning device may further be a pipe cleaning robot, where the autonomous cleaning device operates on an inner surface of the pipe, and the inner surface of the pipe is the operation surface. Merely for the purpose of demonstration, the following description in the present disclosure takes the mopping robot as an example.

[0026] In some embodiments of the present disclosure, the mobile platform 100 may be an autonomous mobile platform or a non-autonomous mobile platform. The autonomous mobile platform means that the mobile platform 100 may make operational decisions autonomously and adaptively on its own based on unexpected environment inputs. The non-autonomous mobile platform cannot make the operational decisions adaptively on its own based on the unexpected environment inputs, but may execute established procedures or operate in accordance with certain logic. Accordingly, when the mobile platform 100 is an autonomous mobile platform, the target direction may be determined autonomously by the autonomous cleaning device. When the mobile platform 100 is a non-autonomous mobile platform, the target direction may be set by a system or manually. When the mobile platform 100 is an autonomous mobile platform, the mobile platform 100 includes a front part 111 and a rear part 110.

[0027] The sensing system 120 includes sensing devices, such as a location determination device 121 located on the mobile platform 100, a buffer 122 located at the front part 111 of the mobile platform 100, a cliff sensor 123 and an ultrasonic sensor (not illustrated in the figures) located at a bottom part of the mobile platform, an infrared sensor (not illustrated in the figures), a magnetometer (not illustrated in the figures), an accelerometer (not illustrated in the figures), a gyroscope (not illustrated in the figures), an odometer (not illustrated in the figures) and the like, and provides various location information and motion state information of the robot to the control system 130.

[0028] In order to describe the operation of the autonomous cleaning device more clearly, directions are defined as follows. The autonomous cleaning device may travel on the floor through various combinations of movement relative to the following three mutually perpendicular axes as defined by the mobile platform 100: a transverse axis x, a front-rear axis y, and a center vertical axis z. A forward driving direction along the front-rear axis y is denoted as being "forward", and a rearward driving direction along the front-rear axis y is denoted as being "rearward". The transverse axis x essentially extends between a right wheel and a left wheel of the autonomous

cleaning device along an axis passing through a center point of the driving wheel assembly 141. The autonomous cleaning device can rotate around the x-axis. When the front part of the autonomous cleaning device is inclined upward and the rear part is inclined downward, it is referred as being "pitching upward". When the front part of the autonomous cleaning device is inclined downward, and the rear part is inclined upward, it is referred as being "pitching downward". In addition, the autonomous cleaning device may rotate around the z-axis. Along the forward direction of the autonomous cleaning device, when the autonomous cleaning device is inclined toward right side of the y-axis, it is referred as being "turning right", and when the autonomous cleaning device is inclined toward left side of the y-axis, it is referred as being "turning left".

[0029] As illustrated in FIG. 2, the cliff sensors 123 are disposed at the bottom part of the mobile platform 100 and also in front of and behind a driving wheel assembly 141. The cliff sensors 123 are configured to prevent the autonomous cleaning device from falling when it moves backwards, thereby avoiding damages to the autonomous cleaning device. The aforementioned wording "front" refers to a side in a direction same as a travelling direction of the autonomous cleaning device, and the aforementioned wording "behind" refers to a side in a direction opposite to the travelling direction of the autonomous cleaning device.

[0030] The location determination device 121 includes, but is not limited to, a camera and a laser distance sensor (LDS).

[0031] Various components of the sensing system 120 may operate independently or cooperate with each other to achieve an intended function more accurately. The cliff sensor 123 and the ultrasonic sensor identify the surface to be cleaned, so as to determine physical properties of the surface to be cleaned, including a surface media, degree of cleanliness, etc. Further, a more accurate determination may be made in combination with a camera, the laser distance sensor, and etc.

[0032] For example, the ultrasonic sensor may determine whether the surface to be cleaned is a carpet. If the ultrasonic sensor determines that the surface to be cleaned is a material of carpet, the control system 130 controls the autonomous cleaning device to perform cleaning in a carpet cleaning mode.

[0033] The front part 111 of the mobile platform 100 is provided with a buffer 122. When the driving wheel assembly 141 drives the autonomous cleaning device to travel on the floor during a cleaning process, the buffer 122 detects one or more events (or objects) along a travelling path of the autonomous cleaning device by a sensor system, such as an infrared sensor. The autonomous cleaning device may control the driving wheel assembly 141, based on the events (or objects) detected by the buffer 122, such as obstacles and walls, such that the autonomous cleaning device responds to the events (or objects), such as moving away from the obstacles.

[0034] The control system 130 is disposed on a main circuit board in the mobile platform 100, and includes a computing processor, such as a central processing unit, an application processor, in communication with a non-transitory memory, such as a hard disk, a flash memory, a random access memory. The application processor is configured to: receive environment information perceived by the multiple sensors and transmitted by the sensing system 120; create a simultaneous map of the environment where the autonomous cleaning device is located through a locating algorithm such as simultaneous localization and mapping (SLAM), according to obstacle information fed back by the laser distance sensor; autonomously determine a travelling path according to the environment information and the environment map; and then control the driving system 140 to perform operations such as moving forward, moving backward, and/or steering according to the autonomously determined travelling path. Further, the control system 130 may further determine whether to start the cleaning module 150 to perform a cleaning operation according to the environment information and the environment map.

[0035] In an embodiment of the present disclosure, in combination with distance information and speed information fed back by the sensing device such as the buffer 122, the cliff sensor 123, the ultrasonic sensor, the infrared sensor, the magnetometer, the accelerometer, the gyroscopes, and the odometer, the control system 130 may determine comprehensively which operation state the autonomous cleaning device is currently in, such as crossing a threshold, moving onto a carpet, being on a cliff, getting stuck at the top or bottom part, a full dust box, being picked up, etc. And further, the control system provides detailed next action strategy for different situations, so that the operation of the autonomous cleaning device conforms to the owner's requirements and provides enhanced user experience. Furthermore, the control system may plan an efficient and reasonable cleaning path and cleaning mode based on the real-time map information created by SLAM, which greatly improves the cleaning efficiency of the autonomous cleaning device.

[0036] The driving system 140 may execute a driving instructions based on distance and angle information (for example, x, y, and θ components), so as to manipulate the autonomous cleaning device to travel across the floor. FIGS. 3 and 4 illustrate respectively an oblique view and a front view of a side driving wheel assembly 141 according to an embodiment of the present disclosure. As illustrated in the figures, the driving system 140 includes the driving wheel assembly 141, and may control the left and right wheels at the same time. In order to more accurately control the motion of the robot, the driving system 140 may include a left driving wheel assembly and a right driving wheel assembly. The left and right driving wheel assemblies are symmetrically disposed along a transverse axis defined by the mobile platform 100. The driving wheel assembly includes a body part, a driving wheel and an elastic element. An end of the

body part is connected to a frame; the driving wheel is disposed in the body part and driven by a driving motor 146; and the elastic element is connected between the body part and the frame, and configured to provide an elastic force between the frame and the body portion. The driving motor 146 is located outside the driving wheel assembly 141, and an axis of the driving motor 146 is located within a cross-sectional projection of the driving wheel assembly. The driving wheel assembly 141 may further be connected to a circuit configured to measure a driving current and the odometer.

[0037] The autonomous cleaning device may include one or more steering assembly 142, so as to make the autonomous cleaning device to move more stably on the floor or have stronger motion ability. The steering assembly may be a driven wheel or a driving wheel, and a structure of the steering assembly includes, but is not limited to, universal wheels. The steering assembly 142 may be located in front of the driving wheel assembly 141.

[0038] The driving motor 146 provides power for rotation of the driving wheel assembly 141 and/or the steering assembly 142.

[0039] The driving wheel assembly 141 may be detachably connected to the mobile platform 100, which is convenient for disassembly, assembly, and maintenance. The driving wheel may have a suspension system of biased drop type. The driving wheel is fastened in a movable mode, for example, attached in a rotatable mode, to the mobile platform 100 of the autonomous cleaning device, and maintains contact with the floor and traction due to a certain grounding force through an elastic element 143, such as a tension spring or a compression spring. In addition, the cleaning module 150 of the autonomous cleaning device further contacts the surface to be cleaned with a certain pressure.

[0040] The power system 160 includes a rechargeable battery, such as a nickel-metal hydride battery and a lithium battery. The rechargeable battery may be connected to a charging control circuit, a battery pack charging temperature detection circuit, and a battery undervoltage monitoring circuit. The charging control circuit, the battery pack charging temperature detection circuit, and the battery undervoltage monitoring circuit are then connected to the single-chip micro-controller circuit. The autonomous cleaning device is connected to a charging station through a charging electrode disposed at a side or below a device body for charging. If there is dust on an exposed charging electrode, a plastic body around the electrode may melt and deform due to an accumulation effect of electric charges during the charging process, which even causes the electrode itself to deform, and interrupts normal charging.

[0041] The human-computer interaction system 170 includes a button on a host panel for the user to select functions. The human-computer interaction system 170 may further include a display screen and/or an indicator light and/or a speaker. The display screen, the indicator light and the speaker provide the user with the current

state of the robot or the function selection options. The human-computer interaction system 170 may further include programs for a mobile client. For a cleaning device of path-navigation type, the mobile client may provide the user with a map of the environment where the device is located, and the location of the robot, thus providing the user with rich and user-friendly functions.

[0042] The cleaning module 150 may include a dry cleaning module 151 and/or a wet cleaning module 400.

[0043] As illustrated in FIGS. 5-8, the dry cleaning module 151 may include a rolling brush, a dust box, a fan, and an air outlet. The rolling brush that has a certain interaction with the floor sweeps garbage on the floor and rolls it to the front of a dust suction port between the rolling brush and the dust box. Then, the garbage is sucked into the dust box by the suction gas generated by the fan and passing through the dust box. The dust removal capacity of the sweeper may be characterized by dust pickup efficiency (DPU) of garbage. The dust pickup efficiency DPU is affected by the structure and material of the rolling brush, and is further affected by the dust suction port, the dust container, the fan, the air outlet, and air utilization of the air duct formed by connection parts between these four components. Further, the dust pickup efficiency DPU is also affected by the type and power of the fan. This is a complicated system scheme problem. Compared with an ordinary plug-in vacuum cleaner, improvement of dust removal capacity is of greater significance to the autonomous cleaning device with limited power. The improvement of dust removal capacity reduces the power requirements directly and effectively. That is to say, a robot that can clean a floor of 80 square meters with a single charge previously may evolve into a single charge for cleaning a floor of 180 square meters or more. In addition, the service life of batteries that undergo fewer charging cycles significantly increases, which also raises the frequency at which users need to replace them. The improvement of dust removal capability is obvious and direct user experience, and the user may directly draw a conclusion about whether the sweeping/mopping is clean. The dry cleaning module may further include a side brush 152 having a rotation shaft, wherein the rotation shaft is at a certain angle with respect to the floor, for moving scraps to sweeping area of a rolling brush of the cleaning module 150.

[0044] FIG. 5 illustrates a schematic structural view of the dust box 152 of the dry cleaning module, FIG. 6 illustrates a schematic structural view of the fan 156 of the dry cleaning module, FIG. 7 illustrates a schematic view of the dust box 152 in an opened state, and FIG. 8 illustrates a schematic view of a dust box and a fan in an assembled state.

[0045] The roller brush, which has a certain interaction with the floor, sweeps the garbage on the floor and rolls it to the front of a dust suction port 154 between the roller brush and the dust box 152. The garbage is then sucked into the dust box 152 by the suction gas generated by the fan 156 and passing through the dust box 152. The

garbage is separated by a filter 153 at a side inside the dust box 152 near the dust suction port 154. The filter 153 completely separates the dust suction port from an air outlet. The filtered air enters the fan 156 through the air outlet 155.

[0046] Typically, the dust suction port 154 of the dust box 152 is located in front of the robot, the air outlet 155 is located on a side of the dust box 152, and the suction port of the fan 156 abuts the air outlet of the dust box.

[0047] A front panel of the dust box 152 may be opened for cleaning the garbage in the dust box 152.

[0048] The filter 153 and a container body of the dust box 152 are detachably connected to facilitate detachment and cleaning of the filter.

[0049] According to embodiments of the present disclosure, as illustrated in FIGS. 9-11, the wet cleaning module 400 in embodiments of the present disclosure is configured to clean at least part of the operation surface using a wet cleaning mode. The wet cleaning module 400 includes a cleaning head 410 and a driving unit 420. The cleaning head 410 is configured to clean at least part of the operation surface, and the driving unit 420 is configured to drive the cleaning head 410 to conduct a substantially reciprocating movement on a target surface. The target surface is part of the operation surface. The cleaning head 410 conducts reciprocating movement on the surface to be cleaned, and a contact surface of the cleaning head 410 in contact with the surface to be cleaned is provided with a cleaning cloth or a cleaning base plate, which leads to high-frequency friction with respect to the surface to be cleaned through the reciprocating movement, thereby removing stains from the surface to be cleaned.

[0050] The higher the friction frequency, the more friction times per unit time. The high-frequency reciprocating movement, also called reciprocating vibration, has a greater cleaning capacity than the ordinary reciprocating movement, such as rotation. The friction cleaning, of which the friction frequency is optionally close to the sound wave, have a better cleaning effect than the rotating friction cleaning with dozens of turns per minute. On the other hand, hair tufts on the surface of the cleaning head may be more uniform and stretched in the same direction under the shaking of high-frequency vibration. In this case, the cleaning effect is not improved by increasing the friction force via the only downward pressure as applied under the low frequency rotation, wherein the only downward pressure would not cause the hair tufts to be stretched nearly in the same direction. Thus, the overall cleaning effect is more uniform. This is reflected in the effect that water marks on the operation surface after high-frequency vibration cleaning are more uniform, and no messy water mark is left.

[0051] The reciprocating movement may be repeated motions along any one or more directions within the operation surface. Alternatively, it may be vibrations perpendicular to the operation surface. The present disclosure is not strictly limited in this regard. In some embod-

iments of the present disclosure, the directions of the reciprocating movements of the cleaning module is approximately perpendicular to the travelling direction of the autonomous cleaning robot, because the directions of the reciprocating movement parallel to the travelling direction of the autonomous cleaning robot would cause instability to the autonomous cleaning robot itself, due to the thrust and resistance in the travelling direction leading to the driving wheels prone to slip. The impact of slipping is more obvious when the wet cleaning module is included, because the wet operation surface increases the possibility of slipping. In addition to affecting the smooth moving and cleaning of the autonomous cleaning robot, the slipping may also cause the sensors such as the odometer, the gyroscope to be inaccurate in range measurement. This makes the autonomous cleaning device of navigation-type unable to accurately locate and create the map. In a case of frequent slipping, the impact on SLAM cannot be ignored. Therefore, it is necessary to avoid the robot from slipping as much as possible. In addition to slipping, the motion component of the cleaning head in the travelling direction of the autonomous cleaning robot causes the autonomous cleaning robot to be continuously pushed forwards or backwards when it is travelling. This makes the travelling of the robot unstable and unsmooth.

[0052] In an optional embodiment of the present disclosure, as illustrated in FIG. 9, the driving unit 420 includes: a driving platform 421, connected to a bottom surface of the mobile platform 100 and configured to provide a driving force; and a support platform 422, detachably connected to the driving platform 421 and configured to support the cleaning head 410, wherein the support platform 422 moves upwards or downwards under driving of the driving platform 421.

[0053] In an optional embodiment of the present disclosure, a lifting module is disposed between the cleaning module 150 and the mobile platform 100, such that the cleaning module 150 is in a good contact with the surface to be cleaned, or different cleaning modes are provided for the surface to be cleaned of different materials.

[0054] In some embodiments of the present disclosure, the dry cleaning module 151 may be connected to the mobile platform 100 through a passive lifting module. When the cleaning device encounters an obstacle, the dry cleaning module 151 may cross over the obstacle through the lifting module more conveniently.

[0055] In some embodiments of the present disclosure, the wet cleaning module 400 may be connected to the mobile platform 100 through an active lifting module. When the wet cleaning module 400 is out of operation temporarily, or when the wet cleaning module 400 cannot be clean the surface to be cleaned, the wet cleaning module 400 may be raised up by the active lifting module and separated from the surface to be cleaned, so as to change the cleaning mode.

[0056] As illustrated in FIGS. 10-11, the driving platform 421 includes: a motor 4211, disposed at a side of

the driving platform 421 close to the mobile platform 100 and configured to output power through an output shaft of the motor; a driving wheel 4212, connected to the output shaft of the motor and having an asymmetrical structure; and a vibration member 4213, disposed at a side of the driving platform 421 opposite to the motor 4211 and connected to the driving wheel 4212, so that reciprocating movement of the vibration member 4213 may be achieved under the asymmetrical rotation of the driving wheel 4212.

[0057] The driving platform 421 may further include a gear mechanism. The gear mechanism may connect the motor 4211 and the driving wheel 4212. The motor 4211 may directly drive the driving wheel 4212 to perform a swing motion, or indirectly drive the driving wheel 4212 to perform the swing motion through the gear mechanism. Those ordinary skilled in the art can understand that the gear mechanism may be a gear or a gear set comprising multiple gears.

[0058] The motor 4211 simultaneously transmits power to the cleaning head 410, the driving platform 421, the support platform 422, a liquid delivery mechanism, a liquid container, and etc. through a power transmission device. The power system 160 provides power for the motor 4211, and is controlled by the control system 130 as a whole. The power transmission device may be a gear drive, a chain drive, a belt drive, or a worm gear and so on.

[0059] The motor 4211 includes a forward output mode and a reverse output mode. The motor 4211 rotates forward in the forward output mode, and the motor 4211 rotates in a reverse direction in the reverse output mode. In the forward output mode of the motor 4211, the motor 4211 may simultaneously drive, through the power transmission device, a vibration member 4213 of the driving platform in the wet cleaning module 400 to conduct a substantively reciprocating movement, and the liquid delivery mechanism to conduct a synchronous movement. In the reverse output mode of the motor 4211, the motor 4211 drives the driving platform 421 to rise up or lower down through the power transmission device.

[0060] Further, the driving platform 421 further includes a connection rod 4214, which extends along an edge of the driving platform 421, and connects the driving wheel 4212 with the vibration member 4213, so that the vibration member 4213 extends to a preset position. An extension direction of the vibration member 4213 is perpendicular to the connection rod 4214, so that a reciprocating direction of the vibration member 4213 is substantially perpendicular to a travelling direction of the autonomous cleaning robot.

[0061] The motor 4211 is connected to, through the power transmission device, the driving wheel 4212, the vibration member 4213, the connection rod 4214, and a vibration buffer device 4215. The vibration member 4213 and the connection rod 4214 constitute an approximate L-shaped structure. As illustrated in FIG. 15, the vibration member 4213 is driven by the connection rod 4214 to conduct the reciprocating movement. The vibration buff-

er device 4215 has an effect of damping and reducing jitter on the motion driven by the driving wheel 4212, so that the vibration member 4213 vibrates smoothly within the movement range that the support platform 422 can provide. In some embodiments of the present disclosure, the vibration buffer device 4215 is made of a soft material, optionally a rubber structure, and the vibration buffer device 4215 is sleeved on the connection rod 4214. On the other hand, the vibration buffer device 4215 may further protect the vibration member 4213 from damage due to collision with the driving platform 421, thereby further affecting the reciprocating movement of the vibration member 4213. A less elastic connection between a movable part and a fixed part of the driving platform 421 restricts movement in the travelling direction of the autonomous cleaning robot, while a flexible connection in a direction substantially perpendicular to the travelling direction, that is, in the vibration direction of the vibration member 4213, allows movement. The two movement restrictions as mentioned above cause the movement of the vibration member 4213 to be not exactly reciprocating, but substantively reciprocating. When the wet cleaning module 400 is activated, the motor 4211 starts to rotate forward, and drives, through the driving wheel 4212, the connection rod 4214 to conduct reciprocating movement along a surface of the driving platform 421. At the same time, the vibration buffer device 4215 drives the vibration member 4213 to substantially conduct reciprocating movement along the surface of the driving platform 421. The vibration member 4213 drives the cleaning base plate 4221 to substantially conduct reciprocating movement along the surface of the driving platform 421. The cleaning base plate 4221 drives a movable section 412 to substantially conduct reciprocating movement along the surface to be cleaned. At this time, a clean liquid pump causes clean water to flow out of a liquid container, and the clean water is sprayed on the cleaning head 410 through a liquid outlet device 4217. The cleaning head 410 cleans the surface to be cleaned through the reciprocating movement.

[0062] Cleaning strength or efficiency of the autonomous cleaning device may also be adjusted automatically and dynamically according to operation environment of the autonomous cleaning device. For example, the autonomous cleaning device may realize the dynamic adjustment through detecting physical information of the surface to be cleaned by the sensing system 120. For example, the sensing system 120 may detect flatness of the surface to be cleaned, a material of the surface to be cleaned, whether there is oil and dust, and so on, and transmit such information to the control system 130 of the autonomous cleaning device. Accordingly, the control system 130 may control the autonomous cleaning device to automatically and dynamically adjust a rotation speed of the motor and a transmission ratio of the power transmission device according to the operation environment of the autonomous cleaning device, thereby adjusting a preset reciprocating cycle of the reciprocating

movement of the cleaning head 410.

[0063] For example, when the autonomous cleaning device is in operation on a flat floor, the preset reciprocating cycle may be automatically and dynamically adjusted to be longer, and a liquid volume of the liquid pump may be automatically and dynamically adjusted to be smaller. When the autonomous cleaning device is in operation on a less flat floor, the preset reciprocating cycle may be automatically and dynamically adjusted to be shorter, and the liquid volume of the liquid pump may be automatically and dynamically adjusted to be greater. This is because the flat floor is easier to clean compared to the less flat floor. Therefore, cleaning an uneven floor requires faster reciprocating movement (that is, higher frequency) of the cleaning head 410 and a larger amount of liquid (such as water).

[0064] For another example, when the autonomous cleaning device is in operation on a desktop, the preset reciprocating cycle may be automatically and dynamically adjusted to be longer, and the liquid volume of the liquid pump may be automatically and dynamically adjusted to be smaller. When the autonomous cleaning device 100 is in operation on the floor, the preset reciprocating cycle may be automatically and dynamically adjusted to be shorter, and the liquid volume of the liquid pump may be automatically and dynamically adjusted to be greater. This is because compared to the floor, the desktop has less dust and oil, and it is easier to clean a material of the desktop. Therefore, the cleaning head 410 is required to perform less reciprocating movements and the liquid pump provides relatively less liquid (such as water) to clean the desktop.

[0065] As an optional embodiment of the present disclosure, the support platform 422 includes: a cleaning base plate 4221, which is disposed on the support platform 422 in a freely movable mode. The cleaning base plate 4221 substantively conducts reciprocating movement under vibration of the vibration member 4213. In some embodiments of the present disclosure, as illustrated in FIG. 16, the cleaning base plate 4221 includes an assembly notch 42211 disposed at a position in contact with the vibration member 4213. When the support platform 422 is connected to the driving platform 421, the vibration member 4213 is fitted in the assembly notch 42211, so that the cleaning base plate 4221 can substantially conduct reciprocating movement synchronously along with the vibration member 4213. There are four first stoppers 42212 on the cleaning base plate 4221 in the travelling direction of the cleaning device. The four first stoppers 42212 are in soft connection with the cleaning base plate 4221, and the soft connection can be deformed in a small scope, thereby limiting the movement of the cleaning base plate 4221 relative to the support platform 422 in the travelling direction of the autonomous cleaning device. There are two second stoppers 42213 in a direction of the cleaning base plate 4221 perpendicular to the travelling direction of the autonomous cleaning device. The two second stoppers 42213 defines a range

of reciprocating movement of the cleaning base plate in the direction perpendicular to the travelling direction of the autonomous cleaning device. In addition, a liquid outlet hole 42214 is disposed near the assembly notch 42211 of the cleaning base plate 4221, such that the liquid discharged from the liquid outlet device 4217 flows to the cleaning head 410 through the liquid outlet hole. Due to influences of the stoppers and the vibration buffer device, the movement of the cleaning base plate 4221 is substantively reciprocating movement. The cleaning base plate 4221 is located on a part of the support platform 422, and a vibration frequency may be increased by means of local vibration, for example, reaching an acoustic wave frequency range. Movement is restricted in the travelling direction of the robot through the less elastic connection between the movable part and the fixed part of the driving platform 421, while movement is allowed in the direction substantially perpendicular to the travelling direction, that is, movement is allowed in the vibration direction of the vibration member 4213 through the flexible connection.

[0066] FIG. 12 illustrates a cleaning head driving mechanism 500 based on a crank-slider mechanism according to another embodiment of the present disclosure. The driving mechanism 500 is applicable to the driving platform 421. The driving mechanism 500 includes a driving wheel 4212, a vibration member 4213, a cleaning base plate 4221, a sliding groove 4222 (a first sliding groove), and a sliding groove 4223 (a second sliding groove).

[0067] The sliding grooves 4222, 4223 are provided on the support platform 422. Both ends of the cleaning base plate 4221 respectively include a slider 525 (a first slider) and a slider 528 (a second slider). The sliders 525 and 528 are respectively protrusions on both ends of the cleaning base plate 4221. The slider 525 is inserted into the sliding groove 4222 and is slideable along the sliding groove 4222. The slider 4223 is inserted into the sliding groove 4223 and is slideable along the sliding groove 4223. In some embodiments of the present disclosure, the sliding groove 4222 and the sliding groove 4223 are located on one straight line. In some embodiments of the present disclosure, the sliding groove 4222 and the sliding groove 4223 are not located on one straight line. In some embodiments of the present disclosure, the sliding groove 4222 and the sliding groove 4223 extend in a same direction. In some embodiments of the present disclosure, an extending direction of the sliding groove 4222 and the sliding groove 4223 is the same as an extending direction of the cleaning base plate 4221. In some embodiments of the present disclosure, the extending direction of the sliding groove 4222 and the sliding groove 4223 is different from the extending direction of the cleaning base plate 4221. In some embodiments of the present disclosure, the extending direction of the sliding groove 4222 is different from the extending direction of the sliding groove 4223. For example, as illustrated in FIG. 12, the extending direction of the sliding groove 4222 is the same

as the extending direction of the cleaning base plate 4221, while the extending direction of the sliding groove 4223 is at a certain angle with respect to the extending direction of the sliding groove 4222.

[0068] The vibration member 4213 includes a swinging end 512 and a sliding end 514. The swinging end 512 is connected to the driving wheel 4212 through a first pivot 516, and the sliding end 514 is connected to the cleaning base plate 4221 through a second pivot 518.

[0069] A swing center of the driving wheel 4212 is point O, and a pivotal center of the first pivot 516 is point A. The point O and the point A do not coincide with each other, and a distance between them is a preset distance d.

[0070] When the driving wheel 4212 rotates, the point A performs a circular swing movement therewith. Accordingly, the swinging end 512 performs a circular swing movement along with the point A. The sliding end 514 drives the cleaning base plate 4221 to perform a sliding movement through the second pivot 518. Accordingly, the slider 525 of the cleaning base plate 4221 performs a linear reciprocating movement along the sliding groove 4222; and the slider 528 performs the linear reciprocating movement along the sliding groove 4223. In FIG. 4, the moving speed of the mobile platform 210 is V_0 , and the moving direction is a target direction. According to some embodiments of the present disclosure, when the sliding groove 4223 and the sliding groove 4222 are respectively approximately perpendicular to a direction of the moving speed V_0 of the mobile platform 210, an overall displacement of the cleaning base plate 4221 is substantially perpendicular to the target direction. According to other embodiments of the present disclosure, when any one of the sliding groove 4223 and the sliding groove 4222 have an angle other than 90 degrees with respect to the target direction, overall displacement of the cleaning base plate 4221 includes both a component perpendicular to the target direction and a component parallel to the target direction.

[0071] Further, the cleaning head driving mechanism further includes a vibration buffer device 4215, which is disposed on the connection rod 4214 and is configured to reduce the vibration in a certain direction. In an embodiment of the present disclosure, the vibration buffer device 4215 is configured to reduce vibration in the direction of the movement component perpendicular to the target direction of the autonomous cleaning device.

[0072] FIG. 13 illustrates a cleaning head driving mechanism 600 based on a double crank mechanism according to another embodiment of the present disclosure. The driving mechanism 600 is applicable to the driving platform 421. The driving mechanism 600 includes a driving wheel 4212 (a first driving wheel), a driving wheel 4212' (a second driving wheel), and a cleaning base plate 4221.

[0073] The cleaning base plate 4221 has two ends, wherein a first end is connected to the driving wheel 4212 through a pivot 624 (a first pivot), and a second end is

connected to the driving wheel 4212' through a pivot 626 (a second pivot). A swing center of the driving wheel 4212 is point O, and a pivotal center of the pivot 624 is point A. The point O and the point A do not coincide with each other, and a distance between them is a preset distance d. A swing center of the driving wheel 236 is point O', and a pivotal center of the pivot 626 is point A'. The point O' and the point A' do not coincide with each other, and a distance between them is the preset distance d. In some embodiments of the present disclosure, the point A, the point A', the point O and the point O' are located on the same plane. Therefore, the driving wheel 4212, the driving wheel 4212' and the cleaning base plate 4221 forms a double crank mechanism (or a parallelogram mechanism), where the cleaning base plate 4221 serves as a coupling rod and the driving wheels 4212, 4212' act as two cranks.

[0074] Further, the cleaning head driving mechanism includes a vibration buffer device 4215, which is disposed on the connection rod 4214, and is configured to reduce vibration in a certain direction. In an embodiment of the present disclosure, the vibration buffer device 4215 is configured to reduce vibration in the direction of the movement component perpendicular to the target direction of the autonomous cleaning device.

[0075] FIG. 14 illustrates a driving mechanism 700 based on a crank-slider mechanism according to an embodiment of the present disclosure. The driving mechanism 700 is applicable to the driving platform 421, and includes a driving wheel 4212, a cleaning base plate 4221 and a sliding groove 4222.

[0076] The sliding groove 4222 is provided on the support platform 422. The cleaning base plate 4221 includes a swinging end 4227 and a sliding end 4226. The swinging end 4227 is connected to the driving wheel 4212 through a pivot 4228. A swing center of the driving wheel 4212 is point O, and a pivotal center of the pivot 4228 of the swinging end is point A. The point O and the point A do not coincide with each other, and a distance between them is a preset distance d. The sliding end 4226 includes a slider 4225 that is a protrusion on the sliding end 4226. The slider 4225 is inserted into the sliding groove 4222 and is slideable along the sliding groove 4222. Therefore, the driving wheel 4221, the cleaning base plate 4221, the slider 4225 and the sliding groove 4222 form a crank-slider mechanism.

[0077] When the driving wheel 4212 rotates, the point A conducts a circular swing movement. Accordingly, the swinging end 4227 of the cleaning base plate 4221 performs a circular swing movement along with the point A. The slider 4225 slides in the sliding groove 4222 to conduct a linear reciprocating movement. As a result, the cleaning base plate 4221 starts to conduct reciprocating movement. According to some embodiments of the present disclosure, the sliding groove 4222 is approximately perpendicular to the target direction of the moving speed of the mobile platform. Therefore, the linear movement of the sliding end 4226 includes a component per-

pendicular to the target direction, and the circular swing movement of the swinging end 4227 includes both a component perpendicular to the target direction and a component parallel to the target direction.

[0078] In FIG. 14, the moving speed of the mobile platform is V_0 , and the moving direction is the target direction. The sliding groove 4222 is approximately perpendicular to the target direction. At this time, the reciprocating movement of the cleaning base plate 4221 as a whole has a motion component parallel to the target direction of the autonomous cleaning device and a motion component perpendicular to the target direction of the autonomous cleaning device.

[0079] Further, the support platform 422 further includes an elastic detachment button 4229, disposed on at least one side of the support platform 422, and configured to detachably connect the support platform 422 to a claw 4216 of the driving platform 421, so that the support platform 422 is detachably and mechanically fixed on the driving platform 421, and fixed relative to the driving platform and the autonomous cleaning device. At least one fitting section 4224 is disposed on the support platform 422 for fitting the cleaning head 410. The fitting section 4224 may be formed of an adhesive layer having adhesive material.

[0080] As an optional embodiment of the present disclosure, as illustrated in FIG. 9, the cleaning head 410 includes a movable section 412 connected to the cleaning base plate 4221 and conducting substantially reciprocating movement along the cleaning surface under driving of the cleaning base plate 4221. The movable section 412 is disposed at a substantially central position of the cleaning head 410.

[0081] In some embodiments of the present disclosure, an adhesive layer is disposed on a side of the movable section 412 connected to the cleaning base plate 4221. The movable section 412 and the cleaning base plate 4221 are connected through the adhesive layer.

[0082] In some embodiments of the present disclosure, the cleaning head 410 further includes a fixed section 411, connected to the bottom part of the support platform 422 through the at least one fitting section 4224. The fixed section 411 cleans at least part of the operation surface with movement of the support platform 422.

[0083] Further, the cleaning head 410 further includes a flexible connection part 413, disposed between the fixed section 411 and the movable section 412 and configured to connect the fixed section 411 with the movable section 412. The cleaning head 410 further includes a sliding buckle 414, extending along an edge of the cleaning head 410 and detachably mounted at a buckle position 4225 of the support platform 422.

[0084] In an embodiment of the present disclosure, as illustrated in FIG. 9, the cleaning head 410 may be made of a material having certain elasticity, and the cleaning head 410 is fixed to a surface of the support platform 422 through the adhesive layer, so as to achieve the reciprocating movement. When the cleaning head 410 is in

operation, the cleaning head 410 is kept in contact with the surface to be cleaned.

[0085] The liquid delivery mechanism includes a liquid outlet device 4217, which may be directly or indirectly connected to a cleaning liquid outlet of the liquid container (not illustrated), such as a liquid outlet of the clean water container. The cleaning liquid may flow to the liquid outlet device 4217 via the cleaning liquid outlet of the liquid container, and may be evenly sprayed onto the surface to be cleaned through the liquid outlet device. The liquid outlet device may be provided with a connection piece (not illustrated in the figure), and the liquid outlet device is connected to the cleaning liquid outlet of the liquid container through the connection piece. The liquid outlet device is provided with a distribution opening, which may be a continuous opening or a combination of several small discontinuous openings. Several nozzles may be disposed at the distribution opening. The cleaning liquid flows to the distribution opening through the cleaning liquid outlet of the liquid container and the connection piece of the liquid outlet device, and is evenly sprayed onto the operation surface through the distribution opening.

[0086] The liquid delivery mechanism may further include a clean liquid pump 4219 and/or a clean liquid pump pipe 4218. The clean liquid pump 4219 may directly communicate with the cleaning liquid outlet of the liquid container or communicate with it through the clean liquid pump pipe 4218.

[0087] The clean liquid pump 4219 may be connected to the connection piece of the liquid outlet device, and may be configured to pump the cleaning liquid from the liquid container to the liquid outlet device. The clean liquid pump can be a gear pump, a vane pump, a plunger pump, a peristaltic pump, and so on.

[0088] The liquid delivery mechanism pumps out the cleaning liquid in the liquid container through the clean liquid pump 4219 and the clean liquid pump pipe 4218, and then deliver the cleaning liquid to the liquid outlet device. The liquid outlet device 4217 may be a nozzle, a drip hole, a soaking cloth, etc., and evenly spread liquid on the cleaning head, so as to wet the cleaning head and the surface to be cleaned. Stains on the wet surface to be cleaned may be cleaned more easily. In the wet cleaning module 400, power or flow rate of the clean liquid pump may be adjusted.

[0089] Further, as illustrated in FIG. 17, the motor 4211 drives the clean liquid pump 4219 in a peristaltic manner via a gear set 42193. Due to the peristaltic movement of the clean liquid pump 4219, liquid enters from the liquid inlet 42191, flows out from the liquid outlet 42192, and is then delivered to the liquid outlet device 4217 via the clean liquid pump pipe 4218. The liquid flowing out through the liquid outlet device 4217 flows to the cleaning head 410 through the liquid outlet hole.

[0090] Further, as illustrated in FIG. 18, the motor 4211 drives a cable gear 42196 to rotate through the gear set 42193, the cable gear 42196 is wound with a cable 42194, the cable 42194 is wrapped on the driving plat-

form 421, and the cable gear 42196 draws the cable 42194 to raise up or lower down, thereby moving the driving platform 421 upwards or downwards. The cable gear 42196 and the cable 42194 are core components of the lifting module.

[0091] The gear set 42193 and the cable gear 42196 are provided with a clutch 42195 including a spring and a sheet-like piece. By controlling clutching of the clutch 42195, the motor 4211 controls three motion modules. For example, the motor 4211 rotates in one direction to drive the vibration member to vibrate, and achieve liquid supply of the clean liquid pump 4219, and the motor 4211 rotates in an opposite direction to drive the lifting module up or down through the cable 42194. In some embodiments of the present disclosure, a combination scheme of the gear set realizes different combinations of control over the three motion modules. For example, rotation of the motor in one direction achieves liquid supply by the clean liquid pump, and the rotation of the motor in the opposite direction achieves control on the lifting and the vibration. In some embodiments of the present disclosure, two motors may be also used to control the three motion modules, but using one more motor increases the cost.

[0092] Since the cleaning module of the autonomous cleaning device is provided with a dry cleaning module and a wet cleaning module, a more comprehensive cleaning function may be provided. In addition, in the wet cleaning module, the cleaning head may conduct reciprocating movement by combining a driving unit and a vibration section. Thus, the surface to be cleaned can be repeatedly cleaned, so that in the movement trajectory of the cleaning robot, a certain area can be cleaned multiple times at one time. This thereby greatly enhances the cleaning effect. Especially for areas with more stains, the cleaning effect is pronounced.

[0093] As illustrated in FIGS. 19-20, the wet cleaning module 400 is movably connected to the mobile platform 100 through a four-linkage lifting structure 500, and is configured to clean at least part of the operation surface using the wet cleaning mode. The four-linkage lifting structure 500 is a parallelogram structure, and is configured to switch the wet cleaning module 400 between a raised state and a lowered state. The raised state is a state where the wet cleaning module 400 leaves the operation surface, as illustrated in FIG. 19. The lowered state is a state where the wet cleaning module 400 is attached onto the operation surface, as illustrated in FIG. 20.

[0094] As illustrated in FIGS. 21-22, the four-linkage lifting structure 500 includes: a first connection end 501, configured to provide an active force to switch the wet cleaning module 400 between the raised state and the lowered state, and a second connection end 502, disposed opposite to the first connection end 501, and rotating under action of the active force. The first connection end 501 and the second connection end 502 are respectively located on each side of the wet cleaning module

400, and raises or lowers the wet cleaning module 400 by stably providing a lifting force.

[0095] In an embodiment of the present disclosure, the first connection end 501 includes a first holder 5011 fixedly connected to a bottom part of the mobile platform 100. The first holder 5011 has a substantively n-shaped structure. The first holder 5011 includes a transverse beam 50111, a first longitudinal beam 50114, and a second longitudinal beam 50115. Ends of the first longitudinal beam 50114 and the second longitudinal beam 50115 are respectively fixedly connected to the mobile platform 100 and the wet cleaning module 400 by bolts, so as to provide a support force when the wet cleaning module 400 is being raised and lowered.

[0096] The first connection end 501 further includes a first pair of connection rods 5012, having one end rotatably connected to the first holder 5011, and the other end rotatably connected to the wet cleaning module 400. The first pair of connection rods 5012 may have a hollow-out structure, which helps to reduce overall weight of a lifting end.

[0097] In some embodiments of the present disclosure, the first pair of connection rods 5012 includes a first connection rod 50121 and a second connection rod 50122 disposed in parallel. First ends of the first connection rod 50121 and the second connection rod 50122 are rotatably connected to the first longitudinal beam 50114 through movable studs, and second ends of the first connection rod 50121 and the second connection rod 50122 are also rotatably connected to the wet cleaning module 400 through movable studs. For example, both ends of the first connection rod 50121 and the second connection rod 50122 are respectively provided with a through hole with a diameter larger than that of the movable stud, so that the movable stud may rotate freely in the through hole, and the movable stud passes through the through hole to be fixedly connected to the first longitudinal beam 50114. When the motor 50131 provides a pulling force to the second end through the cable, the first ends of the first connection rod 50121 and the second connection rod 50122 rotate around the movable studs at the first ends at the same time, and the second end is raised up under action of the pulling force by the cable, so as to raise up the wet cleaning module 400. When the motor 4211 releases the pulling force to the second end through the cable, the first ends of the first connection rod 50121 and the second connection rod 50122 rotate in an opposite direction around the movable studs at the first ends at the same time, and the second end is lowered under action of the gravity, so as to lower down the wet cleaning module 400.

[0098] The lifting structure 500 further includes the cable 42194 configured to provide the pulling force, such that the first pair of connection rods 5012 rotates within a preset angle. The cable 42194 includes a terminal of the cable at the motor 50131 connected to the driving unit 420. For example, the terminal of the cable at the motor 50131 is connected to a gear in a winding way,

which is connected to the output shaft of the motor, so as to achieve raising or lowering under rotation of the motor. A terminal of cable at a holder 50132 is connected to the first holder 5011, and the motor causes the second ends of the first connection rod 50121 and the second connection rod 50122 to rise up or lower down through the cable 42194.

[0099] In some embodiments of the present disclosure, the first holder 5011 further includes: a sliding groove 50112 that extends along a surface of the transverse beam 50111, and a buckle hole 50113 that penetrates through the transverse beam 50111 and is disposed at an end of the sliding groove 50112, and is configured to receive and buckle the terminal of the cable at the holder 50132. The cable 42194 is connected to the second ends of the first connection rod 50121 and the second connection rod 50122 through the sliding groove 50112 and the buckle hole 50113. The sliding groove 50112 helps to restrict a moving direction of the cable to provide stability of raising up and lowering down of the module. A width of the sliding groove matches a thickness of the cable.

[0100] As illustrated in FIG. 23, the second connection end 502 includes: a second holder 5021, fixedly connected to the bottom part of the mobile platform 100; and a second pair of connection rods 5022, having one end rotatably connected to the second holder 5021, and the other end rotatably connected to the wet cleaning module 400. The second pair of connection rods 5022 rotates as the first pair of connection rods 5012 rotates. The second pair of connection rods 5022 may have a hollow-out structure, which helps to reduce the overall weight of the lifting end.

[0101] In an embodiment of the present disclosure, the second pair of connection rods 5022 includes a third connection rod 50221 and a fourth connection rod 50222 disposed in parallel. First ends of the third connection rod 50221 and the fourth connection rod 50222 are rotatably connected to the second holder 5021 through movable studs. Second ends of the third connection rod 50221 and the fourth connection rod 50222 are rotatably connected to the wet cleaning module 400 through movable studs. For example, both ends of the third connection rod 50221 and the fourth connection rod 50222 are respectively provided with a buckle hole with a diameter greater than that of the movable stud, so that the movable stud may rotate freely in the buckle hole, and the movable stud passes through the buckle hole to be fixedly connected to the second holder 5021. When the first connection end 501 is driven by the motor 50131 to rotate, the first ends of the third connection rod 50221 and the fourth connection rod 50222 simultaneously rotate around the movable stud at the first end, and the second ends of the third connection rod 50221 and the fourth connection rod 50222 simultaneously rotate around the movable stud at the second end, so that the wet cleaning module 400 is raised up. When the first connection end 501 releases the pulling force, the third connection rod

50221 and the fourth connection rod 50222 rotate in an opposite direction around the movable stud at the same time, and descend under action of gravity, so that the wet cleaning module 400 is lowered down.

[0102] Through the four-linkage lifting structure disposed between the wet cleaning module and the mobile platform, the wet cleaning module may be raised up and lowered down with respect to the mobile platform. When the mopping operation is performed, the wet cleaning module is lowered down to make the wet cleaning module in contact with the floor. When the mopping operation is completed, the wet cleaning module is raised up to separate the wet cleaning module from the floor and to avoid the increased resistance due to the presence of the cleaning module when the cleaning device moves freely on the surface to be cleaned.

[0103] In conjunction with sensors such as a surface media sensor that is capable of detecting a surface type of the surface to be cleaned, the lifting module helps to enable the wet cleaning module to perform the cleaning operation according to different surfaces to be cleaned. For example, the lifting module raises the wet cleaning module on a carpet surface, and lowers the wet cleaning module onto a surface such as a floor or floor tile, so as to perform cleaning operation and obtain a more comprehensive cleaning effect.

[0104] As illustrated in FIG. 24, which is a state view when the dry cleaning module 151 is raised up, a float lifting structure 600 is connected to the dry cleaning module 151 and configured to enable the dry cleaning module 151 to move up and down passively with respect to the mobile platform 100. For example, the float lifting structure 600 is a parallelogram four-linkage lifting structure, configured to passively switch the dry cleaning module 151 between the raised state and the lowered state under action of an external force.

[0105] In some embodiments of the present disclosure, the float lifting structure 600 includes: a first fixed holder 601 fixedly connected to the mobile platform 100; a second fixed holder 602 fixedly connected to the dry cleaning module 151; and a pair of connection rods 603, having one end rotatably connected to the first fixed holder 601 through a movable stud, and the other end rotatably connected to the second fixed holder 602 through a movable stud. The first fixed holder 601 and the second fixed holder 602 are connected by a flexible connection part. When the obstacle is encountered, the dry cleaning module 151 is lifted upwards, and the first fixed holder 601 rotates around the pair of connection rods 603 and then is stowed upwards with respect to the second fixed holder 602, thereby realizing the passive lifting. After crossing over the obstacle, the dry cleaning module 151 falls under action of gravity and becomes contact with the operation surface, and the cleaning device continues to move forward for performing the cleaning operation. The parallelogram four-linkage lifting structure enables the cleaning device to cross over the obstacle more flexibly and be not easy to be damaged.

[0106] In some embodiments of the present disclosure, the pair of connection rods 603 includes: a first pair of connection rods 6031, having one end rotatably connected to a first end of the first fixed holder 601 through a movable stud, and the other end rotatably connected to a first end of the second fixed holder 602 through a movable stud; and a second pair of connection rods 6032 disposed opposite to the first pair of connection rods 6031, having one end rotatably connected to a second end of the first fixed holder 601 through a movable stud, and the other end rotatably connected to a second end of the second fixed holder 602 through a movable stud. The first pair of connection rods 6031 or the second pair of connection rods 6032 may have a hollow-out structure, which helps to reduce the overall weight of the lifting end.

[0107] In some embodiments of the present disclosure, the first pair of connection rods 6031 includes a first connection rod 60311 and a second connection rod 60312 disposed in parallel. One ends of the first connection rod 60311 and the second connection rod 60312 are provided with a first shaft hole, and the other ends thereof are provided with a second shaft hole. The movable stud passes through the first shaft hole, such that the first connection rod 60311 and the second connection rod 60312 are rotatably fixed to the first end of the first fixed holder 601. The movable stud passes through the second shaft hole, such that the first connection rod 60311 and the second connection rod 60312 are rotatably fixed to the first end of the second fixed holder 602. For example, both ends of the first connection rod 60311 and the second connection rod 60312 are respectively provided with a buckle hole (not illustrated) having a diameter larger than that of the movable stud, so that the movable stud may rotate freely in the buckle hole, and the movable stud passes through the buckle hole to be fixedly connected to the first fixed holder 601. When a bumpy obstacle is encountered, the dry cleaning module 151 is lifted upward under action of the obstacle, and the first ends of the first connection rod 60311 and the second connection rod 60312 rotate around the movable stud at the first end at the same time, and the second ends of the first connection rod 60311 and the second connection rod 60312 rotate around the movable stud at the second end at the same time, so that the dry cleaning module 151 is raised up. After crossing over the obstacle, the dry cleaning module 151 falls down under action of gravity and becomes in contact with the operation surface.

[0108] In some embodiments of the present disclosure, as illustrated in FIG. 25, which illustrates a state view when the dry cleaning module 151 is raised up, the second pair of connection rods 6032 includes a third connection rod 60321 and a fourth connection rod 60322 disposed in parallel. One ends of the three connection rod 60321 and the fourth connection rod 60322 are provided with a third shaft hole, and the other ends of the three connection rod 60321 and the fourth connection rod 60322 are provided with a fourth shaft hole. The movable stud passes through the third shaft holes, such that

the third connection rod 60321 and the fourth connection rod 60322 are rotatably fixed to the second end of the first fixed holder 601. The movable stud passes through the fourth shaft holes, such that the third connection rod 60321 and the fourth connection rod 60322 are rotatably fixed to the second end of the second fixed holder 602. For example, both ends of the third connection rod 60321 and the fourth connection rod 60322 are respectively provided with a buckle hole (not illustrated) having a diameter larger than that of the movable stud, so that the movable stud may rotate freely in the buckle hole, and the movable stud passes through the buckle hole to be fixedly connected to the first fixed holder 601. When a bumpy obstacle is encountered, the dry cleaning module 151 is lifted upward under action of the obstacle, and the first ends of the third connection rod 60321 and the fourth connection rod 60322 rotate around the movable stud at the first end at the same time, and the second ends of the third connection rod 60321 and the fourth connection rod 60322 rotate around the movable stud at the second end at the same time, so that the dry cleaning module 151 is raised up. After crossing over the obstacle, the dry cleaning module 151 falls down under action of gravity and becomes contact with the operation surface.

[0109] As an optional embodiment of the present disclosure, the first fixed holder 601 includes: a first fixed portion 6011, protruding from the first fixed holder 601 and extending outwards laterally, and configured to carry the first pair of connection rods 6031; and a second fixed portion 6012, disposed symmetrical to the first fixed portion 6011, and configured to carry the second pair of connection rods 6032. The first fixed portion 6011 and the second fixed portion 6012 are configured to support the pairs of connection rods in a protruded manner, so that the pairs of connection rods may rotate freely, thereby ensuring free lifting up and descending of the dry cleaning module 151.

[0110] In some embodiments of the present disclosure, the float lifting structure 600 further includes a flexible connection part (not illustrated) connected between the first fixed holder 601 and the second fixed holder 602. When the operation surface is uneven, the second fixed holder 602 moves upward or downward with respect to the first fixed holder 601 through the flexible connection part.

[0111] In the dry cleaning module, with the four-linkage float lifting structure, the dry cleaning module can passively move upward or downward with respect to the mobile platform. When the cleaning device encounters an obstacle during operation, it can easily cross over the obstacle by means of the four-linkage float lifting structure, thus avoiding damage to the cleaning device.

[0112] According to an embodiment of the present disclosure, as shown in FIG. 9, the present disclosure provides an autonomous cleaning device. This embodiment is following on from the above-mentioned embodiments, and the same structure has the same functions and technical effects, which will not be repeated herein. In an ex-

ample, the cleaning device includes: a mobile platform 100, configured to move autonomously on an operation surface; and a cleaning module 150, disposed on the mobile platform 100 and including: a wet cleaning module 400, configured to clean at least part of the operation surface using a wet cleaning mode; a lifting structure 500, connected to the wet cleaning module 400 and configured to enable the wet cleaning module 400 to move upwards or downwards relative to the mobile platform 100; and a driving assembly 900, connected to the lifting structure 500 and configured to provide power for lifting of the lifting structure 500, and/or, to provide a cleaning liquid for the wet cleaning module 400.

[0113] In an optional embodiment of the present disclosure, as shown in FIG. 26, the driving assembly 900 includes: a motor 4211 configured to provide a driving force for forward rotation and reverse rotation; and a gear set 42193 connected to an output shaft of the motor 4211 and configured to output the driving force for the forward rotation and the reverse rotation of the motor 4211.

[0114] In some embodiments of the present disclosure, the driving assembly 900 further includes: a clutch 42195 meshed with the gear set 42193, to provide the driving force when the clutch 42195 is in reverse engagement with the gear set 42193, and not to provide the driving force when the clutch 42195 is in forward non-engagement with the gear set 42193. The clutch 42195 includes a first clutch gear 421951 and a second clutch gear 421952 disposed oppositely back to back. The second clutch gear 421952 has teeth arranged at an oblique angle in a counterclockwise direction, and the oblique angle is not limited. In this way, when the second clutch gear 421952 is in reverse engagement with the gear set 42193, the driving force is provided, and when the second clutch gear 421952 is in forward non-engagement with the gear set 42193, no driving force is provided due to slipping.

[0115] In an optional embodiment of the present disclosure, the driving assembly 900 further includes: a cable gear 42196 meshed with the first clutch gear 421951 to be driven by the first clutch gear 421951 to rotate. One end of the cable 42194 is wound around the cable gear 42196, and the other end is connected to the lifting structure 500 to be driven by the gear set 42193 to pull up or down the lifting structure 500.

[0116] In an optional embodiment of the present disclosure, the driving assembly 900 further includes a clean liquid pump 4219 meshed with the gear set 42193 to be driven by the gear set 42193 to provide the cleaning liquid to the wet cleaning module 400. In an embodiment of the present disclosure, for example, the clean liquid pump peristaltically crushes the liquid pipe under the clean liquid pump, and squeezes water out of the water tank from the liquid pipe.

[0117] In an optional embodiment of the present disclosure, the gear set 42193 includes: a first-stage transmission gear 421931 connected to the output shaft of the motor 4211 and configured to output the driving force of

the motor; a second-stage transmission gear 421932 meshed with the first-stage transmission gear 421931 and configured to output the driving force of the motor to the cable gear 42196; and a third-stage transmission gear 421933 meshed with the second-stage transmission gear 421932 and configured to output the driving force of the motor to the clean liquid pump 4219. In some embodiments of the present disclosure, the output shaft of the motor 4211 includes an output gear 42111 meshed with the first-stage transmission gear 421931 and configured to output the driving force of the motor.

[0118] In an optional embodiment of the present disclosure, the driving assembly 900 further includes: a driving wheel 4212 connected to the output shaft of the motor and having an asymmetric structure; and a vibration member 4213 connected to the driving wheel 4212 to reciprocate under the asymmetric rotation of the driving wheel 4212.

[0119] In the sweeping and mopping integrated cleaning device according to the present disclosure, the motor 4211 simultaneously transmits the power to the cleaning head 410, the driving platform 421, the support platform 422, the liquid delivery mechanism, the liquid container, and etc. through the power transmission device. The power system 160 provides power for the motor 4211, and is controlled by the control system 130 as a whole. The power transmission device may be a gear drive, a chain drive, a belt drive, or a worm gear and so on, such as the driving assembly 900 and its related structures described in this embodiment.

[0120] The motor 4211 includes a forward output mode and a reverse output mode. The motor 4211 rotates forward in the forward output mode, and the motor 4211 rotates in a reverse direction in the reverse output mode. In the forward output mode of the motor 4211, the motor 4211 may simultaneously drive, through the power transmission device, the liquid delivery mechanism and the cleaning head 410 in the wet cleaning assembly 400 to motion synchronously. The driving assembly is connected to the lifting structure, and by means of the cooperation of the clutch and the gear set, when the motor rotates forward, the motor drives the vibration output shaft to rotate, and drives the vibration member to vibrate to achieve a substantively reciprocating movement, and realizes repeated cleaning of the ground. At the same time, by means of the transmission of the gear set, the clean liquid pump operates in a peristaltic manner to discharge water synchronously. At this time, the clutch teeth are in a slipping state and cannot realize transmission, and the lifting mechanism cannot be raised. When the motor rotates in the reverse direction, the clutch teeth are in an operating state to drive the lifting turn table to rise. When the lifting turn table is raised in position, the cable is tightened. At this time, the motor stops due to the limit, the vibration output and the clean liquid pump stop operation, the mopping function is stopped, and the mopping module is raised. Therefore, the cleaning device according to the present disclosure can coordinately control the dis-

charge of the clean liquid pump, the raising and lowering of the lifting mechanism and the vibration of the vibration member, thereby improving the work efficiency.

[0121] Finally, it should be noted that various embodiments in the present specification are described in a progressive mode, and each embodiment focuses on its differences from other embodiments, and for the same or similar parts between the various embodiments, the previous embodiments may be referred to. For the system or device disclosed in embodiments of the present disclosure, corresponding to the method disclosed in embodiments of the present disclosure, the description is relatively simple, and the description of the method part may be referred to.

[0122] The above embodiments are only used to illustrate the technical solutions of the present disclosure, but not intended to limit them. Although the present disclosure has been described in detail with reference to the foregoing embodiments, those ordinary skilled in the art should understand that the technical solutions recorded in the foregoing embodiments may be still modified, and some of the technical features may be equivalently replaced. These modifications or replacements do not cause the essence of the corresponding technical solutions to deviate from the spirit and scope of the technical solutions of embodiments of the present disclosure.

Claims

1. An autonomous cleaning device, comprising:

a mobile platform (100) configured to move autonomously on an operation surface; and
a cleaning module (150) disposed on the mobile platform (100), comprising:

a wet cleaning module (400) configured to clean at least part of the operation surface using a wet cleaning mode;
a lifting structure (500) connected to the wet cleaning module (400), configured to enable the wet cleaning module (400) to move upward or downward relative to the mobile platform (100); and
a driving assembly (900) connected to the lifting structure (500), configured to provide power for lifting of the lifting structure (500), and/or, to provide a cleaning liquid for the wet cleaning module (400).

2. The autonomous cleaning device according to claim 1, wherein the driving assembly (900) comprises:

a motor (4211) configured to provide a driving force for forward rotation and reverse rotation; and
a gear set (42193) connected to an output shaft

- of the motor (4211), configured to output the driving force for the forward rotation and the reverse rotation from the motor (4211).
3. The autonomous cleaning device according to claim 2, wherein the driving assembly (900) further comprises:
a clutch (42195) meshed with the gear set (42193), to provide the driving force when the clutch (42195) is in reverse engagement with the gear set (42193), and not to provide the driving force when the clutch (42195) is in forward non-engagement with the gear set (42193). 5
 4. The autonomous cleaning device according to claim 3, wherein the clutch (42195) comprises a first clutch gear (421951) and a second clutch gear (421952) oppositely disposed, and the second clutch gear (421952) is provided with teeth arranged at an oblique angle in a counterclockwise direction, to provide the driving force when the second clutch gear (421952) is in reverse engagement with the gear set (42193), and not to provide the driving force when the second clutch gear (421952) is in forward non-engagement with the gear set (42193). 10 20 25
 5. The autonomous cleaning device according to claim 4, wherein the driving assembly (900) further comprises:
a cable gear (42196) meshed with the first clutch gear (421951) to be driven by the first clutch gear (421951) to rotate. 30
 6. The autonomous cleaning device according to claim 5, wherein the lifting assembly (500) further comprises:
a cable (42194) with one end wound around the cable gear (42196) and another end connected to the lifting structure (500), to be driven by the gear set (42193) to pull the lifting structure (500) up or down. 35 40
 7. The autonomous cleaning device according to claim 5, wherein the driving assembly (900) further comprises:
a clean liquid pump (4219) meshed with the gear set (42193) to be driven by the gear set (42193) to provide the cleaning liquid to the wet cleaning module (400). 45
 8. The autonomous cleaning device according to claim 7, wherein the gear set (42193) further comprises:
a first-stage transmission gear (421931) connected to the output shaft of the motor (4211), configured to output the driving force from the motor; 50 55
a second-stage transmission gear (421932) meshed with the first-stage transmission gear (421931), configured to output the driving force from the motor to the cable gear (42196); and
a third-stage transmission gear (421933) meshed with the second-stage transmission gear (421932), configured to output the driving force from the motor to the clean liquid pump (4219).
 9. The autonomous cleaning device according to claim 8, wherein the output shaft of the motor (4211) comprises an output gear (42111) meshed with the first-stage transmission gear (421931) to output the driving force from the motor.
 10. The autonomous cleaning device according to claim 9, wherein the driving assembly (900) further comprises:
a driving wheel (4212) connected to the output shaft of the motor, having an asymmetric structure; and
a vibration member (4213) connected to the driving wheel (4212) to reciprocate under asymmetric rotation of the driving wheel (4212).

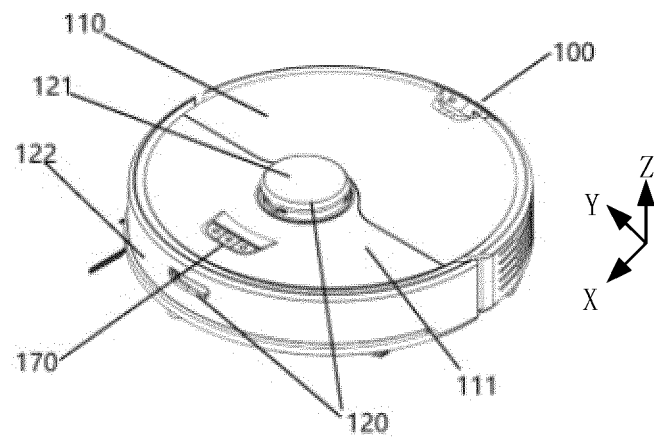


FIG. 1

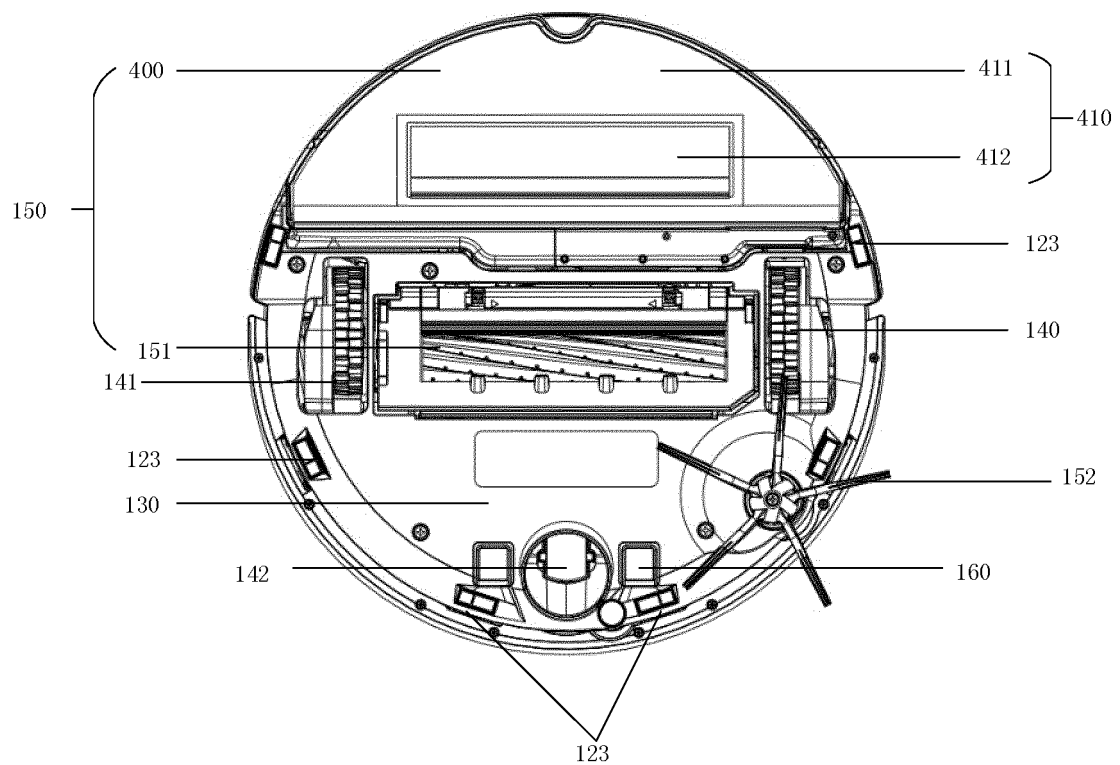


FIG. 2

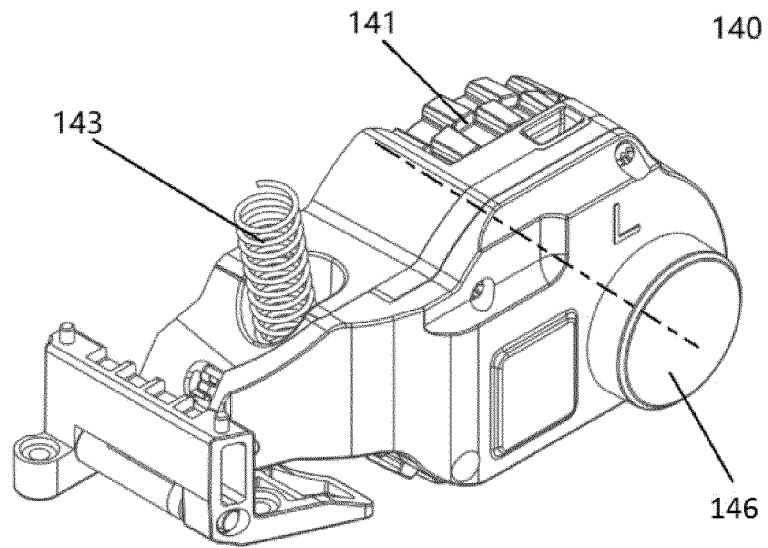


FIG. 3

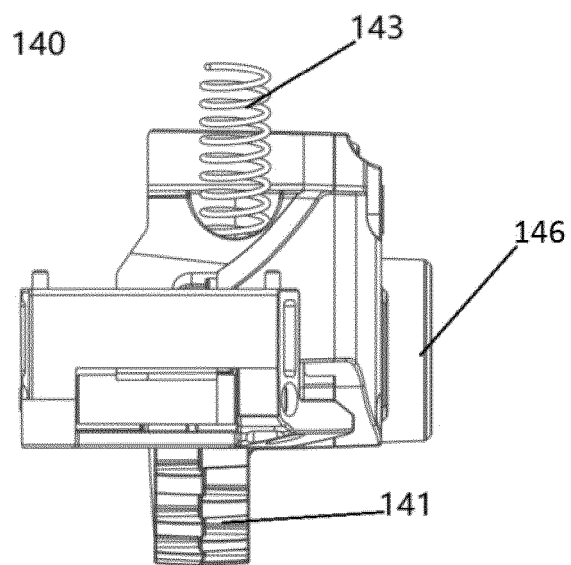


FIG. 4

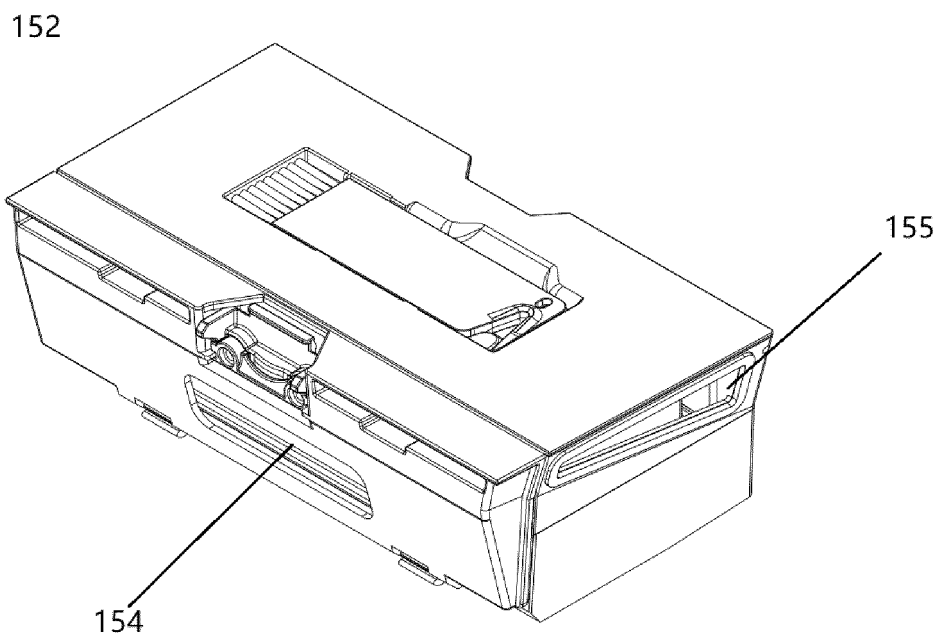


FIG. 5

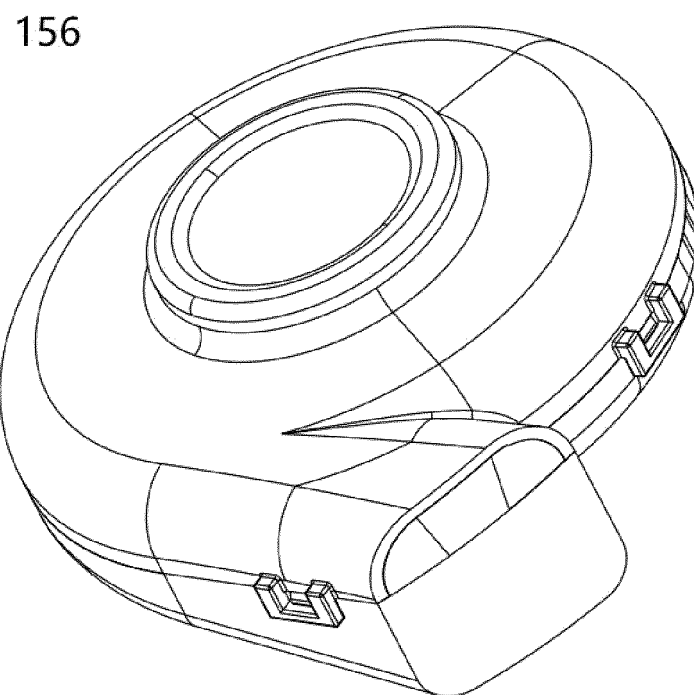


FIG. 6

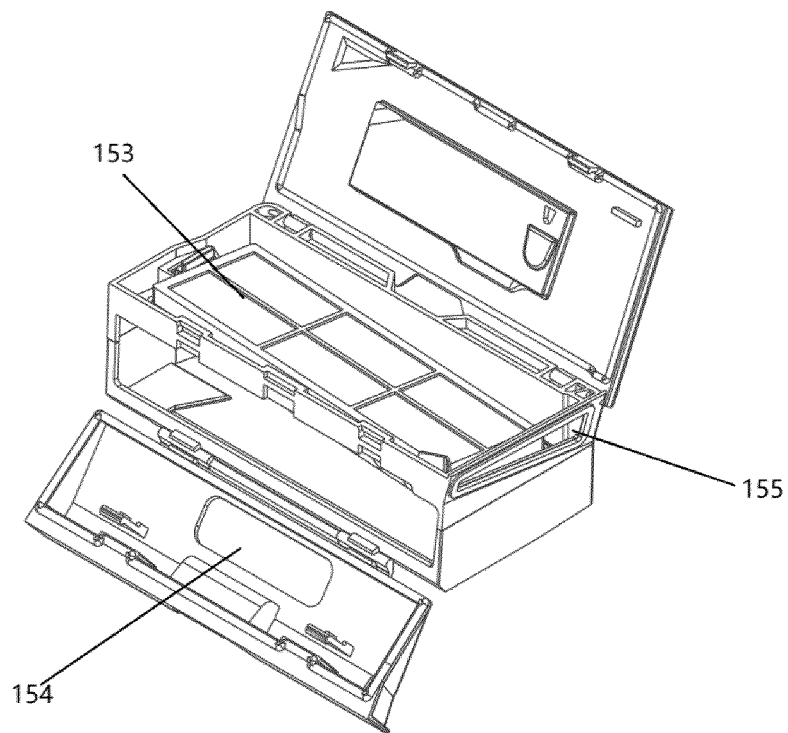


FIG. 7

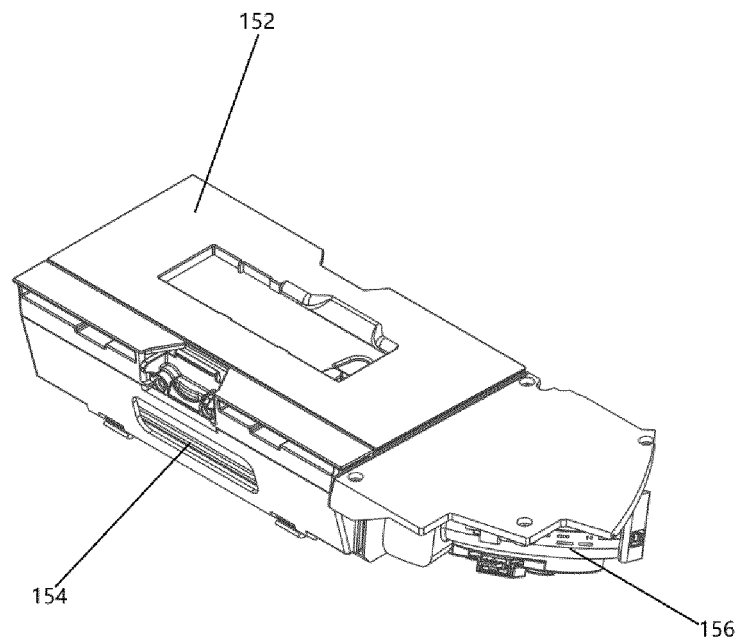


FIG. 8

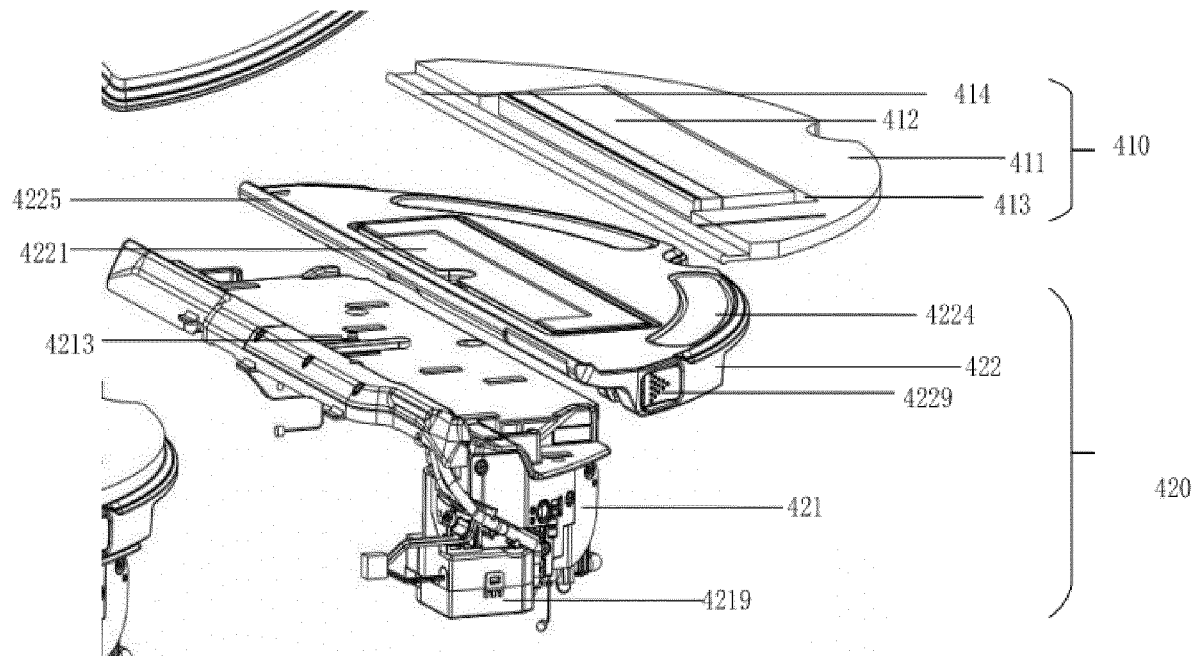


FIG. 9

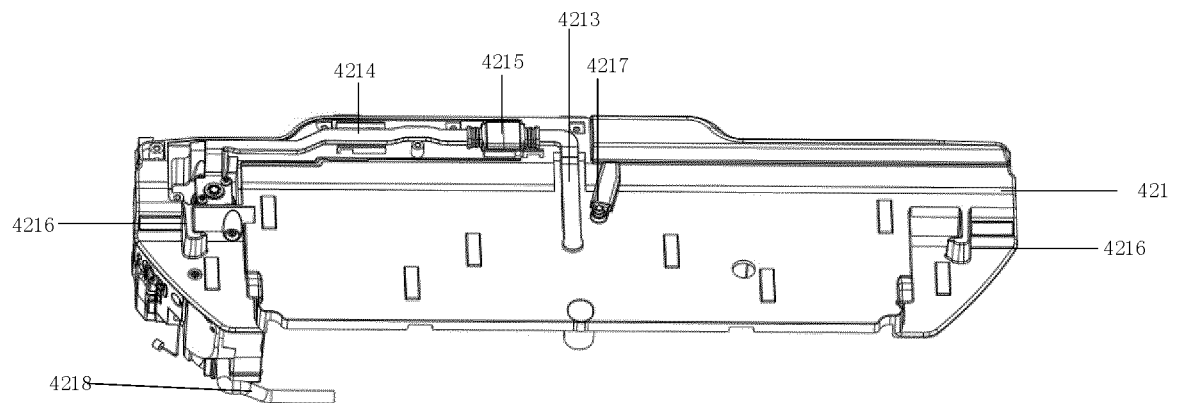


FIG. 10

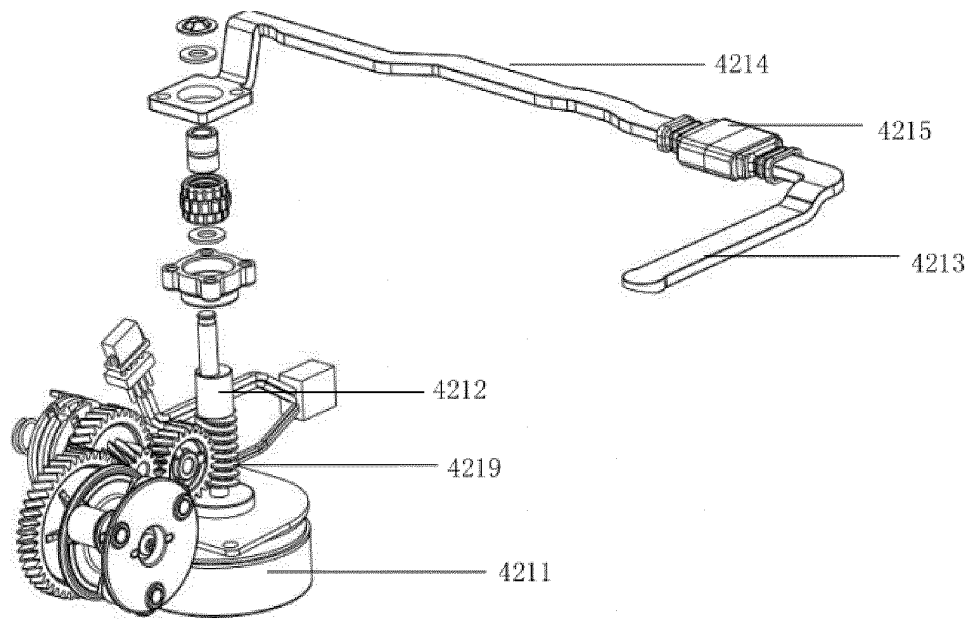


FIG. 11

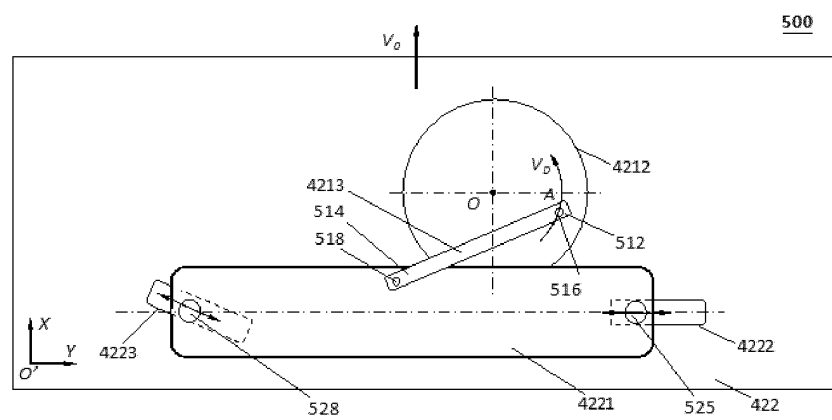


FIG. 12

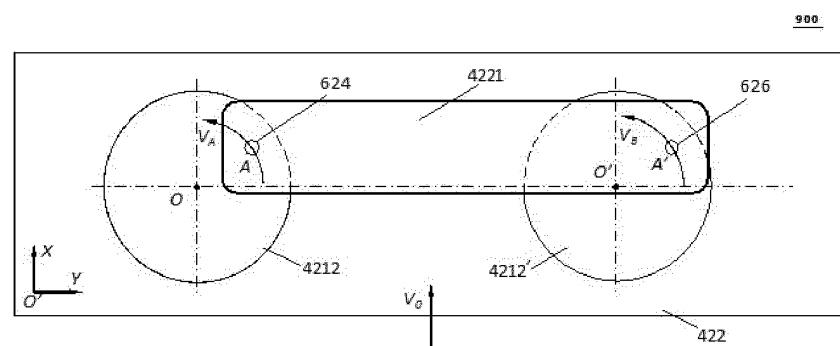


FIG. 13

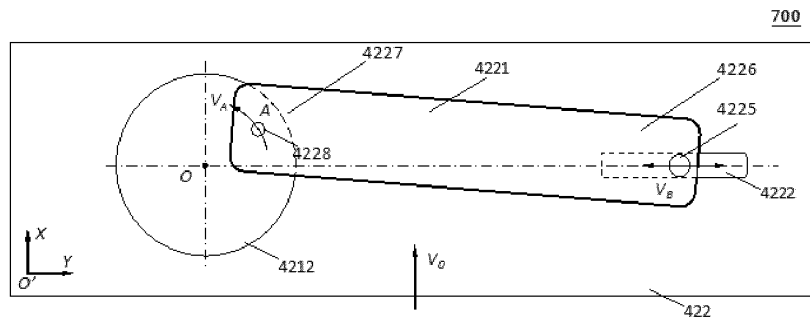


FIG. 14

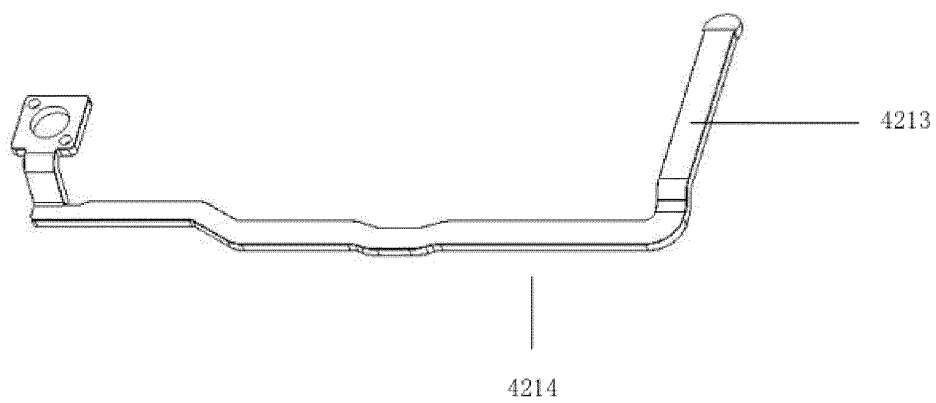


FIG. 15

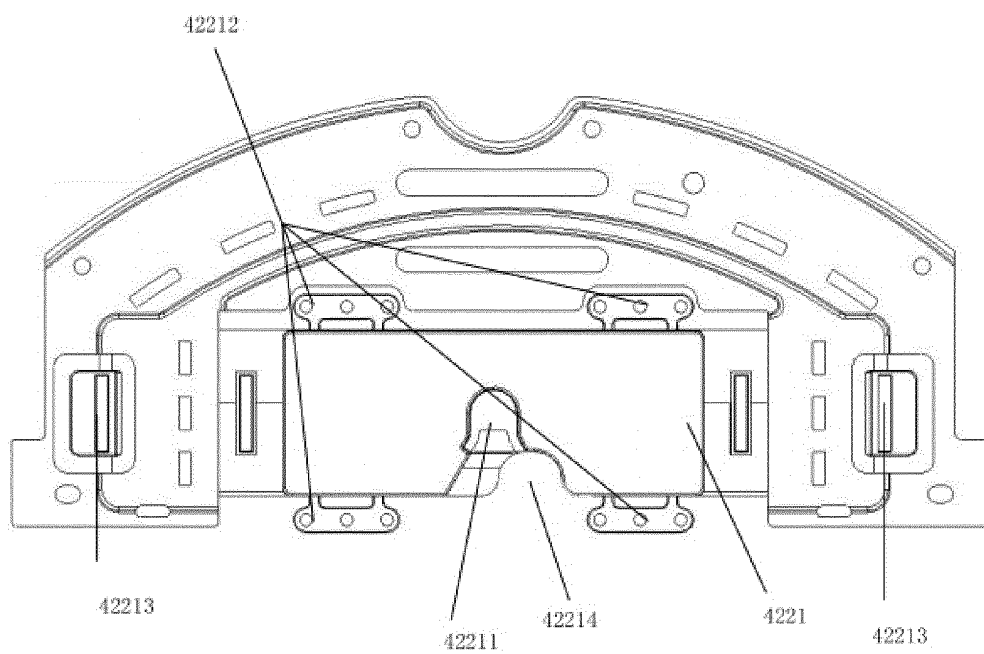


FIG. 16

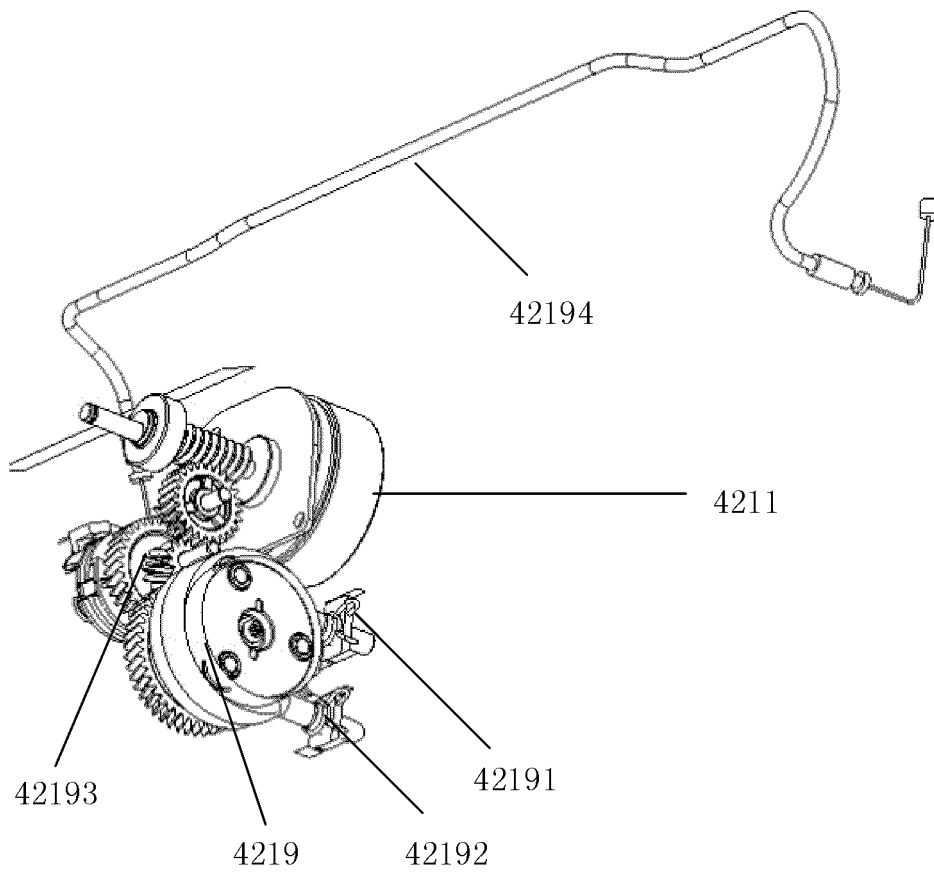


FIG. 17

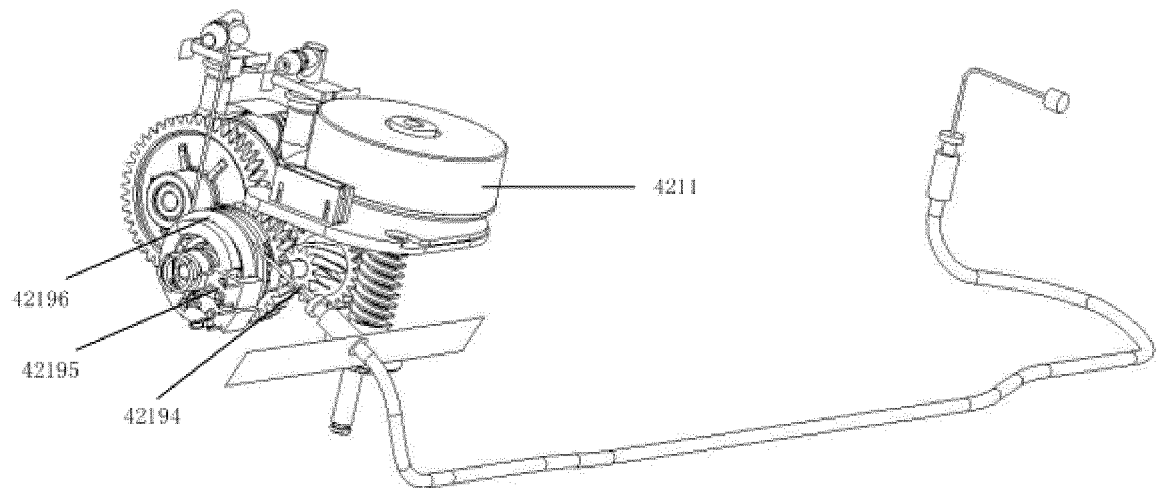


FIG. 18

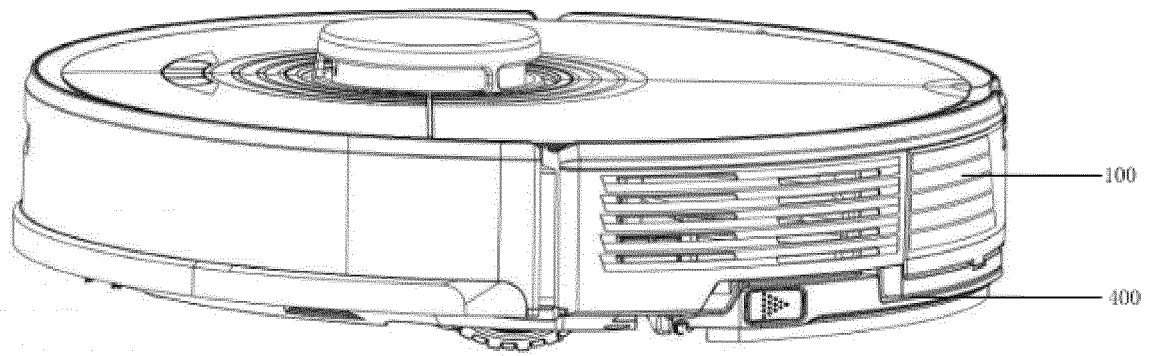


FIG. 19

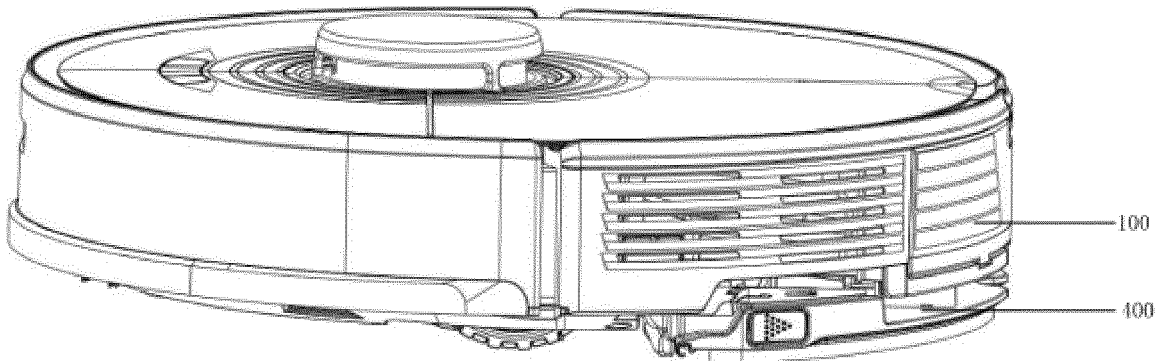


FIG. 20

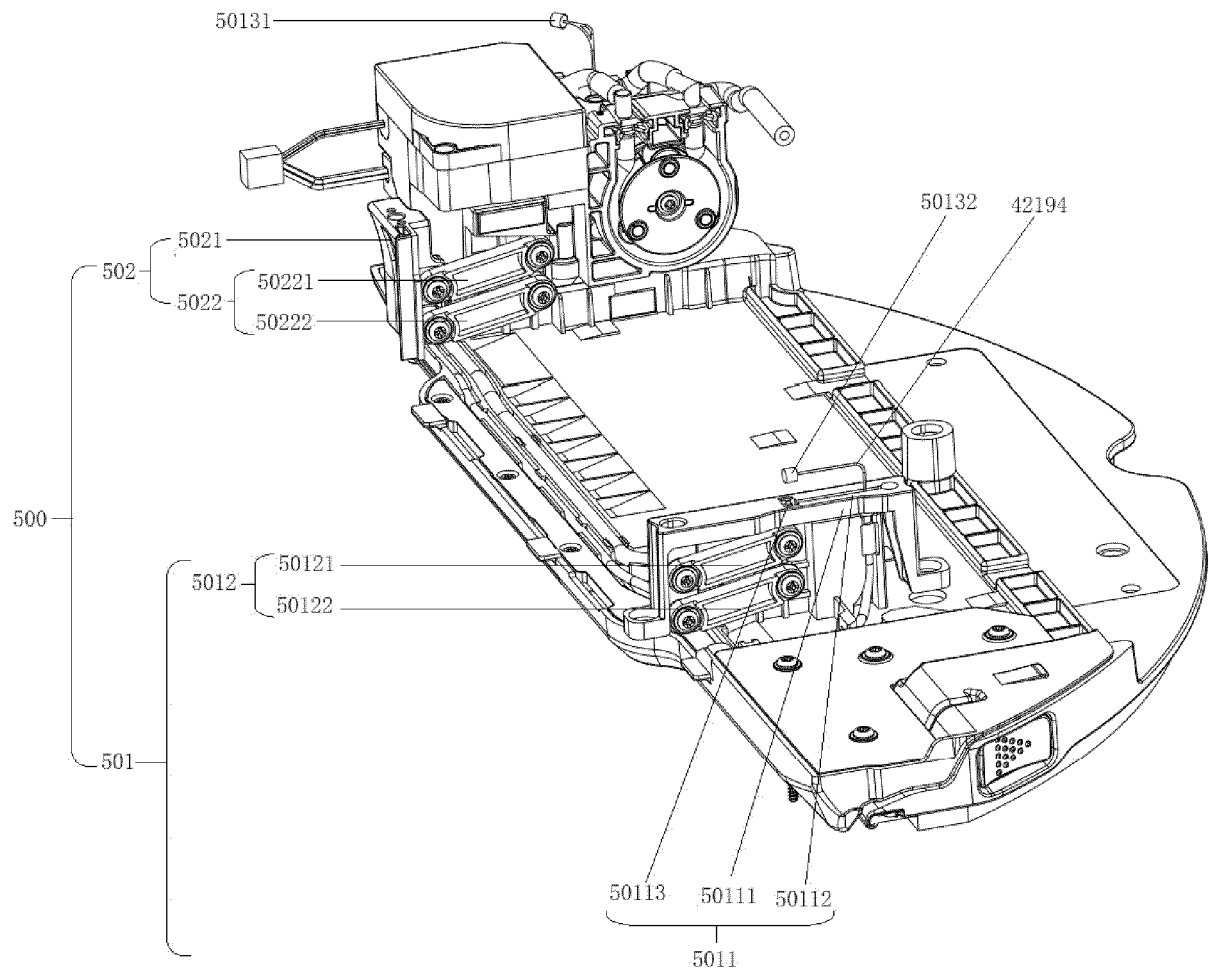


FIG. 21

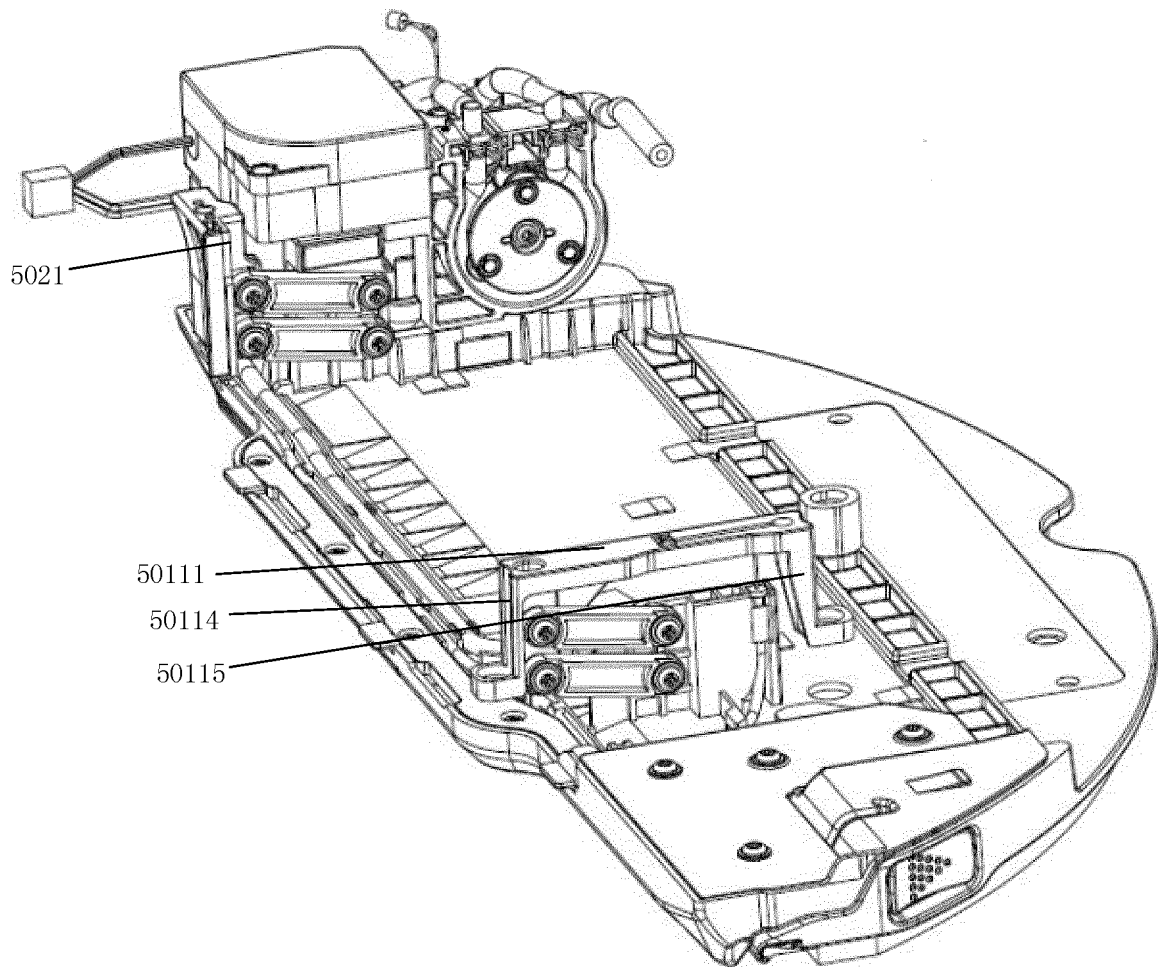


FIG. 22

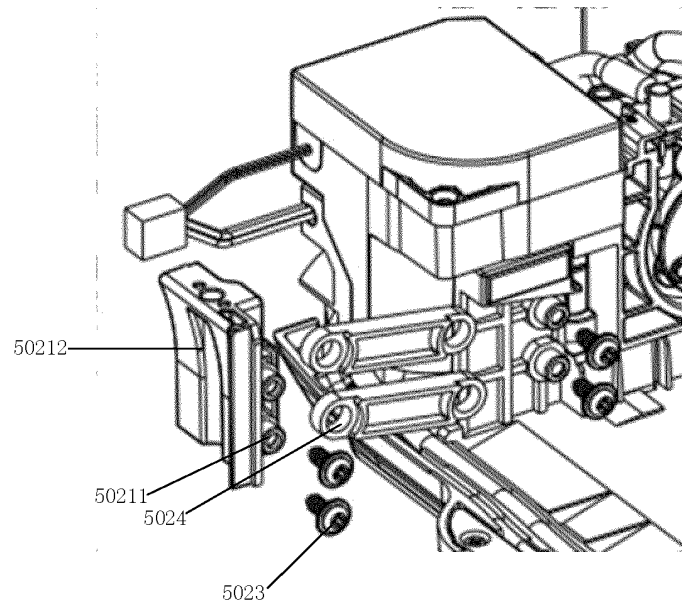


FIG. 23

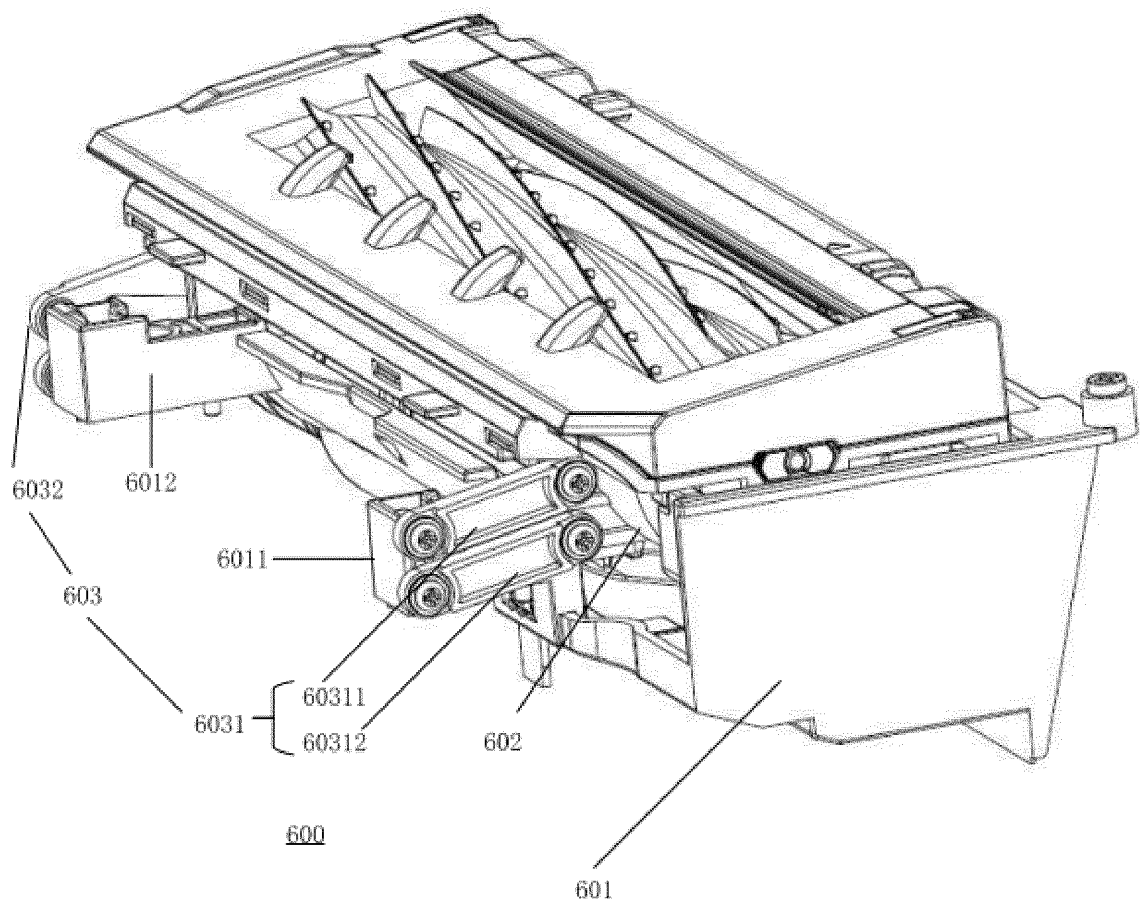


FIG. 24

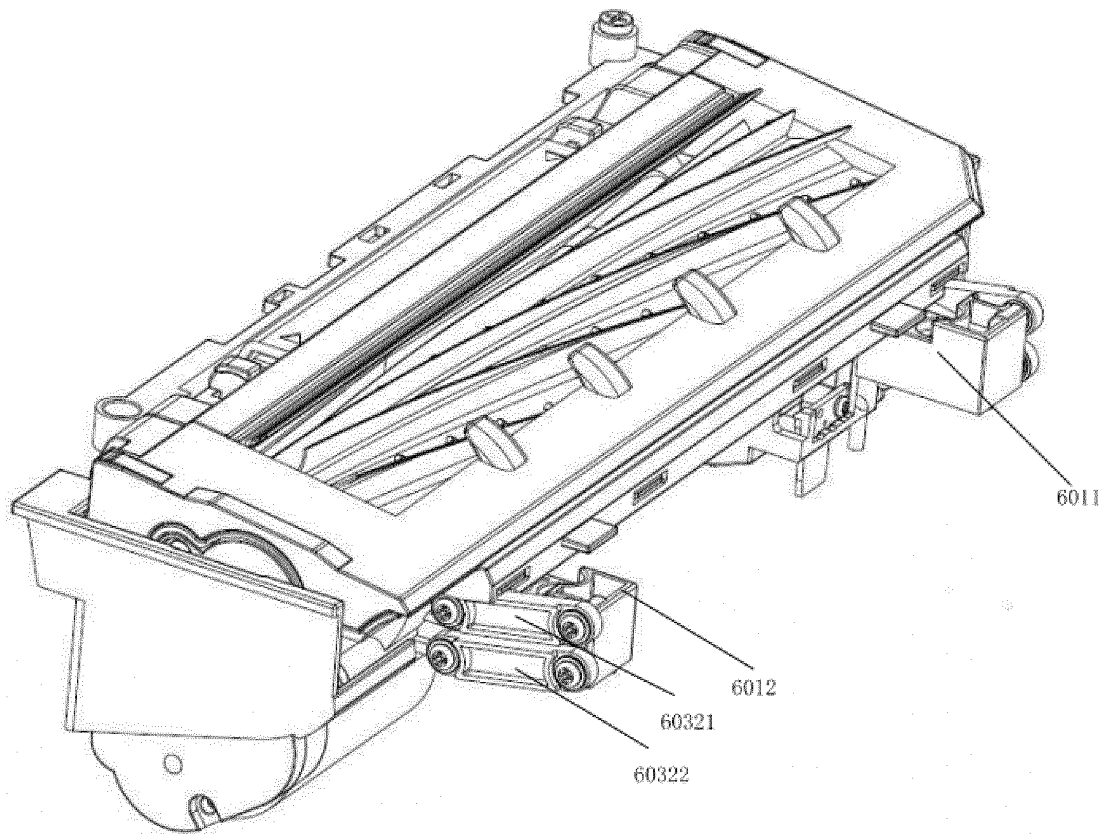


FIG. 25

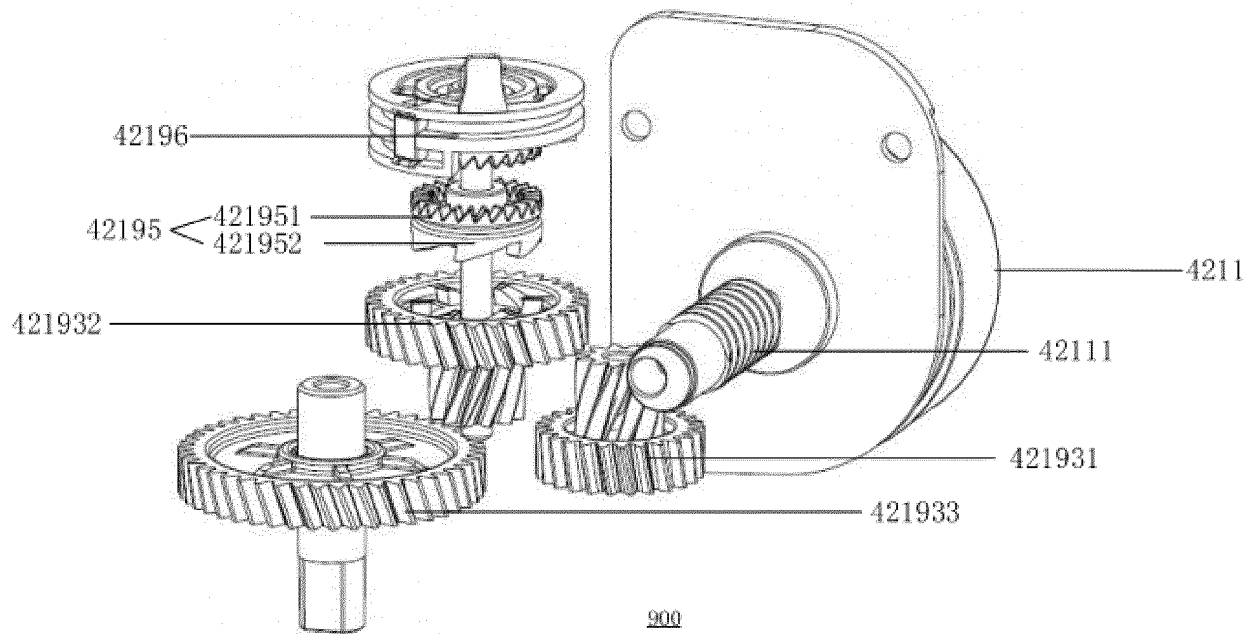


FIG. 26

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/104339

A. CLASSIFICATION OF SUBJECT MATTER

A47L 11/24(2006.01)i; A47L 11/284(2006.01)i; A47L 11/40(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)

A47L11

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)

CNABS; CNTXT; CNKI; VEN; WOTXT; USTXT; JPTXT; EPTXT: 清扫, 清洁, 湿式, 喷水, 喷头, 升降, 下降, 振动, 震动, cleaning robot, water, sprinkler, lift, vibration

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 111375575 A (ZHUJI GAOZONG AUTOMATION TECHNOLOGY CO., LTD.) 07 July 2020 (2020-07-07) description, paragraphs [0016]-[0025], and figures 1-5	1-9
Y	CN 111375575 A (ZHUJI GAOZONG AUTOMATION TECHNOLOGY CO., LTD.) 07 July 2020 (2020-07-07) description, paragraphs [0016]-[0025], and figures 1-5	10
Y	CN 109528093 A (NINGBO FUJIA INDUSTRIAL CO., LTD.) 29 March 2019 (2019-03-29) description paragraph [0059], figures 8, 9	10
A	CN 202665478 U (CHANGGE ELECTRICAL INDUSTRY CO.) 16 January 2013 (2013-01-16) entire document	1-10
A	CN 200987644 Y (YU, Jiumei) 12 December 2007 (2007-12-12) entire document	1-10
A	US 2015320281 A1 (RITTERLING DOUGLAS K et al.) 12 November 2015 (2015-11-12) entire document	1-10

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

* Special categories of cited documents:

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

08 October 2021

Date of mailing of the international search report

26 October 2021

Name and mailing address of the ISA/CN

China National Intellectual Property Administration (ISA/
CN)
No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing
100088, China

Facsimile No. (86-10)62019451

Authorized officer

Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/CN2021/104339

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	111375575	A	07 July 2020	None			
CN	109528093	A	29 March 2019	JP	2020099900	A	02 July 2020
				US	2020196817	A1	25 June 2020
				EP	3669738	A1	24 June 2020
				AU	2019283866	A1	09 July 2020
				CN	209750929	U	10 December 2019
CN	202665478	U	16 January 2013	None			
CN	200987644	Y	12 December 2007	None			
US	2015320281	A1	12 November 2015	None			

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202110188182X [0001]