



EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:

06.03.2024 Bulletin 2024/10

(21) Application number: **22794263.8**

(22) Date of filing: **09.02.2022**

(51) International Patent Classification (IPC):

A47L 11/40 ^(2006.01) **A47L 11/24** ^(2006.01)
A47L 11/284 ^(2006.01)

(52) Cooperative Patent Classification (CPC):

A47L 11/24; A47L 11/302; A47L 11/4013;
A47L 11/4041; A47L 11/4066; A47L 2201/04;
A47L 2201/06

(86) International application number:

PCT/CN2022/075724

(87) International publication number:

WO 2022/227782 (03.11.2022 Gazette 2022/44)

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR

Designated Extension States:

BA ME

Designated Validation States:

KH MA MD TN

(30) Priority: **30.04.2021 CN 202110483998**

(71) Applicant: **Beijing Roborock Technology Co., Ltd.**
Beijing 102206 (CN)

(72) Inventors:

- **LI, Xing**
Beijing 102206 (CN)

• **CHENG, Pan**

Beijing 102206 (CN)

• **DUAN, Chuanlin**

Beijing 102206 (CN)

• **YANG, Zhimin**

Beijing 102206 (CN)

• **LIU, Jungang**

Beijing 102206 (CN)

• **YANG, Fan**

Beijing 102206 (CN)

(74) Representative: **Cabinet Beau de Loménie**

158, rue de l'Université
75340 Paris Cedex 07 (FR)

(54) **AUTOMATIC CLEANING DEVICE**

(57) An automatic cleaning device, comprising: a moving platform (100), which is configured to automatically move on an operation surface; a cleaning module (150), which is disposed on the moving platform (100), and comprises: a wet cleaning module (400), which is configured to clean at least a part of the operation surface by using a wet cleaning manner; a lifting structure (500), which is connected to the wet cleaning module (400), and is configured to move the wet cleaning module (400) up and down relative to the moving platform (100); and a cleaning liquid module, which provides the wet cleaning module (400) with a cleaning liquid; and a driving mechanism (900), which comprises a first driving assembly (901) and a second driving assembly (902). The cleaning device may coordinately control the work of the wet cleaning module (400), the lifting structure (500) and the cleaning liquid module.

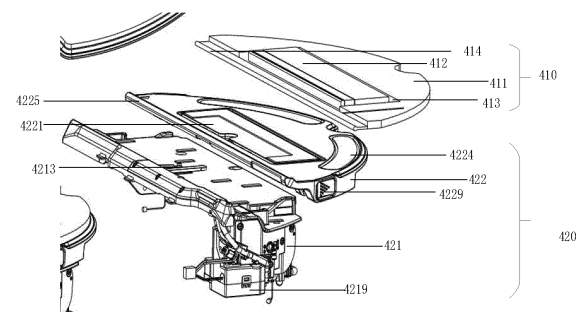


FIG. 9

Description

[0001] This application claims the priority of the Chinese patent application No. 202110483998.5 filed on April 30, 2021, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The disclosure relates to the technical field of cleaning robots, and more particularly to an automatic cleaning apparatus.

BACKGROUND

[0003] Currently, there are two main types of cleaning robots, that is, a ground sweeping robot and a ground mopping robot. The ground sweeping robot or the ground mopping robot has a single function, and may only be used for sweeping or mopping a ground. If it is desired to sweep and mop the ground at the same time, the two apparatus have to be prepared at the same time, occupying a double space.

[0004] In the prior art, the ground sweeping robot and the ground mopping robot may be combined. A mop cloth is added at an end of the ground sweeping robot to obtain a ground sweeping and mopping integrated robot. However, the ground mopping function of the ground sweeping and mopping integrated robot is realized only by using a mop cloth to translate on the ground. With the translation of the mop cloth, the ground is mopped just one time in a movement trajectory of the cleaning robot, so that the effect and efficiency of mopping the ground are greatly reduced, especially for some environments with more stains and more dirty ground, and obviously the ground cannot be cleaned up by mopping the ground in one time in a moving manner.

SUMMARY

[0005] An object of the present disclosure is to provide an automatic cleaning apparatus, which can solve the technical problem that the ground cannot be cleaned up. The specific solutions are as follows.

[0006] According to a first aspect of the present disclosure, there is provided an automatic cleaning apparatus, comprising:

a mobile platform 100 configured to automatically move on an operating surface; and
a cleaning module 150 disposed on the mobile platform 100 and comprising:

a wet cleaning module 400 configured to clean at least a part of the operating surface by means of wet cleaning;
a lifting and lowering structure 500 connected with the wet cleaning module 400 and config-

ured to enable the wet cleaning module 400 to move vertically relative to the mobile platform 100;

a cleaning liquid module for providing cleaning liquid for the wet cleaning module 400;
a driving mechanism 900 comprising a first driving component 901 and a second driving component 902, wherein:

the first driving component 901 is configured to be capable of providing power for at least one of the wet cleaning module 400, the lifting and lowering structure 500 and the cleaning liquid module;

the second driving component 902 is configured to be capable of providing power for at least one of the following that is not connected with the first driving component 901: the wet cleaning module 400, the lifting and lowering structure 500 and the cleaning liquid module.

[0007] Optionally, the driving mechanism 900 further comprises at least two power structures 910, which are connected with the first driving component 901 and the second driving component 902 respectively for providing driving force.

[0008] Optionally, the driving mechanism 900 further comprises a gear set 42193, which is connected to the power structure 910 and is used to output driving force for the first driving component 901 and/or the second driving component 902.

[0009] Optionally, the driving mechanism 900 further comprises:

a clutch 42195 in mesh connection with the gear set 42193, wherein the clutch 42195 provides driving force when the clutch 42195 is engaged with the gear set 42193 in a reverse direction, and provides no driving force when the clutch 42195 is not engaged with the gear set 42193 in a forward direction.

[0010] Optionally, the clutch 42195 comprises a first clutch gear 421951 and a second clutch gear 421952 which are disposed oppositely, wherein the second clutch gear 421952 has teeth which are arranged at an inclined angle in a counterclockwise direction, so as to provide driving force when the second clutch gear 421952 is engaged with the gear set 42193 in the reverse direction, and provide no driving force when the second clutch gear 421952 is not engaged with the gear set 42193 in the forward direction.

[0011] Optionally, the driving mechanism 900 further comprises:

a cable gear 42196, which is meshed with the first clutch gear 421951 and rotates under the driving of the first clutch gear 421951.

[0012] Optionally, the lifting and lowering structure 500 further comprises:

a cable 42194, one end of which is wound around the

cable gear 42196, and the other end of which is connected to the lifting and lowering structure 500 and pulls the lifting and lowering structure 500 vertically under the driving of the gear set 42193.

[0013] Optionally, the power structure 910 is a clean water pump 4219, which provides power for the cleaning liquid module and provides cleaning liquid for the wet cleaning module 400.

[0014] Optionally, the gear set 42193 comprises:

a first-stage drive gear 421931 connected with an output shaft of the motor 4211 for outputting driving force of the motor;

a second-stage drive gear 421932 meshed with the first-stage drive gear 421931 for outputting the driving force of the motor to the cable gear 42196; and a third-stage drive gear 421933 meshed with the second-stage drive gear 421932 for outputting the driving force of the motor to the clean water pump 4219.

[0015] Optionally, the output shaft of the motor 4211 comprises an output gear 42111, which is meshed with the first-stage drive gear 421931 for outputting the driving force of the motor.

[0016] Optionally, the driving mechanism 900 further comprises:

a driving wheel 4212 connected with the output shaft of the motor, and having an asymmetric structure; and

a vibrating member 4213, which is connected with the driving wheel 4212, and reciprocates under the asymmetric rotation of the driving wheel 4212.

[0017] Optionally, the power structure 910 is a motor 4211 for providing driving force for forward rotation and reverse rotation.

[0018] Optionally, the clean water pump 4219 is a peristaltic pump, is meshed with the gear set 42193 to provide power for the cleaning liquid module under the driving of the gear set 42193, and provides cleaning liquid for the wet cleaning module 400.

[0019] Optionally, the clean water pump 4219 is an air pump, which provides power for the cleaning liquid module and provides cleaning liquid for the wet cleaning module 400.

[0020] Optionally, the driving mechanism 900 comprises a third driving component 903, and the first driving component 901, the second driving component 902 and the third driving component 903 are connected with the wet cleaning module 400, the lifting and lowering structure 500 and the cleaning liquid module respectively.

[0021] According to a second aspect of the present disclosure, there is provided an automatic cleaning apparatus, comprising:

a mobile platform 100 configured to automatically move on an operating surface;

a cleaning module 150 disposed on the mobile platform 100 and comprising:

a wet cleaning module 400 configured to clean at least a part of the operating surface by means of wet cleaning;

a lifting and lowering structure 500 connected to the wet cleaning module 400, and configured to enable the wet cleaning module 400 to move vertically relative to the mobile platform 100 and the operating surface in response to an obstacle or undulation on the operating surface;

wherein the wet cleaning module 400 comprises a cleaning head 410 for cleaning the operating surface, and a driving unit 420 for driving the cleaning head 410 to reciprocate along a target surface, which is a part of the operating surface.

[0022] Optionally, the lifting and lowering structure 500 is a parallelogram structure and comprises:

a first connecting end 501 for providing active power to switch the dry cleaning module 151 or the wet cleaning module 400 between a lifting state and a lowering state;

a second connecting end 502 disposed opposite to the first connecting end 501 and rotated under the action of the active power.

[0023] Optionally, the first connecting end 501 comprises a first bracket 5011 fixedly connected to a bottom of the mobile platform 100; and the first bracket 5011 comprises:

a cross beam 50111;

a sliding slot 50112 extending along a surface of the cross beam 50111; and

a snapping hole 50113 running through the cross beam 50111 and disposed at an extended end of the sliding slot 50112.

[0024] Optionally, the first connecting end 501 further comprises a first connecting rod pair 5012, one end of which is rotatably connected to the mobile platform 100, and the other end of which is rotatably connected to the dry cleaning module 151 or the wet cleaning module 400, wherein the first connecting rod pair 5012 comprises a first connecting rod 50121 and a second connecting rod 50122 which are disposed in parallel, wherein a first end of each of the first connecting rod 50121 and the second connecting rod 50122 is rotatably connected to the mobile platform 100 through a movable stud, and a second end of each of the first connecting rod 50121 and the second connecting rod 50122 is rotatably connected to the wet cleaning module 400 through the movable stud.

[0025] Optionally, the lifting and lowering structure 500 further comprises a cable assembly 42194 for providing pulling power to rotate the first connecting rod pair 5012

within a preset angle, wherein the cable assembly 42194 comprises:

a cable motor terminal 50131 connected with the driving unit 420; a cable bracket terminal 50132 connected with the first bracket 5011, wherein the motor lifts or lowers the second end of each of the first connecting rod 50121 and the second the connecting rod 50122 through the cable 42194.

[0026] According to a third aspect of the present disclosure, there is provided an automatic cleaning apparatus, comprising:

a mobile platform 100 configured to automatically move on an operating surface;
a cleaning module 150 disposed on the mobile platform 100 and comprising:

a dry cleaning module 151 configured to clean at least a part of the operating surface by means of dry cleaning;

a wet cleaning module 400 configured to clean at least a part of the operating surface by means of wet cleaning; wherein
the wet cleaning module 400 comprises:

a cleaning head 410 for cleaning the operating surface; and

a driving unit 420 for driving the cleaning head 410 to reciprocate substantially along a target surface, wherein the direction of the reciprocating is substantially perpendicular to the direction in which the mobile platform moves on the operating surface, and the target surface is a part of the operating surface.

[0027] Optionally, the driving unit 420 comprises:

a driving platform 421 connected to a bottom surface of the mobile platform 100 for providing a driving force; and

a supporting platform 422 detachably connected to the driving platform 421 for supporting the cleaning head 410.

[0028] Optionally, the driving platform 421 comprises:

a motor 4211, which is disposed on a side of the driving platform 421 close to the mobile platform 100, and outputs power by an output shaft of the motor; and

a driving wheel 4212 connected with the output shaft of the motor, and having an asymmetric structure.

[0029] Optionally, the driving platform 421 further comprises:

a vibrating member 4213, which is disposed on a side of the driving platform 421 opposite to the motor 4211, is connected with the driving wheel 4212, and substantially

reciprocates under the asymmetric rotation of the driving wheel 4212.

[0030] Optionally, the driving platform 421 further comprises:

a connecting rod 4214, extending along an edge of the driving platform 421, and connecting the driving wheel 4212 with the vibrating member 4213 so that the vibrating member 4213 extends to a preset position.

[0031] According to a fourth aspect of the present disclosure, there is provided an automatic cleaning apparatus, comprising:

a mobile platform 100 configured to automatically move on an operating surface;

a cleaning module 150 disposed on the mobile platform 100 and comprising:

a wet cleaning module 400 configured to clean at least a part of the operating surface by means of wet cleaning, wherein the wet cleaning module 400 comprises:

a cleaning head 410 for cleaning the operating surface; and

a driving unit 420 for driving at least a part of the cleaning head 410 to reciprocate substantially along a target surface which is a part of the operating surface, wherein the frequency of the reciprocating motion is more than 2000 times per minute.

[0032] Optionally, the driving unit 420 comprises:

a driving platform 421 connected to a bottom surface of the mobile platform 100 for providing a driving force, wherein the driving platform 421 comprises:

a motor 4211, which is disposed on a side of the driving platform 421 close to the mobile platform 100, and outputs power through an output shaft of the motor; and

a driving wheel 4212 connected with the output shaft of the motor, and having an asymmetric structure.

[0033] Optionally, the driving unit 420 comprises:

a supporting platform 422 detachably connected to the driving platform 421 for supporting the cleaning head 410.

[0034] Optionally, the driving platform 421 further comprises:

a vibrating member 4213, which is disposed on a side of the driving platform 421 opposite to the motor 4211, is connected with the driving wheel 4212, and substantially reciprocates under the asymmetric rotation of the driving wheel 4212.

[0035] Optionally, the frequency of the reciprocating motion of the vibrating member 4213 is more than 2000 times per minute.

[0036] Compared with the prior art, the disclosed embodiments have the following technical effects.

[0037] The disclosure provides an automatic cleaning apparatus, wherein a plurality of driving mechanisms are respectively connected with a wet cleaning device, a lifting and lowering structure and a cleaning liquid module, and the working combination of the wet cleaning device, the lifting and lowering structure and the cleaning liquid module is synchronously or asynchronously controlled by the plurality of driving mechanisms by means of setting the cooperation of the clutch, the gear set and the like, thereby realizing a variety of cleaning effects. And, the respective connections of the plurality of the driving mechanisms reduces the workload of the driving mechanisms and extends the service life of the whole machine.

[0038] The disclosed automatic cleaning apparatus provides a lifting and lowering structure. When the automatic cleaning apparatus encounters obstacles or undulating surfaces on the operating surface, the height of the wet cleaning device is adjusted through the passive lifting and lowering structure according to the height of obstacles or the undulating degree of the surface, which significantly improves the passing performance and cleaning effect of the automatic cleaning apparatus.

[0039] The disclosed automatic cleaning apparatus provides a wet cleaning module. The reciprocating direction of vibration cleaning of the wet cleaning module is perpendicular to the moving direction of the automatic cleaning apparatus, thus avoiding the influence of the movement of the automatic cleaning apparatus on the wet cleaning effect to the greatest extent, achieving the best cleaning efficiency and the shortest cleaning path of the wet cleaning module, and further preserving the service life of the automatic cleaning apparatus.

[0040] The disclosed automatic cleaning apparatus provides a wet cleaning module, wherein the frequency of reciprocating movement of vibration cleaning of the wet cleaning module is more than 2000 times per minute, that is, a frequency exceeding 2000 Hz, and since the frequency of 20 Hz and above is the sound frequency that the human's ears can hear, such high-frequency vibration greatly improves the cleaning effect and cleaning efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] The accompanying drawings, which are incorporated into and constitute a part of this specification, illustrate embodiments conforming to the present disclosure and, together with the description, serve to explain the principles of the present disclosure. Obviously, the accompanying drawings in the following description are only some embodiments of the present disclosure, and a person of ordinary skill in the art may still derive other drawings from these accompanying drawings without creative efforts. In the drawings:

Fig. 1 is an oblique view of an automatic cleaning apparatus according to one embodiment of the present disclosure;

Fig. 2 is a schematic structural diagram of a bottom of an automatic cleaning apparatus according to one embodiment of the present disclosure;

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

Fig. 4 is a front view of a driving wheel assembly on one side according to one embodiment of the present disclosure;

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

Fig. 6 is an oblique view of a blower according to one embodiment of the present disclosure;

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

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

Fig. 9 is an exploded view of an automatic cleaning apparatus according to one embodiment of the present disclosure;

Fig. 10 is a structural diagram of a supporting platform of an automatic cleaning apparatus according to one embodiment of the present disclosure;

Fig. 11 is a structural diagram of a vibrating member of an automatic cleaning apparatus according to one 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 vibrating member according to one embodiment of the present disclosure;

Fig. 16 is a schematic structural diagram of the assembly of a cleaning substrate according to one embodiment of the present disclosure;

Fig. 17 is a structural diagram of a clean water pump driven by a motor according to one embodiment of the present disclosure;

Fig. 18 is a structural diagram of a lifting and lowering module driven by a motor according to one embodiment of the present disclosure;

Fig. 19 is a schematic diagram of an automatic cleaning apparatus in a lifting state according to one embodiment of the present disclosure;

Fig. 20 is a schematic diagram of an automatic cleaning apparatus in a lowering state according to one embodiment of the present disclosure;

Fig. 21 is a schematic diagram of a four-link lifting and lowering structure in a lifting state according to one embodiment of the present disclosure;

Fig. 22 is a schematic diagram of a four-link lifting and lowering structure in a lowering state according to one embodiment of the present disclosure;

Fig. 23 is a schematic structural diagram of a second end of a four-link lifting and lowering structure according to one embodiment of the present disclosure;

Fig. 24 is a schematic structural diagram of a dry cleaning module in a lowering state according to one embodiment of the present disclosure;

Fig. 25 is a schematic structural diagram of a dry cleaning module in a lifting state according to one embodiment of the present disclosure;

Fig. 26 is a schematic structural diagram of a first driving component according to one embodiment of the present disclosure;

Fig. 27 is a schematic structural diagram of another first driving component according to one embodiment of the present disclosure;

Fig. 28 is a schematic structural diagram of another first driving component according to one embodiment of the present disclosure;

Fig. 29 is a schematic structural diagram of a first driving component with a peristaltic pump according to one embodiment of the present disclosure;

Fig. 30 is a schematic structural diagram of a first driving component with an air pump according to one embodiment of the present disclosure; and

Fig. 31 is a schematic structural diagram of a driving mechanism with a first driving component, a second driving component and a third driving component according to one embodiment of the present disclosure.

Description of reference numbers:

[0042] Mobile platform 100, rearward portion 110, forward portion 111, perception system 120, position determining 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, filtering mesh 153, dust sucking port 154, air outlet 155, blower 156, energy system 160, human-computer interaction system 170, wet cleaning assembly 400, cleaning head 410, driving unit 420, driving platform 421, supporting platform 422, motor 4211, driving wheel 4212, vibrating member 4213, connecting rod 4214, vibration buffering device 4215, pawl 4216, clean water pump pipe 4218, clean water pump 4219, cleaning substrate 4221, elastic detaching button 4229, assembling region 4224, engagement position 4225, first sliding slot 4222, second sliding slot 4223, first slider 525, second slider 528, swiveling end 512 (4227), sliding end 514 (4226), first pivot 516 (624), second pivot 518 (626), vi-

bration driving mechanism 500' (600', 700'), driving mechanism 900, power structure 910, first driving component 901, second driving component 902, third driving component 903, four-link lifting and lowering structure 500, first connecting end 501, second connecting end 502, first bracket 5011, first connecting rod pair 5012, first connecting rod 50121, second connecting rod 50122, cable 42194, cable motor terminal 50131, cable bracket terminal 50132, cross beam 50111, sliding slot 50112, snapping hole 50113, first longitudinal beam 50114, second longitudinal beam 50115, second bracket 5021, second connecting rod pair 5022, third connecting rod 50221, fourth connecting rod 50222, gear set 42193, clutch 42195, first clutch gear 421951, second clutch gear 421952, and cable gear 42196.

DETAILED DESCRIPTION

[0043] In order to make the objects, 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. Obviously, the described embodiments are only part but not all of the embodiments of the present disclosure. Based on the embodiments in the present disclosure, all other embodiments obtained by those of ordinary skills in the art without creative efforts are within the scope of the present disclosure.

[0044] The terms used in the embodiments of the present disclosure are for the purpose of describing specific embodiments only and art not intended to limit the present disclosure. The singular forms of "alan", "the" and "said" used in the embodiments of the present disclosure and the appended claims are also intended to comprise plural forms, unless the context clearly indicates otherwise. The term "a plurality of" generally means at least two.

[0045] It should be understood that the term "and/or" used herein is merely a association relationship describing associated objects, and indicates that there may be three relationships. For example, A and/or B may indicate three cases: A exists separately, A and B exist at the same time, and B exists separately. In addition, the character "/" herein generally indicates an "or" relationship between the contextual objects.

[0046] It should be understood that although the terms such as 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... from another. For example, "first" ...may also be referred to as "second", and similarly, "second" may also be referred to as "first", without departing from the scope of the disclosed embodiments.

[0047] It should also be noted that the terms "comprises", "includes" or any other variants thereof are intended to cover non-exclusive containing, such that a product or a device that comprises a series of elements comprises

not only those elements, but also comprises other elements that are not explicitly listed, or also comprises the inherent elements of such product or device. Without further restrictions, an element modified by the phrase "comprising a..." does not exclude the existence of other identical elements in the product or device comprising such element.

[0048] Alternative embodiments of the present disclosure will be described in detail below with reference to the accompanying drawings.

Embodiment 1

[0049] Figs. 1-2 are schematic structural diagrams of an automatic cleaning apparatus according to an exemplary embodiment. As shown in Figs. 1-2, the automatic cleaning apparatus may be a vacuum ground sucking robot, or may be a ground mopping/brushing robot, or may be a window climbing robot, etc. The automatic cleaning apparatus may include a mobile platform 100, a perception system 120, a control system 130, a driving system 140, a cleaning module 150, an energy system 160 and a human-computer interaction system 170. Wherein:

[0050] The mobile platform 100 may be configured to automatically move on an operating surface in a target direction. The operating surface may be a surface to be cleaned by the automatic cleaning apparatus. In some embodiments, the automatic cleaning apparatus may be a ground mopping robot, and thus the automatic cleaning apparatus works on a ground which is the operating surface. The automatic cleaning apparatus may also be a window cleaning robot, and thus the automatic cleaning apparatus works on an outer surface of glass of a building, and the glass is the operating surface. The automatic cleaning apparatus may also be a pipe cleaning robot, and thus the automatic cleaning apparatus works on an inner surface of the pipe, and the inner surface of the pipe is the operating surface. For the purpose of presentation only, the following description in this application takes a ground mopping robot as an example for illustration.

[0051] In some embodiments, 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 itself can automatically and adaptively make an operational decision based on an unexpected environmental input; and the non-autonomous mobile platform means that the mobile platform 100 itself cannot adaptively make an operational decision based on an unexpected environmental input, but can execute a given procedure or operate according to a certain logic. Correspondingly, when the mobile platform 100 is the autonomous mobile platform, the target direction may be determined autonomously by the automatic cleaning apparatus; and when the mobile platform 100 is the non-autonomous mobile platform, the target direction may be set systematically and manually. When

the mobile platform 100 is the autonomous mobile platform, the mobile platform 100 comprises a forward portion 111 and a rearward portion 110.

[0052] The perception system 120 comprises a position determining device 121 located above the mobile platform 100, a buffer 122 located at the forward portion 111 of the mobile platform 100, a cliff sensor 123 located at a bottom of the mobile platform 100 and sensing devices such as an ultrasonic sensor (not shown in the figures), an infrared sensor (not shown in the figures), a magnetometer (not shown in the figures), an accelerometer (not shown in the figures), a gyroscope (not shown in the figures), and an odometer (not shown in the figures), for providing various position information and motion state information of the automatic cleaning apparatus to the control system 130.

[0053] In order to more clearly describe behaviors of the automatic cleaning apparatus, the following directions are defined: the automatic cleaning apparatus may travel on the ground by various combinations of movements relative to the following three mutually perpendicular axes defined by the mobile platform 100: a transversal axis X, a front and rear axis Y and a center vertical axis Z. A forward driving direction along the front and rear axis Y is designated as "forward" and a rearward driving direction along the front and rear axis Y is designated as "rearward". The transversal axis X extends substantially between a right wheel and a left wheel of the automatic cleaning apparatus along an axis center defined by a center point of the driving wheel assembly 141. The automatic cleaning apparatus may rotate around the X axis. It is called "pitch up" when the forward portion of the automatic cleaning apparatus is tilted upward and the rearward portion thereof is tilted downward, and it is called "pitch down" when the forward portion of the automatic cleaning apparatus is tilted downward and the rearward portion thereof is tilted upward. In addition, the automatic cleaning apparatus may rotate about the Z axis. In a forward direction of the automatic cleaning apparatus, it is called "turn right" when the automatic cleaning apparatus is tilted to the right of the Y axis, and it is called "turn left" when the automatic cleaning apparatus is tilted to the left of the Y axis.

[0054] As shown in Fig. 2, cliff sensors 123 are provided at the bottom of the mobile platform 100 and in front and rear of the driving wheel assembly 141, respectively, for preventing the automatic cleaning apparatus from falling off when the automatic cleaning apparatus retreats, so as to avoid damage to the automatic cleaning apparatus. The aforementioned "front" refers to the side same as a traveling direction of the automatic cleaning apparatus, and the aforementioned "rear" refers to the side opposite to the traveling direction of the automatic cleaning apparatus.

[0055] The position determining device 121 comprises, but is not limited to, a camera, a laser distance sensor (LDS).

[0056] The various components in the perception sys-

tem 120 may operate independently, or operate together to achieve a purpose function more accurately. The surface to be cleaned is identified through the cliff sensor 123 and the ultrasonic sensor to determine physical properties of the surface to be cleaned, including a surface material, degree of cleanliness, etc., which may be more accurately determined in combination with the camera and the laser distance sensor, etc.

[0057] 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 made of a carpet material, the control system 130 controls the automatic cleaning apparatus to perform a carpet mode cleaning.

[0058] The forward portion 111 of the mobile platform 100 is provided with the buffer 122. During cleaning, when the driving wheel assembly 141 propels the automatic cleaning apparatus to travel on the ground, the buffer 122 detects one or more events (or objects) in a traveling path of the automatic cleaning apparatus via a sensor system such as an infrared sensor, and the automatic cleaning apparatus may control the driving wheel assembly 141 based on the events (or objects) detected by the buffer 122, such as obstacles and walls, so as to cause the automatic cleaning apparatus to respond to the events (or objects), such as moving away from the obstacles.

[0059] The control system 130 is disposed on a main circuit board inside the mobile platform 100, and includes a computing processor, such as a central processing unit and an application processor that communicate with a non-transitory memory such as a hard disk, a flash memory and a random-access memory. The application processor is configured to receive environmental information sensed by a plurality of sensors and transmitted from the perception system 120, to draw a simultaneous map of an environment where the automatic cleaning apparatus is located based on obstacle information fed back by the laser distance sensor by use of a positioning algorithm, such as SLAM, to autonomously determine a travelling path based on the environmental information and the environmental map, and then to control the driving system 140 to perform operations such as travelling forward, travelling backward, and/or steering based on the autonomously determined travelling path. Further, the control system 130 may also determine whether to activate the cleaning module 150 to perform a cleaning operation based on the environmental information and the environmental map.

[0060] Specifically, the control system 130 may, based on distance information and speed information which are fed back by the buffer 122, the cliff sensor 123 and sensing devices such as the ultrasonic sensor, the infrared sensor, the magnetometer, the accelerometer, the gyroscope, and the odometer, comprehensively determine a current operating state of the ground sweeping robot, such as crossing a doorsill, getting on a carpet, locating at the edge of a cliff, being stuck from above or below,

having a full dust box, being picked up, etc., and will also give a specific next action strategy for different situations, so that the work of the automatic cleaning apparatus meets the owner's requirements and provides better user experience. Further, the control system may plan the most efficient and reasonable cleaning path and cleaning mode based on the simultaneous map drawn by SLAM, which greatly improves the cleaning efficiency of the automatic cleaning apparatus.

[0061] The driving system 140 may execute a driving command based on specific distance and angular information, such as x, y, and theta components, so as to manipulate the automatic cleaning apparatus to travel across the ground. Figs. 3 and 4 are an oblique view and a front view of a driving wheel assembly 141 on one side according to an embodiment of the present disclosure, respectively. As shown in the figures, the driving system 140 includes the driving wheel assembly 141, and may control a left wheel and a right wheel simultaneously. In order to more precisely control the motion of the automatic cleaning apparatus, the driving system 140 preferably includes a left driving wheel assembly and a right driving wheel assembly, respectively. The left driving wheel assembly and the right driving wheel assembly are arranged symmetrically along the transverse axis defined by the mobile platform 100. The driving wheel assembly includes a body portion, a driving wheel and an elastic element. One end of the body portion is connected to a frame; the driving wheel is disposed at the body portion and driven by a driving motor 146; and the elastic element is connected between the body portion and the frame, and is 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 center of the driving motor 146 is located within a cross-sectional projection of the driving wheel, and the driving wheel assembly 141 may also be connected to a circuit for measuring a driving current and the odometer.

[0062] In order for the automatic cleaning apparatus to move on the ground more stably or have a higher movement ability, the automatic cleaning apparatus may include one or more steering assemblies 142, and the steering assembly 142 may be a driven wheel or a driving wheel, and structurally includes but is not limited to a universal wheel. The steering assembly 142 may be located in front of the driving wheel assembly 141.

[0063] The driving motor 146 provides power for rotation of the driving wheel assembly 141 and/or the steering assembly 142.

[0064] The driving wheel assembly 141 may be detachably connected to the mobile platform 100 to facilitate disassembly, assembly and maintenance. The driving wheel may have an offset drop suspension system which is movably fastened, e.g., rotatably attached, to the mobile platform 100 of the automatic cleaning apparatus, and maintains contact and traction with the ground at a certain grounding force by an elastic element 143 such

as a tension spring or a compression spring, and meanwhile, the cleaning module 150 of the automatic cleaning apparatus is also in contact with the surface to be cleaned at a certain pressure.

[0065] The energy system 160 comprises a rechargeable battery, such as a nickel-hydrate battery and a lithium battery. The rechargeable battery may be connected with a charging control circuit, a battery pack charging temperature detecting circuit and a battery undervoltage monitoring circuit; and the charging control circuit, the battery pack charging temperature detecting circuit and the battery undervoltage monitoring circuit are then connected to a single-chip microcomputer control circuit. A host of the automatic cleaning apparatus is connected to a charging pile through a charging electrode disposed on a side of or below a body of the automatic cleaning apparatus for charging.

[0066] The human-computer interaction system 170 includes buttons on a panel of the host of the automatic cleaning apparatus, and the buttons are used by a user to select functions. The human-computer interaction system 170 may also include a display screen and/or an indicator light and/or a horn. The display screen, the indicator light and the horn present a current state or function items of the automatic cleaning apparatus to the user. The human-computer interaction system 170 may also include a mobile client program. For a route navigation type cleaning apparatus, the mobile client may present a map of the environment where the apparatus is located, as well as a location of the apparatus to the user, which may provide the user with richer and more user-friendly function items.

[0067] The cleaning module 150 may comprise a dry cleaning module 151 and/or a wet cleaning module 400.

[0068] As shown in Figs. 5-8, the dry cleaning module 151 includes a rolling brush, a dust box, a blower, and an air outlet. The rolling brush having a certain interference with the ground sweeps up garbage on the ground, and rolls up the garbage to the front of a dust sucking port between the rolling brush and the dust box and then the garbage is sucked into the dust box by air which has a sucking force, is generated by the blower and passes through the dust box. The dust removal capacity of the ground sweeping robot may be characterized by the dust pickup efficiency (DPU) of the garbage. The DPU is affected by a structure and material of the rolling brush, the utilization rate of air in an air passage formed by the dust sucking port, the dust box, the blower, the air outlet and connecting components among the dust sucking port, the dust box, the blower, the air outlet, and a type and power of the blower, which is a complex system design problem. Compared with an ordinary plug-in vacuum cleaner, for an automatic cleaning apparatus with limited energy, the improvement of dust removal capacity is more meaningful. Because the improvement of the dust removal capacity directly and effectively reduces the demand for energy, that is to say, the original cleaning apparatus that may clean 80 square meters of ground on

a single charge may be evolved to clean 180 square meters or more on a single charge. In addition, the service life of the battery having a reduced number of charging times will also be greatly increased, so that the frequency of replacing the battery by the user will be also reduced. What is more intuitive and important is that the improvement of the dust removal capacity is the most obvious and important user experience as the user will directly come to a conclusion about whether the thorough cleaning is achieved. The dry cleaning module may also include a side brush having a rotating shaft angled relative to the ground, for moving debris to a region of the rolling brush of the cleaning module 150.

[0069] Fig. 5 is a schematic structural diagram of a dust box 152 in the dry cleaning module, Fig. 6 is a schematic structural diagram of a blower 156 in the dry cleaning module, Fig. 7 is a schematic diagram of the dust box 152 in an open state, and Fig. 8 is a schematic diagram of the dust box and the blower in an assembled state.

[0070] The rolling brush having a certain interference with the ground sweeps up garbage on the ground and rolls up the garbage to the front of the dust sucking port 154 between the rolling brush and the dust box 152 and then the garbage is sucked into the dust box 152 by the air which has a sucking force, is generated by the blower 156 and passes through the dust box 152. The garbage is isolated by a filtering mesh 153 on an inner side of the dust box 152 close to the dust sucking port 154. The filtering mesh 153 completely isolates the dust sucking port from the air outlet, and the filtered air enters the blower 156 through the air outlet 155.

[0071] Typically, the dust sucking port 154 of the dust box 152 is located in front of the automatic cleaning apparatus, the air outlet 155 is located on a side of the dust box 152, and an air sucking port of the blower 156 is docked with the air outlet of the dust box.

[0072] A front panel of the dust box 152 may be opened for cleaning garbage within the dust box 152.

[0073] The filtering mesh 153 is detachably connected to a body of the dust box 152 to facilitate disassembly, assembly and cleaning.

[0074] According to a specific embodiment of the present disclosure, as shown in Figs. 9-11, the wet cleaning module 400 according to the present disclosure is configured to clean at least a part of an operating surface by means of wet cleaning. The wet cleaning module 400 comprises: a cleaning head 410 and a driving unit 420. The cleaning head 410 is used for cleaning at least a part of the operating surface, and the driving unit 420 is used for driving the cleaning head 410 to substantially reciprocate along a target surface, the target surface being a part of the operating surface. The cleaning head 410 reciprocates along a surface to be cleaned, and a surface of the cleaning head 410 in contact with the surface to be cleaned is provided with a cleaning cloth or a cleaning plate, which generates a high-frequency friction with the surface to be cleaned through a reciprocating motion thereof, thereby removing stains on the surface to be

cleaned.

[0075] Optionally, the frequency of the reciprocating motion is more than 2000 times per minute, that is, a frequency exceeding 2000 Hz, and since the frequency of 20 Hz and above is the sound frequency that the human's ears can hear, such high-frequency vibration greatly improves the cleaning effect and cleaning efficiency.

[0076] The higher the friction frequency is, the larger the number of friction times per unit time is. A high-frequency reciprocating motion, also called a reciprocating vibration, has a much higher cleaning ability than an ordinary reciprocating motion, such as rotational friction cleaning. Optionally, when the friction frequency approaches that of a sound wave, the cleaning effect will be much higher than that of the rotational friction cleaning of dozens of revolutions per minute. On the other hand, tufts on the surface of the cleaning head extend together in the same direction under the shaking of high-frequency vibration, and thus the overall cleaning effect is more uniform, instead of applying only downward pressure to increase the frictional force in the case of low-frequency rotation to improve the cleaning effect, and only the downward pressure does not cause the tufts to extend in the same direction. Therefore, in terms of the effect, water marks on the operating surface which is cleaned under the high-frequency vibration are more uniform, and there will be no chaotic water stains.

[0077] The higher the frequency of reciprocating motion is, the less water stains will be left. It is preferable that the frequency of reciprocating motion is much higher than 20 Hz (120 revolutions per minute), preferably higher than 2000 revolutions per minute. Driving at least a part of the cleaning head to reciprocate on the operating surface by the driving unit can realize higher-speed vibration, that is, reciprocating motion, because the friction force to be overcome by driving only a part of the cleaning head is smaller, thereby achieving better cleaning effect.

[0078] Preferably, the area of at least a part of the cleaning head that may vibrate can be approximately the same as the cleaning area of the dry cleaning module of the automatic cleaning apparatus. Although a better cleaning effect can be achieved by reducing the area of at least a part of the cleaning head that may vibrate, the cleaning efficiency of the cleaning module will also decrease with the reduction of the reciprocating motion area. Therefore, a suitable area ratio needs to be selected. When the area of at least a part of the cleaning head that may vibrate is approximately the same as the cleaning area of the dry cleaning module of the automatic cleaning apparatus, the synchronization of dry cleaning and wet cleaning can be realized, thereby simultaneously ensuring the cleaning effect and cleaning efficiency of the automatic cleaning apparatus.

[0079] The reciprocating motion may be a repeated motion along any one or more directions within the operating surface, or may be a vibrating motion perpendicular to the operating surface, which is not strictly limited.

Optionally, the direction of the reciprocating motion of the cleaning module is substantially perpendicular to a travelling direction of the automatic cleaning apparatus because the direction of the reciprocating motion being parallel to the travelling direction of the automatic cleaning apparatus may cause the automatic cleaning apparatus itself, which is traveling, to be unstable for the reason that thrust and resistance in the travelling direction make it easy for the driving wheel to skid, and the effect of skid is more obvious when the wet cleaning module is included as the wetness of the operating surface increases the possibility of skid. The skid not only affects smooth travelling for cleaning of the automatic cleaning apparatus, but also causes the sensors such as an odometer and a gyroscope to inaccurately perform a distance measurement, thereby resulting in the inability of the navigation type automatic cleaning apparatus to accurately locate and draw a map. In the case of frequent skid, the effect on SLAM cannot be ignored. Therefore, it is necessary to avoid the skid of the automatic cleaning apparatus as far as possible. In addition to skid, a motion component of the cleaning head in the travelling direction of the automatic cleaning apparatus causes the automatic cleaning apparatus to be constantly pushed forward and backward when the automatic cleaning apparatus travels, so the automatic cleaning apparatus travels unstably.

[0080] As an alternative embodiment of the present disclosure, as shown in Fig. 9, the driving unit 420 comprises: a driving platform 421 connected to a bottom surface of the mobile platform 100 for providing a driving force; and a supporting platform 422 detachably connected to the driving platform 421 for supporting the cleaning head 410 and being able to lift and lower under the driving of the driving platform 421.

[0081] As an alternative embodiment of the present disclosure, a lifting and lowering module is provided between the cleaning module 150 and the mobile platform 100, so that the cleaning module 150 may better contact the surface to be cleaned, or different cleaning strategies are used for surfaces to be cleaned made of different materials.

[0082] Optionally, the dry cleaning module 151 may be connected to the mobile platform 100 by a passive lifting and lowering module. When the cleaning apparatus encounters an obstacle or the surface to be cleaned undulates, the dry cleaning module 151 may more easily pass the obstacle by the lifting and lowering module.

[0083] Optionally, the wet cleaning module 400 may be connected with the mobile platform 100 through a passive lifting and lowering module. When the cleaning apparatus encounters an obstacle or the surface to be cleaned undulates, the wet cleaning module 400 may more easily pass the obstacle by the lifting and lowering module.

[0084] Optionally, the wet cleaning module 400 may be connected with the mobile platform 100 by an active lifting and lowering module. When the wet cleaning module 400 does not participate in the work temporarily, or

when encountering a surface to be cleaned which cannot be cleaned by the wet cleaning module 400, the wet cleaning module 400 is lifted by the active lifting and lowering module and separated from the surface to be cleaned, thereby realizing the change of cleaning means.

[0085] As shown in Figs. 10-11, the driving platform 421 comprises: a motor 4211 disposed on a side of the driving platform 421 close to the mobile platform 100 and outputting power by a motor output shaft; a driving wheel 4212 connected to the motor output shaft and having an asymmetric structure; and a vibrating member 4213 which is disposed on a side of the driving platform 421 opposite to the motor 4211 and connected to the driving wheel 4212 and reciprocates under the asymmetrical rotation of the driving wheel 4212.

[0086] The driving platform 421 may further comprise 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 swivel, or may indirectly drive the driving wheel 4212 to swivel through the gear mechanism. Those skilled in the art can understand that the gear mechanism may be one gear, or may be a gear set composed of a plurality of gears.

[0087] The motor 4211 simultaneously transmits, by a power transmission device, power to the cleaning head 410, the driving platform 421, the supporting platform 422, a water delivery mechanism, a water tank and the like. The energy system 160 provides power and energy for the motor 4211 and is entirely controlled by the control system 130. The power transmission device may be a gear drive, a chain drive, a belt drive, or may be a worm gear or the like.

[0088] The motor 4211 has a forward output mode and a reverse output mode. In the forward output mode, the motor 4211 rotates forward, and in the reverse output mode, the motor 4211 rotates reversely. In the forward output mode of the motor 4211, the motor 4211 may simultaneously drive, by the power transmission device, the vibrating member 4213 of the driving platform in the wet cleaning module 400 to substantially reciprocate and the water delivery mechanism to move synchronously. In the reverse output mode of the motor 4211, the motor 4211 drives the driving platform 421 to lift and lower by the power transmission device.

[0089] Further, the driving platform 421 further includes: a connecting rod 4214 extending along an edge of the driving platform 421 and connecting the driving wheel 4212 and the vibrating member 4213 so that the vibrating member 4213 extends to a preset position. An extending direction of the vibrating member 4213 is perpendicular to the connecting rod 4214, so that the reciprocating motion direction of the vibrating member 4213 is substantially perpendicular to the traveling direction of the automatic cleaning apparatus.

[0090] The motor 4211 is connected to the driving wheel 4212, the vibrating member 4213, the connecting rod 4214 and a vibration buffering device 4215 through the power transmission device. The vibrating member

4213 and the connecting rod 4214 constitute an approximate L-shaped structure, as shown in Fig. 15. The vibrating member 4213 reciprocates under the driving of the connecting rod 4214. The vibration buffering device 4215 has the effect of damping and reducing the shaking of the motion behavior driven by the driving wheel 4212, so that the vibrating member 4213 may vibrate smoothly within the range of motion provided by the supporting platform 422. Optionally, the vibration buffering device 4215 is made of a soft material, optionally a rubber structure, and the vibration buffering device 4215 sleeves the connecting rod 4214. On the other hand, the vibration buffering device 4215 may also protect the vibrating member 4213 from being damaged due to collision with the driving platform 421, and thus may affect the reciprocating motion of the vibrating member 4213. The movable components and the fixed components of the driving platform 421 are constrained from moving through connections with less elasticity in the traveling direction of the automatic cleaning apparatus, and are connected flexibly and allowed to move in the direction substantially perpendicular to the traveling direction of the automatic cleaning apparatus, that is, in the vibrating direction of the vibrating member 4213. The above two movement restrictions make the vibrating member 4213 not exactly reciprocate, but substantially reciprocate. When the wet cleaning module 400 is activated, the motor 4211 starts to rotate forward, the motor 4211 drives, through the driving wheel 4212, the connecting rod 4214 to reciprocate along the surface of the driving platform 421, and at the same time, the vibration buffering device 4215 drives the vibrating member 4213 to substantially reciprocate along the surface of the driving platform 421, the vibrating member 4213 drives a cleaning substrate 4221 to substantially reciprocate along the surface of the supporting platform 422, and the cleaning substrate 4221 drives a movable region 412 to substantially reciprocate along the surface to be cleaned. At this point, a clean water pump makes clean water flow out from a clean water tank, and the clean water is sprinkled on the cleaning head 410 through a water discharging device 4217, and the cleaning head 410 reciprocates to clean the surface to be cleaned.

[0091] The cleaning intensity/efficiency of the automatic cleaning apparatus may also be automatically and dynamically adjusted according to an operating environment of the automatic cleaning apparatus. For example, the automatic cleaning apparatus may achieve dynamical adjustment according to physical information of the surface to be cleaned detected by the perception system 120. For example, the perception system 120 may detect the flatness of the surface to be cleaned, a material of the surface to be cleaned, whether there is oil and dust, and other information and transmit the information to the control system 130 of the automatic cleaning apparatus. Correspondingly, the control system 130 may instruct the automatic cleaning apparatus to automatically and dynamically adjust a rotational speed of the motor and a transmission ratio of the power transmission device ac-

cording to the operating environment of the automatic cleaning apparatus, and thus to adjust a preset reciprocating cycle of the reciprocating motion of the cleaning head 410.

[0092] For example, when the automatic cleaning apparatus operates on a flat ground, the preset reciprocating period may be automatically and dynamically adjusted to be longer, and a water volume of the water pump may be automatically and dynamically adjusted to be smaller; and when the automatic cleaning apparatus operates on a less flat ground, the preset reciprocating period may be automatically and dynamically adjusted to be shorter, and the water volume of the pump may be automatically and dynamically adjusted to be larger. This is because it is easier to clean the flat ground than the less flat ground, and thus the reciprocating motion of the cleaning head 410 at a higher speed (i.e., higher frequency) and a larger water volume are needed for cleaning an uneven ground.

[0093] For another example, when the automatic cleaning apparatus operates on a table, the preset reciprocating period may be automatically and dynamically adjusted to be longer, and the water volume of the water pump may be automatically and dynamically adjusted to be smaller; and when the automatic cleaning apparatus 100 operates on a ground, the preset reciprocating period may be automatically and dynamically adjusted to be shorter, and the water volume of the water pump may be automatically and dynamically adjusted to be larger. This is because the table has less dust and oil compared to the ground, and the material of which the table is made is easier to clean, and thus only a fewer number of reciprocating motions of the cleaning head 410 and a relatively smaller water volume of the water pump are needed for cleaning the table.

[0094] As an alternative embodiment of the present disclosure, the supporting platform 422 includes the cleaning substrate 4221 disposed movably on the supporting platform 422. The cleaning substrate 4221 substantially reciprocates under the vibration of the vibrating member 4213. Optionally, as shown in Fig. 16, the cleaning substrate 4221 includes: an assembling notch 42211 disposed at a position in contact with the vibrating member 4213. When the supporting platform 422 is connected to the driving platform 421, the vibrating member 4213 is assembled to the assembling notch 42211, so that the cleaning substrate 4221 may substantially reciprocate synchronously with the vibrating member 4213. Four first limiting positions 42212 are included in the traveling direction of the cleaning apparatus of the cleaning substrate 4221. The four first limiting positions 42212 are flexibly connected to the cleaning substrate 4221, but the elastic scaling space is small, and thus the movement of the cleaning substrate 4221 relative to the supporting platform 422 in the traveling direction of the cleaning apparatus is limited. Two second limiting portions 42213 are included in the direction of the cleaning substrate 4221 perpendicular to the traveling direction of the clean-

ing apparatus, and the two second limiting positions 42213 limit a range of reciprocating motion of the cleaning substrate 4221 in the direction perpendicular to the travelling direction of the cleaning apparatus. Furthermore, a water discharging hole 42214 is provided near the assembling notch 42211 of the cleaning substrate 4221, so that water flowing out from the water discharging device 4217 flows to the cleaning head 410 via the water discharging hole. The cleaning substrate 4221 substantially reciprocates under the influences of the limiting positions and the vibration buffering device. The cleaning substrate 4221 is located at a part of the supporting platform 422, and a vibration frequency may be made higher by means of local vibration, such as reaching a frequency range of the sound wave. The movable components and the fixed components of the driving platform 421 are restricted from moving through connections with less elasticity in the traveling direction of the automatic cleaning apparatus, and are connected flexibly and allowed to move in the direction substantially perpendicular to the traveling direction of the automatic cleaning apparatus, that is, in the vibrating direction of the vibrating member 4213.

[0095] Fig. 12 shows another vibration driving mechanism 500' of a cleaning head based on a crank slider mechanism according to various embodiments of the present application. The vibration driving mechanism 500' may be applied to the driving platform 421. The vibration driving mechanism 500' comprises a driving wheel 4212, a vibrating member 4213, a cleaning substrate 4221, a sliding slot 4222 (a first sliding slot) and a sliding slot 4223 (a second sliding slot).

[0096] The sliding slots 4222 and 4223 are formed in the supporting platform 422. Both ends of the cleaning substrate 4221 include a slider 525 (a first slider) and a slider 528 (a second slider), respectively. Each of the sliders 525 and 528 is a protrusion at each of both ends of the cleaning substrate 4221. The slider 525 is inserted within the sliding slot 4222 and may slide along the sliding slot 4222; and the slider 528 is inserted within the sliding slot 4223 and may slide along the sliding slot 4223. In some embodiments, the sliding slot 4222 and the sliding slot 4223 are on the same line. In some embodiments, the sliding slot 4222 and the sliding slot 4223 are not on the same line. In some embodiments, the sliding slot 4222 and the sliding slot 4223 extend in the same direction. In some embodiments, an extending direction of the sliding slot 4222 and an extending direction of the sliding slot 4223 are the same as that of the cleaning substrate 4221. In some embodiments, the extending direction of the sliding slot 4222 and the extending direction of the sliding slots 4223 are different from that of the cleaning substrate 4221. In some embodiments, the extending direction of the sliding slot 4222 is different from the extending direction of the sliding slot 4223. For example, as shown in Fig. 12, the extending direction of the sliding slot 4222 is the same as that of the cleaning substrate 4221, and the extending direction of the sliding slot 4223 is angled relative to that of the sliding slot 4222.

[0097] The vibrating member 4213 comprises a swiveling end 512 and a sliding end 514. The swiveling end 512 is connected to the driving wheel 4212 through a first pivot 516, and the sliding end 514 is connected to the cleaning substrate 4221 through a second pivot 518.

[0098] A swiveling center of the driving wheel 4212 is a point O, and a pivoting center of the first pivot 516 is a point A. The point O and the point A do not coincide, and the distance between the point O and the point A is a preset distance d.

[0099] When the driving wheel 4212 rotates, the point A also swivels along a circular path. Correspondingly, the swiveling end 512 follows the point A to swivel along a circular path; and the sliding end 514 drives the cleaning substrate 4221 to slide through the second pivot 518. Correspondingly, the slider 525 of the cleaning substrate 4221 reciprocates linearly along the sliding slot 4222; and the slider 528 of the cleaning substrate 4221 reciprocates linearly along the sliding slot 4223. In Fig. 4, a moving speed of the mobile platform 100 is V_0 , and a moving direction thereof is the target direction. According to some embodiments, when the sliding slot 4223 and the sliding slot 4222 are respectively approximately perpendicular to the direction of the moving speed V_0 of the mobile platform 100, an overall displacement of the cleaning substrate 4221 is substantially perpendicular to the target direction. According to some other embodiments, when any one of the sliding slot 4223 and the sliding slot 4222 forms an angle other than 90 degrees with the target direction, the overall displacement of the cleaning substrate 4221 includes both a component perpendicular to the target direction and a component parallel to the target direction.

[0100] Further, a vibration buffering device 4215 is included, which is disposed on the connecting rod 4214 for reducing vibration in a specific direction. In this embodiment, the vibration buffering device 4215 is used for reducing vibration in the direction of the moving component perpendicular to the target direction of the automatic cleaning apparatus.

[0101] Fig. 13 shows another vibration driving mechanism 600' of a cleaning head based on a double-crank mechanism according to various embodiments of the present application. The vibration driving mechanism 600' may be applied to the driving platform 421. The vibration driving mechanism 600' comprises a driving wheel 4212 (a first driving wheel), a driving wheel 4212' (a second driving wheel), and a cleaning substrate 4221.

[0102] The cleaning substrate 4221 has two ends, a first end thereof is connected to the driving wheel 4212 through a pivot 624 (a first pivot); and a second end thereof is connected to the driving wheel 4212' through a pivot 626 (a second pivot). A swiveling center of the driving wheel 4212 is a point O, and a pivoting center of the pivot 624 is a point A. The point O and the point A do not coincide, and the distance between the point O and the point A is a preset distance d. A swiveling center of the driving wheel 4212' is a point O', and a pivoting center

of the pivot 626 is point A'. The point O' and the point A' do not coincide, and the distance between the point O' and the point A' is a preset distance d. In some embodiments, the point A, the point A', the point O, and the point O' are on the same plane. Therefore, the driving wheel 4212, the driving wheel 4212' and the cleaning substrate 4221 may form a double-crank mechanism (or a parallelogram mechanism), wherein the cleaning substrate 4221 acts as a coupling lever, and the driving wheels 4212 and 4212' act as two cranks.

[0103] Further, a vibration buffering device 4215 is comprised, which is disposed on the connecting rod 4214 for reducing vibration in a specific direction. In this embodiment, the vibration buffering device 4215 is used for reducing vibration in the direction of the moving component perpendicular to the target direction of the automatic cleaning apparatus.

[0104] Fig. 14 shows a vibration driving mechanism 700' based on a crank slider mechanism according to various embodiments of the present application. The vibration driving mechanism 700' may be applied to the driving platform 421. The vibration driving mechanism 700' comprises a driving wheel 4212, a cleaning substrate 4221 and a sliding slot 4222.

[0105] The sliding slot 4222 is formed in the supporting platform 422. The cleaning substrate 4221 comprises a swiveling end 4227 and a sliding end 4226. The swiveling end 4227 is connected to the driving wheel 4212 through a pivot 4228. A swiveling center of the driving wheel 4212 is a point O, and a pivoting center of the pivot 4228 of the swiveling end is a point A. The point O and the point A do not coincide, and the distance between the point O and the point A is a preset distance d. The sliding end 4226 comprises a slider 4225. The slider 4225 is a protrusion on the sliding end 4226. The slider 4225 is inserted within the sliding slot 4222 and may slide along the sliding slot 4222. Therefore, the driving wheel 4221, the cleaning substrate 4221, the slider 4225 and the sliding slot 4222 constitute the crank slider mechanism.

[0106] When the driving wheel 4212 rotates, the point A swivels along a circular path. Correspondingly, the swiveling end 4227 of the cleaning substrate 4221 follows the point A to swivel along a circular path; and the slider 4225 also slides in the sliding slot 4222 to reciprocate linearly. As a result, the cleaning substrate 4221 starts to reciprocate. According to some embodiments, the sliding slot 4222 is approximately perpendicular to the moving direction of the mobile platform. Therefore, the linear motion of the sliding end 4226 includes a component perpendicular to the target direction, and the circular swiveling motion of the swiveling end 4227 comprises both a component perpendicular to the target direction and a component parallel to the target direction.

[0107] In Fig. 14, the moving speed of the mobile platform is V_0 , and a moving direction thereof is the target direction; and the sliding slot 4222 is approximately perpendicular to the target direction. At this point, the entire reciprocating motion of the cleaning substrate 4221 in-

cludes both a movement component parallel to the target direction of the automatic cleaning apparatus and a movement component perpendicular to the target direction of the automatic cleaning apparatus.

[0108] Further, the supporting platform 422 further comprises: an elastic detaching button 4229 disposed on at least one side of the supporting platform 422 for detachably connecting the supporting platform 422 to a pawl 4216 of the driving platform 421, so that the supporting platform 422 is detachably and mechanically fixed on the driving platform 421, and the supporting platform 422 itself is fixed relative to the driving platform and the automatic cleaning apparatus; and at least one assembling region 4224 disposed on the supporting platform 422 for assembling the cleaning head 410. The assembling region 4224 may be formed of an adhesive material with an adhesive layer.

[0109] As an alternative embodiment of the present disclosure, as shown in Fig. 9, the cleaning head 410 comprises a movable region 412 connected to the cleaning substrate 4221 and substantially reciprocating along a surface to be cleaned under the driving of the cleaning substrate 4221. The movable region 412 is disposed at a substantially central position of the cleaning head 410.

[0110] Optionally, a side of the movable region 412 connected to the cleaning substrate 4221 is provided with an adhesive layer, and the movable region 412 is connected to the cleaning substrate 4221 through the adhesive layer.

[0111] Optionally, the cleaning head 410 further comprises: a fixed region 411 connected to a bottom of the supporting platform 422 through the at least one assembling region 4224. The fixed region 411 cleans at least a part of the operating surface along with the movement of the supporting platform 422.

[0112] Further, the cleaning head 410 further comprises: a flexible connecting portion 413 disposed between the fixed region 411 and the movable region 412 for connecting the fixed region 411 and the movable region 412. The cleaning head 410 further comprises: a sliding buckle 414 extending along an edge of the cleaning head 410 and detachably mounted at an engagement position 4225 of the supporting platform 422.

[0113] In this embodiment, as shown in Fig. 9, the cleaning head 410 may be made of a material having a certain elasticity, and the cleaning head 410 is fixed on the surface of the supporting platform 422 through an adhesive layer so as to reciprocate. When operating, the cleaning head 410 is always in contact with the surface to be cleaned.

[0114] The water delivery mechanism comprises a water discharging device 4217. The water discharging device 4217 may be directly or indirectly connected with a cleaning liquid outlet of a water tank (not shown), that is, a liquid discharging port of the clean water tank. A cleaning liquid may flow toward the water discharging device 4217 via the cleaning liquid outlet of the water tank, and may be evenly coated on the surface to be cleaned

through the water discharging device. A connecting member (not shown in the figures) may be provided on the water discharging device, and the water discharging device is connected to the cleaning liquid outlet of the water tank through the connecting member. The water discharging device is provided with a distributing port. The distributing port may be a continuous opening, or a combination of several discontinuous small openings. Several nozzles may be provided at the distributing port. The cleaning liquid flows toward the distributing port via the cleaning liquid outlet of the water tank and the connecting member of the water discharging device, and is evenly coated on the operating surface via the distributing port.

[0115] The water delivery mechanism may also comprise a clean water pump 4219 and/or a clean water pump pipe 4218. The clean water pump 4219 may be communicated with the cleaning liquid outlet of the water tank directly or communicated with the cleaning liquid outlet of the water tank through the clean water pump pipe 4218.

[0116] The clean water pump 4219 may be connected to the connecting member of the water discharging device, and may be configured to pump the cleaning fluid from the water tank to the water discharging device. The clean water pump may be a gear pump, a vane pump, a plunger pump, a peristaltic pump, and the like.

[0117] The water delivery mechanism draws the cleaning liquid out of the clean water tank through the clean water pump 4219 and the clean water pump pipe 4218, and transports the cleaning liquid to the water discharging device. The water discharging device 4217 may be a sprinkler head, a drip hole, a wet cloth, and the like, and may spread water evenly on the cleaning head so as to wet the cleaning head and the surface to be cleaned. Stains on the wetted surface to be cleaned may be cleaned more easily. In the wet cleaning module 400, the power/flow rate of the clean water pump may be adjusted.

[0118] Further, as shown in Fig. 17, the motor 4211 drives the clean water pump 4219 to wriggle through a gear set 42193. Through the wriggle of the clean water pump 4219, the clean water enters from a water inlet 42191, flows out from a water outlet 42192, and is transported to the water discharging device 4217 through the clean water pump pipe 4218, and the water flowing out from the water discharging device 4217 flows to the cleaning head 410 via the water discharging hole.

[0119] Furthermore, as shown in Fig. 18, the motor 4211 drives a cable gear 42196 to rotate through the gear set 42193. A cable 42194 is wound on the cable gear 42196. The cable 42194 is wound and suspended on the driving platform 421. The cable gear 42196 pulls the cable 42194 to rise and drop so as to lift and lower the driving platform 421. The cable gear 42196 and the cable 42194 are core components of a lifting and lowering module.

[0120] A clutch 42195 is provided on the gear set 42193 and the cable gear 42196, which comprises a

spring and a sheet. By controlling engagement and disengagement of the clutch 42195, the motor 4211 controls three moving modules to rotate in one direction to drive the vibrating member to vibrate and simultaneously make the clean water pump 4219 supply water; and to rotate in opposite directions to drive the lifting and lowering module to rise and drop through the cable 42194. Optionally, the combined design of the gear set realizes the control on different combinations of the three moving modules. For example, rotation in one direction realizes that the clean water pump supplies water, and rotation in the opposite directions realizes the control on rising, dropping and vibration. Optionally, two motors may also be used to control the three moving modules, but an extra motor will also increase the cost.

[0121] Since the cleaning module of the automatic cleaning apparatus includes the dry cleaning module and the wet cleaning module, a more comprehensive cleaning function may be provided. Meanwhile, the driving unit and a vibrating region are added to the wet cleaning module, and thus the cleaning head may reciprocate so as to repeatedly clean the surface to be cleaned. Therefore, in the movement trajectory of a cleaning robot, a region may be cleaned several times when the cleaning robot passes through the region just one time, thereby greatly enhancing the cleaning effect, especially for regions with more stains, the cleaning effect is obvious.

[0122] As shown in Figs. 19-20, the wet cleaning module 400 is movably connected to the mobile platform 100 through a four-link lifting and lowering structure 500, and is configured to clean at least a part of the operating surface by means of wet cleaning. The four-link lifting and lowering structure 500 is a parallelogram structure and used to switch the wet cleaning module 400 between a lifting state and a lowering state. The lifting state is a state in which the wet cleaning module 400 leaves the operating surface, as shown in Fig. 19; and the lowering state is a state in which the wet cleaning module 400 is attached to the operating surface, as shown in Fig. 20.

[0123] As shown in Figs. 21-22, the four-link lifting and lowering structure 500 comprises: a first connecting end 501 and a second connecting end 502, which are located at two sides of the wet cleaning module 400, respectively, and configured to move the wet cleaning module 400 vertically relative to the mobile platform 100 and the operating surface in response to an obstacle on or undulation of the operating surface.

[0124] Preferably, the first connecting end 501 can provide active power to switch the wet cleaning module 400 between the lifting state and the lowering state; and the second connecting end 502 is disposed opposite to the first connecting end 501 and rotated under the action of the active power. The first connecting end 501 and the second connecting end 502 are located at two sides of the wet cleaning module 400, respectively, and the wet cleaning module 400 is lifted or lowered by stably providing a lifting force or a lowering force.

[0125] Specifically, the first connecting end 501 com-

prises a first bracket 5011 fixedly connected to a bottom of the mobile platform 100. The first bracket 5011 is roughly shaped like a Chinese character "JL", and the first bracket 5011 includes: a cross beam 50111, a first longitudinal beam 50114 and a second longitudinal beam 50115. A tail end of each of the first longitudinal beam 50114 and the second longitudinal beam 50115 is fixedly connected to the mobile platform 100 and the wet cleaning module 400 through a bolt, so as to provide a supporting force when the wet cleaning module 400 is lifted and lowered.

[0126] The first connecting end 501 further includes a first connecting rod pair 5012. One end of the first connecting rod pair 5012 is rotatably connected to the first bracket 5011, and the other end thereof is rotatably connected to the wet cleaning module 400. The first connecting rod pair 5012 may be of a hollowed-out structure, which can reduce overall weight of lifting ends and lowering ends.

[0127] Optionally, the first connecting rod pair 5012 comprises a first connecting rod 50121 and a second connecting rod 50122 which are arranged in parallel. A first end of each of the first connecting rod 50121 and the second connecting rod 50122 is rotatably connected to the first longitudinal beam 50114 through a movable stud, and a second end of each of the first connecting rod 50121 and the second connecting rod 50122 is rotatably connected to the wet cleaning module 400 through a movable stud. For example, each of two ends of each of the first connecting rod 50121 and the second connecting rod 50122 is provided with a through hole having a diameter larger than that of the movable stud, so that the movable stud may rotate freely within the through hole, and the movable stud is fixedly connected to the first longitudinal beam 50114 through the through hole. When the motor 50131 provides a pulling force to the second end through the cable, the first ends of the first connecting rod 50121 and the second connecting rod 50122 simultaneously rotate around the movable studs at the first ends, and the second ends thereof are lifted under the pulling force of the cable, so that the wet cleaning module 400 is lifted. When the motor 4211 releases the pulling force to the second end through the cable, the first ends of the first connecting rod 50121 and the second connecting rod 50122 simultaneously reversely rotate around the movable studs at the first ends, and the second ends thereof are lowered under the action of gravity, so that the wet cleaning module 400 is lowered.

[0128] The lifting and lowering structure 500 further comprises a cable 42194 for providing a pulling force to rotate the first connecting rod pair 5012 within a preset angle. The cable 42194 comprises: a cable motor terminal 50131 connected to the driving unit 420, for example, wound on and connected to the gear connected to the motor output shaft, and extending and contracting under the rotation of the motor; and a cable bracket terminal 50132 connected to the first bracket 5011. The motor lifts or lowers the second ends of the

first connecting rod 50121 and the second connecting rod 50122 through the cable 42194.

[0129] Optionally, the first bracket 5011 further comprises: a sliding slot 50112 extending along a surface of the cross beam 50111; and a snapping hole 50113 running through the cross beam 50111 and disposed at an extended end of the sliding slot 50112 for accommodating and snapping the cable bracket terminal 50132. The cable 42194 is connected to the second ends of the first connecting rod 50121 and the second connecting rod 50122 through the sliding slot 50112 and the snapping hole 50113. The sliding slot 50112 may restrict a movement direction of the cable, thereby ensuring the stability during lifting and lowering the module, and the width of the sliding slot should be matched with the thickness of the cable.

[0130] As shown in Fig. 23, the second connecting end 502 comprises: a second bracket 5021 fixedly connected to a bottom of the mobile platform 100; and a second connecting rod pair 5022, one end of which is rotatably connected to the second bracket 5021, and the other end of which is rotatably connected to the wet cleaning module 400. The second connecting rod pair 5022 rotates with the rotation of the first connecting rod pair 5012. The second connecting rod pair 5022 may be of a hollowed-out structure, which can reduce overall weight of lifting ends and lowering ends.

[0131] Specifically, the second connecting rod pair 5022 comprises a third connecting rod 50221 and a fourth connecting rod 50222 which are arranged in parallel. A first end of each of the third connecting rod 50221 and the fourth connecting rod 50222 is rotatably connected to the second bracket 5021 through a movable stud, and a second end of each of the third connecting rod 50221 and the fourth connecting rod 50222 is rotatably connected to the wet cleaning module 400 through a movable stud. For example, each of two ends of each of the third connecting rod 50221 and the fourth connecting rod 50222 is provided with a snapping hole having a diameter larger than that of the movable stud, so that the movable stud may rotate freely within the snapping hole, and the movable stud is fixedly connected to the second bracket 5021 through the snapping hole. When the first connecting end 501 rotates under the driving of the motor 50131, the first ends of the third connecting rod 50221 and the fourth connecting rod 50222 simultaneously rotate around the movable studs at the first ends, and the second ends of the third connecting rod 50221 and the fourth connecting rod 50222 simultaneously rotate around the movable studs at the second ends, so that the wet cleaning module 400 is lifted. When the pulling force to the first connecting end 501 is released, the first ends of the third connecting rod 50221 and the fourth connecting rod 50222 simultaneously reversely rotate around the movable studs at the first ends, and the second ends thereof are lowered under the action of gravity, so that the wet cleaning module 400 is lowered.

[0132] By means of the four-link lifting and lowering

structure disposed between the wet cleaning module and the mobile platform, the wet cleaning module may be lifted and lowered relative to the mobile platform. When a mopping task is performed, the wet cleaning module is lowered, so that the wet cleaning module is in contact with the ground, and when the mopping task is completed, the wet cleaning module is lifted, so that the wet cleaning module is separated from the ground, thereby avoiding the increased resistance due to the existence of the cleaning module when the cleaning apparatus moves freely on the surface to be cleaned.

[0133] In cooperation with a surface medium sensor and other sensors that may detect a surface type of the surface to be cleaned, the lifting and lowering module enables the wet cleaning module to perform a cleaning operation according to different surfaces to be cleaned. For example, the lifting and lowering module lifts the wet cleaning module in case of a carpet surface, and lowers the wet cleaning module in case of a floor surface, a floor tile surface or the like, for cleaning. Thus, a more comprehensive cleaning effect is achieved.

[0134] As shown in Fig. 24, which is a diagram of the dry cleaning module 151 in a lowering state, a floating lifting and lowering structure 600 is connected to the dry cleaning module 151 and configured to enable the dry cleaning module 151 to be move vertically relative to the mobile platform 100. Specifically, the floating lifting and lowering structure 600 is a parallelogram four-link lifting and lowering structure, and is configured to passively switch the dry cleaning module 151 between a lifting state and a lowering state under the action of an external force.

[0135] Optionally, the floating lifting and lowering structure 600 comprises: a first fixed bracket 601 fixedly connected to the mobile platform 100; a second fixed bracket 602 fixedly connected to the dry cleaning module 151; and a connecting rod pair 603, one end of which is rotatably connected to the first fixed bracket 601 through a movable stud, and the other end of which is rotatably connected to the second fixed bracket 602 through a movable stud. The first fixed bracket 601 and the second fixed bracket 602 are connected through a flexible connecting member. When encountering an obstacle, the dry cleaning module 151 is pushed upward, and the first fixed bracket 601 rotates around the connecting rod pair 603 and then is retracted upward relative to the second fixed bracket 602, so as to realize passive lifting. After passing the obstacle, the dry cleaning module 151 falls under the action of gravity and comes into contact with the operating surface, and the cleaning apparatus continues to move forward for the cleaning. With the parallelogram four-link lifting and lowering structure, the cleaning apparatus can pass obstacles and thus is more flexible and less liable to damage.

[0136] Optionally, the connecting rod pair 603 comprises: a first connecting rod pair 6031, one end of which is rotatably connected to a first end of the first fixed bracket 601 through a movable stud, and the other end of which is rotatably connected to a first end of the second fixed

bracket 602 through a movable stud; and a second connecting rod pair 6032 disposed opposite to the first connecting rod pair 6031, one end of which is rotatably connected to a second end of the first fixed bracket 601 through a movable stud, and the other end of which is rotatably connected to a second end of the second fixed bracket 602 through a movable stud. The first connecting rod pair 6031 or the second connecting rod pair 6032 may be of a hollowed-out structure, which can reduce overall weight of lifting ends and lowering ends.

[0137] Optionally, the first connecting rod pair 6031 comprises a first connecting rod 60311 and a second connecting rod 60312 which are arranged in parallel. One end of each of the first connecting rod 60311 and the second connecting rod 60312 is provided with a first shaft hole, and the other end thereof is provided with a second shaft hole. The movable studs rotatably fix the first connecting rod 60311 and the second connecting rod 60312 to the first end of the first fixed bracket 601 through the first shaft holes, and the movable studs rotatably fix the first connecting rod 60311 and the second connecting rod 60312 to the first end of the second fixed bracket 602 through the second shaft holes. For example, each of two ends of each of the first connecting rod 60311 and the second connecting rod 60312 is provided with a snapping hole (not shown) having a diameter larger than that of the movable stud, so that the movable stud may rotate freely within the snapping hole, and the movable stud is fixedly connected to the first fixed bracket 601 through the snapping hole. When encountering a raised obstacle, the dry cleaning module 151 is pushed upward under the action of the obstacle, the first ends of the first connecting rod 60311 and the second connecting rod 60312 simultaneously rotate around the movable studs at the first ends, and the second ends of the first connecting rod 60311 and the second connecting rod 60312 simultaneously rotate around the movable studs at the second ends, so that the dry cleaning module 151 is lifted. When passing the obstacle, the dry cleaning module 151 falls under the action of gravity and comes into contact with the operating surface.

[0138] Optionally, as shown in Fig. 25, which is a diagram of the dry cleaning module 151 in a lifting state, the second connecting rod pair 6032 includes a third connecting rod 60321 and a fourth connecting rod 60322 which are arranged in parallel. One end of each of the third connecting rod 60321 and the fourth connecting rod 60322 is provided with a third shaft hole, and the other end thereof is provided with a fourth shaft hole. The movable studs rotatably fix the third connecting rod 60321 and the fourth connecting rod 60322 to the second end of the first fixed bracket 601 through the third shaft holes, and the movable studs rotatably fix the third connecting rod 60321 and the fourth connecting rod 60322 to the second end of the second fixed bracket 602 through the fourth shaft holes. For example, each of two ends of each of the third connecting rod 60321 and the fourth connecting rod 60322 is provided with a snapping hole (not

shown) having a diameter larger than that of the movable stud, so that the movable stud may rotate freely within the snapping hole, and the movable stud is fixedly connected to the first fixed bracket 601 through the snapping hole. When encountering a raised obstacle, the dry cleaning module 151 is pushed upward under the action of the obstacle, the first ends of the third connecting rod 60321 and the fourth connecting rod 60322 simultaneously rotate around the movable studs at the first ends, and the second ends of the third connecting rod 60321 and the fourth connecting rod 60322 simultaneously rotate around the movable studs at the second ends, so that the dry cleaning module 151 is lifted. When passing the obstacle, the dry cleaning module 151 falls under the action of gravity and comes into contact with the operating surface.

[0139] As an alternative embodiment, the first fixed bracket 601 comprises: a first fixed portion 6011 protruding from the first fixed bracket 601 and extending laterally outward for carrying the first connecting rod pair 6031; and a second fixed portion 6012 disposed symmetrically with the first fixed portion 6011 for carrying the second connecting rod pair 6032. The first fixed portion 6011 and the second fixed portion 6012 are used to protrude and support the connecting rod pairs, so that the connecting rod pairs may rotate freely, thereby ensuring the free lifting and lowering of the dry cleaning module 151.

[0140] Optionally, the floating lifting and lowering structure 600 further comprises a flexible connecting member (not shown) connected between the first fixed bracket 601 and the second fixed bracket 602. When the operating surface is uneven, the second fixed bracket 602 moves vertically relative to the first fixed bracket 601 through the flexible connecting member.

[0141] In the dry cleaning module, the four-link floating lifting and lowering structure is provided, so that the dry cleaning module is moved vertically relative to the mobile platform. When encountering an obstacle during operation, the cleaning apparatus can easily pass the obstacle through the four-link floating lifting and lowering structure, thereby avoiding the damage to the cleaning apparatus by the obstacle.

[0142] Optionally, the wet cleaning module 400 may also, together with the dry cleaning module 151, be directly connected to the floating lifting and lowering structure 600 (not shown), which is configured to enable the wet cleaning module 400 and the dry cleaning module 151 to passively move vertically simultaneously with respect to the mobile platform 100. Further optionally, the floating lifting and lowering structure comprises a first fixed bracket and a second fixed bracket, which are movably connected, and passively switch the wet cleaning module 400 and the dry cleaning module 151 between the lifting state and the lowering state under the action of external force. Further optionally, with the four-link floating lifting and lowering structure mentioned above, the floating lifting and lowering structure can easily pass over the obstacle by means of the four-link floating lifting

and lowering structure when the cleaning apparatus encounters the obstacle in the operation process, thereby avoiding the damage to the cleaning apparatus by the obstacle.

Embodiment 2

[0143] According to a specific embodiment of the present disclosure, as shown in Fig. 9, the present disclosure provides an automatic cleaning apparatus. The present embodiment inherits the above embodiment, and the same structure has the same function and technical effect, which will not be repeated here. Specifically, the cleaning apparatus comprises: a mobile platform 100 configured to automatically move on an operating surface; and a cleaning module 150 disposed on the mobile platform 100 and comprising: a wet cleaning module 400 configured to clean at least a part of the operating surface by means of wet cleaning; a lifting and lowering structure 500 connected to the wet cleaning module 400 and configured to enable the wet cleaning module 400 to move vertically relative to the mobile platform 100; and a driving mechanism 900 connected to the lifting and lowering structure 500 and configured to provide power for the lifting and lowering of the lifting and lowering structure 500, and/or provide cleaning liquid for the wet cleaning module 400.

[0144] As an alternative embodiment, as shown in Fig. 26, the driving mechanism 900 comprises: a motor 4211 for providing driving force for forward rotation and reverse rotation; and a gear set 42193 connected to an output shaft of the motor 4211 for outputting the driving force of the motor 4211 for forward rotation and reverse rotation.

[0145] Optionally, the driving mechanism 900 further comprises: a clutch 42195 in mesh connection with the gear set 42193, wherein the clutch 42195 provides driving force when the clutch 42195 is engaged with the gear set 42193 in a reverse direction, and provides no driving force when the clutch 42195 is not engaged with the gear set 42193 in a forward direction. The clutch 42195 comprises a first clutch gear 421951 and a second clutch gear 421952 which are disposed oppositely back to back, wherein the second clutch gear 421952 has teeth which are arranged at an inclined angle, which is not limited, in a counterclockwise direction, so as to provide driving force when the second clutch gear 421952 is engaged with the gear set 42193 in the reverse direction, and provide no driving force due to slippage when the second clutch gear 421952 is not engaged with the gear set 42193 in the forward direction.

[0146] As an alternative embodiment, the driving mechanism 900 further comprises a cable gear 42196 which is meshed with the first clutch gear 421951 and rotates under the driving of the first clutch gear 421951. A cable 42194, one end of which is wound around the cable gear 42196, and the other end of which is connected to the lifting and lowering structure 500 and pulls the lifting and lowering structure 500 vertically under the driv-

ing of the gear set 42193.

[0147] As an alternative embodiment, the driving mechanism 900 further comprises a clean water pump 4219, which is meshed with the gear set 42193, and provides cleaning liquid for the wet cleaning module 400 under the driving of the gear set 42193. In an embodiment, for example, the clean water pump creeps to squeeze the water pipe under the clean water pump, and squeezes the water out of the water tank from the water pipe.

[0148] As an alternative embodiment, the gear set 42193 comprises: a first-stage drive gear 421931 connected with an output shaft of the motor 4211 for outputting driving force of the motor; a second-stage drive gear 421932 meshed with the first-stage drive gear 421931 for outputting the driving force of the motor to the cable gear 42196; and a third-stage drive gear 421933 meshed with the second-stage drive gear 421932 for outputting the driving force of the motor to the clean water pump 4219. Optionally, the output shaft of the motor 4211 comprises an output gear 42111, which is meshed with the first-stage drive gear 421931 for outputting the driving force of the motor.

[0149] As an alternative embodiment, the driving mechanism 900 further comprises: a driving wheel 4212 connected with the output shaft of the motor, and having an asymmetric structure; and a vibrating member 4213, which is connected with the driving wheel 4212, and reciprocates under the asymmetric rotation of the driving wheel 4212.

[0150] With the sweeping and mopping integrated cleaning apparatus provided by the present disclosure, the motor 4211 simultaneously transmits power to the cleaning head 410, the driving platform 421, the supporting platform 422, the water delivery mechanism, the water tank, etc. through the power transmission device. The energy system 160 provides power and energy 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, and a belt drive, and may also be a worm gear, etc., such as the driving structure 900 and its related structures described in the present embodiment.

[0151] The motor 4211 comprises a forward output mode in which the motor 4211 rotates forward and a reverse output mode in which the motor 4211 rotates rearward. In the forward output mode of the motor 4211, the motor 4211 may simultaneously drive the cleaning head 410 in the wet cleaning assembly 400 and the water delivery mechanism to operate synchronously. Wherein, the driving mechanism is connected with the lifting and lowering structure; by setting the cooperation of the clutch, gear set, and etc., when the motor rotates forward, the motor drives the vibration output shaft to rotate so as to drive the vibrating member to vibrate, thereby achieving roughly reciprocating motion and achieving repeated cleaning of the ground; at the same time, the clean water pump creeps to discharge water synchronously through

driven by the gear set, and at this time, the clutch teeth are in a slipping state and do not drive, so the lifting and lowering mechanism cannot be lifted; when the motor rotates rearward, the clutch teeth are in the working state, which drives the lifting and lowering turntable to lift, and when the lifting is in place, the cable is tightened, and at this time, the motor stops due to position limiting, and both the vibration output and the clean water pump stop working; at this time, the mopping function is stopped and the mopping module is lifted. Therefore, the disclosed cleaning apparatus can coordinately control the water outlet of the clean water pump, the lifting and lowering of the lifting and lowering mechanism and the vibration of the vibrating member, thus improving the working efficiency.

[0152] Optionally, more than one driving components can be used to respectively control the wet cleaning module, the cleaning liquid module and the lifting and lowering structure. Although such a control method increases the cost to a certain extent, it is flexible in discrete control, and flexible and changeable working cooperation modes can be set according to the requirements of actual working scene. For example, after the lifting and lowering structure completes the lowering, spray the cleaning liquid for a period of time and then start the vibration wiping work of the wet cleaning module, which can reduce dry wiping to a certain extent and prolong the service life of the vibration module. The specific discrete control mode is as follows:

Embodiment 3

[0153] According to a specific embodiment of the present disclosure, as shown in Fig. 9, the present disclosure provides an automatic cleaning apparatus. The present embodiment inherits the above embodiment, and the same structure has the same function and technical effect, which will not be repeated here. Specifically, the cleaning apparatus comprises: a mobile platform 100 configured to automatically move on an operating surface; cleaning module 150 disposed on the mobile platform 100 and comprising: a wet cleaning module 400 configured to clean at least a part of the operating surface by means of wet cleaning; a cleaning liquid module for providing cleaning liquid for the wet cleaning module 400; a lifting and lowering structure 500 connected with the wet cleaning module 400 and configured to enable the wet cleaning module 400 to move vertically relative to the mobile platform 100; a driving mechanism 900 comprising a first driving component 901 and a second driving component 902, wherein: the first driving component 901 is configured to be capable of providing power for at least one of the wet cleaning module 400, the lifting and lowering structure 500 and the cleaning liquid module; the second driving component 902 is configured to be capable of providing power for at least one of the following that is/are not connected with the first driving component 901: the wet cleaning module 400, the lifting and lowering

structure 500 and the cleaning liquid module.

[0154] In one embodiment of the present disclosure, as shown in Fig. 27, the first driving component 901 is a motor, which is connected with the wet cleaning module 400 through the output gear 42111 and drives the wet cleaning module 400 to perform cleaning operation; at the same time, the first driving component 901 is connected with the clean water pump 4219 through the gear set and the third-stage drive gear 421933, and drives the clean water pump 4219 to provide power for the cleaning liquid module.

[0155] At this time, the second driving component 902 can be directly connected with the lifting and lowering structure 500.

[0156] When started, the first driving component 901 drives the wet cleaning module 400 and the cleaning liquid module to work simultaneously; the second driving component 902 can control the lifting and lowering structure 500 according to a signal automatically sensed by the perception system 120 or a signal sent by the human-computer interaction system 170, so as to further realize the lifting and lowering of the wet cleaning module.

[0157] In one embodiment of the present disclosure, as shown in Fig. 28, the first driving component 901 is a motor, which is connected with the wet cleaning module 400 through the output gear 42111 and drives the wet cleaning module 400 to perform cleaning operation; at the same time, the driving mechanism 900 further comprises a clutch 42195 and a cable gear 42196, the first driving component 901 is connected with the clutch 42195 through a gear set, the clutch 42195 is meshed with the cable gear 42196 and rotates under the driving of the clutch 42195. A cable 42194, one end of which is wound around the cable gear 42196, and the other end of which is connected to the lifting and lowering structure 500 and pulls the lifting and lowering structure 500 vertically under the driving of the gear set 42193.

[0158] At this time, the second driving component 902 can be directly connected with the cleaning liquid module and directly control the cleaning liquid module to provide cleaning liquid for the wet cleaning module 400.

[0159] When the first driving component 901 starts to rotate in the forward direction, it drives the wet cleaning module 400 to work, and at this time, under the action of the clutch 42195, the cable gear 42196 does not rotate, so that the cable 42194 is loosened, thereby lowering the lifting and lowering structure 500; when the first driving component 901 starts to rotate in the reverse direction, the wet cleaning module 400 does not work, and at this time, under the action of the clutch 42195, the cable gear 42196 rotates, so that the cable 42194 is pulled in, thereby lifting the lifting and lowering structure 500.

[0160] The second driving component 902 can control the cleaning liquid module according to a signal automatically sensed by the perception system 120 or a signal sent by the human-computer interaction system 170, and decide whether to continue to control the cleaning liquid module to provide cleaning liquid for the wet cleaning

module 400 according to the working condition of the automatic cleaning apparatus.

[0161] In one embodiment of the present disclosure, as shown in Fig. 29, the first driving component 901 is a motor, which is connected with the cable gear 42196 through the clutch 42195; at the same time, the first driving component 901 is connected with the clean water pump 4219 through the gear set and the third-stage drive gear 421933, and drives the clean water pump 4219 to provide power for the cleaning liquid module. The first driving component 901 is connected with the clutch 42195 through the gear set, the clutch 42195 is meshed with the cable gear 42196 and rotates under the driving of the clutch 42195. A cable 42194, one end of which is wound around the cable gear 42196, and the other end of which is connected to the lifting and lowering structure 500 and pulls the lifting and lowering structure 500 vertically under the driving of the gear set 42193.

[0162] At this time, the second driving component 902 can be directly connected with the wet cleaning module 400 and directly control the wet cleaning module 400 to work.

[0163] When the second driving component 902 works, the wet cleaning module 400 enters the working state; the coordinated working state of the first driving component 901 and the second driving component 902 can be determined according to the signal automatically sensed by the perception system 120 or the signal sent by the human-computer interaction system 170. When the first driving component 901 starts to rotate in the forward direction, it drives the cleaning liquid module to work to provide cleaning liquid for the wet cleaning module 400, and at this time, under the action of the clutch 42195, the cable gear 42196 does not rotate, so that the cable 42194 is loosened, thereby lowering the lifting and lowering structure 500 and making the second driving component 902 enter the working state after the lowering; when the first driving component 901 starts to rotate in the reverse direction, the cleaning liquid module doesn't work, and at this time, under the action of the clutch 42195, the cable gear 42196 rotates, so that the cable 42194 is pulled in, thereby lifting the lifting and lowering structure 500. At this time, generally, the second driving component 902 is also in a non-working state.

[0164] In one embodiment of the present disclosure, as shown in Fig. 30, the first driving component 901 is a motor, which is connected with the cable gear 42196 through the clutch 42195; the second driving component 902 is an air pump, which does not need to output power through a gear structure, and can be directly connected with the cleaning liquid module and control the cleaning liquid module to provide cleaning liquid for the wet cleaning module 400.

[0165] In one embodiment of the present disclosure, as shown in Fig. 31, the driving assembly 900 comprises a first driving component 901, a second driving component 902 and a third driving component 903; the first driving component 901 is connected with the wet cleaning

module 400 for controlling the work of the wet cleaning module 400, and the second driving component 902 is connected with the cleaning liquid module for controlling the work of the cleaning liquid module, and the third driving component 903 is connected with the lifting and lowering structure 500 for controlling the work of the lifting and lowering structure 500.

[0166] The first driving component 901, the second driving component 902 and the third driving component 903 can respectively control their respective working states according to the signal automatically sensed by the perception system 120 or the signal sent by the human-computer interaction system 170, and dynamically adjust their respective working values such as startup, shutdown, power and the like based on the use environment, user commands, cleaning types, stain intensity and the like, so as to better complete the cleaning work.

Embodiment 4

[0167] In one embodiment of the present disclosure, an automatic cleaning apparatus comprises:

- a mobile platform 100 configured to automatically move on an operating surface;
- a cleaning module 150 disposed on the mobile platform 100 and comprising:

- a wet cleaning module 400 configured to clean at least a part of the operating surface by means of wet cleaning;
- a lifting and lowering structure 500 connected with the wet cleaning module 400, configured to move the wet cleaning module 400 vertically relative to the mobile platform 100 and the operating surface in response to an obstacle or undulation on the operating surface;
- wherein the wet cleaning module 400 comprises a cleaning head 410 for cleaning the operating surface, and a driving unit 420 for driving the cleaning head 410 to reciprocate along a target surface, which is a part of the operating surface.

[0168] Finally, it should be noted that in this specification, each embodiment is described in a progressive manner, each embodiment focuses on the differences from other embodiments, and the same or similar parts among the various embodiments may refer to one another. For the system or device disclosed in the embodiments, since it corresponds to the method disclosed in the embodiments, the description is relatively simple, and the relevant parts may refer to the description of the method section.

[0169] The above embodiments are only used to illustrate the technical solutions of the present disclosure and are not intended to limit the present invention. Although the present disclosure has been described in detail with reference to the foregoing embodiments, those of ordi-

nary skills in the art should understand that it is still possible to modify the technical solutions set forth in the foregoing embodiments, or equivalently replace some technical features thereof; however, these modifications or substitutions do not make the essence of the corresponding technical solutions deviate from the spirit and scope of the technical solutions of each embodiment of the present disclosure.

Claims

1. An automatic cleaning apparatus, comprising:

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

a wet cleaning module (400) configured to clean at least a part of the operating surface by means of wet cleaning;
a lifting and lowering structure (500) connected with the wet cleaning module (400) and configured to enable the wet cleaning module (400) to move vertically relative to the mobile platform (100);
a cleaning liquid module for providing cleaning liquid for the wet cleaning module (400);

a driving mechanism (900) comprising a first driving component (901) and a second driving component (902), wherein:

the first driving component (901) is configured to be capable of providing power for at least one of the wet cleaning module (400), the lifting and lowering structure (500) and the cleaning liquid module;
the second driving component (902) is configured to be capable of providing power for at least one of following that is not connected with the first driving component (901):
the wet cleaning module (400), the lifting and lowering structure (500) and the cleaning liquid module.

2. The automatic cleaning apparatus according to claim 1, wherein the driving mechanism (900) comprises:

at least two power structures (910), connected with the first driving component (901) and the second driving component (902) respectively for providing driving force.

3. The automatic cleaning apparatus according to claim 2, wherein the driving mechanism (900) further comprises:

a gear set (42193), connected to the power structure (910) and configured to output driving force for the first driving component (901) and/or the second driving component (902).

4. The automatic cleaning apparatus according to claim 3, wherein

a clutch (42195) is in mesh connection with the gear set (42193), provides driving force when the clutch (42195) is in reverse-direction engagement with the gear set (42193), and provides no driving force when the clutch (42195) is in forward-direction non-engagement with the gear set (42193).

5. The automatic cleaning apparatus according to claim 4, wherein the clutch (42195) comprises a first clutch gear (421951) and a second clutch gear (421952) disposed oppositely, and the second clutch gear (421952) has teeth arranged at an inclined angle in a counterclockwise direction, so as to provide driving force when the second clutch gear (421952) is in reverse-direction engagement with the gear set (42193), and provide no driving force when the second clutch gear (421952) is in forward-direction non-engagement with the gear set (42193).

6. The automatic cleaning apparatus according to claim 5, wherein the driving mechanism (900) further comprises:

a cable gear (42196), meshed with the first clutch gear (421951) and configured to rotate under the driving of the first clutch gear (421951).

7. The automatic cleaning apparatus according to claim 6, wherein the lifting and lowering structure (500) further comprises:

a cable (42194), provided with one end wound around the cable gear (42196) and the other end connected to the lifting and lowering structure (500), and configured to pull the lifting and lowering structure (500) vertically under the driving of the gear set (42193).

8. The automatic cleaning apparatus according to claim 2, wherein the power structure (910) is a motor (4211) configured to provide driving force for forward rotation and reverse rotation.

9. The automatic cleaning apparatus according to claim 2, wherein

the power structure (910) is a clean water pump (4219), configured to provide power for the cleaning liquid module and provide cleaning liquid for the wet cleaning module (400).

10. The automatic cleaning apparatus according to claim 9, wherein

the clean water pump (4219) is a peristaltic pump, is meshed with the gear set (42193) to provide power for the cleaning liquid module under the driving of the gear set (42193), and provides cleaning liquid for the wet cleaning module (400).

11. The automatic cleaning apparatus according to claim 9, wherein

the clean water pump (4219) is an air pump, configured to provide power for the cleaning liquid module and provide cleaning liquid for the wet cleaning module (400).

12. The automatic cleaning apparatus according to claim 1, wherein the driving mechanism (900) comprises a third driving component (903), and the first driving component (901), the second driving component (902) and the third driving component (903) are connected with the wet cleaning module (400), the lifting and lowering structure (500) and the cleaning liquid module, respectively.

13. An automatic cleaning apparatus, comprising:

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

a wet cleaning module (400) configured to clean at least a part of the operating surface by means of wet cleaning;
a lifting and lowering structure (500) connected with the wet cleaning module (400) and configured to move the wet cleaning module (400) vertically relative to the mobile platform (100) and the operating surface in response to an obstacle or undulation on the operating surface;

wherein the wet cleaning module (400) comprises a cleaning head (410) for cleaning the operating surface, and a driving unit (420) for driving the cleaning head (410) to reciprocate along a target surface, wherein the target surface is a part of the operating surface.

14. The automatic cleaning apparatus according to claim 13, wherein the lifting and lowering structure (500) is a parallelogram structure and comprises:

a first connecting end (501) and a second connecting end (502) disposed oppositely, wherein two ends of the first connecting end (501) and the second connecting end (502) are respectively connected with the mobile platform (110) and the wet cleaning module (400), and configured to move the wet cleaning module (400) vertically relative to the mobile platform (100) and the operating surface in response to the

obstacle or undulation on the operating surface.

15. The automatic cleaning apparatus according to claim 14, wherein the first connecting end (501) further comprises a first connecting rod pair (5012) provided with one end rotatably connected to the mobile platform (100) and the other end rotatably connected to the wet cleaning module (400); the first connecting rod pair (5012) comprises a first connecting rod (50121) and a second connecting rod (50122) disposed in parallel, wherein a first end of each of the first connecting rod (50121) and the second connecting rod (50122) is rotatably connected to the mobile platform (100) through a movable stud, and a second end of each of the first connecting rod (50121) and the second connecting rod (50122) is rotatably connected to the wet cleaning module (400) through a movable stud.

16. The automatic cleaning apparatus according to claim 15, wherein the first connecting end (501) comprises a first bracket (5011) fixedly connected to a bottom of the mobile platform (100); the first bracket (5011) comprises:

a cross beam (50111);
a sliding slot (50112) extending along a surface of the cross beam (50111); and
a snapping hole (50113) running through the cross beam (50111) and disposed at an extended end of the sliding slot (50112).

17. The automatic cleaning apparatus according to claim 16, wherein the lifting and lowering structure (500) further comprises a cable assembly (42194) for providing active power for the lifting and lowering structure (500) to rotate the first connecting rod pair (5012) within a preset angle, and the cable assembly (42194) comprises:

a cable motor terminal (50131) connected with the driving unit (420); and a cable bracket terminal (50132) connected with the first bracket (5011), wherein a motor lifts or lowers the second end of each of the first connecting rod (50121) and the second connecting rod (50122) through the cable (42194).

18. An automatic cleaning apparatus, comprising:

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

a dry cleaning module (151) configured to clean at least a part of the operating surface by means of dry cleaning;
a wet cleaning module (400) configured to

- clean at least a part of the operating surface by means of wet cleaning; wherein
- the wet cleaning module (400) comprises:
- 5 a cleaning head (410) for cleaning the operating surface; and
- a driving unit (420) for driving the cleaning head (410) to reciprocate substantially along a target surface, wherein a direction of the reciprocating is perpendicular to a direction of the mobile platform moves on the operating surface, and the target surface is a part of the operating surface.
- 10 15
19. The automatic cleaning apparatus according to claim 18, wherein the driving unit (420) comprises:
- a driving platform (421) connected to a bottom surface of the mobile platform (100) for providing a driving force;
- 20 a supporting platform (422) detachably connected to the driving platform (421) for supporting the cleaning head (410).
- 25
20. The automatic cleaning apparatus according to claim 19, wherein the driving platform (421) comprises:
- a motor (4211), disposed on a side of the driving platform (421) close to the mobile platform (100), and configured to output power by an output shaft of the motor; and
- 30 a driving wheel (4212) connected with the output shaft of the motor, and having an asymmetric structure.
- 35
21. The automatic cleaning apparatus according to claim 20, wherein the driving platform (421) further comprises:
- 40 a vibrating member (4213), disposed on a side of the driving platform (421) opposite to the motor (4211), connected with the driving wheel (4212), and configured to substantially reciprocate under asymmetric rotation of the driving wheel (4212).
- 45
22. The automatic cleaning apparatus according to claim 21, wherein the driving platform (421) further comprises:
- a connecting rod (4214), extending along an edge of the driving platform (421), and connecting the driving wheel (4212) with the vibrating member (4213) so that the vibrating member (4213) extends to a preset position.
- 50 55
23. An automatic cleaning apparatus, comprising:
- a mobile platform (100) configured to automatically move on an operating surface;
- ically move on an operating surface;
- a cleaning module (150) disposed on the mobile platform (100) and comprising:
- a wet cleaning module (400) configured to clean at least a part of the operating surface by means of wet cleaning; wherein the wet cleaning module (400) comprises:
- a cleaning head (410) for cleaning the operating surface; and
- a driving unit (420) for driving at least a part of the cleaning head (410) to reciprocate substantially along a target surface, wherein the target surface is a part of the operating surface, and a frequency of the reciprocating is more than 2000 times per minute.
24. The automatic cleaning apparatus according to claim 23, wherein the driving unit (420) comprises:
- a driving platform (421) connected to a bottom surface of the mobile platform (100) for providing a driving force, wherein the driving platform (421) comprises:
- a motor (4211), disposed on 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; and
- a driving wheel (4212) connected with the output shaft of the motor, and having an asymmetric structure.
25. The automatic cleaning apparatus according to claim 24, wherein the driving unit (420) comprises:
- a supporting platform (422) detachably connected to the driving platform (421) for supporting the cleaning head (410).
26. The automatic cleaning apparatus according to claim 24, wherein the driving platform (421) further comprises:
- a vibrating member (4213), disposed on a side of the driving platform (421) opposite to the motor (4211), connected with the driving wheel (4212), and configured to substantially reciprocate under asymmetric rotation of the driving wheel (4212).
27. The automatic cleaning apparatus according to claim 26, wherein the frequency of the reciprocating of the vibrating member (4213) is more than 2000 times per minute.

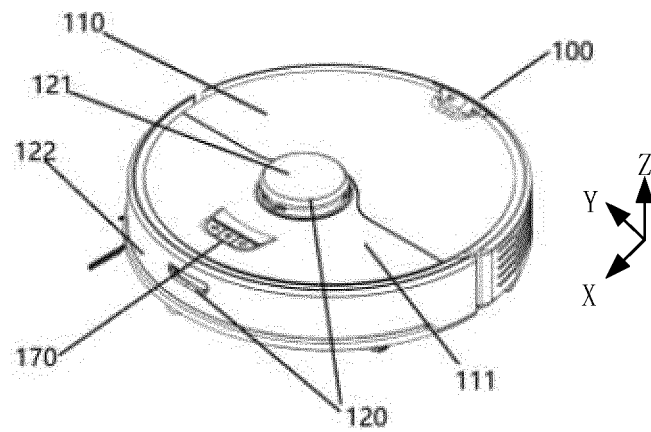


FIG. 1

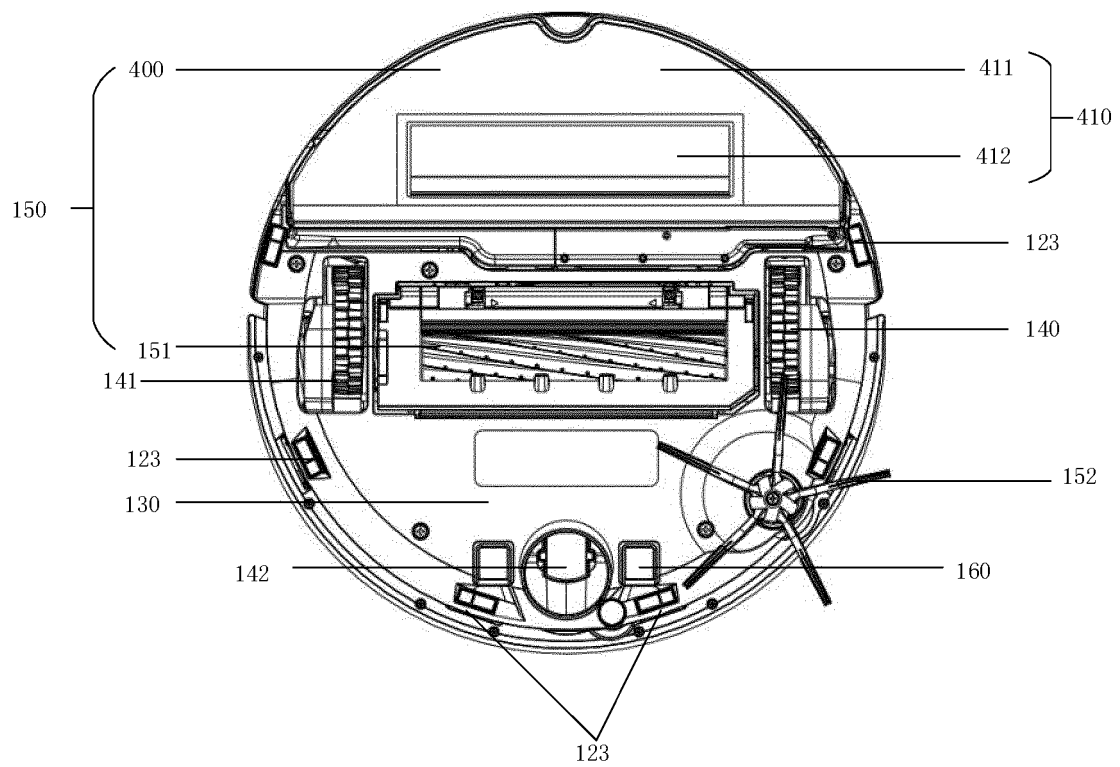


FIG. 2

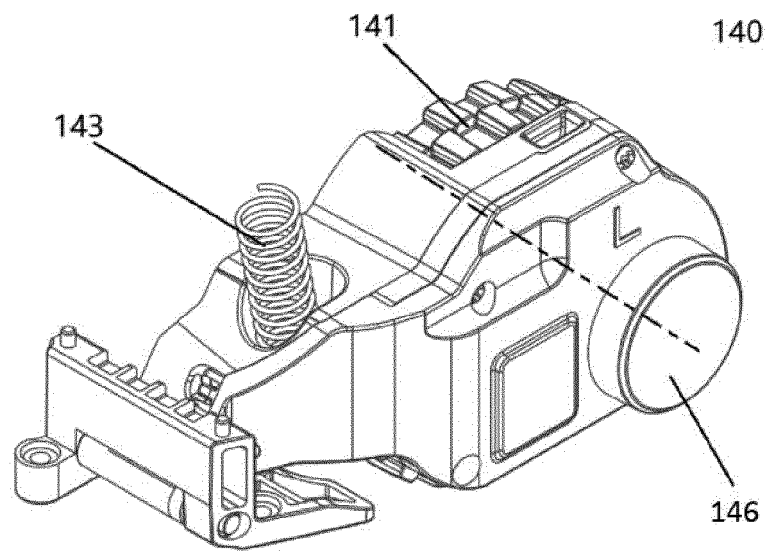


FIG. 3

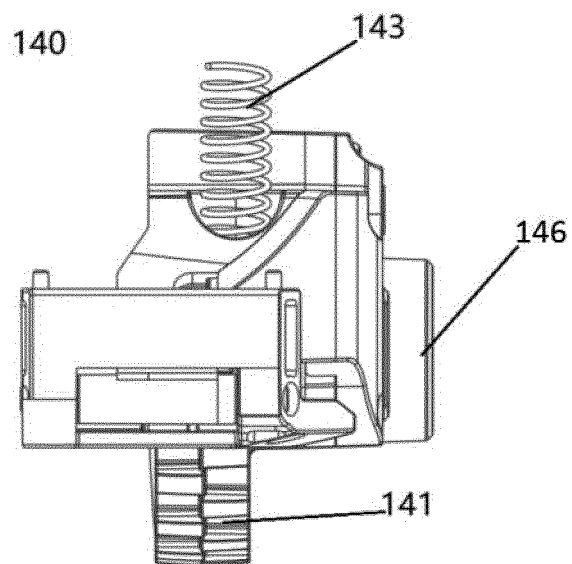


FIG. 4

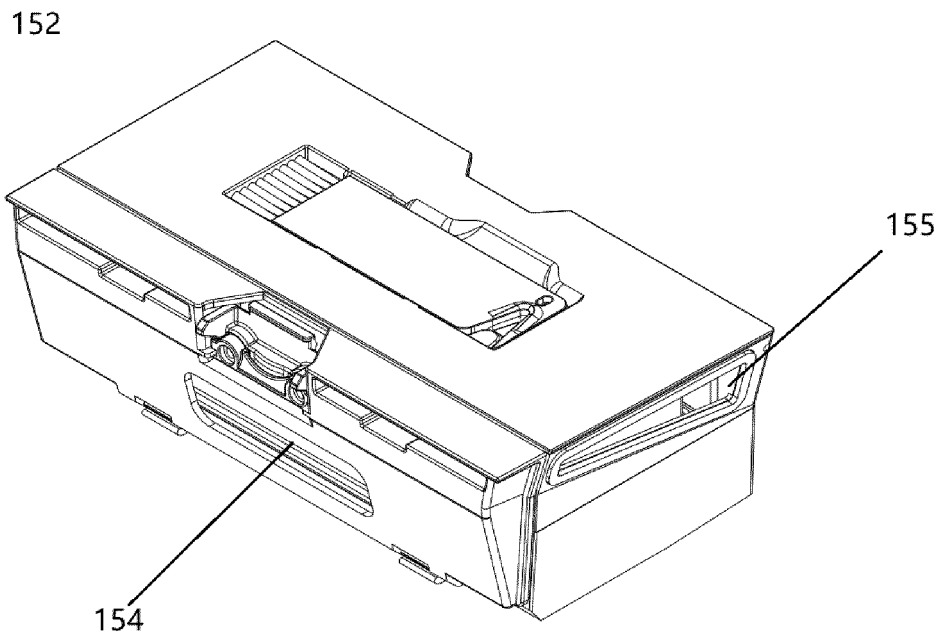


FIG. 5

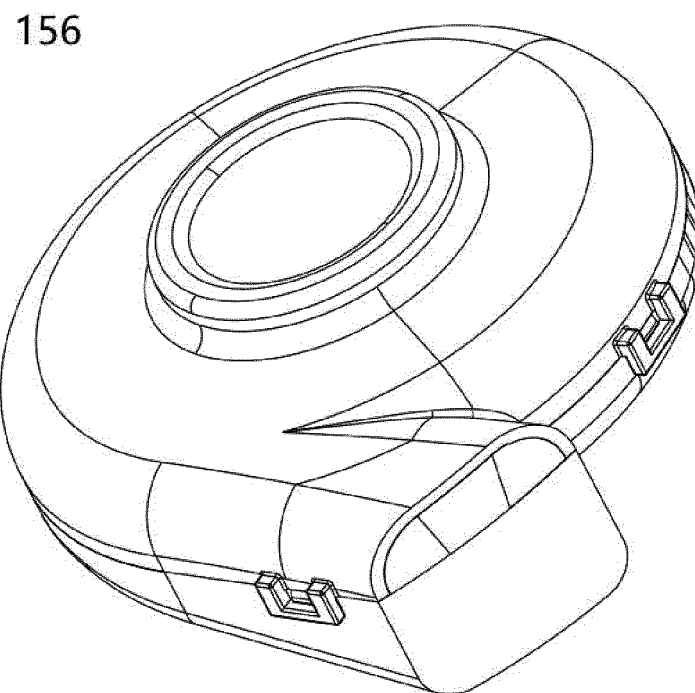


FIG. 6

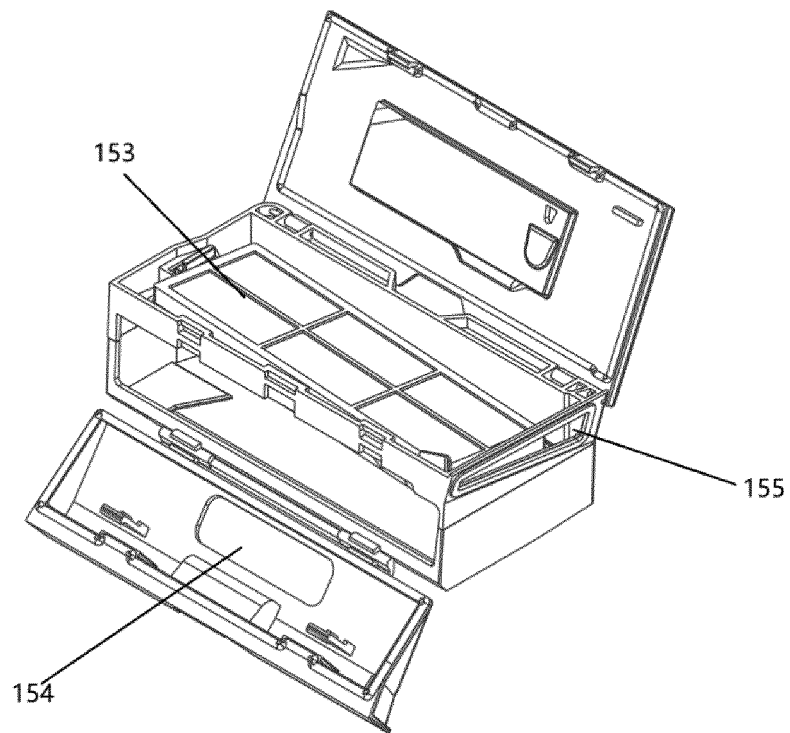


FIG. 7

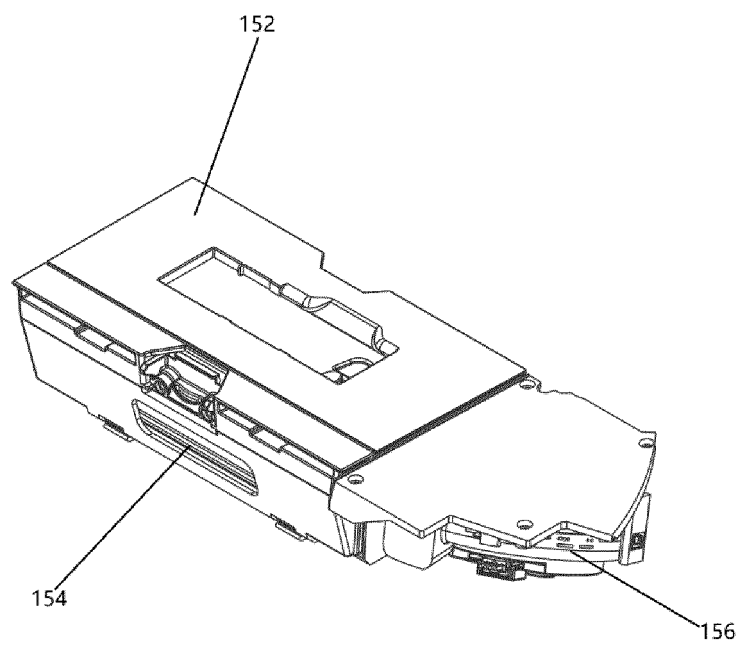


FIG. 8

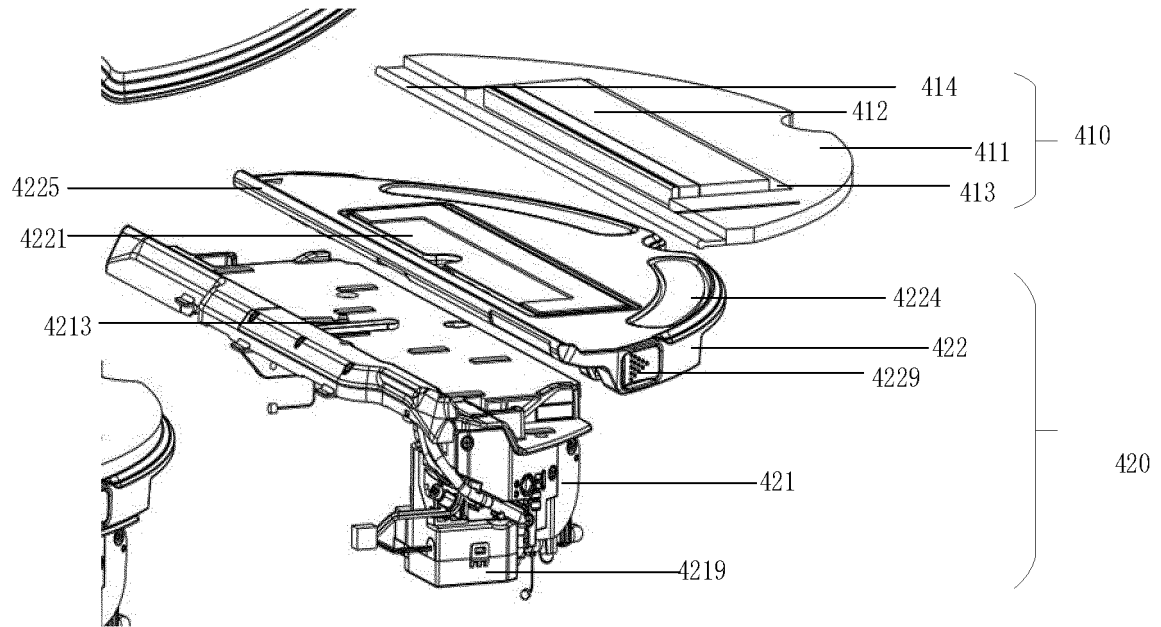


FIG. 9

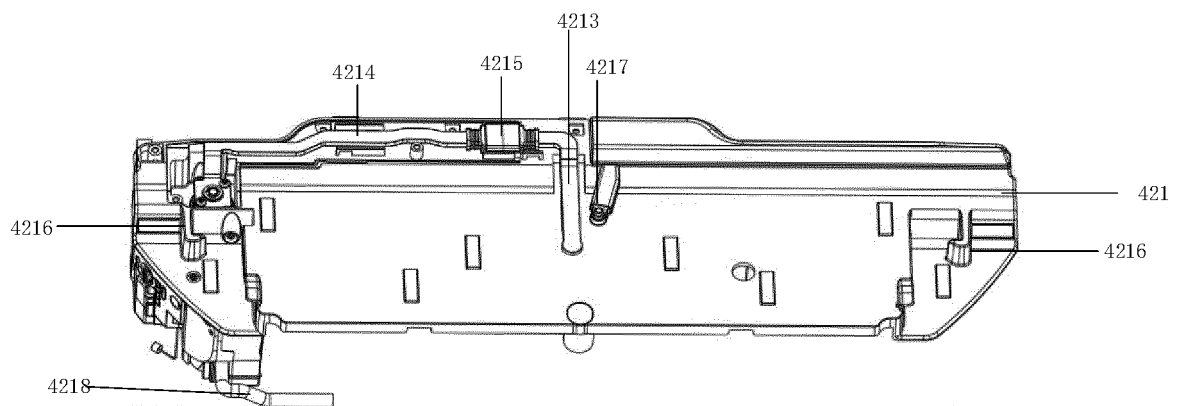


FIG. 10

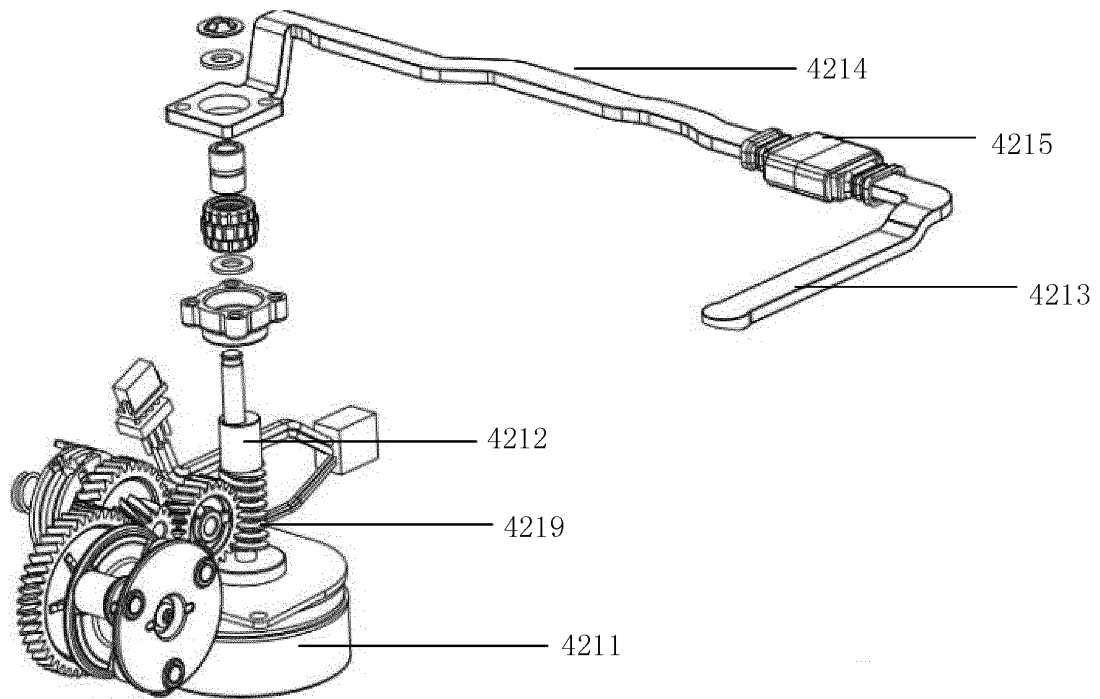


FIG. 11

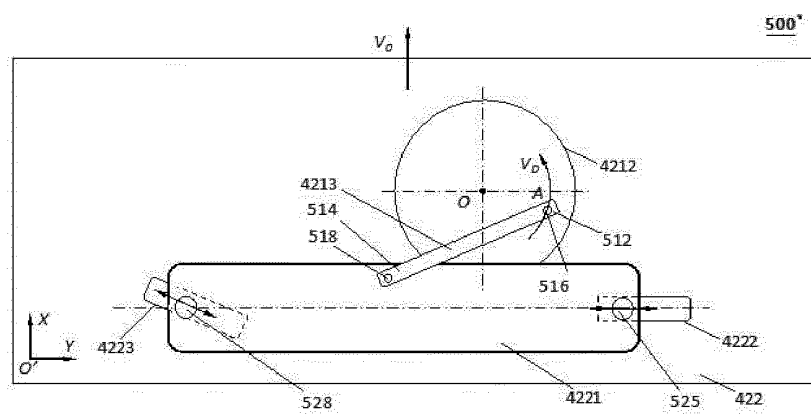


FIG. 12

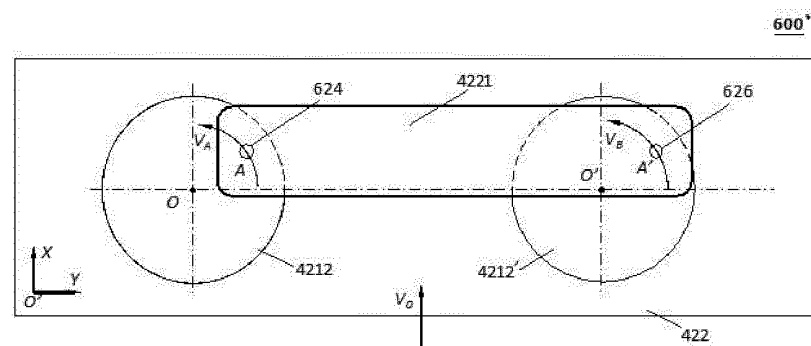


FIG. 13

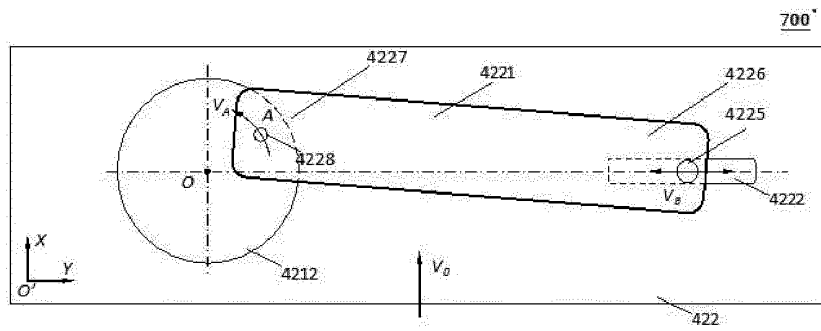


FIG. 14

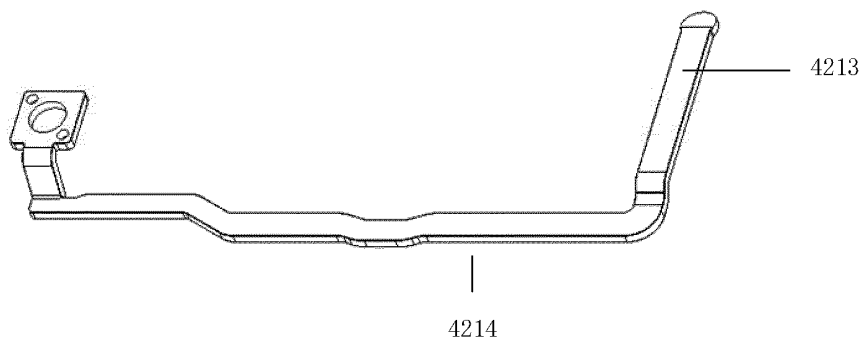


FIG. 15

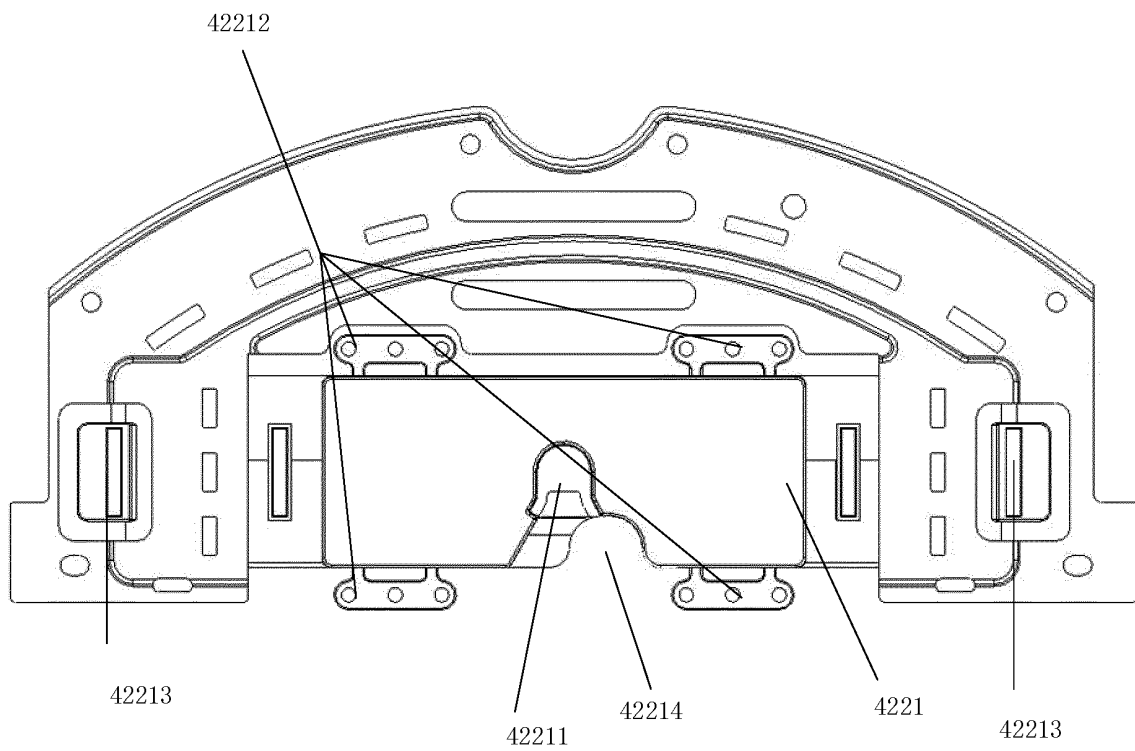


FIG. 16

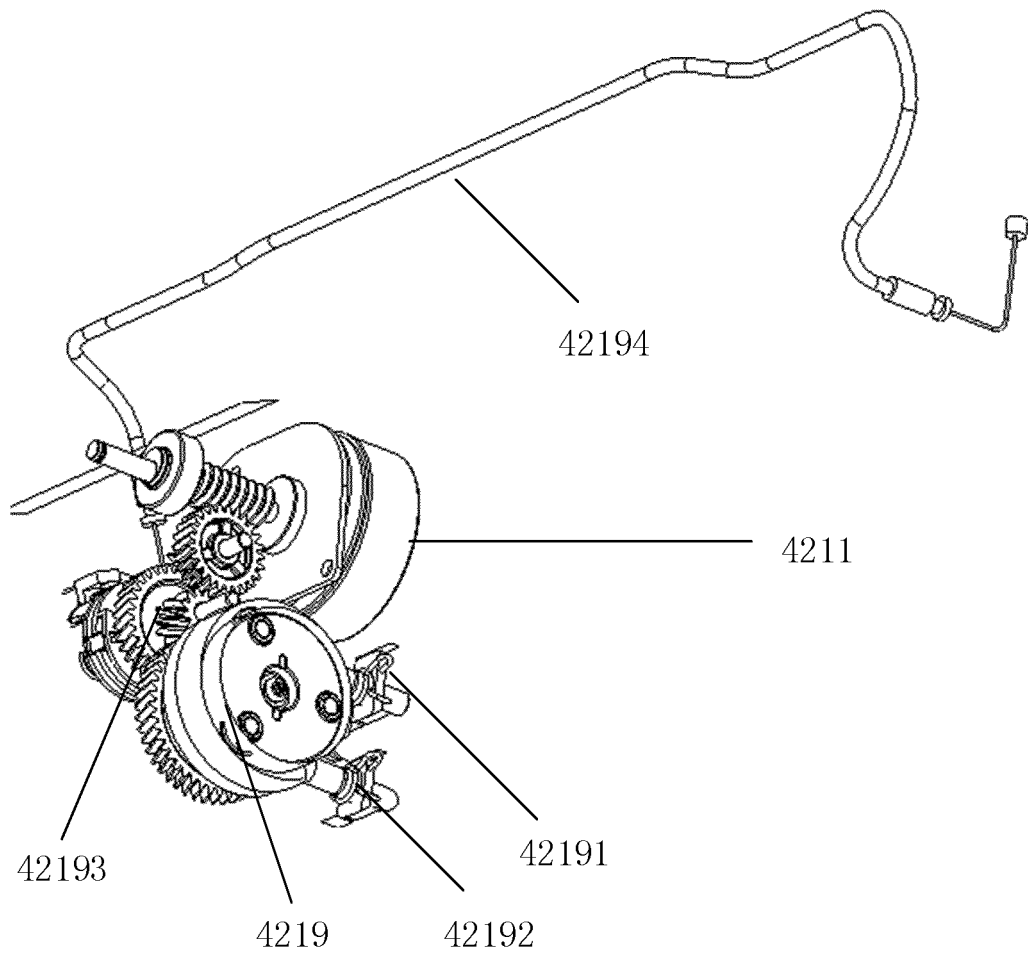


FIG. 17

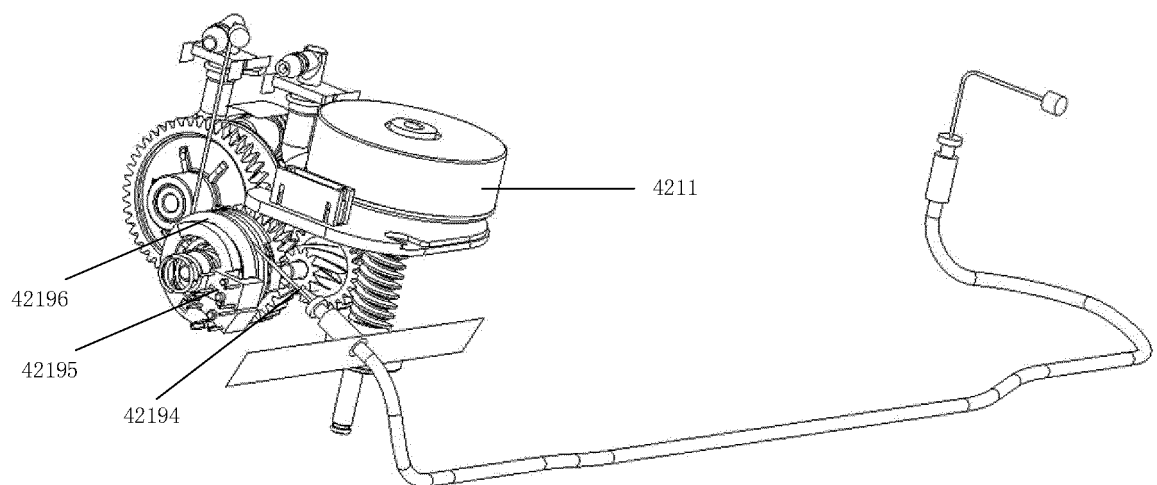


FIG. 18

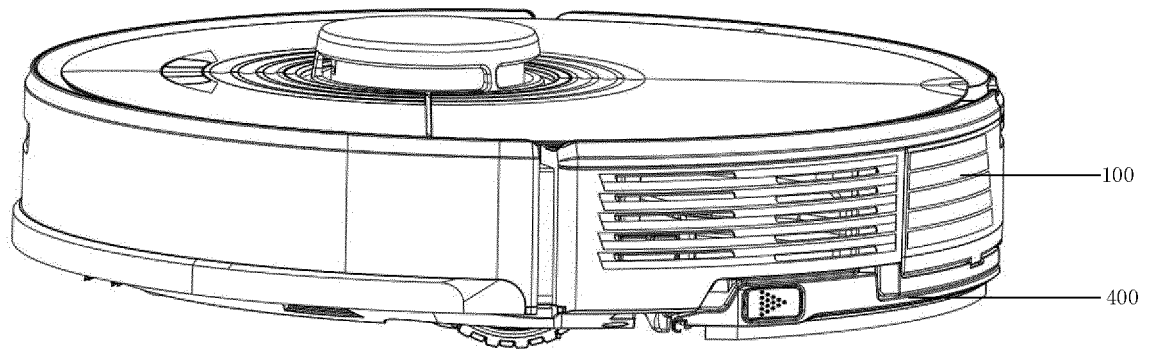


FIG. 19

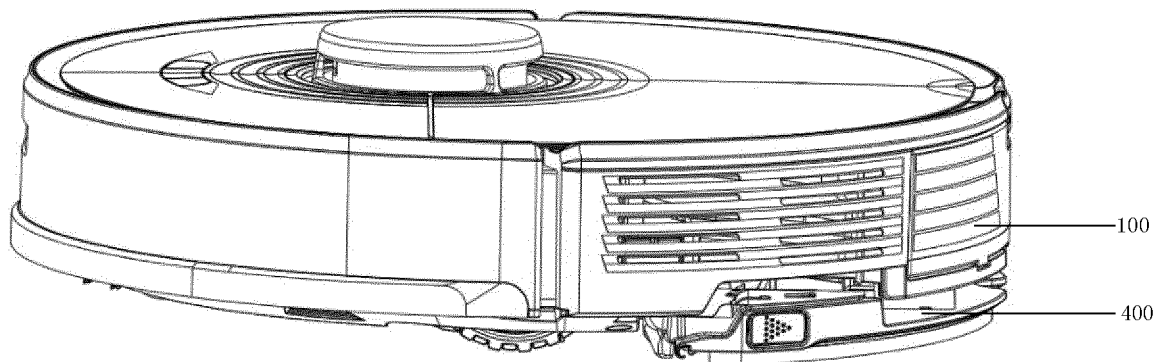


FIG. 20

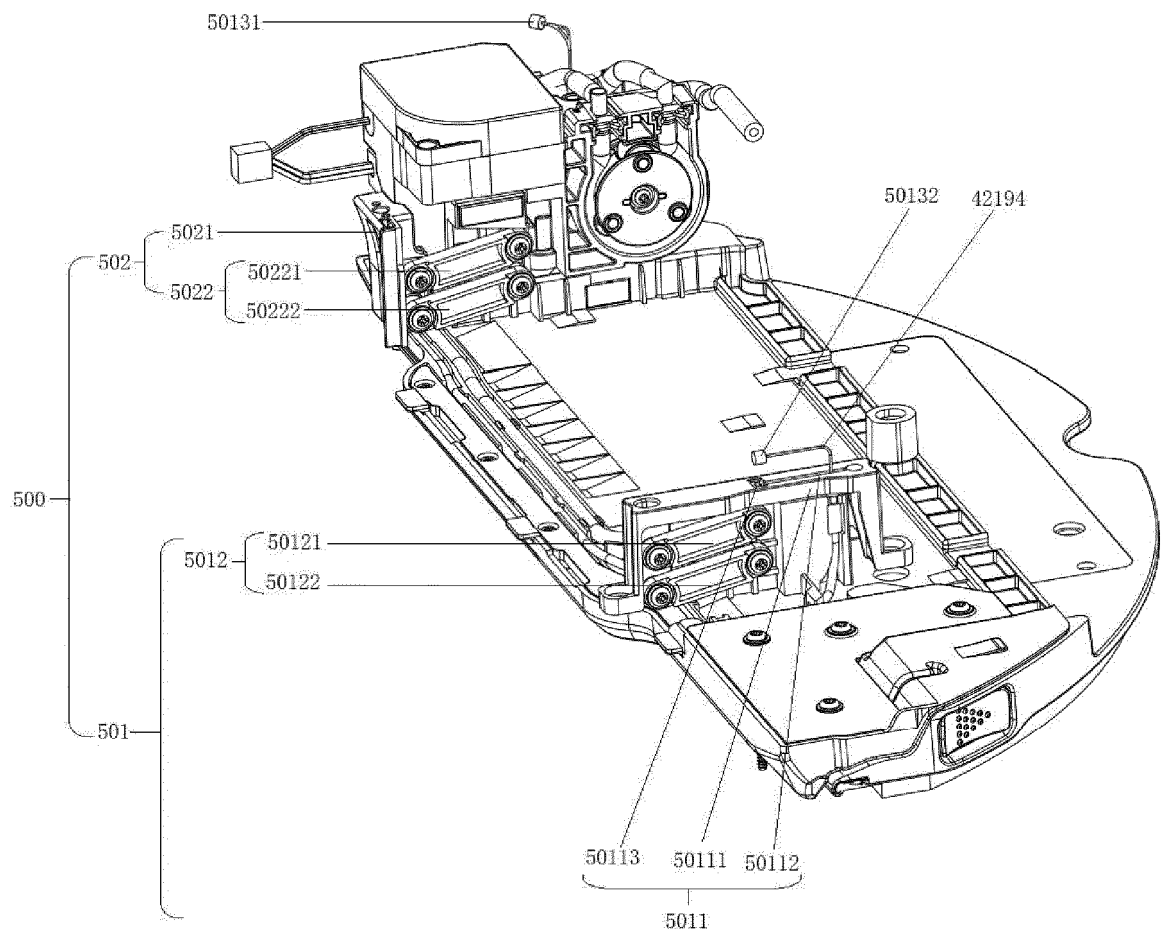


FIG. 21

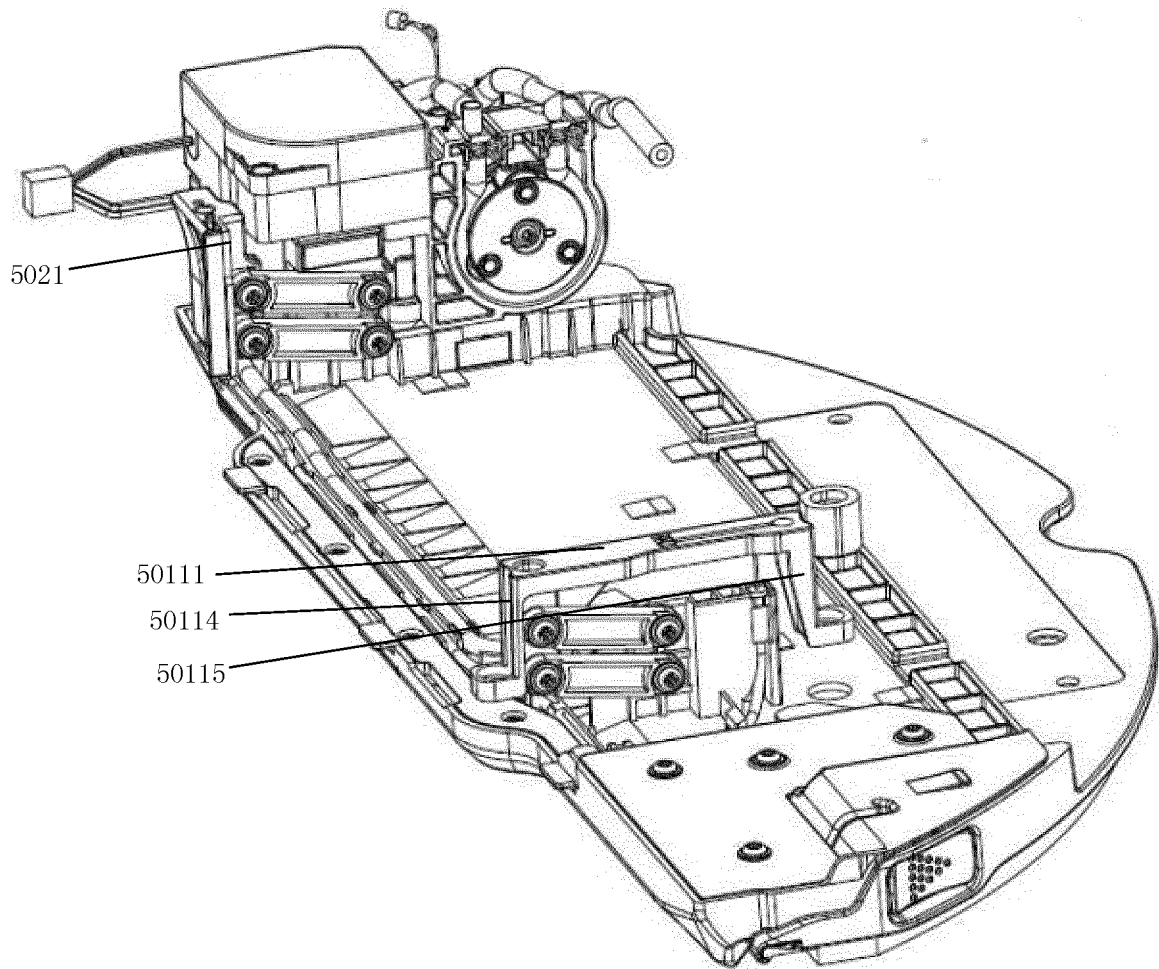


FIG. 22

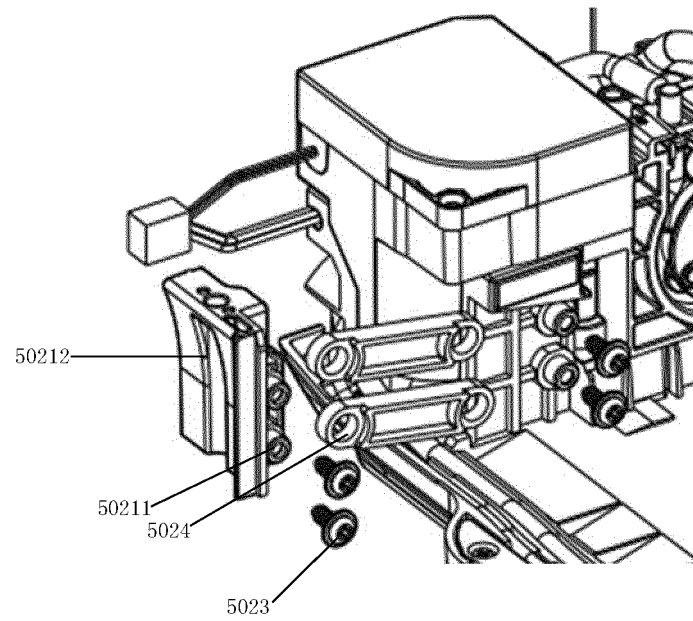


FIG. 23

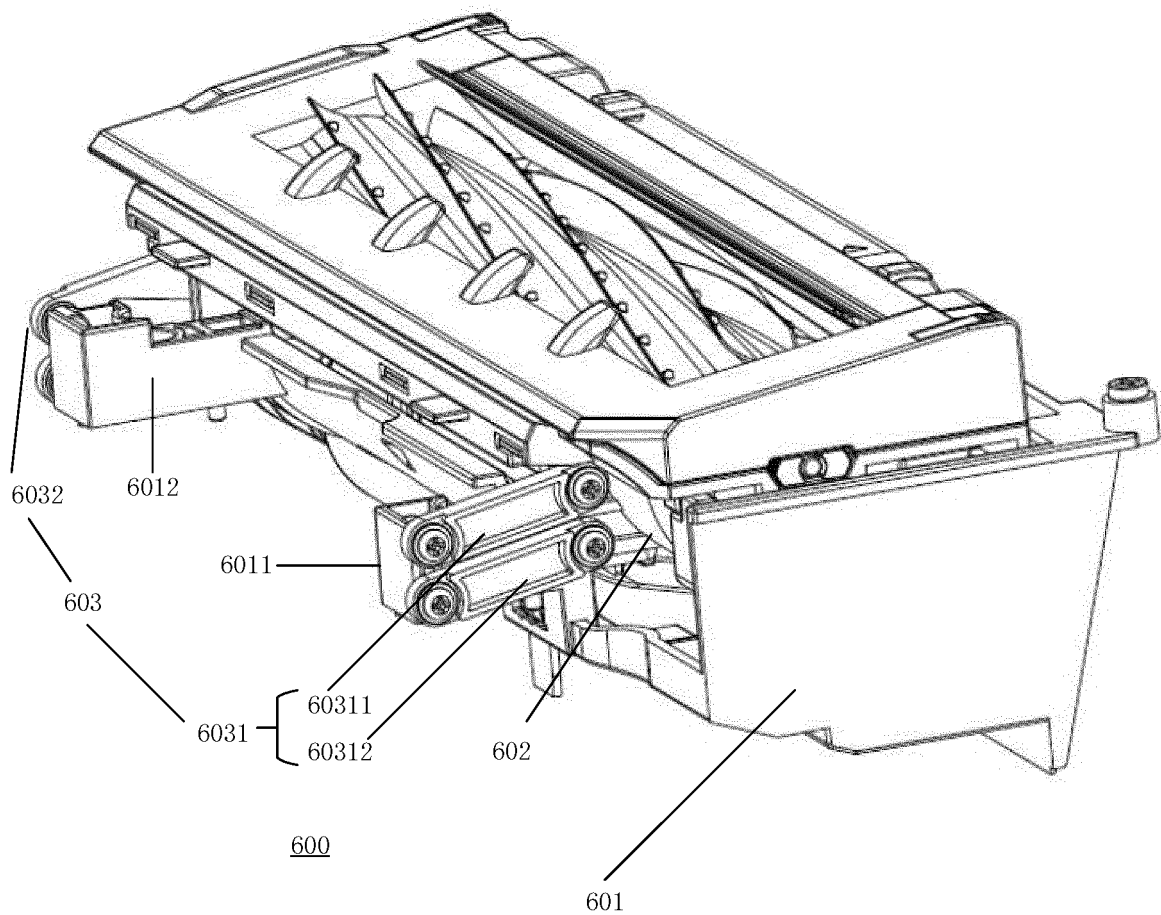


FIG. 24

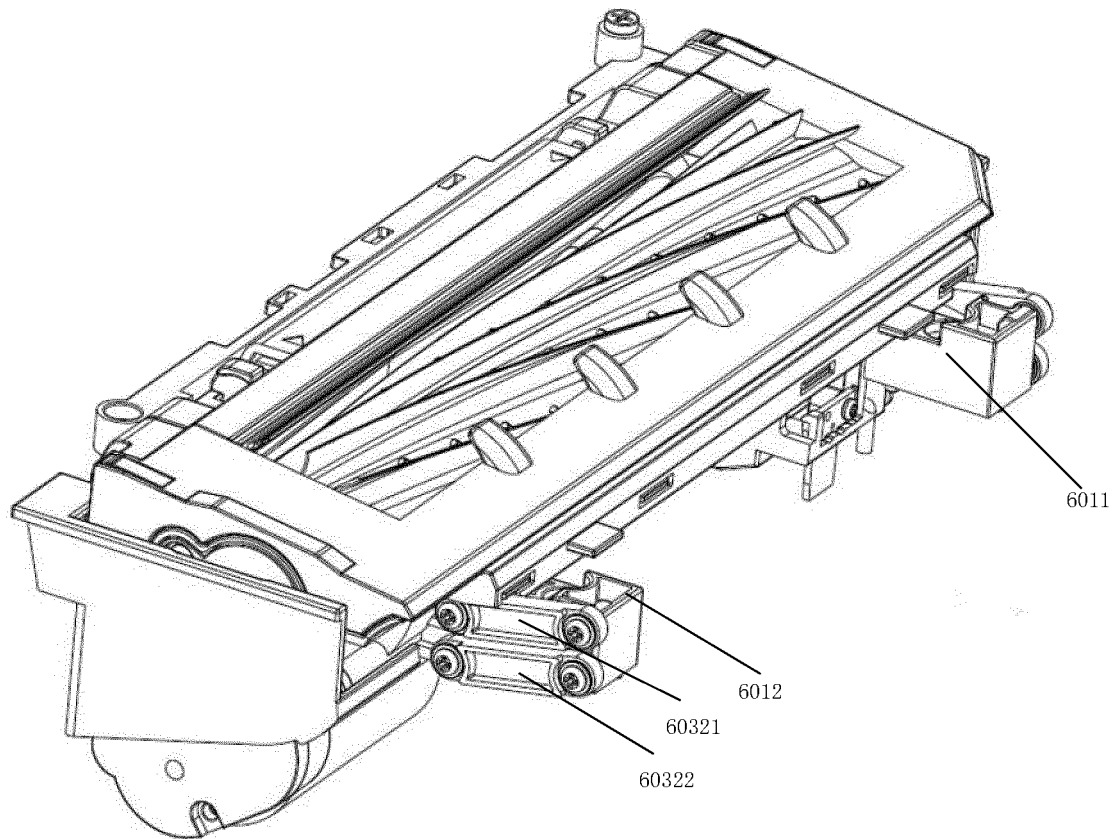


FIG. 25

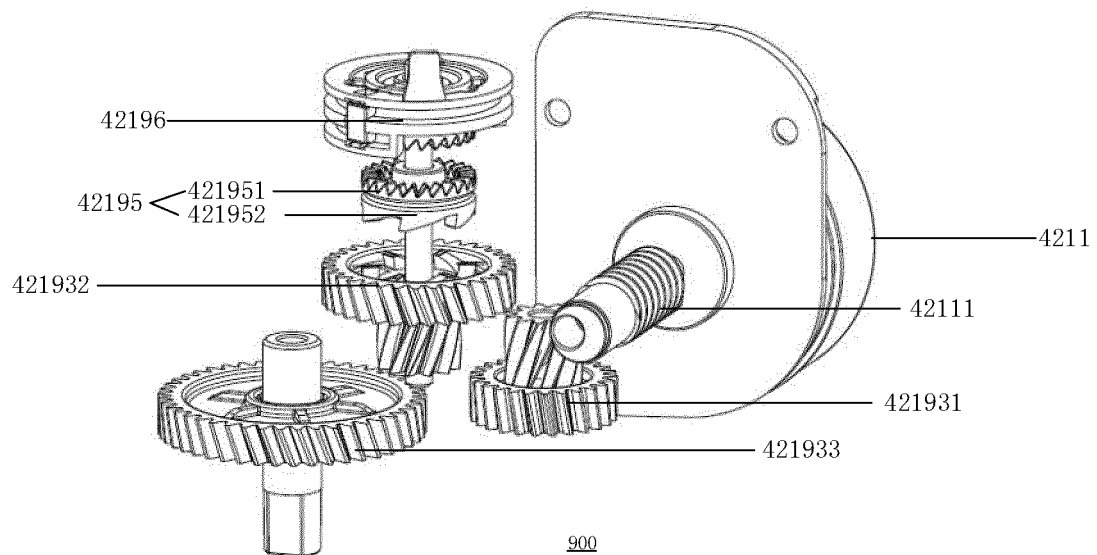


FIG. 26

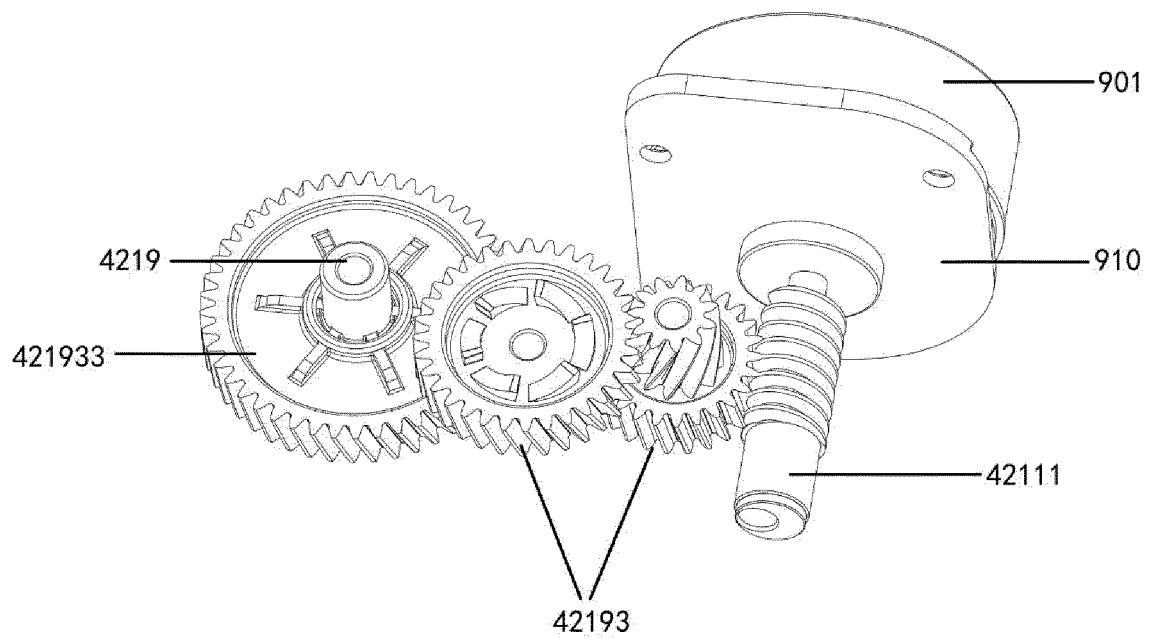


FIG. 27

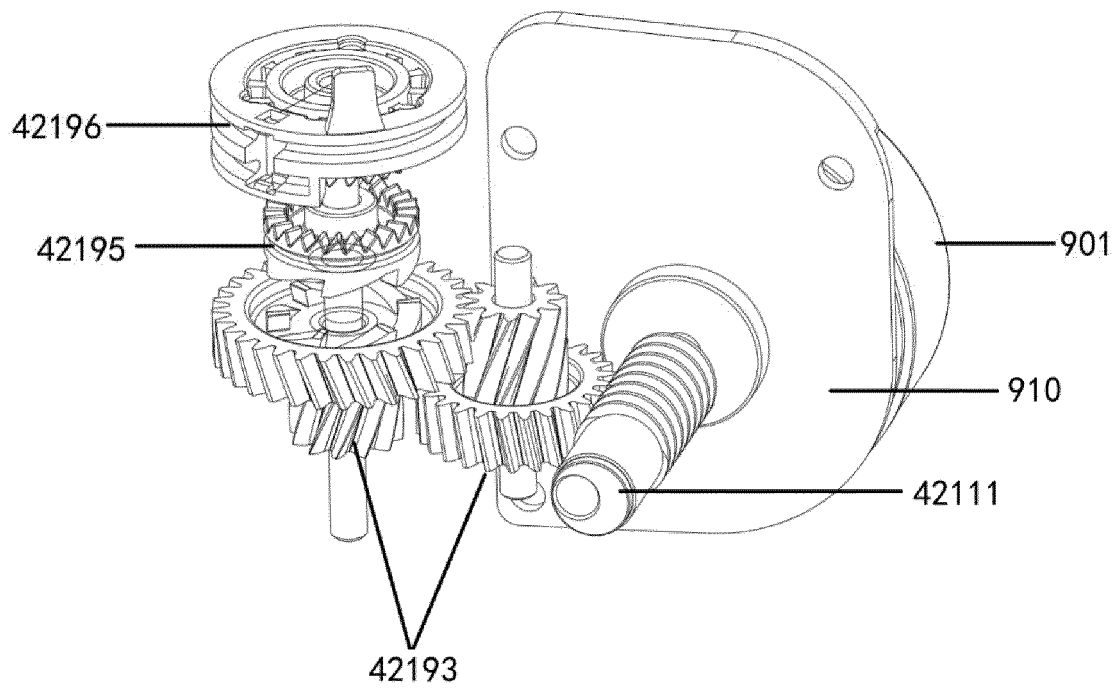


FIG. 28

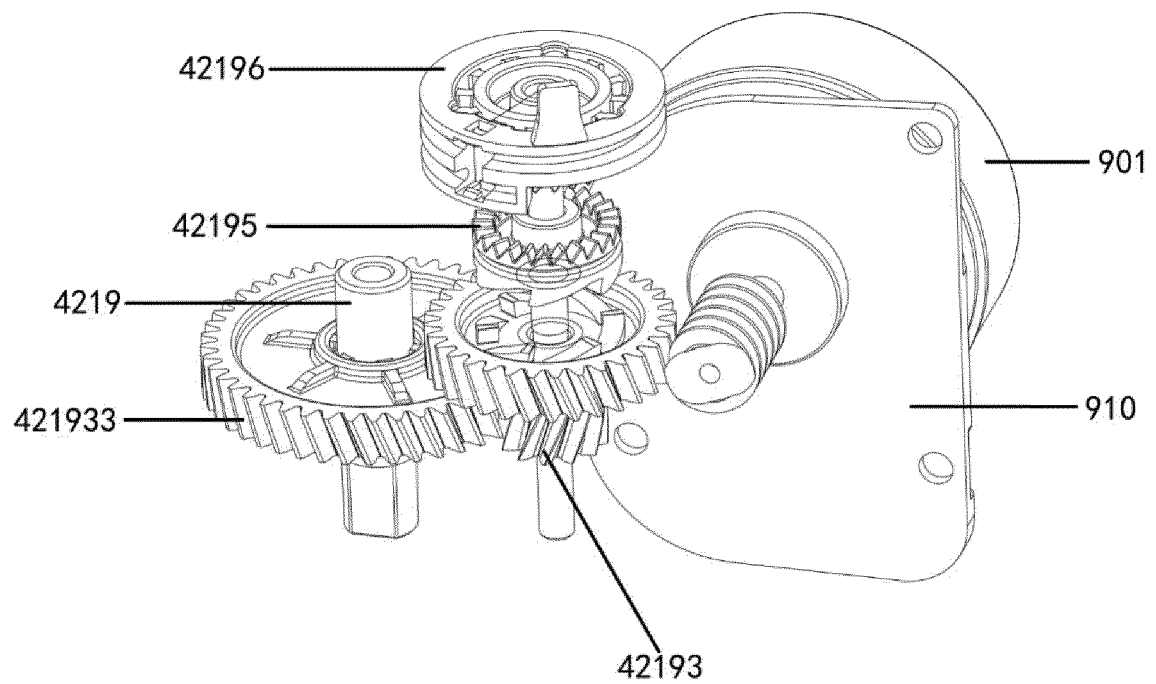


FIG. 29

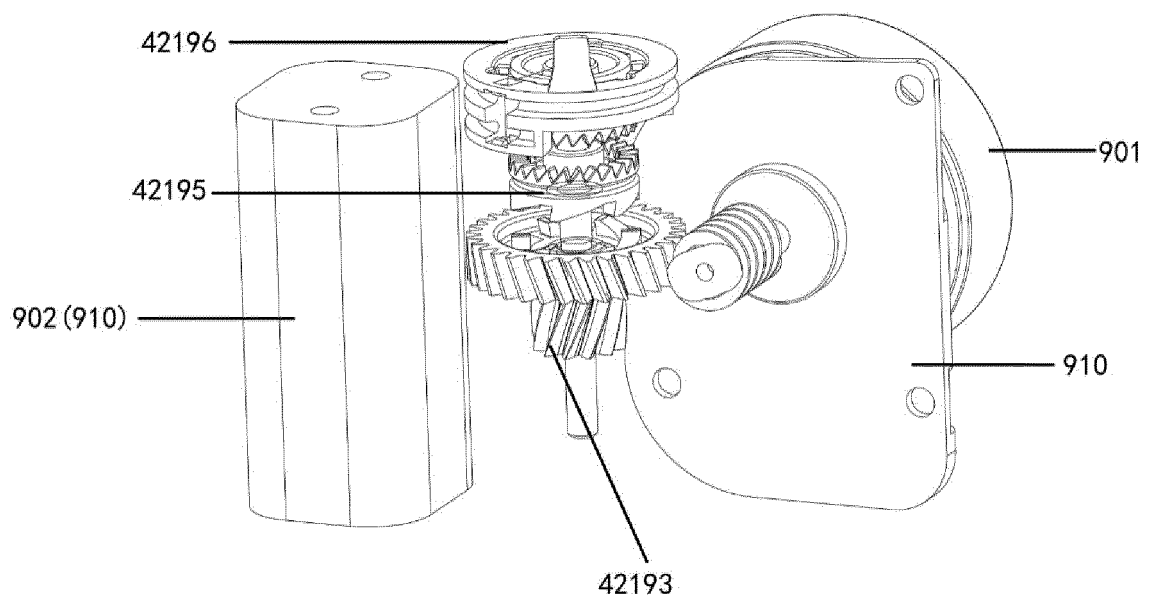


FIG. 30

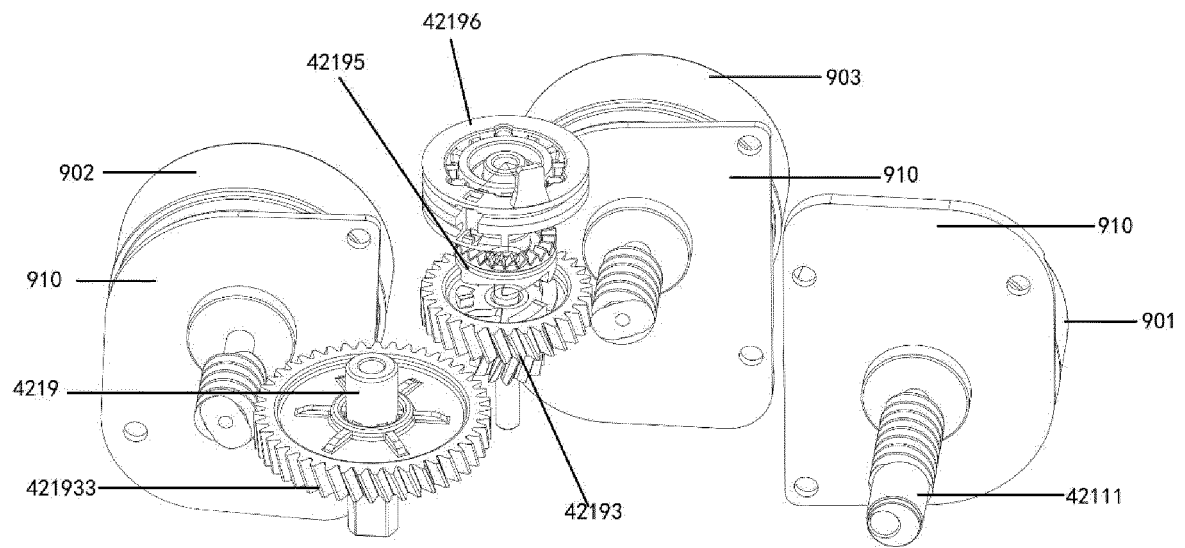


FIG. 31

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/075724

A. CLASSIFICATION OF SUBJECT MATTER

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

A47L

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

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

CNTXT; WPABSC; ENTXTC; VEN: 清洁液, 湿, 擦, 拭, 拖, 布, 传动, 驱动, 动力, 升降, 离合, 正, 反, 齿轮, 平行四边形, cleaning liquid, wet, wip+, mop, transmission, drive, driving, power, force, lift, clutch, forward, clockwise, reverse, counterclockwise

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 112690713 A (BEIJING ROBOROCK TECHNOLOGY CO., LTD.) 23 April 2021 (2021-04-23) description, paragraphs 73-75, 91, 98-110 and 134-142, and figures 1-18	1-3, 8-13, 18-27
Y	CN 112690713 A (BEIJING ROBOROCK TECHNOLOGY CO., LTD.) 23 April 2021 (2021-04-23) description, paragraphs 73-75, 91, 98-110 and 134-142, and figures 1-18	4-7, 14-17
Y	CN 112568810 A (BEIJING ROBOROCK TECHNOLOGY CO., LTD.) 30 March 2021 (2021-03-30) description, paragraph 134	4-7
Y	CN 110215166 A (SUZHOU GAOZHIXIAN AUTOMATION TECHNOLOGY CO., LTD. et al.) 10 September 2019 (2019-09-10) description, paragraphs 27-36, and figures 1-8	14-17
A	CN 111345744 A (POSITEC POWER TOOLS (SUZHOU) CO., LTD.) 30 June 2020 (2020-06-30) entire document	1-27

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

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“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

17 April 2022

Date of mailing of the international search report

06 May 2022

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

Authorized officer

Facsimile No. (86-10)62019451

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/075724

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	CN 111481097 A (HOBOT TECHNOLOGY INC.) 04 August 2020 (2020-08-04) entire document	1-27
A	WO 2016036183 A1 (EVERYBOT INC.) 10 March 2016 (2016-03-10) entire document	1-27
PX	CN 113693499 A (BEIJING ROBOROCK TECHNOLOGY CO., LTD.) 26 November 2021 (2021-11-26) claims 1-27	1-27

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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