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(54) **AUTOMATIC CLEANING APPARATUS AND SYSTEM**

(57) An automatic cleaning apparatus and system having a dust collection function. The automatic cleaning apparatus comprises: a moving platform (100), the moving platform (100) comprising an accommodation chamber (200), and the moving platform (100) being configured to automatically move on an operation surface; and a cleaning module (150), which comprises a dust box (300) and a main brush module (153), wherein the dust box (300) is detachably fitted in the accommodation

chamber (200), and the dust box (300) comprises a first air intake door (3013) and a second air intake door (3014), the first air intake door (3013) and the second air intake door (3014) being respectively located on a first side wall (3015) and a second side wall (3016) of the dust box (300), and the first air intake door (3013) and the second air intake door (3014) being configured to provide intake airflow in different directions during dust collection.

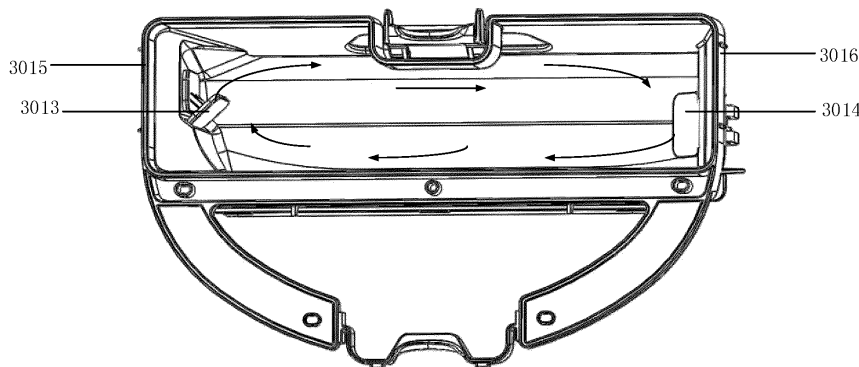


FIG. 21

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority of the Chinese Patent Application No. 202210028896.9, filed on January 11, 2022, which is incorporated herein by reference in its entirety as a part of the present application.

TECHNICAL FIELD

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

BACKGROUND ART

[0003] Cleaning robots are becoming more and more popular, which brings convenience to family life. Cleaning robots include sweeping robots, mopping robots and sweeping-mopping integrated robots. In prior art, some cleaning robots have additional structures or functions such as automatic charging, automatic dust collection and lifting vibration, which makes the cleaning robots more intelligent. However, for cleaning robots that automatically collect dust, dust in a dust box often cannot be completely emptied due to insufficient wind power of a fan and an insufficient or poor supply of dust-collection airflows.

[0004] It should be noted that the information disclosed in the above background section is only to further understanding of the background of the present disclosure, and thus may include information that does not form the prior art known to those of ordinary skill in the art.

SUMMARY OF THE INVENTION

[0005] According to specific embodiments of the present disclosure, the present disclosure provides an automatic cleaning apparatus with a dust-collection function, including a mobile platform with an accommodating chamber, the mobile platform being configured to automatically move along an operating surface; and a cleaning module, including a dust box and a main brush module, where the dust box is detachably assembled in the accommodating chamber and includes a first air inlet door and a second air inlet door, and the first air inlet door and the second air inlet door are located on a first side wall and a second side wall of the dust box, respectively, and are configured to provide intake airflows in different directions during dust collection.

[0006] In some embodiments, the first air inlet door and the second air inlet door are located at asymmetric positions of the first side wall and the second side wall, respectively.

[0007] In some embodiments, the second air inlet door is disposed at a position close to a lower edge of the second side wall, and a lower edge of the second air inlet

door is lower than a lower edge of the first air inlet door.

[0008] In some embodiments, the second air inlet door is disposed close to a rear side wall of the dust box, and the first air inlet door is disposed close to a front side wall of the dust box.

[0009] In some embodiments, the first air inlet door rotates approximately around a first rotating shaft, the second air inlet door rotates approximately around a second rotating shaft, and the first rotating shaft is approximately perpendicular to the second rotating shaft.

[0010] In some embodiments, shapes of the first air inlet door and the second air inlet door are at least one or a combination of following: rectangle, square, circle, ellipse and/or strip.

[0011] In some embodiments, the first air inlet door is of a rectangular structure and long edges of the first air inlet door are longitudinally disposed, and the second air inlet door is of a rectangular structure and long edges of the second air inlet door are transversely disposed.

[0012] In some embodiments, the dust box further includes a first opening and a second opening, with the first opening configured as a dust inlet during dust suction and a dust outlet during dust collection, and the first opening and the second opening are approximately located on a central axis of the automatic cleaning apparatus in a front-rear direction.

[0013] In some embodiments, the accommodating chamber includes a first chamber and a second chamber that are sequentially and adjacently disposed in an advancing direction of the automatic cleaning apparatus, a bottom of a front side wall of the first chamber is provided with a dust-suction port, a rear side wall of a connection between the first chamber and the second chamber is provided with an air outlet; and the dust-suction port, the air outlet, the first opening and the second opening are all approximately located on the central axis of the automatic cleaning apparatus in the front-rear direction.

[0014] In some embodiments, a fan is disposed in a space below the second chamber and the fan, the main brush module, the dust-suction port, the air outlet, the first opening and the second opening are all approximately located on the central axis of the automatic cleaning apparatus in the front-rear direction.

[0015] In some embodiments, the mobile platform further includes a position-determining device and a cover cap covering the position-determining device; and the position-determining device, the cover cap, the main brush module, the dust-suction port, the air outlet, the first opening and the second opening are all approximately located on the central axis of the automatic cleaning apparatus in the front-rear direction.

[0016] In some embodiments, the intake airflows in different directions are from at least one of following: airflows entering from a top-end gap of the mobile platform, an airflow entering from a gap in the main brush module, and an airflow entering from a rear side wall of the mobile platform.

[0017] In some embodiments, the airflows entering

from the top-end gap of the mobile platform include an airflow entering from a gap between the cover cap and a top surface of the mobile platform and an airflow entering from a gap between the cover cap and the position-determining device.

[0018] According to a specific embodiment of the present disclosure, the present disclosure provides an automatic cleaning system, including a dust-collection station and any of the above automatic cleaning apparatuses, where the dust-collection station includes a dust-collection port and the dust-collection port is docked with a port of the main brush module and collects dust.

[0019] Compared with the related art, the embodiments of the present disclosure have the following technical characteristic.

[0020] The present disclosure provides an automatic cleaning apparatus and system. The automatic cleaning apparatus has an automatic dust-collection function. By asymmetrically disposing two air doors in the dust box of the automatic cleaning apparatus, the airflows entering the dust box form convection current that creates a vortex cyclone in the dust box, so that refuse in the dust box is smoothly sucked into the dust-collection station. In addition, the main brush module, the dust-suction port, the air outlet, the first opening and the second opening are all approximately disposed on the central axis of the automatic cleaning apparatus in the front-rear direction, which can further increase a speed of the airflows traveling through the dust box during dust suction and improve the dust-suction efficiency. Meanwhile, it is easier to suck the refuse in the dust box into the dust-collection station during dust collection.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The accompanying drawings herein, which are incorporated into the Description and constitute a part of the Description, show embodiments conforming to the present disclosure and, together with the Description, are used to explain the principles of the present disclosure. The accompanying drawings in the following description show only some embodiments of the present disclosure, and those of ordinary skill in the art can derive other drawings from these accompanying drawings without considerable creative effort. In the accompanying drawings:

FIG. 1 is an oblique view of an automatic cleaning apparatus according to some embodiments of the present disclosure;

FIG. 2 is a schematic diagram of a bottom structure of an automatic cleaning apparatus according to some embodiments of the present disclosure;

FIG. 3a is an oblique view of an accommodating chamber of an automatic cleaning apparatus according to some embodiments of the present disclosure;

FIG. 3b is a schematic diagram of an air outlet

structure of an accommodating chamber of an automatic cleaning apparatus according to some embodiments of the present disclosure;

FIG. 4 is a perspective view of a dust box according to some embodiments of the present disclosure;

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

FIGs. 6a-6h are schematic structural layout diagrams of a top cap according to some embodiments of the present disclosure;

FIG. 7 is an enlarged schematic diagram of a first locking member according to some embodiments of the present disclosure;

FIG. 8 is an enlarged schematic diagram of a first latching member according to some embodiments of the present disclosure;

FIG. 9a is an enlarged schematic diagram of a second locking member according to some embodiments of the present disclosure;

FIG. 9b is a schematic diagram of an overall structure of a second locking member according to some embodiments of the present disclosure;

FIG. 9c is an enlarged schematic diagram of a second knob part according to some embodiments of the present disclosure;

FIG. 10 is an enlarged schematic diagram of a second latching member according to some embodiments of the present disclosure;

FIG. 11 is a perspective view of a dust box filter screen according to some embodiments of the present disclosure from an outside-view angle;

FIG. 12 is a perspective view of a dust box filter screen according to some embodiments of the present disclosure from an inside-view angle;

FIG. 13a is an inside front structural diagram of a dust box filter screen according to some embodiments of the present disclosure;

FIG. 13b is a perspective view of a dust box filter screen according to some embodiments of the present disclosure from an inside-view angle;

FIG. 14 is a schematic assembled structural diagram of a dust box and a filter screen according to some embodiments of the present disclosure;

FIG. 15 is an enlarged schematic diagram of an assembling structure of a dust box and a filter screen according to some embodiments of the present disclosure;

FIG. 16 is a schematic diagram of an air inlet structure of a cover cap according to some embodiments of the present disclosure;

FIG. 17 is a schematic diagram of an air inlet structure of a base according to some embodiments of the present disclosure;

FIG. 18a is a schematic diagram of an internal airflow structure according to some embodiments of the present disclosure;

FIG. 18b is a schematic diagram of an air inlet structure of an exhaust port according to some em-

bodiments of the present disclosure;

FIG. 19 is an enlarged schematic diagram of an air duct structure according to some embodiments of the present disclosure;

FIG. 20 is a schematic structural diagram of an accommodating chamber according to some embodiments of the present disclosure;

FIG. 21 is a schematic structural diagram of a dust box according to some embodiments of the present disclosure;

FIG. 22 is a symmetrical structural diagram of an automatic cleaning apparatus along an axis BB according to some embodiments of the present disclosure;

FIG. 23 is a schematic structural diagram of a dust-collection station according to some embodiments of the present disclosure;

FIG. 24 is a schematic structural diagram of an automatic cleaning system according to some embodiments of the present disclosure;

FIG. 25 is an overall structural diagram of a position-determining element according to some embodiments of the present disclosure;

FIG. 26 is an enlarged structural diagram of a position-determining element according to some embodiments of the present disclosure;

FIG. 27 is a structural diagram of a module bracket according to some embodiments of the present disclosure;

FIG. 28 is a structural diagram of a cover cap according to some embodiments of the present disclosure;

FIG. 29 is a partial cross-sectional structural diagram of a cover cap according to some embodiments of the present disclosure;

FIG. 30 is a structural diagram of an annular blocking member according to some embodiments of the present disclosure;

FIG. 31 is a partially enlarged structural diagram of an annular blocking member according to some embodiments of the present disclosure;

FIG. 32 is a schematic top view of a mobile platform body in the automatic cleaning apparatus shown in FIG. 1;

FIG. 33 is a schematic bottom view of a platform cap body assembled on the upper part of the mobile platform body in the automatic cleaning apparatus shown in FIG. 1;

FIG. 34 is a schematic top view of a platform bottom plate assembled on the mobile platform body in the automatic cleaning apparatus shown in FIG. 1;

FIG. 35 is a schematic structural diagram of a water-retaining bracket according to some embodiments of the present disclosure;

FIG. 36 is a schematic structural diagram of a position-determining device according to some embodiments of the present disclosure;

FIG. 37 is a schematic assembled structural diagram of the position-determining device shown in FIG. 36

and a mobile platform;

FIG. 38 is a schematic structural diagram of a cover cap in the position-determining device shown in FIG. 36;

FIG. 39 is a schematic diagram of a bottom structure of the cover cap shown in FIG. 38;

FIG. 40 is a schematic assembled structural diagram of a mobile platform, a position-determining device and a trigger assembly in some embodiments of the present disclosure;

FIG. 41 is an enlarged schematic diagram of the trigger assembly in the assembling structure shown in FIG. 40;

FIG. 42 is a schematic diagram of an explosion structure of the trigger assembly shown in FIG. 41;

FIG. 43 is a schematic diagram of an assembling structure of a key assembly of an automatic cleaning apparatus according to some embodiments of the present disclosure;

FIG. 44 is a schematic diagram of a key bracket of an automatic cleaning apparatus according to some embodiments of the present disclosure from an upside-view angle;

FIG. 45 is a schematic diagram of a key bracket of an automatic cleaning apparatus according to some embodiments of the present disclosure from a downside-view angle;

FIG. 46 is a schematic diagram of a keycap of an automatic cleaning apparatus from an upside-view angle according to some embodiments of the present disclosure;

FIG. 47 is a downside view angle schematic diagram of a key cap of an automatic cleaning apparatus from a downside-view angle according to some embodiments of the present disclosure;

FIG. 48 is a schematic cross-sectional structural diagram of an assembling structure of a key assembly of an automatic cleaning apparatus according to some embodiments of the present disclosure;

FIG. 49 is a schematic structural diagram of a cap plate of an automatic cleaning apparatus according to some embodiments of the present disclosure; and

FIG. 50 is an enlarged view of a bottom view of a D portion on the cap plate shown in FIG. 49 according to some embodiments of the present disclosure.

Reference numerals:

[0022] 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, cleaning module 150, dry-cleaning module 151, side brush 152, main brush module 153, dust box 300, filter screen 500, energy system 160, human-computer interaction system 170, accommodating chamber 200, first chamber 201, second chamber 202, dust-suction port 203, exhaust port 204, air outlet

208, accommodating part 301, top cap 302, first opening 3011, second opening 3012, first portion 3021, edge portion 30211, step part 205, second portion 3022, support structure 3023, groove 2021, first recess 206, second recess 207, first locking member 601, second locking member 602, first knob recess 603, first elastic arm 6011, first handle part 6012, first buckling part 6013, first latching member 701, second knob recess 605, second elastic arm 6021, second handle part 6022, second buckling part 6023, second latching member 702, soft rubber frame 501, soft rubber protrusion 5011, filter element 502, first rib 510, fool-proof protrusion 509, sealing inner lip 507, sealing outer lip 506, step surface 503, magnet mounting hole 504, second rib 5041, knob 505, hollow structure 508, third protrusion 5012, elastic structure 5013, pillow position 5014, first air inlet door 3013, second air inlet door 3014, dust box first side wall 3015, dust box second side wall 3016, position-determining element 1211, air duct 209, air inlet hole 20111, third side wall 2011, fourth side wall 2012, spacer 20112, notch 20113, dust-collection station 700, dust-collection station base 710, dust-collection station main body 720, dust-collection port 711, sealing rubber pad 714, assembling part 800, assembling structure 900, assembling bracket 910, rotor 920, motor 930, cover cap 940, rotor-accommodating part 911, motor-accommodating part 912, first arc-shaped side wall 9111, second arc-shaped side wall 9121, motor roller 931, conveyor belt 932, opening I 9122, bottom surface 9124 of motor-accommodating part, first support rib 9123, opening II 9112, second support rib 9113, bottom surface 9114 of rotor-accommodating part, circular top surface 941, bottom ring 942, connector 943, annular blocking member 950, plug connector 951, first slot 9431, second slot 9432, third slot 9433, convex beam 9511, T-shaped protrusion 9512, limiting groove 9434, limiting protrusion 9513, mobile platform body 101, accommodating cavity 1011, water-retaining wall 10111, drainage hole 10112, accommodating groove 1012, buckle 10121, platform cap body 102, opening hole 1021, water-retaining rib 1022, access opening 1023, platform bottom plate 103, accommodating groove 1031, drainage port 1032, third opening 1033, water-retaining bracket 104, bottom wall 1041, bracket side wall 1042, first bracket side wall 10421, second bracket side wall 10422, third bracket side wall 10423, fourth bracket side wall 10424, fifth bracket side wall 10425, pivot shaft 1043, mounting hole 1044, circuit board 105, bottom plate 1221, open orifice 12210, buckling cap 1222, window 12220, liquid guide hole 1223, pivot structure 1224, liquid guide groove 1225, trigger protrusion 181, trigger assembly 182, trigger button 1821, elastic plate member 1822, fixed end part 18221, free end part 18222, anti-warpage buckle 1823, positioning column 1824, cap plate 1000, key assembly 400, pressing main body part 411, key mounting hole 1002, keycap 410, bracket 420, positioning column body 1001, positioning hole 425, step structure 430, bracket first side wall 421, bracket second side wall 422, first

assembling part 423, second assembling part 424, elastic arm 426, keypad 427, keypad head 4271, keypad tail 4272, first protruding part 412, second protruding part 413, third protruding part 414, first groove 415, second groove 416, recess 471, abutting part 4171, and light-shielding arm 418.

DETAILED DESCRIPTION

[0023] To make the objectives, technical solutions and advantages of the present disclosure clearer, the present disclosure will be further described in detail below with reference to the accompanying drawings. It is obvious that the described embodiments are only some but not all of the embodiments of the present disclosure. All other embodiments acquired by those of ordinary skill in the art without considerable creative effort based on the embodiments in the present disclosure are within the scope of the protection of the present disclosure.

[0024] The terms used in the embodiments of the present disclosure are for the purpose of describing particular embodiments only and are not intended to limit the present disclosure. The singular forms "a/an," "said" and "the" used in the embodiments of the present disclosure and the appended claims are intended to include the plural forms as well, unless otherwise clearly indicated in the context. The term "a plurality of" generally includes at least two.

[0025] It should be understood that the term "and/or" used herein only describes a relationship between associated objects and indicates that there may be three kinds of relationships. For example, A and/or B may indicate three cases: A exists alone, A and B exist at the same time, and B exists alone. In addition, the character "/" herein generally indicates an "or" relationship between the contextual objects.

[0026] It should be understood that, although the terms first, second, third, etc., may be used to describe in the embodiments of the present disclosure, these should not be limited to these terms. These terms are only used to distinguish. For example, "first" may also be referred to as "second" without departing from the scope of the embodiments of the present disclosure. Similarly, "second" may also be referred to as "first."

[0027] It should also be noted that the terms "including," "containing," or any other variants thereof are intended to cover the nonexclusive inclusion, such that a commodity or device including a series of elements comprises not only those elements, but also other elements not listed explicitly or elements inherent to such a commodity or device. Without more limitations, the element defined by the phrase "including a ..." does not exclude the existence of other same elements in the commodity or device, including the element.

[0028] Optional embodiments of the present disclosure will be described in detail in combination with the accompanying drawings.

[0029] 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 floor vacuuming robot, or may be a ground mopping/brushing robot, or may be a window-climbing robot, or the like. 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.

[0030] The mobile platform 100 may be configured to move automatically along a target direction on an operating surface. 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 operates on a ground, and the ground is the operating surface. The automatic cleaning apparatus may also be a window cleaning robot, and thus the automatic cleaning apparatus operates 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 operates on an inner surface of a pipe, and the inner surface of the pipe is the operating surface. For the purpose of presentation only, the following description in the present disclosure takes a ground mopping robot as an example for illustration.

[0031] In some embodiments, the mobile platform 100 may be an autonomous mobile platform, or a non-autonomous mobile platform. The autonomous mobile platform refers to the mobile platform 100 itself being able to automatically and adaptively make an operational decision based on an unexpected environmental input, while the non-autonomous mobile platform itself cannot adaptively make an operational decision based on an unexpected environmental input but is able to execute a given program or operate according to a certain logic. Correspondingly, when the mobile platform 100 is an autonomous mobile platform, the target direction may be determined autonomously by the automatic cleaning apparatus, and when the mobile platform 100 is a non-autonomous variety of mobile platform, the target direction may be set systematically or manually. When the mobile platform 100 is an autonomous mobile platform, the mobile platform 100 includes a forward portion 111 and a rearward portion 110.

[0032] The perception system 120 includes a position-determining device 121 located on the mobile platform 100, a buffer 122 located in the forward portion 111 of the mobile platform 100, cliff sensors 123 and sensing devices such as an ultrasonic sensor (not shown), an infrared sensor (not shown), a magnetometer (not shown), an accelerometer (not shown), a gyroscope (not shown) an odometer (not shown), and the like located at a bottom of the mobile platform 100 for providing various position information and motion-state information of the automatic cleaning apparatus to the control system 130.

[0033] In order to describe behaviors of the automatic

cleaning apparatus more clearly, directions are defined as follows: the automatic cleaning apparatus may travel along the ground by various combinations of movements relative to the following three mutually perpendicular axes defined by the mobile platform 100, i.e., a transversal axis Y, a front and rear axis X and a center vertical axis Z. A forward driving direction along the front and rear axis X is designated as "forward," and a rearward driving direction along the front and rear axis X is designated as "rearward." The transversal axis Y extends between a right wheel and a left wheel of the automatic cleaning apparatus substantially along an axis center defined by a center point of a driving wheel assembly 141. The automatic cleaning apparatus may rotate around the Y axis. It is referred to as "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 referred to as "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 around the Z axis. In a forward direction of the automatic cleaning apparatus it is referred to as "turn right" when the automatic cleaning apparatus is tilted to the right of the X axis, and it is referred to as "turn left" when the automatic cleaning apparatus is tilted to the left of the X axis.

[0034] As shown in FIG. 2, the cliff sensors 123 are provided at the bottom of the mobile platform 100 in the 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 a direction same as a traveling direction of the automatic cleaning apparatus, and the aforementioned "rear" refers to a side opposite the traveling direction of the automatic cleaning apparatus.

[0035] The position-determining device 121 includes, but is not limited to, a camera and a laser distance sensor (LDS).

[0036] Various components in the perception system 120 may operate independently or operate together to achieve a function more accurately. The surface to be cleaned is identified by the cliff sensors 123 and the ultrasonic sensor to determine physical properties of the surface to be cleaned, including a surface material, a degree of cleanliness and the like, and may be determined more accurately in combination with the camera, the LDS or the like.

[0037] 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 material consistent with carpeting, the control system 130 controls the automatic cleaning apparatus to perform cleaning in a carpet mode.

[0038] 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 auto-

matic cleaning apparatus along 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, e.g., an infrared sensor, and the automatic cleaning apparatus may control the driving wheel assembly 141 based on the event (or object), such as obstacle and wall, detected by the buffer 122, to cause the automatic cleaning apparatus to respond to the event (or object), for example, to move away from the obstacle.

[0039] The control system 130 is disposed on a main circuit board in the mobile platform 100 and includes a computing processor such as a central processing unit and an application processor that communicates with a non-transitory memory such as a hard disk, flash memory or random-access memory. The application processor is configured to receive environmental information sensed by the 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 using a positioning algorithm, e.g., simultaneous localization and mapping (SLAM), based on obstacle information fed back by the LDS, and to autonomously determine a traveling path based on the environmental information and the environmental map, and then to control the driving system 140 to perform operations such as traveling forward, traveling backward, and/or steering based on the autonomously determined traveling 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.

[0040] Specifically, the control system 130 may, based on distance information and speed information that are fed back by the buffer 122, the cliff sensors 123 and the sensing devices such as the ultrasonic sensor, the infrared sensor, the magnetometer, the accelerometer, the gyroscope and the odometer, comprehensively determine a current operation state of the floor-sweeping robot, such as crossing a threshold, navigating onto a carpet, arriving at an edge of a precipice, being stuck from above or below, having a full dust box or being picked up, and may also give specific next-step action strategies for different situations so that the operation of the automatic cleaning apparatus is more in line with requirements of an owner and provides a better user experience. Further, the control system can plan the most efficient and reasonable cleaning path and cleaning mode based on the simultaneous map information drawn by the SLAM, thereby greatly improving the cleaning efficiency of the automatic cleaning apparatus.

[0041] The driving system 140 may execute a driving command based on specific distance and angle information, such as x, y, and θ components, to manipulate the automatic cleaning apparatus to travel along the ground. As shown in FIG. 2, the driving system 140 includes the driving wheel assembly 141 and may control a left wheel and a right wheel simultaneously. In order to control the motion of the automatic cleaning apparatus more pre-

cisely, the driving system 140 preferably includes a left driving wheel assembly and a right driving wheel assembly. The left driving wheel assembly and the right driving wheel assembly are arranged symmetrically along a transversal axis defined by the mobile platform 100.

[0042] In order for the automatic cleaning apparatus to move along the ground more stably or have a higher movement ability, the automatic cleaning apparatus may include one or more steering assemblies 142, where 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.

[0043] The energy system 160 includes a rechargeable battery, such as a nickel-hydrate battery and a lithium battery. The rechargeable battery may be connected to a charging control circuit, a circuit for detecting the charging temperature of the battery pack and a battery undervoltage monitoring circuit, where the charging control circuit, the circuit for detecting the charging temperature of the battery pack 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.

[0044] The human-computer interaction system 170 includes keys that are on a panel of the host and used by a user to select functions. The human-computer interaction system 170 may further include a display screen and/or an indicator light and/or a horn that present a current state or function item of the automatic cleaning apparatus to the user. The human-computer interaction system 170 may further include a mobile client program. For a path navigation type cleaning apparatus, a mobile client may present a map of the environment where the apparatus is located and a position of the apparatus to the user, which can provide richer and more user-friendly functional options to the user.

[0045] As shown in FIG. 2, the cleaning module 150 may include a dry-cleaning module 151.

[0046] 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 refuse on the ground and uses a rolling action to gather the refuse to the front of a dust-suction inlet between the rolling brush and the dust box, and then the refuse is sucked into the dust box by air having a suction force generated by the blower and passes through the dust box. The dust-removal capacity of the ground-sweeping robot may be characterized by a dust pickup efficiency (DPU) of the refuse. The DPU is affected by a structure and material of the rolling brush, by a utilization rate of the air in an air channel formed by the dust-suction inlet, the dust box, the blower, the air outlet and connecting components between the four, and by a type and power of the blower, which is a complex problem about

systematic design. Enhanced dust-removal capacity is more meaningful for an automatic cleaning apparatus with limited energy than for an ordinary plug-in vacuum cleaner because the improvement of the dust-removal capacity directly and effectively reduces requirements for energy, that is, the original cleaning apparatus that may clean 80 square meters of the ground on a single charge may be evolved to clean 180 square meters or more on a single charge. Further, the service life of the battery with the reduced number of charging times will also be greatly increased, so that the frequency of replacing the battery by the user will also be decreased. More intuitively and importantly, improvement of the dust-removal capacity is the most obvious and important user-experience enhancer, as the user will be able to directly determine whether thorough cleaning has been achieved. The dry-cleaning module may further include a side brush 152 having a rotary shaft angled relative to the ground, for moving debris into the vicinity of the rolling brush of the cleaning module 150.

[0047] As an optional cleaning module, the automatic cleaning apparatus may further include a wet-cleaning module configured to clean at least a part of the operating surface in a wet-cleaning manner. The wet-cleaning module includes a water tank, a cleaning head, a driving unit and the like, where water in the water tank flows to the cleaning head along a waterway, and the cleaning head is driven by the driving unit to clean at least a portion of the operating surface.

[0048] A shell of an existing automatic cleaning apparatus has a complex structure, a large number of parts, long assembly time, complicated procedures and high cost. For example, a top-surface flip cap and a turning mechanism of the automatic cleaning apparatus are additionally provided, an upper-shell decorative component is mounted on the top-surface flip cap, and the like. Although the upper-shell decorative component and the upper flip cap serve to beautify the appearance, protect internal elements, and the like, the machine as a whole is complex in structure and high in cost, and there is an adverse impact on the design space of elements such as a dust box under the top-surface flip cap.

[0049] Therefore, the embodiment of the present disclosure provides an automatic cleaning apparatus without a flip cap, which streamlines unnecessary elements of the automatic cleaning apparatus while increasing the design space of a dust box and its accommodating chamber. The same structure has the same technical effects, and some technical components are not repeated herein. Specifically, the present disclosure provides an automatic cleaning apparatus, as shown in FIG. 3, which includes a mobile platform 100 and a dry-cleaning module 151. The mobile platform 100 is configured to automatically move along an operating surface and includes an accommodating chamber 200. In some embodiments, the accommodating chamber 200 is disposed at a rear side in an advancing direction of the automatic cleaning apparatus and includes a first chamber 201 and

a second chamber 202. The dry-cleaning module 151 includes a dust box 300 detachably assembled in the accommodating chamber 200. The first chamber 201 and the second chamber 202 are sequentially and adjacently disposed in the advancing direction of the automatic cleaning apparatus, and the depth of the first chamber 201 is greater than that of the second chamber 202. The first chamber 201 and the second chamber 202 are sequentially and adjacently disposed in the advancing direction of the automatic cleaning apparatus so that a part with larger size and weight can be disposed at the position closer to the middle of the automatic cleaning apparatus, the dust box is more stably disposed in the accommodating chamber 200, the center of gravity of the entire cleaning apparatus is more stable, and the cleaning apparatus is more stable in the process of traveling, turning, navigating obstacles and the like, and is not easy to overturn. Meanwhile, it is convenient to manufacture a dust box accommodating part and a dust box top cap into an integrated structure so that the dust box top cap may be incorporated into the top surface of the mobile platform and is flush with other portions of the top surface of the mobile platform, which does away with the flip-cap structure of the traditional cleaning apparatus. Meanwhile, it is convenient to directly align a dust-suction port located at the approximately central position of the bottom of the cleaning apparatus with the dust box so that dust directly enters the dust box from the dust-suction port, thereby reducing travel of the dust entering the machine and avoiding pollution through dust of the interior of the machine. The depth of the first chamber 201 is greater than the depth of the second chamber 202, and the dust box and the dust box top cap can be accommodated in separate structures, which is convenient for the integrated design of the dust box top cap. The bottom of the front side wall of the first chamber 201 is provided with the dust-suction port 203, a rear side wall of a connection between the first chamber 201 and the second chamber 202 is provided with an air outlet 208, the air outlet 208 has a grid structure, the space below the second chamber 202 accommodates a fan, and the fan can be mounted on a fan bracket. In some embodiments the air outlet 208 is integrated into the fan bracket; the rear side wall of the mobile platform 100 is provided with exhaust ports 204. The fan's suction force causes the dust to enter the dust box 300 from the dust-suction port 203, and airflows are filtered by a dust box filter screen and then discharged from the exhaust ports 204.

[0050] In some embodiments, the dust box 300 includes an accommodating part 301 and a top cap 302 located above the accommodating part 301, and the top cap is fixedly connected to the accommodating part. The fixed manner of connection includes, but is not limited to, bonding, welding, integral molding, bolt connection, buckling connection, and so forth. The accommodating part is used for accommodating refuse sucked from the dust-suction port 203, and the shape of the accommodating part is approximately matched with the first cham-

ber 201.

[0051] A roller brush, which has a certain interference with the ground, sweeps up the refuse on the ground and brings the refuse with a rolling motion to the front of the dust-suction port 203 between the roller brush and the dust box 300 under the action of a negative-pressure airflow generated by the fan; then the refuse is sucked into the dust box 300 through a suction airflow generated by the fan and, passing through the dust box 300, the refuse is isolated in the dust box 300 by a filter screen 500 and filtered air enters the fan.

[0052] Typically, the accommodating part 301 of the dust box 300 has a first opening 3011 on the front side of the dust box, and the first opening 3011 is aligned with the dust-suction port 203. The accommodating part 301 has a second opening 3012 on the rear side of the dust box, the filter screen 500 is disposed at the second opening 3012, and the second opening 3012 is docked with the air outlet 208. The filter screen 500 is detachably connected to a box body of the dust box 300, which facilitates the disassembling and washing of the filter screen. The front side refers to a side, in the X direction, along the advancing direction of the automatic cleaning apparatus after the dust box 300 is assembled in the accommodating chamber 200. The rear side refers to a side, in the X direction, opposite to the advancing direction of the automatic cleaning apparatus.

[0053] In some embodiments, the top cap 302 includes a first portion 3021 covering the accommodating part 301 and a second portion 3022 extending outward beyond the accommodating part 301. When the dust box 300 is assembled in the accommodating chamber 200, the accommodating part 301 and the first portion 3021 of the top cap 302 are accommodated in the first chamber 201, and the second portion 3022 of the top cap 302 is accommodated in the second chamber 202. The top cap 302 is approximately matched with the top-end portion of the first chamber and the structure of the second chamber so that the dust box 300 can be stably mounted in the accommodating chamber 200, which avoids agitation of the dust box caused by bumping of the automatic cleaning apparatus during the traveling process. Meanwhile, the dust box top cap can cover only positions of the accommodating part and the fan so that the upper surface of the dust box top cap is approximately horizontal with the upper surface of the mobile platform, creating a smooth contour of the outer surface of the automatic cleaning apparatus. The overall appearance is better in coordination, which also provides more space choices for the design of various components, including the accommodating part below the top cap, and is convenient for arranging the positions of different components, and the volume of the dust box is improved in selectivity; the specific size can be arranged as required without affecting the overall opening size of the accommodating chamber and a mold opening cost is reduced.

[0054] In some embodiments, the first portion 3021 of the top cap 302 includes an edge portion 30211 protrud-

ing out of the edge contour of the accommodating part to extend outward. The accommodating chamber 200 includes a step part 205 extending around the top-end edge of the accommodating chamber, and the step part 205 is configured to accommodate at least a part of the edge part 30211 and at least a part of the outer edge of the second portion so that the upper surface of the top cap is approximately coplanar with the upper surface of the mobile platform. The step part 205 of the accommodating chamber 200 extending around the top edge of the accommodating chamber can completely accommodate the edge of the top cap 302, so that the top cap 302 can be accommodated in the accommodating chamber 200 in a basically seamless manner, which can prevent foreign objects from directly falling into an edge slit of the dust box, thereby further preventing the dust box from being stuck, and meanwhile the top cap as the upper surface of the automatic cleaning apparatus is aesthetically pleasing.

[0055] In some embodiments, a support structure 3023 is disposed below the second portion 3022 of the top cap 302 and configured to support the second portion 3022 of the top cap. Optionally, the support structure 3023 is integrally formed with at least a part of the accommodating part 301 so as to enhance a supporting force of the support structure 3023 for the second portion 3022 of the top cover 302 and effectively prevent damage to the second portion 3022. The support structure 3023 may include, but is not limited to, an arc-shaped structure and a linear structure. As an embodiment, for example, the support structure 3023 is two arc-shaped structures that are symmetrically disposed and approximately matched with the outer-edge contour of the second portion 3022 of the top cap 302.

[0056] In some embodiments, the lower surface of the second chamber 202 includes a groove 2021, and the groove 2021 is approximately matched with the contour of the support structure 3023. It is configured in such a way that when the second portion of the top cap is accommodated in the second chamber, the support structure 3023 is accommodated in the groove 2021, with the result that the upper surface of the top cap 302 is basically horizontal.

[0057] In some embodiments, the top cap is symmetrically disposed along a central axis in the advancing direction of the automatic cleaning apparatus. In some embodiments, the shape of the top cap is at least one or a combination of the following: D-shaped, rectangular, square, circular, elliptical, triangular, quadrilateral, pentagonal, hexagonal, heptagonal and/or octagonal, as shown in FIGs. 6a-6h. With the symmetrical arrangement, the appearance of the machine can be relatively aesthetic even without being concealed by an external cap, and the dust box can be relatively easily mounted and disassembled.

[0058] In some embodiments, the first chamber 201 includes a first latching member 701, the second chamber 202 includes a second latching member 72, the first

portion 3021 of the top cap includes a first locking member 601, and the second portion 3022 of the top cap includes a second locking member 602. The first locking member 601 cooperates with the first latching member 701 for locking, and the second locking member 602 cooperates with the first latching member 72 for locking.

[0059] As for the dust box of the automatic cleaning apparatus and its mounting structure according to the above embodiments, the accommodating chamber is disposed on the rear side in the advancing direction of the automatic cleaning apparatus, the accommodating chamber includes the first chamber and the second chamber, and the depth of the first chamber is greater than the depth of the second chamber. After the dust box is assembled in the accommodating chamber, the upper surface of the dust box top cap is approximately coplanar with the upper surface of the mobile platform, which simplifies the structure of the top surface of the automatic cleaning apparatus, reduces the production cost and increases the design space of the accommodating chamber.

[0060] The existing automatic cleaning apparatus is provided with a pop-out dust box and a non-pop-out dust box. The pop-out dust box includes a top-surface flip cap and a turning mechanism. When taking and placing the dust box, the top-surface flip cap needs to be opened, and then the dust box is popped out by pressing the dust box. In this embodiment of the existing automatic cleaning apparatus, a complex dust box pop-out mechanism is needed that includes a plurality of parts such as a spring, and the dust box probably cannot be popped out smoothly due to reduced elasticity from the spring's repeated use. In addition, many other parts may easily prevent the dust box from being popped out in the normal fashion, which adversely affects use. The non-pop-out dust box mostly adopts a complex locking structure in which a spring assembly is likely to age and become damaged; the matching comfort level of pressing a part with a finger is also insufficient during operation and the overall user experience is poor.

[0061] Therefore, the embodiment of the present disclosure provides an automatic cleaning apparatus without a flip cap, which eliminates unnecessary elements in the automatic cleaning apparatus while facilitating removal and replacement of the dust box. Compared with the above embodiments, the present embodiment briefly describes some structural features, the structure has the same technical effects, and some technical effects are not repeated herein. Specifically, as shown in FIGs. 1-5 and 7, the automatic cleaning apparatus includes a mobile platform 100 and a cleaning module. The mobile platform 100 is configured to automatically move along an operating surface, and includes an accommodating chamber 200 disposed on the rear side in an advancing direction. The cleaning module includes a dust box 300 detachably situated in the accommodating chamber 200, and the dust box includes an accommodating part 301, a top cap 302 above the accommodating part, and a lock-

ing mechanism. The locking mechanism includes a first locking mechanism 610 approximately located at a central axis of the top cap. The first locking mechanism 610 includes at least a first knob recess 603 and a first locking member 601, the first locking member 601 is located in the first knob recess 603, and the first locking member 601 can move elastically relative to the first knob recess 603 under the action of an external force. The first knob recess 603 forms a recess downward along the edge of a first portion of the top cap, and the first knob recess 603 provides a sufficient depth in the Z direction, so that the height of the first locking member 601 is lower than the surface of the top cap. The first knob recess 603 provides a sufficient elastic space in the X direction so that there is enough movable space when the first locking member 601 elastically moves inward.

[0062] In some embodiments, the first locking member 601 includes a first elastic arm 6011, a first handle part 6012 and a first buckling part 6013, where the first elastic arm 6011 extends upward from the bottom of the first knob recess 603, the first handle part 6012 is located at the upward extending tail end of the first elastic arm 6011, and the first buckling part 6013 transversely extends along the first elastic arm 6011. The overall first elastic arm 6011 is approximately door-shaped, so as to reduce materials and increase elasticity, and this shape and structure are not limited. The first handle part 6012 is transversely disposed above the first elastic arm 6011, and the first handle part 6012 includes a bottom surface approximately protruding outward and a knob surface extending upward along the bottom surface. The knob surface extends to a position approximately flush with the top cap, and the knob surface may be of an arc-shaped structure, that is, a projection thereof on the horizontal plane is arc-shaped. The knob surface is convenient for receiving a manual operation and is more in line with an ergonomic stress relationship with finger shapes. In some embodiments, the first buckling part 6013 is a pair of sheet-like structures symmetrically disposed along two sides of the first elastic arm 6011 and widths of the sheet-like structures from roots to free end parts change from large to small, so as to facilitate smooth insertion of the first latching member 701. The first elastic arm 6011 is made of a common elastic material as a whole, such as a plastic or organic elastic material.

[0063] In some embodiments, as shown in FIG. 8, which is an enlarged schematic diagram of the first latching member at A in FIG. 3a, the first latching member 701 is disposed at the position of the inner wall of the accommodating chamber 200 approximately corresponding to the first locking member 601, and the first locking member 601 cooperates with the first latching member 701 for locking. In some embodiments, the first latching member 701 is a pair of through holes and the free end parts of the sheet-like structures are inserted into the through holes to achieve locking.

[0064] In some embodiments, a first recess 206 is formed in the position of the inner wall of the accommo-

dating chamber approximately corresponding to the first knob recess 603, and the pair of through holes is disposed in two sides of the first recess 206. When the first locking member 601 extends into the through holes, locking is realized, and when fingers sticking in the first recess 206 apply an action force to pull the first locking member 601 out of the through holes, unlocking is realized. Due to coordinate cooperation of the first recess 206 and the first knob recess 603, the finger-sticking operation is easier and more convenient.

[0065] In some embodiments, as shown in FIG. 9a, the locking mechanism further includes a second locking mechanism 620, the second locking mechanism 620 includes a second knob recess 605 and a second locking member 602, the second knob recess 605 forms a notch, such as an arc-shaped notch or a square notch, inward along the approximate centerline position of a second portion 3022 of the top cap, which is convenient for the fingers to stick in for a buckling operation. The second locking member 602 is located on the lower side of the second knob recess 605. The second knob recess 605 provides enough space for the fingers to control the second locking member 602, and the second locking member 602 elastically moves inward under the action of an external force. Specifically, the second locking member 602 includes second elastic arms 6021, a second handle part 6022 and second buckling parts 6023. The second elastic arms 6021 are located below the second knob recess 605, the second elastic arms 6021 include two symmetrical parts, and each second elastic arm 6021 extends along the opening direction of the second knob recess 605, then along the edge direction of the top cap, and then along the edge direction of the second knob recess 605. The opening direction of the second knob recess 605, as shown in FIG. 9a, is the A direction outward from the center of the top cap, and is, in the present embodiment, also the backward direction of the top cap of the dust box. The two parts of second elastic arms 6021 are symmetrically connected approximately in two Π -shaped structures, and the second handle part 6022 is connected to the two parts of second elastic arms 6021 that are symmetrically disposed. Specifically, the second handle part 6022 is disposed above the two second elastic arms, as shown in FIGs. 9b and 9c. FIG. 9c is an enlarged view of the second handle part at C in FIG. 9b. The bottom of the second handle part 6022 includes a bottom surface 60221 approximately protruding outward and a knob surface 60222 extending upward along the bottom surface. The knob surface extends to a position approximately flush with the top cap, may be of an arc-shaped structure, and is convenient for receiving a manual operation for the fingers to exert an action force. Optionally, the second handle part 6022 is integrally formed with the symmetrically disposed second elastic arms 6021, and the second buckling parts 6023 are disposed at transversely extending portions of the second elastic arms. A pair of second buckling parts 6023 is symmetrically disposed along two sides of the second

elastic arms 6021, and for example, is of protruding or sheet-like structures extending along the direction A. As an optional embodiment, each second buckling part 6023 includes a groove extending inward from the end part of the second buckling part 6023 and the groove can prevent difficulty in buckling caused by the fact that the whole second buckling part is deformed too much after molding and cooling. Optionally, the second locking member 602 further includes symmetrically disposed connectors 6024; the connectors 6024 are generally planar; certain ends of the second elastic arms 6021 are connected to certain surfaces of the connectors 6024, and the other surfaces of the connectors 6024 are connected and fixed with end surfaces of support structures. The second knob recess 605 is exposed from the second handle part 6022 in the X direction, so that when unlocking, the fingers can stick into the second knob recess 605 and press on the second handle part 6022 to exert force on the inner side of the dust box along the X axis and drive the second buckling parts 6023 to elastically contract inward. Thus, the second buckling parts 6023 are popped out from the bottom of a second latching member 702 to realize unlocking. The second elastic arms 6021 are made of a common elastic material as a whole, such as a plastic or organic elastic material.

[0066] In some embodiments, as shown in FIG. 10, which is an enlarged view of the second latching member 702 shown at B in FIG. 3b, the second latching member 702 is disposed at the position of the inner wall of the accommodating chamber 200 approximately corresponding to the second locking member 602, and the second locking member cooperates with the second latching member for locking. The second latching member is a pair of protrusions, and the second buckling parts 6023 extend into the bottom of the second latching member 702 to achieve locking. The protrusions may be flat, cylindrical, cuboid, etc., which is not limited herein, so long as the second buckling parts can be blocked.

[0067] In some embodiments, a second recess 207 is disposed at the position of the lower surface of the second chamber 202 approximately corresponding to the second knob recess 605, and the pair of protrusions is disposed on the rear side wall of the second chamber 202 in an equal-height manner and located above the second recess 207. The second recess 207 is configured to avoid and accommodate the second locking member 602 when the dust box 300 is placed in the accommodating chamber 200 so that the whole dust box is better in-place in the accommodating chamber 200.

[0068] In some embodiments, the top cap includes the first portion covering the accommodating part and the second portion protruding from the accommodating part and extending outward, and the second knob recess 605 and the second locking member 602 are located in the second portion of the top cap. The lower side of the second portion of the top cap includes the support structures 3023 that are configured to support the second portion of the top cap, and the second locking member

602 is disposed on the support structures 3023. As shown in FIG. 4, the symmetrically disposed support structures 3023 form an inward compression space in the X direction, and when the second elastic arms 6021 are connected to the symmetrical support structures 3023, there is enough elastic space to respond to the applied inward action force.

[0069] As for the dust box locking structures according to the above embodiment, the locking structures are symmetrically disposed in the front-rear direction of the dust box top cap so that when a single hand exerts the action force on the front and rear elastic structures of the dust box, unlocking can be realized, and the dust box will not be tilted because the dust box is popped out from one side after the unlocking is realized only from one side. Meanwhile, due to the simple elastic structures, elastic unlocking can be realized only by the elastic arms made of the elastic material, thereby avoiding the risk that complex unlocking devices such as springs are likely to be damaged.

[0070] In some embodiments, as shown in FIG. 4, the second locking mechanism 620 includes at least one first magnetic attraction module 604 disposed between the second portion of the top cap and the support structures. As shown in FIG. 3a, the accommodating chamber includes at least one second magnetic attraction module 606 configured to cooperate with and attract the first magnetic attraction module 604 to be locked. In an application process, the first locking member 601 corresponding to the dust box may be retracted by pushing the first locking member 601 and the second knob recess 605 by hand. When the dust box is placed in the accommodating chamber and released by hand, the first buckling part 6013 on the first locking member 601 will be automatically popped out and inserted into the first latching member 701, and the first magnetic attraction module 604 and the second magnetic attraction module 606 attract each other, thereby realizing locking of the dust box. The locking structure is simple, easy for operation and can conveniently realize locking of the dust box.

[0071] In some embodiments, the second locking mechanism 620 as described above may include the second knob recess 605 and the second locking member 602 as described in an embodiment, or may include the first magnetic attraction module 604 as described in another embodiment, or may include the components in the above two embodiments, which are not limited.

[0072] The dust box of the existing automatic cleaning apparatus needs to be equipped with a replaceable dust box filter screen. The traditional filter screen is generally made of plastic or metal into a hard frame. A laminated filter element is placed in the frame, the frame and the filter element are connected by glue dispensing with the peripheries being sealed, and then a sealing strip is bonded to the frame to seal a slit between the filter screen and the dust box. Therefore, part of the structure of the traditional dust box filter screen is complex, mounting steps of the filter screen are cumbersome, which wastes

labor and cost, and the glue used in sealing is neither economical nor environmentally friendly.

[0073] Therefore, the embodiments of the present disclosure provide an automatic cleaning apparatus, which includes a mobile platform and a cleaning module. The mobile platform is configured to automatically move along an operating surface and includes an accommodating chamber. The cleaning module includes a dust box. The dust box is detachably assembled in the accommodating chamber and includes a dust box filter screen, and the dust box filter screen is applied in the dust box of the automatic cleaning apparatus, thereby simplifying an assembling process of the dust box filter screen. Compared with the above embodiments, the present embodiment briefly describes some structural features, the same structure has the same technical effects, and some technical effects are not repeated herein. Specifically, as shown in FIGs. 11-12, the dust box filter screen 500 includes a soft rubber frame 501 and a filter element 502. The soft rubber frame includes at least one soft rubber protrusion 5011 for sealing an assembling gap with the dust box in the assembling process. The filter element 502 is sleeved in the soft rubber frame 501. The soft rubber frame 501 is connected to the filter element 502 in a non-detachable manner. For a specific non-detachable connection process between the soft rubber frame 501 and the filter element 502, a rubber coating injection molding process may be adopted, the filter element is sleeved in the frame in advance, and then soft rubber is sleeved on the sleeved frame combined body to form a plurality of required sealing protrusions integrally. Alternatively, a double injection process may be used for injecting the hard rubber frame main body first, wherein the filter element is sleeved on the frame body and the soft rubber is injected to form the inner and outer sealing protrusions.

[0074] The soft rubber frame may be rectangular, square, oval, circular, polygonal and/or other structures, and the structure is not limited. In some embodiments, the soft rubber frame is a rectangular structure, and the soft rubber frame of the rectangular structure includes oppositely disposed two soft rubber frame first side walls 50111 and two soft rubber frame second side walls 50113. The soft rubber protrusions include first protrusions 5011 distributed on the outer peripheral surface of one soft rubber frame first side wall 50111 and second protrusions 5015 distributed on the outer peripheral surface of the other soft rubber frame first side wall 50111. The pair of soft rubber frame first side walls 50111 and the pair of soft rubber frame second side walls 50113 form the rectangular structure frame, and the filter element is sleeved in the rectangular structure frame, as shown in FIGs. 11 and 12.

[0075] In some embodiments, the first protrusions 5011 and the second protrusions 5015 may be continuous protrusion structures. For example, the first protrusions 5011 and the second protrusions 5015 extend continuously from one end to the other end of the outer

peripheral surface of each soft rubber frame first side wall 50111. Since the first protrusions 5011 and the second protrusions 5015 are of soft rubber structures, when the dust box filter screen is assembled on the dust box, the first protrusions 5011 and the second protrusions 5015 will be pressed and directly sealed between the dust box filter screen 500 and a second opening 3012 of the dust box, and are in full contact and sealed with the inner wall, approximately extending along the horizontal direction, of the second opening 3012 of the dust box, instead of the step of sealing by a sealing strip after the traditional dust box filter screen is assembled on the dust box.

[0076] In some embodiments, as shown in FIG. 14, at least one of the first protrusions and the second protrusions are of an inverted buckle structure, and the inverted buckle structure is configured to seal the assembling gap between the soft rubber frame and the dust box while preventing the dust box filter screen from falling off of the dust box. Specifically, the inverted buckle structure is an arc-shaped structure tilted towards one side opposite to an assembling direction of the dust box filter screen. In an assembling process of the dust box filter screen, it is convenient for the inverted buckle structure to tilt towards one side opposite to the assembling direction along with a frictional force generated when the dust box filter screen extends into a dust box assembling opening, and then, the inverted buckle structure is pressed and sealed between the dust box filter screen and the dust box.

[0077] In some embodiments, the soft rubber frame second side walls further include at least one third protrusion 5012 distributed on the outer peripheral surface of at least one soft rubber frame second side wall 50113 of the frame structure. The third protrusions 5012 may be a plurality of discrete protrusion structures. As an embodiment, the third protrusions 5012 are distributed on the outer peripheral surfaces of two second side walls 50113 of the frame structure. When the dust box filter screen is assembled on the dust box, the third protrusions 5012 located on the outer peripheral surface of one soft rubber frame second side wall 50113 of the frame structure have slightly long structures, which can extend into the recess of the side wall of the dust box to play a role of buckling and preventing the dust box filter screen from falling off. Meanwhile, when assembling the dust box filter screen, the slightly long third protrusions 5012 may be inserted into the recess of the side wall of the dust box at first, and the other side of the dust box filter screen is mounted in the dust box after the dust box filter screen rotates around the third protrusions 5012. The third protrusions 5012 distributed on the outer peripheral surface of the other soft rubber frame second side wall 50113 of the frame structure have smoother structures. When the dust box filter screen is assembled on the dust box, the third protrusions 5012 on this side are in interference blocking with an elastic structure 5013 on the side wall of the dust box to prevent the dust box filter screen from falling off. The elastic structure 5013 is approximately S-shaped and has inner concave parts for accommodating the third

protrusions 5012 and outer convex parts blocked with the third protrusions 5013. The outer convex parts may move elastically under the action of an external force to be blocked with the third protrusions 5012, as shown in FIG. 15, which is a mounting structural diagram of the dust box filter screen viewed from the bottom end of the dust box. In some embodiments, as shown in FIGs. 13a and 13b, the soft rubber frame further includes first ribs 510 disposed on the outer peripheral surfaces of the soft rubber frame second side walls and configured to prevent poor assembling caused by the fact that the dust box filter screen is mounted into the dust box too deeply or too shallowly. In a process that the dust box filter screen is mounted in the dust box after the dust box filter screen is assembled in place, each first rib 510 is abutted against a pillow position 5014 disposed at the corresponding position of a dust box frame to prevent the filter screen from further extending inward, which can prevent the dust box filter screen from being mounted in the dust box too deeply. Meanwhile, when the first rib 510 is not abutted against the pillow position 5014 of the dust box frame in the assembling process, it is considered that the assembly is not in place, and the dust box filter screen can be prevented from being mounted into the dust box too shallowly, as shown in FIG. 15.

[0078] In some embodiments, as shown in FIGs. 13a and 13b, the soft rubber frame further includes fool-proof protrusions 509 disposed on the outer peripheral surfaces of the soft rubber frame second side wall and configured to prevent the dust box filter screen from being mounted reversely. There is a recess disposed at the position of the dust box corresponding to each fool-proof protrusion 509. When the dust box filter screen is mounted normally, the fool-proof protrusion 509 will enter the recess to enable the dust box filter screen to be assembled normally. When the dust box filter screen is mounted reversely, the fool-proof protrusion 509 will block the assembling of the dust box filter screen since there is no such recess in the other side of the dust box, thereby playing a fool-proof role of prompting reverse mounting of the dust box filter screen.

[0079] In some embodiments, as shown in FIGs. 3a and 3b, the accommodating chamber 200 includes a first chamber 201 and a second chamber 202; the first chamber 201 and the second chamber 202 are sequentially and adjacently disposed in the advancing direction of the automatic cleaning apparatus, and the depth of the first chamber 201 is greater than the depth of the second chamber 202. The bottom of the front side wall of the first chamber 201 is provided with a dust-suction port 203, and the rear side wall of a connection between the first chamber 201 and the second chamber 202 is provided with an air outlet 208. The space below the second chamber 202 accommodates a fan, and the rear side wall of the mobile platform 100 is provided with exhaust ports 204. Under a suction force action of the fan, dust enters the dust box 300 from the dust-suction port 203, and airflows are filtered by the dust box filter screen and

then discharged from the exhaust ports 204. The air outlet 208 is provided with a grid structure.

[0080] As shown in FIGs. 11 and 12, the soft rubber frame further includes a sealing inner lip 507 and a sealing outer lip 506. The sealing inner lip 507 is disposed on a first end surface 50116 of the soft rubber frame 501 in a manner around the filter element 502 and configured to realize sealing fit between the dust box filter screen and an assembling surface 30121 of the second opening 3012 of the dust box. The assembling surface 30121 of the second opening 3012 of the dust box is formed on one side in the second opening close to the inner wall of the dust box, is approximately of a planar structure, and is used for assembling the soft rubber frame after being abutted against the first end surface 50116 of the soft rubber frame 501, as shown in FIG. 14. The sealing outer lip 506 is disposed on a second end surface 50115 of the soft rubber frame 501 in a manner around the filter element 502 and configured to seal the edges of the dust box filter screen and the air outlet 208 of the accommodating chamber 200. The sealing inner lip 507 and the sealing outer lip 506 are higher than the first end surface 50116 or the second end surface 50115 where they are located. After being assembled in place, the sealing inner lip 507 will be pressed between the dust box filter screen and the assembling surface of the dust box. Since the sealing inner lip 507 is made of a flexible material, the dust box filter screen and the assembling surface of the dust box are sealed under a pressing force. After the dust box is assembled on the automatic cleaning apparatus, the sealing outer lip 506 of the dust box filter screen is pressed between the dust box filter screen and the outer side of a grid of the air outlet 208 of the accommodating chamber 200, thereby sealing the dust box filter screen and an assembling surface of a fan bracket. As shown in FIGs. 3a and 3b, the side wall where the first chamber 201 and the second chamber 202 are connected forms the assembling surface of the fan bracket, the fan is disposed below the second chamber 202, and the grid air outlet 208 is disposed in the side wall where the first chamber 201 and the second chamber 202 are connected. Through the sealing inner lip 507 and the sealing outer lip 506 disposed on the soft rubber frame 501, the sealing fit between the inner-end face of the dust box filter screen 500 and the assembling surface of the dust box air outlet and between the outer-end surface of the dust box filter screen 500 and the outer surface of the air outlet grid of the accommodating chamber 200 is realized, which deletes tedious steps of additionally mounting sealing strips on inner and outer sides of the traditional dust box filter screen to meet sealing requirements of an air path. In addition, the soft rubber frame 501 is used as a carrier, and the sealing inner lip 507 and the sealing outer lip 506, which also have certain flexibility, are used as sealing structures, so that the contact sealing fit is closer, the fitting is fuller, and the sealing effect is stronger. Thus, the air tightness of the whole air path is ensured and a better role of ensuring the functions such as dust suction and

dust discharge realized by the cleaning apparatus through a negative pressure is achieved.

[0081] In some embodiments, as shown in FIGs. 11 and 12, the soft rubber frame further includes a step surface 503 extending outward along the second end surface 50115 of the soft rubber frame 501, so that the step surface 503 and the side wall of the soft rubber frame 501 form a step structure, which is configured to prevent the dust box filter screen from being mounted into the dust box too deeply. During the assembling, when the dust box filter screen extends into the dust box assembling opening, the step surface 503 will be abutted against the assembling outer edge of the dust box, so as to be stuck at the outer edge of the dust box and to prevent the dust box filter screen from being inserted into the dust box too deeply, as shown in FIG. 14.

[0082] In some embodiments, as shown in FIG. 11, the soft rubber frame further includes a magnetic element mounting hole 504, which is disposed in the second end surface 50115 of the soft rubber frame 501 and configured to mount a magnetic element to ensure that the dust box filter screen is mounted in place. The magnetic element may be a magnet or other electromagnetic elements. The magnetic element mounting hole 504 is provided with an inductive magnetic element, the magnetic element mounting hole 504 has enough depth to ensure that the magnetic element can be mounted at a fixed position inside the filter screen, and the inductive magnetic element can be detected by a Hall sensor when the whole filter screen is mounted at a fixed position, so as to ensure that the filter screen is mounted in place.

[0083] In some embodiments, as shown in FIG. 11, the soft rubber frame further includes a second rib 5041 disposed around the periphery of the magnetic element mounting hole and configured to prevent liquid from entering the magnetic element mounting hole. The second rib 5041 tightly wraps the outer end of the magnetic element outside the magnetic element mounting hole 504, which can prevent the magnetic element from rusting and failing. The second rib 5041 may be made of a soft rubber material and further wraps the magnetic element after being pressed.

[0084] In some embodiments, as shown in FIG. 11, the soft rubber frame further includes a knob 505 disposed at the position where the step surface 503 extends outward and configured to facilitate taking of the dust box filter screen. The shape and structure of the knob 505 are not limited, and may be semicircular, square, rectangular, etc.

[0085] In some embodiments, as shown in FIG. 12, the soft rubber frame further includes hollow structures 508 disposed on the soft rubber frame first side wall and/or the soft rubber frame second side wall and configured to reduce an overall weight of the frame. The hollow structures 508 may be a plurality of blind holes that are recessed inward, and the structures of the blind holes are not limited, and may be circular, square, rectangular, irregular, etc.

[0086] As for the automatic cleaning apparatus according to the above embodiment, the dust box filter screen can be directly pressed and assembled at the opening of the dust box in the assembling process due to the design of the soft rubber frame. Meanwhile, in cooperation with the structures such as the first protrusions, the sealing inner lip and the sealing outer lip, the filter screen and the assembling surface can achieve the effect of tight sealing while assembling, thereby avoiding the manual assembling procedure of glue dispensing bonding after mounting of the filter screen in the traditional process, simplifying the process, reducing the number of parts to be assembled, reducing the cost, and in addition, being more environmentally friendly without glue bonding and peculiar smell.

[0087] In some embodiments, as shown in FIG. 14, the present embodiment further provides a dust box, including the dust box filter screen according to any one of the above embodiments. The structure of the dust box refers to those in some above embodiments and will not be repeated herein.

[0088] In some embodiments, an automatic cleaning apparatus is also provided, including the dust box according to any one of the above embodiments. The structure of the automatic cleaning apparatus refers to those in some above embodiments and will not be repeated herein.

[0089] After completing dust suction, the automatic cleaning apparatus may enter a dust-collection station to collect dust automatically. During the automatic dust collection for the automatic cleaning apparatus, it is difficult for the dust-collection station to suck all the garbage in the dust box into a refusebag of the dust-collection station since the air path entering the automatic cleaning apparatus is single and is insufficiently smooth after being blocked by the machine structure. In order to clean up the refuse in the dust box as much as possible, it is often necessary to increase power of the fan of the dust-collection station, which will bring more noise and more energy consumption.

[0090] Therefore, the embodiments of the present disclosure also provide an automatic cleaning apparatus with a dust-collection function. By improving an air path structure of the automatic cleaning apparatus, airflows of the automatic cleaning apparatus more easily enter the dust box during the dust collection so that it is easier to completely clean the refuse in the dust box. Compared with the above embodiments, the present embodiment briefly describes some structural features; the same structure has the same technical effects, and some technical effects are not repeated herein. Specifically, according to the specific embodiment of the present disclosure, the present disclosure provides an automatic cleaning apparatus with a dust-collection function, which includes a mobile platform 100. The mobile platform 100 is configured to automatically move along an operating surface, and the mobile platform 100 generally includes an upper shell, a lower shell and a side surface shell, which

form the appearance of the automatic cleaning apparatus, as well as structures and accessories that are disposed in inner spaces of the aforementioned shells. Specifically, the mobile platform 100 includes an accommodating chamber 200 and a driving wheel assembly 141. The accommodating chamber 200 is approximately located at the position of a rear half part in an advancing direction of the mobile platform and is formed in a recess inward. The driving wheel assembly 141, as mentioned above, is located on the lower shell of the mobile platform 100 and used for providing power for the automatic cleaning apparatus to advance. The mobile platform 100 further includes a cleaning module 150. The cleaning module 150 includes a dust box 300 and a main brush module 153. The dust box 300 is detachably assembled in the accommodating chamber 200, and part of the structure of the dust box 300 is as described in the previous embodiment and is not repeated herein. The dust box 300 further includes a first air inlet door 3013 and a second air inlet door 3014. The first air inlet door 3013 and the second air inlet door 3014 are located at a first side wall 3015 and a second side wall 3016 of the dust box, respectively, and are configured to provide intake airflows in two different directions during dust collection, which is beneficial to forming an airflow vortex in the dust box during dust collection, greatly reducing a refuse residue in the dust box, reducing dead angles of the airflows, and improving the dust-collection rate. With the arrangement of two air inlet doors, the air intake rate is further improved and the formation efficiency of the airflow vortex is improved. Sources of the intake airflows include at least one of the following: airflows I entering from a top-end gap of the mobile platform 100, an airflow II entering from a gap of the main brush module 153, an airflow III entering from a rear side wall of the mobile platform, or an airflow IV entering from a gap of the driving wheel assembly 141. By setting the plurality of groups of intake airflows, an air intake amount and an air intake speed of the automatic cleaning apparatus are improved so that the dust-collection intensity and the dust-collection efficiency of the dust-collection station are increased, the dead angles of the airflows in the dust box are further reduced, the refuse residue is reduced, and the dust-collection rate is improved.

[0091] When the automatic cleaning apparatus returns to the dust-collection station for a dust-collection operation after completing dust suction, a fan of the dust-collection station is started, and the refuse in the dust box is sucked. During the suction, the airflows enter the dust box after passing through the first air inlet door 3013 and the second air inlet door 3014 through multiple channels and are then sucked out from a dust-collection port by the dust-collection station along with the refuse. In the dust-collection state, a sweeping main brush of the automatic cleaning apparatus moves reversely along with starting of the fan of the dust-collection station, and the automatic cleaning apparatus is in a dust "spitting" state. The airflows enter an inner cavity of the dust

box from the outside of the automatic cleaning apparatus through the slits between the shells of the automatic cleaning apparatus and form a vortex in the inner cavity of the dust box, which rotationally throws up the refuse in the inner cavity of the dust box. The dust-collection fan of the dust-collection station is started and communicated to the main brush, a first opening 3011 of the dust box and the inner cavity of the dust box through a certain air path, and then the refuse in the inner cavity of the dust box is sucked into a refuse collection container or bag in the dust-collection station by a suction force.

[0092] The airflows entering the dust box mainly include the airflows I entering from the top-end gap of the mobile platform 100, as shown in FIG. 16. Specifically, the airflows I entering from the top-end gap of the mobile platform 100 include an airflow entering from the gap between a cover cap 940 and the top surface of the mobile platform 100 and an airflow entering from the gap between the cover cap 940 and a position-determining element 1211. In the present disclosure, when the cover cap 940 and the position-determining element 1211 are assembled, through support structures such as protrusions, airflow gaps are formed between the cover cap 940 and the top surface of the mobile platform 100 and between the cover cap 940 and the position-determining element 1211. Along with the suction of the fan of the dust-collection station, negative pressure is formed in the dust box 300, which is in fluid communication with the fan of the dust-collection station, and the first air inlet door 3013 and the second air inlet door 3014 are opened towards the interior of the dust box to guide the airflow outside the dust box to enter. The negative pressure is also formed in the mobile platform and naturally guides the air outside the mobile platform to enter the interior of the machine from the airflow gaps formed between the cover cap 940 and the top surface of the mobile platform 100 and between the cover cap 940 and the position-determining element 1211. Compared with the traditional sealing structure, the airflow gaps formed between the cover cap 940 and the top surface of the mobile platform 100 and between the cover cap 940 and the position-determining element 1211 can add more airflow channels, so as to ensure that enough airflows enter the dust box and further improve the air intake amount and the air intake speed of the dust box, thereby improving the dust-collection intensity and the dust-collection efficiency of the dust-collection station and meanwhile, reducing the dead angles of the airflows in the dust box, reducing the refuse residue, and increasing the dust-collection rate. More importantly, the airflows are guided to pass near the position-determining element 1211, which plays a role in cooling the position-determining device while it is in operation. Thus, it is beneficial to improving working stability of the position-determining device and prolonging a service life of electronic devices. In addition, the top airflow is cleaner than other parts, which is safer and more friendly to the air path inside the machine.

[0093] The airflows entering the dust box also include the airflow II entering from the gap of the main brush module 153. As shown in FIG. 17, the airflow II enters the shell from an assembling gap of the main brush module 153 on the bottom surface of the lower shell of the mobile platform 100. When the apparatus is assembled, an edge gap of the main brush module 153 and an edge gap of the driving wheel assembly 141 are also formed through the protrusions or grooves or self-contained assembling gaps. Therefore, along with the suction of the fan of the dust-collection station, the negative pressure formed in the mobile platform naturally guides the air outside the mobile platform to enter the interior of the machine from the edge gap of the main brush module 153. Compared with the traditional sealing structure, the edge gap of the main brush module 153 can add more airflow channels, which ensures that enough airflows enter the dust box and further improves the air intake amount and the air intake speed of the dust box, thereby improving the dust-collection intensity and the dust-collection efficiency of the dust-collection station, reducing the dead angles of the airflows in the dust box and meanwhile, reducing the refuse residue, and increasing the dust-collection rate. In addition, the distance for the airflow II to reach the two air inlet doors of the dust box is shorter, and the air duct is smoother, which is beneficial to further improving an airflow replenishment speed and ensuring the dust-collection efficiency.

[0094] In some embodiments, the rear side wall of the mobile platform 100 is provided with exhaust ports 204, as shown in FIG. 3a. The plurality of groups of intake airflows also includes the airflow III entering from the exhaust ports 204 in the dust-collection state. As shown in FIG. 18a, the exhaust ports 204 are in the dust-collection state, and along with the suction of the fan of the dust-collection station, the negative pressure is formed in the mobile platform and naturally guides the air outside the mobile platform to enter the interior of the machine from the exhaust ports 204. Specifically, as shown in FIG. 18b, the air enters two sides of a fan bracket from the exhaust ports 204, then enters the outer side of the side wall of the accommodating chamber from air inlet notches 20115 of sealing baffle plates 20114 on the two sides of the fan bracket, and then enters the dust box through the air inlet holes 20111 in the outer side of the accommodating side wall, so as to ensure that enough airflows enter the dust box and further improve the air intake amount and the air intake speed of the dust box, thereby improving the dust-collection intensity and dust-collection efficiency of the dust-collection station, further reducing the dead angles of the airflows in the dust box, reducing the refuse residue and increasing the dust-collection rate. In the dust-collection process, the rear side of the mobile platform 100 can be relatively fully exposed to the environment, and the exhaust ports disposed here serve as airflow inlets, which can smoothly supplement the airflows, reduce the interference of external devices in contact or cooperation with the cleaning apparatus or the environment on the

airflows, and make the airflow supplement safer and more efficient. In some embodiments, the air inlet notches 20115 are disposed in bottoms of the sealing baffle plates 20114 to reduce the impact of the airflows on other components.

[0095] In addition, as shown in FIG. 18a, the airflows entering the dust box also include the airflow IV entering from the gap of the driving wheel assembly 141, and the driving wheel is provided with an air inlet channel. The airflow entering the shell from the edge gap at the bottom of the driving wheel directly enters two sides of the accommodating chamber from the air inlet channel at the rear side of the upper part of the driving wheel, and then directly enters the dust box through the air inlet holes 20111. The path of the airflow IV entering from the gap of the driving wheel assembly 141 is shorter, so that the airflow channel entering the dust box is simpler, and more intake airflows are easily provided.

[0096] As shown in FIG. 18a, the above I-II and IV path airflows enter the shell of the mobile platform 100 and are approximately divided into two portions, the I-II path airflows form the first portion and the IV path airflow forms the second portion. In the first portion of the airflows, the I path airflow enters from the gap between the cover cap 940 and the top surface of the mobile platform and the gap between the cover cap 940 and the position-determining element 1211 to directly reach the front of the accommodating chamber 200, and the II path airflow enters from the slit between the main brush and the lower shell, and then passes through the opening around a main brush driving motor to reach the front wall of the accommodating chamber, as shown in FIG. 18a. Due to obstruction of a front side wall 2010 of the accommodating chamber 200, the airflows cannot directly reach the side surface of the accommodating chamber 200, but can enter the side surface of the accommodating chamber 200 through air ducts 209 on two sides of the front side wall. Specifically, as shown in FIG. 19, in some embodiments, each of the upper and outer sides of the front side wall of the accommodating chamber 200 includes one air duct 209. The airflow I entering from the top-end gap of the mobile platform 100 and the airflow II entering from the gap of the main brush module 153 reach the plurality of air inlet holes 20111 in the side surface of the accommodating chamber 200 through the air ducts 209, enter the accommodating chamber 200 from the plurality of air inlet holes 20111 and enter the dust box through the first air inlet door 3013 and the second air inlet door 3014. The second portion of airflow IV directly reaches the plurality of air inlet holes 20111 in the side surface of the accommodating chamber 200 from the air inlet channel on the rear side of the upper part of the driving wheel, entering the accommodating chamber 200 from the plurality of air inlet holes 20111 and entering the dust box through the first air inlet door 3013 and the second air inlet door 3014.

[0097] As shown in FIG. 18b, the rear side of the mobile platform includes the fan bracket 20116 and the baffle plates 20114 located on two sides of the fan bracket

20116. The baffle plates 20114 are connected to the upper and lower surfaces and the side wall of the shell, and close the fan bracket 20116 at the rear end of the mobile platform. The fan is connected to part of the exhaust ports 204 of the rear side wall of the mobile platform through an exhaust pipeline, and these exhaust ports may be called first exhaust ports. During cleaning of the automatic cleaning apparatus, the fan exhausts air through the exhaust pipeline and the part of exhaust ports 204, namely, the first exhaust ports, which are communicated with the exhaust pipeline. During dust collection, the air is introduced through other exhaust ports 204, namely, second exhaust ports, around the above part of exhaust ports 204 of the fan. That is to say, the second exhaust ports are actually air inlets that are not directly communicated with the exhaust pipeline of the fan. Since the baffle plates 20114 are provided with the air inlet notches 20115, after entering the interior of the shell of the mobile platform from the second exhaust ports 204, the III path airflow reaches the plurality of air inlet holes 20111 in the side surface of the accommodating chamber 200 from the air inlet notches 20115 of the baffle plates 20114 on two sides of the fan bracket, enters the accommodating chamber 200 from the plurality of air inlet holes 20111 and enters the dust box through the first air inlet door 3013 and the second air inlet door 3014.

[0098] As an alternative embodiment, the exhaust ports 204 further include third exhaust ports disposed in one side of the baffle plates 20114 opposite to the first exhaust ports or the second exhaust ports, namely, those exhaust ports 204 currently visible in FIG. 18b. The III path airflow enters from the third exhaust ports, directly reaches the plurality of air inlet holes 20111 in the side surface of the accommodating chamber 200 from the third exhaust ports, enters the accommodating chamber 200 from the plurality of air inlet holes 20111, and enters the dust box through the first air inlet door 3013 and the second air inlet door 3014. In this way, the air supplement efficiency can be further improved.

[0099] In some other embodiments, the above third exhaust ports are not opened or are decorative holes that are not perforated and only used for decoration, so as to avoid excess unnecessary communication between the inside and the outside of the automatic cleaning apparatus and enable the air intake of the automatic cleaning apparatus to be controllable.

[0100] In some embodiments, as shown in FIG. 20, the accommodating chamber 200 further includes a third side wall 2011 disposed corresponding to the first side wall 3015 of the dust box and a fourth side wall 2012 disposed corresponding to the second side wall 3016 of the dust box. Each of the third side wall 2011 and the fourth side wall 2012 includes a plurality of air inlet holes 20111, and the plurality of air inlet holes 20111 covers at least parts of the first air inlet door 3013 and the second air inlet door 3014. The outer side of each of the third side wall 2011 and the fourth side wall 2012 of the accommodating chamber 200 includes a plurality of spacers

20112, and the plurality of spacers 20112 forms a plurality of air paths. In some embodiments, the top end of each spacer 20112 includes at least one notch 20113 configured to be communicated with the plurality of air paths. The plurality of air paths formed by the plurality of spacers 20112 can ensure uniformity of the airflows entering the accommodating chamber 200, and avoid an airflow loss caused by the fact that part of the airflows reaches outside the air inlet holes 20111, that is, enters the accommodating chamber 200 but does not enter the dust box in time. Meanwhile, the lost airflow forms convection with the I-IV path airflows, which affects the efficiency of the airflows entering the dust box. When the plurality of spacers 20112 is designed and a communication structure is formed, the plurality of air paths can reach the accommodating chamber 200 more evenly through the plurality of air inlet holes 20111, and then efficiently enter the dust box.

[0101] In some embodiments, as shown in FIG. 21, the first air inlet door 3013 and the second air inlet door 3014 are located at asymmetric positions of the first side wall 3015 and the second side wall 3016 of the dust box, respectively, so as to avoid counteraction of the airflows entering from two sides that directly impact face to face, and enable the intake airflows entering from two different directions to be staggered, which is beneficial to forming an airflow vortex in the dust box more quickly during dust collection, improving a swirling speed of the airflows after entering the dust box, greatly reducing the refuse residue in the dust box, reducing the dead angles of the airflows and increasing the dust-collection rate. In some embodiments, the second air inlet door 3014 is disposed at the position close to the lower edge of the second side wall 3016, and the lower edge of the second air inlet door 3014 is lower than the lower edge of the first air inlet door 3013, so as to further improve the swirling speed of the airflows after entering the dust box. In some embodiments, the second air inlet door 3014 is disposed adjacent to the rear side wall of the dust box, and the first air inlet door 3013 is disposed adjacent to the front side wall of the dust box, which further improves the swirling speed of the airflows after entering the dust box. In an assembling state, the front side wall of the dust box is the side wall of the dust box facing the advancing direction of the automatic cleaning apparatus, and the rear side wall of the dust box is the side wall opposite to the front side wall and facing the tail of the automatic cleaning apparatus. In some embodiments, the first air inlet door 3013 approximately rotates around a first rotating shaft, the second air inlet door 3014 approximately rotates around a second rotating shaft, and the first rotating shaft is approximately perpendicular to the second rotating shaft, so as to further improve the swirling speed of the airflows after entering the dust box. The first rotating shaft and the second rotating shaft may be actually disposed rotating shafts of the first air inlet door 3013 and the second air inlet door 3014; or the first air inlet door and the second air inlet door may rotate around the positions of the first rotating shaft

and the second rotating shaft through elastic driving members.

[0102] The first air inlet door 3013 and the second air inlet door 3014, according to the present embodiment, refer to plate surfaces that cover openings in the first side wall and the second side wall of the dust box. In an actual dust-collection process, in order to realize opening and closing of the first air inlet door 3013 and the second air inlet door 3014, it is also necessary to provide elastic members connected onto the first air inlet door 3013 and the second air inlet door 3014, and fixing structures fixed to the outer surfaces of the first side wall and the second side wall of the dust box, which is not repeated herein.

[0103] In some embodiments, the shapes of the first air inlet door 3013 and the second air inlet door 3014 are at least one or a combination of the following: rectangle, square, circle, ellipse, long strip, etc., which is not limited. In some embodiments, the first air inlet door 3013 is of a rectangular structure, and long edges of the first air inlet door 3013 are longitudinally disposed. The second air inlet door 3014 is of a rectangular structure, and long edges of the second air inlet door 3014 are transversely disposed. By disposing the first air inlet door 3013 and the second air inlet door 3014 with the above structure, the airflows generate a vertical surface vortex and a horizontal surface vortex, which blow up the dust in all directions and angles, thereby effectively increasing the dust-collection rate and further improving the swirling speed of the airflows after entering the dust box. In addition, the first air inlet door 3013 and the second air inlet door 3014 are inward opened structures. As shown in FIG. 21, when the first air inlet door 3013 is opened inward, the air door is in a semi-opened state, the air door opening faces the front side wall of the dust box, and the incoming airflow directly blows towards the front side wall direction of the dust box. When the second air inlet door 3014 is opened inward, the air door is also in a semi-opened state, the air door opening faces the bottom of the dust box, and the incoming airflow directly blows towards the bottom direction of the dust box. The airflows from the two air doors will not blow against each other, but form a swirling airflow, which can accelerate the rotation of the refuse in the dust box, thereby facilitating rapid circulation of the refuse to a dust outlet and discharging the refuse out of the dust box.

[0104] In some embodiments, the dust box 300 further includes a first opening 3011 and a second opening 3012. The first opening 3011 is configured as a dust inlet during dust suction and the dust outlet during dust collection, and the dust inlet during dust suction and the dust outlet during dust collection are disposed as the same opening, so that the number of ports is reduced, the existing port is effectively shared, and an air leakage probability can be reduced. The second opening 3012 is provided with a filter screen, and the specific structure and arrangement thereof are as described in the above embodiment, and will not be repeated herein. The first opening 3011 and the second opening 3012 are approximately located on a central axis of the automatic cleaning apparatus in the

front-rear direction. Due to such a design structure, the air path is a straight structure when the fan of the automatic cleaning apparatus sucks dust, which avoids detour of the airflows, thereby improving the fluency of the air path, as shown in FIG. 22.

[0105] In some embodiments, the accommodating chamber 200 includes a first chamber 201 and a second chamber 202, which are sequentially and adjacently disposed in the advancing direction of the automatic cleaning apparatus. The bottom of the front side wall of the first chamber 201 is provided with a dust-suction port 203, and the rear side wall of a connection between the first chamber 201 and the second chamber 202 is provided with an air outlet 208. The dust-suction port 203, the air outlet 208, the first opening 3011, and the second opening 3012 are all approximately located on the central axis of the automatic cleaning apparatus in the front-rear direction. During dust suction or dust collection, the airflows do not pass through the tortuous air duct or air path, so that the power and suction force loss of the fan are small, the efficiency of the fan is maximized, and the energy consumption and the noise levels are reduced.

[0106] In some embodiments, the mobile platform 100 further includes the position-determining element 1211 located on the central axis of the mobile platform 100 in the front-rear direction and a cover cap 940 covering the position-determining element 1211. The fan is disposed in a space below the second chamber 202, and the position-determining element 1211, the cover cap 940, the fan, the main brush module 153, the dust-suction port 203, the air outlet 208, the first opening 3011, and the second opening 3012 are all approximately located on the central axis of the automatic cleaning apparatus in the front-rear direction. In the related art, when there is one air inlet, the intake airflows are asymmetric, the dust inlet is usually offset, which is unaesthetic, the air inlet and air outlet passages of the whole air path are non-linear, and the airflows are obstructed and have loss, which will also adversely affect the arrangement of other apparatuses. After the air inlet is additionally provided, the above air path structure is disposed on the central axis, which avoids the defects of a low dust-collection rate and dust-collection residue in the existing dust-collection mode. The technical defects of the related art, such as the deviation of the air path and the loss of power and suction force of the fan under the tortuous air duct are overcome, and meanwhile, the aesthetic design and the placement space of components are greatly improved. The port of the main brush module 153 is also disposed on the central axis, which ensures that the dust-suction air path is not hindered, reduces the loss, and improves the efficiency.

[0107] According to a specific embodiment of the present disclosure, the present disclosure provides an automatic cleaning system, which includes a dust-collection station and any of the above automatic cleaning apparatuses. The dust-collection station includes a dust-collection port, and the dust-collection port is docked with a

port of the main brush module and collects dust.

[0108] FIG. 23 is a schematic structural diagram of a dust-collection station according to some embodiments of the present disclosure. The dust-collection station 700 is configured to provide refuse collection for the automatic cleaning apparatus.

[0109] As shown in FIG. 23, the dust-collection station 700 includes a dust-collection station base 710 and a dust-collection station main body 720. The dust-collection station main body 720 is configured to collect refuse in the dust box of the automatic cleaning apparatus, and is disposed on the dust-collection station base 710. The dust-collection station base 710 includes a dust-collection port 711, the dust-collection port 711 is configured to be docked with the port of the main brush module of the automatic cleaning apparatus, and the refuse in the dust box of the automatic cleaning apparatus enters the dust-collection station main body 720 through the dust-collection port 711. In some embodiments, as shown in FIG. 22, a sealing rubber pad 714 is also disposed around the dust-collection port 711, and is used for sealing the dust-collection port 711 and the port of the main brush module of the automatic cleaning apparatus after they are docked to prevent the refuse from leaking.

[0110] FIG. 24 is a schematic diagram of a scene after the automatic cleaning apparatus returns to the dust-collection station according to some embodiments of the present disclosure. As shown in FIG. 24, when the mobile platform 100 of the automatic cleaning apparatus, such as a sweeping robot, returns to the dust-collection station 700 after cleaning, the automatic cleaning apparatus moves onto the dust-collection station base 710 in the X direction, so that the port of the main brush module of the automatic cleaning apparatus is docked with the dust-collection port 711, so as to transfer the refuse in the dust box of the automatic cleaning apparatus to a refuse bag of the dust-collection station.

[0111] The present disclosure provides the automatic cleaning apparatus and system. The automatic cleaning apparatus has the function of automatic dust collection. By asymmetrically arranging two air doors in the dust box of the automatic cleaning apparatus, the airflows entering the dust box form convection and form a vortex cyclone in the dust box, so that the refuse in the dust box is smoothly sucked into the dust-collection station. In addition, the main brush module, the dust-suction port, the air outlet, the first opening and the second opening are all approximately disposed on the central axis of the automatic cleaning apparatus in the front-rear direction, which can further increase the speed of the airflows flowing through the dust box during dust suction and improve the dust-suction efficiency. Meanwhile, it is easier to suck the refuse in the dust box into the dust-collection station during dust collection.

[0112] In the related art, the automatic cleaning apparatus includes a position-determining device. The position-determining device includes a position-determining element and a cover cap. Usually, the position-determining

ing element configured in the automatic cleaning apparatus has a fixed size, and the dimension of the position-determining element is basically matched with an assembling space. However, when the application apparatus needs to reduce the dimension of the position-determining element, it is necessary to either redevelop a mold or adjust the position of devices around the assembling space of the position-determining element, which brings great inconvenience to flexible application of the position-determining element.

[0113] Therefore, the embodiment of the present disclosure provides an automatic cleaning apparatus in which a miniaturized position-determining element can be assembled in the original assembling space. The position-determining device according to the present embodiment includes, but is not limited to, a camera and a laser distance sensor (LDS) device. For the convenience of understanding, the position-determining device according to the present embodiment is described by taking the LDS device as an example. In the present embodiment, the structures and position relationships of an assembling bracket, a rotor, a motor, a cover cap, etc., are reasonably set, so that the application of the position-determining device is more flexible. The same structure has the same technical effects, and some technical effects are not repeated herein. Specifically, as shown in FIG. 25, the automatic cleaning apparatus includes an assembling part 800, an assembling structure 900 and a position-determining element 1211, which are disposed on a frame. The position-determining element 1211 is assembled at the assembling part 800 through the assembling structure 900. The assembling part 800 is usually a part of the frame and includes one or more screw holes. The assembling structure 900 includes one or more corresponding screw holes, and the position-determining element 1211 is assembled at the assembling part 800 through bolts. The parts in the automatic cleaning apparatus for assembling the assembling structure 900 and the position-determining element 1211 may be taken as the assembling part 800. Usually, after the design of each component of the automatic cleaning apparatus is completed, the position and the dimension thereof are fixed, and correspondingly, a space position of the reserved assembling part 800 is also fixed. In this way, when the automatic cleaning apparatus needs to replace the position-determining element with a smaller dimension, the reserved assembling part 800 cannot be adapted. Therefore, the assembling structure and the structure of the position-determining element of the automatic cleaning apparatus in the embodiment of the present disclosure are improved as follows.

[0114] As shown in FIG. 26, the assembling structure 900 includes an assembling bracket 910. The position-determining device includes a rotor 920, a motor 930, a cover cap 940, etc. The assembling bracket 910 is fixed to the assembling part 800 through screw holes around the bracket. The rotor 920 and the motor 930 are disposed inside the assembling bracket 910; and the cover

cap 940 covers the top of the rotor 920, and plays a shielding and protection role. The rotor 920 protrudes from the top surface of the automatic cleaning apparatus, and the rotor 920 continuously rotates and scans in a 360-degree range to continuously detect obstacles in a traveling process of the automatic cleaning apparatus. As shown in FIG. 27, the assembling bracket 910 includes a rotor-accommodating part 911 and a motor-accommodating part 912. The rotor-accommodating part 911 includes a first arc-shaped side wall 9111, and the first arc-shaped side wall 9111 may be a circular arc-shaped side wall or an arc-shaped side wall of other curvatures. The circular arc-shaped side wall is at least a part of a circle. As shown in FIG. 27, the first arc-shaped side wall 9111 may be a large part of a circular structure, and for example, may be a part within the range of 180-270 degrees. The motor-accommodating part 912 includes a second arc-shaped side wall 9121, and the second arc-shaped side wall 9121 may be a part of a circular structure, or spliced by arc-shaped structures of different radians, or spliced by the circular structure or a radian structure with a linear structure, which is not limited herein. The first arc-shaped side wall 9111 of the rotor-accommodating part and the second arc-shaped side wall 9121 of the motor-accommodating part are smoothly connected, and are approximately divided into the rotor-accommodating part 911 and the motor-accommodating part 912 at MN as shown in FIG. 27. An opening area formed by the first arc-shaped side wall 9111 is larger than an opening area formed by the second arc-shaped side wall 9121. The position-determining element 1211 includes the rotor 920, and a rotating shaft of the rotor 920 is approximately disposed at a geometric center of the rotor-accommodating part 911. When the first arc-shaped side wall 9111 is the circular arc-shaped side wall, the geometric center of the rotor-accommodating part 911 is equivalent to the center of the circle where the first arc-shaped side wall 9111 is located. When the first arc-shaped side wall 9111 is a combined structure of a plurality of arcs of different curvatures, the geometric center of the rotor-accommodating part 911 is equivalent to the center of the circle where the arc with the largest radian is located, as shown at A in FIG. 27. The rotor 920 is configured to continuously rotate while sending and/or receiving detection signals, such as visible light and/or invisible light. In this case, compared with a rotor in a traditional position-determining element, the rotor 920 has a smaller diameter, that is, it is farther away from the first arc-shaped side wall 9111 of the rotor-accommodating part, but is still assembled at the geometric center of the rotor-accommodating part 9111, to ensure the structural symmetry and the stability after rotation. The position-determining element 1211 includes the motor 930. An output shaft of the motor 930 is approximately disposed at the communication between the rotor-accommodating part 911 and the motor-accommodating part 912, that is, approximately disposed on the connecting line between a geometric center of the motor-accom-

modating part and the geometric center of the rotor-accommodating part, as shown at B in FIG. 27, and specifically, is approximately disposed in the connecting line between the geometric center C of the motor-accommodating part and the geometric center A of the rotor-accommodating part, excluding point A and point C, that is, disposed closer to the geometric center A of the rotor-accommodating part than the geometric center C of the motor-accommodating part. Thus, the motor and the rotor in the miniaturized position-determining element are closer, the internal accommodating structure of the assembling bracket is more adaptive to the motor and the rotor of the position-determining element, the stability is enhanced, the size of a transmission element such as a belt is reduced, and the energy loss and raw material cost are reduced. In some embodiments, the communication is approximately located at the center of the smooth connection of the first arc-shaped side wall 9111 and the second arc-shaped side wall 9121, that is, approximately located on the MN connecting line. When the second arc-shaped side wall 9121 is the circular arc-shaped side wall, the geometric center of the motor-accommodating part 912 is equivalent to the center of the circle where the second arc-shaped side wall 9121 is located. When the second arc-shaped side wall 9121 is a combined structure of a plurality of arcs of different curvatures, the geometric center of the motor-accommodating part 912 is equivalent to the center of the circle where the arc with the largest radian is located, as shown at C in FIG. 27. The motor 930 is configured to be connected to the rotor through a transmission structure 932 such as a belt to provide a driving force for the rotor. The motor 930 drives the rotor 920 through a motor roller 931 and the transmission structure 932, and the transmission structure 932 may be a belt, a metal belt, an organic material belt, etc. A rotating shaft of the motor 930 is in hard connection with the motor roller 931, and the motor roller 931 rotates freely under driving of the motor rotating shaft.

[0115] In some embodiments, the position-determining device is the LDS device. The position-determining element is a laser ranging element, and the laser ranging element performs distance or position detection by continuously rotating and sending and receiving laser signals.

[0116] In some embodiments, as shown in FIG. 27, the motor-accommodating part 912 further includes an opening I 9122 and a first support rib 9123. The opening I 9122 is located in a bottom surface 9124 of the motor-accommodating part 912 and configured to accommodate the motor 930. The first support rib 9123 extends inward to the edge of the opening I 9122 along the inner side of the side wall 9121 of the motor-accommodating part. A geometric center B of the opening I 9122 is closer to the geometric center A of the rotor-accommodating part than the geometric center C of the motor-accommodating part. The geometric center B of the opening I 9122 is approximately located at the center of the circle where

the arc of the opening I 9122 is located, and the geometric center C of the motor-accommodating part is approximately located at the center of the circle where the side wall 9121 of the motor-accommodating part is located. For the motor having a traditional size, its mounting position is usually located at the geometric center C of the motor-accommodating part. However, when the structure of the position-determining element is reduced as a whole and the rotor 920 is still located at the geometric center A of the rotor-accommodating part, in order to reduce a transmission loss, improve the transmission efficiency and improve the stability during the belt transmission, the motor 930 may be assembled close to the rotor. In this case, a rotation gap between the motor 930 and the rotor 920 remains almost unchanged, which can maintain considerable transmission efficiency, is suitable for more miniaturized position-determining elements, does not need additional mold opening, reduces the cost, achieves a shorter distance between the motor and the rotor, and saves a transmission apparatus such as a belt. Further, the cost and the transmission resistance are reduced, and the transmission efficiency is improved. In this case, in order to enhance the stability and rigidity of the assembling bracket 910, it is necessary to additionally provide the first support rib 9123. The farther away from the motor, the longer the first support rib 9123 is.

[0117] In some embodiments, as shown in FIG. 27, the rotor-accommodating part 911 further includes an opening II 9112 and a second support rib 9113. The opening II 9112 is located in a bottom surface 9114 of the rotor-accommodating part 911 and configured to accommodate the rotor 920. The second support rib 9113 extends inward to the edge of the opening II 9112 along the inner side of the side wall 9111 of the rotor-accommodating part, and can enhance the stability and rigidity of the assembling bracket 910. A geometric center of the second opening II 9112 is equivalent to the geometric center of the rotor-accommodating part 911, and is approximately located at the center of the circle where the side wall 9111 of the rotor-accommodating part is located, so as to ensure the structural symmetry and the stability of the rotor after rotation.

[0118] In some embodiments, as shown in FIG. 27, the opening II is communicated with the opening I, and the area of the opening II is greater than the area of the opening I. The opening II is communicated with the opening I to reduce a processing technology of the bracket structure, and the communication structure is also convenient for the motor to drive the rotor to rotate through the transmission structure.

[0119] In some embodiments, as shown in FIG. 28, the position-determining device further includes the cover cap 940, which covers the top of the rotor 920. The cover cap 940 can block stray light, dust, impurities, and the like that enter the position-determining device, and can also shield internal parts of the position-determining device, which plays an aesthetic role. After being equipped with a

pivot structure, the cover cap 940 may also avoid hanging obstacles. The cover cap 940 includes a circular top surface 941, a bottom ring 942 and a plurality of connectors 943 connecting the circular top surface 941 and the bottom ring 942. In some embodiments, the bottom ring 942 has a bottom plate extending horizontally from the bottom thereof, the bottom ring 942 and the bottom plate are fixedly connected or integrally formed, and the bottom plate is used for pivotal connection between the cover cap 940 and the top surface of the mobile platform. A first gap is formed between the bottom ring 942 and the outer peripheral surface of the rotor 920, and clearances are formed between the plurality of connectors 943, so as to send and/or receive detection signals, such as visible light and/or invisible light, through rotation of the rotor. In addition, since the rotor structure in the present embodiment is a miniaturized rotor, and the dimension of the cover cap 940 is equivalent to that of a cover cap in the traditional position-determining device, the first gap is larger than a traditional gap.

[0120] In some embodiments, in order to solve the technical problems caused by an excessively large first gap, such as the entrance of stray light, dust, and impurities, and the problem of the exposure of internal parts of the position-determining device, the dimension of the cover cap may be reduced as a whole to reduce the distance of the first gap. For example, in some embodiments, the cover cap 940 includes the circular top surface 941, the bottom ring 942 and the plurality of connectors 943 connected to the circular top surface 941 and the bottom ring 942. The bottom ring 942 has the bottom plate extending horizontally from the bottom thereof, the bottom ring 942 and the bottom plate are fixedly connected or integrally formed, and the bottom plate is used for the pivotal connection between the cover cap 940 and the top surface of the mobile platform. A second gap is formed between the bottom ring 942 and the outer peripheral surface of the rotor 920. The second gap is smaller than the first gap, and the second gap enables the bottom ring 942 to be as close as possible to the outer peripheral surface of the rotor 920, for example, with a distance of 1-5 mm, without affecting the rotation of the rotor.

[0121] As shown in FIGs. 29-31, in some embodiments, in order to solve the technical problems caused by the excessively large first gap, the assembling structure 900 further includes an annular blocking member 950 that is attached to the inner side of the bottom ring 942. The annular blocking member 950 and the outer peripheral surface of the rotor 920 form a second gap that is smaller than the first gap. The second gap is used for enabling the rotor to rotate flexibly. The second gap enables the annular blocking member 950 to be as close as possible to the outer peripheral surface of the rotor 920, for example, with a distance of 1-5 mm, without affecting the rotation of the rotor.

[0122] In some embodiments, as shown in FIG. 30, the annular blocking member 950 has a width extending in a

radial direction and a height extending in an axial direction, and the width of the annular blocking member is greater than the height. The width of the annular blocking member 950 extending in the radial direction is wide enough to shield the incident stray light due to the excessively large size of the first gap. The height of the annular blocking member 950 extending in the axial direction can facilitate the assembling of the annular blocking member 950 on the inner side of the bottom ring 942.

[0123] In some embodiments, as shown in FIG. 30, the annular blocking member 950 includes plug connectors 951 adapted to the connectors 943. After the plug connectors 951 are inserted into the connectors 943, the annular blocking member 950 is attached to the inner side of the bottom ring 942, and the plug connectors 951 and the connectors 943 are disposed in one-to-one correspondence. A third slot 9433 is disposed below the connector 943, and a T-shaped protrusion 9512 is disposed below each plug connector 951. After the plug connector 951 is inserted into the inner side wall of the corresponding connector 943, the thickness of the connector 943 is increased, thereby reducing the distance of the first gap. Therefore, the stray light entering the rotor 920 can be further reduced.

[0124] In some embodiments, as shown in FIG. 29, the inner wall of the connector 943 includes a first slot 9431, and the outer wall of the plug connector 951 includes a convex beam 9511, which is adapted to the first slot 9431. After the convex beam 9511 is inserted into the first slot 9431, the annular blocking member 950 is attached to the inner side of the bottom ring 942. After the convex beam 9511 is inserted into the first slot 9431, the circumferential stability of the annular blocking member 950 is guaranteed. In some embodiments, as shown in FIG. 29, the bottom ring includes a second slot 9432 extending circumferentially along the bottom surface of the bottom ring, and the third slot 9433 located in the inner surface of the bottom ring 942; the second slot 9432 is communicated with the third slot 9433. As shown in FIG. 31, the annular blocking member 950 includes the T-shaped protrusion 9512 protruding outward along the outer wall of the annular blocking member 950. After the T-shaped protrusion 9512 is inserted into the third slot 9433, the annular blocking member 950 is attached to the inner side of the bottom ring 942. When assembling the annular blocking member 950, the T-shaped protrusion 9512 is inserted along the bottom of the second slot 9432 and then pushed upward to be inserted into the third slot 9433, which further stabilizes the annular blocking member 950 in the circumferential direction and the radial direction.

[0125] In some embodiments, as shown in FIG. 29, the bottom ring 943 further includes limiting grooves 9434 disposed in the inner surface of the bottom ring 943, and the limiting grooves 9434 are symmetrically disposed in two sides of the third slot 9433. The annular blocking member 950 further includes limiting protrusions 9513

disposed on two sides of the T-shaped protrusion 9512. When the annular blocking member 950 is attached to the inner side of the bottom ring 942, the limiting protrusions 9513 are adapted to the limiting grooves 9434. The cooperation between the limiting protrusions 9513 and the limiting grooves 9434 further defines the position of the annular blocking member 950.

[0126] As for the automatic cleaning apparatus according to the embodiment of the present disclosure, in the position-determining device, the position-determining element with the dimension smaller than that of the traditional position-determining element can also be assembled in the assembling part with the dimension equivalent to the traditional dimension through the assembling bracket having a corresponding structure, which brings convenience to the application of changing the dimension of the position-determining element according to application requirements.

[0127] In the related art, since the top of the automatic cleaning apparatus is not completely closed, there is a risk of water entering the interior of the automatic cleaning apparatus. For example, a user accidentally spills water on the automatic cleaning apparatus, the water may enter the interior of the automatic cleaning apparatus through the gap in a top cap of the automatic cleaning apparatus, such as the gap at the position-determining device, which may threaten a circuit board and other elements and lead to a damage to the automatic cleaning apparatus. The present disclosure provides an automatic cleaning apparatus, which includes a mobile platform, a position-determining device, a circuit board, and a water-retaining bracket. The mobile platform includes an accommodating chamber. At least a part of the position-determining device is disposed in the accommodating cavity. The circuit board is disposed in the mobile platform and adjacent to the accommodating cavity. The water-retaining bracket is disposed between the circuit board and the accommodating cavity to prevent a liquid from flowing into the circuit. The position-determining device includes a position-determining element and a cover cap, and may be a camera device, an LDS device, etc. The embodiment of the present disclosure specifically takes the LDS device as an example for describing and explaining, and correspondingly, the position-determining element is a laser ranging unit.

[0128] FIG. 32 is a schematic top view of a mobile platform body in a mobile platform according to some embodiments of the present disclosure. FIG. 33 is a schematic bottom view of a platform cap body assembled on the upper part of a mobile platform body according to some embodiments of the present disclosure. FIG. 34 is a schematic top view of a platform bottom plate assembled on a mobile platform body according to some embodiments of the present disclosure. The automatic cleaning apparatus includes:

[0129] a mobile platform 100, a position-determining device 121, a circuit board 105, and a water-retaining bracket 104. The mobile platform 100 includes an ac-

commodating cavity 1011. At least a part of the position-determining device 121 is disposed in the accommodating cavity. The circuit board 105 is disposed in the mobile platform 100, is used for bearing various electronic components of the automatic cleaning apparatus, and is disposed adjacent to the accommodating cavity 1011. The water-retaining bracket 104 is disposed between the circuit board 105 and the accommodating cavity 1011 to prevent a liquid from flowing into the circuit board 105 and causing damage to the electronic components on the circuit board 105.

[0130] Specifically, the mobile platform 100 includes a mobile platform body 101, a platform cap body 102, and a platform bottom plate 103. The structures of the platform cap body 102 and the platform bottom plate 103 are both adapted to the structure of the mobile platform body 101 and are set according to actual products. The mobile platform body 101 can drive the automatic cleaning apparatus to move and perform various cleaning work. The accommodating cavity 1011 is disposed in the mobile platform body 101, and the accommodating cavity 1011 is used for accommodating at least part of the structure of the position-determining device 121.

[0131] The accommodating cavity 1011 is a hollow cavity, and a water-retaining wall 10111 is disposed in the hollow cavity to guide the liquid entering the accommodating cavity to flow to the inner bottom of the accommodating cavity to prevent external splashing. In some embodiments, as shown in the subsequent FIG. 35, the water-retaining wall 10111 is a part of the side wall of the accommodating cavity 1011.

[0132] The bottom of the accommodating cavity 1011 is provided with drainage holes 10112, so that the liquid collected into the accommodating cavity flows out of the accommodating cavity. In some embodiments, a plurality of drainage holes 10112 is provided, and disposed at different positions on the bottom edge of the accommodating cavity. The water-retaining wall 10111 and the bottom of the accommodating cavity form a waterway, so that the liquid entering the accommodating cavity basically all flows into the drainage holes 10112.

[0133] The mobile platform body 101 also has an accommodating space for accommodating the dust box 300 in the cleaning module 150.

[0134] The platform cap body 102 is the top of the automatic cleaning apparatus and has an opening hole 1021. In response to the platform cap body 102 being buckled on the mobile platform body 101, the platform cap body 102 basically covers the position-determining device 121, and part of the structure of the position-determining device passes through the opening hole 1021 and is exposed to the external environment.

[0135] One side of the platform cap body 102 facing the mobile platform body 101 is also provided with a water-retaining rib 1022 protruding towards the mobile platform body. In response to the platform cap body 102 being buckled on the mobile platform body 101, the water-retaining rib 1022 is located between the circuit board

105 and the accommodating cavity 1011, and located on one side of the water-retaining bracket 104 away from the circuit board 105. The water-retaining rib 1022 can effectively guide condensed water, formed by rising and condensing of water vapor, which is formed on the inner surface of an upper shell and possibly occurs in the automatic cleaning apparatus, and prevent the damage to the electronic components on the circuit board 105 caused by the fact that the condensed water moves along the surface of the platform cap body 102 facing the mobile platform body, passes over the water-retaining bracket 104 from above and flows and drips into the upper part of the circuit board 105.

[0136] The platform cap body 102 also has an access opening 1023 configured to enable the dust box 300 to be inserted or taken out, and an orthographic projection of the access opening 1023 in the mobile platform falls in the accommodating space. In response to the dust box being inserted into the accommodating space, the surface of the dust box away from the platform bottom plate is coplanar with the platform cap body, that is, the upper surface of the dust box serves as a part of the upper surface of the automatic cleaning apparatus. In this way, there is no need to dispose an upper flip cap, which simplifies the structure of the apparatus and further improves the scientific and technological sense and aesthetic feeling of the appearance of the automatic cleaning apparatus.

[0137] The platform bottom plate 103 is buckled at the bottom of the mobile platform body 101 and is disposed opposite to the platform cap body 102. The platform bottom plate 103 is provided with accommodating grooves 1031 configured to collect the liquid discharged from the drainage holes 10112. An orthographic projection of the drainage hole 10112 on the platform bottom plate 103 falls within the accommodating groove 1031, so that the liquid flowing from the drainage hole 10112 can naturally fall into the accommodating groove 1031. The side wall of the accommodating groove 1031 is further provided with a drainage port 1032, and the liquid in the accommodating groove 1031 is discharged through the drainage port 1032, which can accurately guide a specific outflow direction of the liquid and avoid the interference in a cleaning task. In some embodiments, the size and the number of the accommodating grooves 1031 are adapted to the positions and the number of the drainage holes 10112.

[0138] The platform bottom plate 103 further includes a third opening 1033. The third opening 1033 is configured to expose at least part of a dry-cleaning module of the automatic cleaning apparatus, so that the automatic cleaning apparatus can be communicated with the mobile platform body 101. The third opening 1033 is disposed adjacent to the accommodating groove 1031, and the liquid in the accommodating groove 1031 is guided by the drainage port 1032 to flow out of the automatic cleaning apparatus through the third opening 1033.

[0139] The water-retaining bracket 104 on the mobile

platform 100 is at least partially disposed around the position-determining device 121. FIG. 35 is a schematic structural diagram of the water-retaining bracket according to some embodiments of the present disclosure. As shown in FIG. 35, the water-retaining bracket 104 is disposed between the circuit board 105 and the accommodating cavity 1011 to prevent the liquid from flowing into the circuit board 105. The circuit board 105 is a circuit element in the automatic cleaning apparatus, and is generally located on one side of the position-determining device close to a forward portion of the automatic cleaning apparatus.

[0140] In the present disclosure, the external liquid, such as water, will flow into the interior of the automatic cleaning apparatus through a gap between the position-determining device and the platform cap body 102, and the water-retaining bracket 104 can be used for preventing the liquid from flowing into the circuit board from the position of the position-determining device. Therefore, the water-retaining bracket is disposed between the accommodating cavity and the circuit board, which can realize waterproofness. In some embodiments, at least a part of the water-retaining bracket 104 is located at the edge of one side of the circuit board 105 away from the surface of the platform bottom plate 103.

[0141] Specifically, the water-retaining bracket 104 includes a bottom wall 1041 and a bracket side wall 1042. The bottom wall 1041 is disposed at a first end part of the circuit board close to the accommodating cavity and extends along at least a part of the edge of the first end part. The bracket side wall 1042 extends from the edge of the bottom wall close to the circuit board in a direction approximately perpendicular to the bottom wall, and a free end of the side wall away from the bottom wall is farther away from the bottom surface of the mobile platform than the circuit board.

[0142] The bottom wall 1041 is of a flat plate structure with a certain width, and the width is the length of the bottom wall extending from one end close to the circuit board to the accommodating cavity.

[0143] The bracket side wall 1042 includes a first bracket side wall 10421, a second bracket side wall 10422, and a third bracket side wall 10423, which are oppositely disposed at two ends of the first bracket side wall; a fourth bracket side wall 10424 is connected to one end of the second side wall away from the first bracket side wall, and a fifth bracket side wall 10425 is connected to one end of the third side wall away from the first bracket side wall. The first bracket side wall 10421 is disposed at the first end part of the circuit board close to the accommodating cavity, the fourth side wall and the fifth side wall are located at two ends of the water-retaining bracket 104, respectively, and tail ends thereof are free ends. Orthographic projections of the fourth side wall and the fifth side wall on the platform bottom plate 103 fall into the accommodating cavity, and the fourth side wall and the fifth side wall are configured to guide the liquid blocked by the water-retaining bracket to fall into the accommodat-

ing cavity from the free ends. In some embodiments, the first bracket side wall, the second bracket side wall and the third bracket side wall are all planar.

[0144] The water-retaining bracket 104 further includes a pivot shaft 1043 configured to be pivotally connected to the position-determining device 121, so that at least part of the elements of the position-determining device move relative to the water-retaining bracket 104. The direction of the pivot shaft 1043 and the first bracket side wall 10421 are parallel and disposed at intervals, and two ends of the pivot shaft 1043 are fixed to the second bracket side wall 10422 and the third bracket side wall 10423, respectively.

[0145] The water-retaining bracket 104 further includes a mounting hole 1044. The mounting hole 1044 is used for positioning the water-retaining bracket 104 and fixing the water-retaining bracket into the mobile platform 100.

[0146] FIG. 36 is a schematic structural diagram of a position-determining device in an automatic cleaning apparatus according to some embodiments of the present disclosure; and FIG. 37 is a schematic assembled structural diagram of the position-determining device shown in FIG. 36 and the mobile platform. As shown in FIGs. 36-37, at least a part of the position-determining device 121 is disposed in the accommodating cavity of the mobile platform body 101. Specifically, the position-determining device 121 includes a position-determining element 1211 and a cover cap 940. The position-determining element 1211 passes through the opening hole 1021 of the platform cap body and is exposed to the outside, and the position-determining element 1211 is rotatable relative to the mobile platform 100 for measuring a horizontal distance between the automatic cleaning apparatus and an obstacle in the circumferential direction.

[0147] The cover cap 940 is buckled on the position-determining element 1211 to protect the position-determining element from being damaged. FIG. 38 shows a schematic structural diagram of the cover cap in the position-determining device shown in FIG. 36; and FIG. 39 shows a schematic structural diagram of the cover cap in FIG. 38 from another perspective. As shown in FIGs. 38-39, specifically, the cover cap 940 includes a bottom plate 1221 and a buckling cap 1222 protruding from the bottom plate. A liquid guide hole 1223 is formed at the junction of the bottom plate 1221 and the buckling cap 1222. The number of the liquid guide holes 1223 is one or more. When there is a plurality of liquid guide holes, they are distributed at intervals at the junction, so that part of the liquid dripping on the bottom plate 1221 enters the accommodating cavity 1011 through the liquid guide holes 1223.

[0148] The bottom plate 1221 is of a flat plate structure, and the bottom plate 1221 is provided with an open orifice 12210. The buckling cap 1222 protrudes from the open orifice 12210 of the bottom plate to one side away from the platform bottom plate 103 to accommodate the posi-

tion-determining element 1211. The surface of one end part of the bottom plate 1221 close to the platform bottom plate 103 is provided with a pivot structure 1224, and the pivot structure 1224 is adapted to the pivot shaft 1043, so that the bottom plate 1221 and the water-retaining bracket 104 are pivotally connected through the pivot shaft 1043.

[0149] At least a part of the bottom plate 1221 is overlapped with the bottom wall of the water-retaining bracket 104, and a liquid guide groove 1225 is formed between the edge of the bottom plate 1221 close to the water-retaining bracket 104 and the side wall of the water-retaining bracket, and is configured to guide the liquid falling on the bottom plate 1221 into the accommodating cavity. In other words, the liquid guide groove 1225 is used for collecting the liquid originally flowing to the circuit board and guiding the liquid out.

[0150] It should be noted that the liquid guide hole 1223 and the liquid guide groove 1225 are disposed in the present disclosure. When the external liquid entering from the gap of the position-determining device 121 falls onto the surface of the bottom plate 1221 and diffuses and flows around, part of the liquid directly flows into the accommodating cavity through the liquid guide hole 1223, and part of the liquid directly flows into the liquid guide groove 1225 when flowing to the circuit board. Part of the liquid in the liquid guide groove 1225 flows into the accommodating cavity along the first bracket side wall 10421, the third bracket side wall 10423, and the fifth bracket side wall 10425, and part of the liquid flows into the accommodating cavity along the first bracket side wall 10421, the second bracket side wall 10422, and the fourth bracket side wall 10424.

[0151] The buckling cap 1222 is of a groove structure configured to accommodate at least a part of the position-determining element, and a specific shape of the buckling cap 1222 is adapted to the structure of the position-determining element. In some embodiments, the groove structure is a hollow cylinder. The groove structure is reversely buckled on the open orifice 12210 of the bottom plate, and the edge of the groove away from the bottom of the groove intersects with the opening edge of the bottom plate, where the intersection manner may be a specific fixed or detachable manner. A plurality of windows 12220 is disposed around the side wall of the groove structure, and the position-determining element located in the buckling cap 1222 emits a laser signal and receives a returned laser signal through the windows 12220.

[0152] In response to the complete assembling of the mobile platform 100, the position-determining device 121, and the water-retaining bracket 104, the liquid entering from the gap between the position-determining device 121 and the opening of the platform cap body 102 falls to the surface of the bottom plate 1221 of the position-determining device, partially flows into the accommodating cavity through the liquid guide hole 1223 and partially flows into the accommodating cavity through the liquid guide groove 1225; and/or, when water vapor is

generated in the automatic cleaning apparatus, the water vapor is gathered on the inner surface of the platform cap body 102 to form condensed water, and the water-retaining rib 1022 guides the condensed water to flow to the bottom plate surface of the position-determining device, and to flow into the accommodating cavity through the liquid guide hole and the liquid guide groove, respectively. Afterwards, the liquid gathered in the accommodating cavity 1011 falls into the accommodating groove 1031 of the platform bottom plate 103 through the drainage holes 10112 in the bottom of the accommodating cavity, and the liquid in the accommodating groove flows out of the automatic cleaning apparatus through the drainage port 1032 and the third opening 1033, so as to avoid the damage to the circuit board caused by accidental splashing or the condensed water. The automatic cleaning apparatus has a waterproof function.

[0153] As for the automatic cleaning apparatus according to the present disclosure, the water-retaining bracket is disposed between the circuit board and the accommodating cavity, so that the liquid flowing in from outside can be prevented from entering the circuit board, and the circuit elements are prevented from being damaged. The design of the upper flip cap in the original automatic cleaning apparatus is canceled, the structure of the apparatus is simplified, and the scientific and technological sense and aesthetic feeling of the automatic cleaning apparatus are improved.

[0154] Another embodiment of the present disclosure provides an automatic cleaning apparatus. The automatic cleaning apparatus in the present embodiment differs from the automatic cleaning apparatus in the above embodiments in that the automatic cleaning apparatus in the present embodiment further includes a trigger system 180. The trigger system 180 includes a trigger protrusion 181 and a trigger assembly 182. FIG. 40 is a schematic assembled structural diagram of a mobile platform, a position-determining device, and a trigger assembly according to some embodiments of the present disclosure. FIG. 41 is a partial schematic structural diagram of the assembling structure shown in FIG. 40; and FIG. 42 is a schematic diagram of an explosion structure of the trigger assembly shown in FIG. 41.

[0155] As shown in FIG. 39, the trigger protrusion 181 is disposed on the bottom surface of the other end part of the bottom plate 1221 away from the water-retaining bracket 104. The trigger protrusion is of a hard structure configured to apply pressure to the trigger assembly, and the specific shape thereof is not limited.

[0156] As shown in FIGs. 40-42, the trigger assembly 182 is disposed on the mobile platform 100. Specifically, the trigger assembly 182 is disposed in an accommodating groove 1012 of the mobile platform 100, and the accommodating groove 1012 is disposed in a rearward portion of the automatic cleaning apparatus. Specifically, the trigger assembly 182 includes a trigger button 1821 and an elastic plate member 1822. The trigger button

1821 is configured to be pressed by the trigger protrusion, so that the automatic cleaning apparatus performs an anti-jamming action. The elastic plate member 1822, which is disposed in the accommodating groove 1012, and the bottom of the accommodating groove are basically in parallel and disposed at intervals. The elastic plate member may be a flat plate and will bend under the action of an external force. In some embodiments, the elastic plate member 1822 is made of a flexible material such as a carbon nanotube film and a polyester film.

[0157] The elastic plate member 1822 includes a fixed end part 18221 and a free end part 18222. In some embodiments, the elastic plate member 1822 is of a T-shaped structure, the fixed end part 18221 is of a long strip structure, and the free end part 18222 is of a square structure. One end of the free end part is connected to one end of the fixed end part, and the fixed end part 18221 is fixedly connected on the side wall of the accommodating groove 1012, so that the long strip structure is clamped at a clamping opening 10121 of the side wall of the accommodating groove. The free end part is suspended. The trigger button 1821 is disposed on the elastic plate member and located at the free end part 18222. In response to the cover cap 940 being mounted on the mobile platform, the trigger button 1821 faces the trigger protrusion 181 with a certain distance therebetween.

[0158] The trigger assembly 182 further includes an anti-warpage buckle 1823 and a positioning column 1824. The anti-warpage buckle 1823 is configured to prevent the elastic plate member from rebounding in a direction away from the bottom of the accommodating groove 1012 after being pressed. The anti-warpage buckle 1823 is located on the side wall of the accommodating groove 1012 away from the fixed end part 18221 of the elastic plate member. When the elastic plate member 1822 is in an unpressurized state, a free end of the anti-warpage buckle 1823 is as close as possible to the surface of the elastic plate member away from the bottom of the accommodating groove 1012.

[0159] One end of the positioning column 1824 is fixed to the bottom of the accommodating groove 1012, extends upward in the direction perpendicular to the bottom of the accommodating groove, and passes through the elastic plate member to fix the elastic plate member.

[0160] When the automatic cleaning apparatus is jammed due to blockage of an upper obstacle in the process of performing a cleaning, the position-determining device 121 pivots around the pivot shaft 1043, and the bottom plate moves towards the direction close to the trigger assembly 182. The trigger protrusion 181 on the bottom plate triggers the trigger button 1821, the triggered trigger button 1821 generates and transmits an anti-jamming control signal to a control system 130, and then the control system 130 may generate a corresponding control command to enable the cleaning apparatus to execute the anti-jamming action, which includes, but is not limited to, stopping, retreating, steering, etc. The

trigger button 1821 has a certain pressing stroke. Under normal circumstances, an action amplitude of the bottom plate 1221 caused by the upper obstacle is less than or equal to the pressing stroke of the trigger button 1821, and the anti-jamming control signal can be safely generated. When the cleaning apparatus runs too fast and the height of the upper obstacle is just too low, a pivot amplitude of the position-determining device 121 may be too large. As a result, a motion amplitude of the trigger protrusion 181 driven by the bottom plate 1221 exceeds the pressing stroke of the trigger button 1821, which may cause damage to the trigger button. When the trigger button 1821 is disposed at the free end part 18222 of the elastic plate member 1822, a pressing force brought by the excessive stroke acts on the free end part, so that the trigger button 1821 continues to move downward together with the free end part 18222. Such a buffering action avoids the damage to the trigger button 1821, prolongs the service life of the anti-jamming element, and improves the safety coefficient of the cleaning apparatus. Meanwhile, after the automatic cleaning apparatus leaves the upper obstacle, the elastic plate member 1822 generates a counter-acting force away from the bottom of the accommodating groove and rebounds. Under the blocking effect of the anti-warpage buckle 1823, the elastic plate member finally remains parallel to the plane where the bottom of the accommodating groove is located, and is ready to carry out the next possible triggering process of the anti-jamming control signal. The arrangement of the elastic plate member 1822 ensures working safety of the trigger button 1821, and meanwhile, the use of other additional elements such as a spring is reduced, so that the structure of the apparatus is more concise, maintenance or replacement of the elements is easy, and the interference in the position-determining element possibly generated by surrounding metal elements is reduced.

[0161] The pressing structure on a cap plate of the existing automatic cleaning apparatus is complex. For example, for the key structure of the existing cleaning apparatus, a soft rubber bracket is mostly disposed on a hard rubber bracket, a hard rubber keycap and the soft rubber bracket are bonded together, then the soft rubber bracket and the decorative cap of an upper shell of the machine are bonded together by a double-sided adhesive tape, and for the lower side of the apparatus, the hardware bracket is fixed on the upper shell through a hook. Such a key assembling structure is complex and has a large number of parts, long assembling time, complicated working procedures, and high cost. Due to such a multi-layer structure, when the soft rubber bracket is bonded to the decorative cap of the upper shell of the machine, it is likely to have deviated mounting when the soft rubber is used for positioning, and the key is difficult to disassemble. During disassembling, since the double-sided adhesive tape and the soft rubber are firmly bonded and thus are likely to be torn up, the key cannot be repeatedly used.

[0162] Therefore, the embodiment of the present disclosure provides an automatic cleaning apparatus without a flip cap, which simplifies unnecessary elements of the key assembly of the automatic cleaning apparatus, increases the space between the lower part of the key assembly and the upper part of the circuit board, enables more electronic components to be disposed in the space, increases an elastic force of the key assembly, and makes pressing easier. Specifically, the present disclosure provides an automatic cleaning apparatus, as shown in FIG. 43. According to a specific embodiment of the present disclosure, the present disclosure provides an automatic cleaning apparatus, which includes a mobile platform 100 and a key assembly 400. The mobile platform 100 is configured to automatically move along an operating surface, and the mobile platform 100 includes a cap plate 1000, which forms at least a part of the top surface of the mobile platform. The key assembly 400 is used for manual operation and pressing to control operation of the automatic cleaning apparatus. The key assembly 400 includes a keycap 410 and a bracket 420, which are assembled on the cap plate 1000. The cap plate 1000 includes a key mounting hole 1002, the key assembly 400 includes a pressing main body part 411, and the pressing main body part 411 is assembled in the key mounting hole 1002, so that the top surface of the pressing main body part is approximately flush with the top surface of the cap plate. During operation, a user only needs to directly exert an action force through the pressing main body part, without a need to dispose an additional decorative part. In some embodiments, the top surface of the pressing main body part is slightly lower or slightly higher than the top surface of the cap plate, so that the user can easily find the position of the key assembly only by touch. The key assembly 400 may be applied to the outer shell of any apparatus that requires mechanical keys, including but not limited to sweeping robots, mopping robots, sweeping-mopping robots, hand-held robots, and sprinkling robots. The key assembly is usually disposed on the upper surface of the outer shell of a mechanical apparatus, and may also be disposed on the side surface of the outer shell of the mechanical apparatus, which is not limited. The outer shell of the mechanical apparatus is usually made of hard plastic, resin, metal, or alloy material, which is not limited.

[0163] Specifically, as shown in FIGs. 43-47, the key assembly 400 includes the keycap 410 and the bracket 420. The keycap 410 is usually made of a soft rubber opaque material to provide sealing, waterproofness, and light shielding during interference assembling, and the bracket 420 is usually made of a hard rubber material to provide support during assembling of the keycap, and is also matched with the hard cap plate to fix the keycap. As shown in FIG. 43, in the assembling process, the soft rubber keycap is first assembled with the cap plate from bottom to top, so that at least the pressing main body part 411 is assembled in the corresponding key mounting hole 1002, and then the hard rubber bracket is assembled

below the soft rubber keycap, and is fixed by positioning column bodies 1001 on the cap plate 1000 and positioning holes 425 in the bracket 420, thereby forming the key assembly. The two circular positioning holes 425 in the key bracket and the positioning column bodies 1001 with a buckling structure on the cap plate achieve a positioning role together, so that the keycap 410 is assembled between the bracket 420 and the cap plate.

[0164] In some embodiments, as shown in FIG. 45, the bracket 420 includes a step structure 430 extending along a circumferential direction. In an assembling state, the step structure is formed by continuous ascending steps from outside to inside or from inside to outside. Compared with the bracket that is relatively flat and regular as a whole, the ascending part of the step structure can provide a layout space and design degree of freedom for other components, which effectively utilizes the upper space of the bracket. Specifically, the trend of steps can be designed according to space requirements of other components. Optionally, in the assembling state, the step structure is formed by continuous ascending steps from outside to inside; the continuous ascending steps from outside to inside increase an extra space that is in the middle, which is beneficial to arranging enough space, required to realize a pressing action, below the pressing main body part, so that the pressing stroke and restoring elasticity can be reasonably set, improving the user experience. Each layer of step of the step structure 430 extends circumferentially around and is parallel to an overall outer contour shape of the bracket 420 to form a closed structure, such as a surrounding and closed ellipse, circle, square, rectangle, etc., which is not limited. The step structure 430 is formed into a generally conical step structure by continuously ascending steps from outside to inside, and extends upward from an outer ring step to an inner ring step. The specific number of steps is not limited, for example, 2-5 steps or 2-3 steps. As shown in FIGs. 44-45, the width and the height of each step are not limited; and the steps may have or may not have equal width and equal height. Due to the circumferentially extending step structure 430 of the bracket 420, there is more suspended space below the bracket. Since the docked circuit board 105 is below the bracket, as shown in FIG. 48, the suspended space can increase the convenience in designing components for the circuit board compared with the closed space, and can enable the space originally occupied by the lower part of the bracket to be used for laying more electronic components. In addition, due to the circumferentially extending step structure 430 of the bracket 420, there is a larger suspended space below the bracket, which increases the elasticity of the hard bracket. When a pressing action force is applied to the key assembly it is transmitted to the hard bracket, the bracket is more prone to elastic deformation and is easier to reset after the elastic deformation, which brings better touch feeling to the key assembly and increases the convenience in pressing contact of the devices.

[0165] In some embodiments, as shown in FIG. 44, the bracket 420 includes a bracket first side wall 421 circumferentially extending continuously along the outer edge of the bracket 420 and a bracket second side wall 422 circumferentially extending continuously along the interior of the bracket 420. A first assembling part 423 is formed between the bracket first side wall 421 and the bracket second side wall 422, and a second assembling part 424 is formed in the bracket second side wall 422. The bracket first side wall 421 and the bracket second side wall 422 extend circumferentially around and are parallel to the overall outer contour shape of the bracket 420 to form a closed structure, such as a surrounding closed ellipse, circle, square, rectangle, etc., which is not limited. The first bracket side wall 421 and the second bracket side wall 422, which extend in a closed manner, form the first assembling part 423 and the second assembling part 424 for accommodating a first protruding part 412 and a second protruding part 413 of the keycap, and play a role in fixing and supporting the whole keycap.

[0166] Specifically, in some embodiments, at least a part of the step structure is located at the first assembling part 423, and the other part of the step structure is located at the second assembling part 424. For example, the first assembling part 423 includes at least one step structure, and the second assembling part 424 includes the highest step surface of the step structure. The bracket first side wall 421 and the bracket second side wall 422 essentially also form a high-low structure along with the ascending of the step structure 430, for example, the bracket second side wall 422 is higher than the bracket first side wall 421, so that the support for the keycap is more stable and the sealing is more thorough.

[0167] In some embodiments, each of the two ends of the bracket 420 includes one positioning hole 425, the lower surface of the cap plate is provided with the positioning column bodies 1001 disposed corresponding to the positioning holes 425, and the positioning column bodies 1001 penetrate the positioning holes 425 to fix the bracket 420. Optionally, the side wall of the positioning column body 1001 includes at least one protrusion, so that the positioning column bodies 1001 are in interference assembly with the positioning holes 425, thereby firmly fixing the bracket 420 to the lower surface of the cap plate and meanwhile, providing an upward pressing force to fix the keycap 410.

[0168] In some embodiments, the bracket 420 further includes keypads 427 connected by at least one elastic arm 426. The keypads are configured to move downward under the action of an external force to implement a pressing function, and the elastic arm 426 is configured to reset the keypads 427. As shown in FIG. 44, the keypads 427 are usually located inside the bracket, and there are a pair of symmetrically disposed keypads 427. The keypad 427 includes a keypad head 4271 in contact with an abutting part 4171 of the keycap and a keypad tail 4272 in contact with the components of the circuit board 105 in a pressing manner. Generally, the

width of the keypad head 4271 is greater than the width of the keypad tail 4272. The large width of the keypad head 4271 facilitates the receiving of the pressing action force, while the small width of the keypad tail 4272 facilitates accurate contact with the pressing element and avoids pressing errors. The keypad 427 is connected to the inner edge of the bracket 420 through the slender elastic arm 426, and one or more slender elastic arms 426 are disposed around the keypads 427 to provide sufficient pressing and resetting elasticity for the keypads 427.

[0169] In some embodiments, as shown in FIGs. 46 and 47, the keycap 410 includes the pressing main body part 411 approximately located in the center of the keycap 410, and the first protruding part 412 and the second protruding part 413 which extend downward around the pressing main body part 411. The first protruding part 412 and the second protruding part 413 extend circumferentially around and are parallel to the contour shape of the pressing main body part 411 to form a closed structure. When the keycap 410 is assembled to the bracket 420, the first protruding part 412 and the second protruding part 413 are adapted to the first assembling part 423 and the second assembling part 424, respectively. In order to match the step structure inside the first assembling part 423 and the second assembling part 424, the downward extending length of the first protruding part 412 is greater than the downward extending length of the second protruding part 413. The first protruding part 412 and the second protruding part 413 may be in interference assembly with the first assembling part 423 and the second assembling part 424, respectively, so as to increase the stability and sealing performance in the assembling of the keycap.

[0170] In some embodiments, as shown in FIG. 46, the upper surface of the keycap 410 includes a third protruding part 414 connected to the first protruding part 412 and the second protruding part 413 and extending upward around the pressing main body part 411. The third protruding part 414 extends circumferentially around and is parallel to the contour shape of the pressing main body part 411 to form a closed structure. The keycap 410 further includes a first groove 415 and a second groove 416 which extend around two sides of the third protruding part 414. The depth of the first groove 415 is greater than the depth of the second groove 416. As shown in FIGs. 49-50, FIG. 50 is an enlarged view of the bottom view at D of the cap plate in FIG. 49. The cap plate 1000 includes a key mounting hole 1002, and the pressing main body part 411 is assembled in the key mounting hole 1002. In this case, a downward extending edge part 1004 is disposed around the edge of the key mounting hole 1002, and the edge part is inserted into the key mounting hole 1002 from bottom to top along with the pressing main body part 411, and is naturally and conveniently inserted into the second groove around the pressing main body part 411. The edge part 1004 forms one of the waterproof ribs of the cap plate 1000, and the side wall of the edge part 1004 may include at least one convex point, so that the press-

ing main body part 411 and the key mounting hole 1002 are in interference assembling, the sealing connection is realized, and waterproof and light leakage prevention effects are achieved. Further, in some embodiments, the cap plate 1000 further includes a waterproof rib 1003 extending downward around the key mounting hole 1002. The waterproof rib 1003 is assembled in the first groove 415, and the side wall of the waterproof rib 1003 may include at least one convex point, so that the waterproof rib 1003 is in interference assembling in the first groove 415. As the pressing main body part 411 is inserted into the key mounting hole 1002, the edge part of the key mounting hole 1002 is inserted into the second groove 416 around the pressing main body part 411, the waterproof rib 1003 is also inserted into the first groove 415 in an interference manner, and the downward extending length of the waterproof rib 1003 is greater than the length of the edge part of the key mounting hole 1002, so that the pressing main body part 411 is more hermetically connected to the key mounting hole 1002, and better waterproof and light leakage prevention effects are achieved.

[0171] In some embodiments, as shown in FIGs. 47-48, FIG. 48 is a cross-sectional view along line AB in FIG. 1, the second protruding part 413 includes two recesses 417 disposed at intervals, and the recesses 417 are configured to accommodate the keypads 427 in an assembling state. The top-end of the recess 417 is provided with the abutting part 4171. After the assembling of the keycap and the bracket is completed, the keypad heads 4271 are closely abutted against the abutting parts 4171, which is convenient for receiving the pressing action force.

[0172] In some embodiments, as shown in FIGs. 47-48, a downward extending light-shielding arm 418 is disposed between the two recesses 417 disposed at intervals. The light-shielding arm 418 is made of an opaque material or coated with an opaque material, and can prevent an adverse influence on the acquisition of optical prompt information by a user caused by optical interference between optical elements associated with the pressing operation after the keypads 427 on the two sides press the components on the circuit board 105. The light-shielding arm 418 and the keycap may be integrally formed or later synthesized by processing such as bonding and clamping, which is not limited.

[0173] As for the automatic cleaning apparatus according to the present disclosure, the key assembly is assembled on the cap plate of the automatic cleaning apparatus, the key assembly includes the soft rubber keycap and the hard rubber bracket, the keycap is assembled on the bracket, and the bracket includes the circumferentially extending step structure. In the assembling state, the step structure is formed by continuous ascending steps from outside to inside, and the continuous ascending step structure provides enough space for the lower side of the key assembly to accommodate more components. Meanwhile, the elastic force of the

bracket is increased, so that the key assembly can be more easily restored to the original position after being pressed. Thus, the settable length of the waterproof rib of the top cap is further increased, and the waterproof effect of the key assembly is enhanced.

[0174] Finally, it should be noted that various embodiments in the Description are 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.

[0175] The above embodiments are only used for illustrating the technical solutions of the present disclosure and are not intended to limit the present disclosure. Although the present disclosure has been described in detail with reference to the foregoing embodiments, those of ordinary skill in the art should understand that they can still make modifications to the technical solutions described in the foregoing embodiments or make equivalent substitutions to part of the technical features; and 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 the various embodiments of the present disclosure.

Claims

1. An automatic cleaning apparatus with a dust-collection function, comprising:

a mobile platform containing an accommodating chamber, the mobile platform being configured to automatically move along an operating surface; and

a cleaning module comprising a dust box and a main brush module, wherein the dust box is detachably assembled in the accommodating chamber, and comprises a first air inlet door and a second air inlet door, and the first air inlet door and the second air inlet door are located on a first side wall and a second side wall of the dust box, respectively, and are configured to provide intake airflows in different directions during dust collection.

2. The automatic cleaning apparatus according to claim 1, wherein the first air inlet door and the second air inlet door are located at asymmetric positions of the first side wall and the second side wall, respectively.
3. The automatic cleaning apparatus according to claim 2, wherein the second air inlet door is disposed at a position close to a lower edge of the second side wall, and a lower edge of the second air inlet door is lower than a lower edge of the first air inlet door.

4. The automatic cleaning apparatus according to claim 2, wherein the second air inlet door is disposed close to a rear side wall of the dust box, and the first air inlet door is disposed close to a front side wall of the dust box.

5. The automatic cleaning apparatus according to claim 2, wherein the first air inlet door rotates approximately around a first rotating shaft, the second air inlet door rotates approximately around a second rotating shaft, and the first rotating shaft is approximately perpendicular to the second rotating shaft.

6. The automatic cleaning apparatus according to any one of claims 3 to 5, wherein shapes of the first air inlet door and the second air inlet door are at least one or a combination of following: rectangle, square, circle, ellipse, and/or strip.

7. The automatic cleaning apparatus according to claim 6, wherein the first air inlet door is of a rectangular structure, and long edges of the first air inlet door are longitudinally disposed; and the second air inlet door is of a rectangular structure, and long edges of the second air inlet door are transversely disposed.

8. The automatic cleaning apparatus according to claim 1, wherein the dust box further comprises a first opening and a second opening, the first opening is configured as a dust inlet during dust suction and a dust outlet during dust collection, and the first opening and the second opening are approximately located on a central axis of the automatic cleaning apparatus in a front-rear direction.

9. The automatic cleaning apparatus according to claim 8, wherein the accommodating chamber comprises a first chamber and a second chamber which are sequentially and adjacently disposed in an advancing direction of the automatic cleaning apparatus, a bottom of a front side wall of the first chamber is provided with a dust-suction port, a rear side wall of a connection between the first chamber and the second chamber is provided with an air outlet, and the dust-suction port, the air outlet, the first opening, and the second opening are all approximately located on the central axis of the automatic cleaning apparatus in the front-rear direction.

10. The automatic cleaning apparatus according to claim 9, wherein a fan is disposed in a space below the second chamber, and the fan, the main brush module, the dust-suction port, the air outlet, the first opening, and the second opening are all approximately located on the central axis of the automatic cleaning apparatus in the front-rear direction.

11. The automatic cleaning apparatus according to claim 10, wherein the mobile platform further comprises a position-determining device and a cover cap covering the position-determining device; and the position-determining device, the cover cap, the main brush module, the dust-suction port, the air outlet, the first opening, and the second opening are all approximately located on the central axis of the automatic cleaning apparatus in the front-rear direction. 5 10
12. The automatic cleaning apparatus according to claim 11, wherein the intake airflows in different directions are from at least one of following: airflows entering from a top-end gap of the mobile platform, an airflow entering from a gap of the main brush module, or an airflow entering from a rear side wall of the mobile platform. 15
13. The automatic cleaning apparatus according to claim 12, wherein the airflows entering from the top-end gap of the mobile platform comprise an airflow entering from a gap between the cover cap and a top surface of the mobile platform and an airflow entering from a gap between the cover cap and the position-determining device. 20 25
14. An automatic cleaning system, comprising a dust-collection station and the automatic cleaning apparatus according to any one of claims 1 to 13, wherein the dust-collection station comprises a dust-collection port, and the dust-collection port is docked with a port of the main brush module and collects dust. 30

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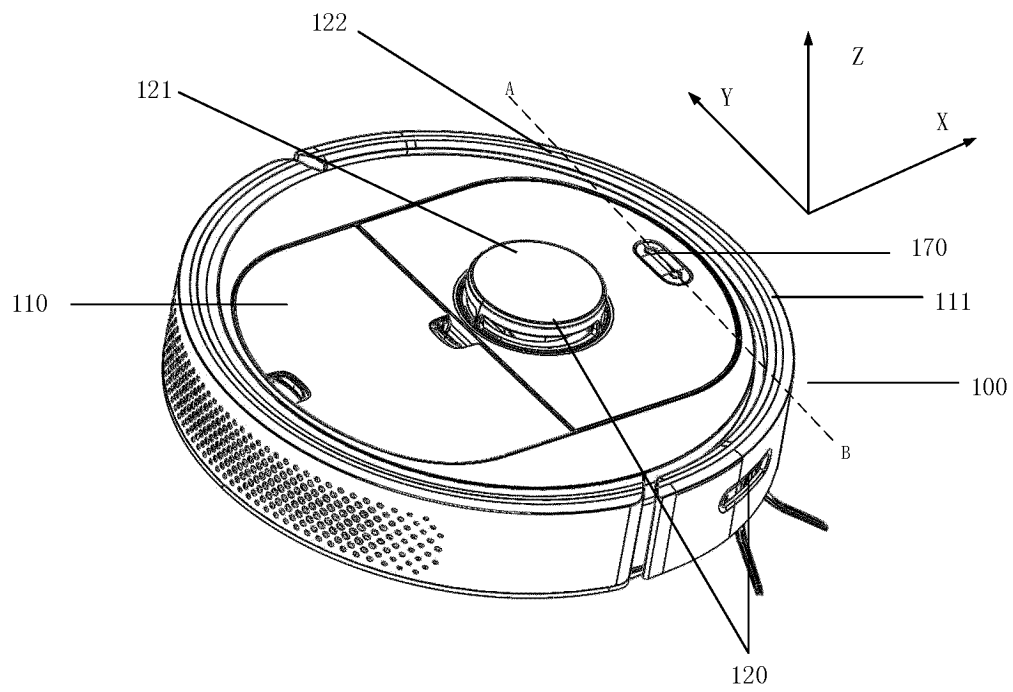


FIG. 1

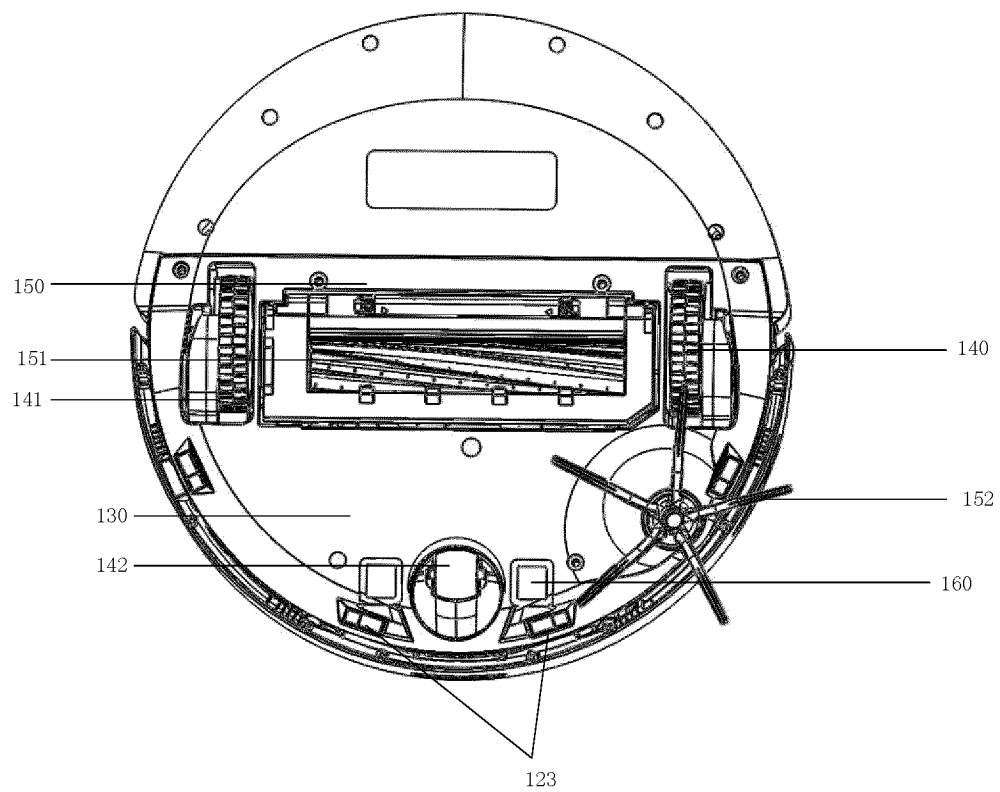


FIG. 2

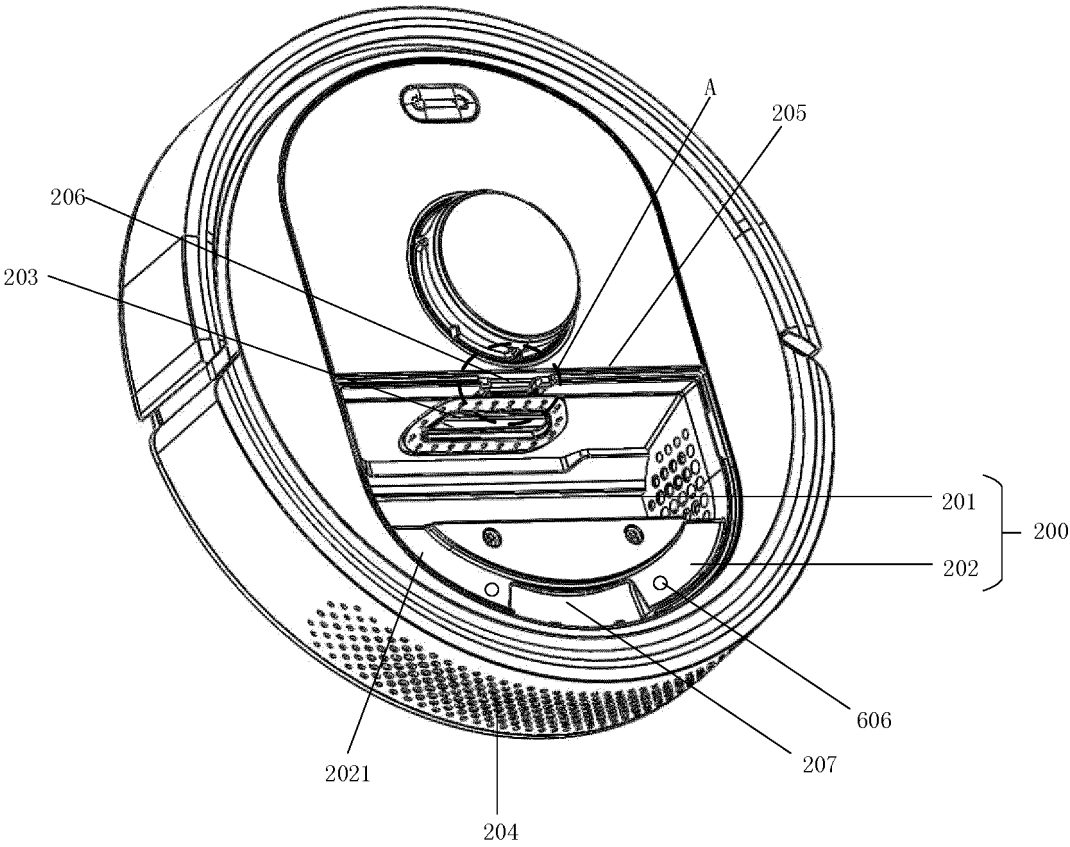


FIG. 3a

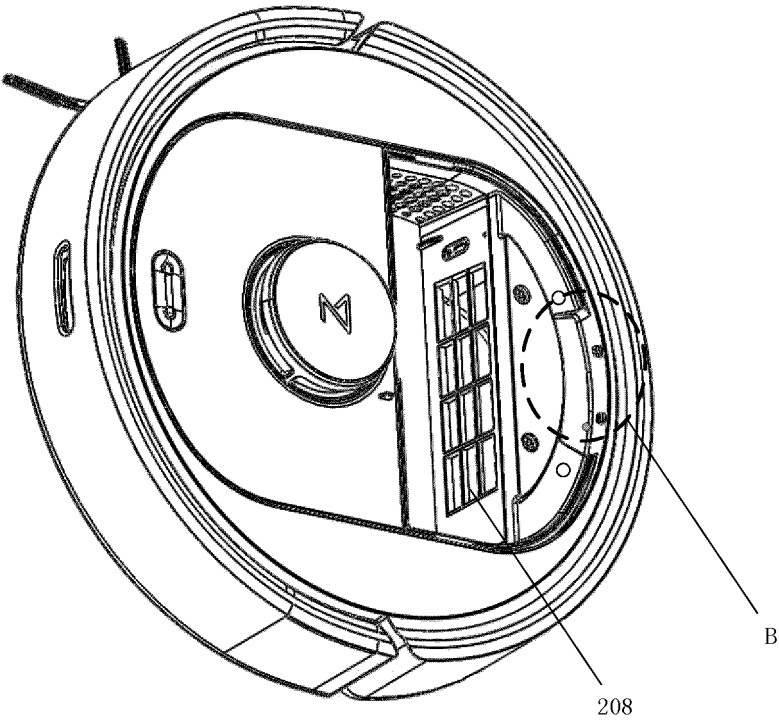


FIG. 3b

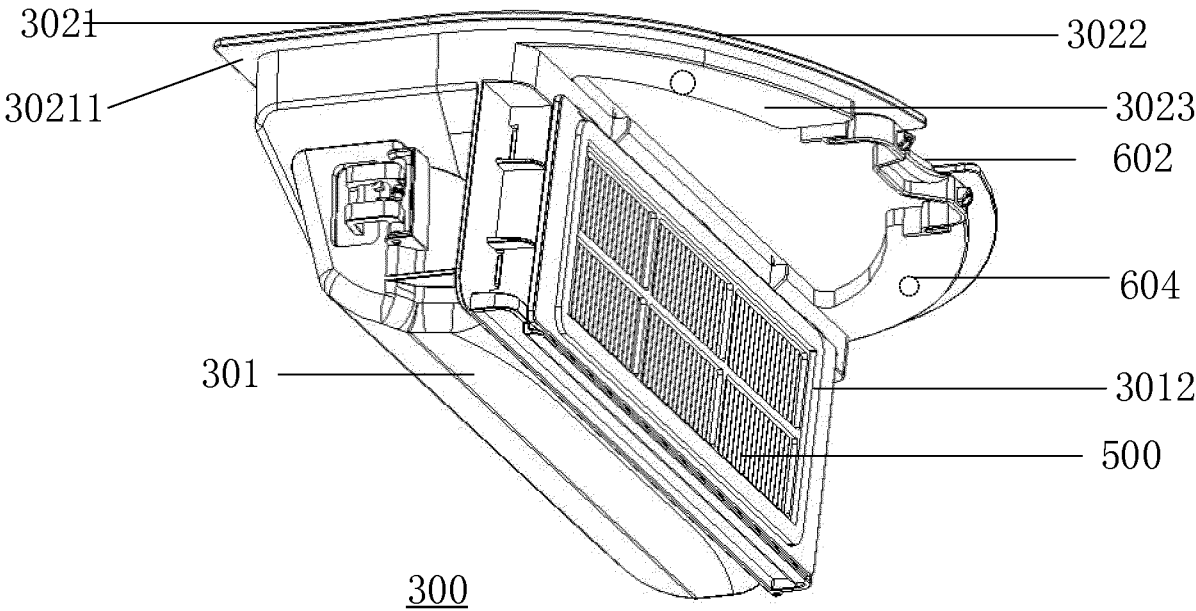


FIG. 4

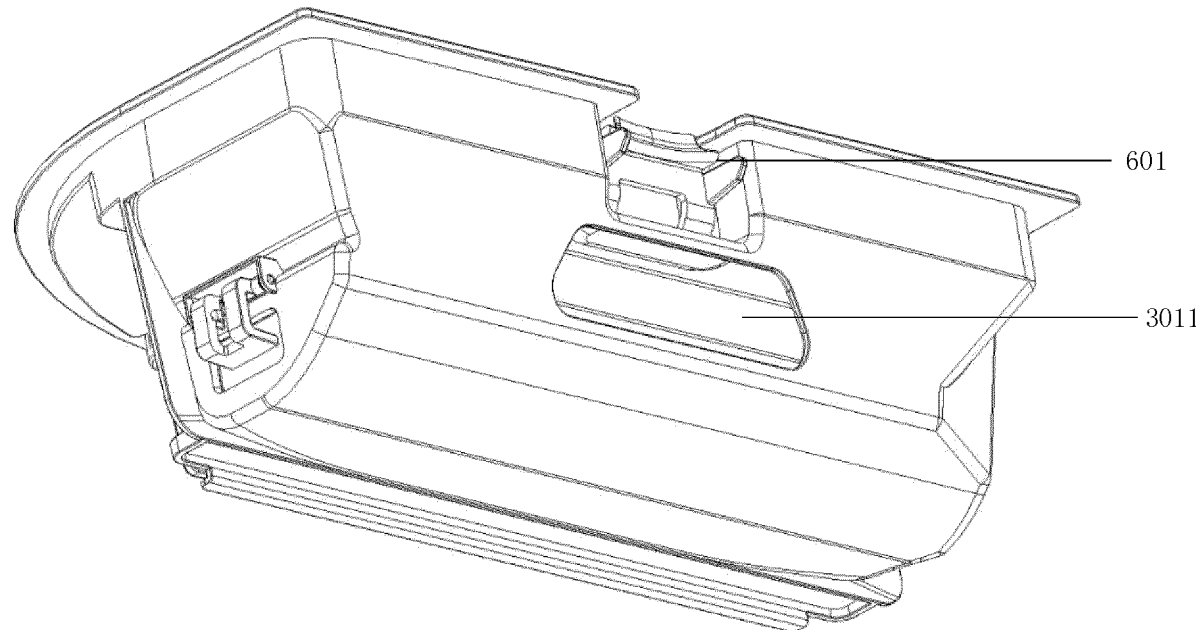


FIG. 5

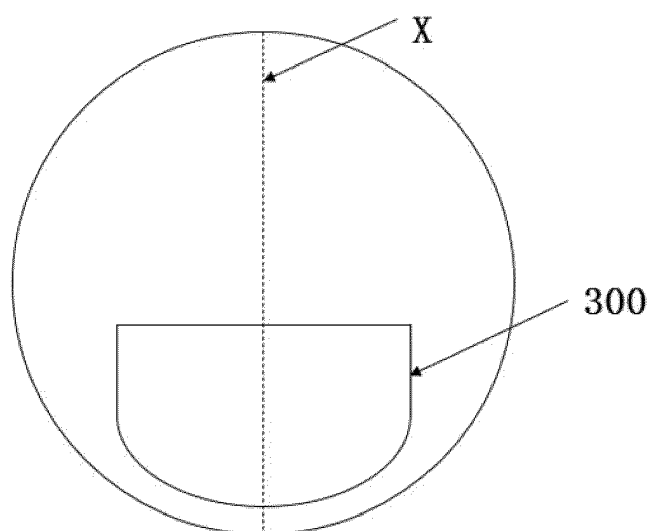


FIG. 6a

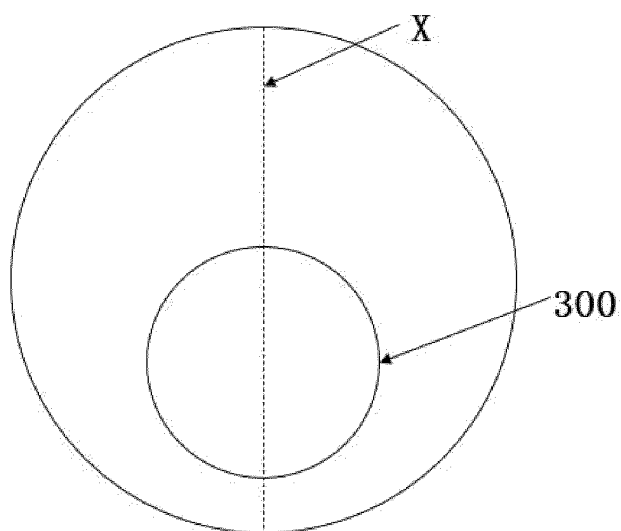


FIG. 6b

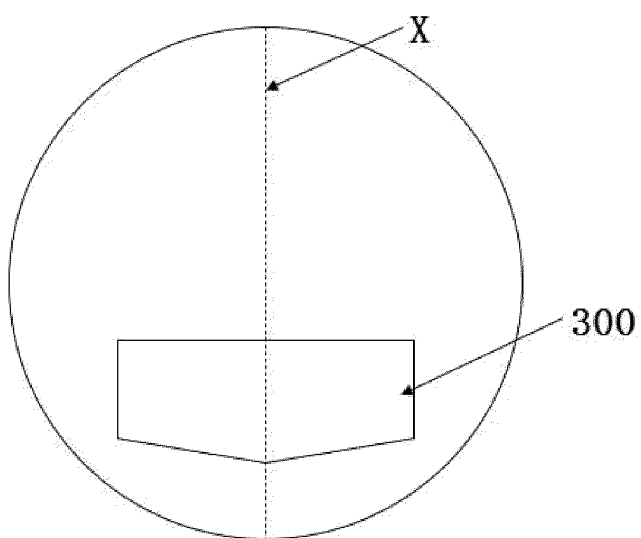


FIG. 6c

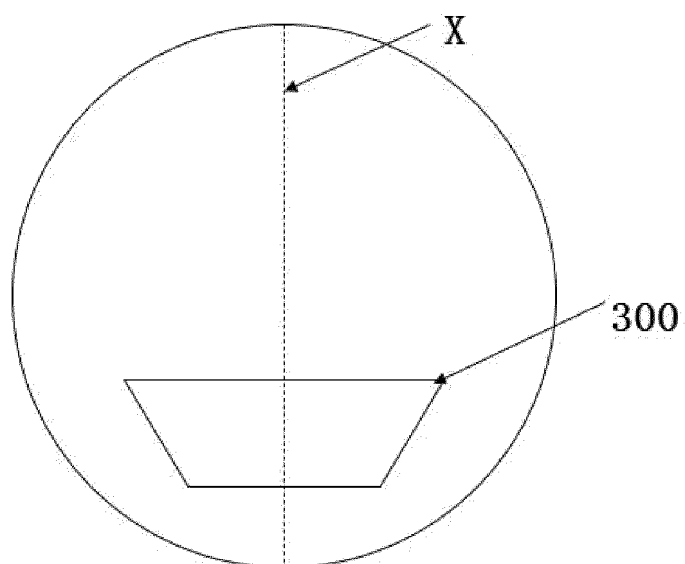


FIG. 6d

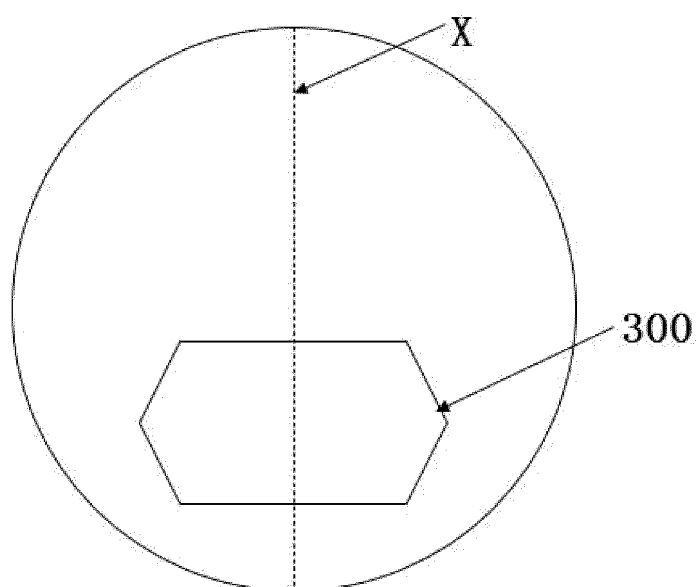


FIG. 6e

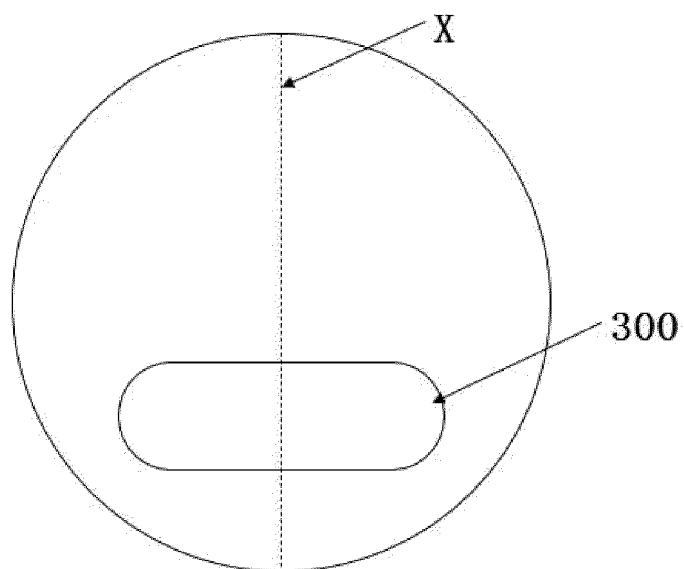


FIG. 6f

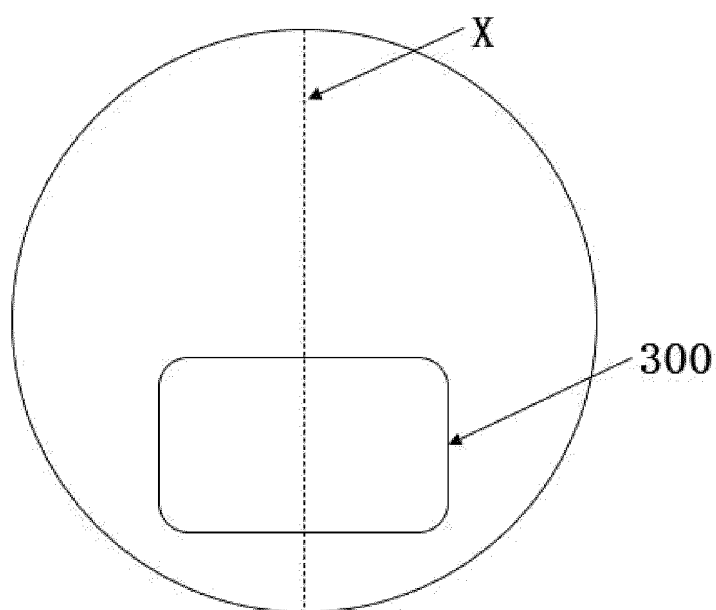


FIG. 6g

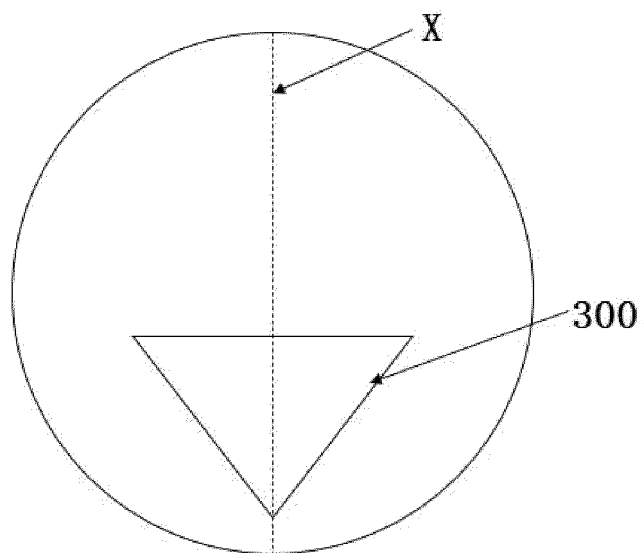


FIG. 6h

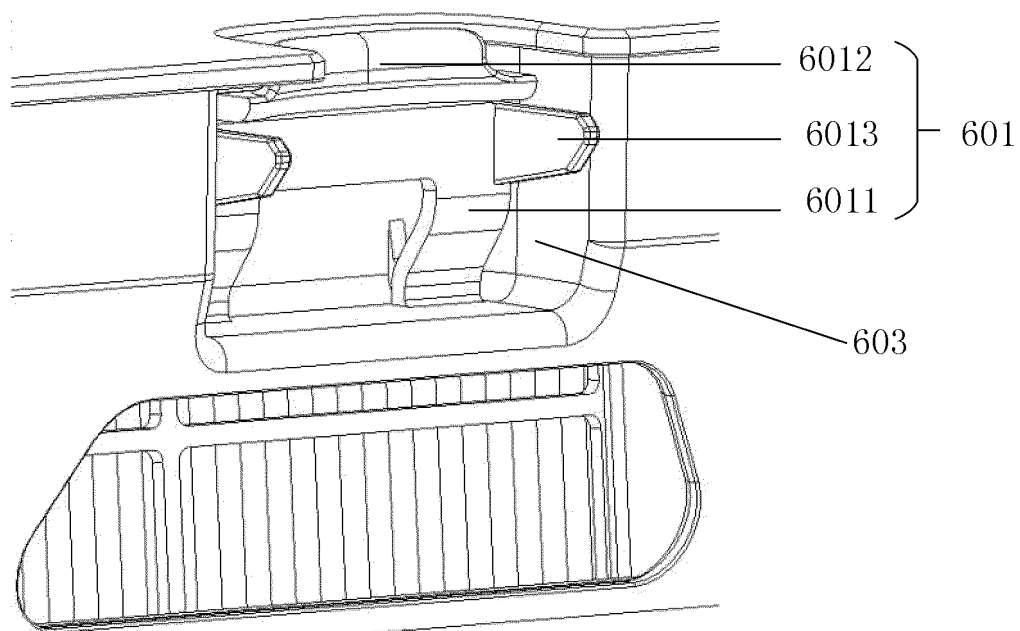


FIG. 7

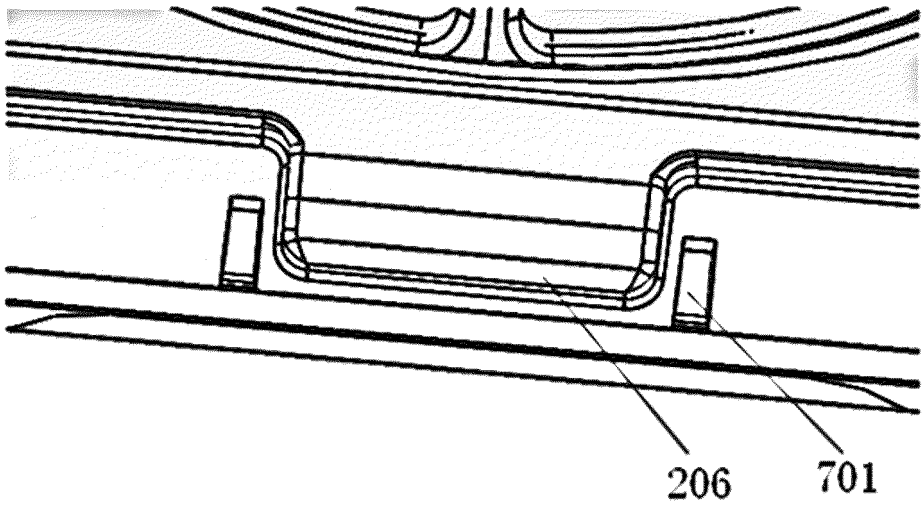


FIG. 8

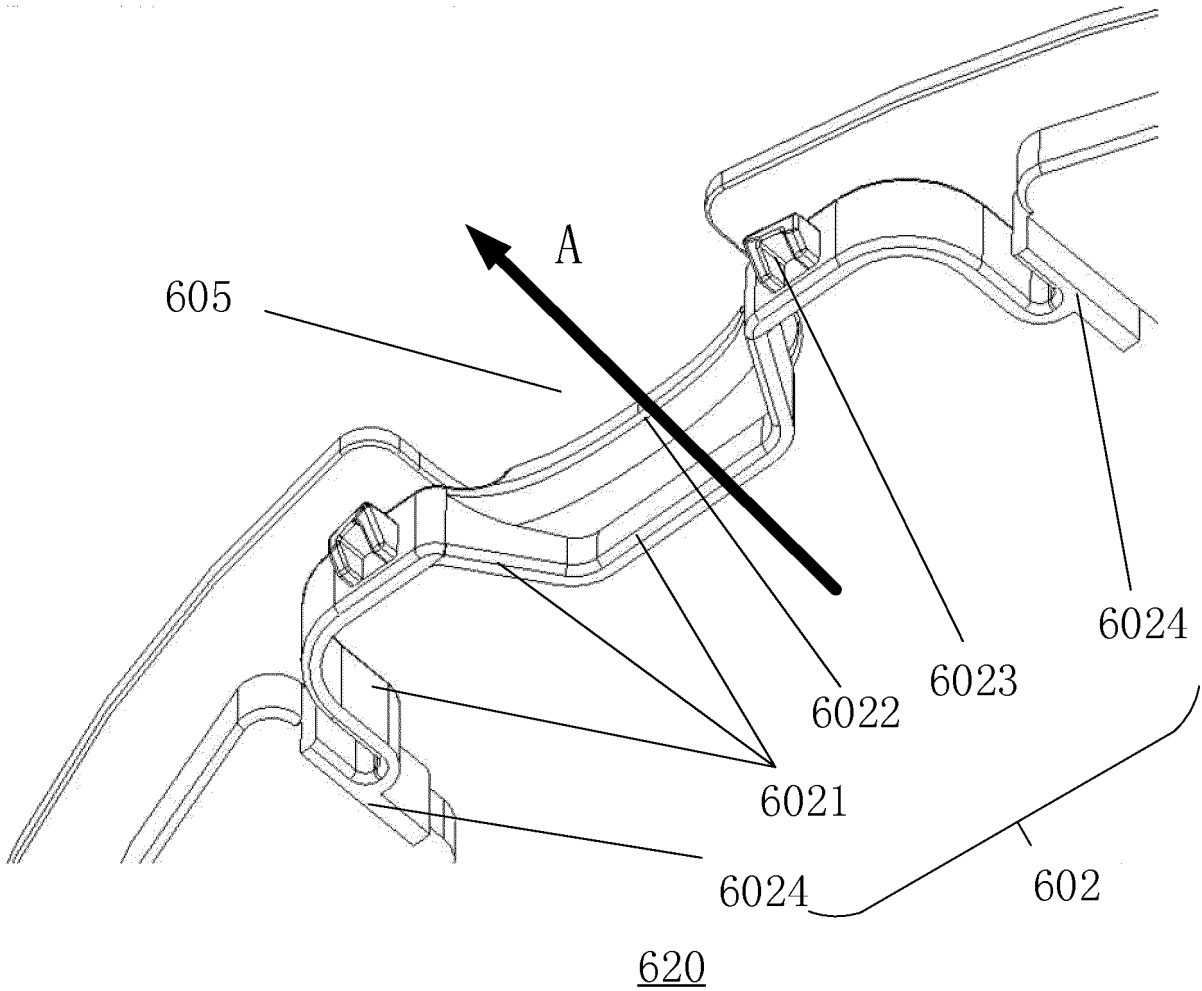


FIG. 9a

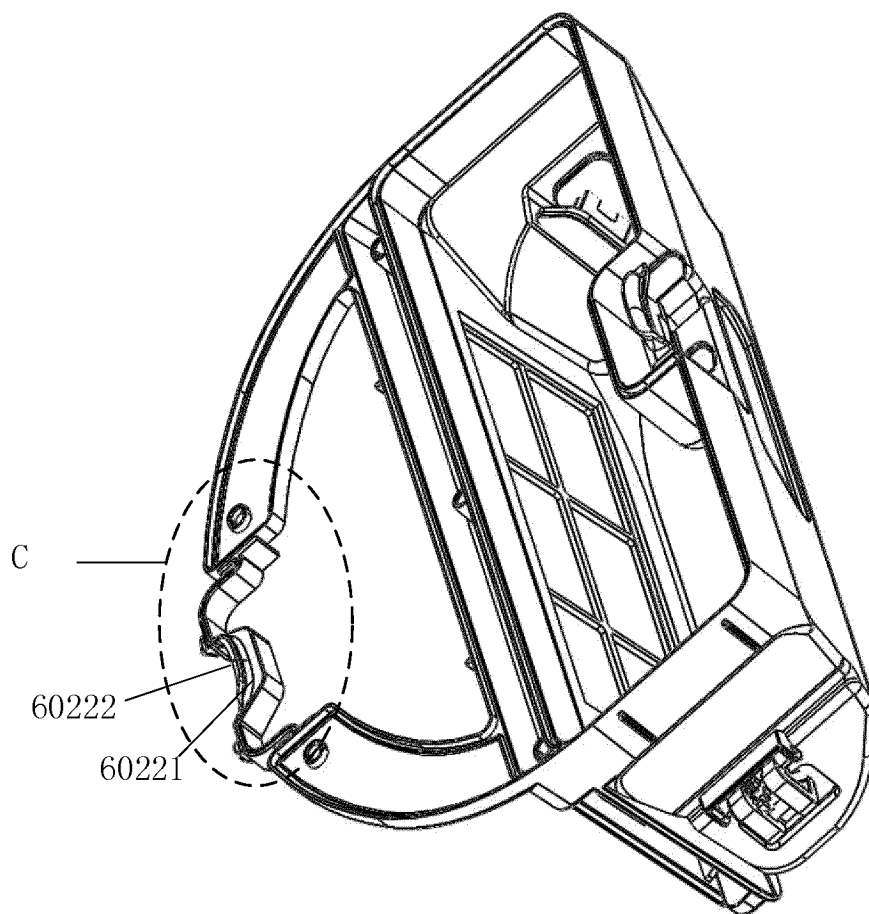


FIG. 9b

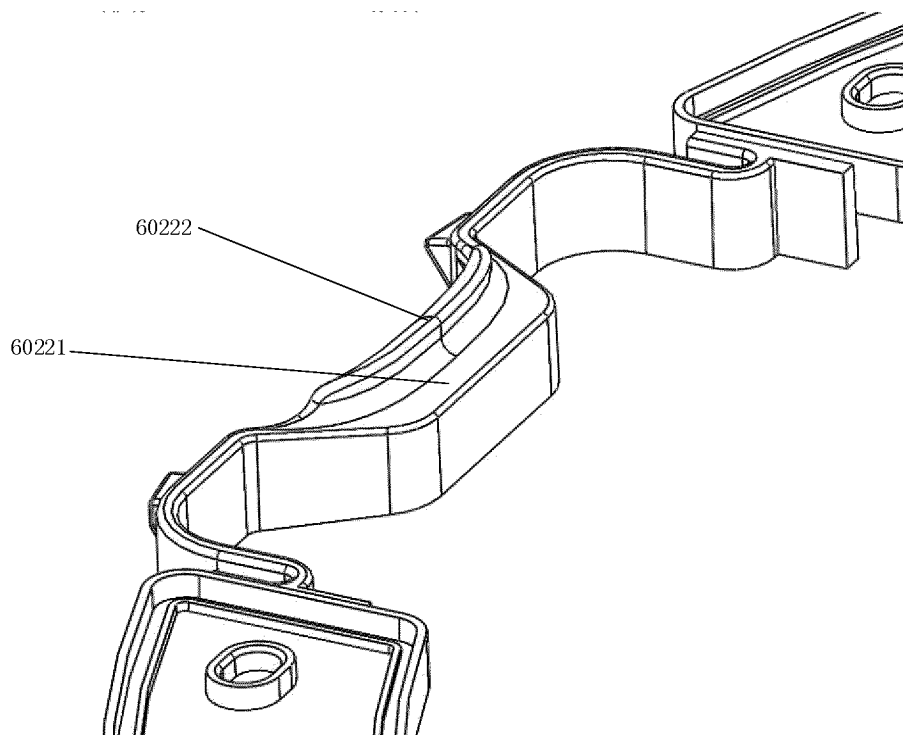


FIG. 9c

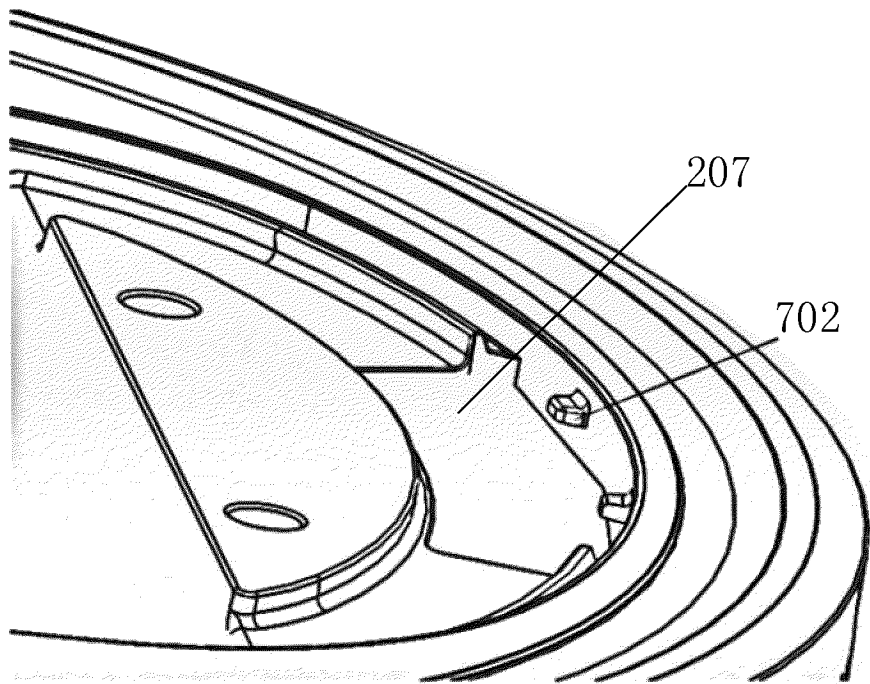


FIG. 10

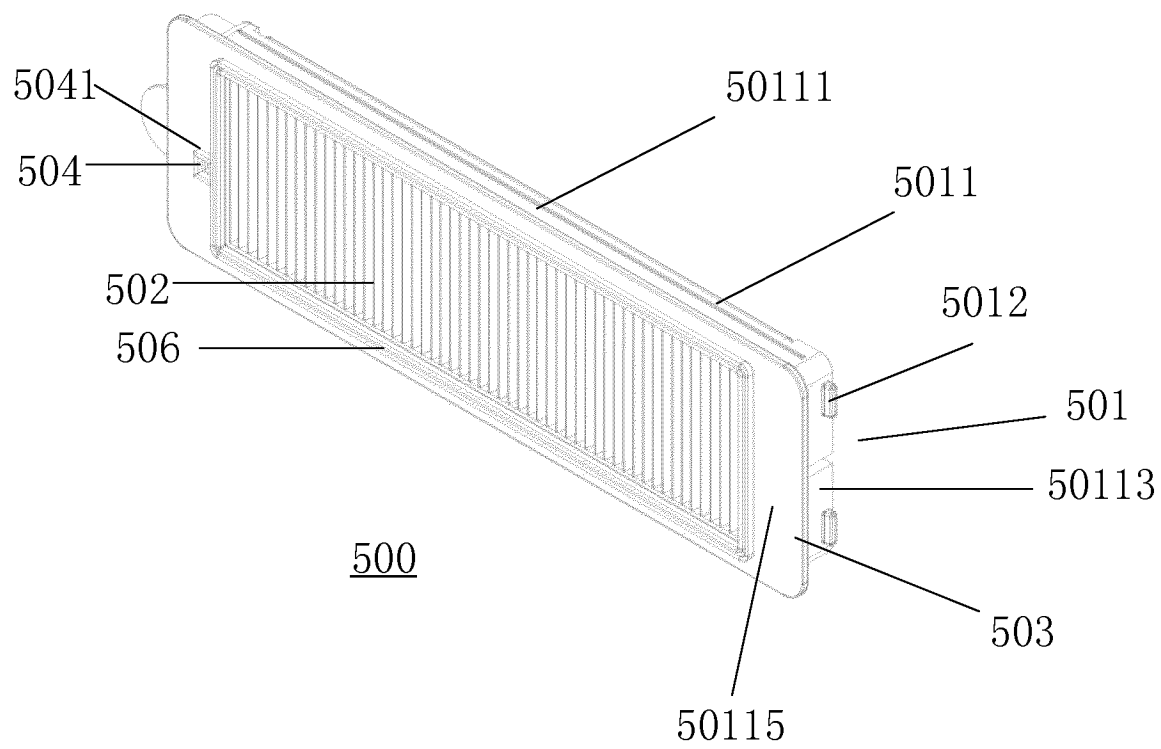


FIG. 11

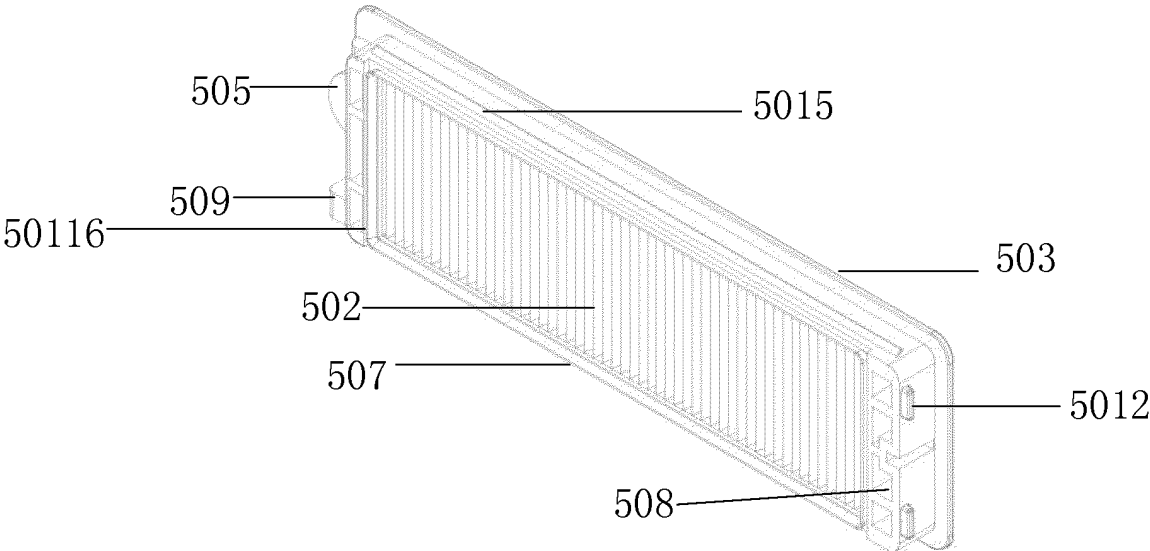


FIG. 12

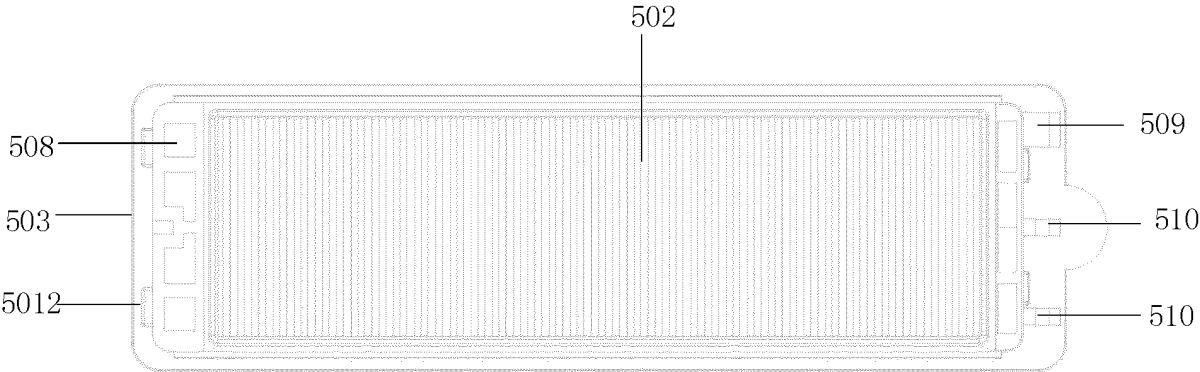


FIG. 13a

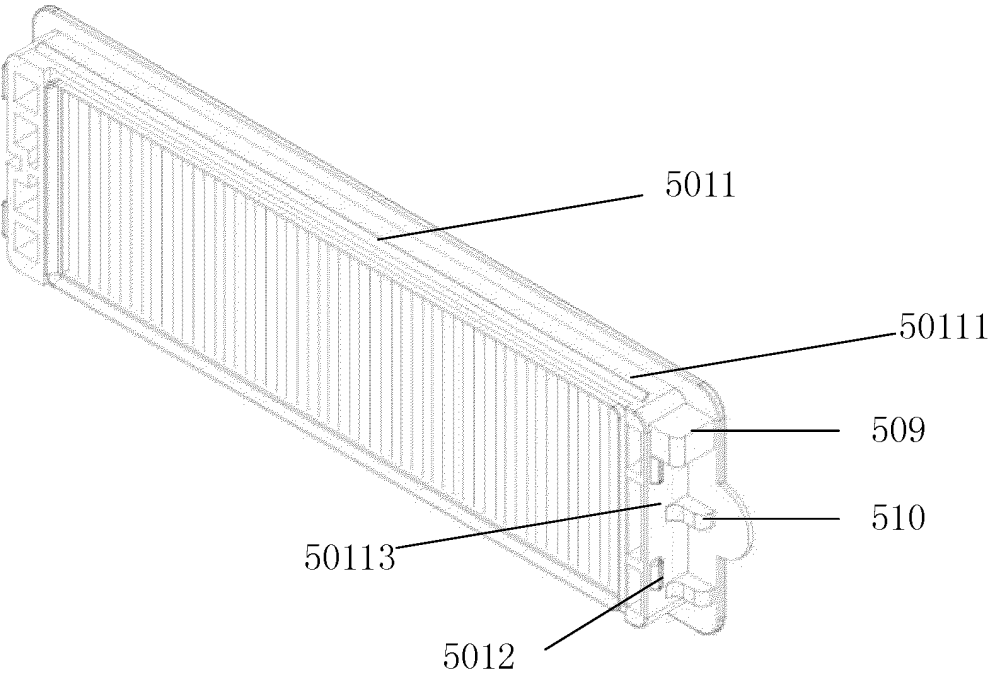


FIG. 13b

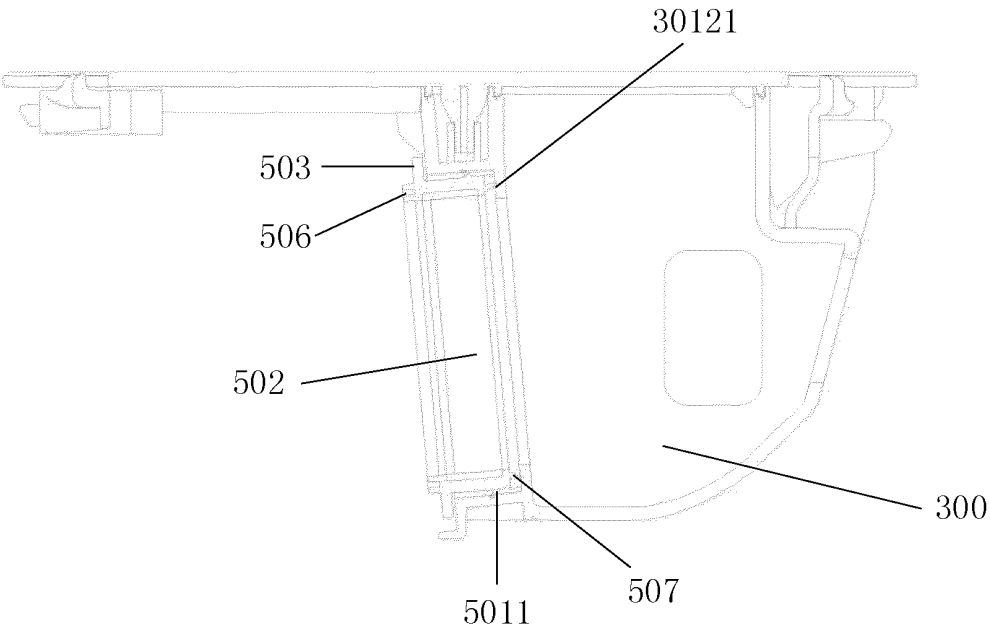


FIG. 14

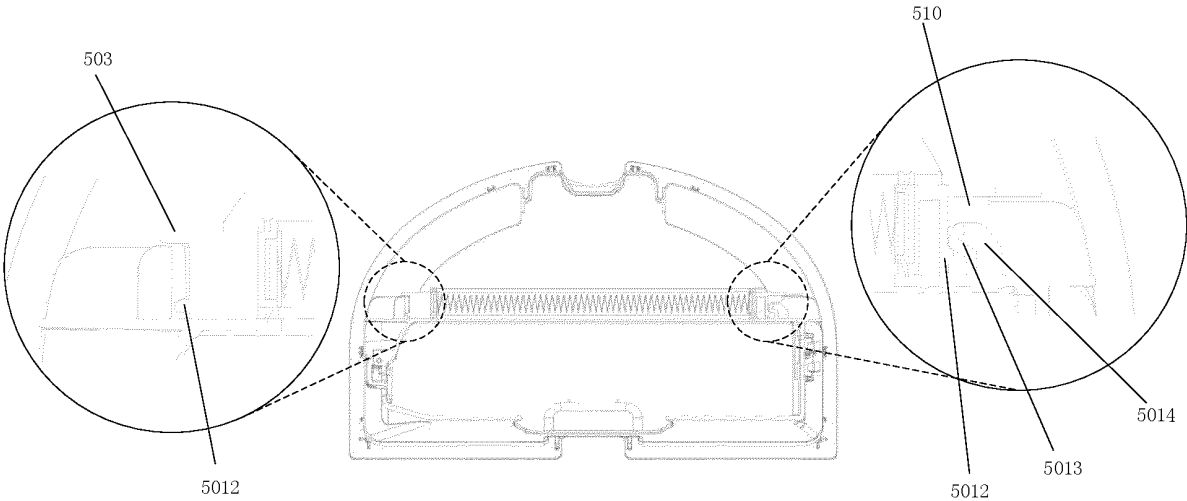


FIG. 15

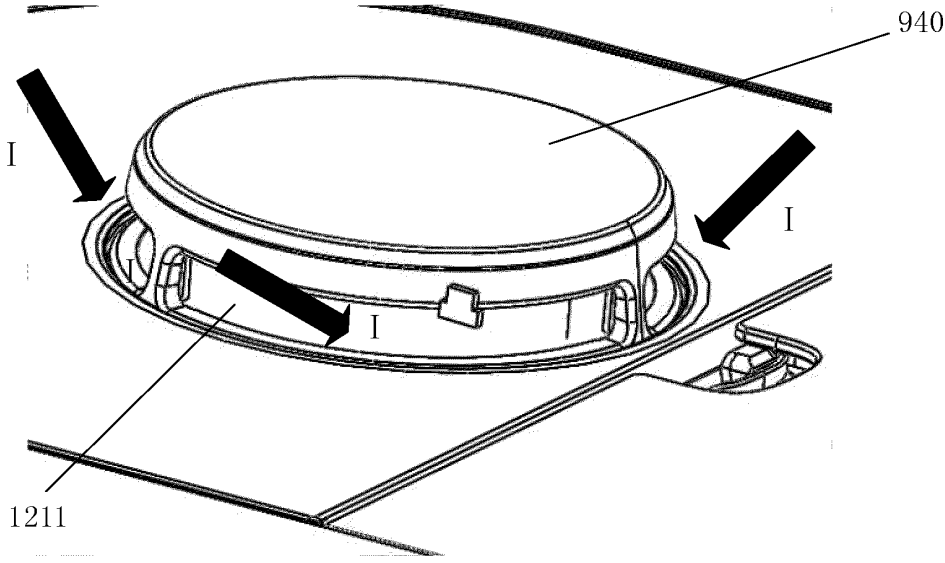


FIG. 16

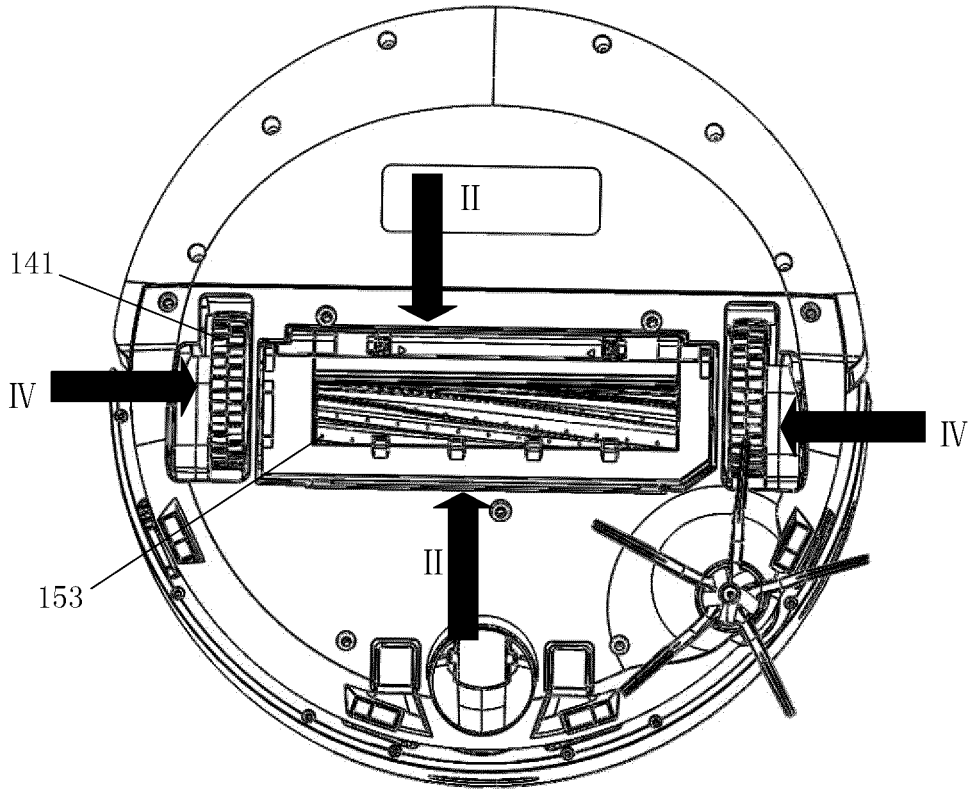


FIG. 17

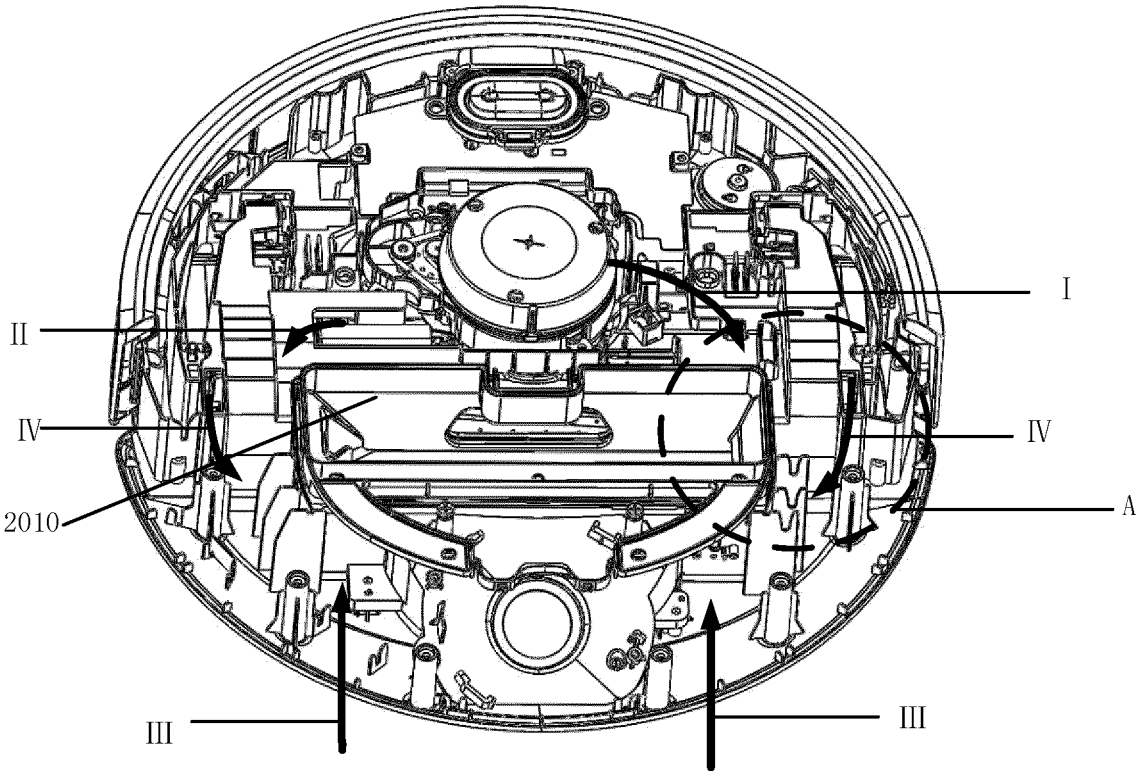


FIG. 18a

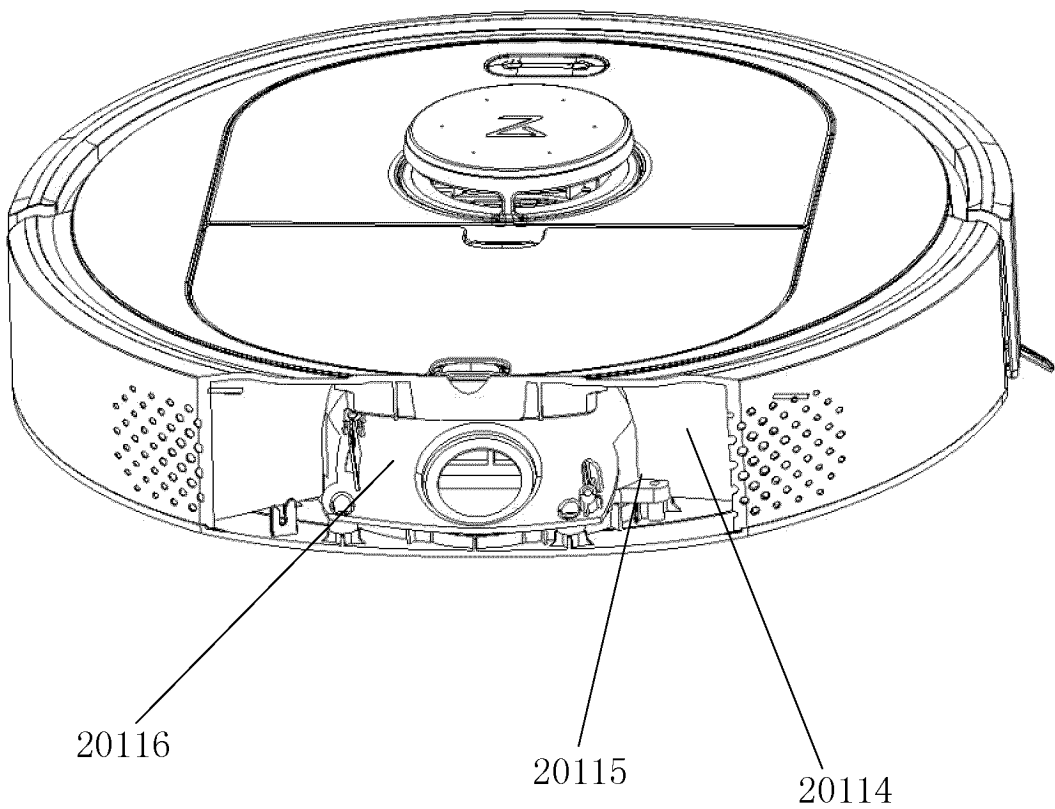


FIG. 18b

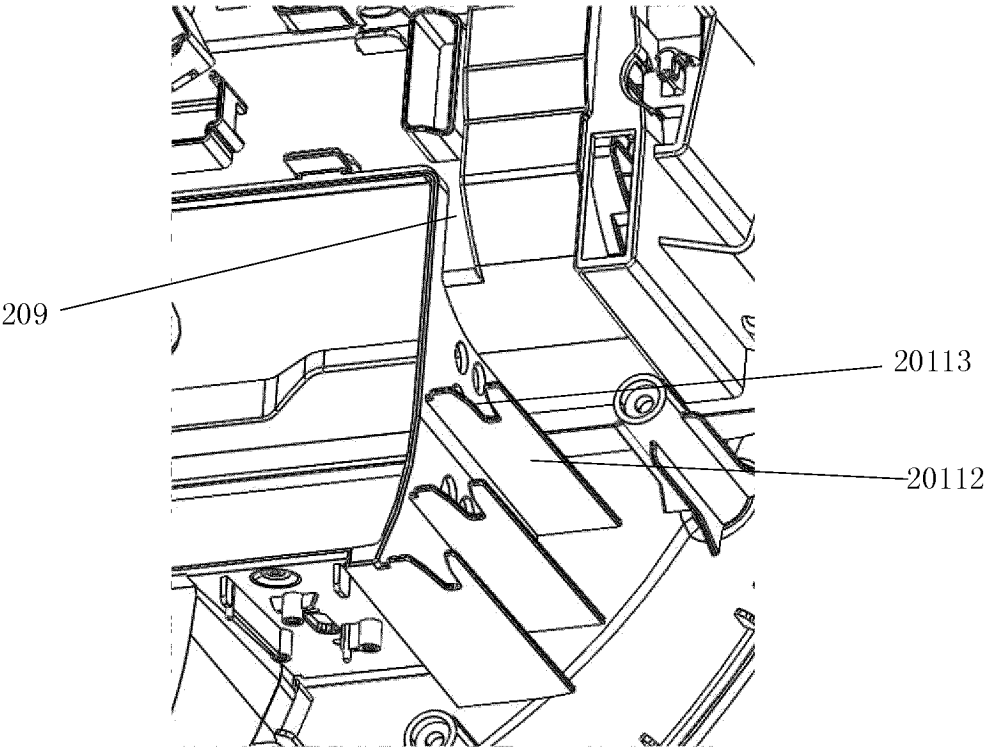


FIG. 19

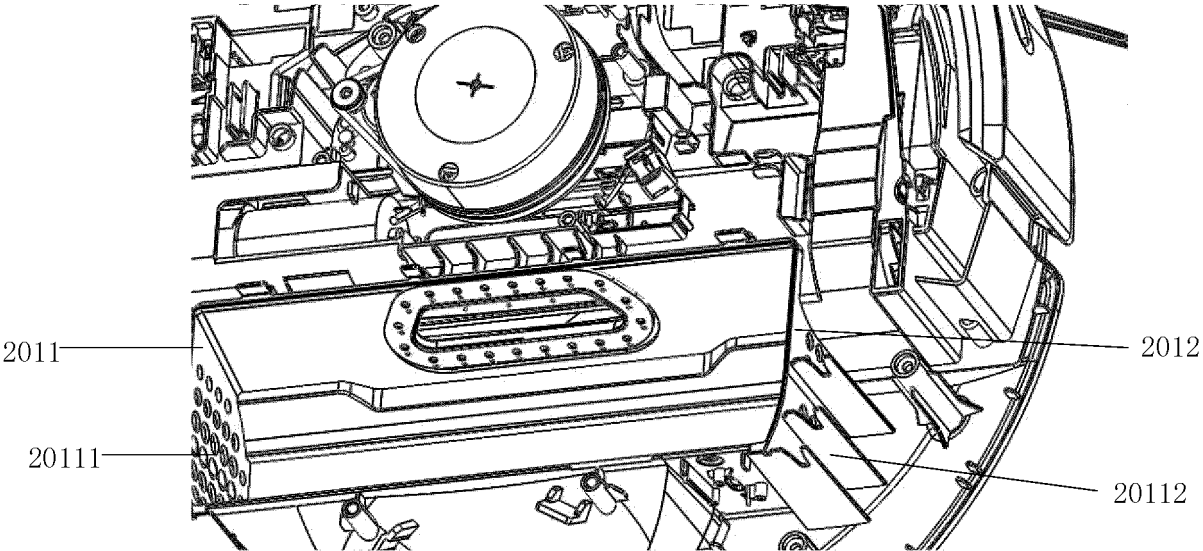


FIG. 20

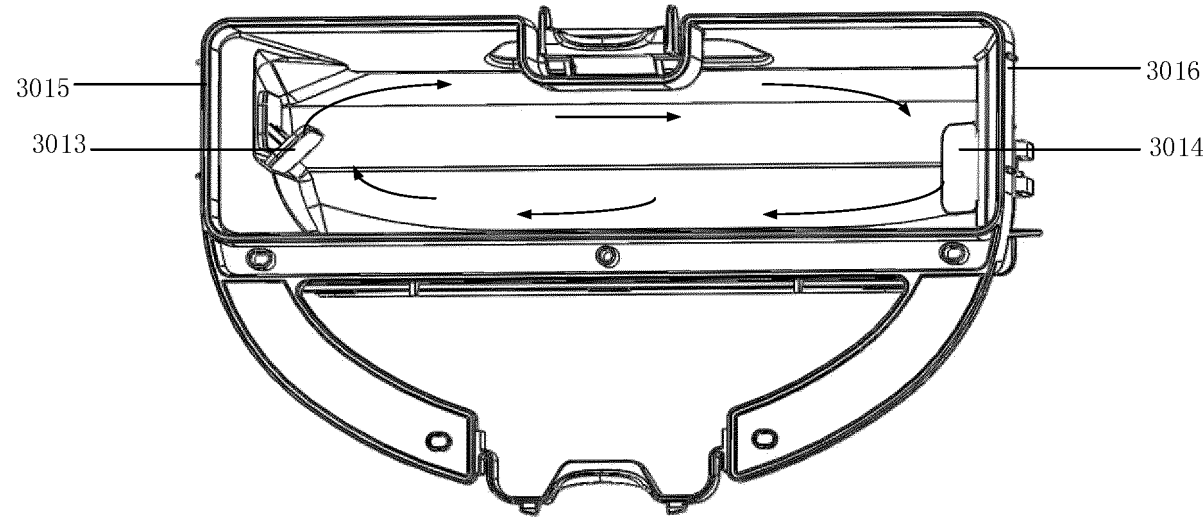


FIG. 21

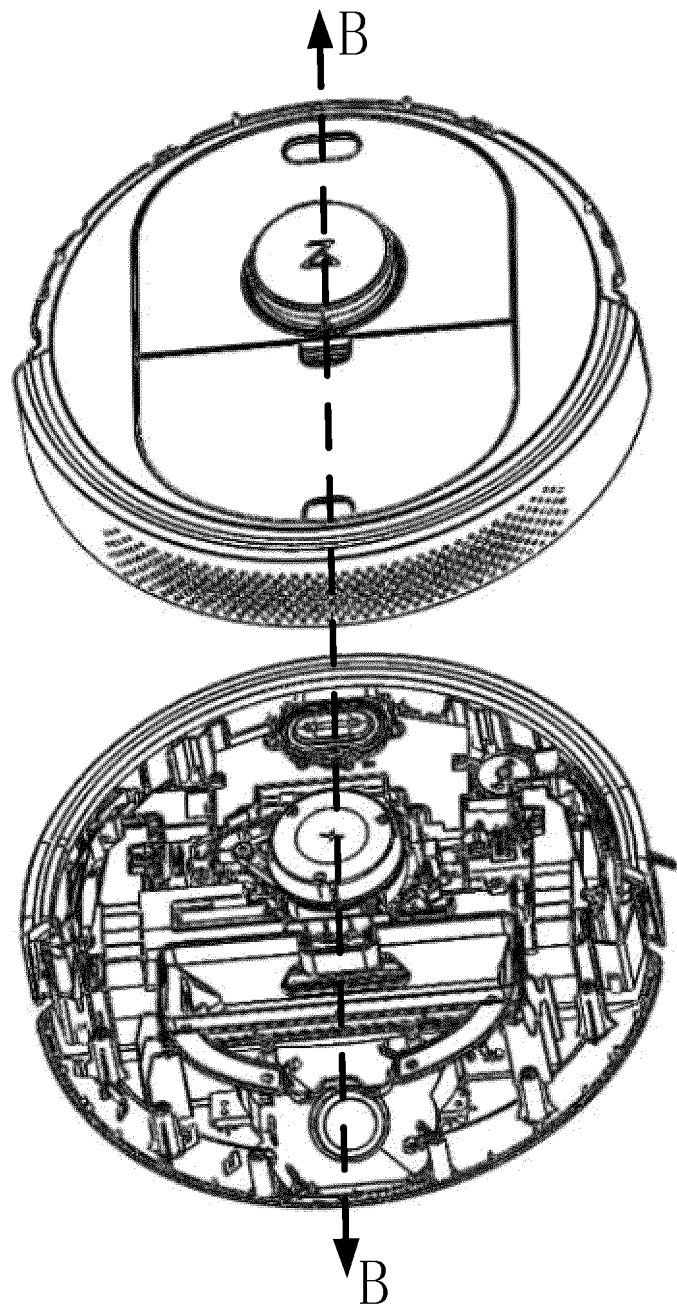


FIG. 22

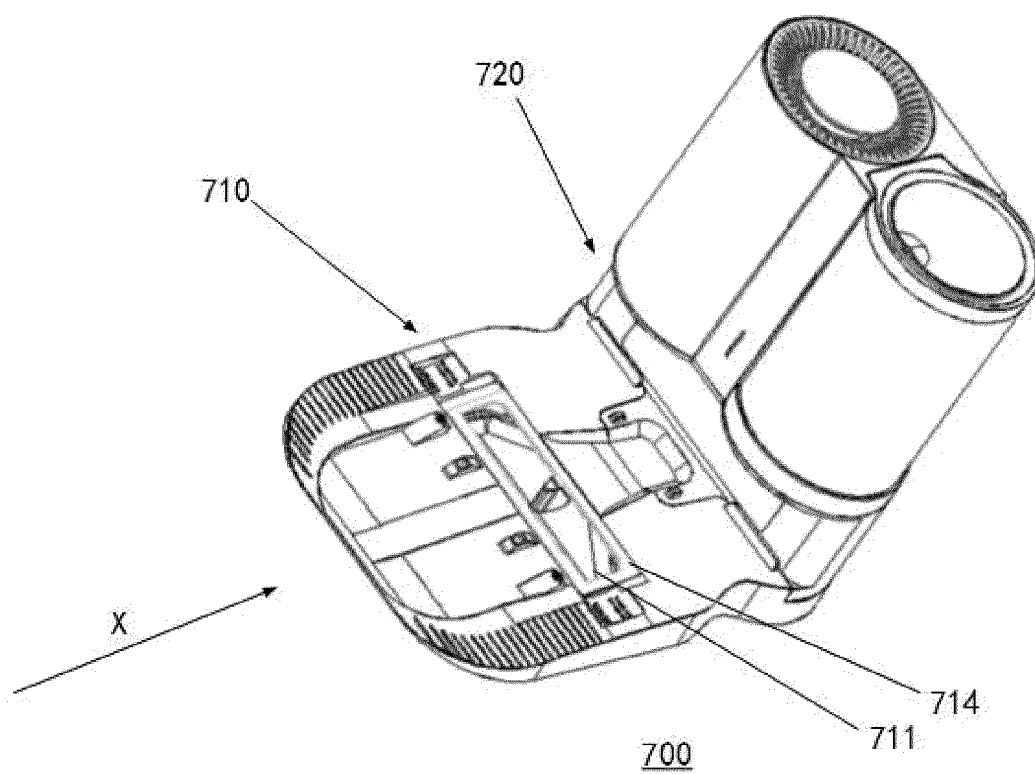
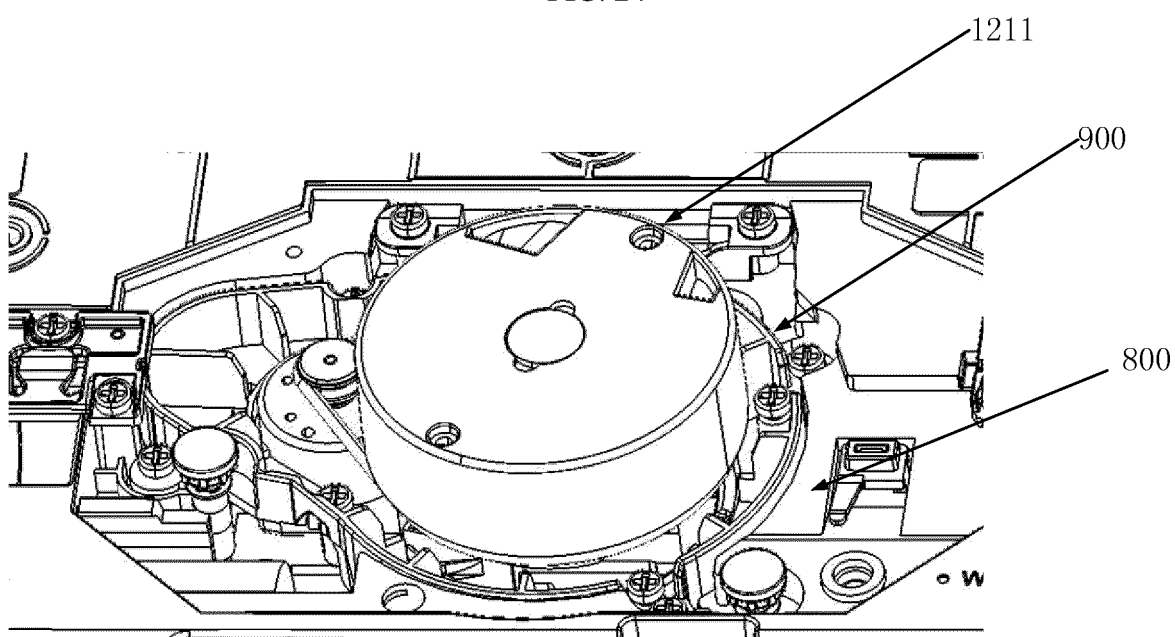
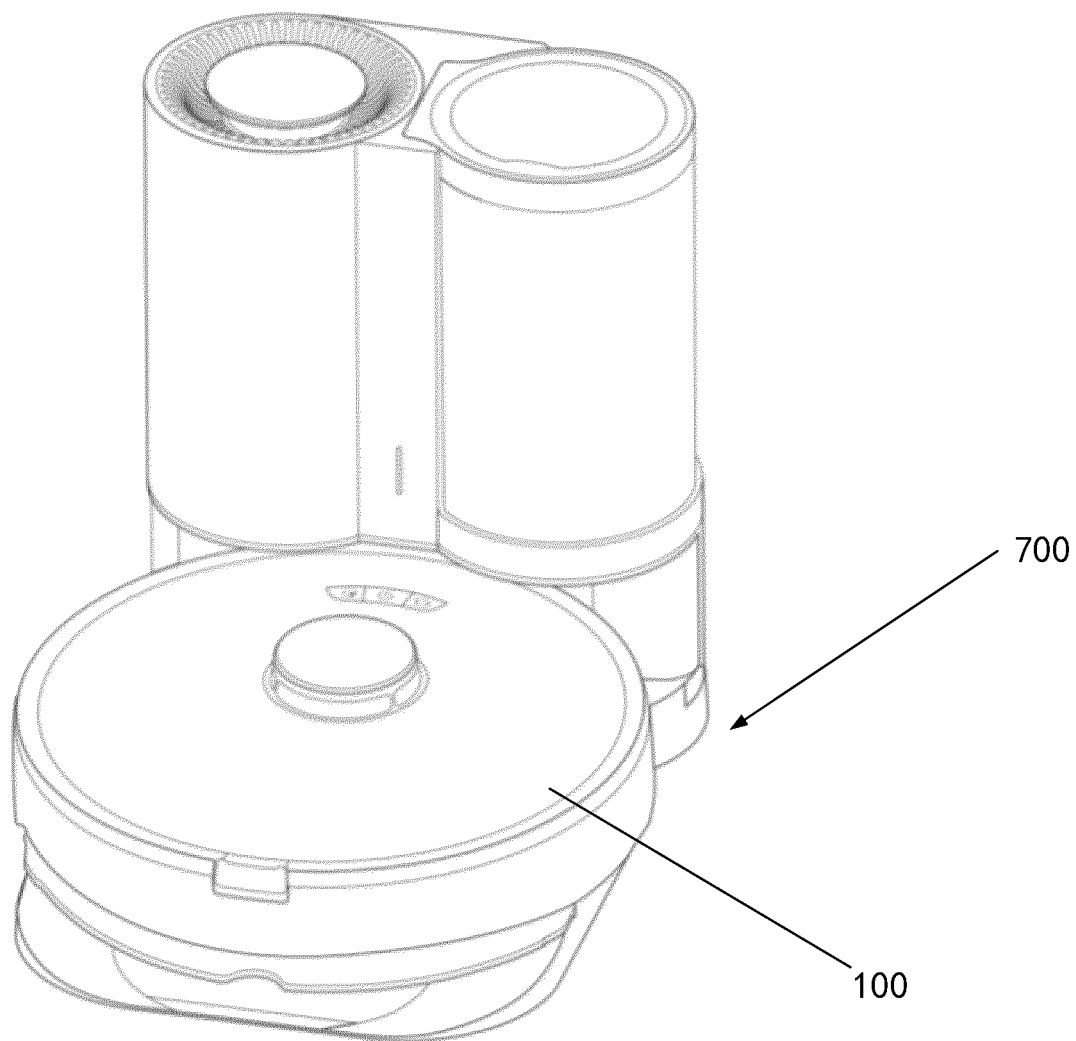


FIG. 23



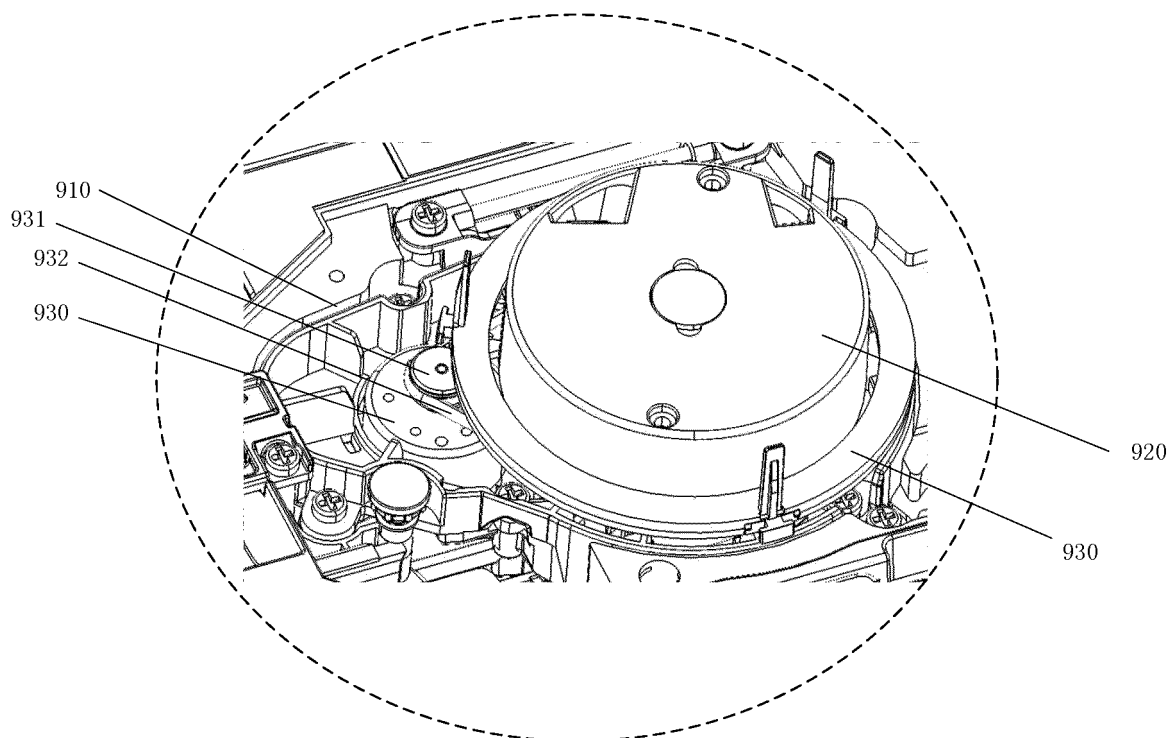


FIG. 26

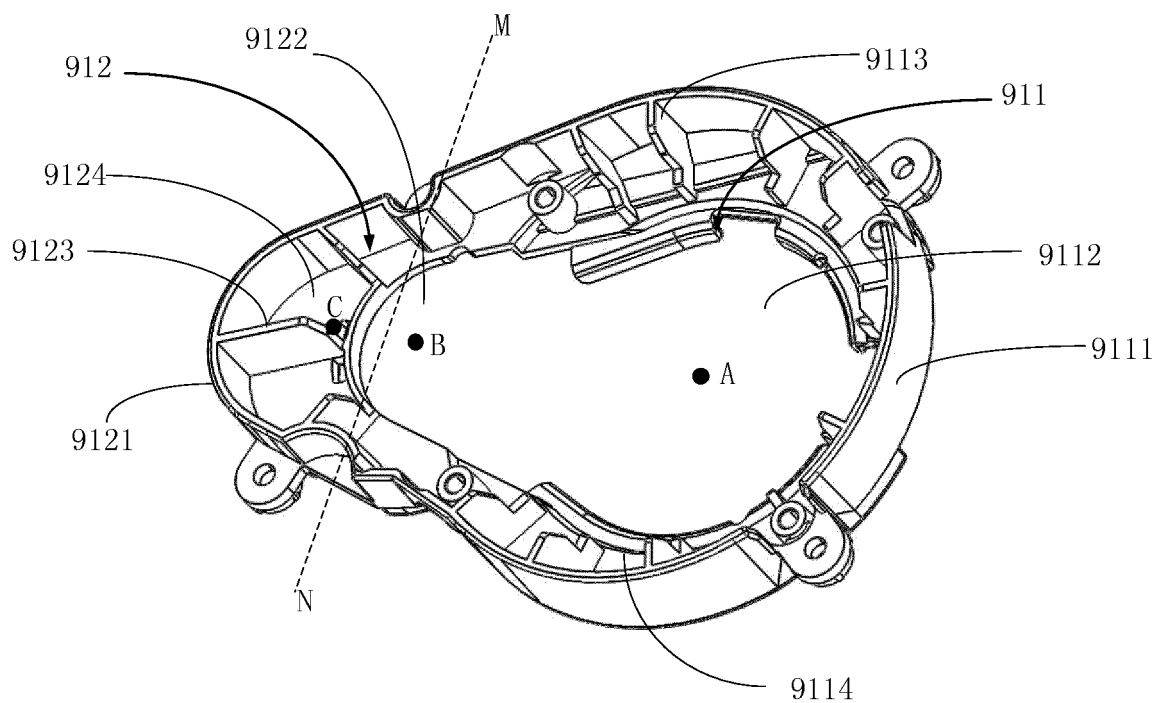


FIG. 27

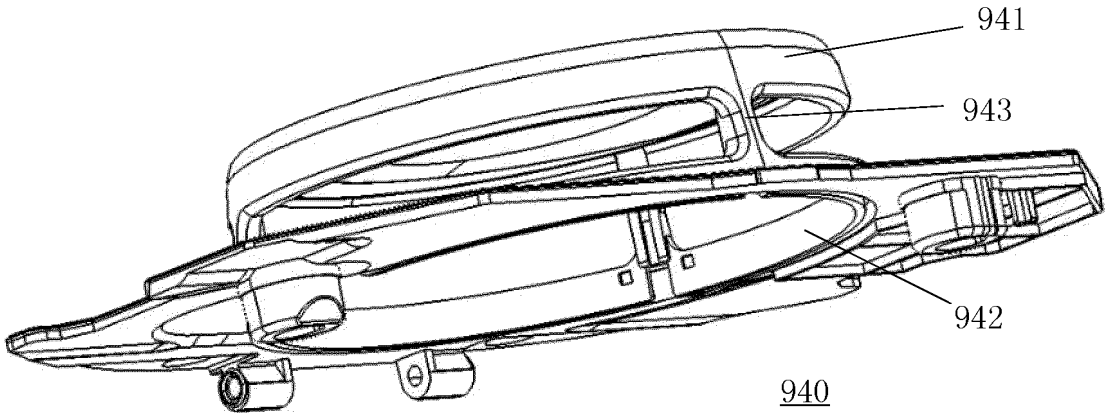


FIG. 28

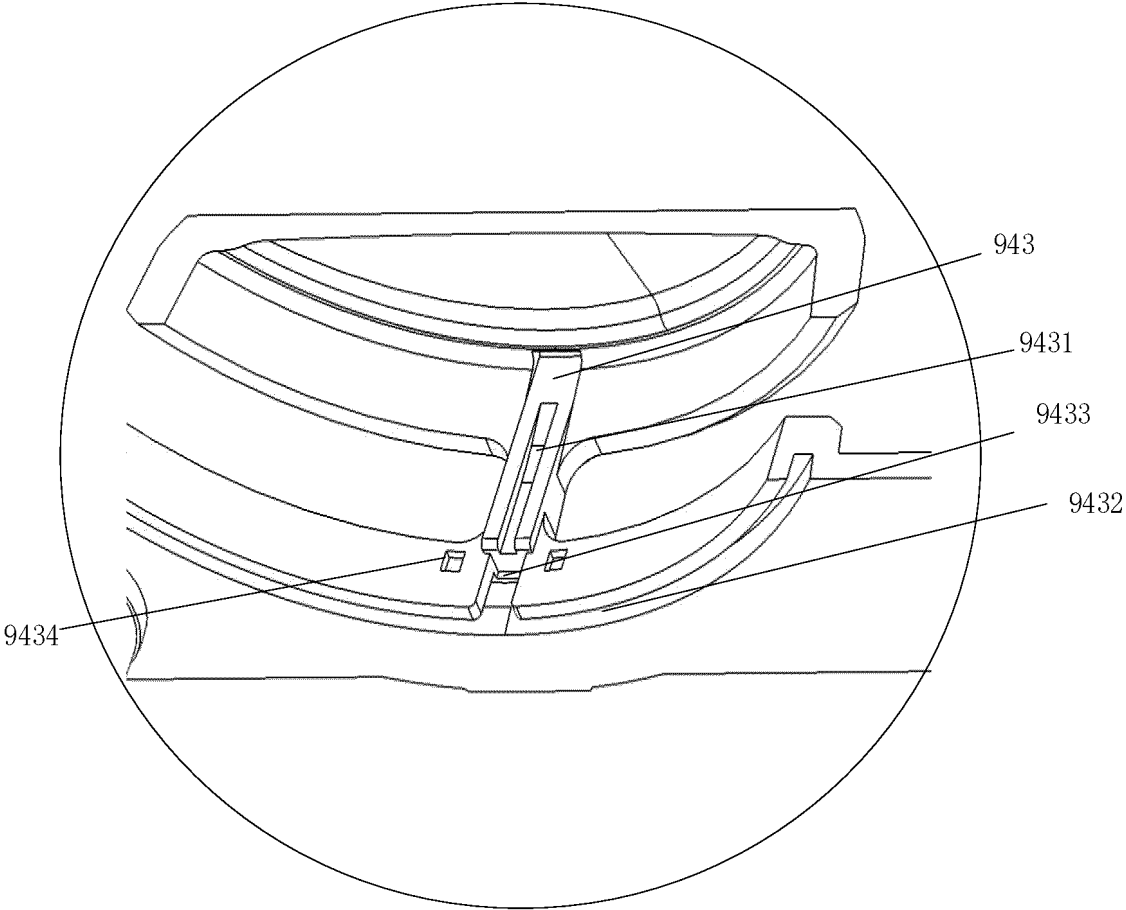


FIG. 29

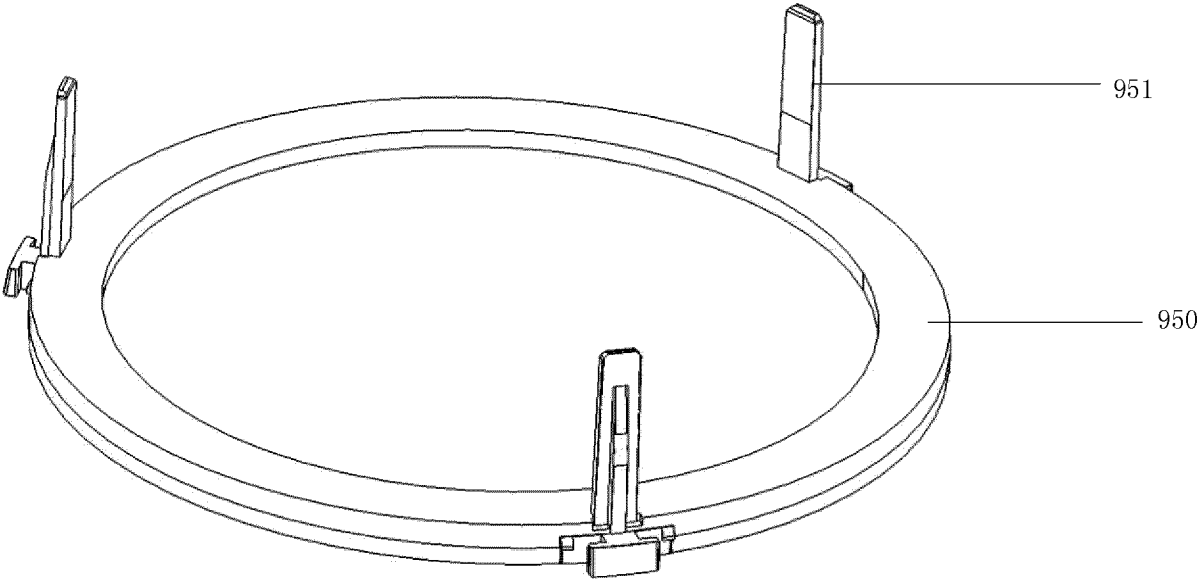


FIG. 30

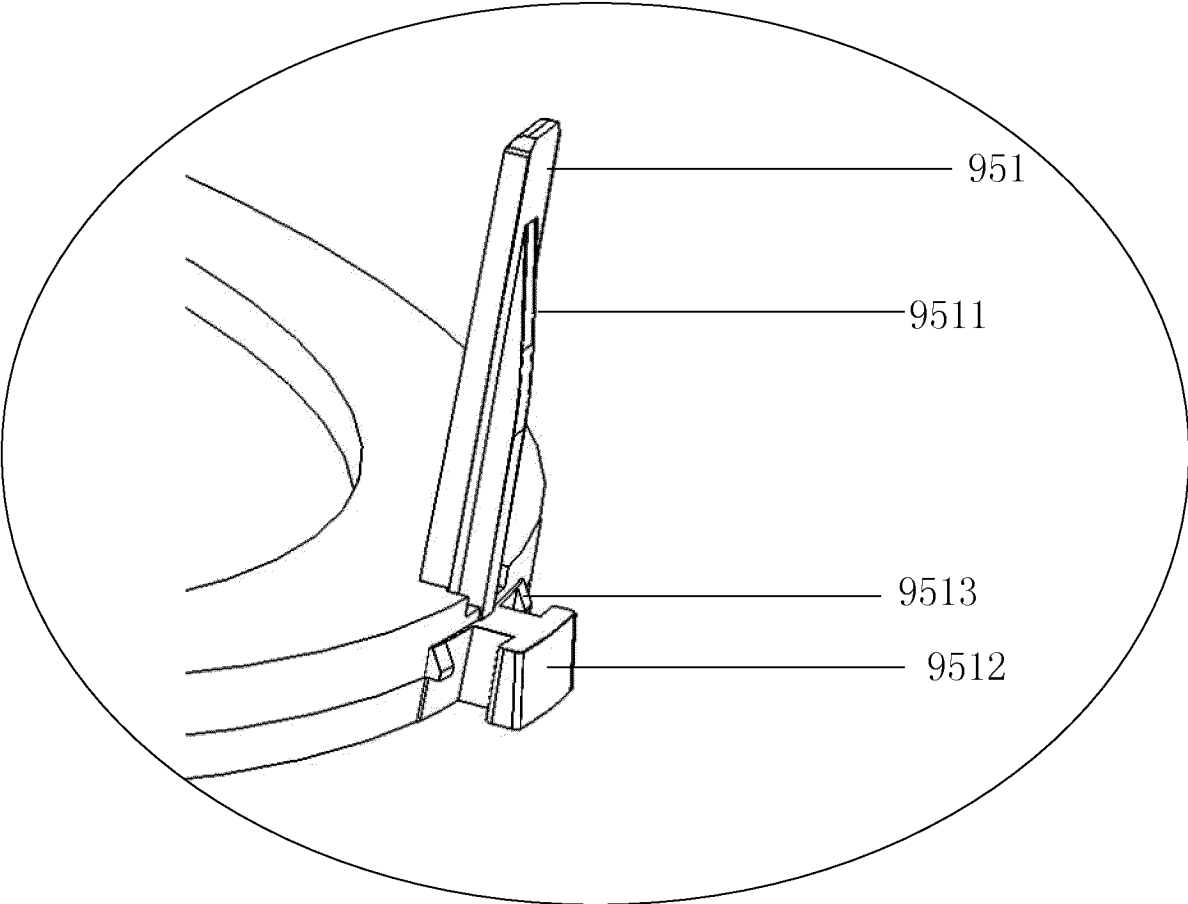


FIG. 31

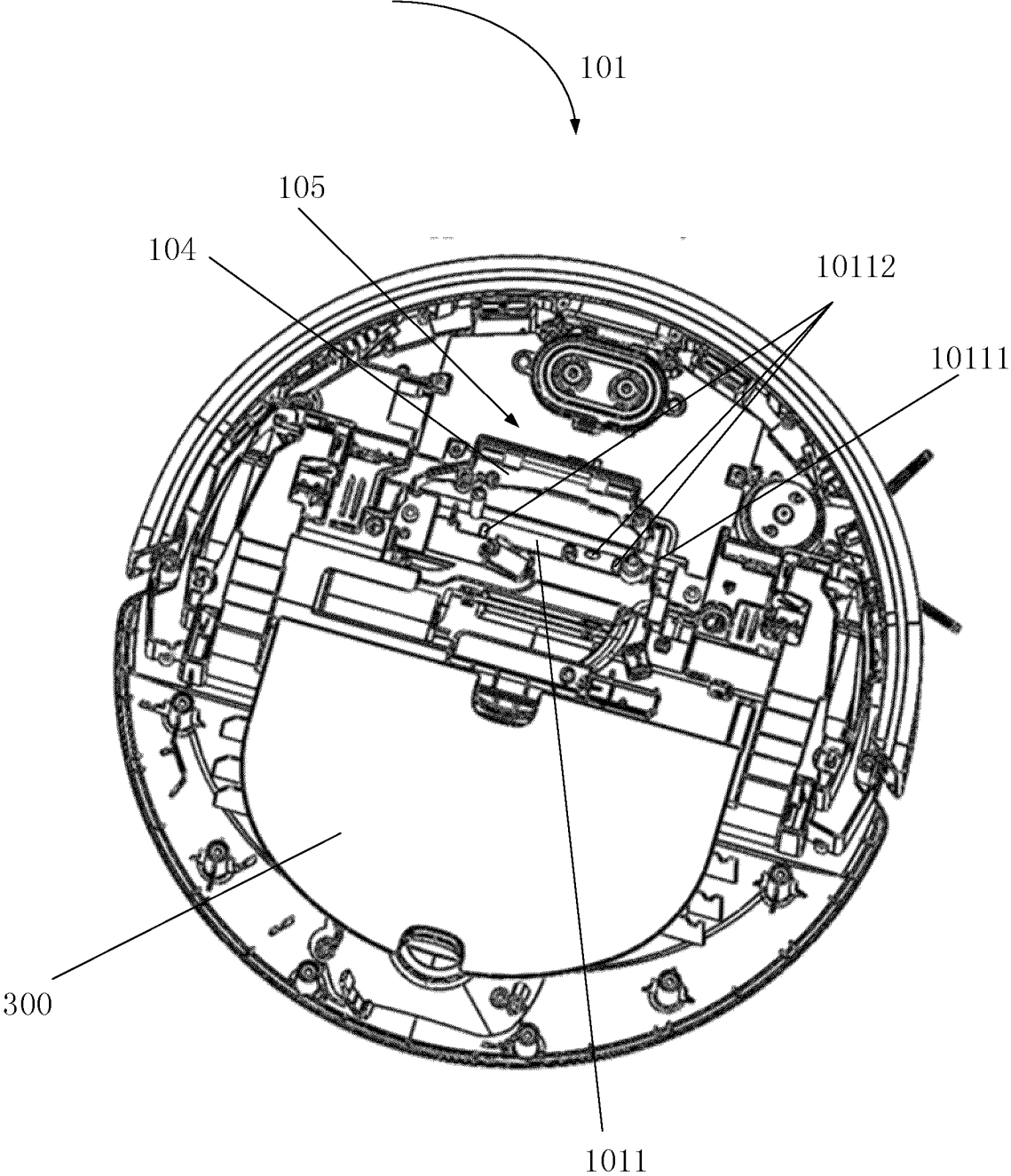


FIG. 32

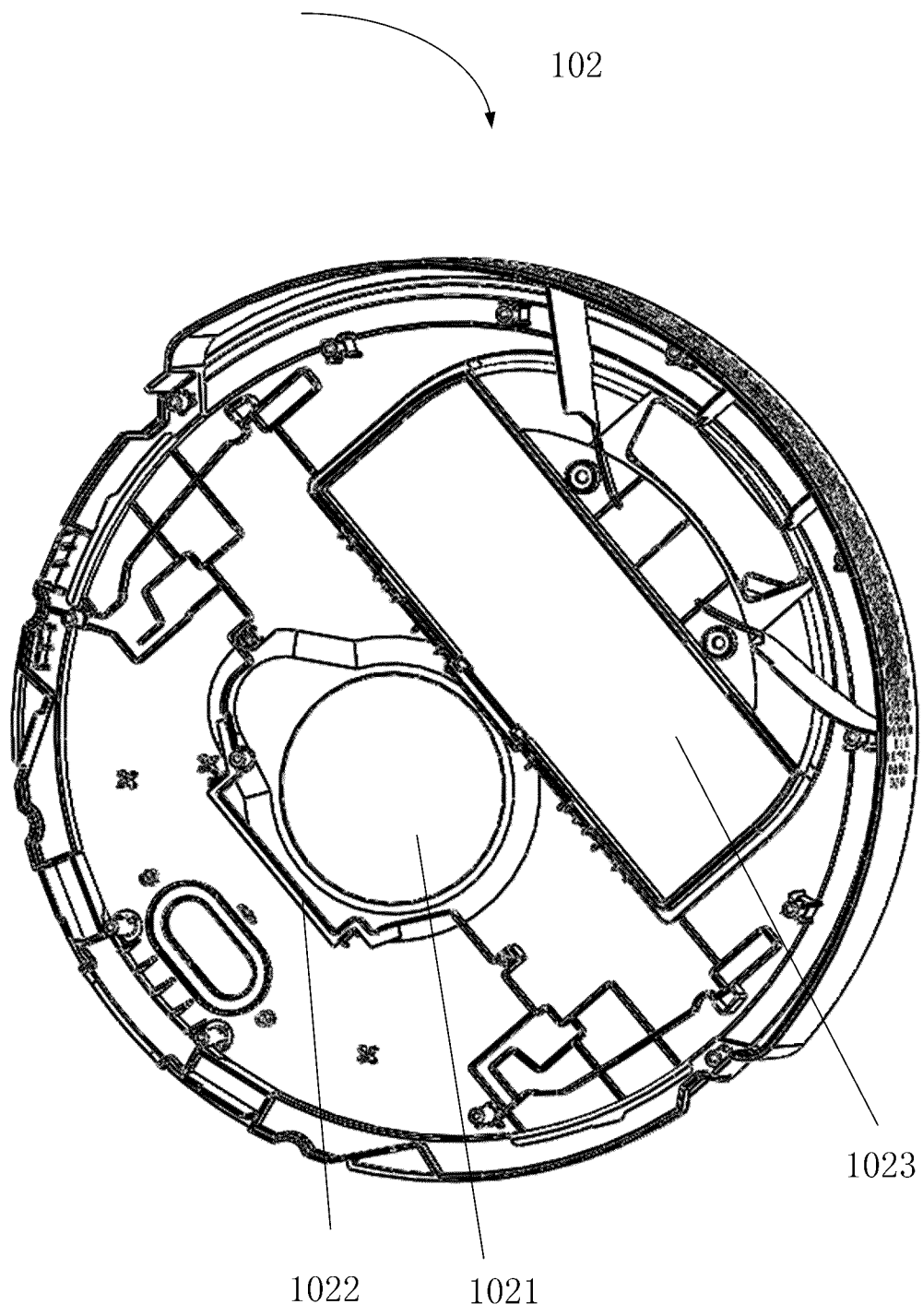


FIG. 33

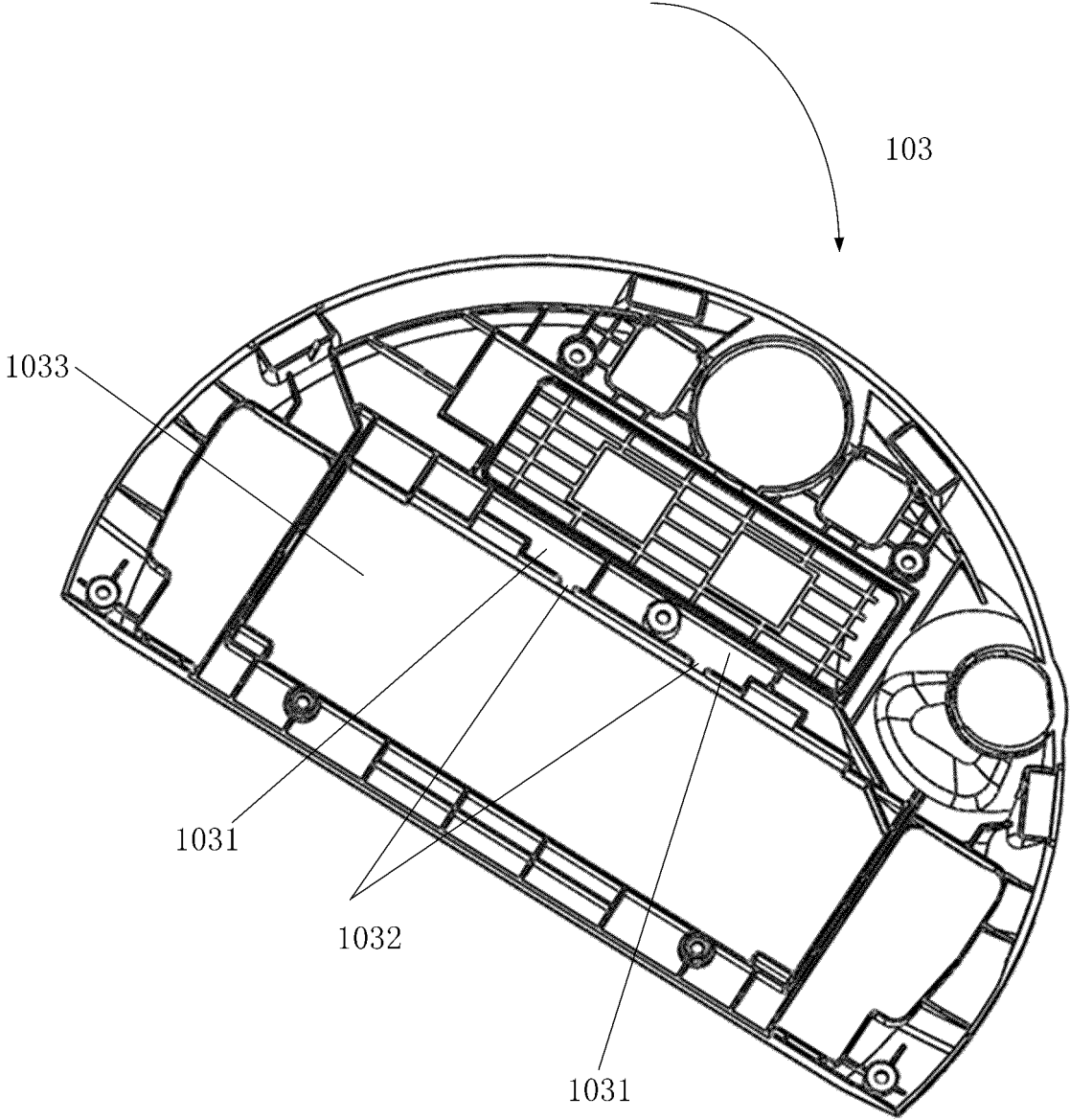


FIG. 34

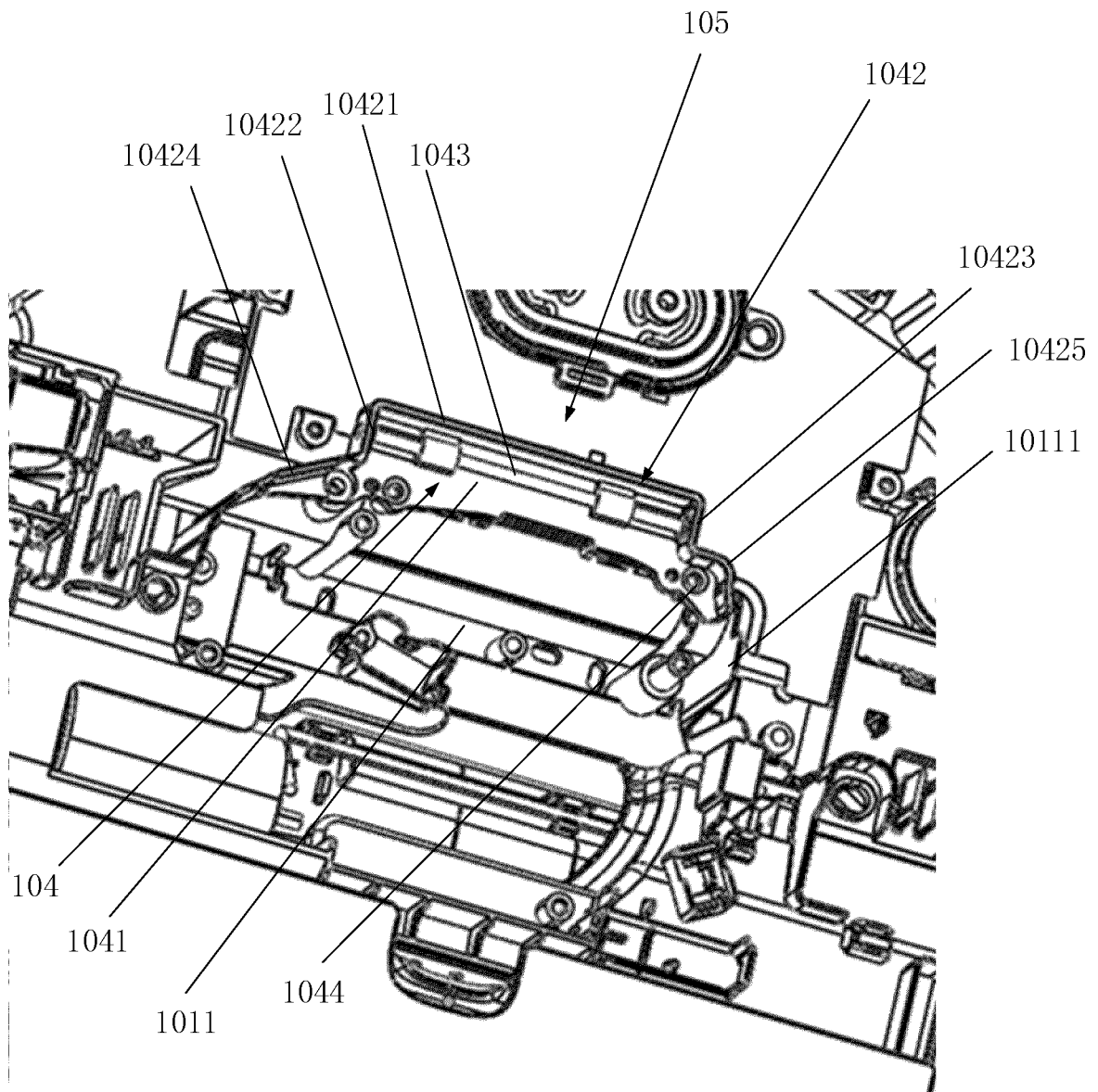


FIG. 35

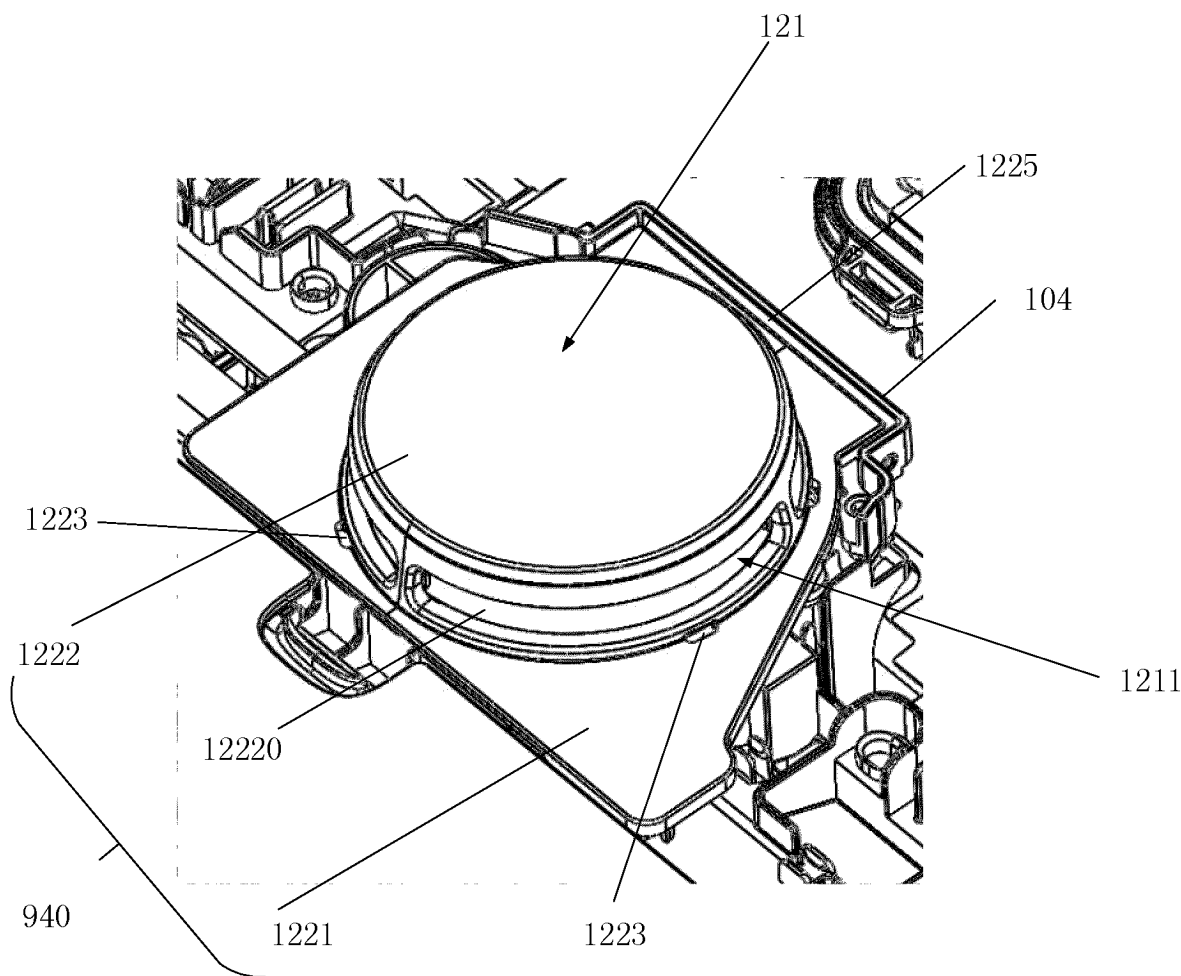


FIG. 36

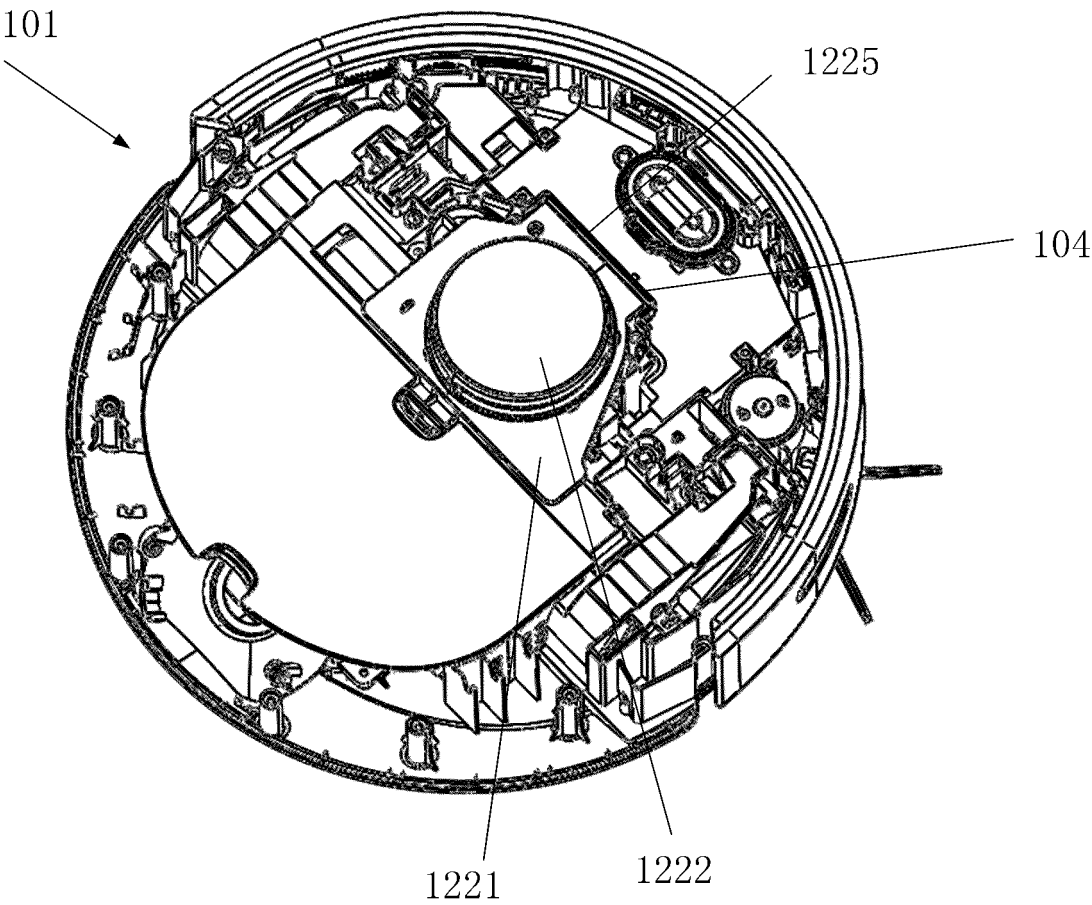


FIG. 37

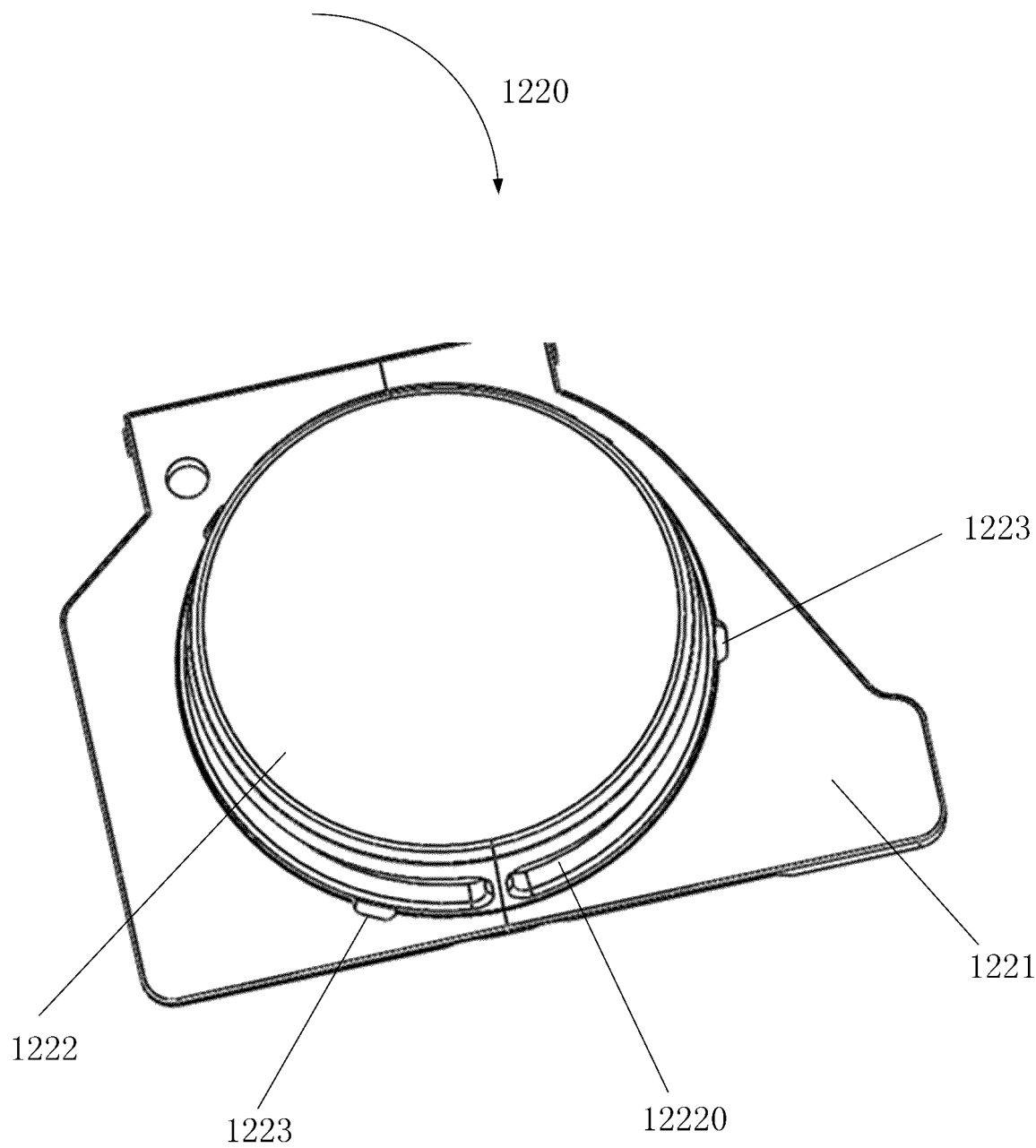


FIG. 38

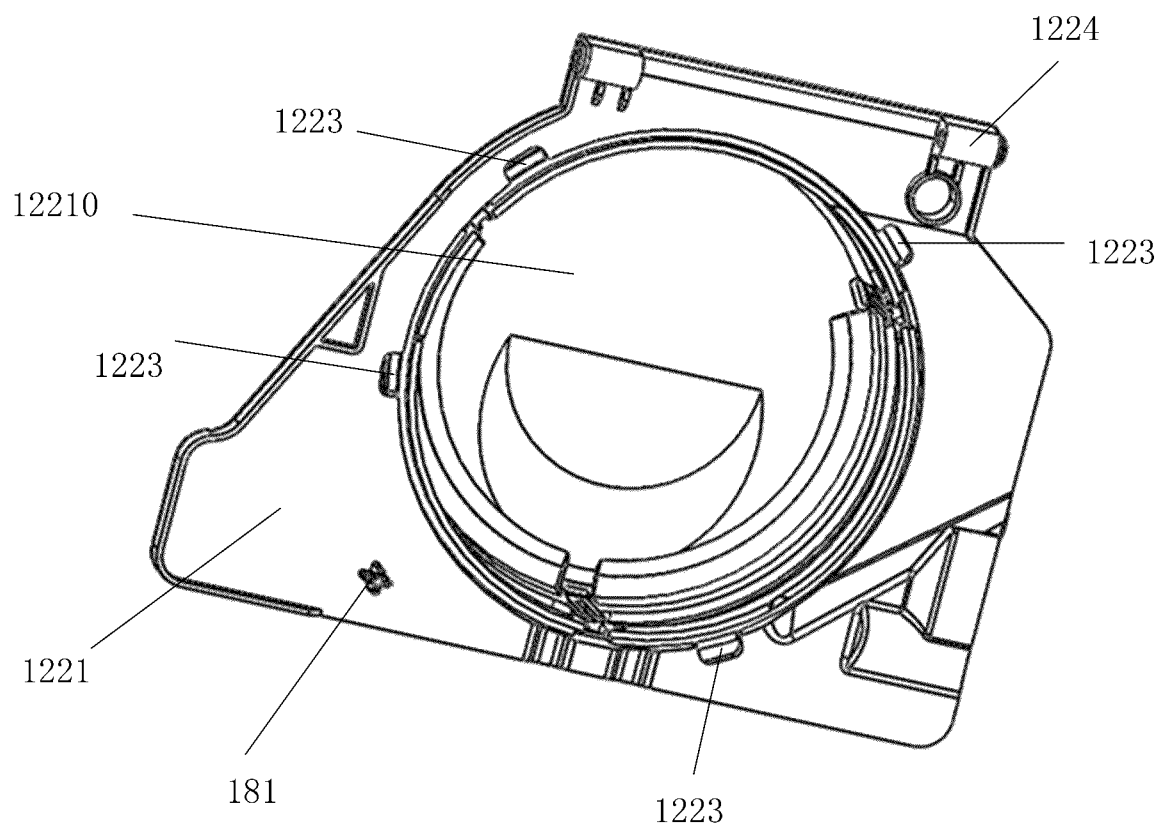


FIG. 39

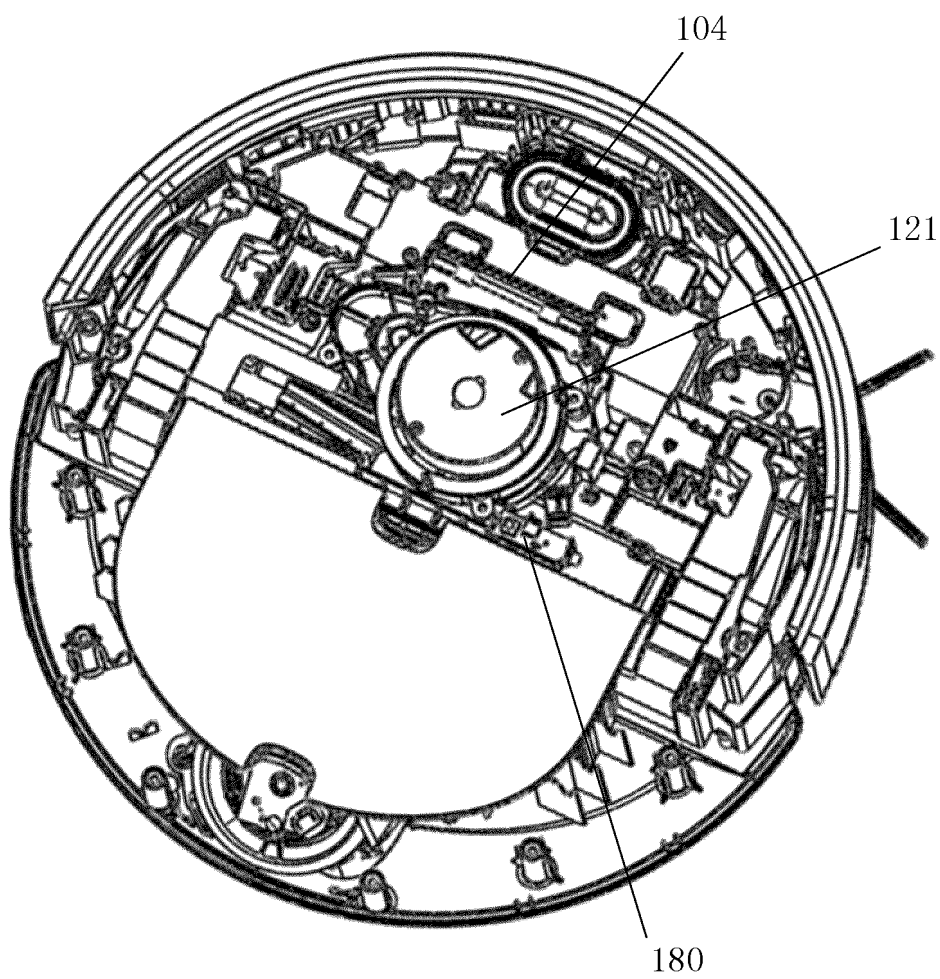


FIG. 40

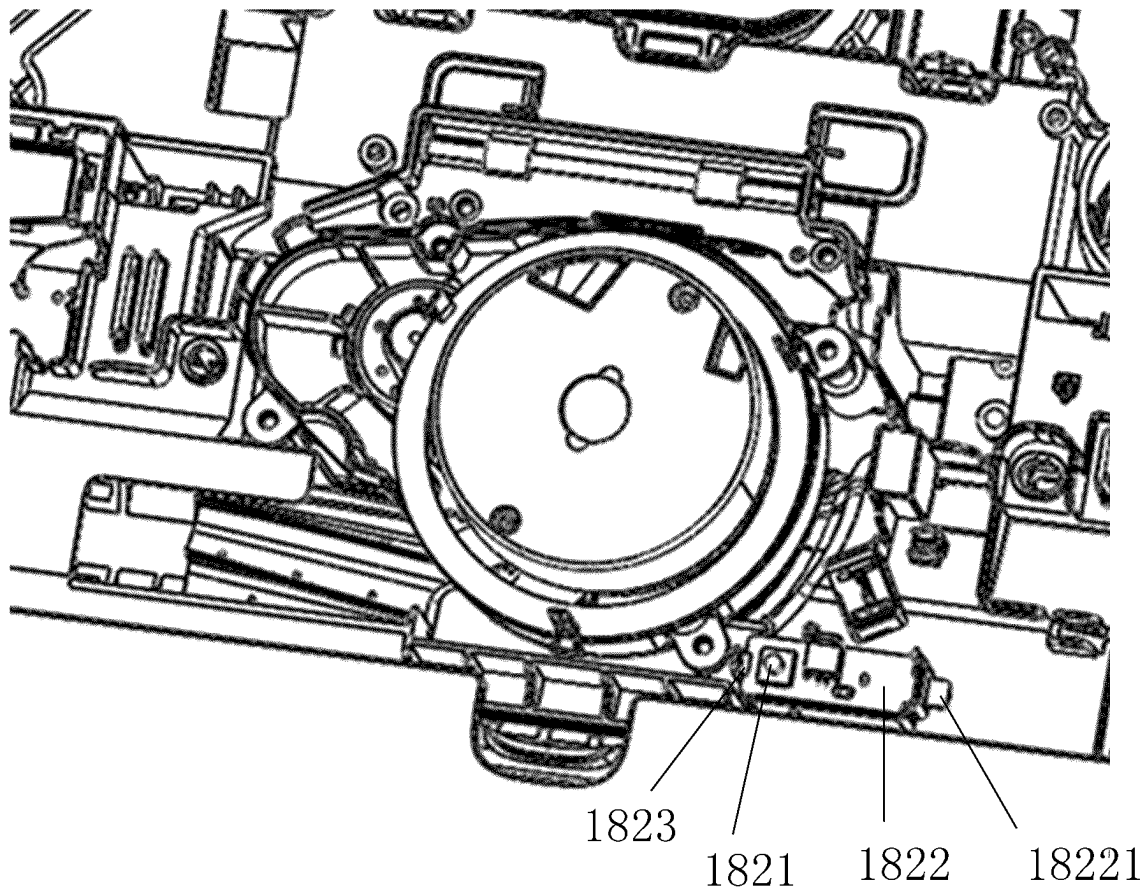


FIG. 41

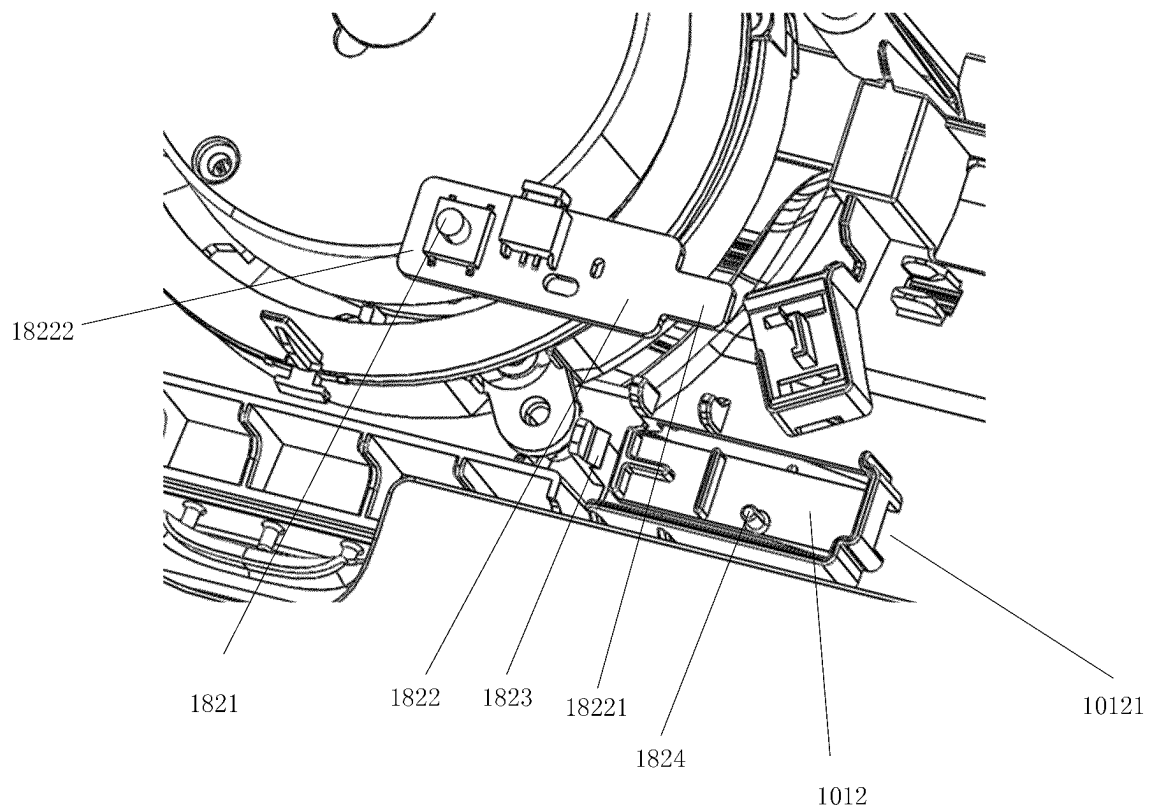


FIG. 42

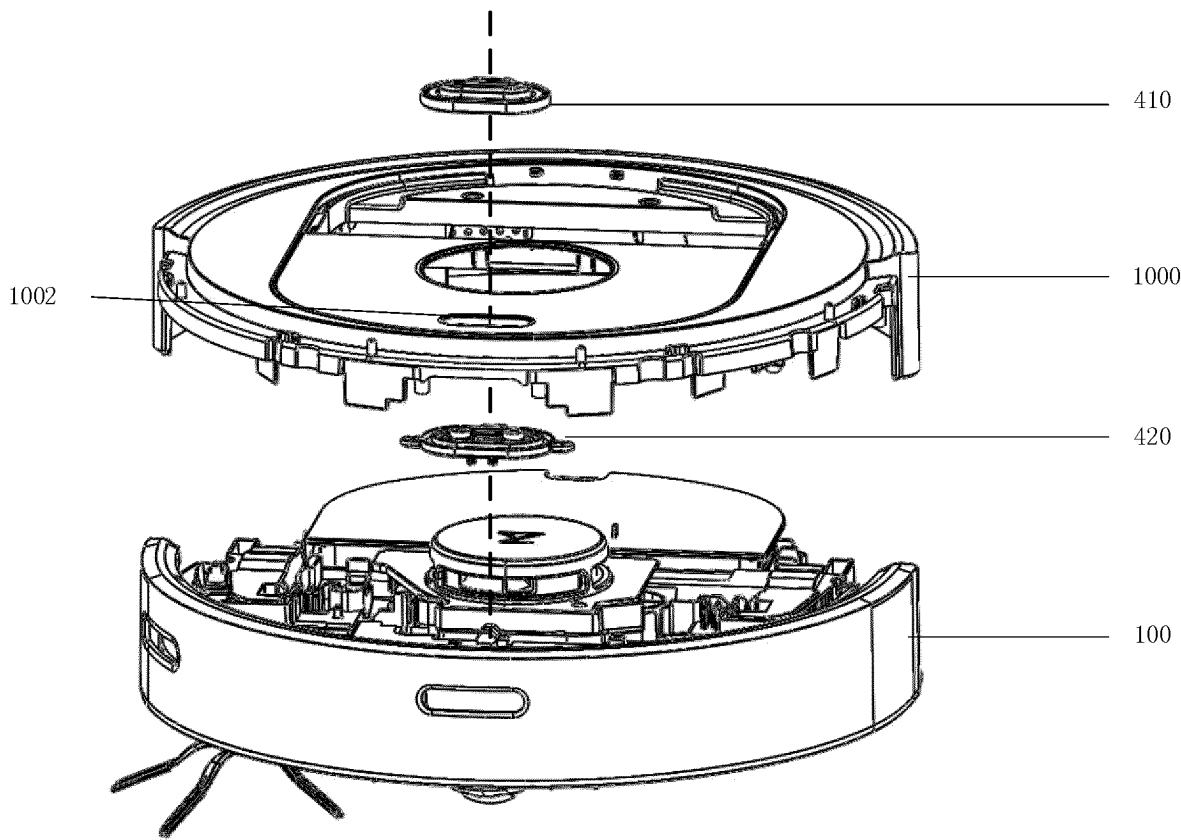


FIG. 43

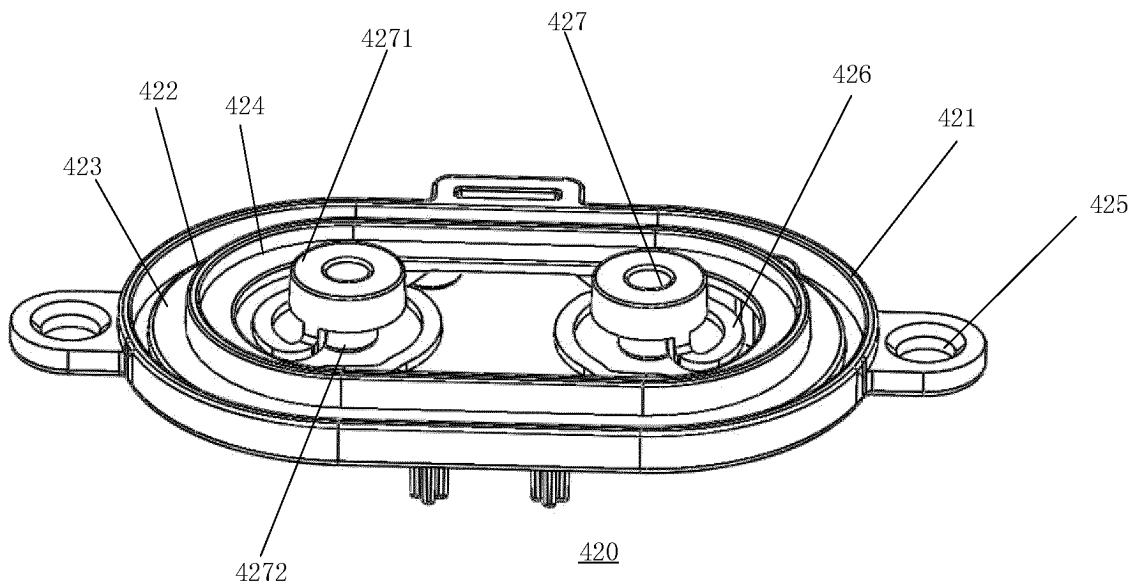


FIG. 44

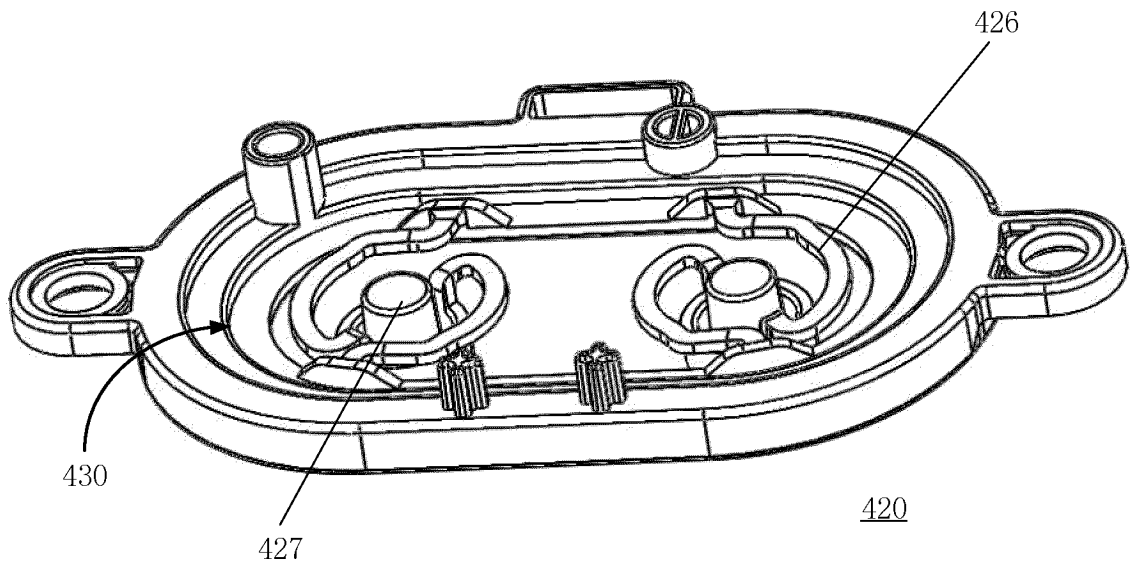


FIG. 45

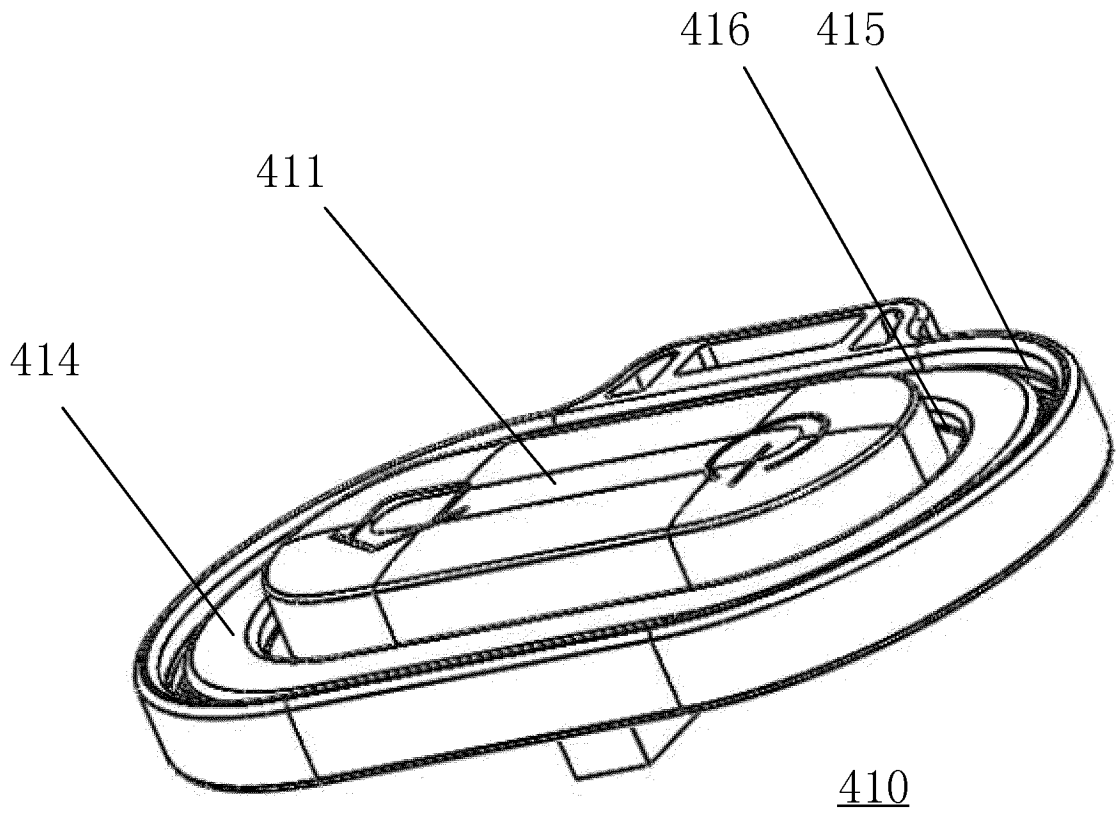


FIG. 46

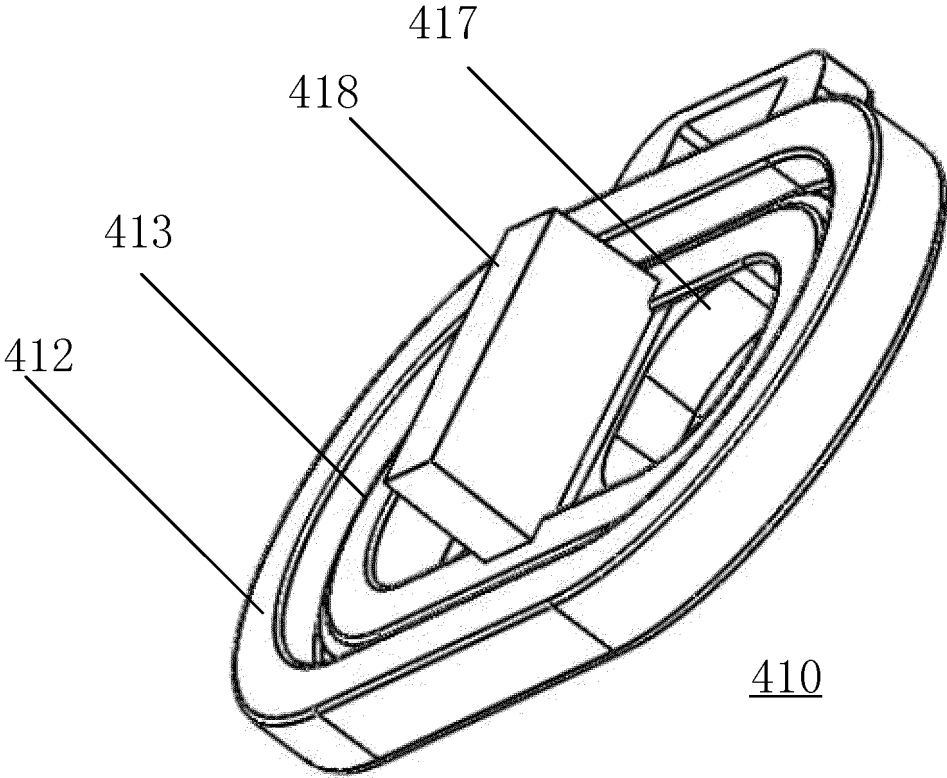


FIG. 47

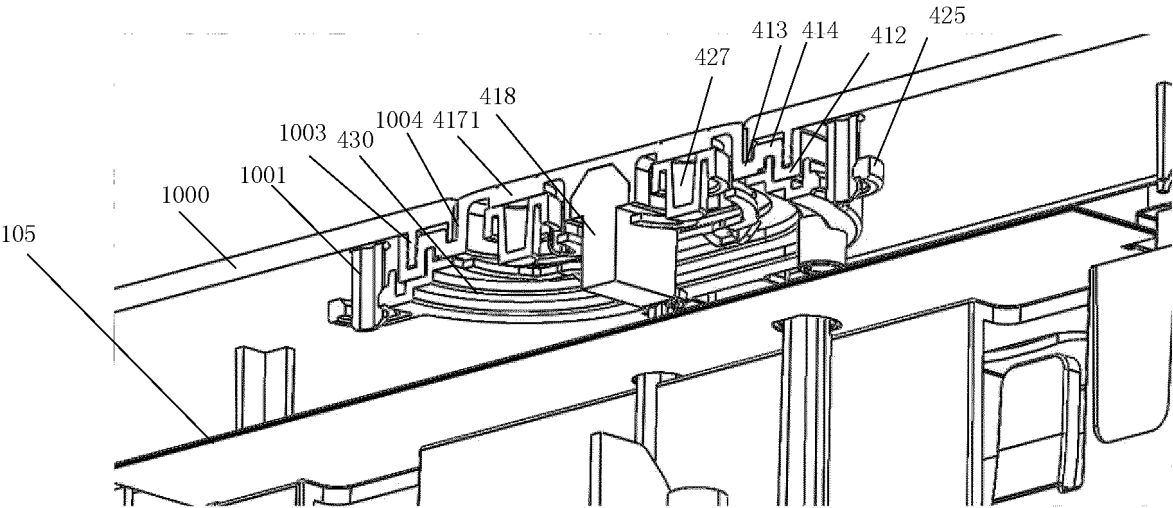


FIG. 48

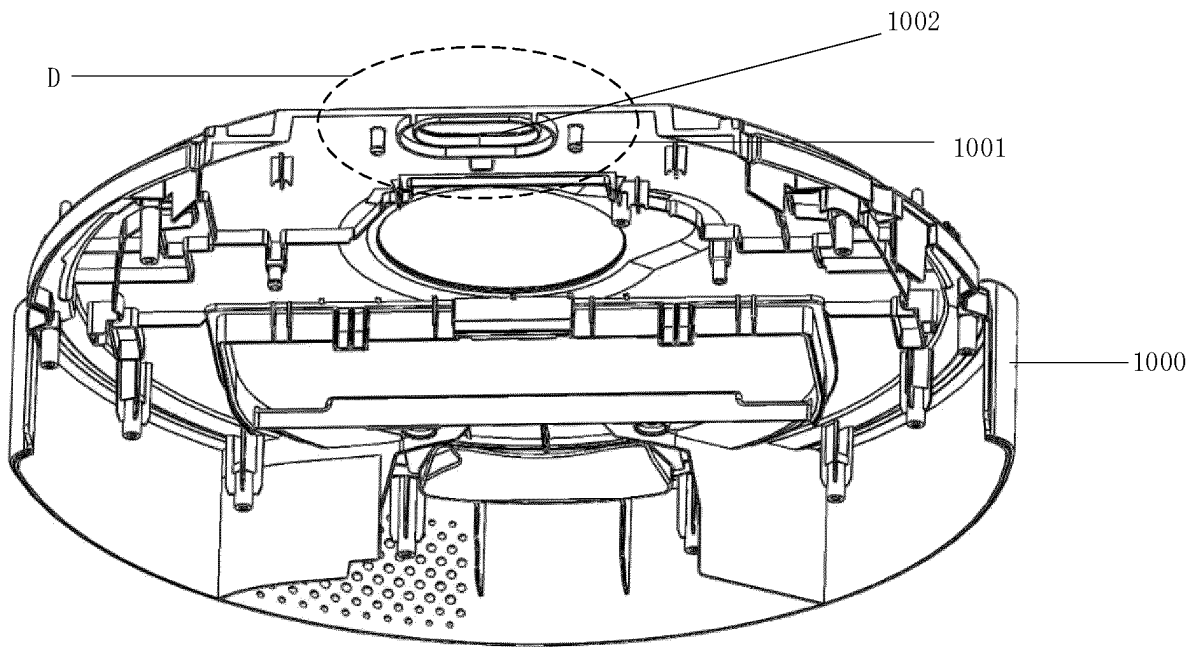


FIG. 49

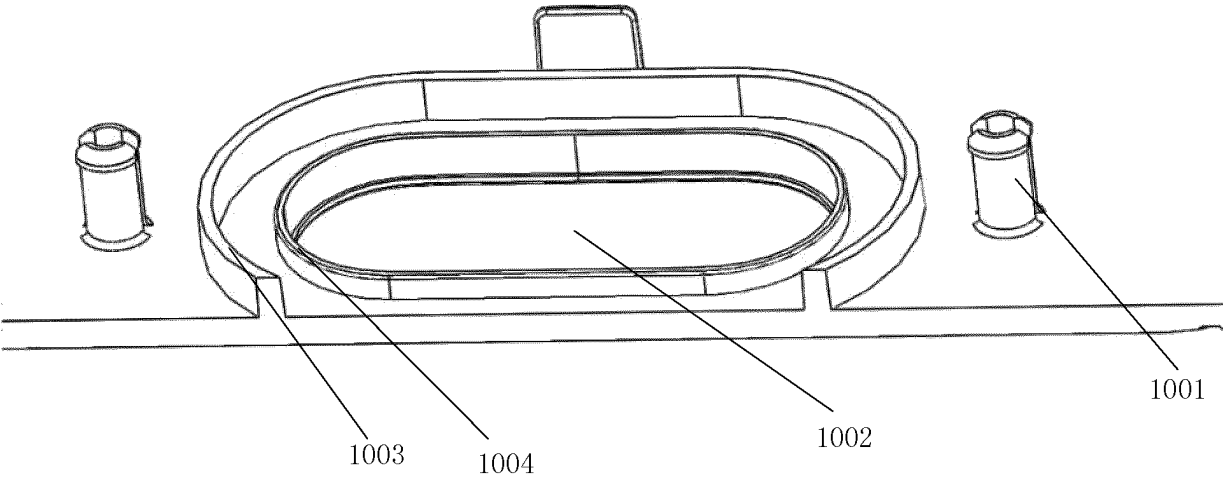


FIG. 50

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/098738

A. CLASSIFICATION OF SUBJECT MATTER

A47L 11/24(2006.01)i; A47L 11/28(2006.01)i; A47L 11/40(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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)

CNABS; CNTXT; CNKI; VEN; ENTXT; WPABS: 清洁, 清扫, 尘盒, 尘杯, 尘桶, 尘筒, 漩涡, 旋流, 门, 对流, 气旋, clean, base, box, bucket, vortex, cyclonic

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	CN 216854581 U (BEIJING ROBOROCK TECHNOLOGY CO., LTD.) 01 July 2022 (2022-07-01) claims 1-14, and description, paragraphs [0083]-[0174]	1-14
E	CN 216854579 U (BEIJING ROBOROCK TECHNOLOGY CO., LTD.) 01 July 2022 (2022-07-01) claims 1-13, description, paragraphs [0056]-[0138], and figures 1-24	1-14
X	CN 214259224 U (SHENZHEN 3IROBOTIX CO., LTD.) 24 September 2021 (2021-09-24) description, paragraphs [0038]-[0051], and figures 1-8	1-14
A	JP 2008253376 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 23 October 2008 (2008-10-23) entire document	1-14
A	CN 209899270 U (SHENZHEN ZHIYI SCIENCE & TECHNOLOGY CO., LTD.) 07 January 2020 (2020-01-07) entire document	1-14

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Date of the actual completion of the international search

30 August 2022

Date of mailing of the international search report

07 September 2022

Name and mailing address of the ISA/CN

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Authorized officer

Facsimile No. (86-10)62019451

Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2022/098738

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	216854581	U	01 July 2022	None			
CN	216854579	U	01 July 2022	None			
CN	214259224	U	24 September 2021	None			
JP	2008253376	A	23 October 2008	None			
CN	209899270	U	07 January 2020	WO	2020077561	A1	23 April 2020

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202210028896 [0001]