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(54) **CLEANING SYSTEM FOR SELF-MOVING CLEANING DEVICE AND CLEANING METHOD THEREOF**

(57) The present invention involves a washing device and a cleaning method for cleaning self-moving cleaning devices. The cleaning method includes: moving the self-moving cleaning device towards the washing device, and causing a first side of the self-moving cleaning device to be aligned with the washing device, wherein the self-moving cleaning device includes a mop; and moving

a mop to a location over a cleaning unit of the washing device, and cleaning the mop of the cleaning member of the cleaning unit, including, during a first period, causing the cleaning unit in a first direction over the first side; and during a second period, causing the self-moving cleaning device to move in a second direction different from the first direction.

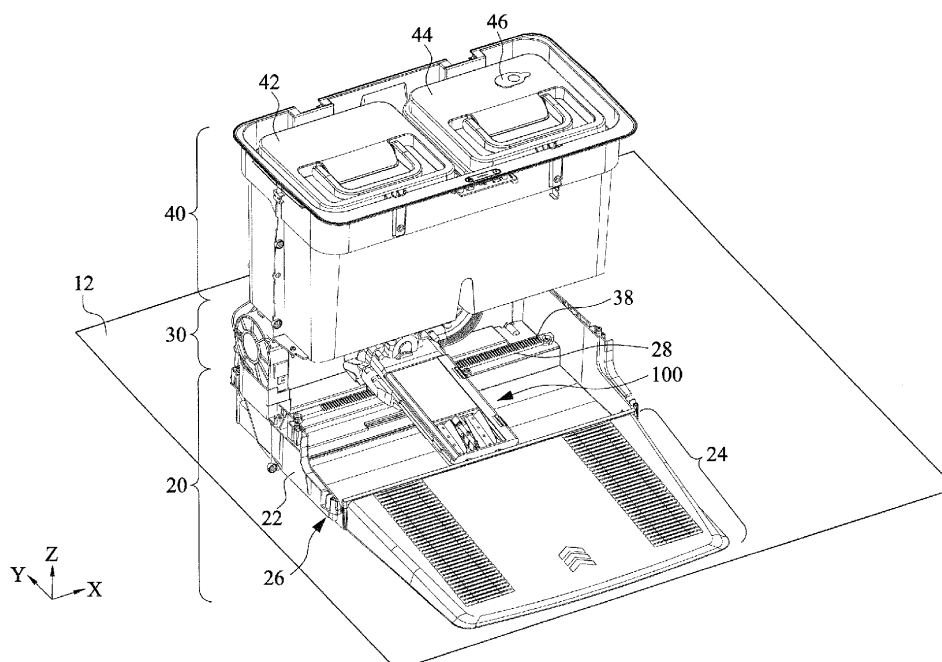


FIG. 2A

Description

TECHNICAL FIELD

[0001] Embodiments of the present invention relate to a cleaning system for a self-moving cleaning device and a cleaning method thereof, and more particularly to a mop washing device and a cleaning method for a self-moving robot.

BACKGROUND

[0002] The existing sweeping robots usually clean the floor with a dry-cleaning mode, or with a wet-cleaning mode through help of water or cleaning liquid to clean the floor after the mop or the surface to be cleaned is wetted. However, in this way, dirt, dust, hair or fine debris tends to accumulate on the mop. Therefore, after a period of operation with the dry-cleaning or wet-cleaning mode, it is necessary to replace or wash the soiled mop to maintain the cleaning performance in the subsequent mopping operations. The current sweeping robot can automatically clean the floor, but it cannot automatically clean the mop. That would require cleaning or replacing the mop manually, but such requirement seriously compromises the intended effect of automatic sweeping of the sweeping robot without human intervention. Therefore, it is necessary to design a new sweeping robot to resolve the above-mentioned deficiencies.

INVENTION SUMMARY

[0003] One aspect of the present disclosure discusses a method of operating a washing device, the method includes: moving a self-moving cleaning device toward the washing device and aligning a first side of the self-moving cleaning device with the washing device, wherein the self-moving cleaning device includes a first mop; and moving the first mop of the self-moving cleaning device to be over a cleaning unit of the washing device, and cleaning the first mop using a cleaning member of the cleaning unit, including: during a first period, moving the cleaning unit in a first direction to be under the first mop; and during a second period, causing the self-moving cleaning device to move in a second direction different from the first direction.

[0004] According to some embodiments, the first direction and the second direction are perpendicular to each other; and the cleaning unit is configured to move in a third direction relative to the self-moving cleaning device, wherein the third direction is consistent with a first edge contour of the first mop.

[0005] According to some embodiments, a cleaning route, relative to the self-moving cleaning device, of the cleaning unit during the cleaning is formed of a plurality of connected cleaning segments, and a shape of the cleaning route corresponds to a first edge contour of the first mop.

[0006] According to some embodiments, control signals associated with a formation of a present one of the plurality of connected cleaning segments are transmitted to the cleaning unit and the self-moving cleaning device during a period for proceeding with another previous one of the plurality of connected cleaning segments before the one of the plurality of connected cleaning segments.

[0007] According to some embodiments, the cleaning unit further includes a water outlet configured to spray cleaning liquid in a direction facing the first mop, the self-moving cleaning device includes a first infrared module, the washing device includes a second infrared module, and the aligning of the first side of the self-moving cleaning device with the washing device is performed via the first infrared module and the second infrared module. The method further includes using the first infrared module and the second infrared module to transmit the control signals of the cleaning unit and the self-moving cleaning device, wherein the control signals include information on at least one of a displacement, a moving direction, and a moving speed.

[0008] According to some embodiments, the first period does not overlap the second period so that when the cleaning unit is configured to move in the first direction, the self-moving cleaning device is kept still; or when the self-moving cleaning device is configured to move in the second direction, the cleaning unit is kept still.

[0009] According to some embodiments, the first period overlaps the second period with at least an overlapping portion of the first period; and during the overlapping portion of the first period, when the cleaning unit is configured to move in the first direction, the self-moving cleaning device is configured to simultaneously move in the second direction.

[0010] According to some embodiments, the method further includes: causing the self-moving cleaning device to exit from the washing device; aligning a second side of the self-moving cleaning device with the washing device, wherein the self-moving cleaning device includes a second mop; and moving the second mop of the self-moving cleaning device to be above the cleaning unit of the washing device, and cleaning the second mop by the cleaning member of the cleaning unit.

[0011] According to some embodiments, a length of the cleaning member measured in the second direction is less than a length of the first mop or the second mop measured in the second direction.

[0012] According to some embodiments, the first side of the self-moving cleaning device is a rear side of the self-moving cleaning device and the second side of the self-moving cleaning device is a front side, or the first side of the self-moving cleaning device is the front side of the self-moving cleaning device and the second side is the rear side of the self-moving cleaning device.

[0013] According to some embodiments, the cleaning unit includes a roller brush, and the roller brush includes the cleaning member; and during the cleaning of the first mop with the cleaning member of the roller brush of the

cleaning unit, the roller brush contacts the first mop and rotates.

[0014] According to some embodiments, the roller brush further includes a brush shaft configured to support the cleaning member, and the cleaning member includes scraping strips or bristles extending outward along a surface of the cleaning member.

[0015] According to some embodiments, the cleaning unit includes a cleaning tank configured to accommodate the roller brush, and the cleaning tank has an opening disposed at a bottom thereof, the opening overlapping the cleaning member.

[0016] According to some embodiments, a rotational speed of the roller brush and a moving speed of the cleaning unit in the first direction are independent of each other.

[0017] According to some embodiments, the washing device includes a toothed rack, and the cleaning unit includes a driving assembly configured to move the cleaning unit along the first direction, wherein the cleaning unit further includes a sliding block connected to the driving assembly, wherein when the cleaning unit is configured to move along the first direction, the sliding block presses against the toothed rack and slides along the first direction.

[0018] According to some embodiments, the toothed rack includes a sliding rail, and the sliding block is configured to engage the sliding rail to slide along the first direction.

[0019] According to some embodiments, the toothed rack is connected to one side of the cleaning unit, and the driving assembly is configured to drive the cleaning unit to move on the toothed rack via a single side of the cleaning unit.

[0020] According to some embodiments, the sliding block has a length substantially equal to that of the driving assembly measured in the first direction.

[0021] According to some embodiments, the cleaning unit forms an included angle with a bottom of a base of the washing device in the second direction.

[0022] Yet another aspect of the present disclosure discusses a cleaning system, including a self-moving cleaning device and a washing device for cleaning the self-moving cleaning device, wherein the self-moving cleaning device includes a mop, and the washing device includes: a clean water tank configured to store cleaning liquid; a base arranged on one side of the clean water tank; and a cleaning unit, including: a driving assembly adjacent to the base and configured to move on the base in a first direction; a water outlet configured to spray the cleaning liquid in a direction away from the base; and a cleaning member extending in a second direction and configured to clean the mop of the self-moving cleaning device. The cleaning system further includes a sewage tank, configured to collect the cleaning liquid sprayed from the water outlet when the cleaning unit is configured to clean the mop. The washing device and the self-moving cleaning device are configured to communicate with each other and perform the methods discussion above.

[0023] With the above-mentioned method of operating the washing device in the present invention, the dirty mop can be effectively and automatically cleaned, so that the mobile robot can be advanced to perform floor cleaning and self-cleaning in a fully automatic manner, greatly reducing human intervention. Moreover, the cleaning method of the present invention with a single-sided toothed rack-driven cleaning unit is not only efficient in operation, but also simplifies the design, reduces the apparatus size, and decreases the failure rate. The method for operating the washing device of the present invention can also cooperate with the cleaning robot to clean any irregularly shaped mop, so that the performance of cleaning the mop is not affected by the shape of the mop. Therefore, the working efficiency of the self-moving cleaning device (such as the self-moving robot) can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] Aspects of the embodiments of the present invention can be better understood from the implementation manners described below when read in conjunction with the accompanying drawings. It should be noted that, in accordance with the standard practice in the industry, various structures may not be drawn to scale. In fact, the dimensions of the various structures may be arbitrarily increased or decreased for clarity of discussion. The drawings in the following description are only some embodiments of the present application. For those skilled in the art, other drawings can also be obtained according to these drawings on the premise of referring to the known technology.

FIGS. 1A and 1B show a perspective view and a bottom view, respectively, of a self-moving cleaning device, according to some embodiment of the present invention.

FIGS. 2A and 2B show a perspective view and a front view, respectively, of a washing device, according to some embodiments of the present invention.

FIG. 3 shows an exploded view of a cleaning unit, according to some embodiments of the present invention.

FIG. 4 shows a perspective view of a cleaning unit and a mop, according to some embodiments of the present invention.

FIG. 5 shows a perspective view of a driving assembly of a cleaning unit, according to some embodiments of the present invention.

6A, 6B and 6C show perspective views of a cleaning tank of a cleaning unit according to some embodiments of the present invention.

7A, 7B and 7C show perspective views of a cleaning unit and its sliding block, according to some embodiments of the present invention.

8A and 8B respectively show a perspective view and a side view, respectively, of a sliding block, according to some embodiments of the present invention.

FIG. 9 shows perspective views of a base, a cleaning unit and a mop, according to some embodiments of the present invention.

FIG. 10 shows a perspective view of a cleaning unit, according to some embodiments of the present invention.

11A, 11B, 11C and 11D are schematic diagrams of different stages of a cleaning method, according to embodiments of the present invention, respectively.

FIG. 12 shows a flowchart of a cleaning method, according to some embodiments of the present invention.

13A, 13B, 13C and 13D are schematic diagrams showing different stages of a cleaning method, according to some embodiments of the present invention.

FIG. 14 shows a flowchart of a cleaning method, according to some embodiments of the present invention.

DETAILED DESCRIPTION

[0025] The following disclosure provides many different embodiments, or examples, for implementing different features of the provided subject matter. Specific examples of components and arrangements are described below to simplify the present disclosure. These are, of course, merely examples and are not intended to be limiting. For example, the formation of a first feature over or on a second feature in the description that follows may include embodiments in which the first and second features are formed in direct contact, and may also include embodiments in which additional features may be formed between the first and second features, such that the first and second features may not be in direct contact. In addition, the present disclosure may repeat reference numerals and/or letters in the various examples. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various embodiments and/or configurations discussed.

[0026] Further, spatially relative terms, such as "beneath," "below," "lower," "above," "over," "upper," "on," and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures.

The spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. The apparatus may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein may likewise be interpreted accordingly.

[0027] As used herein, although the terms such as "first," "second" and "third" describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms may be only used to distinguish one element, component, region, layer or section from another. The terms such as "first," "second" and "third" when used herein do not imply a sequence or order unless clearly indicated by the context.

[0028] Notwithstanding that the numerical ranges and parameters setting forth the broad scope of the disclosure are approximations, the numerical values set forth in the specific examples are reported as precisely as possible. Any numerical value, however, inherently contains certain errors necessarily resulting from the deviation normally found in the respective testing measurements. Also, as used herein, the terms "about," "substantial" or "substantially" generally mean within 10%, 5%, 1% or 0.5% of a given value or range. Alternatively, the terms "about," "substantial" or "substantially" mean within an acceptable standard error of the mean when considered by one of ordinary skill in the art. Other than in the operating/working examples, or unless otherwise expressly specified, all of the numerical ranges, amounts, values and percentages such as those for quantities of materials, durations of times, temperatures, operating conditions, ratios of amounts, and the likes thereof disclosed herein should be understood as modified in all instances by the terms "about," "substantial" or "substantially." Accordingly, unless indicated to the contrary, the numerical parameters set forth in the present disclosure and attached claims are approximations that can vary as desired. At the very least, each numerical parameter should at least be construed in light of the number of reported significant digits and by applying ordinary rounding techniques. Ranges can be expressed herein as being from one endpoint to another endpoint or between two endpoints. All ranges disclosed herein are inclusive of the endpoints, unless specified otherwise.

[0029] The present invention relates to a washing device for a self-moving cleaning device. It is designed so that after the self-moving cleaning device uses a mop to perform a cleaning task, if the mop becomes soiled, the automatic cleaning provided by the washing device according to embodiments of the present invention can restore the mop to its original clean status, and enable the self-moving cleaning device to continue the cleaning task. Therefore, the washing device can achieve a complete cleaning process without human intervention, and greatly improve the user experience.

[0030] FIGS. 1A and 1B respectively show a perspective view and a bottom view, respectively, of a self-moving cleaning device 11, according to some embodiments of the present invention. The self-moving cleaning device 11 can be used to clean an ordinary ground or a large-area surface 12, such as a stage, a large-area desktop or a work platform, with different types, e.g., toys, remote control cars, robots, etc., and can move on the surface 12 on which it contacts. During a cleaning task, the purpose of cleaning the surface 12 is accomplished by moving the self-moving cleaning device 11 back and forth on the surface 12 and wiping the surface 12 with a mop on the self-moving cleaning device 11. The self-moving cleaning device 11 is described herein as a floor cleaning robot serving as an example, but the present invention is not limited thereto.

[0031] Referring to FIG. 1A, the self-moving cleaning device 11 includes a bumper 13, a casing 14 and an upper cover 15. The self-moving cleaning device 11 can move freely in different directions on the surface to be cleaned 12. For convenience of description, the self-moving cleaning device 11 has a forward-moving direction F and a backward-moving direction B herein. The bumper 13 faces the forward-moving direction F, in which the bumper 13 serves as the front side of the self-moving cleaning device 11 and has a straight profile, while the casing 14 faces the backward-moving direction B, in which the casing 14 serves as the rear side of the self-moving cleaning device 11 and has a curved shape. Referring to FIG. 1B, the bottom surface 12 of the self-moving cleaning device 11 further includes various components, such as a suction port 7, a roller brush device 17, a mobile unit 18 and a spray device 19. According to some embodiments, the self-moving cleaning device 11 has a cloth seat disposed on the rear bottom of the self-moving cleaning device 11. The cloth seat usually has a flat surface, which is convenient for the mop 16 to stick or attach thereon for cleaning. According to some embodiments, the mop 16 is disposed near the rear side of the base of the self-moving cleaning device 11. The above-mentioned components of the self-moving cleaning device 11 are only shown as examples. The above-mentioned components may be removed from the self-moving cleaning device 11 in other different embodiments, or some other components may be added to the self-moving cleaning device 11 in other embodiments.

[0032] FIGS. 2A and 2B show a perspective view and a front view, respectively, of a washing device 10, according to some embodiments of the present invention. In some embodiments, the washing device 10 is not used to clean the surface 12 directly, but rather is used to clean the mop 16 of the self-moving cleaning device 11. According to some embodiments, the washing device 10 is a cloth-washing machine. According to some embodiments, the washing device 10 can be used as the base station of the self-moving cleaning device 11, so that the self-moving cleaning device 11 can perform different actions at the base station where the washing device 10 is

disposed, such as docking the station, charging, cleaning the dust box, cleaning the mop 16, etc. The various actions described above can be performed at different times or simultaneously.

[0033] According to some embodiments, the washing device 10 includes a lower stage 20, a middle stage 30 and a water tank seat 40. According to some embodiments, the lower stage 20 includes a base 22, a guiding plate 24, a connecting member 26, a toothed rack 28 and a cleaning unit 100. According to some embodiments, the cleaning unit 100 may also be referred to as a cloth washing stand. According to some embodiments, the middle stage 30 is provided with components such as a circuit board 48, infrared modules 52, 54, charging electrodes 56, an alignment unit (not shown), and a range finder (not shown). According to some embodiments, the water tank seat 40 has an inner space for accommodating a sewage tank 42 and a clean water tank 44. According to some embodiments, the clean water tank 44 is used to store cleaning liquid. According to some embodiments, the clean water tank 44 is provided with a liquid level gauge for detecting the level of the cleaning liquid. When the liquid level gauge detects that the cleaning liquid is insufficient, the user can be notified to replenish the cleaning liquid. According to some embodiments, the clean water tank 44 is provided with an air hole for balancing the air pressure between the clean water tank 44 and an ambient air pressure when the cleaning liquid level drops. According to some embodiments, the clean water tank 44 is provided with an air hole cover 46 to cover the air hole, and a slit is provided in the air hole cover 46 to allow air to pass through. The air hole cover 46 can be made of elastic materials, and when the air pressure inside and outside the clean water tank 44 is balanced, the slit is kept closed. Otherwise, when the air pressure is unbalanced, the slit is opened due to the pressure difference to allow air to pass through. According to some embodiments, the sewage tank 42 is used to collect cleaning liquid or sewage sprayed by the cleaning unit 100 when the mop 16 is cleaned. According to some embodiments, the sewage tank 42 is provided with a liquid level gauge for detecting the sewage level. When the liquid level gauge detects that the sewage is full, the user can be notified to empty the sewage tank 42, which can prevent the sewage from polluting the surrounding environment of the washing device 10 and effectively reduce the frequency of dumping the sewage by the user.

[0034] Referring to FIG. 1B, the self-moving cleaning device 11 transmits and receives control signals to communicate with the washing device 10 during a predetermined event (such as charging, the dust box is full or is recalled) to complete the actions for the abovementioned predetermined event. According to some embodiments, the self-moving cleaning device 11 is provided with infrared modules 62, 64, 66, each of which including an infrared emitting unit for emitting infrared signals and an infrared receiving unit for receiving the emitted infrared signals. When it is determined that the self-moving clean-

ing device 11 return to the washing device 10 or the base station, an infrared signal is emitted or an infrared signal is received for alignment of the washing device 10 or the base station. According to some embodiments, the infrared modules 62, 64, and 66 are used as foreign object detectors or cliff detectors, which can actively detect whether there are foreign objects around the self-moving cleaning device 11 for dodging, or whether it is approaching a cliff and needs to turn or back off.

[0035] Referring to FIG. 2B, the washing device 10 is provided with infrared modules 52 and 54 on the circuit board 48 for receiving/transmitting control signals. According to some embodiments, the infrared module 52 has an infrared emitting unit 52A and an infrared receiving unit 52B, each of which is used to respectively transmit and receive infrared signals. According to some embodiments, the infrared module 54 has one or more (for example, 4) infrared emitting units for emitting infrared signals. According to some embodiments, the infrared modules 52, 54 communicate with the self-moving cleaning device 11, and are used to transmit the control signal generated by a controller of the washing device 10 or receive the feedback signal from the self-moving cleaning device 11. For example, when the self-moving cleaning device 11 returns to the washing device 10, the washing device 10 emits or receives an infrared signal to enable the self-moving cleaning device 11 to be aligned with the washing device 10. Alternatively, it indicates that, through receiving the infrared signal from the self-moving cleaning device 11, the self-moving cleaning device 11 has returned to the washing device 10 and has been positioned in place or aligned with the washing device 10, or that the self-moving cleaning device 11 is about to leave or has left the washing device 10.

[0036] Referring to FIGS. 1A, 1B, 2A and 2B, the washing device 10 is provided with a charging electrode 56, which is located in the middle stage 30 and can be used to charge the self-moving cleaning device 11, or serve as an alignment unit for enabling the self-moving cleaning device 11 to align with the washing device 10 when returning to the washing device 10. According to some embodiments, when the self-moving cleaning device 11 needs to return to the washing device 10 due to self judgment or other essential reasons (such as charging, the dust box being full or a recall), the signal transmitting unit of the washing device 10 (such as the infrared emitting unit) sends a guiding signal, and the self-moving cleaning device 11 aligns itself with the alignment unit (e.g., a charging electrode 56) of the washing device 10 along the a direction (such as the direction of X-axis) with the help of the guiding signal and the alignment unit. Subsequently, the self-moving cleaning device 11 moves toward the lower stage 20 along the guiding plate 24 (for example, along the direction of Y-axis) until the self-moving cleaning device 11 stops after arriving at a predetermined position or proceeding with a predetermined distance, for example, the battery electrodes of the self-moving cleaning device 11 contacts the charging elec-

trodes 56 of the middle stage 30 or abuts the alignment members.

[0037] According to some embodiments, the infrared module 54 of the washing device 10 is divided into a left emitting unit group and a right emitting unit group, and each of the emitting unit groups has one or more (for example, two) infrared emitting units. The infrared emitting units of the left emitting unit group emit a left alignment control signal, while the infrared emitting units of the right emitting unit group emit a right alignment control signal, and the signal formats of the left alignment control signal and the right alignment control signal are different from each other. In this way, when the self-moving cleaning device 11 is going to perform an alignment procedure with the washing device 10, it can determine whether the self-moving cleaning device 11 itself has been fully aligned with the washing device 10 based on whether the detected signal is a left alignment control signal or a right alignment control signal, as well as the relative signal strengths or encoded formats of the two signals. According to some embodiments, after the self-moving cleaning device 11 is aligned with the washing device 10 with help of the infrared module 54 of the washing device 10, the completion of the alignment procedure is further confirmed through determination that the battery electrode has made electrical contact with the charging electrode 56 of the middle stage 30.

[0038] According to some embodiments, the mop 16 is moved above the cleaning unit 100 on the base 22 through the movement of the self-moving cleaning device 11. According to some embodiments, the self-moving cleaning device 11 can simultaneously perform the steps of charging and cleaning the mop 16 using the cleaning unit 100. In other embodiments, the self-moving cleaning device 11 performs the steps of charging and cleaning the mop 16 at different time instants.

[0039] According to some embodiments, the toothed rack 28 is disposed on the base 22 and extends along the direction of X-axis. According to some embodiments, a plurality of teeth 38 of the toothed rack 28 are located on the upper side of the toothed rack 28, extending along the direction of Y-axis and arranged in parallel. The lower side of the toothed rack 28 is opposite to the upper side and is connected to or facing the base 22. According to some embodiments, the cleaning unit 100 is connected to the toothed rack 28 and configured to move back and forth along the direction of X-axis, and through the arrangement that the mop 16 is moved in the direction of Y-axis to be directly above the cleaning unit 100 that the cleaning unit 100 can move back and forth in the inner space of the base 22 in the direction of X-axis and clean the mop 16 by the roller brush 122. According to some embodiments, a trench is provided below the base 22, in which sewage or the overflowing cleaning liquid that is generated when the cleaning unit 100 cleans the mop 16 can be collected by the trench and drained to the sewage tank 42 through the trench and a recycling pipeline (not shown).

[0040] FIG. 3 shows an exploded view of a cleaning unit 100, according to some embodiments of the present invention. According to some embodiments, the cleaning unit 100 includes a housing, which is composed of a cleaning tank 102 (including a tank body 108 and an upper cover 118), a motor front cover 104, a motor rear cover 106, and a spacer 107, for accommodating the various components of the cleaning unit 100. According to some embodiments, the cleaning unit 100 includes the following components: a moving motor 112, a rotating motor 114, a water outlet 116, a roller brush 122, a sliding block 130 and various gears 134, 136, 138, 140, 142. According to some embodiments, the roller brush 122 includes a brush handle 124, a cleaning member 126 and a fixing member 128. The roller brush 122 can be classified into a bristle-type roller brush 122X or a scraper-type roller brush 122Y, according to the different structure of the cleaning member 126. According to some embodiments, the bristle-type roller brush 122X has bristles on the cylinder of the cleaning member 126 in a uniform arrangement and radially extends outward from the surface of the cylinder of the cleaning member 126. According to some embodiments, the scraper-type roller brush 122Y is provided with a scraper on the roller of the cleaning member 126 and extends outward along the surface of the cleaning member 126 in a spiral shape. The functions and interconnections of other components of the cleaning unit 100 will be further described with reference to the following figures.

[0041] FIG. 4 shows a perspective view of the cleaning unit 100 and the mop 16, according to some embodiments of the present invention. For the sake of clarity, other parts of the self-moving cleaning device 11 and other components of the washing device 10 have been omitted in FIG. 4. Referring to FIGS. 1A, 1B and 4, the weight of the self-moving cleaning device 11 presses down the cleaning member 126 of the roller brush 122 via the mop 16, thus making the mop 16 close to the cleaning member 126. Due to the contact and friction between the cleaning member 126 and the mop 16, coupled with the flushing of the cleaning liquid, the dust and garbage on the mop 16 can be scraped off from the surface or inside of the mop 16. According to some embodiments, the brush handle 124 of the roller brush 122 is located in the cleaning tank 102 and is fixed on one side of the cleaning unit 100, and firmly supports the cleaning member 126. By rotating the brush handle 124 to rotate the cleaning member 126, scraping force is generated in the tangential direction along the surface of the mop 16. Therefore, the cleaning ability of the cleaning member 126 is determined by the downward force of the self-moving cleaning device 11 and the rotation force of the roller brush 122, plus the auxiliary effect of cleaning liquid and bristles (or scrapers).

[0042] According to some embodiments, the roller brush 122A or 122B has a first end and a second end, and the two ends are opposite to each other. The first end is connected to the gear 142 at the side of the brush

handle 124 and receives the driving force delivered by the gear 142. The second end is located at the end of the cleaning member 126, which end is also on the side of the fixing member 128, and is further away from the toothed rack 28 than the first end. The second ends of the roller brush 122A or 122B can respectively rotate relative to the fixing member 128. According to some embodiments, the brush handle 124 is basically composed of a material with substantially no or low flexibility. According to some embodiments, the length of the cleaning member 126 only accounts for a part of the roller brush 122 to concentrate the cleaning force. According to some embodiments, the ratio of the length of the cleaning member 126 to the length of the roller brush 122 is substantially lower than 1/2, for example between 1/4 and 1/2, between 1/3 and 1/2, or 1/3 and 1/2. Therefore, when the cleaning unit 100 cleans different parts of the mop 16 along the Y-axis direction, the purpose of shifting the cleaning member 126 cannot be achieved by stretching or compressing the brush handle 124. Rather, only by moving the self-moving cleaning device 11 on the Y-axis to change the relative positions of the mop 16 and the cleaning member 126, the different portions of the mop 16 along the Y-axis can be touched.

[0043] FIG. 5 shows a perspective view of the driving assembly 110 of the cleaning unit 100, according to some embodiments of the present invention. Other components of cleaning unit 100 are not shown in FIG. 5 for clarity of illustration. The driving assembly 110 of the cleaning unit 100 is adjacent to the base 22 and above the toothed rack 28. The driving assembly 110 is connected to the toothed rack 28 and the roller brush 122, and is used to generate a driving force to move the cleaning unit 100 or rotate the roller brush 122. According to some embodiments, the driving assembly 110 is mainly divided into a first driving component 210 and a second driving component 220. Firstly, the first driving component 210 (also referred to as the moving assembly) includes the moving motor 112 and gears 132, 134, and 140. The driving force is generated by the moving motor 112 and transmitted to the gear 140 through the gears 132 and 134, so that the gear 140 drives the cleaning unit 100 to move back and forth on the toothed rack 28 along the X-axis in a linear or translational way. Furthermore, the second driving component 220 (also referred to as the rotating assembly) includes the rotating motor 114 and the gears 136, 138, 142A and 142B. The driving force is generated by the rotating motor 114 and transmitted to the gears 142A and 142B through the gears 136 and 138, so that the gears 142A, 142B respectively drive the brush handles 124A and 124B of the roller brushes 122A and 122B to rotate along the respective axes of the brush handles 124A and 124B. According to some embodiments, the roller brushes 122A and 122B are parallel to each other and extend in the Y-axis direction. According to some embodiments, the roller brushes 122A and 122B are located on the same plane and cling to the mop 16 at the same time.

[0044] According to some embodiments, the washing device 10 or the cleaning unit 100 is provided with a controller (not shown), which generates preset control signals through the control circuit, and determines the output powers of the moving motor 112 and the rotating motor 114 through a control voltage or control current, thereby respectively determining the moving speed or stop position of the cleaning unit 100 on the toothed rack 28, and the rotation speed of the roller brushes 122A and 122B. Since the moving motor 112 and the rotating motor 114 operate independently of each other, the output powers of the two motors are independent of each other, so the moving speed of the cleaning unit 100 and the rotating speed of the roller brush 122 are independent of each other as well.

[0045] Compared with the existing washing device operated by a single motor, the output power of a single motor can select only one output power at a time. As a result, no matter whether it is selected for the optimal adjustment of the moving speed of the cleaning unit 100 or of the rotation speed of the roller brush 122, either selection will show the effect of speeding up or slowing down at the same time. That cannot satisfy the design of individual optimization of the movement and the rotation at the same time. In contrast, the dual-motor drive design of the present invention can optimize the movement and rotation individually, thereby providing a better cleaning effect. According to some embodiments, since the roller brushes 122A and 122B are driven by the same rotating motor 114, the rotating speeds of the roller brushes 122A and 122B are dependent upon each other. According to some embodiments, the roller brushes 122A and 122B rotate at the same speed but in the opposite directions. According to some embodiments, the roller brushes 122A and 122B rotate in a clockwise or counterclockwise direction. According to some embodiments, the roller brushes 122A and 122B are located above the toothed rack 28 and separated from the toothed rack 28 by a distance.

[0046] FIGS. 6A and 6B show perspective views of the cleaning tank 102 of the cleaning unit 100, according to some embodiments of the present invention. Referring to FIG. 4, FIG. 6A and FIG. 6B, the cleaning unit 100 is provided with a cleaning tank 102 for accommodating the roller brush 122 and the water outlet 116. According to some embodiments, the water outlet 116 is located in the middle of the two roller brushes 122A and 122B, and includes one or more nozzles arranged along the Y-axis direction. According to some embodiments, the nozzle of the water outlet 116 face one side of the mop 16 to spray the cleaning liquid on the mop 16. According to some embodiments, the nozzles of the water outlet 116 spray the cleaning liquid in a direction away from the base 22.

[0047] According to some embodiments, the cleaning tank 102 includes a tank body 108 and an upper cover 118 (as shown in FIG. 3), wherein the upper cover 118 is pivotally connected to the tank body 108, and the upper

cover 118 can be opened or closed for cleaning or replacing the roller brush 122. According to some embodiments, the bottom and sidewalls of the tank body 108 form an enclosed space as a water collection structure, which can prevent the cleaning liquid from flowing out from the bottom or sidewalls of the tank body 108, so that the use efficiency of the cleaning liquid can be increased, and the leakage of the cleaning liquid can also be avoided. According to some embodiments, the upper cover 118 is provided with an opening 118W, so that the roller brush 122 can be exposed through the opening 118W and contact the mop 16. According to some embodiments, when performing the task of cleaning the mop 16, the mop 16 contacts the roller brush 122 from the above, the upper cover 118 is in a closed state which forms a water collection space with the cleaning tank 102, and the mop 16 also covers the opening 118W from above. In this way, the sides of the water outlet 116 are surrounded by the roller brushes 122A and 122B and the cleaning tank 102 (preferably surrounded by the tank body 108 and the upper cover 118), and the top of the water outlet 116 is covered by the mop 16. When the cleaning liquid is sprayed upward from the opening 118W of the water outlet 116 (i.e., in a direction facing the mop 16), the cleaning members 126A and 126B rotate in opposite directions R1 and R2, respectively, to generate friction with the mop 16. According to some embodiments, since the upper cover 118 of the cleaning tank 102 abuts the mop 16, the upper cover 118 and the mop 16 form an approximately airtight space between the roller brushes 122A and 122B, the water outlet 116 and the opening 118W for cleaning a portion of the mop 16 which is exposed at the opening 118W. According to some embodiments, the outer sides of the second ends of the roller brushes 122A and 122B are covered by the cleaning tank 102, and connected to the cleaning tank 102 with the fixing member 128, and are not directly driven by the first driving component 210 or the second driving component 220. Further, the front side of the tank body 108 of the cleaning tank 102 separates the fixing member 128 from the sidewall of the base 22 as well.

[0048] According to some embodiments, the cleaning members 126A and 126B rotate in opposite directions R1, R2, that is, their portions exposed through the upper cover 118 and close to the mop 16 rotate toward the water outlet 116, respectively. According to some embodiments, the cleaning members 126A and 126B rotate in the directions facing the base 22 on a side close to the water outlet 116. According to some embodiments, the roller brushes 122A and 122B not only cause the cleaning member 126 to rotate for achieving the purpose of cleaning the mop 16, but also are located on opposite sides of the water outlet 116, so that they can serve as shielding walls for each other. Each one of the shielding walls can prevent the cleaning liquid thrown out by the other of the shielding walls. Most of the cleaning liquid can be stopped when it is thrown toward the outer area of the cleaning tank 102. According to some embodiments, due to the

enclosed space provided by the cleaning tank 102, the cleaning liquid can be picked up by the roller brush 122 in the cleaning tank 102 and brought to the mop 16, so as to increase the recycling rate of the cleaning liquid. Therefore, the design of the double roller brush of the present invention can also be used as an auxiliary structure of the cleaning tank 102 to prevent the cleaning liquid from spilling out or push the cleaning liquid toward the central area of the cleaning tank 102, and therefore the cleaning performance of the cleaning liquid can be optimized and sewage collecting efficiency can be maximized.

[0049] According to some embodiments, the scraper provided in the cleaning member 126 rubs the mop 16 when moving along the first direction so as to scrape off the dust or garbage on the mop 16. According to some embodiments, when the driving assembly 110 drives the roller brush 122 along the X-axis to perform cleaning task, the roller brush 122 can rotate clockwise, counterclockwise or stand still depending upon the requirements. When the roller brush 122 stands still, the cleaning unit 100 relies on the movement of the roller brush 122 along the X-axis direction to generate friction with the mop 16. Referring to FIG. 6B, according to some embodiments, the bottom of the tank body 108 of the cleaning tank 102 is provided with a drain hole (not shown) and a drain valve (not shown), and the drain valve controls the opening and closing of drain hole. According to some embodiments, the controller of the washing device 10 controls the drain valve to close the drain hole and clean the mop 16 for a period of time. After the cleaning task lasts for the period of time, the controller enables the drain valve to open the drain hole to discharge the sewage in the cleaning tank 102. According to some embodiments, the cleaning unit 100 is provided with a pumping motor and a pipeline (not shown) connected to the sewage tank 42, and the sewage collected in the cleaning tank 102 is transported to sewage tank 42 through the drain hole and the pipe by the pressure generated by the pumping motor. According to some embodiments, the controller of the washing device 10 controls the supply volume of the water outlet 116 to be greater than or equal to the drainage volume of the drain hole, so that the sewage can be discharged regularly, and the cleaning tank 102 can also continuously provide cleaning liquid to the roller brush 122 to clean the mop 16.

[0050] Referring to FIG. 6C, according to another embodiment, the bottom of the tank body 108 of the cleaning tank 102 is not provided with a drain hole, but an opening 108D is provided facing the base 22, overlapped with the cleaning member 126, and used to drain the excess cleaning liquid or sewage to base 22. According to some embodiments, the opening 108D and the drain hole are used in different scenarios, in which one of them is selected for implementation. According to some embodiments, the drainage volume of the opening 108D is greater than the water supply volume provided by the water outlet 116 so as to avoid unnecessary contamination of

the mop 16 by the sewage when the cleaning liquid gets dirty rather soon due to a more dirty mop 16 but is still retained in the cleaning tank 102. According to some embodiments, the washing device 10 is provided with a pumping motor (not shown) and a pipeline connected to the sewage tank 42, and the sewage collected by the base 22 is transported to the sewage tank 42 through the pipeline under the pressure provided by the pumping motor.

[0051] FIG. 7A shows a perspective view of the cleaning unit 100, according to some embodiments of the present invention. Referring to FIG. 5 and FIG. 7A, the cleaning unit 100 of FIG. 7A shows an additional sliding block 130, wherein the sliding block 130 and the driving assembly 110 (or the moving motor 112, the rotating motor 114) are located on the same side of the toothed rack 28. The driving assembly 110 is connected to the sliding block 130 and fastened to the toothed rack 28 via the sliding block 130. According to some embodiments, FIG. 7B shows a perspective view of the toothed rack 28 and the sliding block 130 alone. It can be seen more clearly from FIG. 7B that the toothed rack 28 is provided with a sliding rail 702 on a lateral side facing the moving motor 112 or the rotating motor 114, and the sliding rail 702 and the teeth 38 are located on different sides of the toothed rack 28. When the driving assembly 110 moves along the X-axis direction, the sliding block 130 is fastened on the sliding rail 702 to slide along the X-axis direction, thereby driving the driving assembly 110 and the entire cleaning unit 100 to slide along the X-axis direction. According to some embodiments, the sliding rail 702 is in a shape of the English letter "I." The sliding block 130 is in the shape of a strip in the X-axis direction, and has the same or greater length as the driving assembly 110 in the X-axis direction. A concave shape or a shape of the English letter "C" is shown along the direction of the Z-axis. According to some embodiments, the sliding block 130 has a notch facing the sliding rail 702, and the notch is engaged to the sliding rail 702 to slide. According to some embodiments, the length of the sliding rail 702 is the same as that of the toothed rack 28, so that the sliding range of the sliding block 130 is substantially the same as the length of the toothed rack 28. Referring to FIG. 7C, when viewed from the side, the sliding block 130 is located at the bottom of the cleaning unit 100 and between the cleaning unit 100 and the toothed rack 28. The cleaning unit 100 clings to the toothed rack 28 more firmly by help of the sliding block 130, so that the cleaning unit 100 can smoothly move on the toothed rack 28 along the X-axis.

[0052] Referring to FIG. 7B and FIG. 7C, the sliding block 130 is provided with an opening 704, for example, arranged on the side of the sliding block 130 facing the moving motor 112, and the sliding block 130 can be fixed on the driving assembly 110 by using a locking member, e.g., a screw, such as being fixed on the motor front cover 104. According to some embodiments, the cleaning unit 100 drives the gear 140 through the moving motor

112, drives the cleaning unit 100 to move along the X-axis direction through the engagement of the gear 140 and the plurality of teeth 38 of the toothed rack 28. Further, through the motor front cover 104, which is fixed on the sliding block 130, and through the sliding block 130, which is fastened to the sliding rail 702, the cleaning unit 100 can be moved to slide along the X-axis direction. According to some embodiments, the integration of the sliding block 130 and the sliding rail 702 carries most of the weight of the cleaning unit 100, and the function of the gear 140 can be simplified, that is, the gear 140 is engaged with the plurality of teeth 38 of the toothed rack 28 to drive the cleaning unit 100 to move along the X-axis direction without bearing all the weight of the cleaning unit 100.

[0053] Referring to FIGS. 3, 6A, 6B and 7A, according to some embodiments, the base 22 is only provided with a toothed rack 28 on one side for the cleaning unit 100 to move thereon. In this way, the roller brush 122 can only be connected to the driving assembly 110 of the cleaning unit 100 through the gear 142 from the first end of the brush handle 124, while the second end of the roller brush 122 leans on the groove 108T of the front sidewall of the cleaning tank 102 through the fixing member 128 on. In other words, the roller brush 122 is unilaterally driven by the driving assembly 110. According to some embodiments, the roller brush 122 of the cleaning unit 100 is suspended or covered by the cleaning tank 102 on the side of the cleaning member 126, and is free of driving elements or tracks to rotate or move the roller brush 122 from the side of the connecting member 26.

[0054] According to some embodiments, when the first end of the cleaning unit 100 is driven by the driving assembly 110 and the second end is not driven by the driving assembly 110, the first end and the second end of the cleaning unit 100 are unevenly stressed so that a torque may be generated easily on the cleaning unit 100, causing the cleaning unit 100 unable to move smoothly, such as exhibiting vibration. In response to such phenomenon, the sliding block 130 is made elongated to extend along the axial direction of the toothed rack 28, and the upper and lower sides of the "C" shape of the sliding block 130 and the sides connecting the upper and lower sides are tightly clamped to the sliding rail 702. The sliding rail 702 limits the freedom of movement or rotation of the sliding block 130 and the cleaning unit 100 in directions other than the X-axis direction. Therefore, according to some embodiments, the gear 140 of the cleaning unit 100 provides the power for the cleaning unit 100 to move on the toothed rack 28 and determines the speed at which the cleaning unit 100 moves on the toothed rack 28. The sliding block 130 has a length equivalent to the length of the driving assembly 110 in the direction of X-axis, which can provide a sufficiently great stabilizing force to limit the movement of the cleaning unit 100 to move along the X-axis direction only, thereby decreasing the chance of unsmooth moment or vibration caused by the uneven force on both ends of the cleaning unit 100.

[0055] Furthermore, referring to FIG. 6B, according to some embodiments, protrusions 602 are provided on the lower portion of the front sidewall of the cleaning tank 102 and extend along the Y direction. Referring to FIG. 2A, the base 22 is provided with a groove (not shown) on the inner side near the side of the guiding plate 24 close to the connecting member 26 and corresponding to the protrusions 602, so that the protrusion 602 can be accommodated in the base 22. In the groove of the base 22, the movement of the protrusions 602 in the groove of the base 22 along the X-axis direction limit the cleaning unit 100 to move in the X-axis direction only. Furthermore, the rear side of the cleaning tank 102 is connected to the motor front cover 104. In this way, when the cleaning unit 100 moves on the toothed rack 28 via the gear 140, the cleaning tank 102 is also driven to move in the X-axis direction of the base 22 without deviation. According to some embodiments, the protrusions 602 on the front wall of the cleaning tank 102 abut the groove of the base 22 and slide on the groove when the cleaning unit 100 moves along the X direction. According to some embodiments, the cleaning tank 102 is provided with a plurality of protrusions 602, which are accommodated in the grooves of the base 22 at a fixed distance from each other on the front sidewall of the cleaning tank 102. Therefore, there is almost no space present between the cleaning tank 102 and the base 22 for rotation of the cleaning tank 102, thereby further reducing the chance of vibration or torque generated by the roller brush 122.

[0056] As mentioned above, when the design of the conventional single-sided toothed rack 28 enables the cleaning unit 100 or the roller brush 122 to move in the X-axis direction, the moving speeds and receiving forces between the first side of driving assembly 110 and the second side of the fixed member 128 may be somewhat different due to the single-sided driving of the driving assembly 110. A torque is generated in the planar direction of the cleaning unit 100, so that the cleaning tank 102 or the roller brush 122 cannot maintain stability without vibration or rotation in the Y direction. Through the arrangement of the above-mentioned sliding block 130 and the protrusions 602 of the present invention, the single-sided driving of the driving assembly 110 or the torque generated by the single-sided toothed rack 28 can be suppressed or compensated for by the design of the sliding block 130 and the protrusions 602. As a result, movement stability of the cleaning unit 100 can be effectively maintained, and rotations or vibrations in any direction can be reduced. Regarding the arrangement of the single-sided toothed rack 28, compared with the driving mode of the double-sided rack, two racks of the double-sided rack need to be positioned on the front side and back side, respectively, in the Y-axis direction. Further, it is necessary to arrange two gears 140 on the front side and the rear side, respectively, of the cleaning unit 100, and simultaneously drive the gears 140 on the both side of double-sided rack so as to enable synchronous movements of the two sides of roller brush on the base 22.

along the X-axis direction. In this way, the unsmooth movement caused by the aforementioned torque can be reduced. However, the disadvantage of such design is that the manufacturing tolerance of the cleaning unit 100 is very small. When the manufacturing tolerance of the cleaning unit 100 is too large, the gears 140 at both ends may not be precisely engaged with the teeth 38 of the toothed rack 28 at the same time. Furthermore, during the assembly and manufacture processes, the gears 140 located at both ends of the cleaning unit 100 also need to correspond to specific teeth 38 of the toothed rack 28 so that the gears 140 on both sides can meet the stringent requirement of synchronization during movement, and such synchronization requirement will increase the complexity and cost of the design or the maintenance difficulty in the future. The assembling process would also be relatively difficult. In contrast, the design of the single-sided toothed rack 28 of the present invention is simpler, the area of the cleaning unit is decreased, and the failure rate can be reduced, thereby saving the cost and power consumption spent on the driving on the second side.

[0057] In addition, the cleaning unit 100 moves along the X-axis direction using the sliding block 130 and the protrusions 602, in which fast movement is not necessary, so it is not necessary to use rollers or gears to move back and forth on the base 22 or the toothed rack 28. Time is sufficient to complete the cleaning task on each portion of the mop 16 with the movement under a low-noise manner, which can further reduce noise caused by the rotary drive. According to some embodiments, the moving speed of the cleaning unit 100 during the cleaning task is within 1 cm per second, or within 3 cm per second.

[0058] FIGS. 8A and 8B show a perspective view and a side view, respectively, of the sliding block 130, according to some embodiments of the present invention. In order to clearly show the internal structure of the sliding block 130, the toothed rack 28, the sliding rail 702 and other components of the cleaning unit 100 are not shown in FIGS. 8A and 8B. Referring to FIG. 8A, according to some embodiments, the upper side, the lower side and the side of the sliding block 130 are connected to form the shape of the English letter "C", and the inner side of the sliding block 130 is provided with an extension portion 802 which extends from the upper side and the lower side of the sliding block 130 toward the notch of the English letter "C". The extension portion 802 can be in a strip shape, block shape or other suitable shapes, and is used to reduce the notch size of the sliding block 130. The sliding block 130 can be fitted into the sliding rail 702 through the gap, and can be engaged to the sliding rail 702 more firmly without slipping off. According to some embodiments, the inner side of the sliding block 130 or the side facing the sliding rail 702 is provided with at least one protruding strip 804 or protruding ball 806, extending from the upper side, the lateral side, or the lower side of the sliding block 130 toward the hollow space of the sliding block 130. According to some embodiments, the protruding strip 804 is arranged on the lateral side of the

sliding block 130, and the length of the protruding strip 804 is equal to that of the sliding block 130 along the X-axis direction. According to some embodiments, the protruding ball 806 is arranged on the upper side or the lower side of the sliding block 130, and the protruding ball 806 is in a conical shape, a hemispherical shape, a hexahedral shape, a tower shape, or other suitable shapes. The height of the protruding balls 806 may be smaller than the height of the extension portion 802. In other embodiments, the protruding strips 804 and the protruding balls 806 can be arbitrarily arranged on the upper side, the lower side or the lateral side of the sliding block 130 and located at the center line of the upper side, the lower side or the lateral side, and can be arranged alternatively arranged or replaced each other. When the sliding block 130 is clamped to the sliding rail 702 and slides on the sliding rail 702, the protruding strip 804 and the protruding balls 806 abut the sliding rail 702 to slide, which can lower friction force to thereby reduce noise and resistance, and enable the cleaning unit 100 to move in an efficient and power-saving manner.

[0059] FIG. 9 shows a combined perspective view of the base 22, the cleaning unit 100 and the mop 16, according to some embodiments of the present invention. Referring to FIGS. 2A, 4 and 9, the cleaning unit 100 is arranged on the bottom of the base 22, and is used for cleaning one side (such as the lower side) of the mop 16 facing the surface 12 to be cleaned (such as the ground) from a location below the mop 16. Therefore, the platform of the bottom of the base 22 needs to be raised to generate an accommodating space for the cleaning unit 100. According to some embodiments, the guiding plate 24 will guide the self-moving cleaning device 11 from a surface to be cleaned 12 (for example, the ground) back to the base 22 of the washing device 10. Therefore, the surface of the guiding plate 24 is an inclined surface, and the bottom of the base 22 or the ground to be cleaned 12 form an included angle A. The guiding plate 24 is connected to the front side of the base 22 via a connecting member 26, so that the mobile device (such as a wheel) of the self-moving cleaning device 11 can move to the bottom platform of base 22. According to some embodiments, the included angle A is between 5 degrees and 30 degrees. According to some embodiments, the mop 16 is parallel to the upper cover 118 of the cleaning tank 102, so that when the roller brush 122 and the mop 16 move along the X-axis direction and the Y-axis direction, respectively, to perform the cleaning task, the mop 16 can always keep close engagement with the cleaning members 126 to ensure the cleaning performance and reduce the overflow of sewage. Referring to FIG. 7C, as mentioned above, the toothed rack 28 is fixed on the bottom of the base 22, and the cleaning unit 100 is engaged to the sliding rail 702 of the toothed rack 28 through the sliding block 130. As can be seen from FIG. 7C, when viewed from the lateral side, the sliding rail 702 and the sliding block 130 are inclined at an included angle A toward the guiding plate 24, so that the housing of the clean-

ing unit 100 is also inclined downward at an angle A, while the cleaning tank 102 faces downward to the guiding plate 24 and maintains the stance with the included angle A. Referring to FIG. 7C and FIG. 9, according to some embodiments, the cleaning unit 100 and the guiding plate 24 are closely engaged, and both maintain the same included angle A to be combined into a continuous slope, so that when the self-moving cleaning device 11 moves from an outer side of guiding plate 24 to an inner side of the guiding plate 24 and arrives at the top of the cleaning unit 100, the included angle A can be maintained unchanged. In this way, no matter which relative position between the mop 16 and the cleaning unit 100 is present, it can be ensured that the cleaning tank 102 and the mop 16 are always parallel and close to each other to keep the cleaning performance of the roller brush 122.

[0060] In contrast, in the conventional washing device the cleaning unit is arranged parallel to the ground, so its guiding plate must be formed by two sections, in which the first section is similar to the guiding plate of the present invention and has an inclined angle, while the second section is parallel to the ground and connected to the base. The first section can guide the self-moving cleaning device from the ground to the height of the cleaning unit, then keep it in an inclined posture. Next, moving forward to the second section, which becomes parallel to the ground and within the range of which the cleaning task is performed. The guiding plate of the above-mentioned conventional washing device will become longer, so that the volume of the entire washing device would be too bulky. Alternatively, the self-moving cleaning device would move back and forth on a planar surface with a corner to perform the cleaning task. However, under that situation, due to the potential corner arranged between the mop and the cleaning unit, the mop and the cleaning unit cannot be in close contact with each other, so the cleaning task cannot be effectively performed.

[0061] FIG. 10 shows a perspective view of a cleaning unit 101, according to some embodiments of the present invention. The cleaning unit 101 has many features similar to those of the aforementioned cleaning unit 100, so these similar features will not be repeated. The difference between the cleaning unit 101 and the cleaning unit 100 is that the cleaning unit 101 is provided with only one roller brush 122A, which is accommodated in a cleaning tank 902. Although there is no another roller brush 122B serving as a tool to cleaning the mop 16 arranged on the side of the water outlet 116 opposite to the roller brush 122A, such design has the advantage of reducing the area of the cleaning unit. Further, similar to the cleaning tank 102, and the cleaning tank 902 can still effectively cover the roller brush 122A and the water outlet 116 from lateral sides of the cleaning tank 902 so that the overflow of sewage can still be managed well. According to some embodiments, the cleaning tank 902 has a tank body and an upper cover (similar to the upper cover 118, not shown in FIG. 10), wherein the upper cover covers the brush handle 124A and has openings to expose the water outlet

116 and the cleaning member 126A. According to some embodiments, the upper cover covers all or at least a part of the brush handle 124A. In an embodiment, the tank body of the cleaning tank 902 may have different configurations on the sidewall closer to the roller brush 122A and the sidewall closer to the water outlet 116 side; for example, the sidewall closer to the water outlet 116 is higher than the sidewalls closer to the roller brush 122A in order to effectively prevent the cleaning liquid sprayed by the water outlet 116 from overflowing outward.

[0062] FIG. 11A shows a schematic diagram of a cleaning method, according to some embodiments of the present invention. FIG. 12 shows a flowchart corresponding to the cleaning method 1200 of FIG. 11A, according to some embodiments of the present invention. In some embodiments, in the cleaning method 1200 shown in FIG. 12, some steps may be omitted, and other steps may be added before or after any step of the method 1200. In some embodiments, in the cleaning method 1200 shown in FIG. 12, different steps may be performed in a different order or simultaneously.

[0063] According to some embodiments, the washing device 10 and the self-moving cleaning device 11 form a cleaning system, wherein the cleaning unit 100 is configured to clean the mop 16. For the convenience of illustration, FIG. 11A only shows a single roller brush 122, but the arrangement of double roller brushes 122 can also be applied to the cleaning method in FIG. 11A. The mop 16 has a maximum length H1 in the direction of the Y-axis, and the cleaning member of the roller brush 122 of the cleaning unit 100 has a length H2 in the direction of the Y-axis. Since the length H1 is usually greater than the length H2, the task of cleaning the entire mop 16 can be achieved by cleaning the mop 16 section by section.

[0064] According to the embodiment of FIG. 11A, the length H1 is approximately two to three times of the length H2 (in other embodiments, other ratios greater than 1 are also possible). Therefore, after the washing device 10 receives the information on the lengths H1 and H2, the method 1200 can partition the cleaning area of the mop 16 into three strip-shaped zones Z1, Z2, and Z3 that are approximately equal in length along the Y-axis. In another embodiment, the zones Z1, Z2 and Z3 each have different lengths measured along the Y-axis.

[0065] According to some embodiments, the method 1200 aligns one of the front side and the rear side (for example, the rear side) of the self-moving cleaning device 11 with the washing device 10, and moves the self-moving cleaning device 11 to the guiding plate 24 of the washing device 10. The respective step may correspond to step 1202 in FIG. 12 or descriptions with reference to FIG. 9. Next, in the method 1200 the self-moving cleaning device 11 is moved to a location above the cleaning unit 100 of the washing device 10, and caused to align the mop 16 with the cleaning unit 100 in the Z-axis direction. The respective step may correspond to step 1204 in FIG. 12 or descriptions with reference to FIG. 4.

[0066] According to some embodiments, the method

1200 sets a first zone of the mop 16, such as zone Z1, as the current cleaning zone. The respective step may correspond step 1206 in FIG. 12. Next, according to some embodiments, the method 1200 aligns the roller brush 122 (or the cleaning member 126) of the cleaning unit 100 with the current cleaning zone Z1, enables the water outlet 116 to spray the cleaning liquid to the current cleaning zone Z1 of the mop 16 and causes the roller brush 122 to rotate. The respective step may correspond to step 1208 in FIG. 12.

[0067] According to some embodiments, in step 1208, the controller of the washing device 10 is connected to the moving motor 112 of the cleaning unit 100 to control the related parameters of the displacement Dx of the cleaning unit 100 in the first direction (such as the X-axis direction), such as the moving speed, the moving period, the pause location, and the pause period. According to some embodiments, the controller of the washing device 10 is connected to the rotating motor 114 of the cleaning unit to control the rotational parameters of the roller brush 122, such as the rotational speed and the direction of rotation about the second direction (which can be the Y-axis direction) as the axis. According to some embodiments, the first direction and the second direction are different directions, for example, the first direction and the second direction are perpendicular to each other. According to some embodiments, the controller of the washing device 10 is connected to the signal emitting unit (such as an infrared emitting unit) of the washing device 10 to transmit a control signal to the self-moving cleaning device 11 and control the parameters related to displacement Dy of the mop 16 on the self-moving cleaning device, such as the moving speed, the moving period, the pause location, and the pause period. By simultaneously controlling the displacement-related parameters of the cleaning unit 100, the rotation-related parameters of the roller brush 122 and the displacement-related parameters of the mop 16 for the cleaning task of the current cleaning zone Z1 can be accomplished. According to some embodiments, the controller of the washing device 10 controls the valve of the water outlet 116 to determine parameters related to the spray, such as the length of spraying time, the time interval of spraying, and the amount of spraying. According to some embodiments, the controller of the washing device 10 controls the pumping motor (not shown) connected to the sewage tank 42 to determine the pumping time and pumping rate with which the sewage collected at the bottom of the base 22 or in the cleaning tank 102 is pumped to the sewage tank 42.

[0068] According to some embodiments, the method 1200 determines a cleaning mode for the current cleaning zone Z1. The respective step may correspond to step 1210 in FIG. 12. Since the zone Z1 has a strip shape extending along the first direction, the method 1200 selects a linear cleaning mode. At the present time, the method 1200 moves the cleaning unit 100 along the first direction, such as generating a displacement Dx, and

controls the roller brush 122, the water outlet 116 and the pumping motor to operate according to the respective determined parameters so as to complete the cleaning task of the current cleaning zone Z1. The respective step may correspond to step 1212 in FIG. 12. According to some embodiments, in the linear cleaning mode, the controller of the washing device 10 cause the self-moving cleaning device 11 to stand still without moving, and causes the cleaning unit 100 or the roller brush 122 to move along the first direction to perform the cleaning task until the cleaning task for zone Z1 is completed. The respective step may correspond to step 1214 in FIG. 12. According to some embodiments, the linear cleaning mode enables the cleaning unit 100 to move back and forth multiple times along the first direction in the current cleaning zone Z1, so that the roller brush can clean the same portion of the zone Z1 repeatedly until the predetermined cleaning times are reached, or until the clean level of the sewage reaches the standard.

[0069] According to some embodiments, step 1210 may be performed before step 1208, or step 1208 and step 1210 may be performed simultaneously. According to some embodiments, steps 1208, 1212, 1214 are performed simultaneously or in a different order.

[0070] When the cleaning task for the current cleaning zone Z1 is accomplished, the method 1200 would determine whether the cleaning tasks of all the cleaning zones have been accomplished. The respective step may correspond to step 1216 in FIG. 12. If the method 1200 determines that there are other zones of the mop 16 that have not been cleaned yet, it proceeds to step 1218 and sets the next cleaning zone, such as zone Z2, to be the current cleaning zone. According to some embodiments, the controller of the washing device 10 enables the cleaning unit 100 to suspend or continue operation to accomplish cleaning tasks, and makes the self-moving cleaning device 11 to generate the necessary displacement Dy along the second direction again to reach zone Z2. At this point, the method 1200 returns to step 1208 and repeats the steps 1210-1214 in the previous cleaning task for cleaning zone Z1 so as to complete the cleaning task of the current cleaning zone Z2. The same operation is repeated until the cleaning task of zone Z3 is accomplished. According to some embodiments, when the cleaning task of each zone Z1, Z2, Z3 is completed according to the cleaning method shown in FIG 11A, a linear cleaning mode is used, so that the self-moving cleaning device 11 does not produce a displacement Dy in the second direction (e.g. exhibits a stationary status), and the cleaning task is performed only by the cleaning unit 100 through driving the roller brush 122 back and forth in the first direction on the zone Z1, Z2 or Z3. For example, in a static state), only the cleaning unit 100 drives the roller brush 122 to clean the zone Z1, Z2 or Z3 back and forth along the first direction. At the present time, the moving direction of the cleaning unit 100 or the roller brush 122 relative to the mop 16 is the same as the moving direction of the roller brush 122 itself, for example,

according to the cleaning trajectories of the displacement Dx traversed on the zones Z1, Z2, and Z3.

[0071] According to some embodiments, the method 1200 follows the trajectory of the English letter "Z" to complete the cleaning task of the successive cleaning zones Z1 to Z3. For example, when cleaning task is performed on the cleaning zones Z1 and Z3, the cleaning is performed from the left side of FIG. 11A to the right side of FIG. 11A. When the cleaning task is performed on the cleaning zone Z2, the cleaning is performed from the right side of FIG. 11A to the left side of FIG. 11A. Alternatively, the cleaning task is performed in directions exactly opposite to the abovementioned cleaning directions.

[0072] If the cleaning tasks of all the cleaning zones have been completed, the method 1200 proceeds to step 1226. According to some embodiments, when the cleaning tasks of all the zones are completed, the self-moving cleaning device 11 would exit from the washing device 10. According to some embodiments, the controller of the washing device 10 causes the self-moving cleaning device 11 to leave the base 22 and generate a necessary displacement Dy along the second direction to leave the washing device 10 from the guiding plate 24.

[0073] FIG. 11B shows a schematic diagram of a cleaning method, according to some embodiments of the present invention. FIG. 12 shows a flowchart corresponding to the cleaning method 1200 of FIG. 11B, according to some embodiments of the present invention. The cleaning method shown in FIG. 11B is similar to the cleaning method in FIG. 11A in that a linear cleaning mode is used to perform the cleaning task on the mop 16, so these similar features will not be repeated. The cleaning method shown in FIG. 11B is different from the cleaning method shown in FIG. 11A in that the method 1200 determines to partition the mop 16 into more overlapping strip-shaped zones Z1 to Z5, wherein the adjacent zones Z1 to Z5 have portions overlapping each other along the second direction (Y-axis). By allocating the current cleaning zones Z1 to Z5 as being overlapping with each other, the cleaning task of the mop 16 needs to repeat the linear cleaning mode five times (for example, repeat steps 1208, 1210, 1212, 1214, 1218) to clean the zones Z1 to Z5 sequentially. Therefore, as shown in FIG. 11A, the part of the mop 16 close to the boundary of the zone Z1 to Z3 will be cleaned twice in the cleaning method of FIG. 11B, so that a more consistent cleaning performance can be achieved across each portion of the mop 16.

[0074] FIG. 11C shows a schematic diagram of a cleaning method, according to some embodiments of the present invention. FIG. 12 shows a flowchart corresponding to the cleaning method 1200 of FIG. 11C, according to some embodiments of the present invention. The cleaning method shown in FIG. 11C is similar to that shown in FIGS. 11A and 11B, so these similar features will not be repeated. The difference between the cleaning method shown in FIG. 11C and the cleaning methods shown in FIGS. 11A and 11B lies in that the controller can determine to partition the mop 16 into different types

of zones for local cleaning. Referring to FIG. 1B, the mop 16 is disposed at the bottom of the self-moving cleaning device 11. The greater area the mop 16 occupies on the bottom, the more area it can be used for the cleaning task. However, the actual situation needs to take in consideration the bottom area occupied by other components, such as the suction port 7, the roller brush device 17, the mobile unit 18, the spray device 19, etc. In addition, the locations of these components mentioned above cannot be allocated arbitrarily, and their locations and areas must be determined according to factors of their functions and coordination with other components. Therefore, the size, location and shape of the mop 16 are limited by the arrangement of other components. In order to maximize the utilization of the remaining area at the bottom to increase the area of the mop 16, the mop 16 may come in an irregular shape. According to some embodiments, the mop 16 may be in a rectangular shape, a square shape, a semicircle shape or any other shapes. In the embodiments of FIGS. 11A-11C, the mop 16 has an irregular shape like a semicircle with its upper and lower sides cut off. According to some embodiments, the controller partitions the mop 16 to be regular zones Z11, Z12, and Z13 and irregular zones Z21, Z22, Z23, Z24, Z25, and Z26. The regular zones Z11, Z12, and Z13 are generally stripshaped or rectangular-shaped, but irregular zones Z21, Z22, Z23, Z24, Z25 and Z26, which have different shapes, are all located at the edge area of the mop 16.

[0075] According to some embodiments, when the cleaning unit 100 is used to clean the regular zones Z11, Z12 and Z13, the cleaning tasks can be completed sequentially with reference to the linear cleaning mode shown in FIG. 11A or FIG. 11B. As mentioned previously, when the cleaning unit 100 is within any of the regular cleaning zones Z11, Z12, Z13, the self-moving cleaning device 11 does not generate any displacement Dy in the second direction (Y-axis) (for example, exhibiting a stationary status), and the zone Z11, Z12 or Z13 is cleaned merely by the cleaning unit 100 through driving the roller brush 122 along the first direction (X-axis).

[0076] According to some embodiments, when the cleaning unit 100 is used to clean the irregular zones Z21, Z22, Z23, Z24, Z25 and Z26, the method 1200 determines at step 1210 that a curved cleaning mode is suitable for the above-mentioned zones. According to some embodiments, the method 1200 generates the displacement Dx by shifting the cleaning unit 100 in the first direction (e.g., the X-axis direction). The respective steps may correspond to step 1222 in FIG. 12. Step 1222 is similar to step 1212. At a later time or the same time, the method 1200 causes a displacement Dy by moving the self-moving cleaning device 11 in the second direction (for example, the Y-axis direction) to enable a relative movement of the roller brush 122 or the cleaning member 126 with respect to the current cleaning zone (for example, zone Z2) of the mop 16 and generate a displacement Ds in a third direction (for example, toward a lower-right

direction). The respective step may correspond to step 1224 in FIG. 12. For example, the irregular zone Z22 includes a segment of an irregular edge contour 16P of the mop 16. As far as the cleaning task of the irregular zone Z22 is concerned, when the cleaning unit 100 enters into zone Z22, the controller moves the self-moving cleaning device 11 along the second direction (Y-axis) and generates an upward displacement D_y . At the same time, the controller moves the cleaning unit 100 along the first direction (X-axis) and generates a displacement D_x to the right. As a result, the moving direction of the roller brush 122 against the cleaning zone Z22 is equivalent to the lower-right displacement D_s . According to some embodiments, the cleaning trajectory of the displacement D_s is consistent with or similar to the edge contour 16P of the mop 16 in the irregular zone Z22, so that the cleaning unit 100 can perform the cleaning task in an irregular zone through cooperation with the self-moving cleaning device 11. According to some embodiments, steps 1208, 1222, 1224 are performed simultaneously or in a different order.

[0077] Referring to FIG. 4 and FIG. 6B, when the cleaning unit 100 cleans the mop 16 around a central zone (such as zone Z12) of the mop 16, the mop 16 covers the cleaning tank 102, the water outlet 116, at least a portion of the roller brush 122 and the entirety of the opening 118W from the top of cleaning tank 102. Furthermore, since the length of the cleaning member 126, which is part of roller brush 122, is less than the length of the entire roller brush 122, the area of the opening W118 is reduced and accordingly the chance of the cleaning liquid overflowing from opening 118W is decreased. Therefore, when the cleaning unit 100 sprays the cleaning liquid from the water outlet 116 toward the mop 16, the cleaning liquid will substantially be blocked by the mop 16. When the cleaning liquid is sprayed upward or the cleaning member 126 is rotated, the sprayed or thrown-out cleaning liquid or sewage can be effectively blocked by the tank body 108 and the upper cover 118 of the cleaning tank 102. As a result, the cleaning liquid can be effectively leveraged with such arrangement.

[0078] Referring back to FIGS. 11A, 11B and 11C, the three different cleaning modes introduced in FIG. 11A-11C can be applied to the irregular zone Z22, but their cleaning performances may vary. As explained above, when the cleaning task is performed on the regular zones Z11, Z12, Z13, the mop 16 can completely cover the opening 118W of the upper cover 118, so the cleaning liquid will be blocked by the regular zone Z11, Z12 or Z13 of the mop 16. Thus, the overflow of the cleaning liquid would not be a serious issue. However, when the cleaning task is performed on the irregular zones Z21, Z22, Z23, Z24, Z25 and Z26, the opening 118W is in a rectangular shape so that, unlike the edge contour of a rectangle, the edge contours of these irregular zones are not parallel to the first direction or the second direction. Therefore, these zones may not be able to cover the opening 118W completely, which may cause a portion

of the cleaning liquid to overflow from the gap of the mop 16. Such problem will become more pronounced when the cleaning mode shown in FIG. 11A or FIG. 11B is performed. Among the cleaning modes, the percentage of the irregular edge contour in two edges of the cleaning zones Z1 to Z3 under the linear cleaning mode shown in FIG. 11A is higher than that of the cleaning zones Z1 to Z5 under the linear cleaning mode shown FIG. 11B. Therefore, the extent of overflow under the cleaning mode shown in FIG. 11A would be more serious than that shown in FIG. 11B. Conversely, if the cleaning task is performed under the cleaning mode of FIG. 11C, the relative displacement D_s generated based on the displacements D_x and D_y through the movement of cleaning unit 100 in corporation with the mop 16 enables the cleaning tank 102 to move along the irregular edge contour 16P of the mop 16. Thus, the area in which the underlying water outlet 116 or the cleaning member 126 are not covered by the mop 16 can be greatly reduced, thereby effectively preventing the cleaning liquid from overflowing. Therefore, even if the mop 16 has an irregular shape, the cleaning performance of the mop 16 with a regular shape can be approached through performing the cleaning task under the curved cleaning mode shown in FIG. 11C.

[0079] According to some embodiments, the cleaning tasks performed by moving the cleaning unit 100 laterally along the X-axis direction and moving the self-moving cleaning device 11 vertically along the Y-axis direction may be performed in parallel or interleaved. According to some embodiments, the controller divides the execution time of the cleaning task into a plurality of segmented periods. The cleaning unit 100 moves along the X-axis direction to clean the mop 16 in one or more first periods of the segmented periods, and the self-moving cleaning device 11 moves along the Y-axis direction during one or more second periods of the segmented periods. These first periods and second periods may be set as alternate with each other. According to some embodiments, when cleaning the regular zones of the mop 16, such as zone Z11, Z12 or Z13, only one or more first periods are allocated, or the first periods and the second periods are not overlapped with each other. In these one or more first periods, the cleaning unit 100 moves along the X-axis direction to clean the mop 16, while the self-moving cleaning device 11 is kept still. In another embodiment, when cleaning the irregular zone of the mop 16, such as the edge contour of the zone Z25 or Z26, only one or more second periods are allocated, or the second period are not overlapped with the first periods. Further, during the one or more second periods, the self-moving cleaning device 11 is moved along the Y-axis direction to clean the mop 16 while the cleaning unit 100 is kept still. In yet another embodiment, when the irregular zone of the mop 16 is cleaned, such as the edge contour of the zone Z23 or Z24, a plurality of first periods and second periods are allocated, wherein these first periods and second periods at least partially overlap. As a result, in the multiple first

periods or second periods, at least in part of the periods, the cleaning unit 100 can move along the X-axis direction, and at the same time the self-moving cleaning device 11 also moves along the Y-axis direction to clean mop 16.

[0080] FIG. 11D shows a schematic diagram of cleaning method 1200, according to some embodiments from the present invention. FIG. 12 shows a flowchart of cleaning method 1200 corresponding to FIG. 11D, according to some embodiments from the present invention. The cleaning method shown in FIG. 11D is similar to the cleaning method shown in FIG. 11C in many aspects, and these similar features will not be repeated. The cleaning method shown in Figure 11D is different from the cleaning method shown in Figure 11C lies in that the cleaning target is the mop 36, and the shape of the mop 36 is different from the shape of the mop 16. For example, the shape of the mop 36 is closer to a semicircle than the mop 16. Therefore, the controller partitions the cleaning area of the mop 36 into arc-shaped rectangular zones for zone-based cleaning. According to some embodiments, the controller partitions the mop 36 into irregular zones Z31, Z32, Z33 and Z34 in order to clean the edge contour 36P of the mop 36, and each of the above-mentioned zones Z31 - Z34 has different sizes and shapes.

[0081] According to some embodiments, when the cleaning unit 100 is used to clean the irregular zones Z31 to Z34, the method 1200 determines to perform the cleaning task in a curved cleaning mode at step 1210. According to some embodiments, the method 1200 moves the cleaning unit 100 along the first direction (e.g., the X-axis) to thereby generate a displacement D_x . The perspective step may correspond to step 1222 in FIG. 12. At a later time or at the same time, the method 1200 causes the self-moving cleaning device 11 to move along the second direction (for example, the Y-axis) to thereby generate a displacement D_y , so that the roller brush 122 or its cleaning member 126 generates a displacement D_s in the third direction by moving relative to the current cleaning zones Z31 to Z34 of the mop 36. The perspective step may correspond to step 1224 in FIG. 12. For example, the irregular zone Z31 includes the irregular edge contour 36P of the mop 36, and exhibits an substantially arc-shaped contour. For the cleaning task of the irregular zone Z31, when the cleaning unit 100 enters the left half of zone Z31, the controller causes the self-moving cleaning device 11 to generate a downward displacement D_y along the second direction (such as the Y-axis), and at the same time causes the cleaning unit 100 to generate a rightward displacement D_x along the first direction (such as the X-axis). Eventually, the generated relative movement is equivalent to an upper-right displacement D_s , which corresponds to, is close to or coincides with the edge contour 36P in the left half of the mop 36. When the cleaning unit 100 enters the right half of zone Z31, the controller causes the self-moving cleaning device 11 to generate an upward displacement D_y along the second direction (such as the Y-axis), and at the same time causes the cleaning unit 100 to generate a rightward

displacement D_x along the first direction (such as the X-axis). Eventually, the generated relative movement is equivalent to a lower-right displacement D_s , which corresponds to, is close to or coincides with the edge contour 36P of the right half of the mop 36. According to some embodiments, the cleaning trajectory 36T of the relative displacement D_s in the irregular cleaning zone Z31 is consistent or similar to the edge contour 36P of the mop 36.

[0082] According to some embodiments, one or more intermediate points 36V are set for each irregular zone Z31 to Z34 according to the cleaning trajectory 36T. The controller can form a cleaning trajectory 36T by connecting multiple cleaning segments 36S according to multiple intermediate points 36V, and causes the cleaning unit 100 to perform cleaning tasks along the cleaning trajectory 36T. Specifically, although the shapes and contours of the irregular zones Z31 to Z34 are not formed of pure rectangles or are formed by pure irregular shapes, thereby the corresponding cleaning trajectory 36T may include linear lines and non-linear lines, the cleaning unit 100 can still simulate the shapes of the actual irregular zones Z31 to Z34 in a computationally-efficient manner through a piecewise linear trajectory or a curved trajectory, which is achieved by forming multiple segmented cleaning segments 36S and connecting them via multiple intermediate points 36V. According to some embodiments, when the cleaning task for a certain cleaning segment 36S is in progress or completed, the relevant parameters of a next cleaning segment 36S can be determined. The predetermined length of the next cleaning segment 36S can be any length, the predetermined direction can be any direction, and the predetermined moving time can be any time, all of which are determined at the intermediate point 36V serving as the end point of the currently cleaning segment 36S which is completed. For example, a certain relative displacement D_s shown in FIG. 11D is determined at the time of the intermediate point 36V, which is the end point of a previous cleaning segment 36S with respect to the displacement D_s . According to some embodiments, the control signals of the cleaning unit 100 and the self-moving cleaning device 11 for each of a certain cleaning segment 36S are determined during a time period (for example, a time point at the beginning of, a time point during, or a time point after the completion of the cleaning task of the previous cleaning segment 36S) of the cleaning task for a previous cleaning segment 36S before the certain cleaning segment 36S. According to some embodiments, the relative displacement D_s enables the shape of the cleaning trajectory 36T to correspond to or coincide with the edge contour 36P of the mop 36. According to some embodiments, in order to reduce the alignment error between the washing device 10 and the self-moving cleaning device 11, both of them can execute an adjustment procedure, such as timing synchronization or location adjustment of the cleaning unit 100 and the self-moving cleaning device 11 when the cleaning trajectory 36T arrives at any one of interme-

diate points 36V. According to some embodiments, when the number of the intermediate points 36V is increased, the simulation performance of the optimal cleaning trajectory 36T for the irregular zones Z31 to Z34 would be more accurate, and the consumed computational resources would also grow.

[0083] According to some embodiments, as mentioned above, before the cleaning unit 100 performs the cleaning task of each next cleaning segment 36S, the controller needs to perform calculations to determine the relevant parameter information on the relative displacement Ds of the cleaning unit 100 relative to the mop 36. Moreover, according to the relative displacement Ds, the relevant parameter information on the displacement Dy of the self-moving cleaning device 11 in the Y-axis direction and the relevant parameter information on the displacement Dx of the cleaning unit 100 in the X-axis direction are further determined. In order to simplify the calculation and reduce the transmission load, the controller can send a control signal to the cleaning unit 100 and/or the self-moving cleaning device 11 for the relative displacement Ds of the next cleaning segment 36S when the cleaning trajectory 36T of the cleaning unit 100 arrives at each of the intermediate points 36V.

[0084] According to some embodiments, the controller is used for the cleaning unit 100 and/or the control signal sent to the self-moving cleaning device 11 may include one or more sets of data formed of various parameters, which include at least one of parameters such as respective displacements Dx and Dy, or at least one of parameters such as the respective moving times, moving speeds, and moving directions. Parameters such as displacement Dx and Dy, moving time, moving speed, and moving direction can be used to determine the magnitude of the relative displacement Ds and the trajectory direction. According to some embodiments, the controller transmits a control signal for the cleaning task of the cleaning segment 36S starting at each intermediate point 36V. When multiple sets of data in the control signal are transmitted, the time interval between the two sets of data is a fixed period. When the controller of washing device 10 and the self-moving cleaning device 11 executes the multiple sets of data in sequence, it can represent the current cleaning segment 36S starting at the corresponding intermediate point 36V in the cleaning task of the cleaning unit 100 and/or self-moving cleaning device 11 during cleaning. Therefore, under this presumption, it is not required to additionally transmit control signals or parameters of the cleaning time (moving time) for all cleaning segments 36S.

[0085] According to some embodiments, the aforementioned controller may be an embedded controller of the washing device 10, or an embedded controller of the self-moving cleaning device 11. In an embodiment, an embedded controller of the self-moving cleaning device 11 is used. The controller of the self-moving cleaning device 11 calculates the control signal, and transmits the control signal necessary for the cleaning unit 100 to the

washing device 10. According to some embodiments, the control signal includes multiple sets of data, and each set of data records various parameters such as the moving direction and the moving speed. The controllers of the self-moving cleaning device 11 and the washing device 10 execute multiple sets of data in the respective control signals sequentially, so as to continuously control or change the moving direction and the moving speed of the self-moving cleaning device 11 and the washing device 10 on a time basis.

[0086] As mentioned above, the controller, the cleaning unit 100 and the self-moving cleaning device 11 only need to transmit and receive control signals for a predetermined intermediate point 36V. Nevertheless, the controller, the cleaning unit 100 and the self-moving cleaning device 11 do not need to transmit and receive control signals when the cleaning task in each cleaning segment 36S does not reach the next intermediate point 36V. In this way, the transmission load of the control signals can be further reduced.

[0087] According to some embodiments, since the transmission load of the control signal is reduced, the information exchange between the cleaning unit 100 and the self-moving cleaning device 11 can use the control signals generated by the infrared modules 52 and 54 to transmit the control signals. As mentioned above, the infrared modules 52, 54, 62, 64, and 66 respectively provide communication channels between the cleaning unit 100 and the self-moving cleaning device 11, and can be used for alignment operations of the cleaning unit 100 and the self-moving cleaning device 11. According to some embodiments, the infrared modules 52, 54, 62, 64, and 66 can also be used to transmit other control signals, such as the displacements Dx and Dy of the cleaning unit 100 and the self-moving cleaning device 11 during performing the cleaning task, or their respective moving times, moving directions, and moving speeds. According to some embodiments, transmission and reception of the control signal for the cleaning unit 100 and the self-moving cleaning device 11 are performed by respective infrared modules 52, 54, 62, 64, 66.

[0088] In addition, the controller can determine the position of the next intermediate point 36V or the relative displacement Ds of the next cleaning segment 36S in real time according to the received sensing information at each intermediate point 36V, such as the degree of contamination of the sewage. In this way, the cleaning trajectory 36T can be optimized for the cleaning task of the mop 36 with the same shape and profile but with different dirt distribution conditions, so as to improve the cleaning efficiency of the cleaning unit 100.

[0089] The above description shows that the cleaning unit 100 can clean the irregular zones Z31 to Z34 through cooperation with the self-moving cleaning device 11, so that the roller brush 122 can generate a relative displacement Ds in any direction relative to the mop 36. The advantage is that an adaptive cleaning is performed according to the edge contour 36P of the mop 36 to achieve

better cleaning performance and save cleaning time. In addition, the cleaning task is performed through the cleaning zone partition method shown in FIG. 11D along with the curved cleaning mode. When the cleaning liquid is sprayed upward or the cleaning member 126 is rotated, the tank body 108 of the cleaning tank 102 can effectively block the cleaning liquid or sewage which is sprayed or thrown out, so that the cleaning liquid can be leveraged more efficiently.

[0090] FIGS. 13A, 13B, 13C and 13D are schematic diagrams showing different stages of a cleaning method, according to some embodiments of the present invention. FIG. 14 shows a flowchart of a cleaning method 1400 corresponding to FIGS. 13A, 13B, 13C, and 13D, according to some embodiments of the present invention. In some embodiments, in the cleaning method 1400 shown in FIG. 14, some steps may be omitted, and other steps may be added before or after any step of the method 1400. In some embodiments, in the cleaning method 1400 shown in FIG. 14, different steps may be performed in a different order or at the same time.

[0091] FIGS. 13A, 13B, 13C and 13D also show a self-moving cleaning device 60 and the roller brush 122 to represent the washing device 10. The bottom of the self-moving cleaning device 60 is similar to the bottom of the self-moving cleaning device 11, so these similar features will not be repeated. As mentioned above, the mop 16 may have an irregular shape due to design constraints. According to some embodiments, referring to FIG. 13A, in order to maximize the area of the mop 16, two or more mops, such as mops 16 and 76, are arranged on the bottom of the self-moving cleaning device 60, and the mops 16 and 76 are not connected to each other. According to some embodiments, the mop 16 is closer to the rear side of the self-moving cleaning device 60, and the mop 76 is closer to the front side of the self-moving cleaning device 60. According to some embodiments, the mops 16 and 76 are separated by other components, such as one or more of the suction port 7, the roller brush device 17, the mobile unit 18 and the spray device 19. According to some embodiments, the area or the shape of the mop 16 and the mop 76 are different, or both are different in area and shape.

[0092] The cleaning method shown in FIGS. 13A-13D is different from the cleaning method shown in FIGS. 11A-11D in that the controller can determine to partition the mops 16 and 76 into different stages to perform zone-based cleaning from the front side or the rear side of the self-moving cleaning device 60. Referring to FIG. 13A, one of the front side and the rear side of the self-moving cleaning device, for example, the rear side, is aligned with the washing device 10. The perspective step may correspond to step 1402 in FIG. 14. According to some embodiments, the controller aligns the rear side of the self-moving cleaning device 60 with the base 22 of the washing device 10, for example, it can move or turn in response to the guiding signal or alignment signal sent by the washing device 10, so as to align the self-moving

cleaning device 60 with the base 22 of the washing device 10. The rear side of the self-moving cleaning device 60 is aligned with the base 22 of the washing device 10. Next, the self-moving cleaning device 60 is moved to a location above the washing device 10 and the cleaning member 126 of the roller brush 122 is leveraged to clean the mop 16. The perspective step may correspond to step 1404 in FIG. 14. According to some embodiments, the steps of cleaning the mop 16 shown in FIG. 13A can be performed on the mop 16 using the linear cleaning mode or the curved cleaning mode of the cleaning method 1200 described with reference to FIGS. 11A-11D and FIG. 12.

[0093] Referring to FIG. 13B, when the cleaning task of the mop 16 is completed, the self-moving cleaning device 60 is caused to exit the washing device 10, and the respective step may correspond to step 1406 in FIG. 14.

[0094] Next, referring to FIG. 13C, the other side of the front side and the rear side, such as the front side, of the self-moving cleaning device 60 is aligned with the washing device 10. The respective step may correspond to step 1408 in FIG. 14. According to some embodiments, the steps of FIG. 13C includes turning the self-moving cleaning device 60 by 180 degrees to reverse the directions of its front side and rear side. According to some embodiments, the controller causes the front side of the self-moving cleaning device 60 to be aligned with the base 22 of the washing device 10, for example, it can move or turn in response to the guiding signal or alignment signal sent by the washing device 10, so as to align the self-moving cleaning device 60 of the front side of with the base 22 of the washing device 10.

[0095] Referring to FIG. 13D, the self-moving cleaning device 60 is moved to a location above the washing device 10 to clean the mop 76 with the cleaning member 126 of the roller brush 122, and the respective step may correspond to step 1410 in FIG. 14. The steps of cleaning the mop 76 shown in FIG. 13D can leverage the linear cleaning mode or the curved cleaning mode of the cleaning method 1200 described with reference to FIGS. 11A-11D and FIG. 12. According to some embodiments, after the cleaning task for the mop 76 is completed, the controller causes the self-moving cleaning device 60 to exit the washing device 10, in which the respective step may correspond to step 1412 in FIG. 14. According to some embodiments, the first side of the self-moving cleaning device 60 may be the front side of the self-moving cleaning device 60, and the second side of the self-moving cleaning device 60 may be the rear side, and the cleaning task is performed by following the cleaning method 1400 shown in FIG. 14.

[0096] The cleaning method 1400 shown in FIGS. 13A-13D or FIG. 14 may provide advantages. As the function of the self-moving cleaning device 11 or 60 becomes more and more complex, the shapes and positions of the mops may be different for different purposes or different generations of the self-moving cleaning device 11 or 60.

However, when the mop design of the user's self-moving cleaning device evolves from the single-piece mop 16 shown in FIGS. 11A-11D to the double-piece mops 16 and 76 shown in FIGS. 13A-13D, the existing mop cleaning unit is incapable of coping with the cleaning demand of the double-piece mop. On the other hand, even if the mop washing device used by users can clean two mops 16 and 76 of the self-moving cleaning device from the same side, its base must have a greater depth to accommodate the entire self-moving cleaning device 60, so that it is possible to clean the different mops 16 and 76 from a same side of the front side or the rear side. However, in this way, the size of the overall mop washing device will inevitably increase greatly. It would be inconvenient for users because of the increased requirements in cost and placing space. On the contrary, the two-sided cleaning method used in the present invention can meet the requirements of the mop setting positions on different sides at the same time without increasing the size of the cleaning unit 100 or the cleaning member 126. Therefore, regarding the self-moving cleaning device 11 or 60 of different specifications, as long as any of its sides (front side or rear side) can be accommodated by the base 22, the same washing device 10 can be applied to the self-moving cleaning device 11 or 60 with the specifications of multiple different mop. The user's troubles of frequently replacing the mop washing device can be eliminated.

[0097] The foregoing outlines structures of several embodiments so that those skilled in the art may better understand the aspects of the present disclosure. Those skilled in the art should appreciate that they may readily use the present disclosure as a basis for designing or modifying other processes and structures for carrying out the same purposes and/or achieving the same advantages of the embodiments introduced herein. Those skilled in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the present disclosure, and that they may make various changes, substitutions, and alterations herein without departing from the spirit and scope of the present disclosure.

Claims

1. A method of operating a washing device, comprising:

moving a self-moving cleaning device toward the washing device and aligning a first side of the self-moving cleaning device with the washing device, wherein the self-moving cleaning device comprises a first mop; and
moving the first mop of the self-moving cleaning device to be over a cleaning unit of the washing device, and cleaning the first mop using a cleaning member of the cleaning unit, including:

during a first period, moving the cleaning

unit in a first direction to be under the first mop; and
during a second period, causing the self-moving cleaning device to move in a second direction different from the first direction.

2. The method according to claim 1, wherein

the first direction and the second direction are perpendicular to each other; and
the cleaning unit is configured to move in a third direction relative to the self-moving cleaning device, wherein the third direction is consistent with a first edge contour of the first mop.

3. The method according to claim 1, wherein a cleaning route, relative to the self-moving cleaning device, of the cleaning unit during the cleaning is formed of a plurality of connected cleaning segments, and a shape of the cleaning route corresponds to a first edge contour of the first mop.

4. The method according to claim 3, wherein control signals associated with a formation of a present one of the plurality of connected cleaning segments are transmitted to the cleaning unit and the self-moving cleaning device, during a period for proceeding with another previous one of the plurality of connected cleaning segments before the present one of the plurality of connected cleaning segments.

5. The method according to claim 4, wherein

the cleaning unit further comprises a water outlet configured to spray cleaning liquid in a direction facing the first mop,
the self-moving cleaning device comprises a first infrared module,
the washing device comprises a second infrared module,
the aligning of the first side of the self-moving cleaning device with the washing device is performed via the first infrared module and the second infrared module, and
the method further comprises using the first infrared module and the second infrared module to transmit the control signals of the cleaning unit and the self-moving cleaning device, wherein the control signals include information on at least one of a displacement, a moving direction, and a moving speed.

6. The method according to claim 1, wherein the first period does not overlap the second period so that when the cleaning unit is configured to move in the first direction, the self-moving cleaning device is kept still, or when the self-moving cleaning device is configured to move in the second direction, the cleaning

unit is kept still.

7. The method according to claim 1, wherein

the first period overlaps the second period with at least an overlapping portion of the first period; and
during the overlapping portion of the first period, when the cleaning unit is configured to move in the first direction, the self-moving cleaning device is configured to simultaneously move in the second direction.

8. The method according to claim 1, further comprising:

causing the self-moving cleaning device to exit from the washing device;
aligning a second side of the self-moving cleaning device with the washing device, wherein the self-moving cleaning device includes a second mop; and
moving the second mop of the self-moving cleaning device to be above the cleaning unit of the washing device, and cleaning the second mop by the cleaning member of the cleaning unit.

9. The method according to claim 8, wherein a length of the cleaning member measured in the second direction is less than a length of the first mop or the second mop measured in the second direction.

10. The method according to claim 8, wherein

the first side of the self-moving cleaning device is a rear side of the self-moving cleaning device and the second side of the self-moving cleaning device is a front side, or
the first side of the self-moving cleaning device is the front side of the self-moving cleaning device and the second side is the rear side of the self-moving cleaning device.

11. The method according to claim 1, wherein

the cleaning unit comprises a roller brush, and the roller brush includes the cleaning member; and
during the cleaning of the first mop with the cleaning member of the roller brush of the cleaning unit, the roller brush contacts the first mop and rotates.

12. The method according to claim 11, wherein the roller brush further comprises a brush shaft configured to support the cleaning member, and the cleaning member includes scraping strips or bristles extending outward along a surface of the cleaning member,

wherein the cleaning unit comprises a cleaning tank configured to accommodate the roller brush, and the cleaning tank has an opening disposed at a bottom thereof, the opening overlapping the cleaning member.

13. The method according to claim 11, wherein a rotational speed of the roller brush and a moving speed of the cleaning unit in the first direction are independent of each other.

14. The method according to claim 1, wherein the washing device comprises a toothed rack, and the cleaning unit comprises a driving assembly configured to move the cleaning unit along the first direction, wherein the cleaning unit further comprises a sliding block connected to the driving assembly, wherein when the cleaning unit is configured to move along the first direction, the sliding block presses against the toothed rack and slides along the first direction,

wherein the toothed rack comprises a sliding rail, and the sliding block is configured to engage the sliding rail to slide along the first direction, wherein the toothed rack is connected to one side of the cleaning unit, and the driving assembly is configured to drive the cleaning unit to move on the toothed rack via a single side of the cleaning unit, wherein the sliding block has a length substantially equal to that of the driving assembly measured in the first direction, wherein the cleaning unit forms an included angle with a bottom of a base of the washing device in the second direction.

15. A cleaning system, comprising a self-moving cleaning device and a washing device for cleaning the self-moving cleaning device, wherein the self-moving cleaning device includes a mop, and the washing device includes:

a clean water tank configured to store cleaning liquid;
a base arranged on one side of the clean water tank;
a cleaning unit, including:

a driving assembly adjacent to the base and configured to move on the base in a first direction;
a water outlet configured to spray the cleaning liquid in a direction away from the base; and
a cleaning member extending in a second direction and configured to clean the mop of the self-moving cleaning device; and

a sewage tank, configured to collect the cleaning liquid sprayed from the water outlet when the cleaning unit is configured to clean the mop, wherein the washing device and the self-moving cleaning device are configured to communicate with each other and perform the method according to any one of claims 1 to 14.

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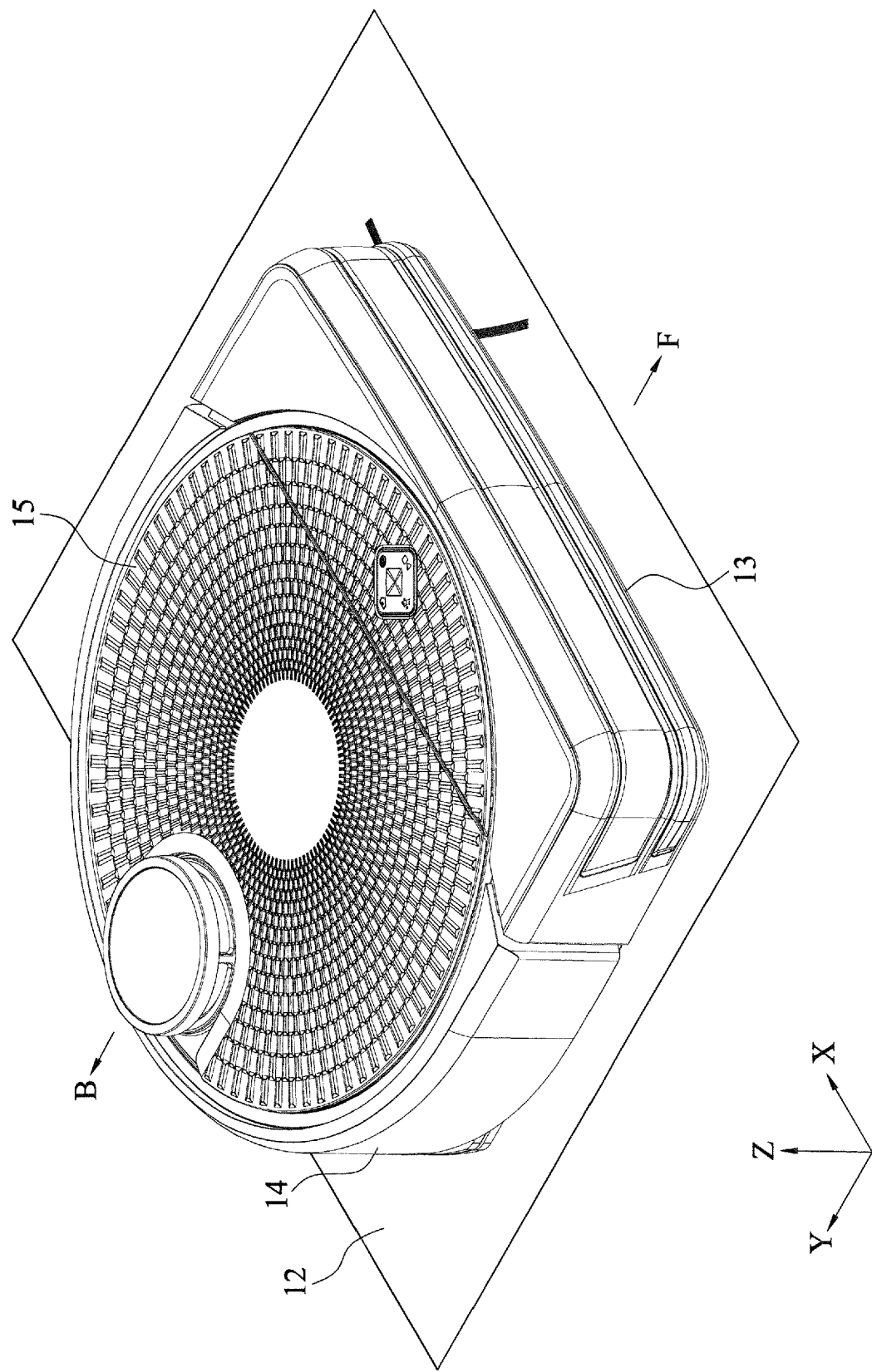


FIG. 1A

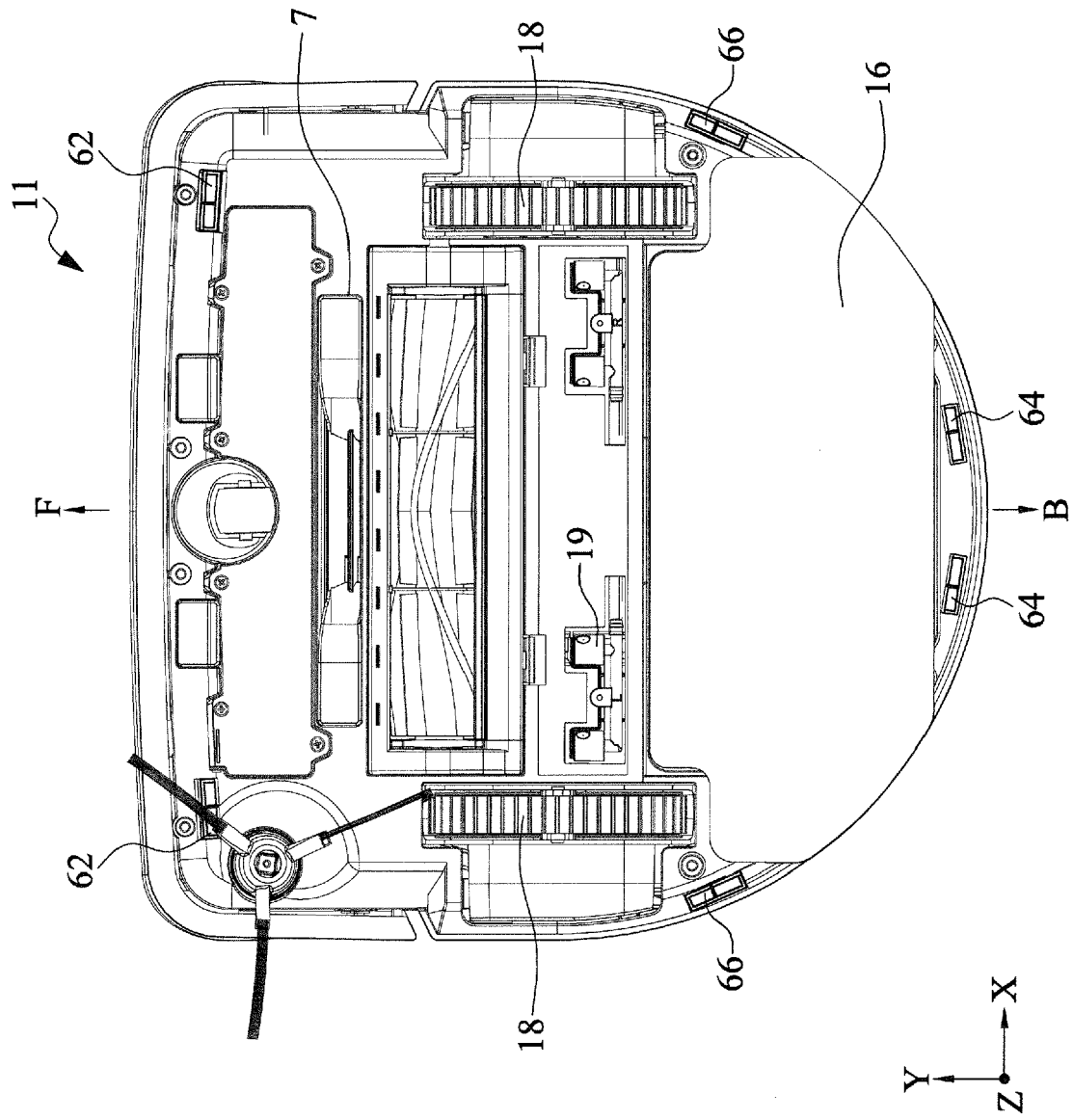


FIG. 1B

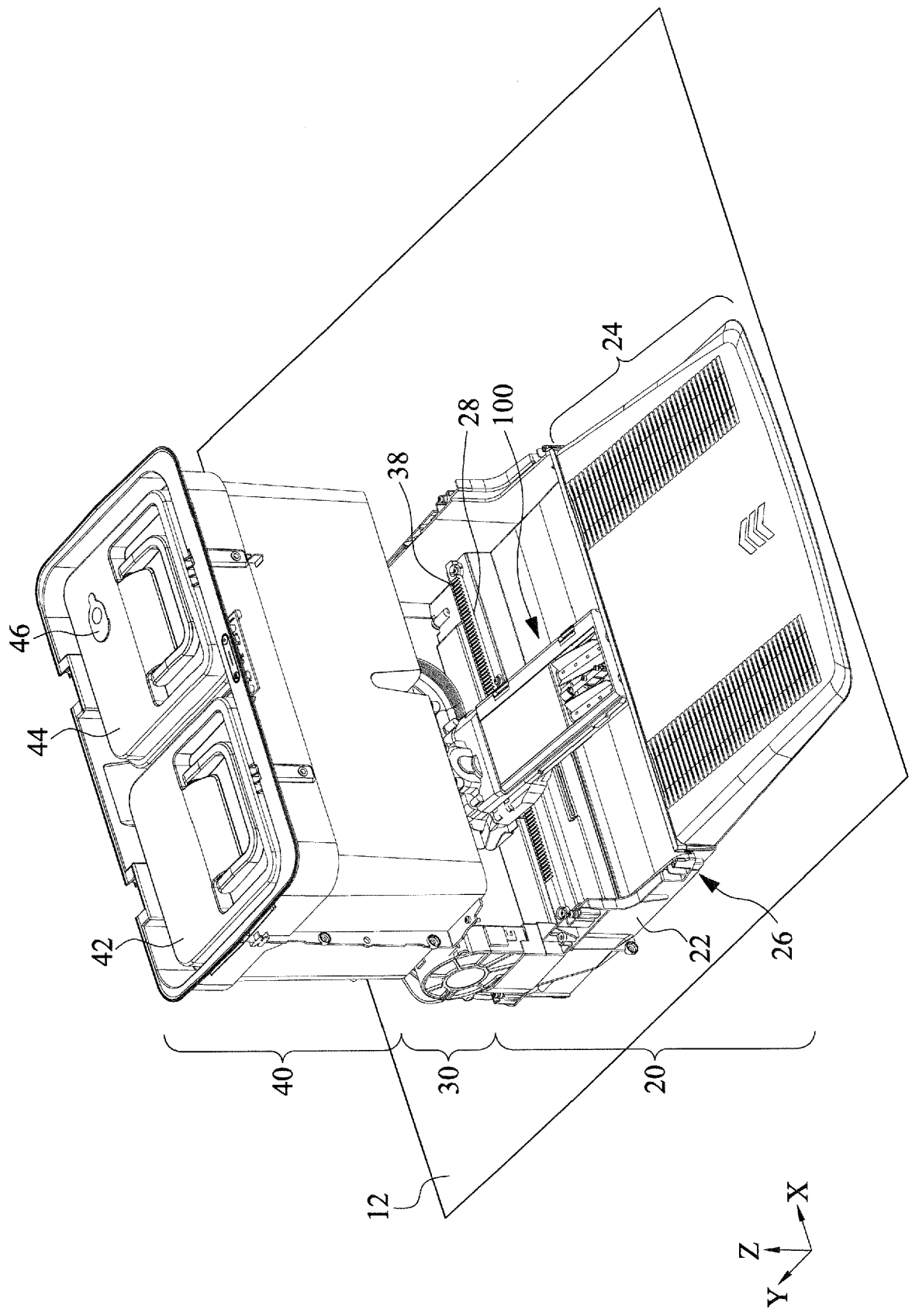


FIG. 2A

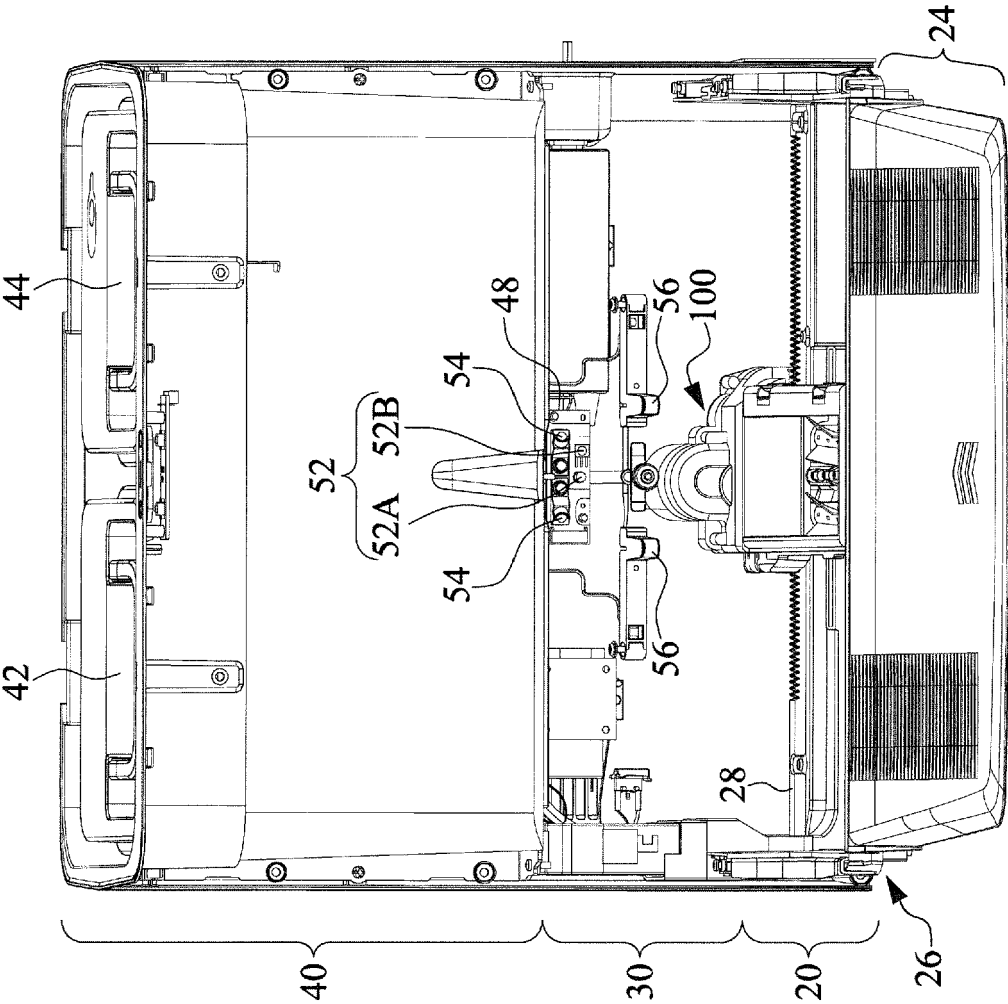


FIG. 2B

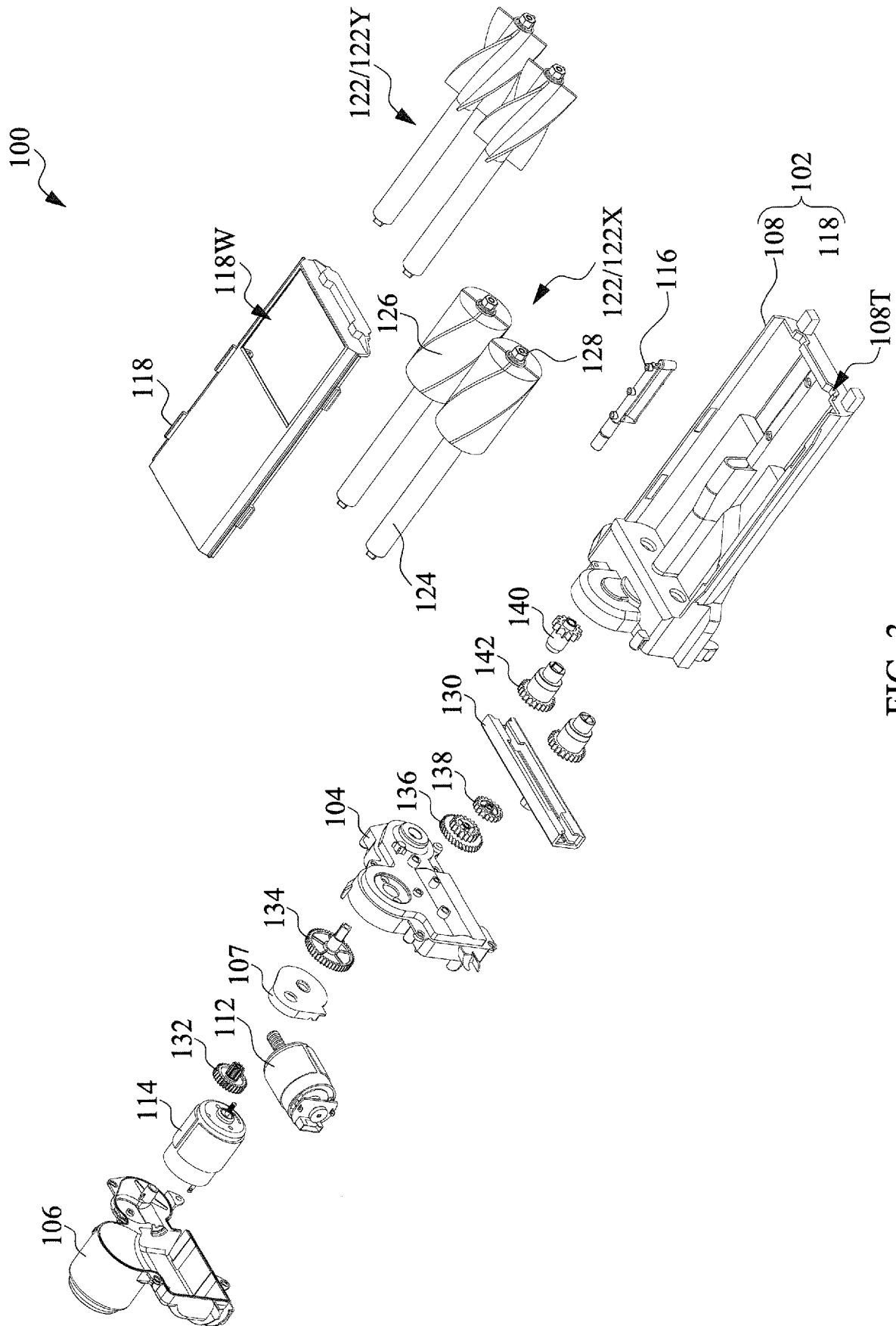


FIG. 3

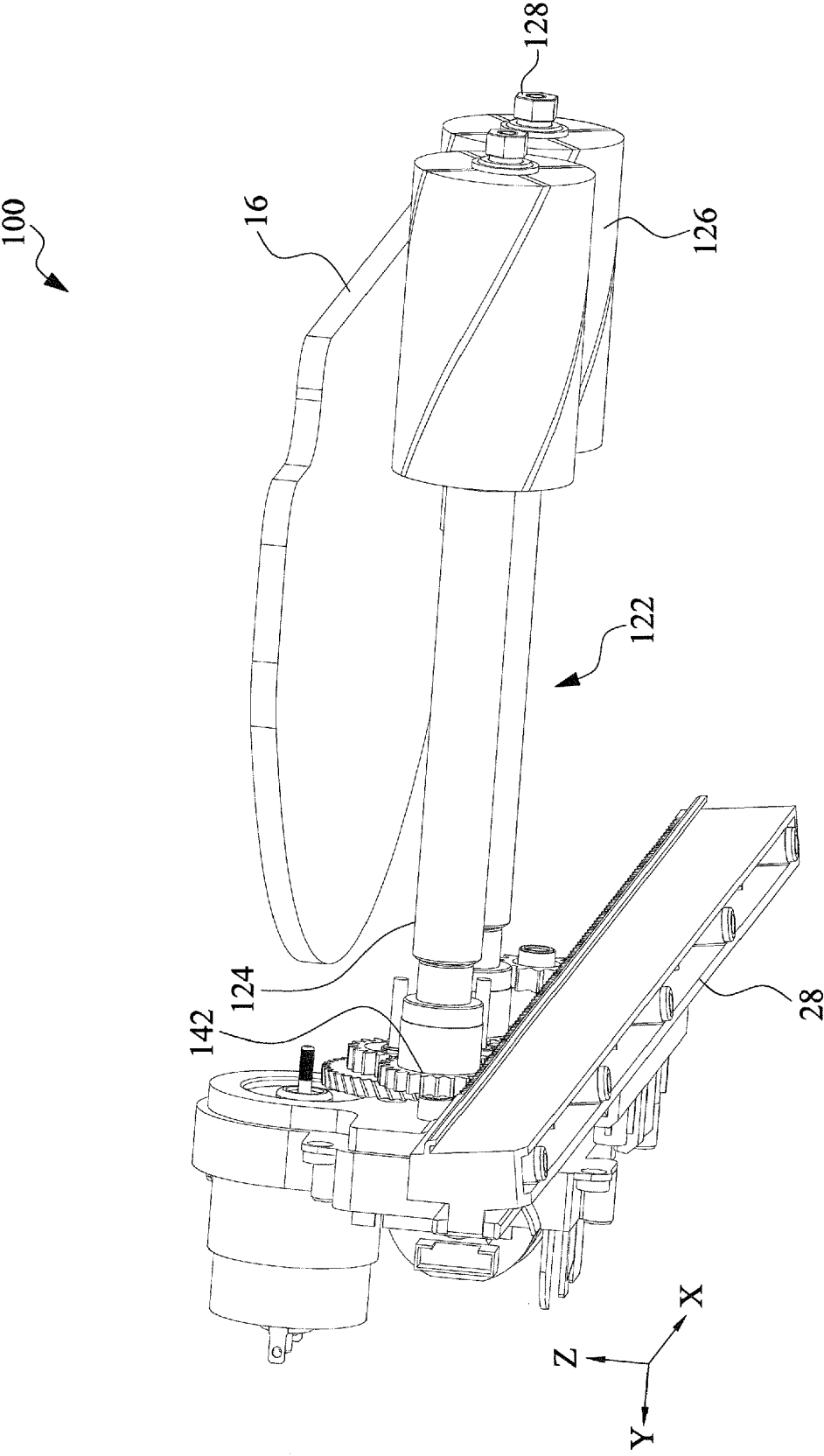


FIG. 4

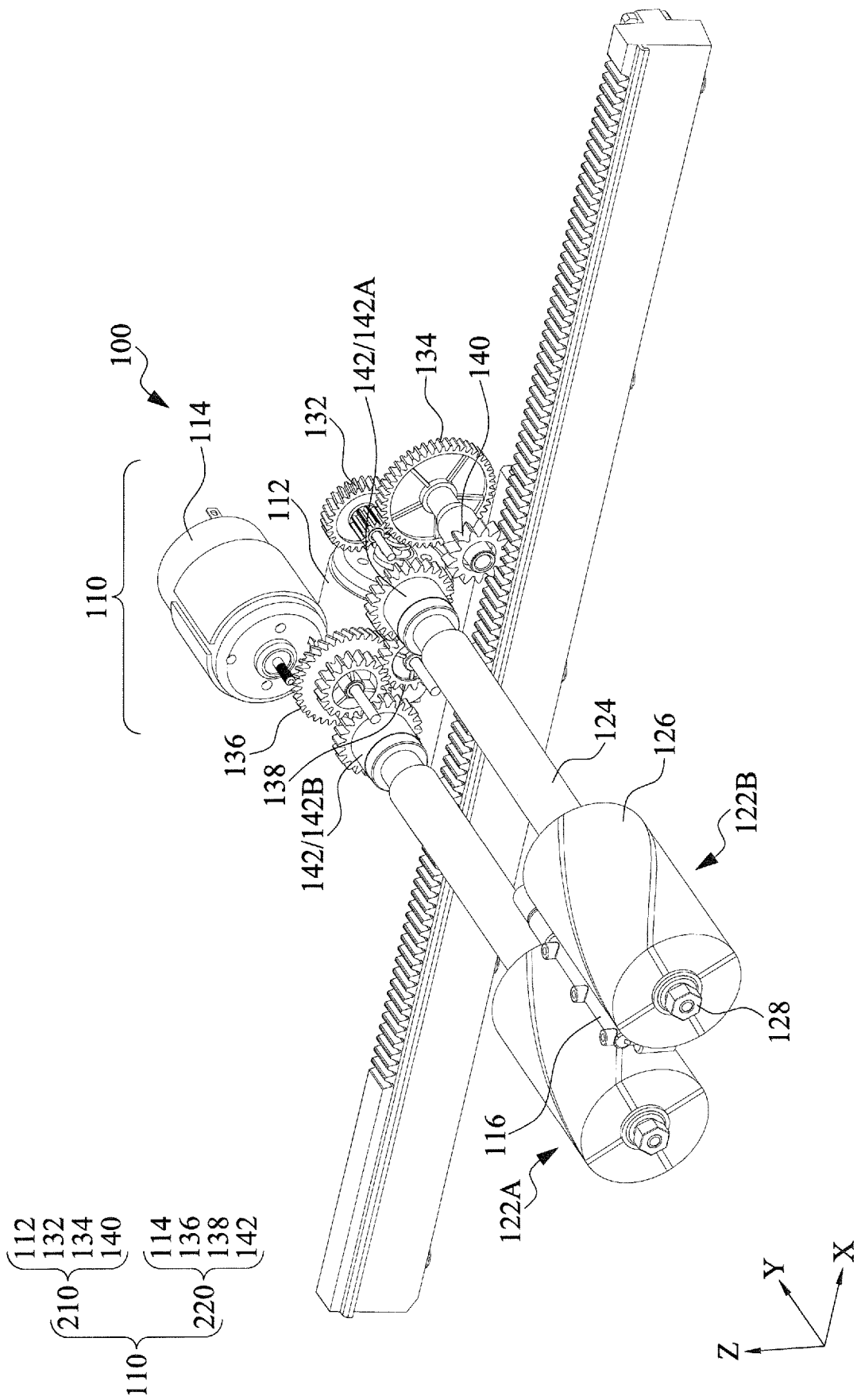


FIG. 5

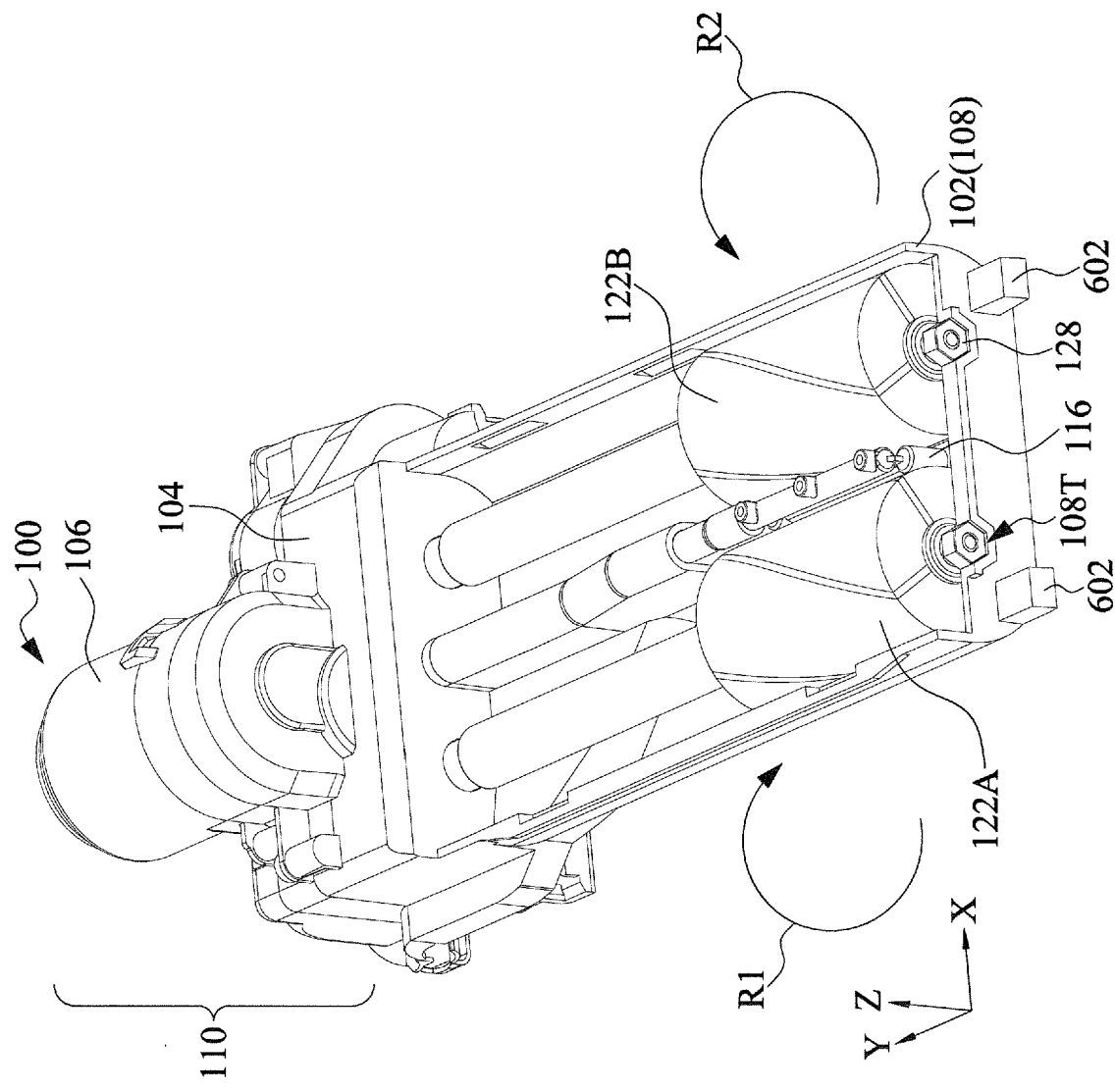


FIG. 6A

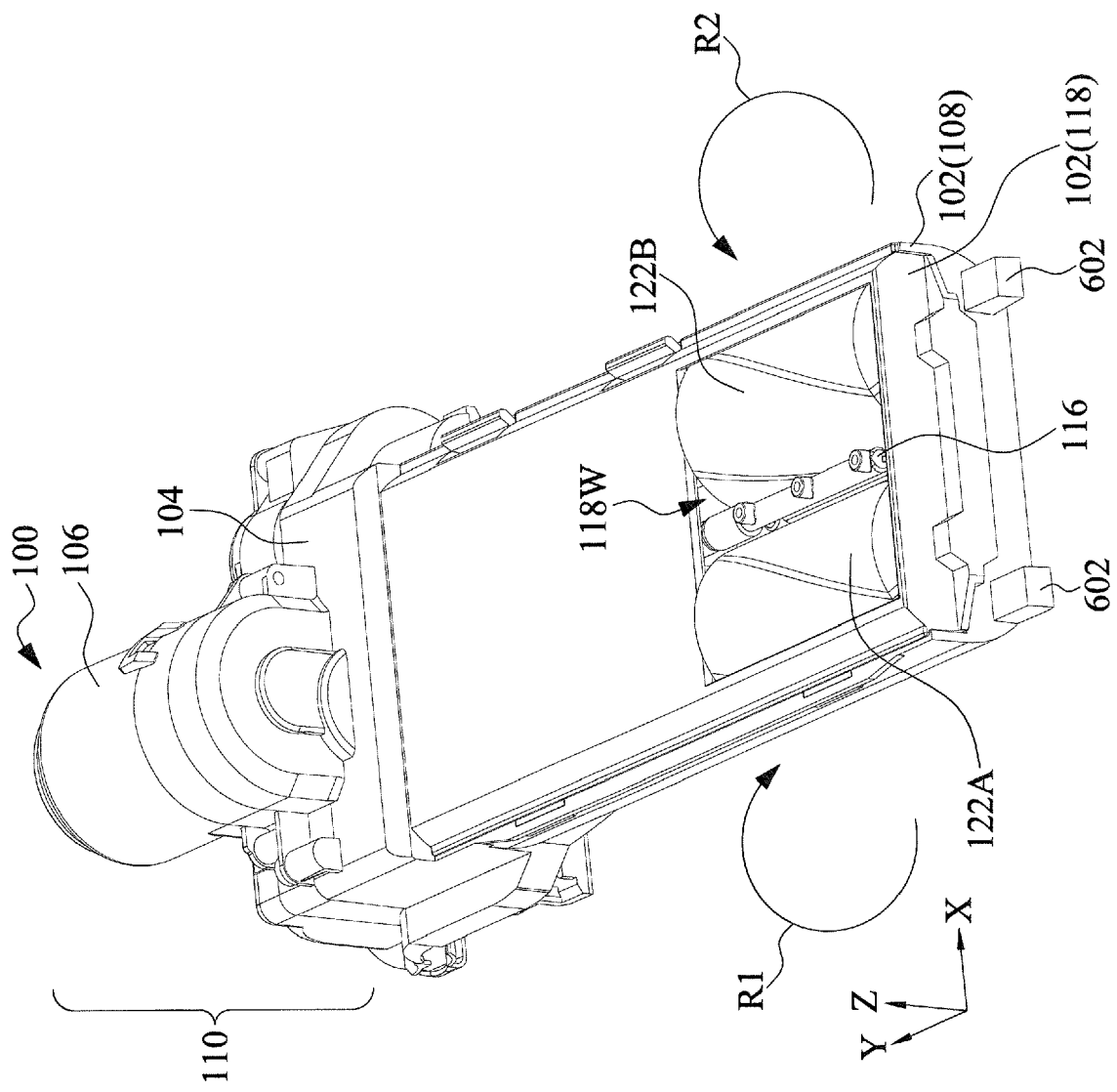


FIG. 6B

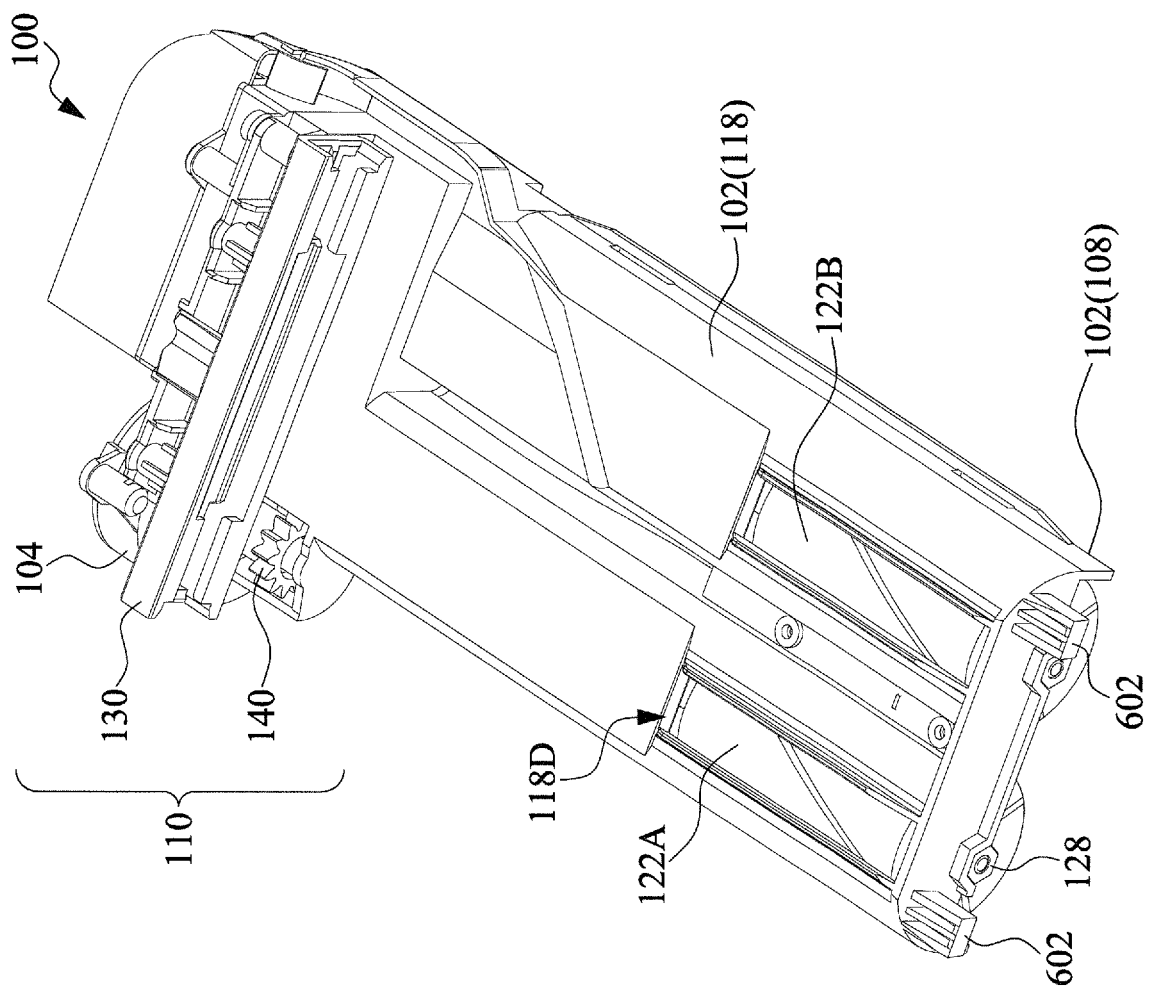


FIG. 6C

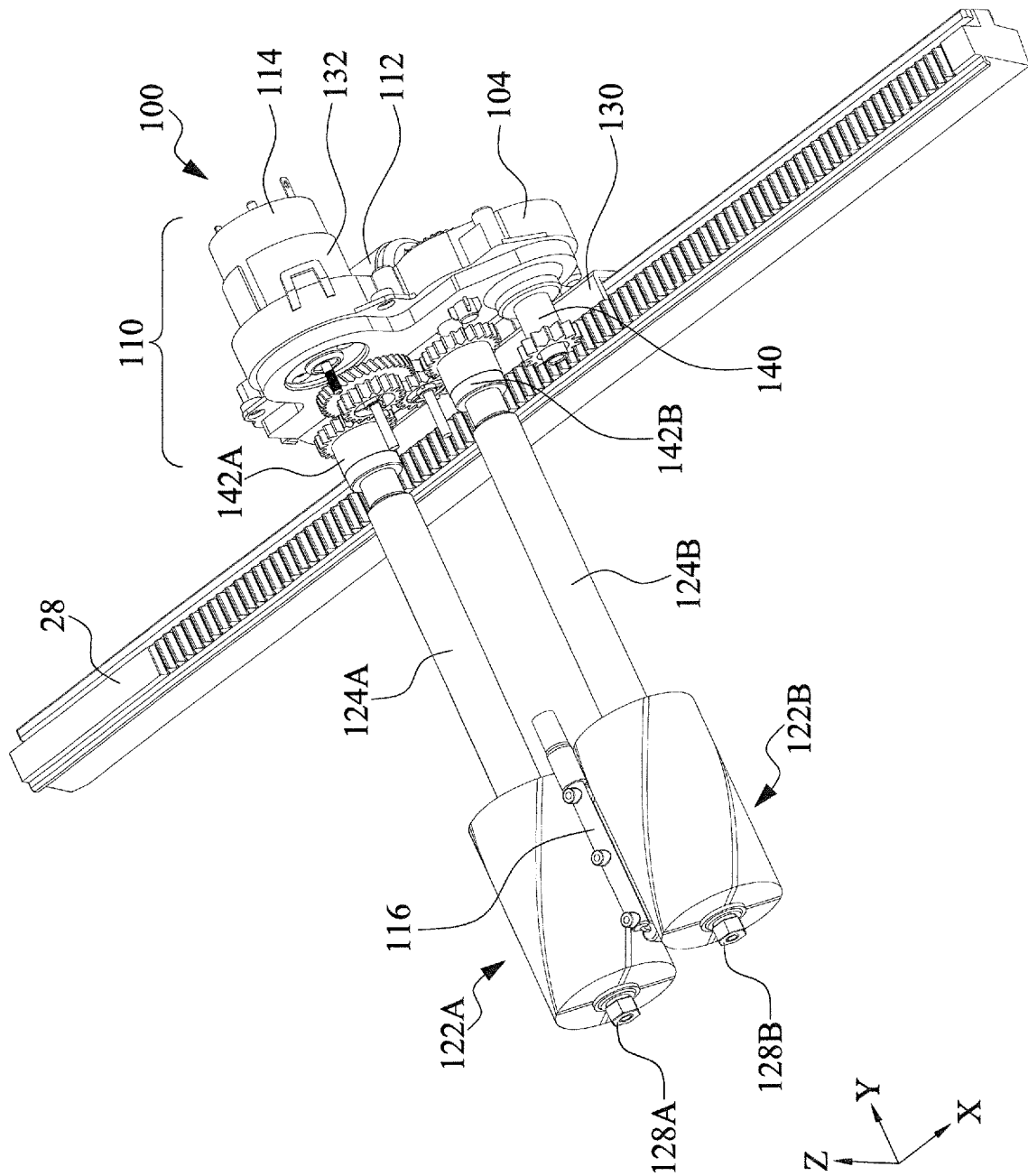


FIG. 7A

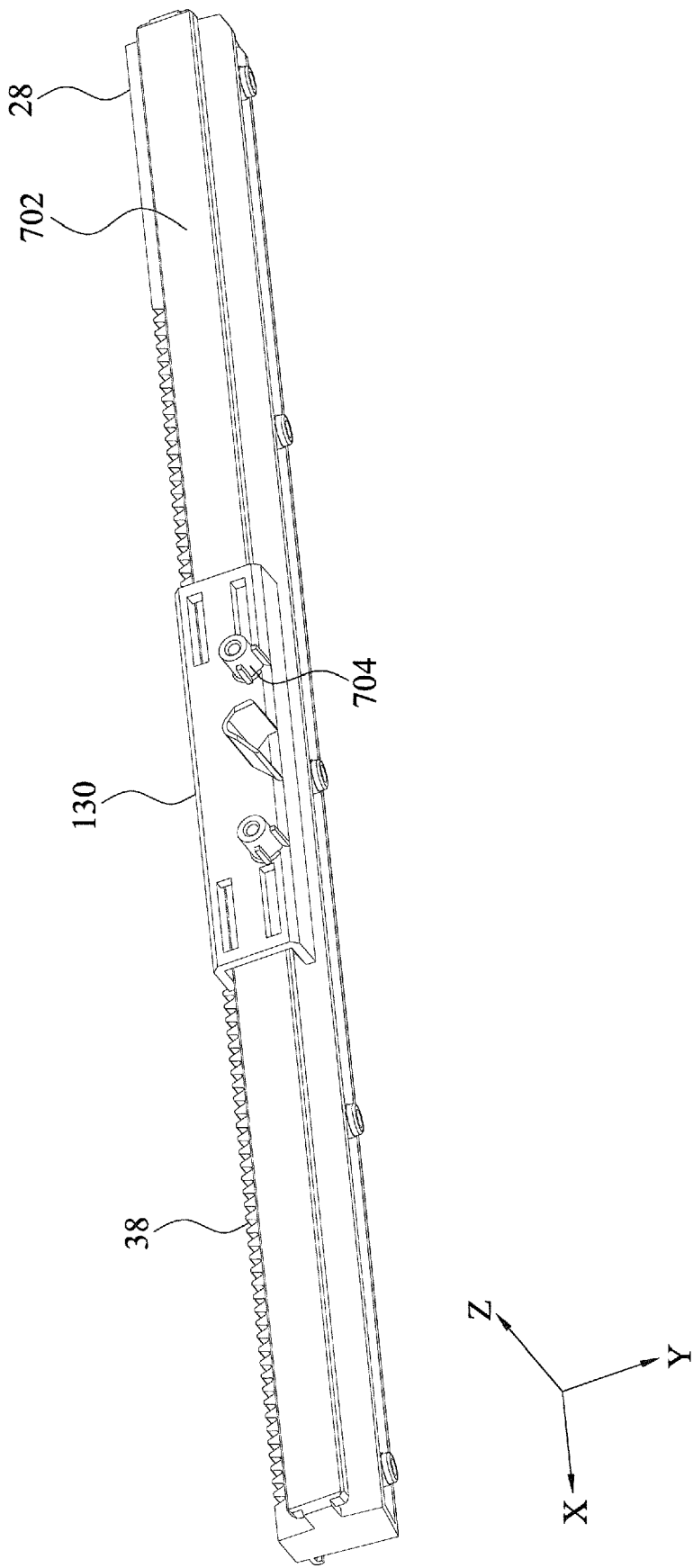


FIG. 7B

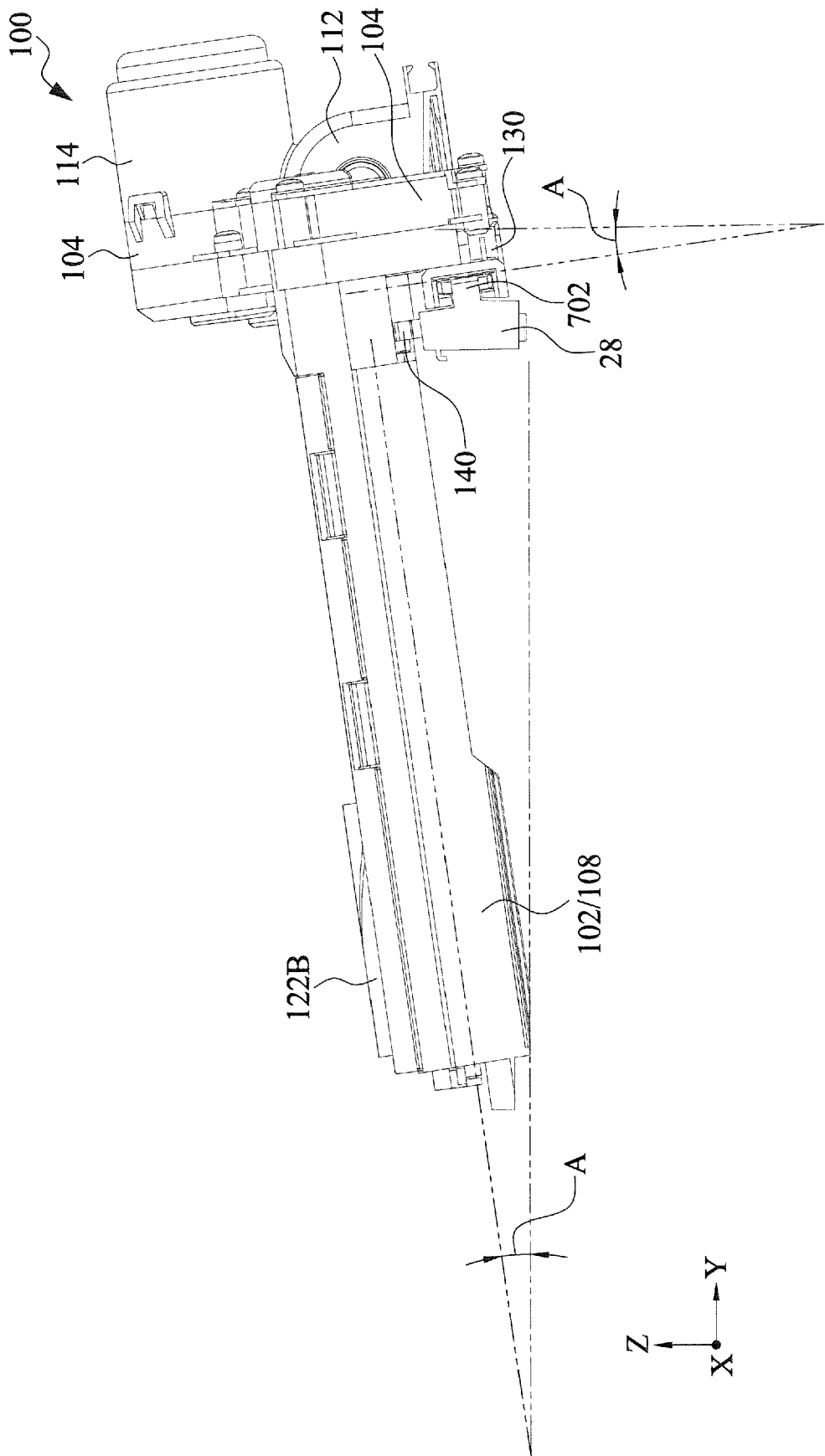


FIG. 7C

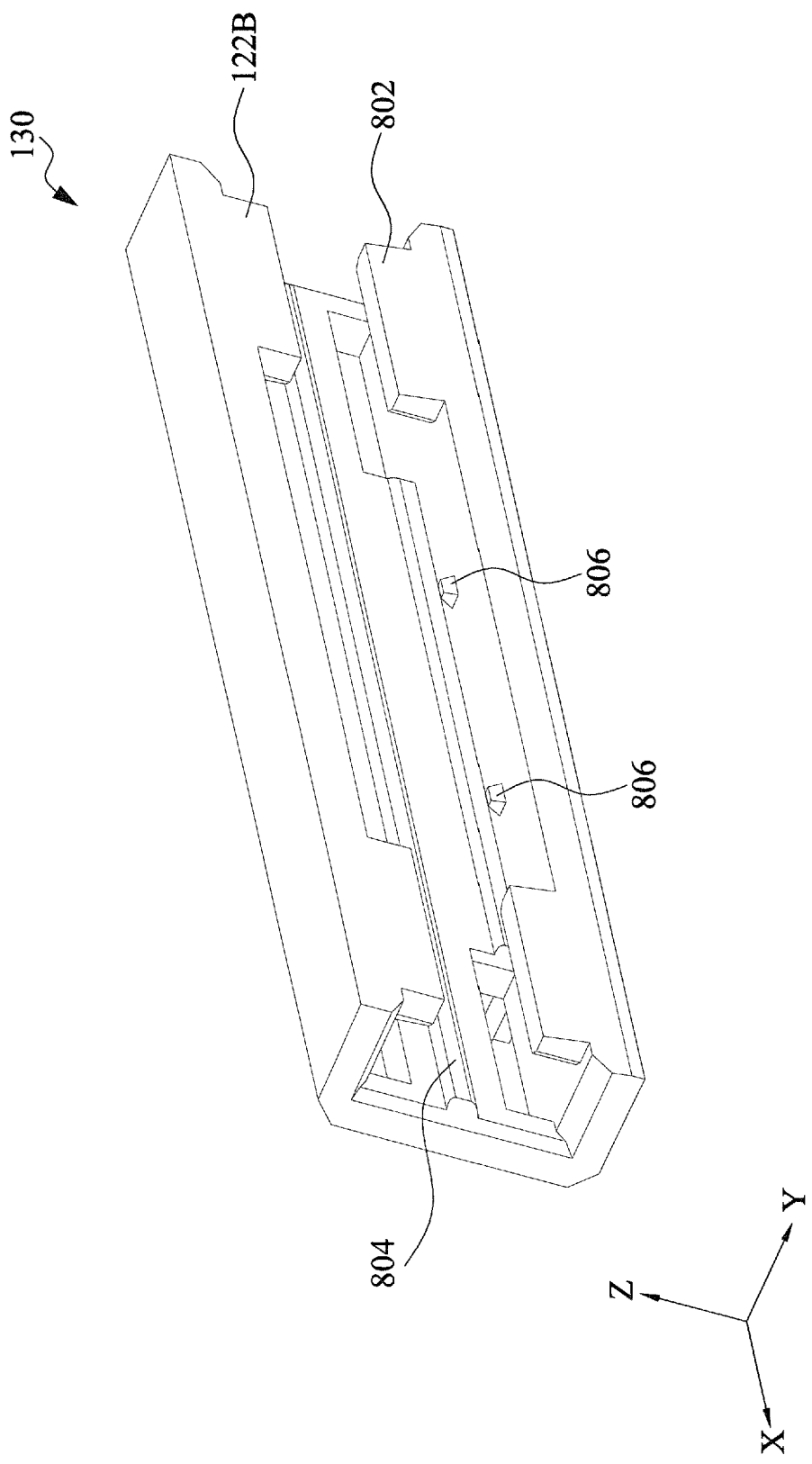


FIG. 8A

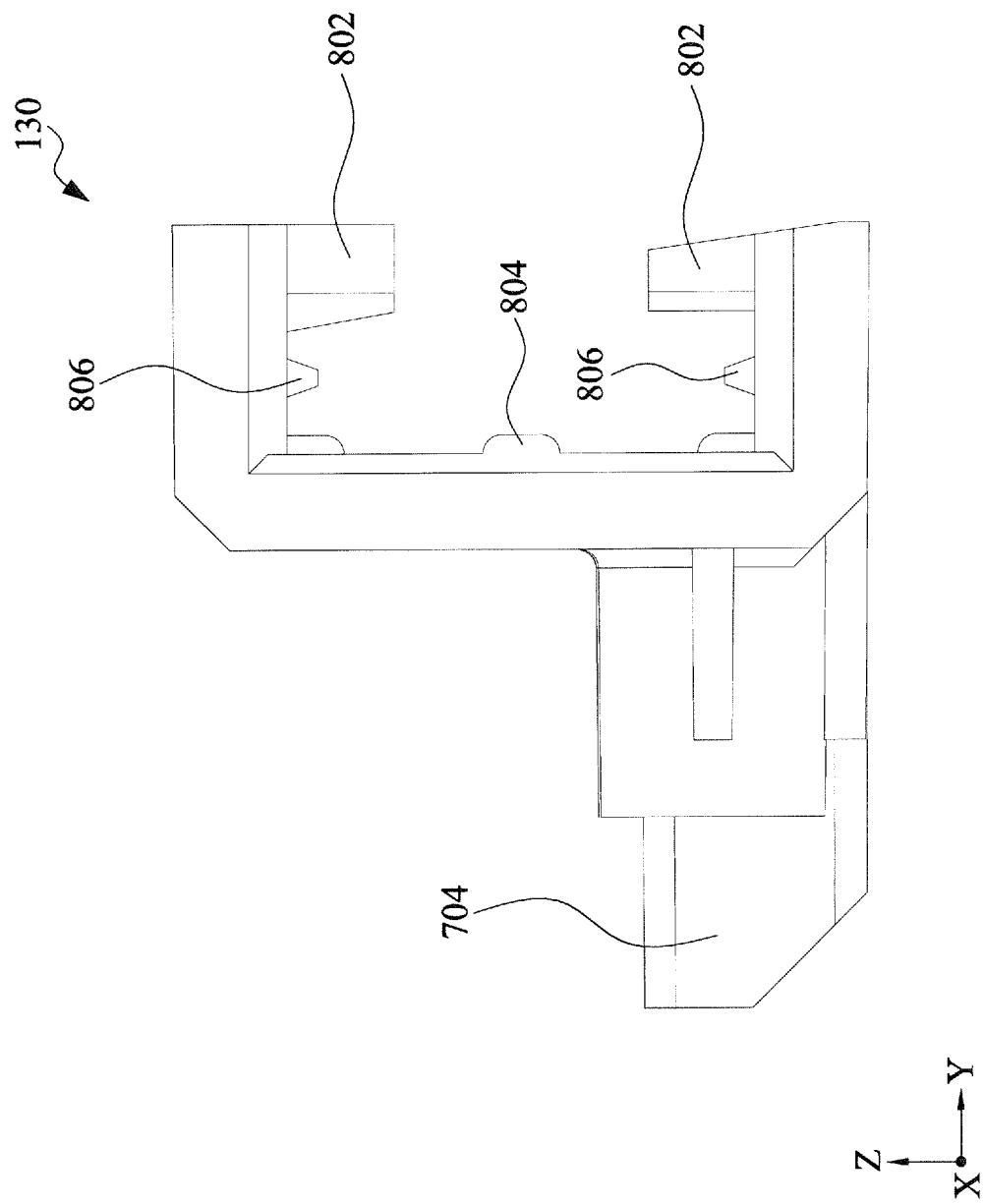


FIG. 8B

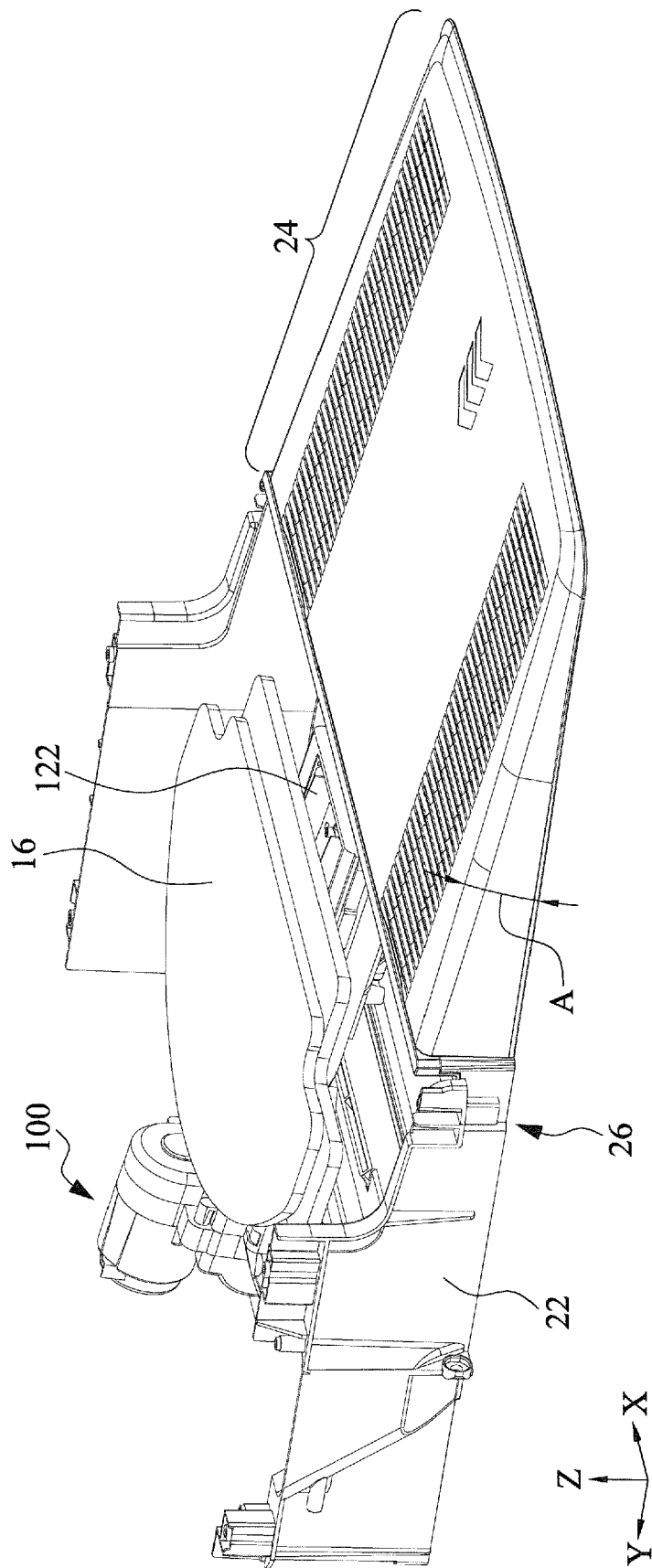


FIG. 9

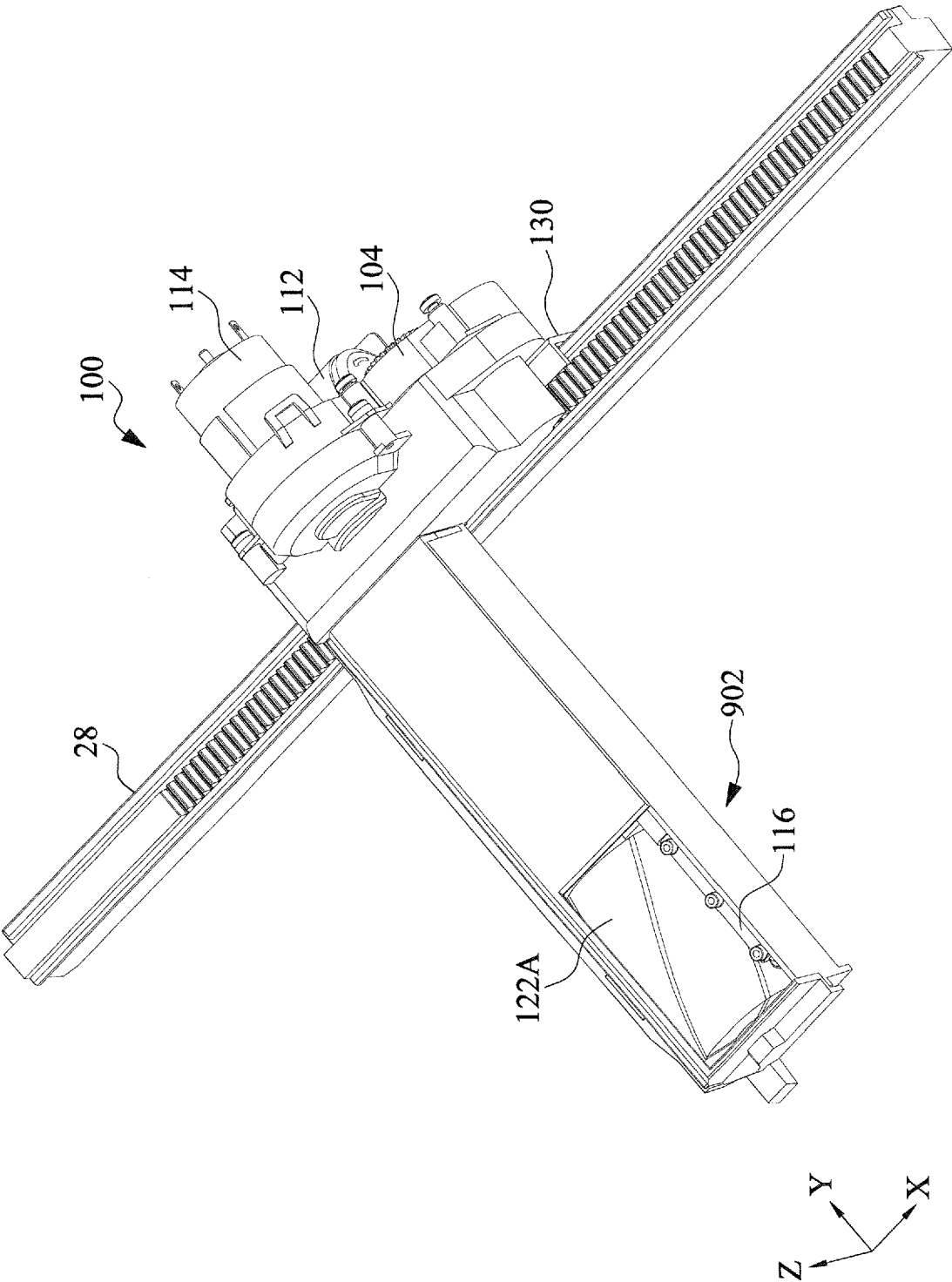


FIG. 10

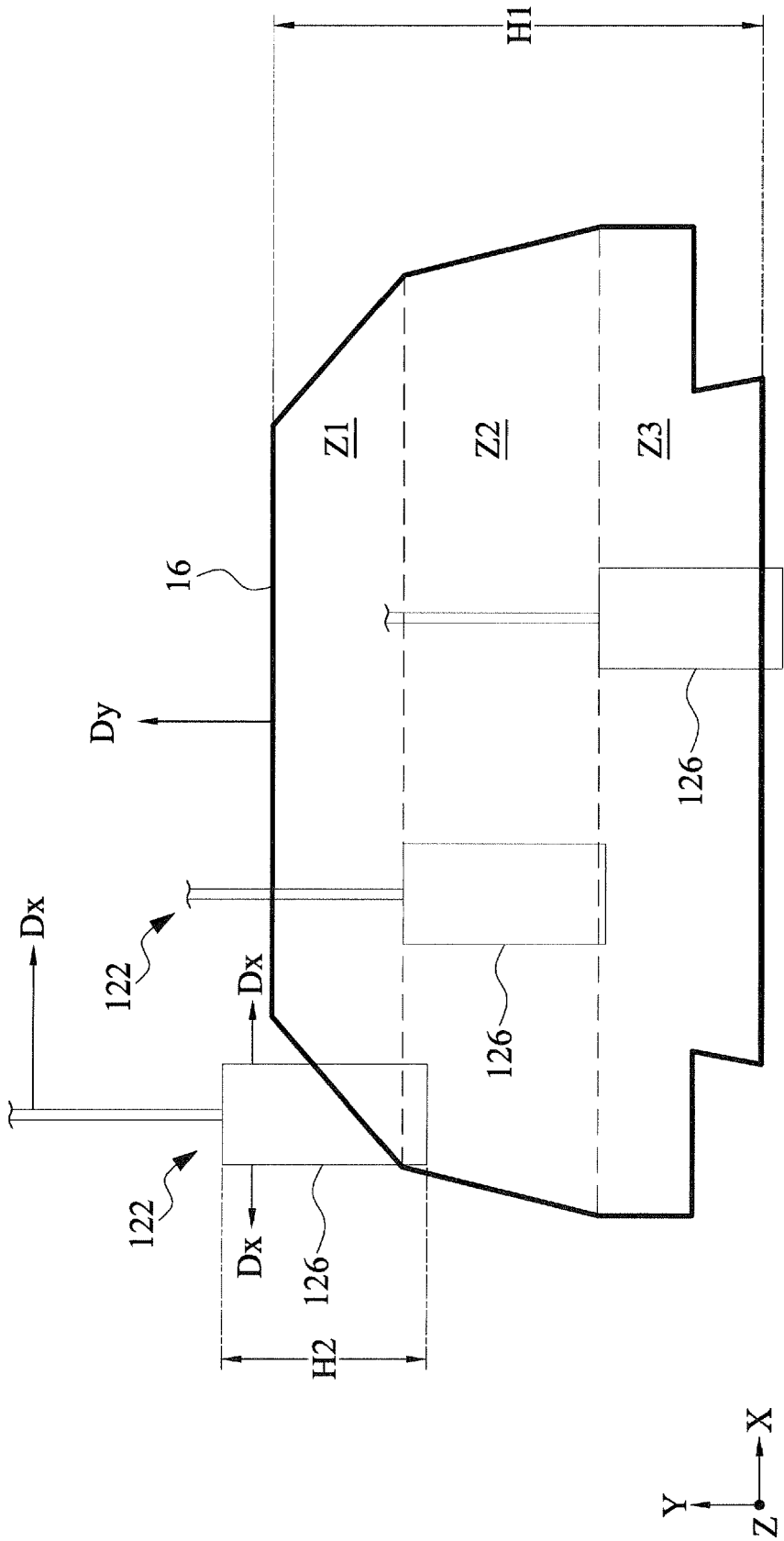
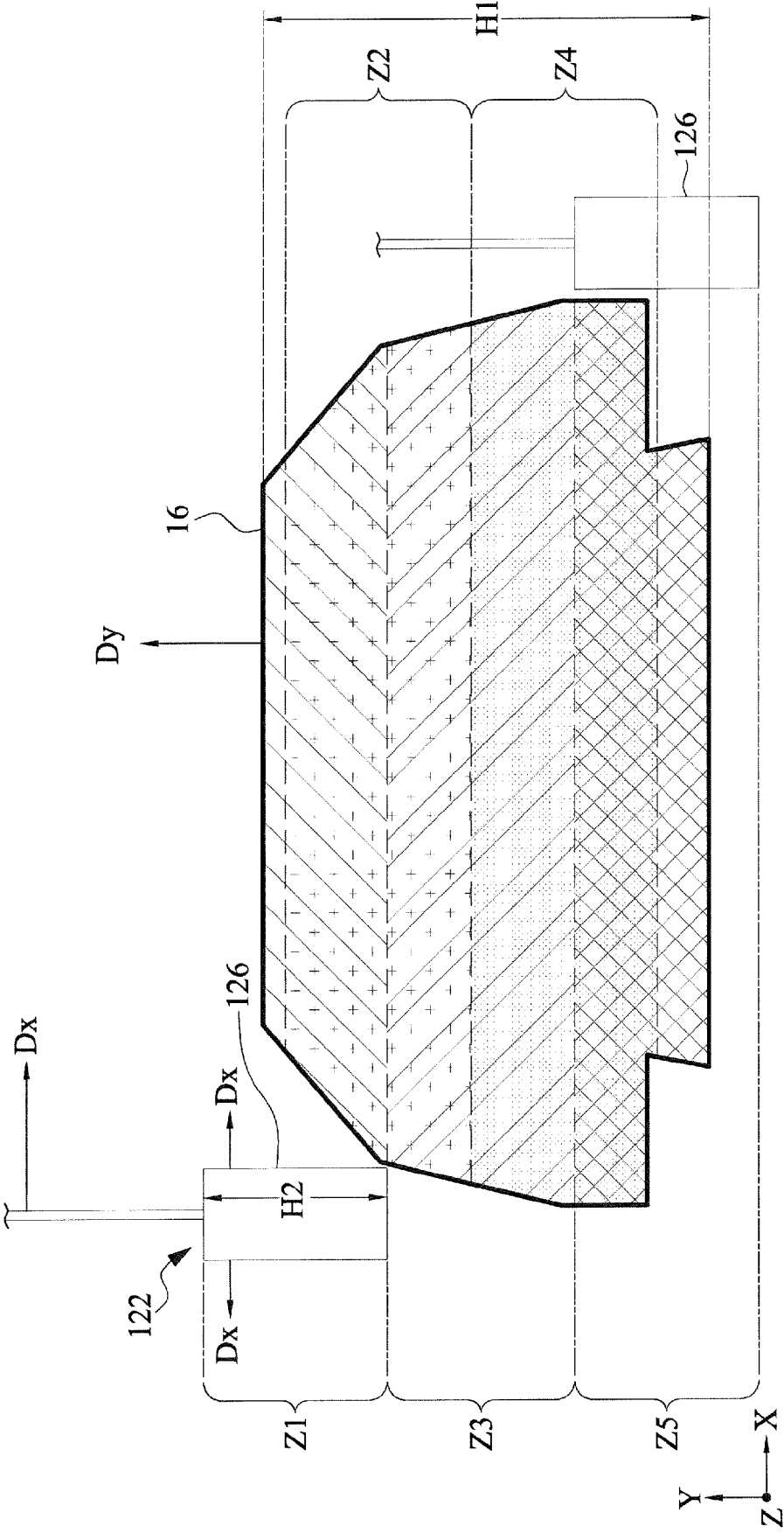


FIG. 11A



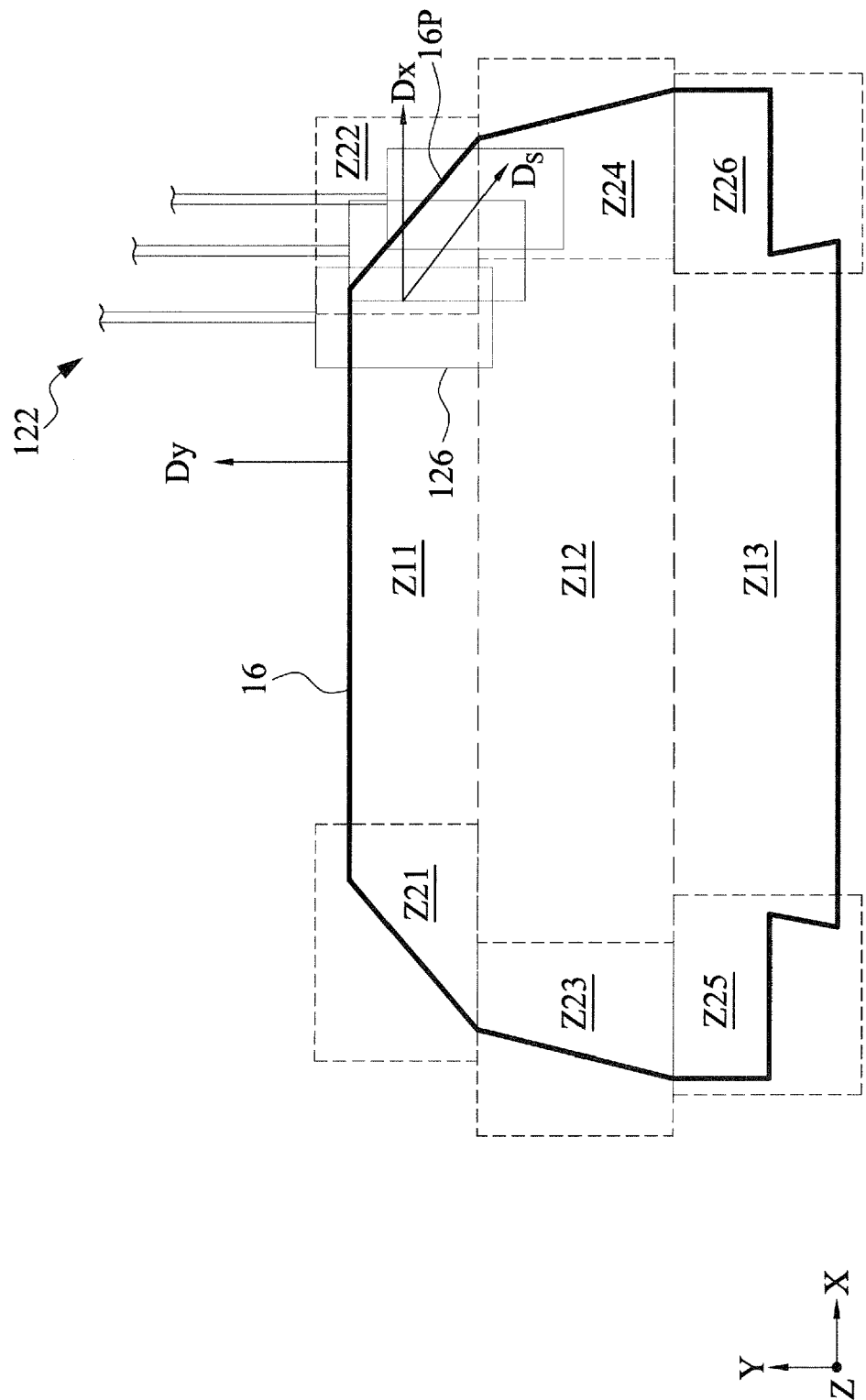


FIG. 11C

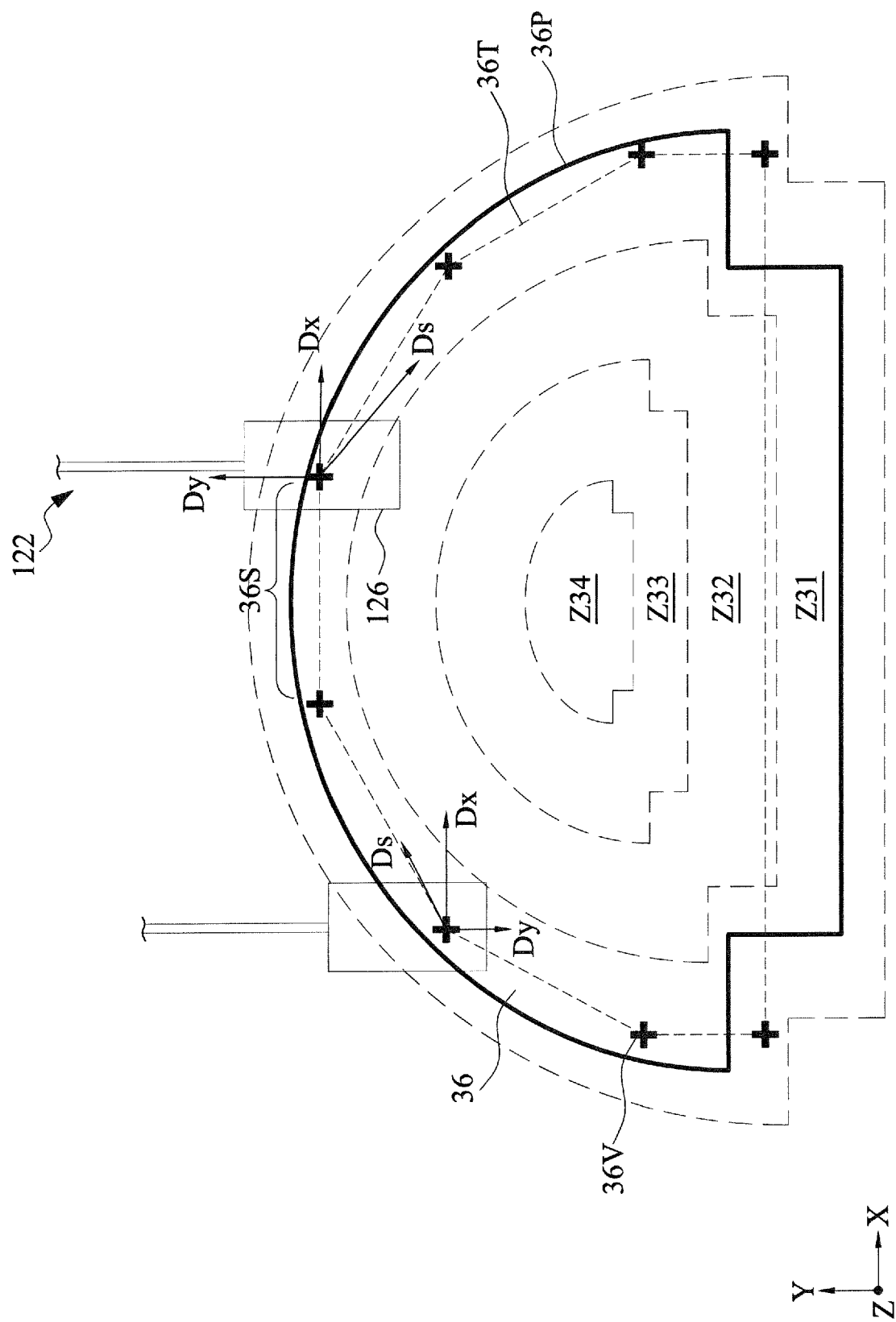


FIG. 11D

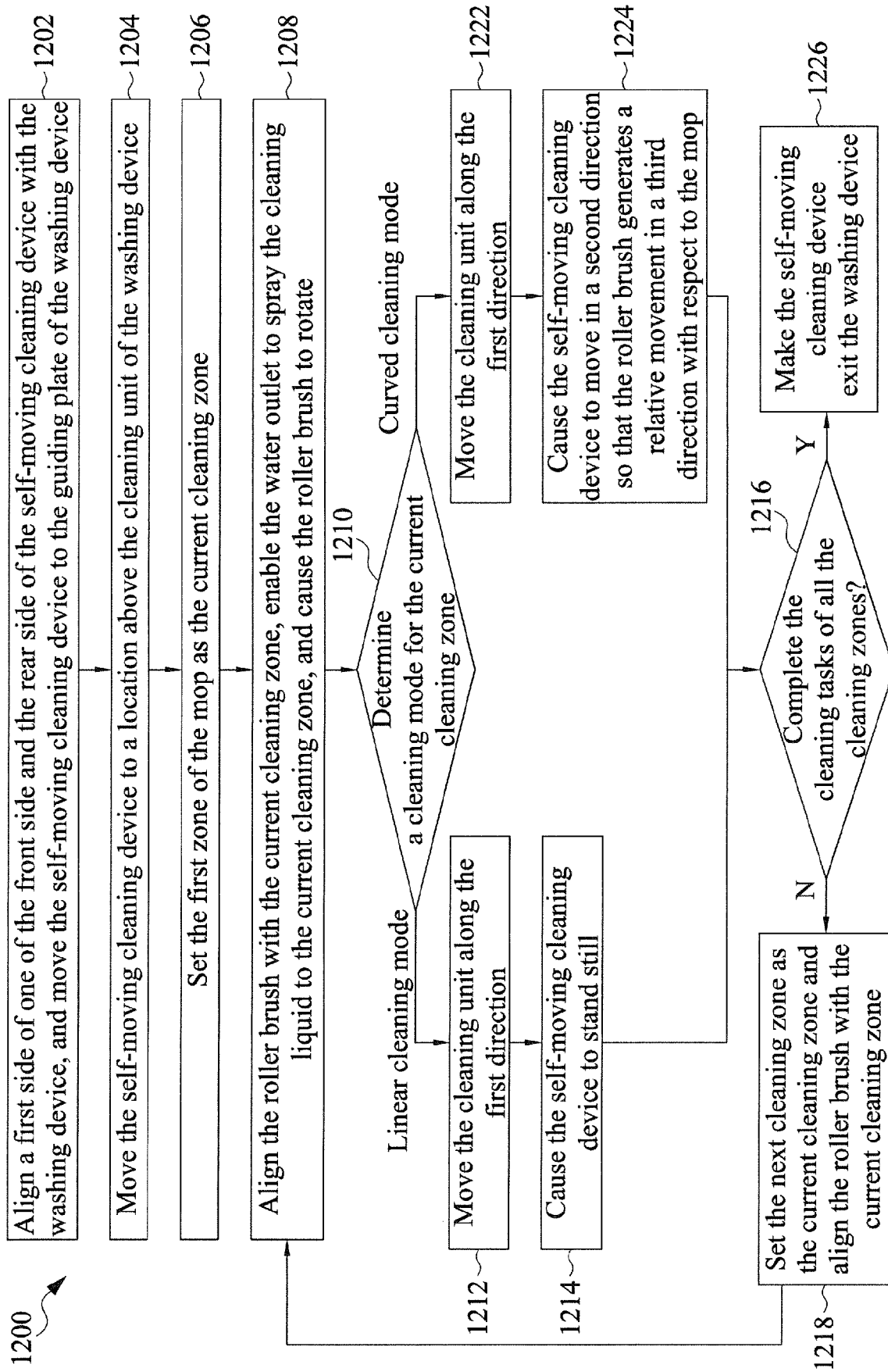


FIG. 12

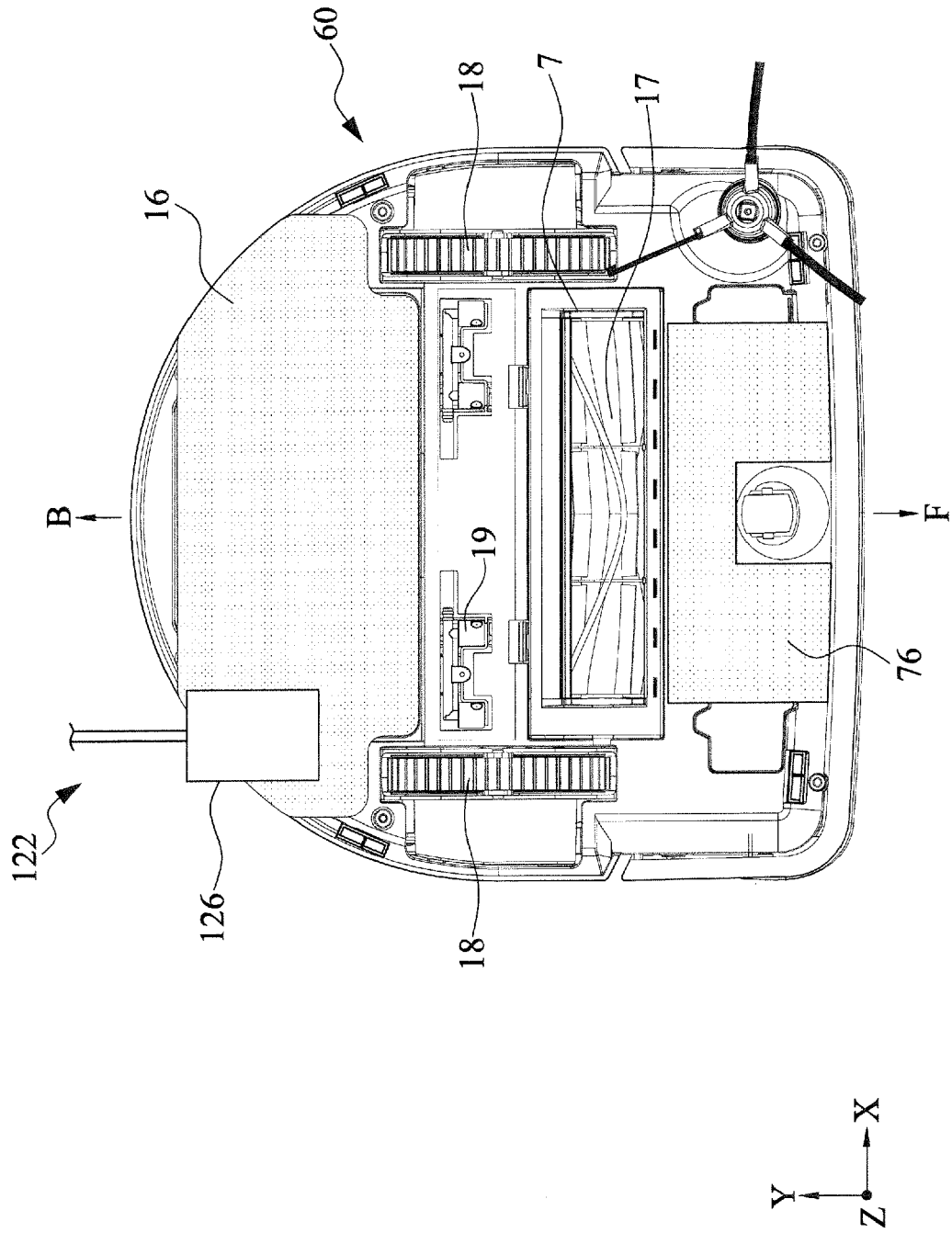


FIG. 13A

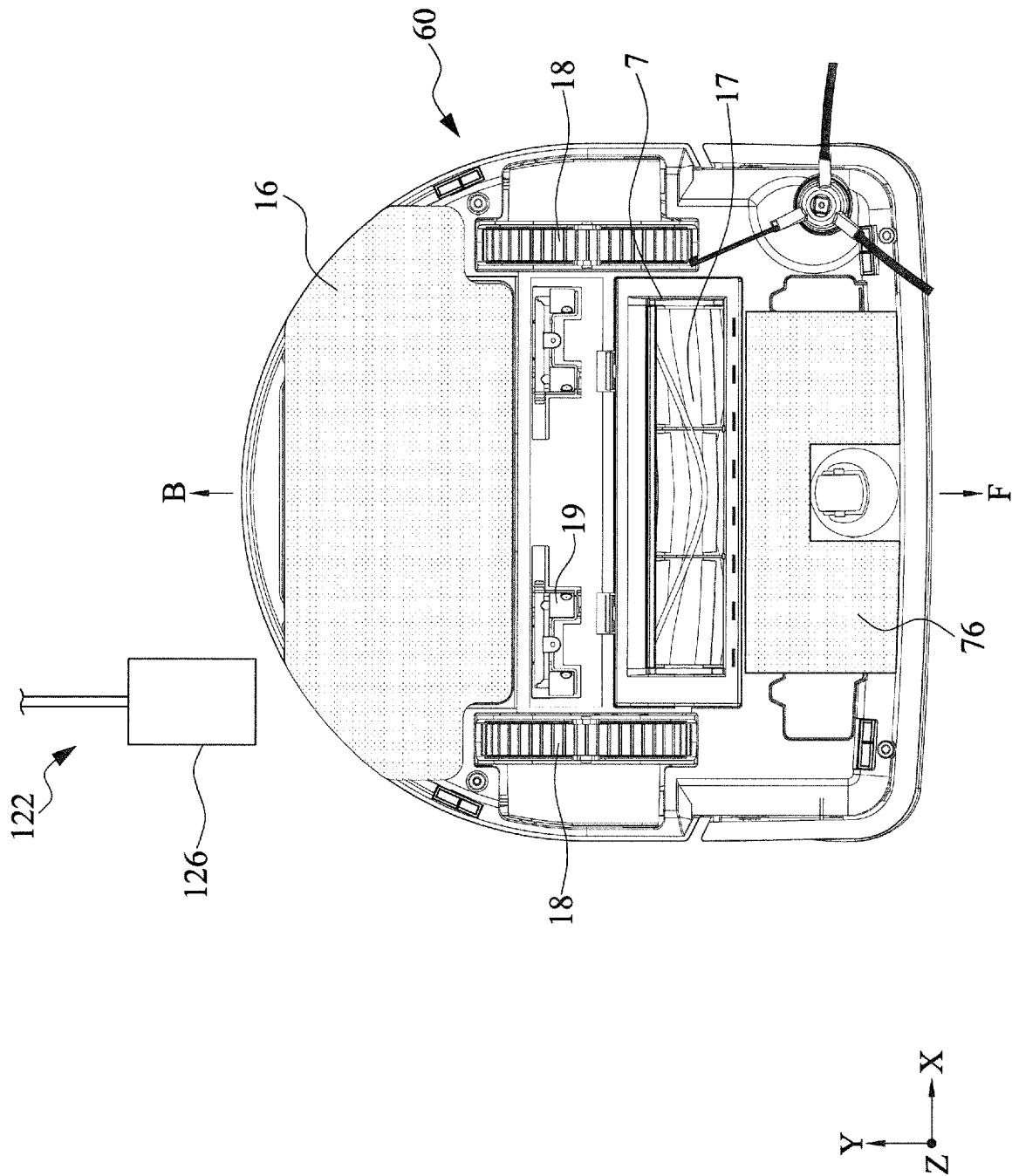


FIG. 13B

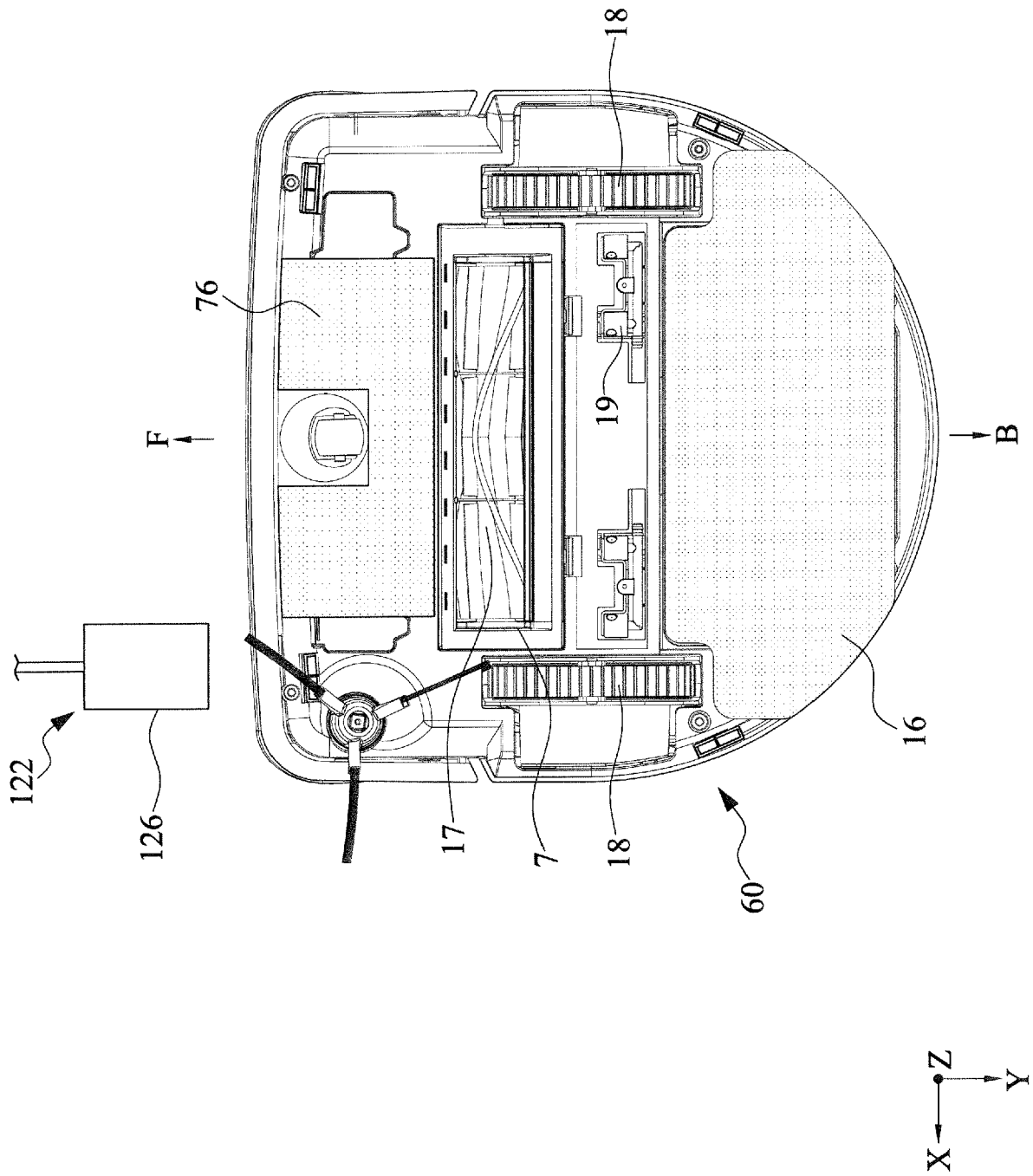


FIG. 13C

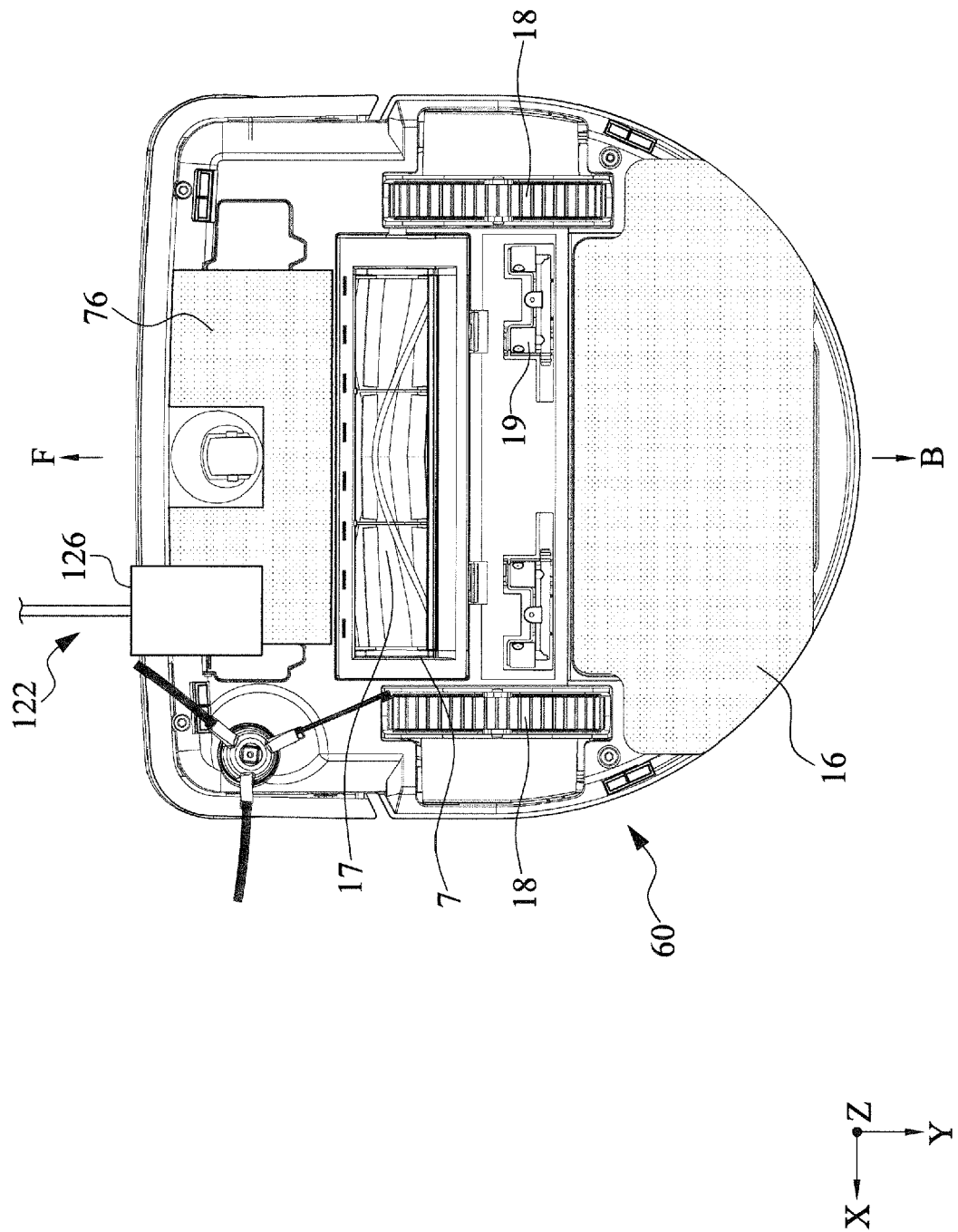


FIG. 13D

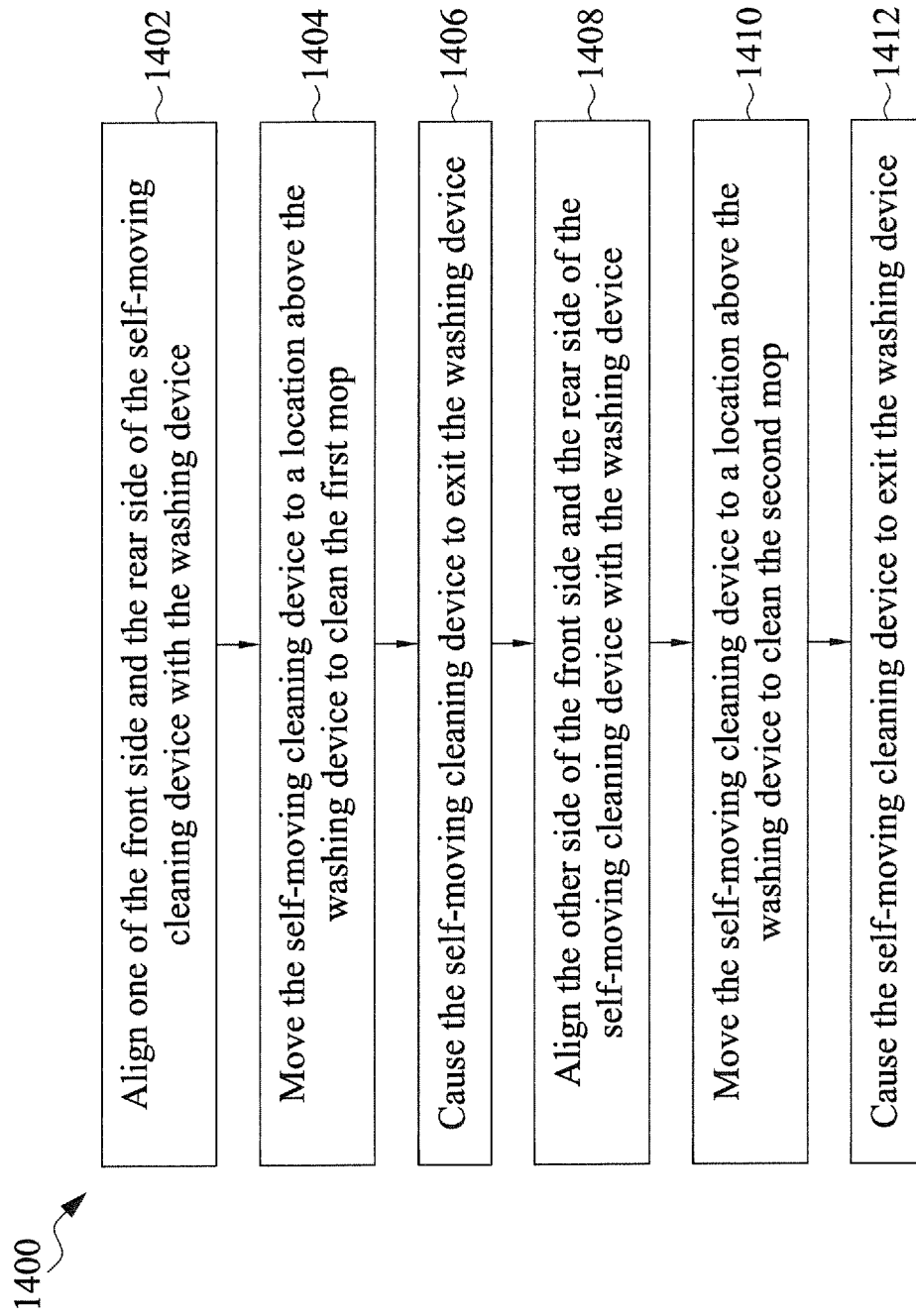


FIG. 14



EUROPEAN SEARCH REPORT

Application Number

EP 23 19 0971

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EPO FORM 1503 03.82 (P04C01)

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A	CN 111 568 325 A (SHENZHEN 3IROBOTIX CO LTD) 25 August 2020 (2020-08-25) * abstract; figures 1-4 * -----	1-15	
A	WO 2021/190862 A1 (FREUDENBERG CARL KG [DE]) 30 September 2021 (2021-09-30) * abstract; figures 1-4 * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			A47L
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 23 January 2024	Examiner Hubrich, Klaus
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 23 19 0971

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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23-01-2024

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