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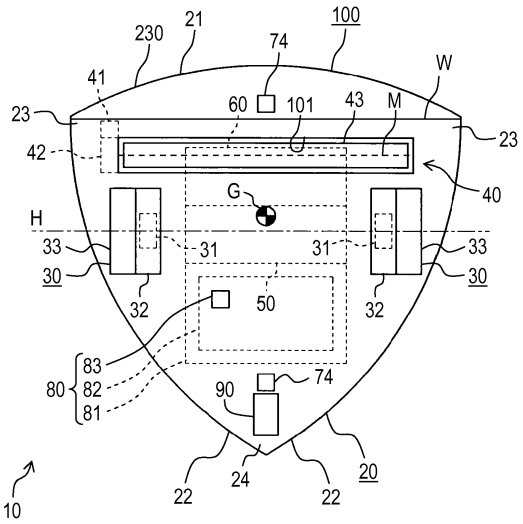
(54) AUTONOMOUS TRAVEL-TYPE CLEANER

(57) Self-travelling vacuum cleaner (10) has body (20) having suction port (101), drive unit (30), and an electric fan. Since suction port (101) is disposed in a maximum width part of body (20) closer than drive unit (30), self-travelling vacuum cleaner (10) can suck a trash on a corner in a target region to be cleaned easily and can move from the corner to another area quickly.

FIG. 2



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Description

TECHNICAL FIELD

[0001] The present invention relates to a self-travelling vacuum cleaner.

BACKGROUND ART

[0002] Generally, a self-travelling vacuum cleaner has a body in which various components are mounted, a driving device which moves the body, a main brush disposed at a suction port formed on the body so as to collect a trash on a cleaning floor, and a sucking device which is configured to suck the trash from the suction port of the body. As disclosed in many literatures such as PTL 1 and PTL 2, a body of a conventional self-travelling vacuum cleaner is formed in a substantially circular shape. The self-travelling vacuum cleaner having the circular shaped body has high turning ability.

[0003] On the other hand, according to the conventional self-travelling vacuum cleaner having the circular shaped body, when the self-travelling vacuum cleaner is moved to the limit to a corner area in a target region to be cleaned, a relatively large gap is generated between the suction port of the body and an apex in the corner area. Thus, the trash on the corner area in the target region to be cleaned is not sufficiently sucked by the sucking device.

[0004] In order to solve this problem, an improved conventional self-travelling vacuum cleaner has one or more side brushes disposed on a bottom surface of a body. For example, such an improved self-travelling vacuum cleaner is disclosed in PTLs 3 to 6. In the improved self-travelling vacuum cleaner, the side brush has bristle bundles which protrude from an outline of the body toward the outside. The bristle bundles collect the trash outside of the outline of the body to the suction port of the body. Accordingly, the self-travelling vacuum cleaner disclosed in PTLs 3 to 6 can suck much more trashes on the corner area in the target region to be cleaned.

[0005] However, according to the self-travelling vacuum cleaner disclosed in PTLs 3 to 6, sucking ability, that is an ability to suck the trash on the corner area in the target region to be cleaned (hereinafter, merely also referred to as "corner cleaning ability"), is mainly defined by an aspect of the side brush. However, the aspect of the bristle bundles is determined under various restrictions. For example, when a length of the bristle bundles is set to be longer, the bristle bundles are easily caught by an obstacle, or the bristle bundles interfere with other component in the self-travelling vacuum cleaner such as a driving device, and therefore travelling of the self-travelling vacuum cleaner might be disturbed. Accordingly, the corner cleaning ability obtained by the side brush is also influenced by such restriction.

[0006] Further, when the trash on the corner area in the target region to be cleaned is collected by the side brush, although the side brush can sweep the trash on the corner area, it is difficult to deliver all the swept trash to the suction port directly, and the trash diffused by the side brush is remained on the target region to be cleaned without being sucked from the suction port.

[0007] Thus, the self-travelling vacuum cleaner, which collects the trash on the corner area in the target region to be cleaned by the side brush, as disclosed in PTLs 3 to 6, has a room for improvement in view of the corner cleaning ability.

[0008] On the other hand, PTL 7 discloses an example of a self-travelling vacuum cleaner in which the corner cleaning ability is further improved. The self-travelling vacuum cleaner disclosed in PTL 7 has a body formed in substantially D-shape, a suction port formed on a bottom side of the body, and a pair of side brushes mounted to a corner of a bottom surface of the body. When the self-travelling vacuum cleaner disclosed in PTL 7 is located at the corner area in the target region to be cleaned, a shaft of the side brush and the suction port of the body are located further closer to the apex in the corner area compared to, for example, when the self-travelling vacuum cleaner disclosed in PTLs 3 to 6 is located at the corner area. Thus, the body formed in the D-shape appears to be able to suck much more trashes than the conventional self-travelling vacuum cleaner disclosed in PTLs 3 to 6.

[0009] However, when the self-travelling vacuum cleaner disclosed in PTL 7 is located at the corner area in the target region to be cleaned, since a front surface and a side surface of the body formed in the D-shape make contact with a wall forming the corner area or approach the wall closer to the extent of making contact with the wall, the body cannot pivotally rotate at the position. Thus, the self-travelling vacuum cleaner disclosed in PTL 7 indeed has a relatively large restriction in a track when the self-travelling vacuum cleaner moves from the corner area to other area after cleaning the corner area in the target region to be cleaned, and therefore it takes much time to move out of the corner area.

Citation List

Patent Literatures

[0010]

PTL 1: Unexamined Japanese Patent Publication No. 2008-296007
PTL 2: Japanese Translation of PCT Publication No. 2014-504534
PTL 3: Unexamined Japanese Patent Publication No. 2011-212444
PTL 4: Unexamined Japanese Patent Publication No. 2014-073192
PTL 5: Unexamined Japanese Patent Publication No. 2014-094233
PTL 6: Japanese Translation of PCT Publication No.

2014-512247

PTL 7: Unexamined Japanese Patent Publication No. 2014-061375

SUMMARY OF THE INVENTION

[0011] In view of the above-described problem of the conventional self-travelling vacuum cleaner, an object of the present invention is to provide a self-travelling vacuum cleaner having high cleaning efficiency capable of more reliably and directly sucking a trash on a corner area in a target region to be cleaned from a suction port and quickly moving from the corner area in the target region to be cleaned to other area.

[0012] Specifically, a self-travelling vacuum cleaner of the present invention has a body having a suction port, a drive unit which moves the body, and an electric fan. The body has two apex parts which define a maximum width of the body. The suction port is disposed on a bottom side of the body and at a part closer to the maximum width of the body than the drive unit.

[0013] With such configuration, trash on a corner in a target region to be cleaned can be sucked more reliably and directly from the suction port and the self-travelling vacuum cleaner can move from the corner in the target region to be cleaned to other area quickly, and therefore cleaning efficiency can be enhanced.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

FIG. 1 is a plane view of a self-travelling vacuum cleaner according to a first exemplary embodiment of the present invention.

FIG. 2 is a bottom view of the self-travelling vacuum cleaner according to the first exemplary embodiment of the present invention.

FIG. 3 is a block diagram illustrating a function of an electric system of the self-travelling vacuum cleaner according to the first exemplary embodiment of the present invention.

FIG. 4 is a plane view illustrating movement of a conventional self-travelling vacuum cleaner.

FIG. 5 is a plane view illustrating movement of the self-travelling vacuum cleaner according to the first exemplary embodiment of the present invention.

FIG. 6 is other plane view illustrating the movement of the self-travelling vacuum cleaner according to the first exemplary embodiment of the present invention.

FIG. 7 is another plane view illustrating the movement of the self-travelling vacuum cleaner according to the first exemplary embodiment of the present invention.

FIG. 8 is a plane view of a self-travelling vacuum cleaner according to a second exemplary embodiment of the present invention.

FIG. 9 is a bottom view of the self-travelling vacuum cleaner according to the second exemplary embodiment of the present invention.

FIG. 10 is a perspective view of a self-travelling vacuum cleaner according to a third exemplary embodiment of the present invention.

FIG. 11 is a plane view of the self-travelling vacuum cleaner according to the third exemplary embodiment of the present invention.

FIG. 12 is a plane view illustrating an inside of the self-travelling vacuum cleaner according to the third exemplary embodiment of the present invention.

FIG. 13 is a bottom view of the self-travelling vacuum cleaner according to the third exemplary embodiment of the present invention.

FIG. 14 is a side view of the self-travelling vacuum cleaner according to the third exemplary embodiment of the present invention.

FIG. 15 is an exploded perspective view of a part in the configuration of the self-travelling vacuum cleaner when seen from a front side according to the third exemplary embodiment of the present invention.

FIG. 16 is an exploded perspective view of a part in the configuration of the self-travelling vacuum cleaner when seen from a bottom side according to the third exemplary embodiment of the present invention.

FIG. 17 is a cross-sectional view taken along line XVII-XVII in FIG. 11.

FIG. 18 is a cross-sectional view taken along line XVII-XVII in FIG. 11, in which a part in the configuration of the self-travelling vacuum cleaner is separated according to the third exemplary embodiment of the present invention.

FIG. 19 is a cross-sectional view taken along line XIX-XIX in FIG. 14.

FIG. 20 is a perspective view illustrating an inner structure of a lower unit of the self-travelling vacuum cleaner according to the third exemplary embodiment of the present invention.

FIG. 21 is a perspective view of the inner structure of the lower unit of the self-travelling vacuum cleaner when seen from a side according to the third exemplary embodiment of the present invention.

FIG. 22 is a perspective view of the inner structure of the lower unit of the self-travelling vacuum cleaner when seen from a front side according to the third exemplary embodiment of the present invention.

FIG. 23 is another perspective view of the inner structure of the lower unit of the self-travelling vacuum cleaner when seen from the front side according to the third exemplary embodiment of the present invention.

FIG. 24 is a perspective view of an upper unit of the self-travelling vacuum cleaner according to the third exemplary embodiment of the present invention.

FIG. 25 is a bottom view of the upper unit of the self-travelling vacuum cleaner according to the third ex-

emplary embodiment of the present invention.

FIG. 26 is a block diagram illustrating a function of an electric system of the self-travelling vacuum cleaner according to the third exemplary embodiment of the present invention.

FIG. 27 is a perspective view of a trash box unit of a self-travelling vacuum cleaner according to a fourth exemplary embodiment of the present invention.

FIG. 28 is a cross-sectional view of the trash box unit according to the fourth exemplary embodiment of the present invention.

FIG. 29 is a plane view of a self-travelling vacuum cleaner according to a first modified example of the present invention.

FIG. 30 is a plane view of a self-travelling vacuum cleaner according to a second modified example of the present invention.

FIG. 31 is a plane view of a self-travelling vacuum cleaner according to a third modified example of the present invention.

DESCRIPTION OF EMBODIMENTS

[0015] Hereinafter, exemplary embodiments of the present invention are described with reference to the drawings. However, the present invention is not limited to the exemplary embodiments.

FIRST EXEMPLARY EMBODIMENT

[0016] FIG. 1 is a plane view of self-travelling vacuum cleaner 10 according to a first exemplary embodiment of the present invention. FIG. 2 is a bottom view of self-travelling vacuum cleaner 10 according to the first exemplary embodiment of the present invention.

[0017] As shown in FIG. 1, self-travelling vacuum cleaner 10 is a robot type vacuum cleaner which autonomously travels on a cleaning surface of a target region to be cleaned (hereinafter, referred to as "target region to be cleaned" or merely "target region") and sucks a trash on the cleaning surface. The target region to be cleaned denotes, for example, a room, and the cleaning surface denotes, for example, a floor of the room.

[0018] According to the present exemplary embodiment, self-travelling vacuum cleaner 10 has body 20 in which various components are mounted, drive unit 30 (see FIG. 2) which drives body 20, cleaning unit 40 (see FIG. 2) which collects a trash in the target region to be cleaned, and sucking unit 50 which is configured to suck the trash into an inside of body 20. Self-travelling vacuum cleaner 10 may further have trash box unit 60 which stores the trash sucked by sucking unit 50, and control unit 70 which controls at least drive unit 30, cleaning unit 40 and sucking unit 50.

[0019] Self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have caster 90 which rotates in accordance with rotation of drive unit 30, and power source unit 80 which supplies electric power to drive unit 30, cleaning unit 40, sucking unit 50 and the like.

[0020] An upper side in each of FIG. 1 and FIG. 2 is a front side of body 20, and a lower side in each of FIG. 1 and FIG. 2 is a rear side of body 20. A width direction of self-travelling vacuum cleaner 10 is defined based on a forward movement direction (upper side in FIG. 1) of self-travelling vacuum cleaner 10. For example, in the present exemplary embodiment, the width direction of self-travelling vacuum cleaner 10 is defined by a direction (lateral direction in FIG. 1 and FIG. 2) substantially orthogonal to the forward movement direction of self-travelling vacuum cleaner 10.

[0021] In the present exemplary embodiment, a pair of drive units 30 are disposed respectively at a left side and a right side (hereinafter, left side drive unit 30 may also be referred to as a first drive unit, and right side drive unit 30 may also be referred to as a second drive unit) with respect to a center of body 20 in the width direction in a plane view. Further, a number of drive unit 30 is not limited to two, and it may be one or three or more.

[0022] Further, body 20 has lower unit 100 (see FIG. 2) which forms an outer shape of a lower side of body 20, and upper unit 200 (see FIG. 1) which forms an outer shape of an upper side of body 20. Body 20 is formed by combining lower unit 100 and upper unit 200. As shown in FIG. 1, upper unit 200 has cover 210 which forms a main part of upper unit 200, lid 220 disposed in an openable and closable manner against cover 210, and bumper 230 displaceable against cover 210.

[0023] A plane shape of body 20 is preferably the Reuleaux triangle shape, or the Reuleaux polygonal shape which is substantially the same shape as the Reuleaux triangle, or a shape in which apex parts of the Reuleaux triangle or the Reuleaux polygonal shape are formed in a round shape (circular arc R shown in FIG. 11 and FIG. 31). With such shape, the same or a similar characteristic to a geometrical characteristic of the Reuleaux triangle can be applied to body 20. Namely, since the Reuleaux triangle has a curve of constant width, the Reuleaux triangle can rotate while being inscribed inside a rectangle having a constant width (namely, a length of a side of a regular triangle inscribed in the Reuleaux triangle). With this, body 20 can draw a track of a rectangle (substantially square). In the present exemplary embodiment, as shown in FIG. 1, body 20 has substantially the same plane shape as the Reuleaux triangle.

[0024] Further, body 20 has a plurality of outer peripheral surfaces and a plurality of apex parts. In the present exemplary embodiment, a plurality of the outer peripheral surfaces include front surface 21 disposed at the forward movement side (upper side in FIG. 1) of self-travelling vacuum cleaner 10, right side surface 22 disposed at a right and rear side with respect to front surface 21, and left side surface 22 disposed at a left and rear side with respect to front surface 21 in the plan view of body 20. Further, in the present exemplary embodiment, front surface 21 has a curve surface protruded outwardly. Bumper

230 may be formed on the curve surface protruded outwardly. Each side surface 22 has a curve surface protruded outwardly at least in a part of side surface 22. In the present exemplary embodiment, the curve surface protruded outwardly is formed on a side part of bumper 230 and a side part of cover 210.

[0025] In the present exemplary embodiment, a plurality of the apex parts include right side front apex part 23 defined by front surface 21 and right side surface 22, and left side front apex part 23 defined by front surface 21 and left side surface 22. A plurality of the apex parts may further include rear apex part 24 defined by right side surface 22 and left side surface 22. As shown in FIG. 1, each of the angles formed between tangent L1 of front surface 21 and tangent L2 of side surface 22 and between tangent L1 of front surface 21 and tangent L3 of side surface 22 is an acute angle.

[0026] A maximum width of body 20 is defined by a distance between apexes of a plurality of the apex parts of body 20. In the present exemplary embodiment, the maximum width of body 20 is defined by right side front apex part 23 and left side front apex part 23. According to an example shown in FIG. 1, for example, the maximum width of body 20 is defined by a distance between an apex of right side front apex part 23 and an apex of the left side front apex part 23, or a distance between two apexes among three apexes of the Reuleaux triangle.

[0027] Further, in body 20, a part on and closer to line W (hereinafter, referred to as "maximum width line W of body 20") connecting the apex of right side front apex part 23 and the apex of left side front apex part 23 is called as "a part having the maximum width of body 20" or "maximum width part of body 20". Further, "a part closer to maximum width line W of body 20" and "a part near maximum width line W of body 20" means a part near maximum width line W of body 20, namely a part between maximum width line W of body 20 and a center of gravity G (see FIG. 2) of self-travelling vacuum cleaner 10 and a part between maximum width line W of body 20 and front surface 21, more specifically a part between maximum width line W of body 20 and a front end of drive unit 30 in the forward movement direction of body 20 and a part between maximum width line W of body 20 and front surface 21.

[0028] Further, the maximum width part of body 20 is preferably set to a part closer to front surface 21 of body 20. Further, an extending direction of maximum width line W of body 20 is preferably set to be substantially orthogonal to the forward movement direction of body 20.

[0029] As shown in FIG. 2, body 20 further has suction port 101 for sucking a trash to an inside of body 20. Suction port 101 is formed on a bottom surface of lower unit 100 of body 20. Suction port 101 is formed in a laterally elongate shape, preferably in a rectangular shape or a substantially rectangular shape. Further, the shape of suction port 101 is not limited to this, but may be an oval shape, a trapezoid shape, and a shape curved along the outer peripheral shape of body 20, etc. In the present exemplary embodiment, suction port 101 has a rectangular shape. Further, in the present exemplary embodiment, suction port 101 is disposed on the bottom surface of lower unit 100 of body 20 such that a longitudinal direction of suction port 101 is extended substantially in the width direction of body 20, and a short direction of suction port 101 is extended substantially in a front-rear direction of body 20.

[0030] Further, suction port 101 is formed on the bottom surface of lower unit 100 of body 20 at a part closer to the part having the maximum width of body 20, and more preferably at a part closer to maximum width line W of body 20. This positional relationship is specifically defined by a positional relationship of suction port 101 against other components of self-travelling vacuum cleaner 10. For example, it is defined by one or both of the following two kinds of positional relationships:

In a first positional relationship, suction port 101 is located at a position closer to the front side of the outer periphery of body 20 than the center of gravity G (see FIG. 2) of self-travelling vacuum cleaner 10. More specifically, a center line M (hereinafter, referred to as "center line of suction port 101 in the longitudinal direction) of suction port 101 which extends substantially in the longitudinal direction of suction port 101 is located at a position closer to the front side of the outer periphery of body 20 than the center of gravity G (see FIG. 2) of self-travelling vacuum cleaner 10, or a front part of body 20, or the maximum width part of body 20. Further, the center line of suction port 101 in the longitudinal direction may be located at a part closer to front surface 21 than maximum width line W of body 20.

[0031] In a second positional relationship, suction port 101 is located at a part closer to maximum width line W of body 20 than drive unit 30, and preferably at a part on or a part closer to maximum width line W of body 20, and more preferably at a part closer to front surface 21 than maximum width line W of body 20.

[0032] Further, in the present exemplary embodiment, a width of suction port 101 in the longitudinal direction is set to be wider than an inner distance between right side drive unit 30 and left side drive unit 30. Such configuration can be achieved, for example, by the second positional relationship of suction port 101 described above. With such configuration, suction port 101 can be formed more widely, and therefore the trash can be sucked more reliably and directly from suction port 101 and an amount of the trash sucked by sucking unit 50 described below can be increased.

[0033] Next, drive unit 30 is described.

[0034] As shown in FIG. 2, each drive unit 30 is disposed on a bottom side of lower unit 100 and has a plurality of elements such as wheel 33 which travels on the cleaning surface. According to the present exemplary

embodiment, each drive unit 30 has travel motor 31 which applies torque to wheel 33, and housing 32 which houses travel motor 31, in addition to wheel 33 which travels on the cleaning surface. Each wheel 33 is housed in a recess part formed on lower unit 100 and supported by lower unit 100 in a rotatable manner with respect to lower unit 100.

[0035] Each wheel 33 is disposed at a position closer to the outer periphery of body 20 in the width direction than travel motor 31 which applies torque to each wheel 33. With such configuration, a distance between right side wheel 33 and left side wheel 33 is longer than that of a configuration in which each wheel 33 is disposed at a position closer to the center of body 20 in the width direction than travel motor 31, and therefore stability of body 20 can be improved.

[0036] A driving system of self-travelling vacuum cleaner 10 according to the present exemplary embodiment is a facing two wheels type. Namely, right side drive unit 30 and left side drive unit 30 are arranged so as to face each other in the width direction of body 20. Further, in the present exemplary embodiment, as shown in FIG. 2, rotation axis H of right side wheel 33 and rotation axis H of left side wheel 33 are arranged to be substantially coaxial.

[0037] A distance between rotation axis H and the center of gravity G of self-travelling vacuum cleaner 10 is defined for example such that self-travelling vacuum cleaner 10 has a predetermined turning ability. The predetermined turning ability means that body 20 can draw the same or a similar track to a rectangular track formed by an outline of the Reuleaux triangle. According to the present exemplary embodiment, a position of rotation axis H is set at a position closer to the rear side of the outer periphery of body 20 than the center of gravity G of self-travelling vacuum cleaner 10, and a distance between rotation axis H and the center of gravity G is set to be a predetermined distance. According to self-travelling vacuum cleaner 10 of the facing two wheels type, with such configuration, the track described above can be formed by using contact between body 20 and an object around.

[0038] Next, cleaning unit 40 is described.

[0039] As shown in FIG. 2, cleaning unit 40 is disposed inside and outside of body 20, and has a plurality of elements such as brush driving motor 41 and so on. According to the present exemplary embodiment, cleaning unit 40 has gear box 42, and main brush 43 disposed in suction port 101 of body 20 in addition to brush driving motor 41 disposed inside of body 20 (right side of suction port 101).

[0040] Brush driving motor 41 and gear box 42 are mounted to lower unit 100. Gear box 42 is connected to an output shaft of brush driving motor 41 and main brush 43. Gear box 42 transmits torque of brush driving motor 41 to main brush 43.

[0041] Main brush 43 has a length substantially equal to a length of suction port 101 in longitudinal direction. Main brush 43 is rotatably supported against lower unit 100 by a shaft receiving part. The shaft receiving part is formed, for example, on one or both of gear box 42 and lower unit 100. According to the present exemplary embodiment, a rotation direction of main brush 43 is set such that its rotation track at a side of the cleaning surface is along a direction from a front side to a rear side of body 20 as shown by an arrow AM in FIG. 14 illustrating a side view of self-travelling vacuum cleaner 10.

[0042] Next, sucking unit 50 is described.

[0043] As shown in FIG. 1, sucking unit 50 is disposed inside of body 20, and has a plurality of elements such as fan case 52 and so on. According to the present exemplary embodiment, sucking unit 50 is disposed at a rear side of trash box unit 60 and at a front side of power source unit 80 described below. Sucking unit 50 has fan case 52 mounted to lower unit 100 (see FIG. 2), and electric fan 51 disposed inside fan case 52.

[0044] Electric fan 51 sucks air inside of trash box unit 60 and discharges the air toward an outside of the electric fan 51. The air discharged from electric fan 51 is passed through a space inside of fan case 52 and a space around fan case 52 inside of body 20, and is exhausted to the outside of body 20.

[0045] Next, trash box unit 60 is described.

[0046] As shown in FIG. 2, trash box unit 60 is disposed inside of body 20 at a rear side of main brush 43 and at a front side of sucking unit 50 between drive units 30. Body 20 and trash box unit 60 have a detachable structure in which a user can arbitrarily select a state in which trash box unit 60 is mounted to body 20 and a state in which trash box unit 60 is detached from body 20.

[0047] Next, control unit 70 is described.

[0048] As shown in FIG. 1, control unit 70 is disposed inside of body 20 at a rear side of sucking unit 50. As shown in FIG. 1 and FIG. 2, self-travelling vacuum cleaner 10 may further have a plurality of sensors. According to the present exemplary embodiment, a plurality of the sensors include obstacle detecting sensor 71 (see FIG. 1) which detects an obstacle in front of body 20, and distance measuring sensor 72 (see FIG. 1) which detects a distance between an object around body 20 and body 20. A plurality of the sensors further include collision detecting sensor 73 (see FIG. 1) which detects a collision between body 20 and the object around, and a plurality of floor detecting sensors 74 (see FIG. 2) which detect the cleaning surface below the bottom surface of body 20. Each of obstacle detecting sensor 71, distance measuring sensor 72, collision detecting sensor 73, and floor detecting sensor 74 sends a detection signal to control unit 70.

[0049] For example, an ultrasonic wave sensor is used for obstacle detecting sensor 71. Obstacle detecting sensor 71 has a transmitting part and a receiving part. For example, an infrared sensor is used for distance measuring sensor 72 and floor detecting sensor 74. Each of distance measuring sensor 72 and floor detecting sensor 74 has a light emitting part and a light receiving part. For example, a contact type displacement sensor is used for

collision detecting sensor 73. For example, collision detecting sensor 73 has a switch which is turned on when bumper 230 is pushed against cover 210.

[0050] As shown in FIG. 1, in the present exemplary embodiment, each of distance measuring sensors 72 is respectively arranged at a right side and a left side of body 20 with respect to the center in the width direction in a plane view. Right side distance measuring sensor 72 is disposed at a right side of front apex part 23 and emits light toward a diagonally forward right direction of body 20. Left side distance measuring sensor 72 is disposed at a left side of front apex part 23 and emits light toward a diagonally forward left direction of body 20. With such configuration, when self-travelling vacuum cleaner 10 turns, a distance between an object around closest to the outline of body 20 and body 20 can be detected.

[0051] As shown in FIG. 2, a plurality of floor detecting sensors 74 are arranged respectively, for example, at a position closer to the front side of the outer periphery of body 20 and at a position closer to the rear side of the outer periphery of body 20 than drive unit 30.

[0052] Next, power source unit 80 is described.

[0053] Self-travelling vacuum cleaner 10 may further have power source unit 80 which supplies electric power to drive unit 30, cleaning unit 40, sucking unit 50, obstacle detecting sensor 71, distance measuring sensor 72, collision detecting sensor 73, and floor detecting sensor 74. Power source unit 80 is disposed at a part on the rear side of the body farther than the center of gravity G of self-travelling vacuum cleaner 10 and at a part on the rear side of body 20 farther than to sucking unit 50. Power source unit 80 has a plurality of elements such as power source case 81 and the like. According to the present exemplary embodiment, power source unit 80 has power source case 81 mounted to lower unit 100, battery 82 housed in power source case 81, and main switch 83 which switches power supply and interruption of the power supply to each element from power source unit 80. For example, a secondary battery is used for battery 82.

[0054] Next, a controlling method of self-travelling vacuum cleaner 10 by control unit 70 is described.

[0055] FIG. 3 is a block diagram illustrating a function of an electric system of self-travelling vacuum cleaner 10.

[0056] Control unit 70 is disposed on power source unit 80 (see FIG. 1 and FIG. 2) inside of body 20 and electrically connected to power source unit 80. Control unit 70 is further electrically connected to obstacle detecting sensor 71, distance measuring sensor 72, collision detecting sensor 73, floor detecting sensor 74, a pair of travel motors 31, brush driving motor 41, and electric fan 51.

[0057] Control unit 70 determines whether an object, which interferes the traveling of self-travelling vacuum cleaner 10, exists or not in a predetermined range in front of body 20 based on a detection signal input from obstacle detecting sensor 71. Control unit 70 calculates a distance between the object which exists around front apex part 23 of body 20 and the outline of body 20 based on a detection signal input from distance measuring sensor 72.

[0058] Control unit 70 determines whether body 20 collides with the object around or not based on a detection signal input from collision detecting sensor 73. Control unit 70 judges whether the cleaning surface in the target region to be cleaned exists or not under body 20 based on a detection signal input from floor detecting sensor 74.

[0059] Control unit 70 controls travel motor 31, brush driving motor 41, and electric fan 51 by using one or more results of the judgment or the calculation described above such that the cleaning surface in the target region is cleaned by self-travelling vacuum cleaner 10.

[0060] FIG. 4 is a plane view illustrating movement of conventional self-travelling vacuum cleaner 900.

[0061] In FIG. 4, room RX which is the target region to be cleaned has, for example, corner area R3 formed by first wall R1 and second wall R2. According to an example shown in FIG. 3, corner area R3 has a substantially right-angled corner, for example. When self-travelling vacuum cleaner 900 reaches to corner area R3, self-travelling vacuum cleaner 900 cannot cover apex part R4 of corner area R3. Thus, a relatively large space is generated between suction port 910 of self-travelling vacuum cleaner 900 and apex part R4. Here, in a case where a side brush is mounted in self-travelling vacuum cleaner 900, it is possible to sweep the trash on apex part R4 by the side brush. However, since the trash on apex part R4 is swept by rotation of side brush and at the same time the trash is diffused around, the trash directly sucked from suction port 910 distantly disposed from apex part R4 is merely a part of the trashes on apex part R4.

[0062] Next, movement of self-travelling vacuum cleaner 10 according to the present exemplary embodiment when self-travelling vacuum cleaner 10 cleans corner area R3 is described.

[0063] FIGS. 5 to 7 are plane views illustrating the movement of self-travelling vacuum cleaner 10 which cleans corner area R3 according to the present exemplary embodiment.

[0064] Control unit 70, for example, moves self-travelling vacuum cleaner 10 to clean corner area R3 in room RX as described below. Namely, as shown in FIG. 5, control unit 70 moves self-travelling vacuum cleaner 10 along second wall R2 toward first wall R1 while body 20 faces first wall R1. At this time, self-travelling vacuum cleaner 10 travels while one front apex part 23 makes contact with second wall R2 or one front apex part 23 keeps a state to be closer to the extent of making contact with second wall R2.

[0065] As shown in FIG. 6, control unit 70 temporarily stops the travelling of self-travelling vacuum cleaner 10 at a position where front surface 21 of body 20 makes contact with first wall R1 or front surface 21 is to be closer to the extent of making contact with first wall R1. At this time, a part of front apex part 23 covers a part of apex part R4 of corner area R3. In this way, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, suction port 101 of body 20 is to be closer

to apex part R4 of corner area R3 compared to conventional self-travelling vacuum cleaner 900 (see FIG. 4) located closer to the limit to corner area R3.

[0066] Next, as shown in FIG. 7, control unit 70 makes self-travelling vacuum cleaner 10 repeatedly perform movement in which front surface 21 is turned while making contact with first wall R1 and movement in which right side surface 22 is turned while making contact with second wall R2. Thus, self-travelling vacuum cleaner 10 is turned toward a left direction while changing a position of the center of gravity G by (i) reaction force applied to body 20 caused by contact between front surface 21 and first wall R1 and (ii) reaction force applied to body 20 caused by contact between side surface 22 and second wall R2. This turning movement is a similar to a part of movement of the Reuleaux triangle forming a rectangular track.

[0067] When self-travelling vacuum cleaner 10 is turned at a predetermined angle from a state in which self-travelling vacuum cleaner 10 faces first wall R1, as shown in FIG. 7, right side front apex part 23 is directed to the apex of corner area R3 or adjacent area thereof, and front apex part 23 is located to be the closest to the apex of corner area R3. At this time, body 20 covers a relatively large part of apex part R4. Further, as described above, since suction port 101 is disposed closer to the maximum width of body 20 defined by two front apex parts 23, a distance between suction port 101 of body 20 and apex part R4 of corner area R3 is shorter than a distance between suction port 910 and apex part R4 of corner area R3 when conventional self-travelling vacuum cleaner 900 (see FIG. 4) is located to be close to the limit to corner area R3.

[0068] With such configuration, the trash on apex part R4 of corner area R3 can be more reliably and directly sucked from suction port 101, and therefore the corner cleaning ability of self-travelling vacuum cleaner 10 can be enhanced compared to that of conventional self-travelling vacuum cleaner 900.

[0069] Such a corner cleaning ability of self-travelling vacuum cleaner 10 according to the present exemplary embodiment can be further described as below. According to self-travelling vacuum cleaner 10 of the present exemplary embodiment, as described above, each angle formed between tangent L1 of front surface 21 and tangent L2 and tangent L3 of two side surfaces 22 is an acute angle. Thus, when self-travelling vacuum cleaner 10 is located at corner area R3 in the target region to be cleaned, self-travelling vacuum cleaner 10 is pivotally turned, and therefore self-travelling vacuum cleaner 10 can take various positions against corner area R3. Examples of the position include that front apex part 23 of body 20 is directed to apex part R4 or an adjacent part thereof including the apex of corner area R3 in the target region to be cleaned.

[0070] In a case in which self-travelling vacuum cleaner 10 takes such a position, the outline of body 20 is located further closer to the apex of corner area R3 and suction port 101 of body 20 is also located closer to the apex of corner area R3 compared to a case in which conventional self-travelling vacuum cleaner 900 having a circular body is located closer to the limit to corner area R3 in the target region to be cleaned. Thus, body 20 can suck the trash on the cleaning surface of corner area R3 more reliably and directly from suction port 101. Namely, according to the configuration of self-travelling vacuum cleaner 10 of the present exemplary embodiment, it is possible to suck the trash on corner area R3 in the target region to be cleaned more reliably and directly from suction port 101 compared to conventional self-travelling vacuum cleaner 900 having the circular body.

[0071] Further, when self-travelling vacuum cleaner 10 takes a position in which front apex part 23 of body 20 is directed to apex part R4 or the adjacent part thereof including the apex of corner area R3, self-travelling vacuum cleaner 10 can pivotally turn and change its direction. Thus, when self-travelling vacuum cleaner 10 moves from corner area R3 in the target region to be cleaned to another area, a restriction in moving such as in the conventional self-travelling vacuum cleaner having the D-shape body may not be applied. Namely, self-travelling vacuum cleaner 10 according to the present exemplary embodiment can move quickly from corner area R3 to another area compared to the conventional self-travelling vacuum cleaner having the D-shape body.

[0072] According to self-travelling vacuum cleaner 10 according to the present exemplary embodiment, further effects described below can be obtained.

(1) In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, suction port 101 is disposed closer to maximum width line W of body 20. With such configuration, even if the width of suction port 101 in the longitudinal direction is set to be narrower than a distance between drive units 30, the trash can be sucked more reliably and directly from suction port 101 compared to conventional self-travelling vacuum cleaner 900, and therefore much more trashes can be sucked.

Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, the width of suction port 101 in the longitudinal direction is wider than the distance between drive units 30. With such configuration, much more trashes can be sucked directly from suction port 101 compared to a configuration in which the width of suction port 101 is narrower than the distance between drive units 30. Thus, a configuration in which the width of suction port 101 is wider than the distance between drive units 30 is more preferable.

(2) In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, suction port 101 is disposed adjacent to maximum width line W of body 20. With such configuration, even if suction port 101 is disposed between drive units 30, the trash on apex part R4 of corner area R3 can be sucked more

reliably and directly from suction port 101 compared to conventional self-travelling vacuum cleaner 900.
Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, suction port 101 is disposed at a position closer to the outer periphery at the front side of body 20 than drive unit 30, preferably adjacent to maximum width line W of body 20, more preferably adjacent to the maximum width part of body 20 in an area closest to front surface 21 of body 20. With such configuration, when self-travelling vacuum cleaner 10 approaches the wall, suction port 101 is located much closer to the wall compared to a configuration in which suction port 101 is disposed between drive units 30.
Thus, with such configuration in which suction port 101 is disposed at a position closer to the front side of the outer periphery of body 20 than drive unit 30, preferably adjacent to maximum width line W of body 20, more preferably adjacent to the maximum width part of body 20 in the area closest to front surface 21 of body 20, the trash can be sucked more reliably and directly from suction port 101.
(3) In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, the maximum width of body 20 is defined by both front apex parts 23. Namely, the maximum width of body 20 is determined by a distance between the apex of right side front apex part 23 and the apex of left side front apex part 23.
Further, in self-travelling vacuum cleaner 10, a width of a rear part of body 20 is narrower than a width of a front part of body 20. Specifically, a width at a rear part of body 20 which is defined to be a part on a rear side of body 20 with respect to the center of gravity G of self-travelling vacuum cleaner 10 is narrower than a width at a front part of body 20 which is defined to be a part on a front side of body 20 with respect to the center of gravity G of self-travelling vacuum cleaner 10.
With such configuration, when self-travelling vacuum cleaner 10 turns around an object, since the possibility of contact between the rear part of body 20 and the object is reduced and self-travelling vacuum cleaner 10 can move more quickly, moving ability of self-travelling vacuum cleaner 10 can be enhanced.
(4) Self-travelling vacuum cleaner 10 according to the present exemplary embodiment can adopt a steering type driving system. On the other hand, as described above, self-travelling vacuum cleaner 10 according to the present exemplary embodiment can also adopt the facing two wheels type driving system. According to a configuration in which the facing two wheels type driving system is adopted, a structure can be simplified compared to the steering type driving system. In this point, the configuration in which the facing two wheels type driving system is adopted is more preferable.
(5) In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, a positional relationship between rotation axis H of each drive unit 30 and the center of gravity G of self-travelling vacuum cleaner 10 is one of the main factors to determine a movable track of body 20. In self-travelling vacuum cleaner 10, rotation axis H of drive unit 30 may be arranged to be located at a part on the rear side of body 20 farther than the center of gravity G of self-travelling vacuum cleaner 10. In such configuration, self-travelling vacuum cleaner 10 is apt to turn while changing a position of the center of gravity G thereof in the target region to be cleaned by making contact with the object around. Thus, in self-travelling vacuum cleaner 10, at least a part of the rectangular track drawn by the Reuleaux triangle described above can be appropriately traced by body 20 and therefore the corner cleaning ability can be enhanced.

SECOND EXEMPLARY EMBODIMENT

[0073] FIG. 8 is a plane view of self-travelling vacuum cleaner 10 according to a second exemplary embodiment of the present invention. FIG. 9 is a bottom view of the self-travelling vacuum cleaner according to the second exemplary embodiment of the present invention.
[0074] Self-travelling vacuum cleaner 10 according to the present exemplary embodiment further has the following configuration which is not shown in the first exemplary embodiment. Here, in the present exemplary embodiment, an element to which the same reference mark as the first exemplary embodiment is assigned has the same or a similar function to the corresponding element in the first exemplary embodiment.
[0075] As shown in FIG. 9, cleaning unit 40 may further have side brush 44 disposed on a bottom side of lower unit 100 of body 20, and gear boxes 42 arranged at a right side and a left side of suction port 101 respectively. In the present exemplary embodiment, side brushes 44 are arranged at a right side and a left side on the bottom side of lower unit 100 of body 20 respectively. One gear box 42 (right side of body 20 in a plane view) is connected to an output shaft of brush driving motor 41, main brush 43, and one side brush 44. One gear box 42 transmits torque of brush driving motor 41 to main brush 43 and one side brush 44. Another gear box 42 (left side of body 20 in a plane view) is connected to main brush 43 and another side brush 44. Another gear box 42 transmits torque of main brush 43 to another side brush 44.
[0076] In the present exemplary embodiment, one side brush 44 has brush shaft 44A and a plurality of bristle bundles 44B mounted to one of two front apex parts 23 of body 20. Another side brush 44 has brush shaft 44A and a plurality of bristle bundles 44B mounted to another one of two front apex parts 23 of body 20. Side brush 44 is disposed with respect to body 20 such that a part of a rotation track of side brush 44 (hereinafter, it means a circular track drawn by side brush 44 when side brush

44 is rotated once) capable of collecting the trash to suction port 101 is located in the maximum width part of body 20. According to the present exemplary embodiment, a number of bristle bundles 44B mounted to each brush shaft 44A is three, and three bristle bundles 44B are mounted to brush shaft 44A at a predetermined angular interval.

[0077] Each brush shaft 44A has a rotation axis extending in the same or a substantially same direction as a height direction of body 20. Each brush shaft 44A is supported by body 20 in a rotatable manner against body 20, and disposed at a part of the front side of body 20 closer to the outer periphery of the front side of body 20 than the center line of suction port 101 in a longitudinal direction.

[0078] Each of bristle bundles 44B is formed by a plurality of bristles and fixed to brush shaft 44A so as to extend in the same or a substantially same direction as a radius direction of brush shaft 44A. According to the present exemplary embodiment, a length of bristle bundles 44B is set such that a tip of bristle bundles 44B is protruded toward an outside from the outline of body 20.

[0079] A rotation direction of each side brush 44 is set, as shown by an arrow AS in FIG. 8, to a direction in which the rotation track of side brush 44 is directed from a front side toward a rear side of body 20 at a center side in the width direction of body 20. Namely, side brushes 44 are rotated in directions opposite to each other. In the present exemplary embodiment, each side brush 44 is rotated from the front side toward the rear side of body 20 at a part of its rotation track adjacent to the rotation track of another side brush 44.

[0080] According to self-travelling vacuum cleaner 10 of the present exemplary embodiment, in addition to the effects of (1) to (5) obtained from self-travelling vacuum cleaner 10 according to the first exemplary embodiment described above, following effects can be further obtained.

(6) Self-travelling vacuum cleaner 10 according to the present exemplary embodiment has side brush 44. According to such configuration, since the trash on corner area R3 (see FIGS. 5 to 7) in the target region to be cleaned is collected to suction port 101 of body 20 by side brush 44, the corner cleaning ability of self-travelling vacuum cleaner 10 can be further enhanced.

(7) In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, each of side brushes 44 is mounted to the bottom sides of two front apex parts 23 of body 20. According to such configuration, brush shaft 44A of side brush 44 can approach the apex of corner area R3 compared to conventional self-travelling vacuum cleaner 900. Thus, the corner cleaning ability of self-travelling vacuum cleaner 10 can be further enhanced.

(8) According to self-travelling vacuum cleaner 10 of the present exemplary embodiment, two side brushes 44 are rotated in the directions opposite to each other. Each side brush 44 is rotated from the front side toward the rear side of body 20 at a part of its rotation track adjacent to the rotation track of another side brush 44. According to such configuration, since the trash is collected to suction port 101 from the front side of body 20 by side brush 44, the trash can be easily sucked from suction port 101 compared to, for example, a configuration in which the trash is collected to suction port 101 from around a side area of suction port 101. Thus, the trash on the cleaning surface of corner area R3 can be removed efficiently.

(9) In the conventional self-travelling vacuum cleaner having the side brush, in order to collect the trash on the cleaning surface of corner area R3 to suction port 101 of body 20, it may be considered to set a length of the bristle bundles to be longer. However, in a case in which the length of the bristle bundles is set to be longer, the bristle bundles may be caught by the object around when the self-travelling vacuum cleaner is travelling.

On the other hand, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, each of side brushes 44 is arranged at two front apex parts 23 of body 20. With such configuration, suction port 101 of body 20 can further approach apex part R4 of corner area R3. This configuration can eliminate the need for setting the length of the bristle bundles to be longer, and therefore the length of bristle bundles 44B can be set to be a relatively short length. Thus, a possibility that bristle bundles 44B is caught by the object around can be reduced.

(10) According to the conventional self-travelling vacuum cleaner having the side brush, the bristle bundles are apt to be bent when the bristle bundles move the trash as the length of the bristle bundles becomes longer. And when the bristle bundles are largely bent, the bristle bundles might not move the trash appropriately to the suction port of the body.

[0081] On the other hand, self-travelling vacuum cleaner 10 according to the present exemplary embodiment can set the length of bristle bundles 44B to be relatively shorter as described above. Since the length of bristle bundles 44B can be set to the relatively short length, a bending amount of bristle bundles 44B is decreased. Thus, the trash on corner area R3 can be collected more reliably to suction port 101 by bristle bundles 44B.

THIRD EXEMPLARY EMBODIMENT

[0082] FIG. 10 is a perspective view of self-travelling vacuum cleaner 10 according to a third exemplary embodiment of the present invention. Self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have the following configurations which are not shown in the second exemplary embodiment.

Here, in the third exemplary embodiment, an element to which the same reference mark as the second exemplary embodiment is assigned has the same or a similar function to the corresponding element in the second exemplary embodiment.

[0083] Self-travelling vacuum cleaner 10 shown in FIG. 10 illustrates self-travelling vacuum cleaner 10 shown in FIGS. 1 to 9 in detail. As shown in FIG. 11, each of front apex parts 23 and rear apex part 24 of body 20 has a round shape (circular arc R). Upper unit 200 has a plurality of exhaust ports 211 which communicate an inner space of body 20 with an outside, recess part 214 formed at a front side of lid 220, light receiving part 212 which is a communication part disposed in recess part 214, and lid button 213 for opening lid 220. The plurality of exhaust ports 211 is arranged, for example, along an edge of lid 220.

[0084] Light receiving part 212 receives a signal output from a charge mount (not shown) which charges self-travelling vacuum cleaner 10 or a signal output from a remote controller (not shown) which operates self-travelling vacuum cleaner 10. When light receiving part 212 receives the signal, light receiving part 212 outputs a receiving signal corresponding to the signal to control unit 70 (see FIG. 9 and FIG. 15). Surface 215 of recess part 214 including an edge of recess part 214 is inclined such that a part at an outer peripheral side of body 20 is to be lower than a part at a center side of body 20. With such configuration, recess part 214 functions as a parabola antenna and therefore communication ability of light receiving part 212 can be enhanced.

[0085] FIG. 11 is a plane view of self-travelling vacuum cleaner 10 according to the present exemplary embodiment. In the present exemplary embodiment, self-travelling vacuum cleaner 10 has a substantially linear symmetrical shape with respect to a center line extending in a front-rear direction of body 20 (upper side in Fig. 11 is front side, and lower side in FIG. 11 is rear side). Bumper 230 has a pair of curved protruded parts 231 protruded from front apex part 23. Curved protruded part 231 is curved along the round shape (circular arc R) of side surface 22 and forms a part of the outline of body 20.

[0086] Next, upper unit 200 of self-travelling vacuum cleaner 10 according to the present exemplary embodiment is described.

[0087] FIG. 12 is a plane view of self-travelling vacuum cleaner 10 according to the present exemplary embodiment in which lid 220 is opened. Upper unit 200 may further have interface part 240 in which a member operated by a user is disposed, and trash box receiver 250 which supports trash box unit 60, in addition to cover 210, lid 220, and bumper 230. Lid 220 has a pair of arms 221 forming a hinged structure of lid 220. As shown in FIG. 24 illustrating a bottom side of upper unit 200 and in FIG. 25 illustrating an upper side of upper unit 200, upper unit 200 may further have a pair of arm housing parts 260 which house arms 221.

[0088] As shown in FIG. 12, interface part 240 forms a part of cover 210 and when lid 220 is closed, interface part 240 is closed (see FIG. 11) and when lid 220 is opened, interface part 240 is opened. According to the present exemplary embodiment, interface part 240 has operation button 242 for turning on and off of the movement of self-travelling vacuum cleaner 10, and panel 241 including display part 243 and the like, which displays information of self-travelling vacuum cleaner 10. Panel 241 may further have an operation button (not shown) for inputting various settings with respect to the movement of self-travelling vacuum cleaner 10. In the present exemplary embodiment, main switch 83 is disposed in interface part 240.

[0089] FIG. 24 is a perspective view at the bottom side of upper unit 200 of self-travelling vacuum cleaner 10.

[0090] Trash box receiver 250 is formed in a box shape having an opening at an upper side of upper unit 200. Trash box receiver 250 has bottom opening 251 opened at a bottom side of body 20 and rear opening 252 opened at a rear side of body 20. As shown in FIG. 12, trash box unit 60 is inserted into trash box receiver 250.

[0091] Next, lower unit 100 of self-travelling vacuum cleaner 10 according to the present exemplary embodiment is described.

[0092] FIG. 13 is a bottom view of self-travelling vacuum cleaner 10 according to the present exemplary embodiment.

[0093] Lower unit 100 has base 110 forming a frame, and supporting shaft 91 which is disposed parallel to the longitudinal direction of suction port 101 and supports caster 90. Base 110 has power port 102 opened at the bottom side of body 20 and formed in a shape corresponding to power source unit 80, and a pair of charge terminals 103 connected to the charge mount (not shown).

[0094] In the present exemplary embodiment, power port 102 is disposed at a part on a rear side of body 20 farther than the center of gravity G of self-travelling vacuum cleaner 10 and a part of power port 102 is disposed between a pair of drive units 30. Further, charge terminal 103 is disposed at the front side of body 20 farther than suction port 101. According to the present exemplary embodiment, each charge terminal 103 is disposed in a part at a side of front surface 21 on the bottom surface of base 110.

[0095] Base 110 further has bottom part shaft receiver 111 which supports support shaft 91. Bottom part shaft receiver 111 is disposed at a part on a rear side of body 20 farther than drive unit 30. According to the present exemplary embodiment, bottom part shaft receiver 111 is disposed on the bottom surface of base 110 at a part on a rear side of body 20 farther than power port 102 and at the bottom side of rear apex part 24.

[0096] Support shaft 91 is inserted into caster 90 so as to allow caster 90 to rotate. End parts of support shaft 91 are fixed into bottom part shaft receivers 111, respectively. With such configuration, caster 90 is mounted to base 110 in a rotatable manner.

[0097] Self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have magnet 77 which can be detected by a hall element (not shown) disposed in the charge mount. Magnet 77 is preferably disposed closer to charge terminal 103. According to the present exemplary embodiment, a distance between magnet 77 and charge terminal 103 is shorter than a distance between magnet 77 and suction port 101. With such configuration, when self-travelling vacuum cleaner 10 approaches the charge mount, magnet 77 is easily detected by the charge mount.

[0098] FIG. 14 is a side view of self-travelling vacuum cleaner 10 according to the present exemplary embodiment.

[0099] According to the present exemplary embodiment, main brush 43 is rotated in a direction of arrow AM. A distance between a rotation axis of wheel 33 of drive unit 30 and a rotation axis of caster 90 is longer than a distance between the rotation axis of wheel 33 and a rotation axis of main brush 43. With such configuration, a position of body 20 can be stabilized.

[0100] FIG. 15 is an exploded perspective view of lower unit 100 when seen from the front side.

[0101] At an upper side of lower unit 100, gear box 42 (in the present exemplary embodiment, a pair of gear boxes 42), sucking unit 50, trash box unit 60 (see FIG. 12), and control unit 70 are mounted. Brush driving motor 41 is housed in gear box 42 (in FIG. 15, one of a pair of gear boxes 42).

[0102] Lower unit 100 may further have brush housing 170 mounted at an upper side of base 110, in addition to base 110. Brush housing 170 may have duct 171 having a space for housing main brush 43 and connected to trash box unit 60.

[0103] According to the present exemplary embodiment, fan case 52 has front side case 52A disposed at a front side of electric fan 51, and rear side case 52B disposed at a rear side of electric fan 51. Fan case 52 is formed by combining front side case 52A and rear side case 52B. Fan case 52 may further have suction port 52C facing exit 61B (see FIG. 17) of trash box 61, discharging port 52D (see FIG. 19) opened at a side of drive unit 30, and louver 52E which covers suction port 52C.

[0104] FIG. 16 is an exploded perspective view of the bottom side of lower unit 100 of self-travelling vacuum cleaner 10 according to the present exemplary embodiment.

[0105] At the bottom side of lower unit 100, drive unit 30, main brush 43, side brush 44, caster 90, and power source unit 80 are mounted. In the present exemplary embodiment, as shown in FIG. 16, drive units 30 are disposed at the right side and the left side as a pair at the bottom side of lower unit 100, and side brushes 44 are also arranged at the right side and the left side as a pair. Here, a number of a pair of drive units 30 and a pair of side brushes 44 are not limited to one. One or more than three drive units or side brushes may be disposed.

[0106] Lower unit 100 may further have brush cover 180 mounted at the bottom side of brush housing 170, and holding frame 190 mounted to power port 102 (see FIG. 13). Holding frame 190 holds power source unit 80 in conjunction with base 110 when holding frame 190 is fixed to power port 102.

[0107] Base 110 and brush cover 180 have a detachable structure in which a user can arbitrarily select a state in which brush cover 180 is mounted to base 110 and a state in which brush cover 180 is detached from base 110.

[0108] Further, base 110 and holding frame 190 have a detachable structure in which a user can arbitrarily select a state in which holding frame 190 is mounted to base 110 and a state in which holding frame 190 is detached from base 110.

[0109] FIG. 20 is a perspective view illustrating a structure of lower unit 100 of self-travelling vacuum cleaner 10 according to the present exemplary embodiment. FIG. 21 is a perspective view of lower unit 100 of self-travelling vacuum cleaner 10 according to the present exemplary embodiment when seen from the side. FIG. 22 is a perspective view of lower unit 100 according to the present exemplary embodiment when seen from the front side.

[0110] Base 110 has a plurality of functional regions. For example, in the present exemplary embodiment, base 110 has driving part 120, cleaning part 130, trash box part 140, sucking part 150, and power source part 160 as a plurality of functional regions.

[0111] Driving part 120 is a functional region which houses drive unit 30, and has a plurality of elements. For example, in the present exemplary embodiment, driving part 120 has wheel house 121 which is opened at the bottom side of base 110 and houses drive unit 30, and spring hooked part 122 to which suspension spring 36 (see FIG. 21) forming a suspension mechanism described below is hooked. Further, in the present exemplary embodiment, a pair of wheel houses 121 is disposed so as to correspond to a pair of drive units 30, and further a pair of spring hooked parts 122 is disposed so as to correspond to a pair of suspension springs 36.

[0112] As shown in FIG. 20, each wheel house 121 is protruded upward from an upper surface of base 110 and is disposed at a side adjacent to side surface 22 (see FIG. 19) in base 110. Each spring hooked part 122 is formed at a front part of wheel house 121 and is protruded substantially upward from wheel house 121. As shown in FIG. 21, running off detecting switch 75 is disposed above each wheel house 121. Running off detecting switch 75 is pushed by spring hooked part 32B when drive unit 30 (see FIG. 15) is run off from the cleaning surface of the target region to be cleaned.

[0113] Cleaning part 130 shown in FIG. 20 is a functional region which supports cleaning unit 40 (see FIG. 2), and has a plurality of elements. Specifically, in the present exemplary embodiment, cleaning part 130 has a pair of shaft insertion parts 131 which supports brush shaft 44A (see FIG. 22) of side brush 44, and connecting part 132 in which gear box 42 (see FIG. 22) is disposed.

Brush housing 170 and brush cover 180 shown in FIG. 16 form a part of cleaning part 130.

[0114] FIG. 17 is a cross-sectional view taken along line XVII-XVII in FIG. 11. FIG. 18 is a cross-sectional view taken along line XVII-XVII in FIG. 11 in which a part of components of self-travelling vacuum cleaner 10 according to the present exemplary embodiment is separated. FIG. 19 is a cross-sectional view taken along line XIX-XIX in FIG. 14.

[0115] As shown in FIG. 17, when the main brush 43 is disposed inside brush housing 170, both end parts of main brush 43 are protruded from brush housing 170 toward connecting parts 132 (see FIG. 20). Brush shaft 44A of side brush 44 shown in FIG. 15 is inserted into a hole formed in shaft insertion part 131 (see FIG. 20).

[0116] One gear box 42 shown in FIG. 15 is disposed in one connecting part 132 (see FIG. 20) and is connected to one end of main brush 43 and one brush shaft 44A. Another gear box 42 is disposed in another connecting part 132 (see FIG. 20) and is connected to another end of main brush 43 and another brush shaft 44A.

[0117] As shown in FIG. 20, trash box part 140 is a functional region formed between cleaning part 130 and sucking part 150 in the front-rear direction of body 20 and has a space in which trash box receiver 250 (see FIG. 18) is disposed.

[0118] Further, sucking part 150 is a functional region which supports sucking unit 50 (see FIG. 15) and is disposed at a substantially center part of base 110 or adjacent thereof. Wheel house 121 is disposed at a side part of sucking part 150. In the present exemplary embodiment, a pair of wheel houses 121 is disposed.

[0119] Power source part 160 is a functional region which supports power source unit 80 (see FIG. 16) and is a recess part recessed toward an upper side when seen from a bottom surface of base 110. Control unit 70 is mounted above power source part 160.

[0120] As shown in FIG. 17, brush cover 180 is mounted to base 110 so as to protrude downwardly from the bottom surface of base 110. Brush cover 180 has suction port 101 which exposes main brush 43 to an outside of body 20, and inclined surface 181 formed at a front part of body 20. Inclined surface 181 is formed such that a distance between the bottom surface of lower unit 100 and inclined surface 181 is increased as it goes from the rear side toward the front side of body 20. With such configuration, when inclined surface 181 makes contact with a stepped part on the cleaning surface of the target region to be cleaned, the front side of body 20 can rise.

[0121] Duct 171 is formed to extend in a substantially vertical direction of body 20 and has entrance 172 which houses an upper part of main brush 43 and exit 173 which communicates with an inner space of trash box unit 60. Exit 173 is inserted into bottom opening 251 of trash box receiver 250. A passage area of exit 173 is smaller than a passage area of entrance 172. According to an example shown in FIG. 17 and the like, a passage inside duct 171 is slightly inclined toward the rear side of body 20 as it goes from entrance 172 to exit 173. With such configuration, the trash sucked inside body 20 via suction port 101 can be guided to a side of filter 62 described below.

[0122] As shown in FIG. 18, trash box unit 60 has trash box 61 having a space for storing trashes, and filter 62 mounted to trash box 61. Trash box 61 has entrance 61A connected to exit 173 of duct 171, exit 61B in which filter 62 is disposed, and bottom part 61C in which its size is set to be smaller than a size of an upper part.

[0123] As shown in FIG. 19, filter 62 is disposed in rear opening 252 of trash box receiver 250 so as to be across substantially a whole region of trash box 61 in a width direction. Filter 62 faces sucking unit 50. As shown in FIG. 17, bottom part 61C of trash box 61 is disposed between a rear side of duct 171 and a front side of fan case 52. With such configuration, bottom part 61C is disposed at a lower position in a height direction of body 20, and therefore a center of gravity of trash box 61 can be lowered.

[0124] As shown in FIG. 17, sucking unit 50 is disposed so as to be inclined relative to base 110. Specifically, sucking unit 50 is disposed such that a bottom part of sucking unit 50 is positioned at a part on a front side of body 20 relative to a top part of sucking unit 50, and the top part of sucking unit 50 is positioned at a part on a rear side of body 20 relative to the bottom part of sucking unit 50. With such configuration, the height of body 20 can be lowered.

[0125] As shown in FIG. 19, one side part of fan case 52 is closed and discharging port 52D is disposed at another side part. With such configuration, a flow of air discharged from electric fan 51 can be stabilized.

[0126] FIG. 23 is another perspective view of the inner structure of lower unit 100 of self-travelling vacuum cleaner 10 according to the present exemplary embodiment when seen from the front side along a different view line from that in FIG. 22.

[0127] As shown in FIG. 21, FIG. 22, and FIG. 23, lower unit 100 of self-travelling vacuum cleaner 10 according to the present exemplary embodiment has gear box 42, main brush 43, side brush 44, sucking unit 50, control unit 70, and power source unit 80 (see FIG. 17).

[0128] FIG. 25 is a bottom view of upper unit 200 of self-travelling vacuum cleaner 10 according to the present exemplary embodiment.

[0129] When upper unit 200 shown in FIG. 24 and FIG. 25 is mounted to lower unit 100 as described above, body 20 is formed as shown in FIG. 10.

[0130] Next, drive unit 30 of self-travelling vacuum cleaner 10 according to the present exemplary embodiment is described in detail.

[0131] Drive unit 30 has a function which drives self-travelling vacuum cleaner 10 in a forward direction and a rearward direction, or drives self-travelling vacuum cleaner 10 to turn. Drive unit 30 is provided with a plurality of elements. For example, in the present exemplary embodiment, as shown in FIGS. 15 and 16, each drive unit 30 has travel motor 31 (see FIG. 19), housing 32, wheel

33, and tire 34 mounted around wheel 33, as a plurality of elements. Block type tread patterns may be formed on tire 34.

[0132] In the present exemplary embodiment, each drive unit 30 further has support shaft 35 having a rotation axis of housing 32, and a suspension mechanism which absorbs impact applied to wheel 33 by using suspension spring 36 (see FIG. 21).

[0133] Each housing 32 has motor housing part 32A which houses travel motor 31, spring hooked part 32B to which one end of suspension spring 36 is hooked, and shaft receiving part 32C into which support shaft 35 is fitted. Each wheel 33 is supported by housing 32 in a rotatable manner against housing 32.

[0134] One end of support shaft 35 is fitted into shaft receiving part 32C, and another end is inserted into a shaft receiving part formed in diving part 120. With such configuration, housing 32 and support shaft 35 can be rotated around the rotation axis of support shaft 35 against driving part 120.

[0135] As shown in FIG. 21, another end of each suspension spring 36 is hooked to spring hooked part 122 of driving part 120. Each suspension spring 36 applies reaction force to housing 32 in a direction to push tire 34 (see FIG. 16) against the cleaning surface of the target region to be cleaned. With such configuration, a state in which tire 34 makes contact with the cleaning surface is maintained.

[0136] On the other hand, when force to push up tire 34 shown in FIG. 16 toward a side of body 20 is applied to tire 34 from the cleaning surface, housing 32 is rotated around a center line of support shaft 35 from a side of the cleaning surface toward a side of body 20 while compressing suspension spring 36 (see FIG. 21). With such configuration, the force applied to tire 34 is absorbed by suspension spring 36.

[0137] Further, when wheel 33 is run off, housing 32 is rotated against driving part 120 by the reaction force of suspension spring 36 (see FIG. 21), and therefore spring hooked part 32B pushes running off detecting switch 75 (see FIG. 21). With this, running off detecting switch 75 shown in FIG. 21 outputs a signal to control unit 70. Control unit 70 stops the travelling of self-travelling of vacuum cleaner 10 based on the signal.

[0138] A distance between brush driving motor 41 and one of a pair of drive units 30 (in the present exemplary embodiment, first drive unit 30 as left side drive unit 30) connected to brush driving motor 41 is shorter than a distance between brush driving motor 41 and another drive unit 30 (in the present exemplary embodiment, second drive unit 30 as right side drive unit 30) not connected to brush driving motor 41. Thus, weight of brush drive unit 41 is applied largely to wheel 33 and tire 34 of first drive unit 30. Thus, in a case in which suspension springs 36, which apply the reaction force to respective drive units 30, have the same elastic modulus, positions of wheels 33 against body 20 may not be balanced. Thus, elastic modulus of suspension spring 36 which applies the reaction force to first drive unit 30 is set to be larger than elastic modulus of suspension spring 36 which applies the reaction force to second drive unit 30.

[0139] With such configuration, the balance of positions of wheels 33 against body 20 is maintained.

[0140] As shown in FIG. 21 to FIG. 23, self-travelling vacuum cleaner 10 has a plurality of floor detecting sensors 74. According to the present exemplary embodiment, the plurality of floor detecting sensors 74 includes three floor detecting sensors 74 disposed at the front side of body 20 relative to a pair of drive units 30, and two floor detecting sensors 74 disposed at a part on the rear side of body 20 relative to the pair of drive units 30.

[0141] For example, front side three floor detecting sensors 74 include a sensor mounted at a center of the front side of base 110, a sensor mounted to right side front apex part 23 of base 110, and a sensor mounted to left side front apex part 23 of base 110. As shown in FIG. 19, for example, rear side two floor detecting sensors 74 include a sensor mounted adjacent to right side surface 22 of base 110, and a sensor mounted adjacent to left side surface 22 of base 110.

[0142] As shown in FIG. 13, base 110 has a plurality of sensor windows 112, each of which corresponds to each floor detecting sensor 74. The plurality of sensor windows 112 includes sensor window 112 corresponding to front side center floor detecting sensor 74, sensor window 112 corresponding to front right side floor detecting sensor 74, and sensor window 112 corresponding to front left side floor detecting sensor 74. The plurality of sensor windows 112 further includes sensor window 112 corresponding to rear right side floor detecting sensor 74, and sensor window 112 corresponding to rear left side floor detecting sensor 74.

[0143] As shown in FIG. 24, obstacle detecting sensor 71 has one transmitting part 71A which outputs ultrasonic wave, and two receiving parts 71B which receive the reflected ultrasonic wave. Transmitting part 71A and receiving part 71B are mounted to a back surface of bumper 230.

[0144] Upper unit 200 has a plurality of windows in addition to cover 210, lid 220, and bumper 230. According to the present exemplary embodiment, the plurality of the windows includes transmitting window 232 disposed at a front side center part shown in FIG. 10, receiving windows 233 disposed at front side right and left parts, and a pair of distance measuring windows 234 disposed at right and left front apex parts 23.

[0145] As shown in FIG. 19, transmitting window 232 is formed in bumper 230 so as to correspond to transmitting part 71A of obstacle detecting sensor 71. With this, the ultrasonic wave output from transmitting part 71A is guided to an outside through transmitting window 232.

[0146] Receiving window 233 is formed in bumper 230 so as to correspond to each receiving part 71B of obstacle detecting sensor 71. With this, the ultrasonic wave reflected by the object around is guided to each receiving part 71B through each receiving window 233.

[0147] Each of a pair of distance measuring windows 234 is formed in bumper 230 so as to correspond to distance detecting sensor 72. As shown by a dashed arrow in FIG. 19, light output from distance measuring sensor 72 is directed toward a diagonally forward direction of body 20 through distance measuring window 234.

[0148] FIG. 26 is a block diagram illustrating a function of an electric system of self-travelling vacuum cleaner 10 according to the present exemplary embodiment.

[0149] Control unit 70 is electrically connected to obstacle detecting sensor 71, distance measuring sensor 72, collision detecting sensor 73, floor detecting sensor 74, running off detecting switch 75, light receiving part 212, operation button 242, a pair of travel motor 31, brush driving motor 41, electric fan 51, and display part 243.

[0150] Self-travelling vacuum cleaner 10 according to the present exemplary embodiment is, for example, operated as described below.

[0151] Control unit 70 starts operation of both right and left travel motors 31, brush driving motor 41, and electric fan 51 when self-travelling vacuum cleaner 10 is turned on by operation of operation button 242.

[0152] When electric fan 51 is driven, air inside trash box 61 shown in FIG. 17 is sucked to electric fan 51, and air inside electric fan 51 is exhausted around electric fan 51. Thus, air residing on a bottom side of base 110 is sucked to an inside of trash box 61 via suction port 101 and duct 171, and air inside fan case 52 is exhausted to an outside of body 20 via a plurality of exhaust ports 211 shown in FIG. 10. Namely, the air at a bottom part of base 110 shown in FIG. 17 is flowed suction port 101, duct 171, trash box 61, filter 62, electric fan 51, fan case 52, a space around fan case 52 in body 20, and exhaust port 211 in this order.

[0153] Control unit 70 shown in FIG. 26 sets a travel route of self-travelling vacuum cleaner 10 based on detection signals input from obstacle detecting sensor 71, distance measuring sensor 72, collision detecting sensor 73, and floor detecting sensor 74, and makes self-travelling vacuum cleaner 10 travel in accordance with the set travel route. When corner area R3 in the target region to be cleaned is included in the travel route, control unit 70 makes self-travelling vacuum cleaner 10 travel and turn similar to a case in which self-travelling vacuum cleaner 10 according to the first exemplary embodiment described above cleans corner area R3 (see FIG. 5 to FIG. 7).

[0154] According to self-travelling vacuum cleaner 10 according to the present exemplary embodiment, in addition to the effects of (1) to (10) obtained by self-travelling vacuum cleaner 10 according to the second exemplary embodiment described above, for example, the following effect can be obtained.

(11) Self-travelling vacuum cleaner 10 according to the present exemplary embodiment has front apex part 23 and rear apex part 24 in which the round shape (circular arc R) is formed. With such configuration, when body 20 is turned by making contact with the object around, body 20 can make contact softly with the object.

FOURTH EXEMPLARY EMBODIMENT

[0155] FIG. 27 is a perspective view illustrating a structure of trash box unit 300 disposed in self-travelling vacuum cleaner 10 according to a fourth exemplary embodiment of the present invention. FIG. 28 is a cross-sectional view of self-travelling vacuum cleaner 10 according to the present exemplary embodiment.

[0156] The structure of self-travelling vacuum cleaner 10 according to the present exemplary embodiment corresponds with most parts of the structure of self-travelling vacuum cleaner 10 according to the third exemplary embodiment; however, the following two points are mainly different from the third exemplary embodiment:

A first point is that, as shown in FIG. 27 and FIG. 28, trash box unit 300 having a different structure from trash box unit 60 according to the third exemplary embodiment described above is disposed.

A second point is that, as shown in FIG. 28, a structure around trash box unit 300 in body 20 is modified.

Here, in the descriptions of the present exemplary embodiment, an element to which the same reference mark as the third exemplary embodiment is assigned have the same or a similar functions to the corresponding element of the third exemplary embodiment.

[0157] As shown in FIG. 28, a position of trash box unit 300 inside body 20 is substantially the same as the position of trash box unit 60 in body 20 according to the third exemplary embodiment described above. Body 20 and trash box unit 300 have a detachable structure in which a user can arbitrary select a state in which trash box unit 300 is mounted to body 20 and a state in which trash box unit 300 is detached from body 20.

[0158] As shown in FIG. 27, trash box unit 300 has trash box 310 having a space 311 to store trashes, lid 320 which closes exit 313 as an opening of trash box 310, and filter 330 mounted to lid 320. Trash box 310 and lid 320 are connected by hinge 360. Trash box 310 has entrance 312 connected to exit 173 (see FIG. 28) of duct 171, and exit 313 in which filter 330 is disposed.

[0159] As shown in FIG. 28, when lid 320 is closed, space 311 is closed by lid 320. Duct 171 is formed in an elongate shape extended in substantially a vertical direction of body 20. Duct 171 has entrance 172 formed at a front side of main brush 43 and exit 173 opened at a rear side of body 20. Suction port 101 and trash box 310 are communicated by passage 174 formed inside duct 171.

[0160] Self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have trash detecting sensor 76 which detects information with respect to the trash included in air flowed in duct 171. As

shown in FIG. 28, trash detecting sensor 76 is disposed in passage 174 of duct 171. Trash detecting sensor 76 is preferably disposed in a region in passage 174 of duct 171 in which a flowing speed of air is faster than that on center line 175 of passage 174 in a cross section of passage 174 taken along a flowing direction of air in passage 174. For example, an infrared sensor is used for trash detecting sensor 76. Trash detecting sensor 76 has a light transmitting part and a light receiving part. A detection signal of trash detecting sensor 76 is input to control unit 70.

[0161] As shown in FIG. 27, filter 330 has collecting part 340 which collects trashes in air passing through thereof, and frame 350 which supports collecting part 340. Frame 350 and lid 320 have a detachable structure to each other. Frame 350 has a pair of windows 351 in which collecting part 340 is disposed, and intermediate wall 352 which partitions a pair of windows 351. In a state in which space 311 is closed by lid 320, entrance 312 of trash box 310 does not face collecting part 340 but intermediate wall 352 of frame 350. Thus, the flow of air passed through entrance 312 is separated in two directions by intermediate wall 352, and each air in the separated flow is passed through each collecting part 340 disposed in each of a pair of windows 351.

[0162] According to a configuration of self-travelling vacuum cleaner 10 according to the present exemplary embodiment described above, in addition to the effects of (1) to (11) obtained by self-travelling vacuum cleaner 10 according to the first to third exemplary embodiments described above, for example following effects can be obtained.

(12) In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, trash detecting sensor 76 is disposed in the region in passage 174 of duct 171 in which the flowing speed of air is faster than that on center line 175 of passage 174 in the cross section of passage 174 taken along the flowing direction of air in passage 174. With such configuration, even if the trash adheres to a surface of trash detecting sensor 76, the adhered trash is easily blown away from the surface of trash detecting sensor 76 by air flowed through passage 174.

(13) Generally, in a self-travelling vacuum cleaner, a size of a trash box to be mounted is restricted. Thus, in a case in which a collecting part of a filter is disposed at a part facing an entrance of the trash box, the trash is concentrated and stored on a part of the collecting part facing the trash box, and therefore the entrance may be blocked by the trash even if there is a space to store the trashes in other part of the collecting part.

[0163] On the other hand, according to self-travelling vacuum cleaner 10 according to the present exemplary embodiment, entrance 312 of trash box 310 does not face collecting part 340 but intermediate wall 352 of frame 350. With such configuration, it is possible to prevent the trash from being concentrated and stored on the part of collecting part 340 facing entrance 312 of trash box 310.

MODIFIED EXAMPLE

[0164] The present invention includes, for example, modified examples described below in addition to the exemplary embodiments described above.

[0165] Body 20 of self-travelling vacuum cleaner 10 according to a first to a third modified examples of the present invention has an outline different from the outline of body 20 shown in the exemplary embodiments described above.

FIRST MODIFIED EXAMPLE

[0166] FIG. 29 is a plane view of self-travelling vacuum cleaner 10 according to a first modified example of the present invention. A double-dashed line in FIG. 29 shows the outline of representative body 20 shown in the first exemplary embodiment described above. As shown in FIG. 29, in body 20 of self-travelling vacuum cleaner 10 according to the first modified example of the present invention, each side surface 22 is provided with front side surface 22A and rear side surface 22B of body 20 formed in shapes different from each other. According to the present modified example, front side surface 22A is formed in a curved shape, and rear side surface 22B is formed in a flat shape.

[0167] In self-travelling vacuum cleaner 10 provided with body 20 having such an outline, the similar effects obtained in each of the exemplary embodiments described above can be also obtained.

SECOND MODIFIED EXAMPLE

[0168] FIG. 30 is a plane view of self-travelling vacuum cleaner 10 according to a second modified example of the present invention. A double-dashed line in FIG. 30 shows the outline of representative body 20 shown in the first exemplary embodiment described above. As shown in FIG. 30, in body 20 of self-travelling vacuum cleaner 10 according to the present modified example, rear surface 25 is formed instead of forming a part of a rear part of body 20 including rear apex part 24. In the present modified example, rear surface 25 is formed in a curved shape protruded outwardly. Here, rear surface 25 may be formed in a flat shape.

[0169] In self-travelling vacuum cleaner 10 provided with body 20 having such an outline, the similar effects obtained in each of the exemplary embodiments described above can be also obtained.

THIRD MODIFIED EXAMPLE

[0170] FIG. 31 is a plane view of self-travelling vacuum cleaner 10 according to a third modified example of the

present invention. A double-dashed line in the figure shows the outline of representative body 20 shown in the third exemplary embodiment described above. As shown in FIG. 31, in body 20 of the present modified example, rear surface 25 is formed instead of forming a part of a rear part of body 20 including rear apex part 24. Rear surface 25 is formed in a flat shape. Here, rear surface 25 may be formed in a curved shape protruded outwardly.

[0171] In self-travelling vacuum cleaner 10 provided with body 20 having such an outline, the similar effects obtained in each exemplary embodiment described above can be also obtained.

FOURTH MODIFIED EXAMPLE

[0172] In self-travelling vacuum cleaner 10 according to a fourth modified example of the present invention, each side brush 44 is rotated from the rear side toward the front side of body 20 at a part of its rotation track adjacent to the rotation track of another side brush 44. According to such configuration, the trash moved by side brush 44 can be moved toward the front side in a center region in the width direction of body 20. With this, since the trash collected by side brush 44 is apt to approach suction port 101 when self-travelling vacuum cleaner 10 is moved in the forward movement direction, the trash may not be remained at a rear side of suction port 101.

[0173] In self-travelling vacuum cleaner 10 having such configuration, the similar effects obtained in each exemplary embodiment described above can be also obtained.

FIFTH MODIFIED EXAMPLE

[0174] In self-travelling vacuum cleaner 10 according to a fifth modified example of the present invention, side brush 44 has bristle bundles 44B in which a distal end thereof is located at an inner side than front surface 21 and side surface 22 of body 20.

[0175] In self-travelling vacuum cleaner 10 having such configuration, the similar effects obtained in each of the exemplary embodiments described above can be also obtained. For example, according to self-travelling vacuum cleaner 10 according to the second exemplary embodiment described above, side brushes 44 are arranged in two front apex parts 23 of body 20 respectively. Also, suction port 101 of body 20 can further approach apex part R4 in corner area R3. Such effects as those obtained in the second exemplary embodiment can be also obtained in the fifth modified example.

SIXTH MODIFIED EXAMPLE

[0176] Self-travelling vacuum cleaner 10 according to a sixth modified example of the present invention has a brush driving motor which applies torque to main brush 43 and one side brush 44, and a brush driving motor which applies torque to another side brush 44.

[0177] In self-travelling vacuum cleaner 10 having such configuration, the similar effects obtained in each of the exemplary embodiments described above can be also obtained.

SEVENTH MODIFIED EXAMPLE

[0178] Self-travelling vacuum cleaner 10 according to a seventh modified example of the present invention has three brush driving motors respectively mounted to main brush 43, right side brush 44, and left side brush 44. The brush driving motor applies torque to corresponding brush independently.

[0179] In self-travelling vacuum cleaner 10 having such configuration, the similar effects obtained in each of the exemplary embodiments described above can be also obtained.

EIGHTH MODIFIED EXAMPLE

[0180] Self-travelling vacuum cleaner 10 according to an eighth modified example of the present invention has a sensor, which is a different kind of sensor from the ultrasonic wave sensor, as obstacle detecting sensor 71. For example, as obstacle detecting sensor 71, an infrared sensor may be used.

NINTH MODIFIED EXAMPLE

[0181] Self-travelling vacuum cleaner 10 according to a ninth modified example of the present invention has a sensor, which is a different kind of sensor from the infrared sensor, as distance measuring sensor 72. For example, as distance measuring sensor 72, an ultrasonic wave sensor may be used.

TENTH MODIFIED EXAMPLE

[0182] Self-travelling vacuum cleaner 10 according to a tenth modified example of the present invention has a sensor, which is a different kind of sensor from the contact type displacement sensor, as collision detecting sensor 73. For example, as collision detecting sensor 73, an impact sensor may be used.

ELEVENTH MODIFIED EXAMPLE

[0183] Self-travelling vacuum cleaner 10 according to an eleventh modified example of the present invention has a sensor, which is a different kind of sensor from the infrared sensor, as floor detecting sensor 74. For example, as floor detecting sensor 74, an ultrasonic wave sensor may be used.

TWELFTH MODIFIED EXAMPLE

[0184] Self-travelling vacuum cleaner 10 according to a twelfth modified example of the present invention has

a plurality of casters 90 disposed at the rear side of body 20 farther than drive unit 30.

THIRTEENTH MODIFIED EXAMPLE

[0185] Self-travelling vacuum cleaner 10 according to a thirteenth modified example of the present invention has at least one caster 90 disposed at the front side of body 20 farther than a pair of drive units 30.

[0186] In self-travelling vacuum cleaner 10 having such configuration according to each of the eighth to thirteenth modified examples, the similar effects obtained in each of the exemplary embodiments described above can be also obtained.

FOURTEENTH MODIFIED EXAMPLE

[0187] Self-travelling vacuum cleaner 10 according to a fourteenth modified example has caster 90 having an uneven part on an outer peripheral surface. Friction coefficient of a first part, which is a convex part having a large diameter, on the outer peripheral surface of caster 90 is smaller than friction coefficient of a second part which is a concave part having a diameter smaller than a diameter of the first part on the outer peripheral surface of the caster.

[0188] According to such configuration, when self-travelling vacuum cleaner 10 travels, an outer peripheral surface of the first part in the outer peripheral surface of caster 90 mainly makes contact with the cleaning surface. Further, since the friction coefficient of the outer peripheral surface of the first part is smaller than the friction coefficient of the outer peripheral surface of the second part, resistance in a forward travelling of body 20 is small and therefore body 20 can be moved smoothly. Further, when body 20 is turned, since caster 90 is apt to make a sideslip, the turning ability of body 20 can be enhanced.

FIFTEENTH MODIFIED EXAMPLE

[0189] Self-travelling vacuum cleaner 10 according to a fifteenth modified example has a steering type driving system instead of the facing two wheels type driving system.

[0190] Each of the exemplary embodiments and the modified examples described above is merely one example of the present invention. For example, each of the exemplary embodiments and one or more modified examples may be combined where necessary.

[0191] Further, the present invention includes the following exemplary embodiments.

FIFTH EXEMPLARY EMBODIMENT

[0192] Self-travelling vacuum cleaner 10 according to a fifth exemplary embodiment of the present invention has body 20 having suction port 101, drive unit 30, and electric fan 51. Suction port 101 is disposed in the maximum width part of body 20. As shown in FIG. 31, body 20 has two front apex parts 23.

[0193] Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, each of the angles formed between tangent L1 (first tangent) and tangent L2 (second tangent), and between tangent L1 and tangent L3 (third tangent) is an acute angle. Tangent L1 is a tangent of an outer periphery of body 20 in a plane view and is parallel to maximum width line W of body 20. Here, maximum width line W is defined to be a line connecting apexes of two front apex parts 23. Tangent L2 and tangent L3 on two side surfaces 22 or two side surfaces 22A of body 20 are other tangents of the outer periphery of body 20 in the plane view.

[0194] According to such configuration, since a shape of body 20 is approximated to the Reuleaux triangle, body 20 can easily turn in corner area R3 in the target region to be cleaned. Further, suction port 101 can easily reach to a corner of the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0195] Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, suction port 101 is preferably formed in a laterally elongate shape, more preferably in a rectangular shape or a substantially rectangular shape. Body 20 has front surface 21 having a curved surface protruded outwardly.

[0196] Further, as shown in FIG. 31, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, each of two front apex parts 23 of body 20 has the round shape (circular arc R). In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, a curvature of the curved surface of front surface 21 of body 20 is smaller than a curvature of the round shape (circular arc R) of two front apex parts 23.

[0197] According to such configuration, since the shape of body 20 is approximated to the Reuleaux triangle, body 20 can easily turn in corner area in the target region to be cleaned. Further, suction port 101 can easily reach to corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0198] Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, suction port 101 is disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0199] According to such configuration, since the shape of body 20 is approximated to the Reuleaux triangle, body 20 can easily turn in corner area in the target region to be cleaned. Further, suction port 101 can easily reach to a corner area R3 of the target region to be cleaned, and therefore cleaning efficiency can be enhanced.

[0200] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have caster 90. In this case, in the front-rear direction of body 20, caster 90 is disposed at a part farther from the maximum width part of body 20 than drive unit 30, more preferably at a part farther from front surface 21 of

body 20.

[0201] According to such configuration, since caster 90 is disposed farther from corner area R3 in the target region to be cleaned, the trash on corner area R3 can be prevented from being caught by caster 90.

[0202] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment may have side brush 44. In this case, side brush 44 is disposed at a part closer to the maximum width part of body 20 than drive unit 30, preferably at a part closer to front surface 21 of body 20, more preferably at a part closer to the maximum width part and front surface 21 of body 20.

[0203] According to such configuration, the trash collected by side brush 44 can be sucked more reliably and directly from suction port 101.

[0204] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment may have floor detecting sensor 74. In this case, floor detecting sensor 74 is disposed at a part closer to the maximum width part of body 20 than drive unit 30 in the front-rear direction of body 20.

[0205] According to such configuration, since floor detecting sensor 74 is disposed at the front side of body 20, the cleaning surface in the forward movement direction of body 20 can be detected quickly, and wheel 33 of drive unit 30 can be prevented from running off.

[0206] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment may have charge terminal 103. In this case, charge terminal 103 is disposed at a part closer to the maximum width part of body 20 than drive unit 30 in the front-rear direction of body 20.

[0207] According to such configuration, since charge terminal 103 is disposed at the front side of body 20, charge terminal 103 can be further reliably connected to the charge mount.

[0208] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment may have power source unit 80. In this case, power source unit 80 is disposed at a part farther from the maximum width part of body 20 than drive unit 30, preferably at a part farther from front surface 21 of body 20.

[0209] According to such configuration, since the front part of body 20 relatively rises due to weight of power source unit 80, for example, possibility of contact between a sensor such as obstacle detecting sensor 71 disposed at the front side of body 20 and the cleaning surface can be reduced.

[0210] Further, in a case in which self-travelling vacuum cleaner 10 according to the present exemplary embodiment has side brush 44, a part of the rotation track of side brush 44 is located in the maximum width part of body 20. Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, side brush 44 is disposed in body 20 such that a part of side brush 44 is located in the maximum width part of body 20.

[0211] According to such configuration, the trash collected by side brush 44 can be more reliably sucked by suction port 101.

SIXTH EXEMPLARY EMBODIMENT

[0212] Self-travelling vacuum cleaner 10 according to a sixth exemplary embodiment of the present invention has body 20 having suction port 101, drive unit 30, and electric fan 51. Body 20 has front surface 21 having a curved surface protruded outwardly, and two side surfaces 22. A curved surface protruded outwardly is formed on at least a part of each of two side surfaces 22.

[0213] Further, body 20 has right side front apex part 23 defined by front surface 21 and right side surface 22, and left side front apex part 23 defined by front surface 21 and left side surface 22. As shown in FIG. 31, each of the angles formed between tangent L1 of front surface 21 and tangent L2 of side surface 22, and between tangent L1 of front surface 21 and tangent L3 of side surface 22 is an acute angle. Namely, as shown in FIG. 31, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, (i) an angle formed between first tangent L1 which is a tangent of an outer periphery of body 20 in the plane view and is parallel to maximum width line W of body 20, and second tangent L2 which is another tangent of the outer periphery of body 20 in the plane view and makes contact with the outer periphery at a point of the rear side, the point being closer to a rear end of body 20 than maximum width line W of body 20, is an acute angle, and (ii) an angle formed between first tangent L1 and third tangent L3 which is still another tangent of the outer periphery of body 20 in the plane view and makes contact with the outer periphery at another point of the rear side, another point being closer to the rear end of body 20 than maximum width line W of body 20, is also an acute angle. Here, maximum width line W of body 20 is defined to be a line connecting apexes of two front apex parts 23.

[0214] According to such configuration, since a shape of body 20 is approximated to the Reuleaux triangle, body 20 can easily turn in corner area R3 in the target region to be cleaned. Further, suction port 101 can easily reach to corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0215] Further, as shown in FIG. 31, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, front apex part 23 has the round shape (circular arc R). In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, a curvature of a curved surface of front surface 21 of body 20 is smaller than a curvature of the round shape of front apex part 23.

[0216] According to such configuration, since the shape of body 20 is approximated to the Reuleaux triangle, body 20 can easily turn in corner area R3 in the target region to be cleaned. Further, suction port 101 can easily reach to corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0217] Further, in self-travelling vacuum cleaner 10 ac-

cording to the present exemplary embodiment, suction port 101 is disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0218] According to such configuration, suction port 101 can easily reach to corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0219] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have caster 90. Caster 90 may be disposed farther from the maximum width part of body 20 than drive unit 30, more preferably at a part farther from front surface 21 of body 20.

[0220] According to such configuration, since caster 90 is disposed farther from corner area R3 in the target region to be cleaned, the trash on corner area R3 can be prevented from being caught by caster 90.

[0221] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30, electric fan 51, and side brush 44. Side brush 44 is disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0222] According to such configuration, the trash collected by side brush 44 can be more reliably sucked from suction port 101.

[0223] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30, electric fan 51, and floor detecting sensor 74. Floor detecting sensor 74 is disposed at a part closer to the maximum width part of body 20 than drive unit 30, preferably at a part closer to the maximum width part of body 20 than suction port 101. More preferably, floor detecting sensor 74 is disposed at a part closer to front surface 21 of body 20.

[0224] According to such configuration, since floor detecting sensor 74 is disposed at the front side of body 20, the cleaning surface in the forward movement direction of body 20 can be detected quickly, and therefore wheel 33 of drive unit 30 can be prevented from running off.

[0225] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30, suction port 101, electric fan 51, and charge terminal 103. Charge terminal 103 is disposed at a part closer to the maximum width part of body 20 than drive unit 30 in a direction along the rotation axis of wheel 33.

[0226] According to such configuration, since charge terminal 103 is disposed at the front side of body 20, charge terminal 103 can be further reliably connected to the charge mount.

[0227] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30, electric fan 51, and power source unit 80. Power source unit 80 is disposed at a part farther from the maximum width part of body 20 than drive unit 30.

[0228] According to such configuration, since the front part of body 20 relatively rises due to weight of power source unit 80, for example, possibility of contact between a sensor such as obstacle detecting sensor 71 disposed at the front side of body 20 and the cleaning surface can be reduced.

[0229] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30, suction port 101, electric fan 51, and side brush 44. In the self-travelling vacuum cleaner 10 according to the present exemplary embodiment, a part of side brush 44 is located in the maximum width part of body 20. More preferably, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, a part of side brush 44 and suction port 101 are located in the maximum width part of body 20.

[0230] According to such configuration, the trash collected by side brush 44 can be more reliably sucked by suction port 101.

SEVENTH EXEMPLARY EMBODIMENT

[0231] Self-travelling vacuum cleaner 10 according to a seventh exemplary embodiment of the present invention has body 20 having suction port 101, drive unit 30 which drives body 20, and electric fan 51 which is configured to suck a trash from suction port 101. Body 20 has at least two apex parts (front apex parts 23). Body 20 has a maximum width (maximum width of body 20) defined by a distance between apexes of two apex parts. Suction port 101 is formed preferably in a laterally elongate shape, more preferably in a rectangular shape or a substantially rectangular shape. In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, suction port 101 is disposed at a bottom side of body 20 such that a longitudinal direction of suction port 101 is substantially parallel to a width direction (lateral direction in FIG. 13) of body 20.

[0232] Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, body 20 has front surface 21 having a curved surface protruded outwardly, and two side surfaces 22. A curved surface protruded outwardly is formed on at least a part of each of two side surfaces 22.

[0233] Further, body 20 has right side front apex part 23 defined by front surface 21 and right side surface 22, and left side front apex part 23 defined by front surface 21 and left side surface 22 as two apexes described above. As shown in FIG. 31, each of the angles formed between tangent L1 of front surface 21 and tangent L2 of side surface 22, and between tangent L1 and tangent L3 of side surface 22 is an acute angle. Namely, as shown in FIG. 31, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, (i) an angle formed between first tangent L1 which is a tangent of an outer periphery of body 20 in a plane view and is parallel to line W (maximum width line W of body 20 which is a

line connecting apexes of two front apex parts 23), and second tangent L2, which is another tangent of the outer periphery of body 20 in the plane view and makes contact with the outer periphery at a point of the rear side of body 20, the point being closer to a rear end of body 20 than maximum width line W of body 20 is an acute angle, and (ii) an angle formed between first tangent L1 and third tangent L3 which is still another tangent of the outer periphery of body 20 in the plane view and makes contact with the outer periphery of at another point of the rear side of body 20, another point being closer to the rear end of body 20 than maximum width line W of body 20 is also an acute angle.

[0234] According to such configuration, since a shape of body 20 is approximated to the Reuleaux triangle, self-travelling vacuum cleaner 10 can easily turn in corner area R3 in the target region to be cleaned. Further, suction port 101 can easily reach to corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0235] Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, a curvature of a curved surface of front surface 21 of body 20 is smaller than a curvature of the round shape (circular arc R shown in FIG. 31) of front apex part 23 of body 20.

[0236] According to such configuration, since the shape of body 20 is approximated to the Reuleaux triangle, self-travelling vacuum cleaner 10 can easily turn in corner area R3 in the target region to be cleaned. Further, suction port 101 can easily reach to corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0237] Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, suction port 101 is preferably disposed such that the longitudinal direction of suction port 101 is substantially parallel to a direction in which maximum width line W of body 20 is extended. Further, more preferably, suction port 101 is disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0238] According to such configuration, suction port 101 can easily reach to corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0239] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30 which moves body 20, caster 90 disposed at a part on the rear side of body 20 farther than drive unit 30 in the front-rear direction of body 20 and rotated in accordance with a movement of wheel 33 of drive unit 30, and electric fan 51 which is configured to suck the trash from suction port 101. Body 20 has the maximum width part whose width is the widest in body 20. Suction port 101 is formed preferably in a laterally elongate shape, more preferably in a rectangular shape or a substantially rectangular shape. In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, the longitudinal direction of suction port 101 is extended along the width direction of body 20. Caster 90 may be disposed at a part farther from the maximum width part than drive unit 30.

[0240] According to such configuration, since caster 90 is disposed farther from corner area R3 in the target region to be cleaned, the trash on corner area R3 can be prevented from being caught by caster 90.

[0241] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30 which moves body 20, electric fan 51 which is configured to suck the trash from suction port 101, and side brush 44 disposed on the bottom surface of body 20. Body 20 has the maximum width part whose width is the widest in body 20. Suction port 101 is formed preferably in a laterally elongate shape, more preferably in a rectangular shape or a substantially rectangular shape. In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, the longitudinal direction of suction port 101 is extended along the width direction of body 20. Side brush 44 is disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0242] According to such configuration, the trash collected by side brush 44 can be more reliably sucked from suction port 101. Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30 which moves body 20, electric fan 51 which is configured to suck the trash from suction port 101, and floor detecting sensor 74 which detects the cleaning surface on which body 20 travels. Body 20 has the maximum width part whose width is the widest in body 20. Suction port 101 is formed preferably in a laterally elongate shape, more preferably in a rectangular shape or a substantially rectangular shape. In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, the longitudinal direction of suction port 101 is extended along the width direction of body 20. Floor detecting sensor 74 is disposed at the front side of body 20 relative to suction port 101 in the front-rear direction of body 20 and disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0243] According to such configuration, since floor detecting sensor 74 is disposed at the front side of body 20, the cleaning surface in the forward movement direction of body 20 can be detected quickly, and wheel 33 can be prevented from running off.

[0244] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30 which moves body 20, electric fan 51 which is configured to suck the trash from suction port 101, and charge terminal 103 used for charge of a power source capable of supplying electric power to electric fan 51. Body 20 has the maximum width part whose width is the widest in body 20. Suction port 101 is formed preferably in a laterally elongate shape, more preferably in a rectangular shape or a substantially rectangular shape. In self-travelling vacuum cleaner 10

according to the present exemplary embodiment, the longitudinal direction of suction port 101 is extended along the width direction of body 20. Charge terminal 103 is disposed at the front side of body 20 relative to suction port 101 in the front-rear direction of body 20 and disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0245] According to such configuration, since charge terminal 103 is disposed at the front side of body 20, charge terminal 103 can be further reliably connected to the charge mount.

[0246] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30 which moves body 20, electric fan 51 which is configured to suck the trash from suction port 101, and power source unit 80 capable of supplying electric power to electric fan 51. Body 20 has the maximum width part whose width is the widest in body 20. Suction port 101 is formed preferably in a laterally elongate shape, more preferably in a rectangular shape or a substantially rectangular shape.

[0247] In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, the longitudinal direction of suction port 101 is extended along the width direction of body 20. Drive unit 30 and power source unit 80 are disposed at a part on the rear side of body 20 relative to suction port 101 in the front-rear direction of body 20, and power source unit 80 is disposed at a part farther from the maximum width part of body 20 than drive unit 30.

[0248] According to such configuration, since the front part of body 20 relatively rises due to weight of power source unit 80, for example, possibility of contact between a sensor such as obstacle detecting sensor 71 disposed at the front side of body 20 and the cleaning surface can be reduced.

[0249] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30 which moves body 20, electric fan 51 which is configured to suck the trash from suction port 101, and side brush 44 disposed on the bottom surface of body 20. Body 20 has the maximum width part whose width is the widest in body 20. Suction port 101 is formed preferably in a laterally elongate shape, more preferably in a rectangular shape or a substantially rectangular shape.

[0250] In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, suction port 101 is disposed at the bottom side of body 20 such that the longitudinal direction of suction port 101 is extended along the width direction of body 20. Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, a part of side brush 44 is located in the maximum width part of body 20 at the bottom side of body 20. More preferably, a part of side brush 44 and suction port 101 are disposed in the maximum width part of body 20 at the bottom side of body 20.

[0251] According to such configuration, the trash collected by side brush 44 can be more reliably sucked by suction port 101.

EIGHTH EXEMPLARY EMBODIMENT

[0252] Self-travelling vacuum cleaner 10 according to an eighth exemplary embodiment of the present invention has body 20 having suction port 101, drive unit 30 having wheel 33 which moves body 20, and electric fan 51 which is configured to suck a trash from suction port 101. Body 20 has a maximum width part whose width is the widest in body 20.

[0253] In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, wheel 33 of drive unit 30 is disposed in body 20 such that a center axis of wheel 33 is extended along a width direction of body 20.

[0254] Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, body 20 has front surface 21 having a curved surface protruded outwardly, and two side surfaces 22. A curved surface protruded outwardly is formed on at least a part of each of two side surfaces 22.

[0255] Further, body 20 has right side front apex part 23 defined by front surface 21 and right side surface 22, and left side front apex part 23 defined by front surface 21 and left side surface 22.

[0256] As shown in FIG. 31, each of the angles formed between tangent L1 of front surface 21 and tangent L2 of side surface 22, and between tangent L1 and tangent L3 of side surface 22 is an acute angle. Namely, as shown in FIG. 31, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, (i) an angle formed between first tangent L1 which is a tangent of an outer periphery of body 20 in a plane view and is parallel to line W (maximum width line W of body 20 which is a line connecting apexes of two front apex parts 23), and second tangent L2 which is another tangent of the outer periphery of body 20 in the plane view and makes contact with the outer periphery at a point of the rear side of body 20, the point being closer to a rear end of body 20 than maximum width line W of body 20 is an acute angle, and (ii) an angle formed between first tangent L1 and third tangent L3 which is still another tangent of the outer periphery of body 20 in the plane view and makes contact with the outer periphery at another point of the rear side of body 20, another point being closer to the rear end of body 20 than maximum width line W of body 20 is also an acute angle.

[0257] According to such configuration, since a shape of body 20 is approximated to the Reuleaux triangle, body 20 can easily turn in corner area R3 in the target region to be cleaned. Thus, self-travelling vacuum cleaner 10 can move quickly from corner area R3 and the like. Further, suction port 101 can easily reach to corner area R3 in the target region to be cleaned, and therefore cleaning efficiency can be enhanced.

[0258] Further, as shown in FIG. 31, in self-travelling vacuum cleaner 10 according to the present exemplary

embodiment, each front apex part 23 of body 20 has a round shape (circular arc R). A curvature of a curved surface of front surface 21 of body 20 is smaller than a curvature of the round shape of each front apex part 23.

[0259] According to such configuration, since the shape of body 20 is approximated to the Reuleaux triangle, self-travelling vacuum cleaner 10 can easily turn in corner area R3 in the target region to be cleaned. Further, suction port 101 can easily reach to corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0260] Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, suction port 101 is disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0261] According to such configuration, since the shape of body 20 is approximated to the Reuleaux triangle, self-travelling vacuum cleaner 10 can easily turn in corner area R3 in the target region to be cleaned. Further, suction port 101 can easily reach to corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0262] Self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have caster 90 disposed at a part on the rear side of body 20 farther than drive unit 30 and rotated in accordance with a movement of wheel 33 of drive unit 30. In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, a center axis of wheel 33 of drive unit 30 is extended along the width direction of body 20. Caster 90 may be disposed at a part farther from the maximum width part of body 20 than drive unit 30.

[0263] According to such configuration, since caster 90 is disposed farther from corner area R3 in the target region to be cleaned, the trash on corner area R3 can be prevented from being caught by caster 90.

[0264] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have side brush 44 disposed at the bottom side of body 20. In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, the center axis of wheel 33 is extended along the width direction of body 20. Side brush 44 is disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0265] According to such configuration, the trash collected by side brush 44 can be more reliably sucked from suction port 101.

[0266] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have floor detecting sensor 74 which detects the cleaning surface on which body 20 travels. In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, floor detecting sensor 74 is disposed at the front side of body 20 relative to suction port 101 in the front-rear direction of body 20 at the bottom side of body 20 and disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0267] According to such configuration, since floor detecting sensor 74 is disposed at the front side of body 20, the cleaning surface in the forward movement direction of body 20 can be detected quickly, and wheel 33 of drive unit 30 can be prevented from running off.

[0268] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have charge terminal 103 used for charge of a power source capable of supplying electric power to electric fan 51. In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, charge terminal 103 is disposed at the front side of body 20 relative to suction port 101 in the front-rear direction of body 20 at the bottom side of body 20 and disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0269] According to such configuration, since charge terminal 103 is disposed at the front side of body 20, charge terminal 103 can be further reliably connected to the charge mount.

[0270] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have power source unit 80 capable of supplying electric power to electric fan 51. In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, drive unit 30 and power source unit 80 are disposed at a part on the rear side of body 20 relative to suction port 101 in the front-rear direction of body 20. Further, power source unit 80 is disposed at a part farther from the maximum width part of body 20 than drive unit 30.

[0271] According to such configuration, since the front part of body 20 relatively rises due to weight of power source unit 80, for example, possibility of contact between a sensor such as obstacle detecting sensor 71 disposed at the front side of body 20 and the cleaning surface can be reduced.

[0272] Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, a part of side brush 44 is located in the maximum width part at the bottom side of body 20. More preferably, a part of side brush 44 and suction port 101 are located in the maximum width part at the bottom side of body 20.

[0273] According to such configuration, the trash collected by side brush 44 can be more reliably sucked by suction port 101.

NINTH EXEMPLARY EMBODIMENT

[0274] Self-travelling vacuum cleaner 10 according to a ninth exemplary embodiment of the present invention has body 20 having suction port 101, drive unit 30 having wheel 33, electric fan 51, and communication part 212. Communication part 212 is disposed in a recess part formed on body 20, and a surface of the recess part including an edge of the recess part is inclined such that a part at an outer peripheral side of body 20 is lower than a part at a center side of body 20.

[0275] According to such configuration, the recess part is functioned as a parabola antenna and therefore communication ability of communication part 212 can be en-

hanced.

[0276] Further, in the present exemplary embodiment, communication part 212 can also receive a signal output from a charge mount which charges self-travelling vacuum cleaner 10 or a signal output from a remote controller which operates self-travelling vacuum cleaner 10.

TENTH EXEMPLARY EMBODIMENT

[0277] Self-travelling vacuum cleaner 10 according to a tenth exemplary embodiment of the present invention has body 20 having suction port 101, drive unit 30 having wheel 33, electric fan 51, and trash box unit 60. Trash box unit 60 has trash box 61 having an entrance communicated with suction port 101, and filter 62 mounted to trash box 61. Collecting part 340, which collects trashes in air passing through thereof, is disposed on filter 62. Collecting part 340 is disposed at a part not facing entrance 312.

[0278] Generally, in a self-travelling vacuum cleaner, a size of a trash box to be mounted is restricted. Thus, in a case in which a collecting part is disposed at a part facing an entrance of the trash box, the trash is concentrated and stored on a part of the collecting part facing the entrance of the trash box, and therefore the entrance may be blocked by the trashes even if there is a space to store the trashes in other part of the collecting part.

[0279] However, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, since collecting part 340 is disposed at the part not facing entrance 312, it is possible to prevent the trash from being concentrated and stored on the part of collecting part 340 facing entrance 312 of trash box 310.

[0280] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30 having a plurality of wheels 33, a plurality of suspension springs 36, electric fan 51, main brush 43, and brush driving motor 41. Suspension spring 36 applies reaction force to wheel 33 such that wheel 33 is protruded from body 20. Elastic modulus of suspension spring 36 which applies the reaction force to first wheel 33 as one of the plurality of wheels 33 is larger than elastic modulus of suspension spring 36 which applies the reaction force to second wheel 33 as one of the plurality of wheels 33 disposed at a part farther from brush driving motor 41 than first wheel 33.

[0281] According to such configuration, weight of brush driving motor 41 is applied larger to first wheel 33 than to second wheel 33. Thus, in a case in which suspension springs 36, which apply the reaction force to respective wheels 33, have the same elastic modulus, positions of wheels 33 against body 20 may not be balanced. However, with such configuration, by setting elastic modulus of suspension springs 36, the balance of positions of wheels 33 against body 20 is maintained.

[0282] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30 having wheel 33, electric fan 51, trash box 61, and trash detecting sensor 76. In passage 174 which communicates with suction port 101 and trash box 310, trash detecting sensor 76 is disposed in a region in which a flowing speed of air is faster than that on center line 175 of passage 174 in a cross section of passage 174 taken along a flowing direction of air in passage 174.

[0283] According to such configuration, even if the trash adheres to a surface of trash detecting sensor 76, the adhered trash is easily blown away from the surface of trash detecting sensor 76 by air flowed through passage 174.

[0284] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30 having wheel 33, electric fan 51, charge terminal 103, and magnet 77. Charge terminal 103 can be electrically connected to a terminal of a charge mount which charges a power source. Magnet 77 is disposed at a part adjacent to charge terminal 103.

[0285] According to such configuration, when self-travelling vacuum cleaner 10 approaches the charge mount, magnet 77 is easily detected by the charge mount.

[0286] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30, electric fan 51, and caster 90. A rotation shaft of caster 90 is disposed so as to be parallel or substantially parallel to a longitudinal direction of suction port 101. Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, caster 90 has a first part having a large diameter, and a second part having a smaller diameter than the first part. A friction coefficient of an outer peripheral surface of the first part is smaller than a friction coefficient of an outer peripheral surface of the second part.

[0287] According to such configuration, when self-travelling vacuum cleaner 10 travels, the outer peripheral surface of the first part in the outer peripheral surface of caster 90 is mainly contacted with the cleaning surface. Since the friction coefficient of the outer peripheral surface of the first part is smaller than the friction coefficient of the outer peripheral surface of the second part, resistance in a forward travelling of body 20 is small and therefore body 20 can be moved smoothly. Further, when body 20 is turned, since caster 90 is apt to make a sideslip, the turning ability of body 20 can be enhanced.

ELEVENTH EXEMPLARY EMBODIMENT

[0288] Self-travelling vacuum cleaner 10 according to an eleventh exemplary embodiment of the present invention has body 20 having suction port 101, drive unit 30 which moves body 20 and has wheel 33, electric fan 51 which is configured to suck a trash from suction port 101, and trash box unit 60 disposed in body 20. Trash box unit 60 has trash box 61 which stores the trash sucked by electric fan 51, and filter 62 mounted to trash box 61.

Filter 62 has collecting part 340 which collects trashes in air passing through thereof, and frame 350 which supports collecting part 340. Frame 350 includes a part facing entrance 312 of trash box 310. Collecting part 340 is disposed at a part not facing entrance 312 of trash box 310.

[0289] Generally, in a self-travelling vacuum cleaner, a size of a trash box to be mounted is restricted. Thus, in a case in which a collecting part is disposed so as to face an entrance of the trash box, the trash is concentrated and stored on a part of the collecting part facing the entrance of the trash box, and therefore the entrance may be blocked by the trashes even if there is a space to store the trashes in other part of the collecting part.

[0290] However, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, since collecting part 340 is disposed at the part not facing entrance 312 of trash box 310, it is possible to prevent the trash from being concentrated and stored on the part of collecting part 340 facing entrance 312 of trash box 310.

[0291] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, main brush 43 disposed on suction port 101, brush driving motor 41 which rotates main brush 43, and a pair of wheels 33 (first wheel 33 and second wheel 33) which moves body 20. Self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have first spring 36 which applies reaction force to first wheel 33 such that first wheel 33 makes contact with the cleaning surface, second spring 36 which applies reaction force to second wheel 33 such that second wheel 33 makes contact with the cleaning surface, and electric fan 51 which is configured to suck the trash from suction port 101. Brush driving motor 41 is disposed at a part closer to first wheel 33 than second wheel 33. Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, elastic modulus of first spring 36 is larger than elastic modulus of second spring 36.

[0292] According to such configuration, weight of brush drive unit 41 is applied larger to first wheel 33 than to second wheel 33. Thus, in a case where both springs 36, which apply the reaction force to respective wheels 33, have the same elastic modulus, positions of wheels 33 against body 20 may not be balanced.

[0293] However, by setting elastic modulus of springs 36 based on the configuration of self-travelling vacuum cleaner 10 according to the present exemplary embodiment, the balance of positions of wheels 33 against body 20 is maintained.

[0294] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30 which moves body 20 and has wheel 33, electric fan 51 which is configured to suck a trash from suction port 101, trash box 310 which stores the trash sucked by electric fan 51, and trash detecting sensor 76 disposed in passage 174 which communicates with electric fan 51 and trash box 310 and detects information with respect to the trash moving inside passage 174. Trash detecting sensor 76 is disposed in a region in which a flowing speed of air is faster within passage 174.

[0295] According to such configuration, even if the trash adheres to a surface of trash detecting sensor 76, the adhered trash is easily blown away from the surface of trash detecting sensor 76 by air flowed through passage 174.

[0296] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30, electric fan 51 which is configured to suck the trash from suction port 101, charge terminal 103 used for charge of a power source of electric fan 51, and magnet 77 which can be detected by a charge mount which supplies electric power to charge terminal 103. In self-travelling vacuum cleaner 10 according to the present exemplary embodiment, a distance between magnet 77 and charge terminal 103 is shorter than a distance between magnet 77 and suction port 101.

[0297] According to such configuration, when self-travelling vacuum cleaner 10 approaches the charge mount, magnet 77 is easily detected by the charge mount.

[0298] Further, self-travelling vacuum cleaner 10 according to the present exemplary embodiment has body 20 having suction port 101, drive unit 30, caster 90 rotated in accordance with a movement of wheel 33, and electric fan 51 which is configured to suck the trash from suction port 101. Suction port 101 is formed preferably in a laterally elongate shape, more preferably in a rectangular shape or a substantially rectangular shape. A longitudinal direction of suction port 101 is extended along the width direction of body 20. A center axis of caster 90 is substantially parallel to the longitudinal direction of suction port 101. Caster 90 may have a first part having a large diameter, and a second part having a smaller diameter than the first part. A friction coefficient of an outer peripheral surface of the first part is smaller than a friction coefficient of an outer peripheral surface of the second part.

[0299] According to such configuration, when self-travelling vacuum cleaner 10 travels, the outer peripheral surface of the first part in the outer peripheral surface of caster 90 mainly makes contact with the cleaning surface. Since the friction coefficient of the outer peripheral surface of the first part is smaller than the friction coefficient of the outer peripheral surface of the second part, resistance in a forward travelling of body 20 is small and therefore body 20 can be moved smoothly. Further, when body 20 is turned, since caster 90 is apt to make a sideslip, the turning ability of body 20 can be enhanced.

TWELFTH EXEMPLARY EMBODIMENT

[0300] Self-travelling vacuum cleaner 10 according to a twelfth exemplary embodiment of the present invention has body 20 having suction port 101, a plurality of drive units 30 which make body 20 move, and sucking unit 50

mounted in body 20.

[0301] Body 20 has front surface 21 having a curved shape protruded outwardly in the plane view, a plurality of side surface 22, and a plurality of front apex parts 23 each of which is an apex defined by front surface 21 and side surface 22.

[0302] A maximum width of body 20 is defined by at least two apexes (front apex parts 23) among a plurality of apexes. Further, suction port 101 is disposed in a part having the maximum width of body 20. "A part having the maximum width of body 20" or "maximum width part of body 20" means, as described above, a part on or a part closer to line W ("maximum width line W of body 20") connecting the apex of right side front apex part 23 and the apex of left side front apex part 23.

[0303] As shown in FIG. 31, each of the angles formed between tangent L1 (first tangent) of front surface 21 and tangent L2 (second tangent) of side surface 22, and between tangent L1 and tangent L3 (third tangent) of side surface 22 is an acute angle.

[0304] Self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have at least one side brush 44 disposed on a bottom side of body 20. A part of a rotation track of side brush 44 covers at least a part of the maximum width part of body 20. More preferably, side brush 44 is located in the maximum width part and suction port 101 of body 20.

[0305] According to such configuration, the trash on corner area R3 in the target region to be cleaned can be more reliably collected to suction port 101 disposed at the bottom side of body 20 by side brush 44. Thus, ability to suck the trash on corner area R3 in the target region to be cleaned can be further enhanced. Further, this configuration can eliminate the need for lengthening bristle bundles 44B forming side brush 44, and therefore the possibility that side brush 44 is caught by an obstacle can be reduced.

[0306] In the present exemplary embodiment, a plurality of side brushes 44 may be disposed. In this case, the plurality of side brushes 44 includes right side brush 44 disposed at a right side of body 20, and left side brush 44 disposed at a left side of body 20. A track which delivers the trash to suction port 101 is formed by a rotation track of right side brush 44 and a rotation track of left side brush 44.

[0307] According to such configuration, the trash on corner area R3 in the target region to be cleaned can be collected to suction port 101 efficiently and reliably by the plurality of side brushes 44. Thus, the ability to suck the trash on corner area R3 in the target region to be cleaned can be further enhanced.

[0308] Further, in the present exemplary embodiment, in a case in which self-travelling vacuum cleaner 10 has the plurality of side brushes 44, the plurality of side brushes 44 is formed such that the rotation track of right side brush 44 and the rotation track of left side brush 44 are directed from the front side toward the rear side of body 20 at a center side in the width direction of body 20. Namely, the plurality of side brushes 44 is rotated in directions opposite to each other, and each side brush 44 is rotated from the front side toward the rear side of body 20 at a part of its rotation track adjacent to the rotation track of another side brush 44.

[0309] According to such configuration, since the trash is collected to suction port 101 from the front side of body 20 by side brush 44, the trash can be more reliably sucked from suction port 101 compared to, for example, a configuration in which the trash is collected to suction port 101 from around a side area of suction port 101.

THIRTEENTH EXEMPLARY EMBODIMENT

[0310] Self-travelling vacuum cleaner 10 according to a thirteenth exemplary embodiment of the present invention has body 20 having suction port 101 disposed on a bottom surface thereof, a plurality of drive units 30 which drive body 20, and sucking unit 50 mounted in body 20.

[0311] Body 20 has a maximum width part whose width is the widest in body 20. The maximum with part is arranged at a front side relative to a center of gravity G of self-travelling vacuum cleaner 10. Body 20 also has a rear part disposed at a rear side relative to the maximum width part and becoming narrower toward a rear end. In the present exemplary embodiment, as shown in FIG. 31, an outer peripheral surface of the maximum width part of body 20 has a round shape (circular arc R).

[0312] Further, in the present exemplary embodiment, front surface 21 of body 20 has a curved shape protruded outwardly in a plane view of body 20.

[0313] Further, in the present exemplary embodiment, a curvature of a curved surface of front surface 21 of body 20 is smaller than a curvature of the round shape (circular arc R) of the outer peripheral surface of the maximum width part of body 20.

[0314] Further, in self-travelling vacuum cleaner 10 of the present exemplary embodiment, side surface 22 is disposed at a rear part of body 20. Side surface 22 has a curved surface protruded outwardly in the plane view of body 20.

[0315] In the present exemplary embodiment, a curvature of the curved surface of side surface 22 of body 20 is smaller than the curvature of the round shape (circular arc R) of the outer peripheral surface of the maximum width part of body 20.

[0316] With such configuration, since a shape of body 20 is approximated to the Reuleaux triangle, body 20 can easily turn in corner area R3 in the target region to be cleaned. Thus, self-travelling vacuum cleaner 10 can move quickly from corner area R3 and the like in the target region to be cleaned. Further, suction port 101 can easily reach to apex part R4 of corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0317] Further, in the present exemplary embodiment, suction port 101 is disposed at a part closer to the maximum width part of body 20 than the center of gravity G

of self-travelling vacuum cleaner 10. Further, in the present exemplary embodiment, sucking unit 50 is disposed at the rear side relative to suction port 101 in the front-rear direction of body 20.

[0318] With such configuration, since suction port 101 can approach an apex of corner area R3 in the target region to be cleaned, the trash on apex part R4 of corner area R3 can be more reliably and directly sucked from suction port 101.

[0319] In the present exemplary embodiment, drive unit 30 may be disposed at the bottom side of body 20 and at an outer side relative to suction port 101 in the width direction of body 20. With such configuration, since suction port 101 is disposed in the maximum width part of body 20, the trash on the cleaning surface can be efficiently sucked.

FOURTEENTH EXEMPLARY EMBODIMENT

[0320] Self-travelling vacuum cleaner 10 according to a fourteenth exemplary embodiment of the present invention has body 20 having suction port 101 disposed on a bottom surface thereof, a plurality of drive units 30 which drive body 20, and sucking unit 50 mounted in body 20.

[0321] Body 20 has front surface 21 having a curved shape protruded outwardly in a plane view and a plurality of side surfaces 22. Body 20 further has a plurality of front apex parts 23 each of which is an apex defined by front surface 21 and the plurality of side surfaces 22. The maximum width of body 20 is defined by at least two apexes (front apex parts 23) among a plurality of apexes. Suction port 101 is disposed in a part having the maximum width of body 20. Here, "a part having the maximum width of body 20" or "maximum width part of body 20" means, as described above, a part on or a part closer to line W ("maximum width line W of body 20") connecting the apex of right side front apex part 23 and the apex of left side front apex part 23.

[0322] According to such configuration, since each of the angles formed between tangent L1 of front surface 21 and tangent L2 of side surface 22, and between tangent L1 and tangent L3 of side surface 22 is set to be an acute angle, when self-travelling vacuum cleaner 10 is located on corner area R3 in the target region to be cleaned, self-travelling vacuum cleaner 10 can pivotally turn and take various positions against corner area R3. Examples of the position of body 20 include that front apex part 23 of body 20 is directed to an apex or an adjacent part thereof of corner area R3 in the target region to be cleaned. In a case in which self-travelling vacuum cleaner 10 takes such a position, the apex (front apex part 23) of body 20 is located further closer to the apex of corner area R3 and suction port 101 of body 20 is also located further closer to the apex of corner area R3 compared to a case in which conventional self-travelling vacuum cleaner 10 having a circular body 20 is located closer to the limit to corner area R3 in the target region to be cleaned. Thus, the trash on the cleaning surface of corner area R3 can be sucked more reliably from suction port 101.

[0323] Further, according to such configuration as described above, when self-travelling vacuum cleaner 10 takes the position in which front apex part 23 of body 20 approaches toward the apex or the adjacent area thereof of corner area R3, self-travelling vacuum cleaner 10 can pivotally turn. Thus, when self-travelling vacuum cleaner 10 according to the present exemplary embodiment moves from corner area R3 in the target region to be cleaned toward another area, self-travelling vacuum cleaner 10 can move quickly from corner area R3 to another area compared to the conventional self-travelling vacuum cleaner having D-shape body 20.

[0324] Further, in the present exemplary embodiment, the plurality of side surfaces 22 includes right side surface 22 disposed at a right side with respect to a center in a width direction of body 20 (in the present exemplary embodiment, a direction substantially orthogonal to the forward movement direction of body 20), and left side surface 22 disposed at a left side with respect to the center in the width direction of body 20. Body 20 has right side front apex part 23 defined by front surface 21 and right side surface 22, and left side front apex part 23 defined by front surface 21 and left side surface 22. A maximum width of body 20 is defined by right side front apex 23 and left side front apex 23.

[0325] Further, in self-travelling vacuum cleaner 10 according to the present exemplary embodiment, a width of the rear side (rear part) of body 20 is narrower than a width of the front side (front part) of body 20. With such configuration, when self-travelling vacuum cleaner 10 turns around an object, possibility of contact between the rear part of body 20 and the object is reduced. Thus, moving ability of self-travelling vacuum cleaner 10 can be enhanced.

[0326] Further, in the present exemplary embodiment, the plurality of drive units 30 includes first drive unit 30 and second drive unit 30. Each of first drive unit 30 and second drive unit 30 has rotation axe and is formed to be driven independently to each other. Further, in the present exemplary embodiment, a driving system of the plurality of drive units 30 is a facing two wheels type driving system provided with first drive unit 30 and second drive unit 30. With such configuration, a structure can be simplified compared to a self-travelling vacuum cleaner having a steering type driving system.

[0327] Self-travelling vacuum cleaner 10 according to the present exemplary embodiment may further have control unit 70 which controls the plurality of drive units 30. Control unit 70 controls the plurality of drive units 30 such that body 20 forms a part of a rectangular track drawn by the Reuleaux triangle.

[0328] According to such configuration, control unit 70 operates each drive unit 30 such that front apex part 23 of body 20 approaches the apex or the adjacent part thereof of corner area R3 in the target region to be

cleaned, and therefore suction port 101 can be located further closer to the apex of corner area R3 in the target region to be cleaned. Thus, self-travelling vacuum cleaner 10 according to the present exemplary embodiment can efficiently suck the trash on corner area R3 in the target region to be cleaned.

[0329] Further, in the present exemplary embodiment, the rotation axes of first drive unit 30 and second drive unit 30 are located respectively at a part on the rear side of body 20 farther than the center of gravity G of self-travelling vacuum cleaner 10.

[0330] A relationship between the rotation axis of each drive unit 30 and the center of gravity G of self-travelling vacuum cleaner 10 corresponds to one of main factors which determines the track drawn by body 20. Self-travelling vacuum cleaner 10 of the present invention has body 20 having suction port 101, drive unit 30, suction port 101, and electric fan 51. Body 20 has two apexes (front apex parts 23) which define the maximum width of body 20. Suction port 101 is disposed at a part having the maximum width part at the bottom side of body 20, and disposed at a part closer to the maximum width part of body 20 than drive unit 30.

[0331] According to such configuration, since a shape of body 20 is approximated to the Reuleaux triangle, body 20 can easily turn in corner area R3 in the target region to be cleaned. Thus, self-travelling vacuum cleaner 10 can move quickly from corner area R3 and the like in the target region to be cleaned. Further, suction port 101 can easily reach to apex part R4 of corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0332] Self-travelling vacuum cleaner 10 of the present invention may further have caster 90 disposed at the bottom side of body 20. Caster 90 may be disposed at a part on the rear side of body 20 farther than drive unit 30 with respect to the maximum width part of body 20. According to such configuration, since caster 90 is disposed farther from suction port 101 from which the trash on corner area R3 in the target region to be cleaned is sucked, the trash on corner area R3 in the target region to be cleaned can be prevented from being caught by caster 90.

[0333] Self-travelling vacuum cleaner 10 of the present invention may further have side brush 44 disposed at the bottom side of body 20. A part of a rotation track of side brush 44 covers at a part having the maximum width part of body 20. More preferably, the part of the rotation track of side brush 44 is located at a part having suction port 101 and the maximum width part of body 20. According to such configuration, the trash collected by side brush 44 can be more reliably sucked by suction port 101.

[0334] In self-travelling vacuum cleaner 10 of the present invention, (i) an angle formed between first tangent L1 and second tangent L2 is an acute angle, and (ii) an angle formed between first tangent L1 and third tangent L3 is also an acute angle. Here, first tangent L1 is a tangent of an outer periphery of body 20 in a plane view and is parallel to maximum width line W of body 20 (which is a line connecting apexes of two front apex parts 23). Second tangent L2 is another tangent of the outer periphery of body 20 in the plane view and makes contact with the outer periphery at a point on the rear side of body 20relative to the maximum width line W of body 20. Third tangent L3 is still another tangent of the outer periphery of body 20 in the plane view and makes contact with the outer periphery at another point on the rear side of body 20 relative to maximum width line W of body 20.

[0335] According to such configuration, since the shape of body 20 is approximated to the Reuleaux triangle, body 20 can easily turn in corner area R3 in the target region to be cleaned. Thus, self-travelling vacuum cleaner 10 can move quickly from corner area R3 and the like in the target region to be cleaned. Further, suction port 101 can easily reach to apex part R4 of corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

[0336] In self-travelling vacuum cleaner 10 of the present invention, body 20 has an outer peripheral surface on which a curved surface protruded outwardly in the plane view is formed. Further, body 20 has two apexes (front apex parts 23) which define the maximum width of body 20. As shown in FIG. 31, each of two apexes (front apex parts 23) has a round shape (circular arc R), and a curvature of the curved surface of the outer peripheral surface of body 20 is smaller than a curvature of the round shape of two apexes.

[0337] According to such configuration, since the shape of body 20 is approximated to the Reuleaux triangle, body 20 can easily turn in corner area R3 in the target region to be cleaned. Thus, self-travelling vacuum cleaner 10 can move quickly from corner area R3 and the like in the target region to be cleaned. Further, suction port 101 can easily reach to apex part R4 in corner area R3 in the target region to be cleaned, and therefore the cleaning efficiency can be enhanced.

INDUSTRIAL APPLICABILITY

[0338] As described above, the present invention provides a self-travelling vacuum cleaner having high cleaning efficiency capable of more reliably and directly sucking a trash on a corner in a target region to be cleaned from a suction port, and moving from the corner in the target region to be cleaned to another area. Thus, the present invention can be applied to a self-travelling vacuum cleaner used in various circumstances such as a self-travelling vacuum cleaner for domestic use or commercial use.

REFERENCE MARKS IN THE DRAWINGS

[0339]

10	self-travelling vacuum cleaner
20	body
21	front surface

22	side surface
22A	side surface
22B	side surface
23	front apex part
24	rear apex part
25	rear surface
30	drive unit
31	travel motor
32	housing
32A	motor housing part
32B	spring hooked part
32C	shaft receiving part
33	wheel
34	tire
35	support shaft
36	suspension spring (spring)
40	cleaning unit
41	brush driving motor
42	gear box
43	main brush
44	side brush
44A	brush shaft
44B	bristle bundle
50	sucking unit
51	electric fan
52	fan case
52A	front side case
52B	rear side case
52C	suction port
52D	discharging port
52E	louver
60	trash box unit
61	trash box
61A	entrance
61B	exit
61C	bottom part
62	filter
70	control unit
71	obstacle detecting sensor
71A	transmitting part
71B	receiving part
72	distance measuring sensor
73	collision detecting sensor
74	floor detecting sensor
75	running off detecting sensor
76	trash detecting sensor
77	magnet
80	power source unit
81	power source case
82	battery
83	main switch
90	caster
91	support shaft
100	lower unit
101	suction port
102	power port
103	charge terminal
110	base
111	bottom part shaft receiver
112	sensor window
120	driving part
121	wheel house
122	spring hooked part
130	cleaning part
131	shaft insertion part
132	connecting part
140	trash box part
150	sucking part
160	power source part
170	brush housing
171	duct
172	entrance
173	exit
180	brush cover
181	inclined surface
190	holding frame
200	upper unit
210	cover
211	exhaust port
212	light receiving part (communication part)
213	lid button
220	lid
221	arm
230	bumper
231	curved protruded part
232	transmitting window
233	receiving window
234	distance measuring window
240	interface part
241	panel
242	operation button
243	display part
250	trash box receiver
251	bottom opening
252	rear opening
260	arm housing part
300	trash box unit
310	trash box
311	space
312	entrance
313	exit
320	lid
330	filter
340	collecting part
350	frame
351	window
352	intermediate wall
360	hinge
G	center of gravity
H	rotation axis of wheel
RX	room
R1	first wall
R2	second wall
R3	corner area
R4	apex part
L1	tangent (first tangent)

L2 tangent (second tangent)
L3 tangent (third tangent)

Claims

1. A self-travelling vacuum cleaner comprising:

a body having a suction port;
a drive unit which, in operation, moves the body; and
an electric fan,
wherein
the body has two apex parts which define a maximum width of the body,
the suction port is disposed at a part having the maximum width of the body on a bottom side of the body, and
the suction port is disposed at a part closer to the part having the maximum width of body than the drive unit.

2. The self-travelling vacuum cleaner according to claim 1, further comprising a caster disposed at the bottom side of the body,
wherein the caster is disposed at a rear side of the body farther than the drive unit with respect to the part having the maximum width of the body.

3. The self-travelling vacuum cleaner according to claim 1 or 2, further comprising a side brush disposed on the bottom side of the body,
wherein a part of a rotation track of the side brush overlaps the part having the maximum width of the body.

4. The self-travelling vacuum cleaner according to any one of claims 1 to 3,
wherein each of angles formed between a first tangent and a second tangent and between a first tangent and a third tangent is an acute angle, wherein the first tangent is a tangent of an outer periphery of the body in a plane view and is parallel to a line connecting apexes of the two apex parts of the body, and the second tangent is another tangent of the outer periphery of the body in the plane view and makes contact with the outer periphery at a point on the rear side of the body relative to the line connecting the apexes of the two apex parts of the body, and the third tangent is still another tangent of the outer periphery of the body in the plane view and makes contact with the outer periphery at another point at the rear side of the body relative to the line connecting the apexes of the two apex parts of the body.

5. The self-travelling vacuum cleaner according to any one of claims 1 to 4,
wherein an outer peripheral surface has a curved surface with which the first tangent makes contact, the curved surface being protruded outwardly in the plane view of the body, and the first tangent being a tangent of the outer periphery of the body in the plane view and being parallel to a line connecting the apexes of the two apex parts of the body,
each of the two apex parts of the body has a round shape, and
a curvature of the curved surface of the outer peripheral surface of the body is smaller than curvatures of the round shapes of two apex parts.

FIG. 1

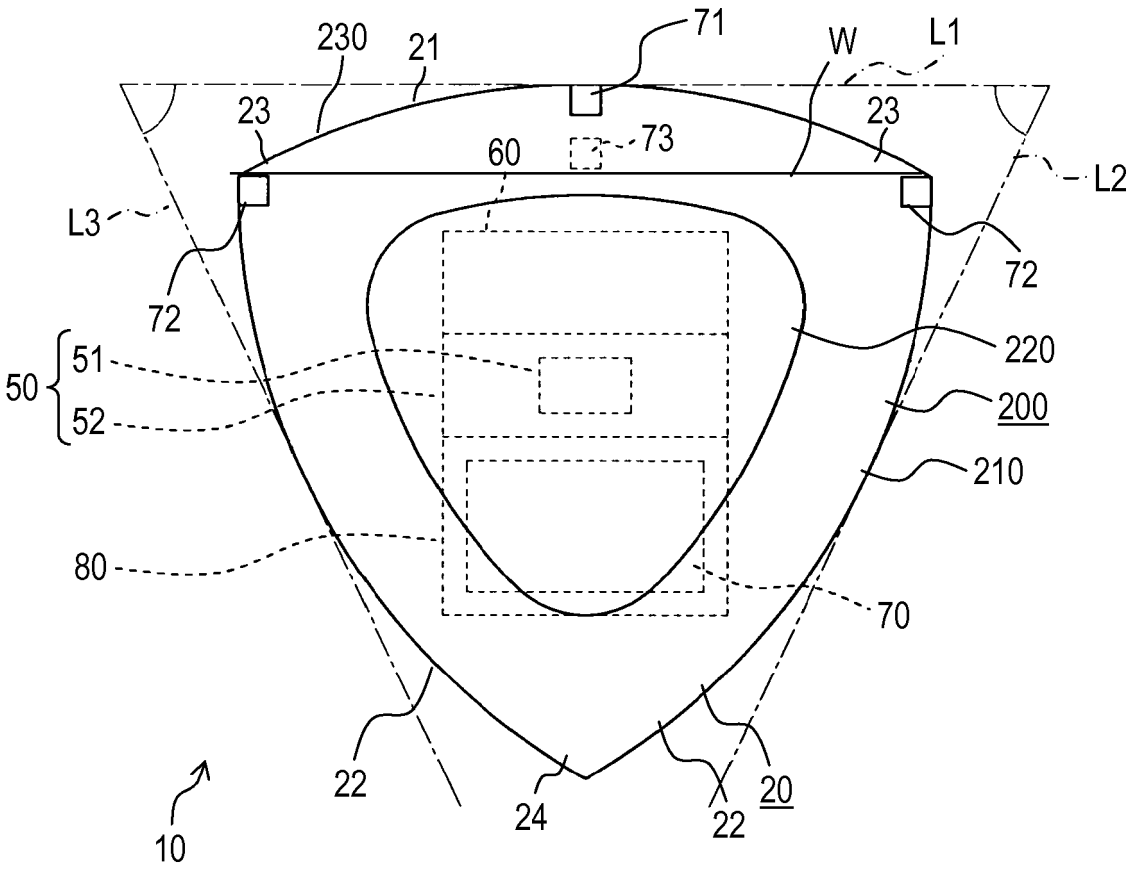
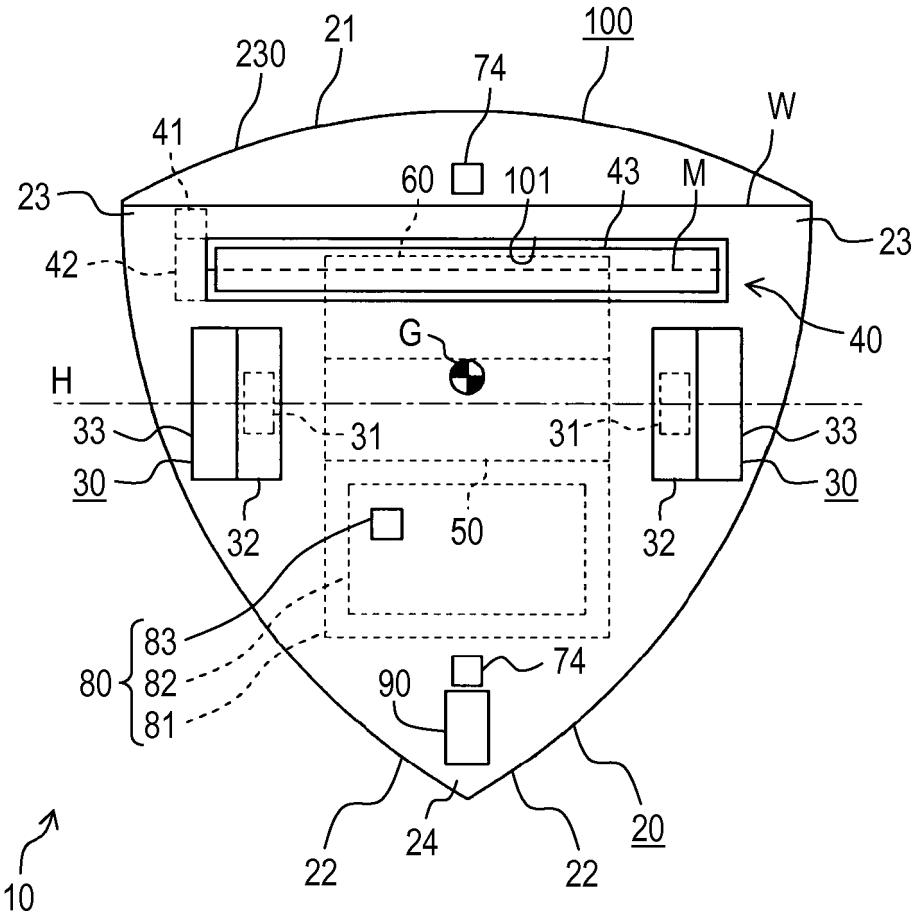

230
21
71
W
L1
23
23
60
73
L2
L3
72
72
50
51
52
220
200
210
80
70
22
24
22
20
10

FIG. 2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W
41
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101
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M
23
23
42
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G
H
33
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30
30
32
50
32
83
82
81
80
74
90
10
22
24
22
20

FIG. 3

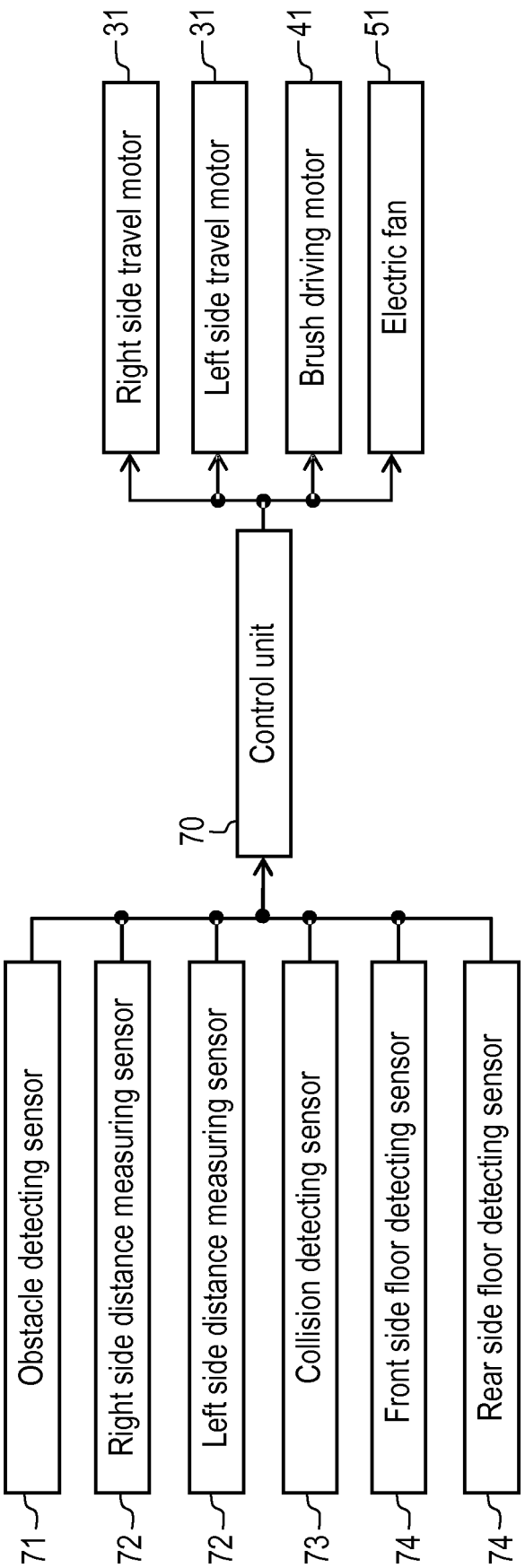

Obstacle detecting sensor
71
Right side distance measuring sensor
72
Left side distance measuring sensor
72
Collision detecting sensor
73
Front side floor detecting sensor
74
Rear side floor detecting sensor
74
70
Control unit
Right side travel motor
31
Left side travel motor
31
Brush driving motor
41
Electric fan
51

FIG. 4

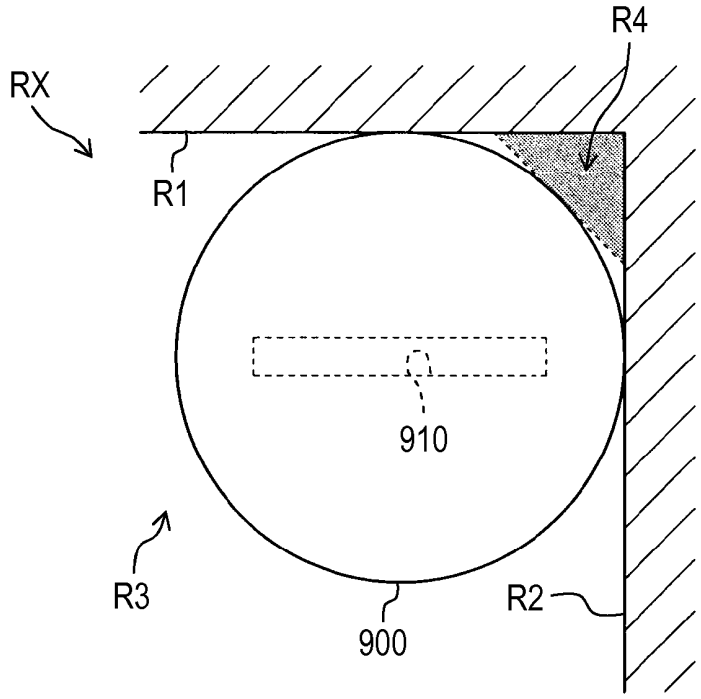


FIG. 5

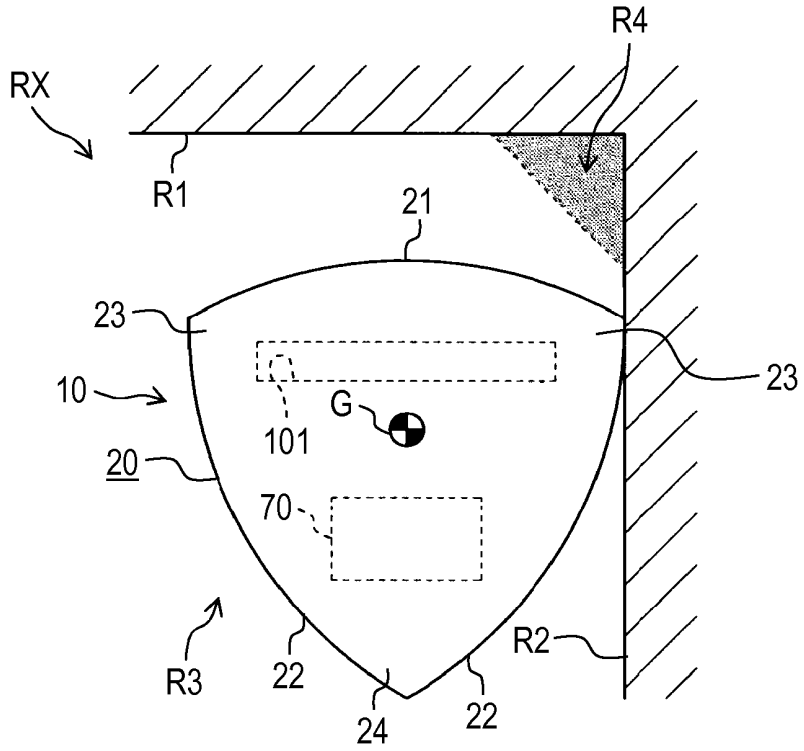


FIG. 6

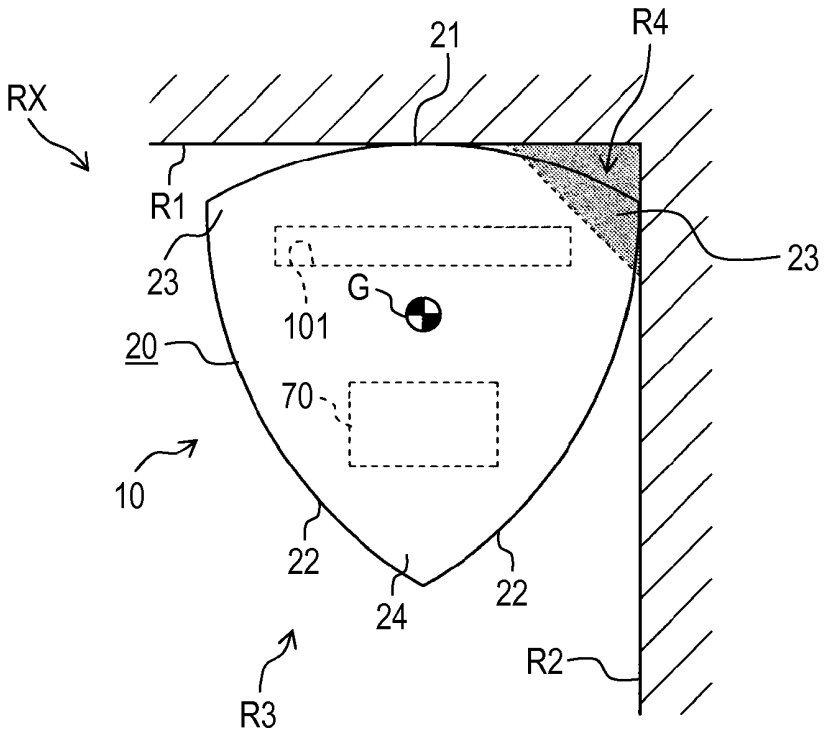

RX
21
R4
R1
23
23
G
101
20
70
10
22
24
22
R2
R3

FIG. 7

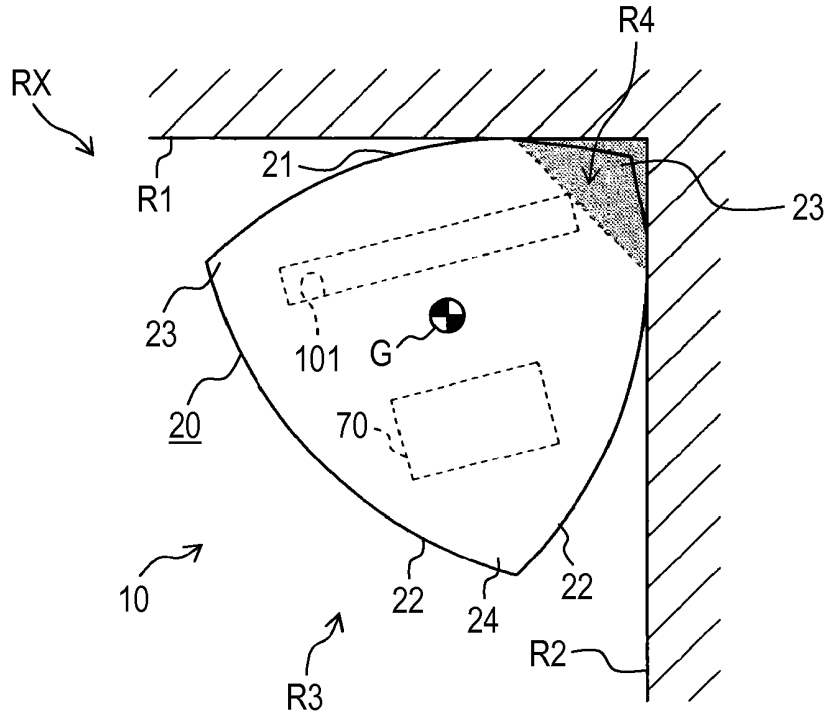

RX
R4
R1
21
23
23
101
G
20
70
10
22
24
22
R2
R3

FIG. 8

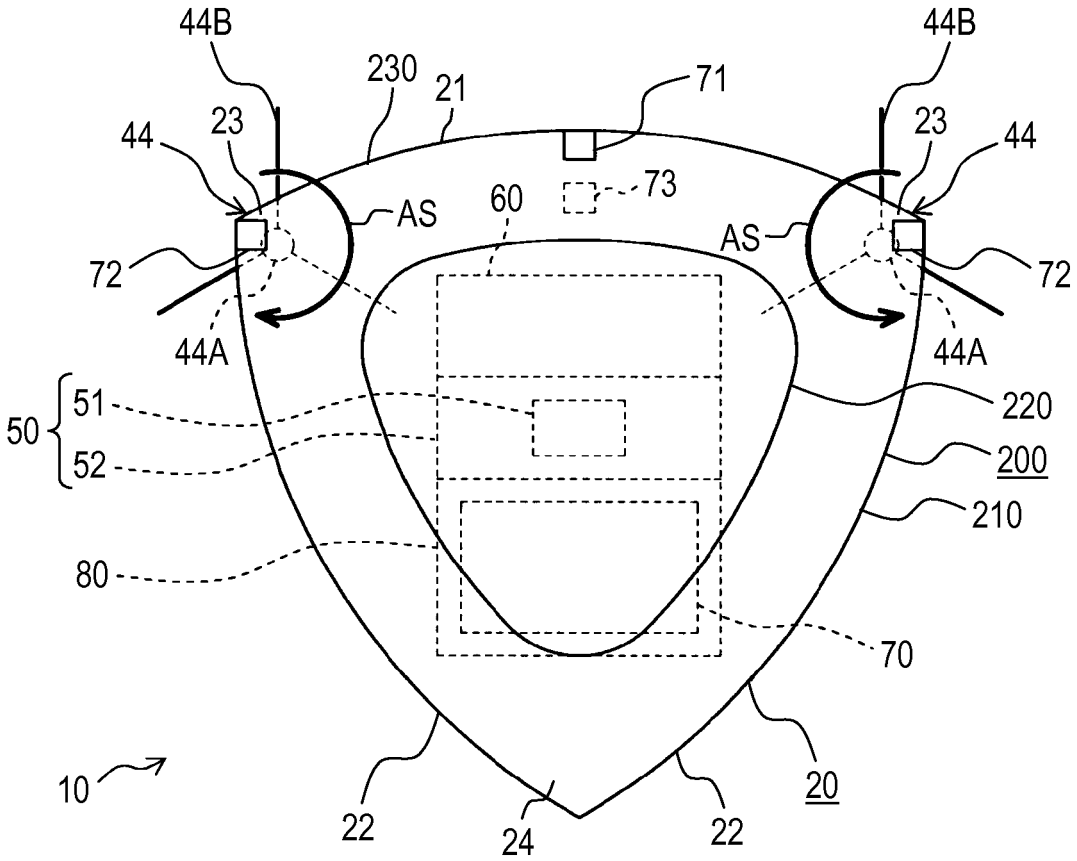
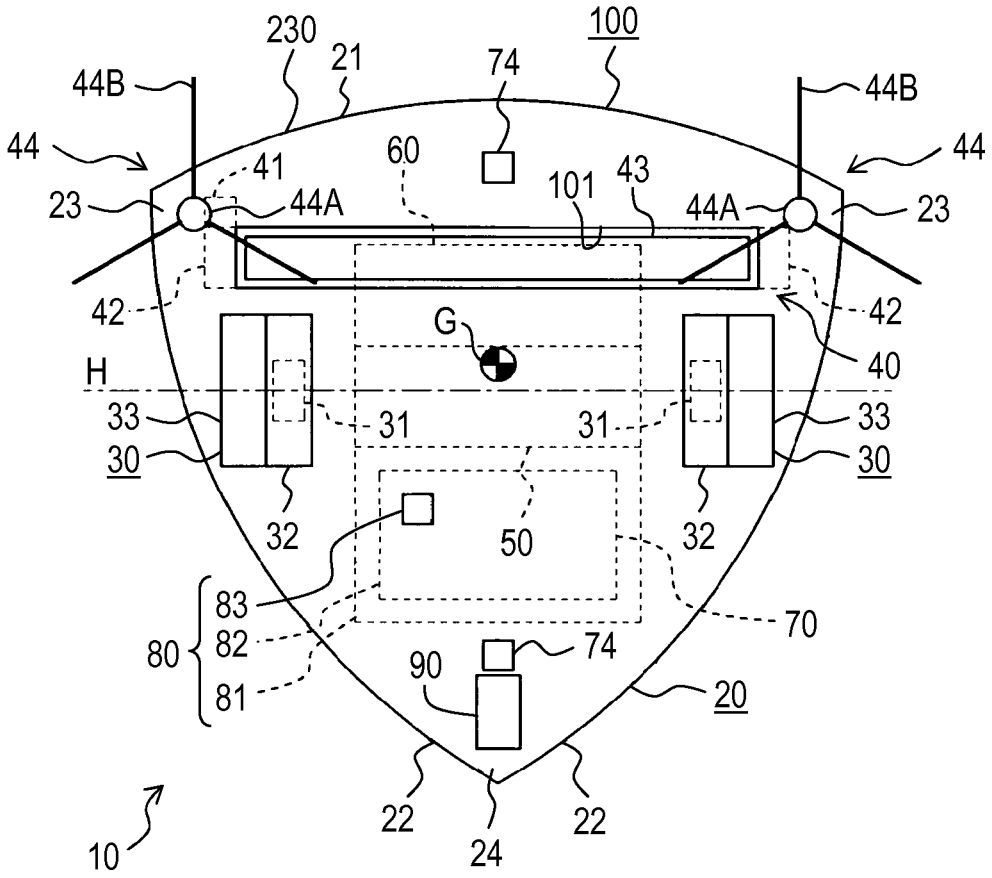

44B
230
21
71
44B
44
23
23
44
AS
60
73
AS
72
72
44A
44A
50
51
52
220
200
210
80
70
10
22
24
22
20

FIG. 9


230
21
74
100
44B
44B
44
44
41
60
101
43
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44A
44A
23
42
42
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H
33
31
31
33
30
30
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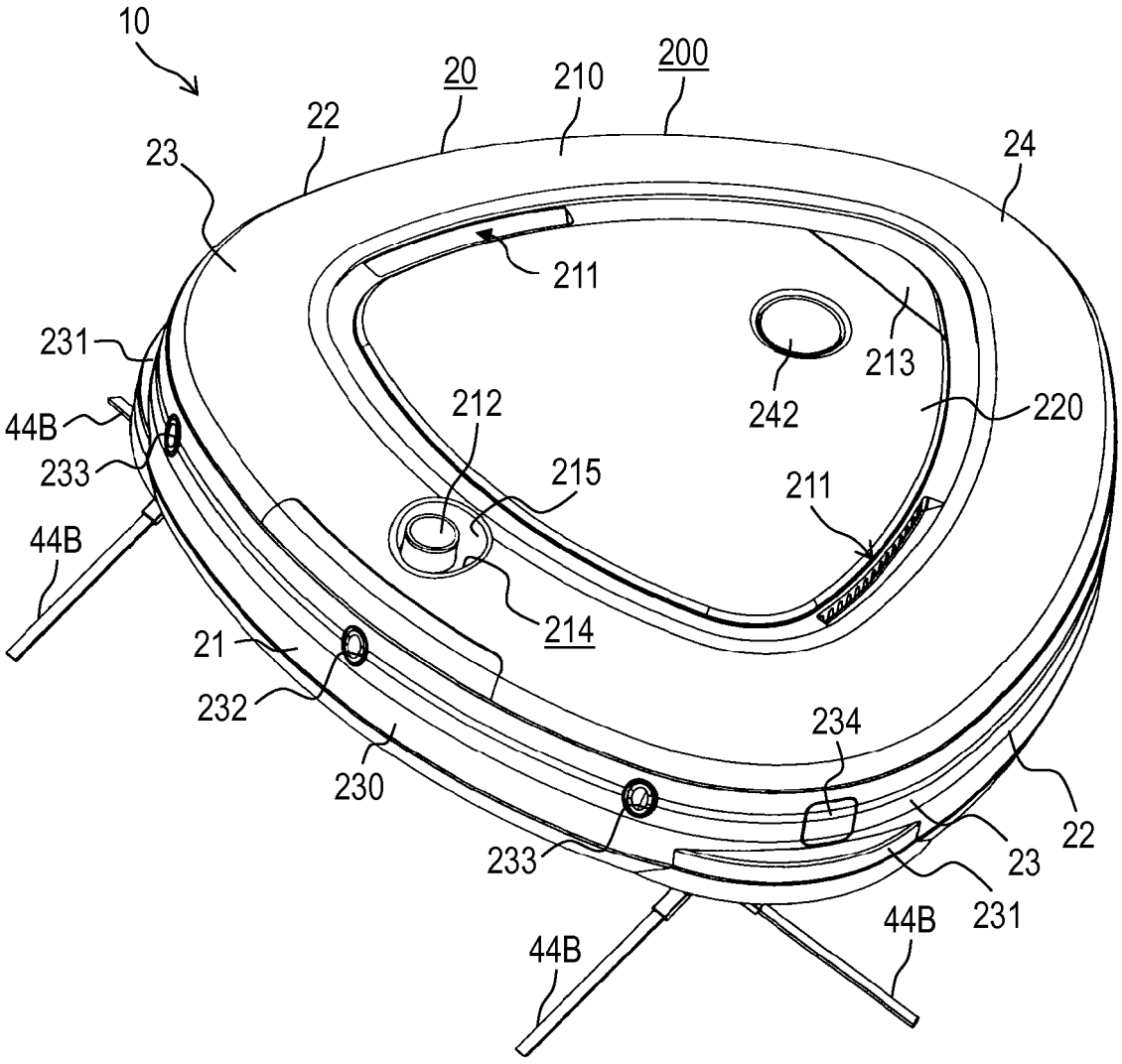
50
32
83
82
81
80
70
74
90
20
22
24
22
10

FIG. 10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20
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200
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23
24
211
213
231
242
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212
44B
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211
44B
214
21
232
234
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22
233
23
231
44B
44B

FIG. 11

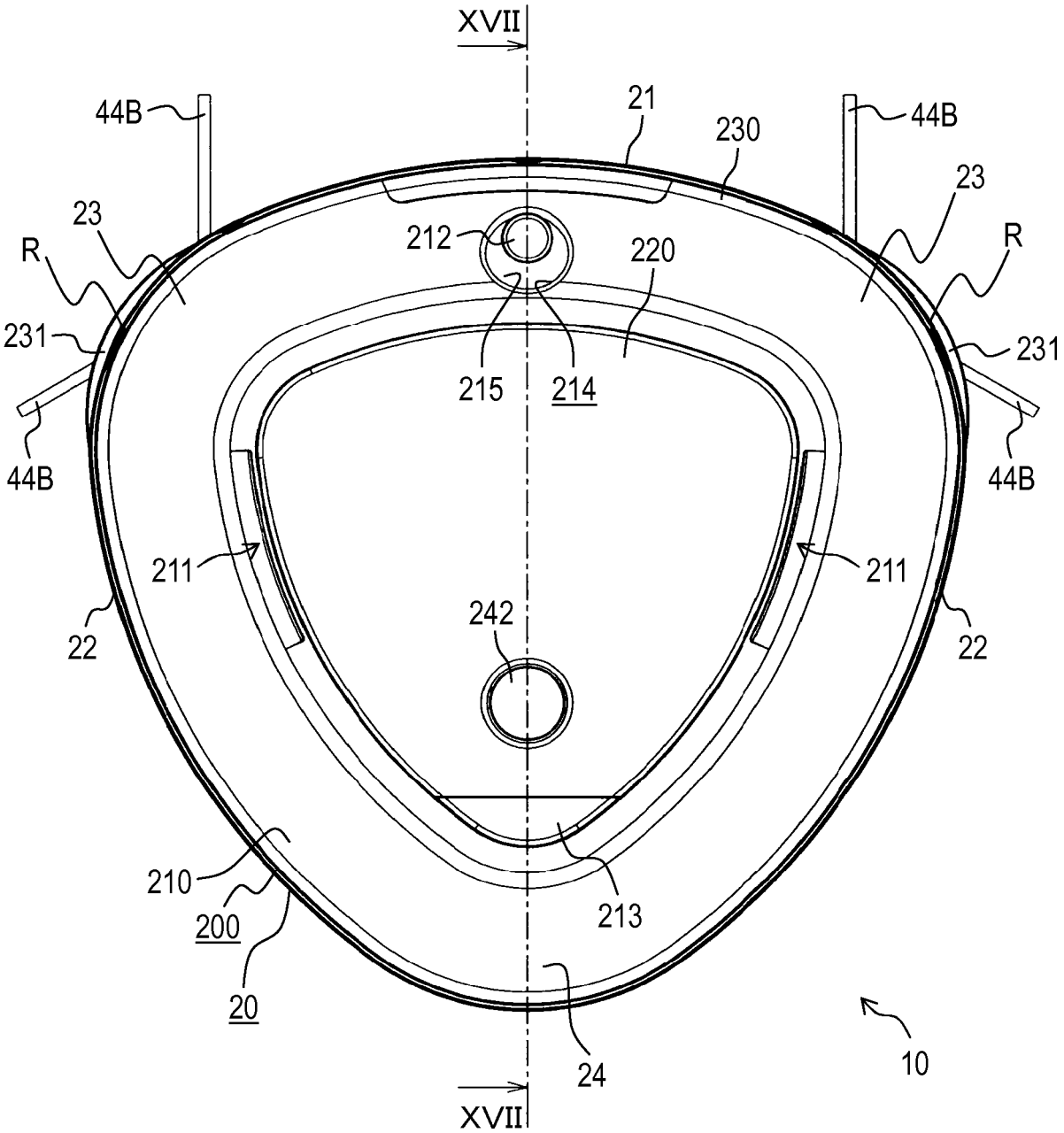
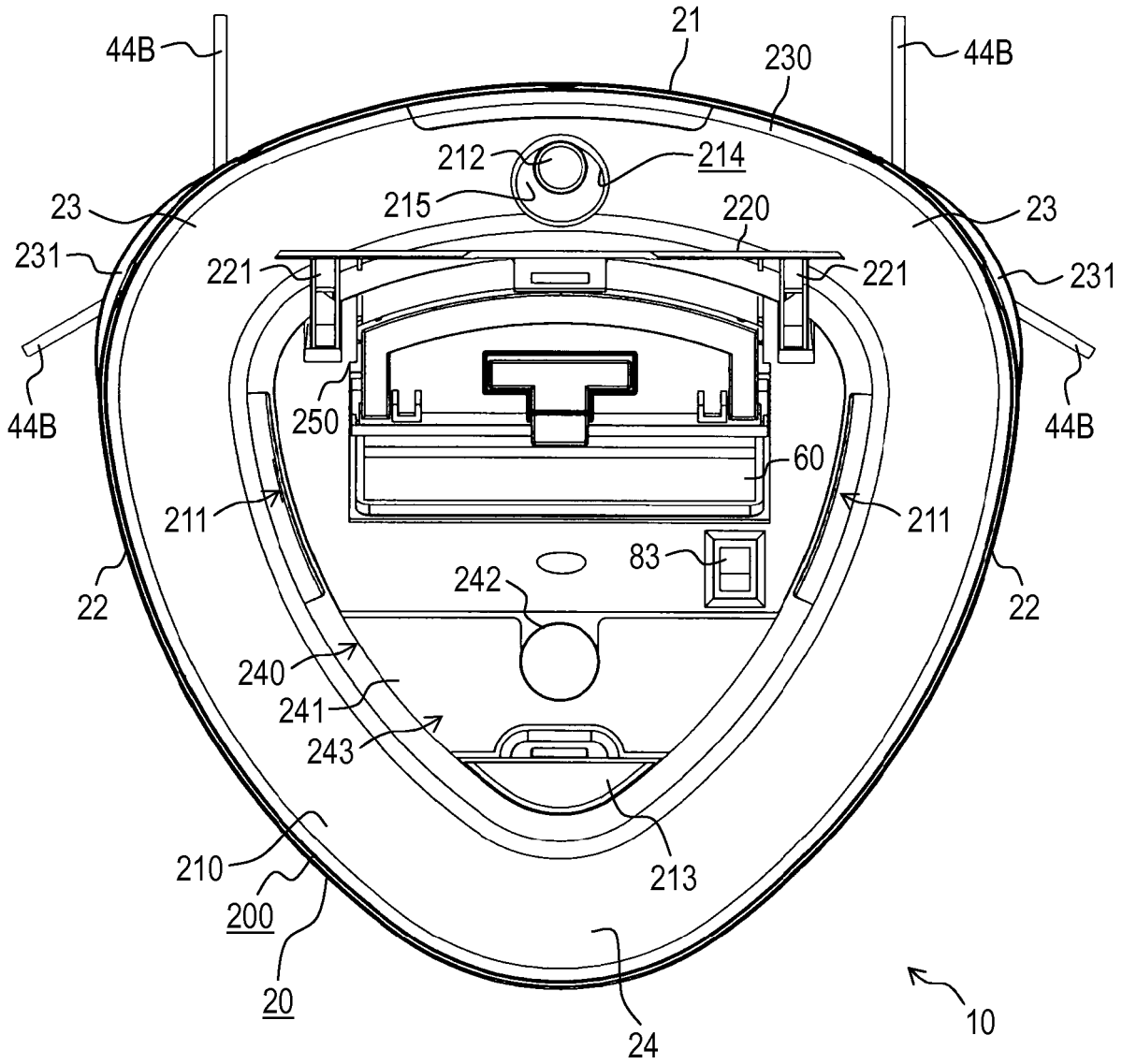

XVII
44B
21
230
44B
23
23
R
212
220
R
231
231
215
214
44B
44B
211
211
242
22
22
210
200
213
20
24
10
XVII

FIG. 12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230
44B
212
214
23
215
220
23
231
221
221
231
44B
250
44B
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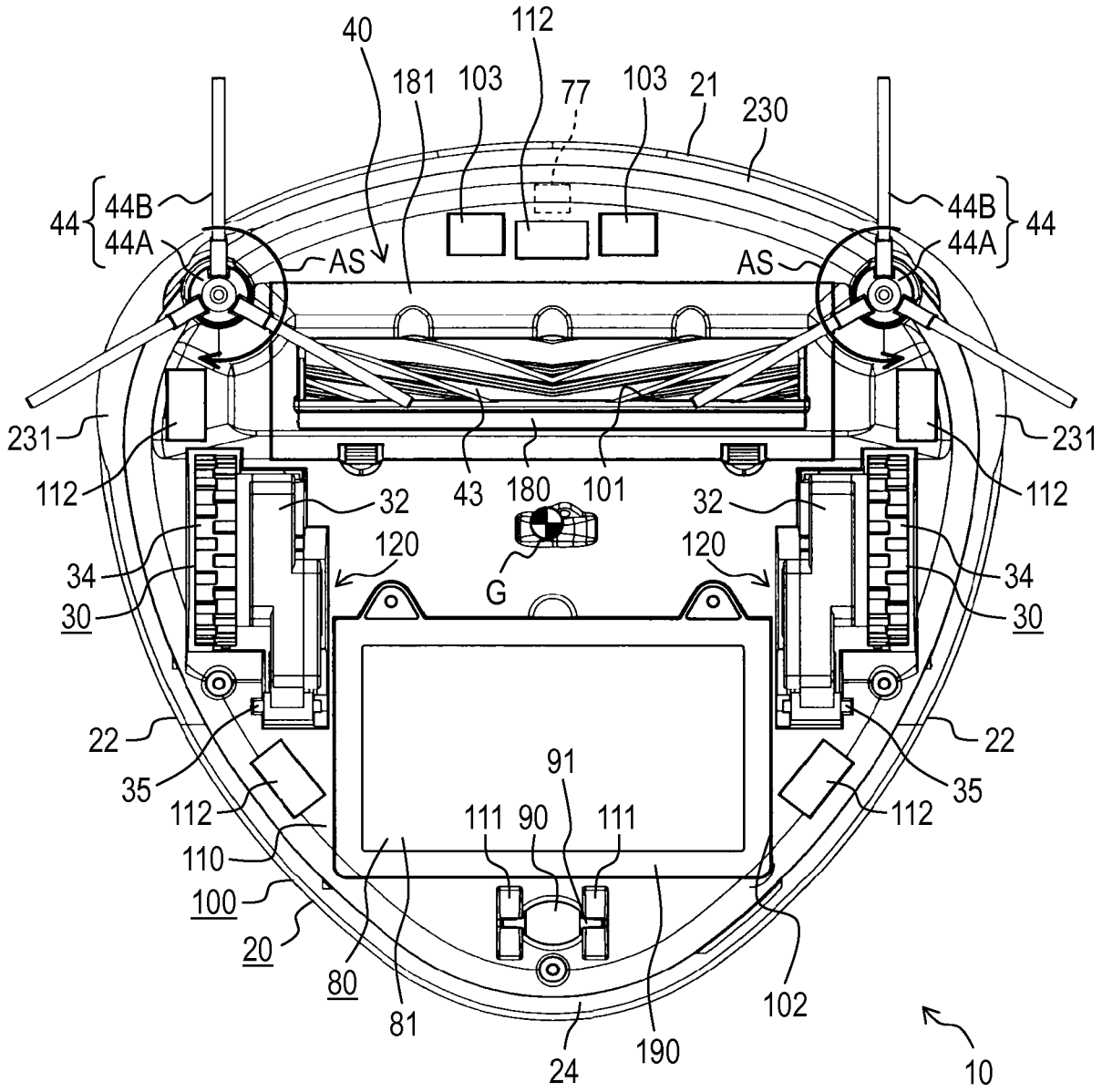
211
211
83
22
242
22
240
241
243
210
213
200
20
24
10

FIG. 13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112
181
103
77
103
21
230
44
44B
44A
AS
AS
44B
44A
44
231
112
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43
180
101
32
120
120
34
30
G
34
30
231
112
22
35
112
110
100
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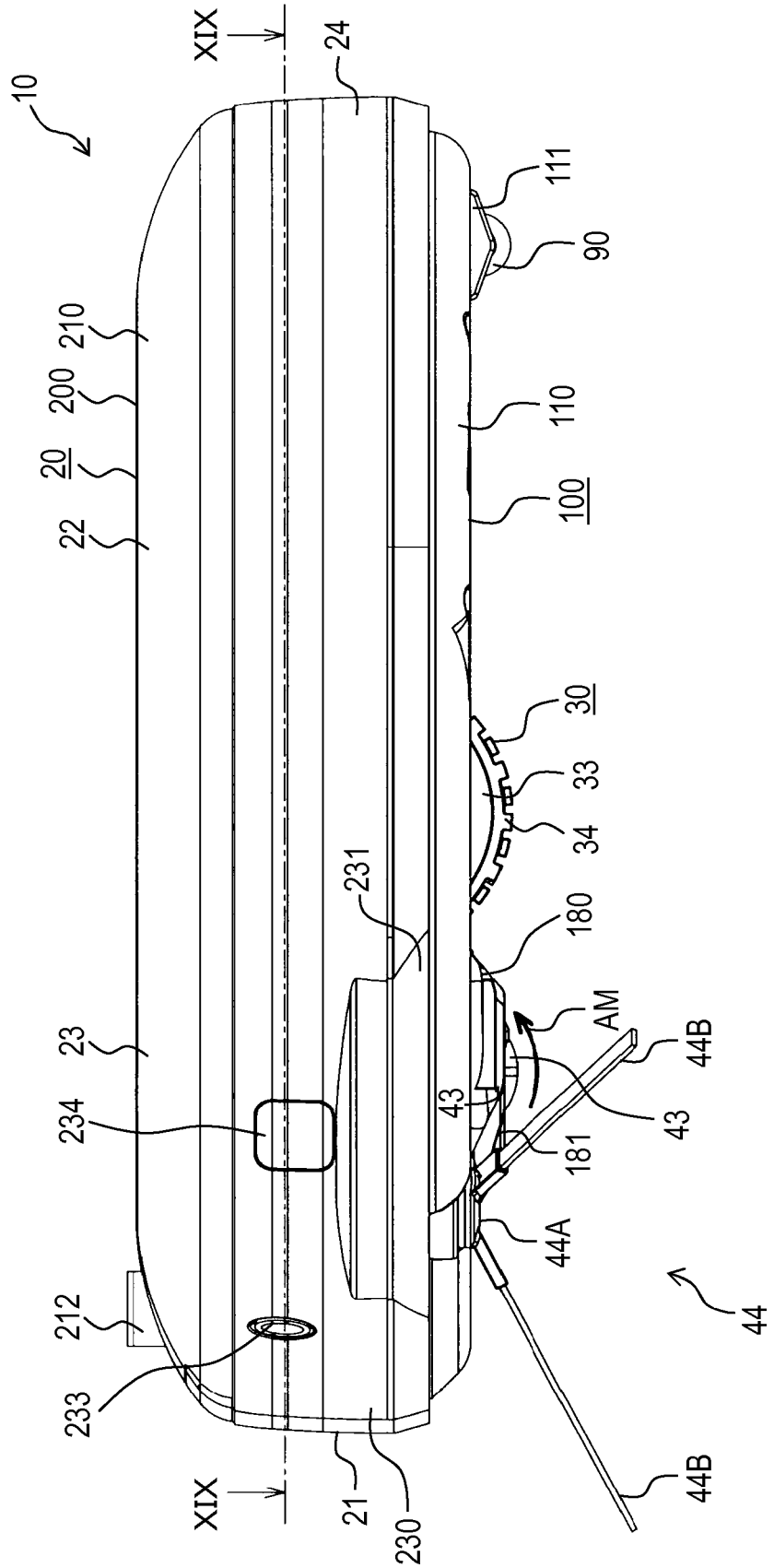
80
81
24
190
102
91
111
90
111
112
22
35
112
10

FIG. 14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XIX
24
111
90
210
200
20
22
110
100
30
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34
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180
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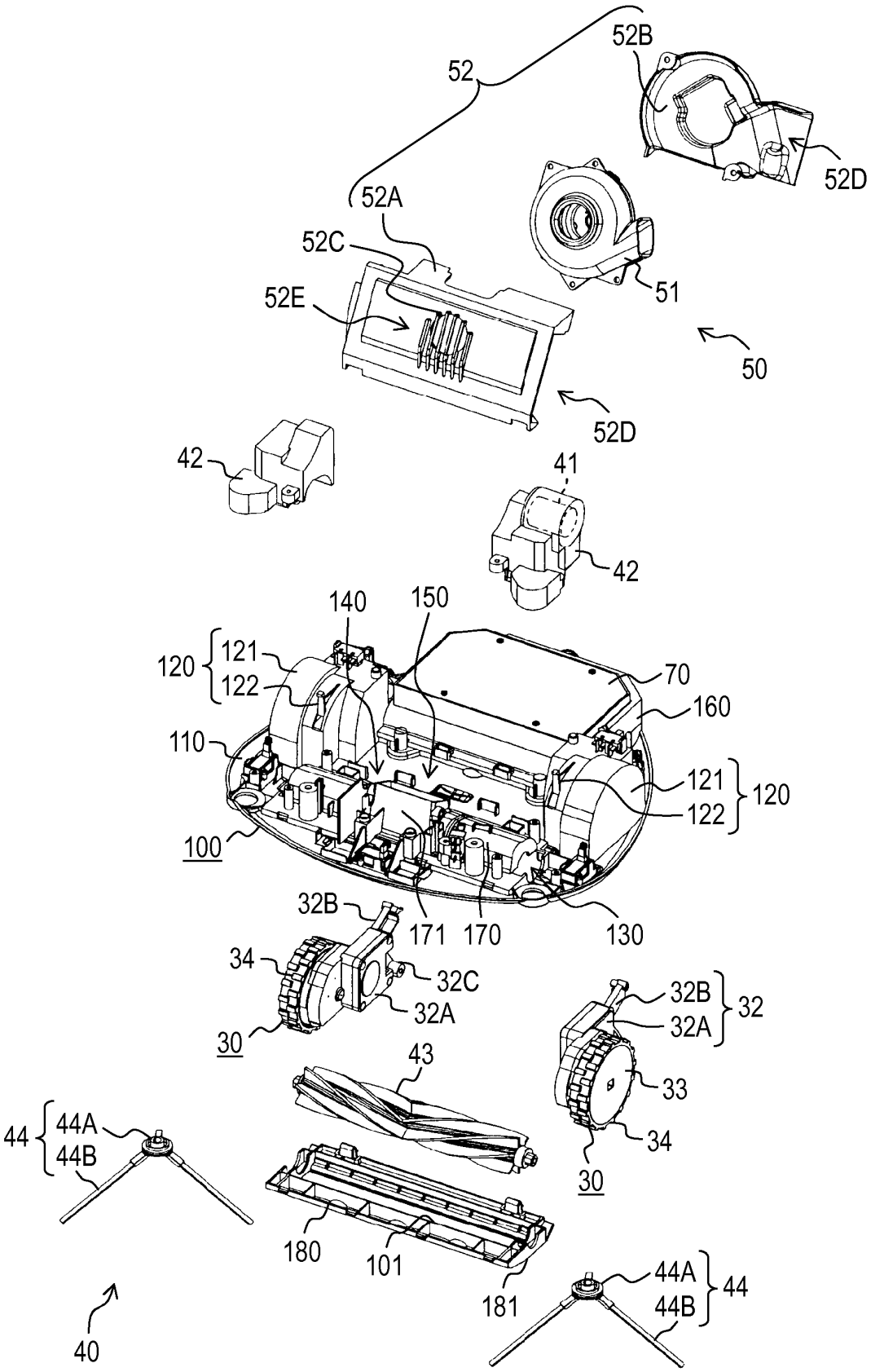
44B
23
234
43
181
44A
44
212
233
21
230

FIG. 15


52
52B
52D
52A
52C
52E
51
50
52D
42
41
42
140
150
120
121
122
70
160
110
121
122
120
100
32B
171
170
130
34
32C
32A
30
32B
32A
32
43
33
34
30
44
44A
44B
180
101
181
44A
44B
44
40

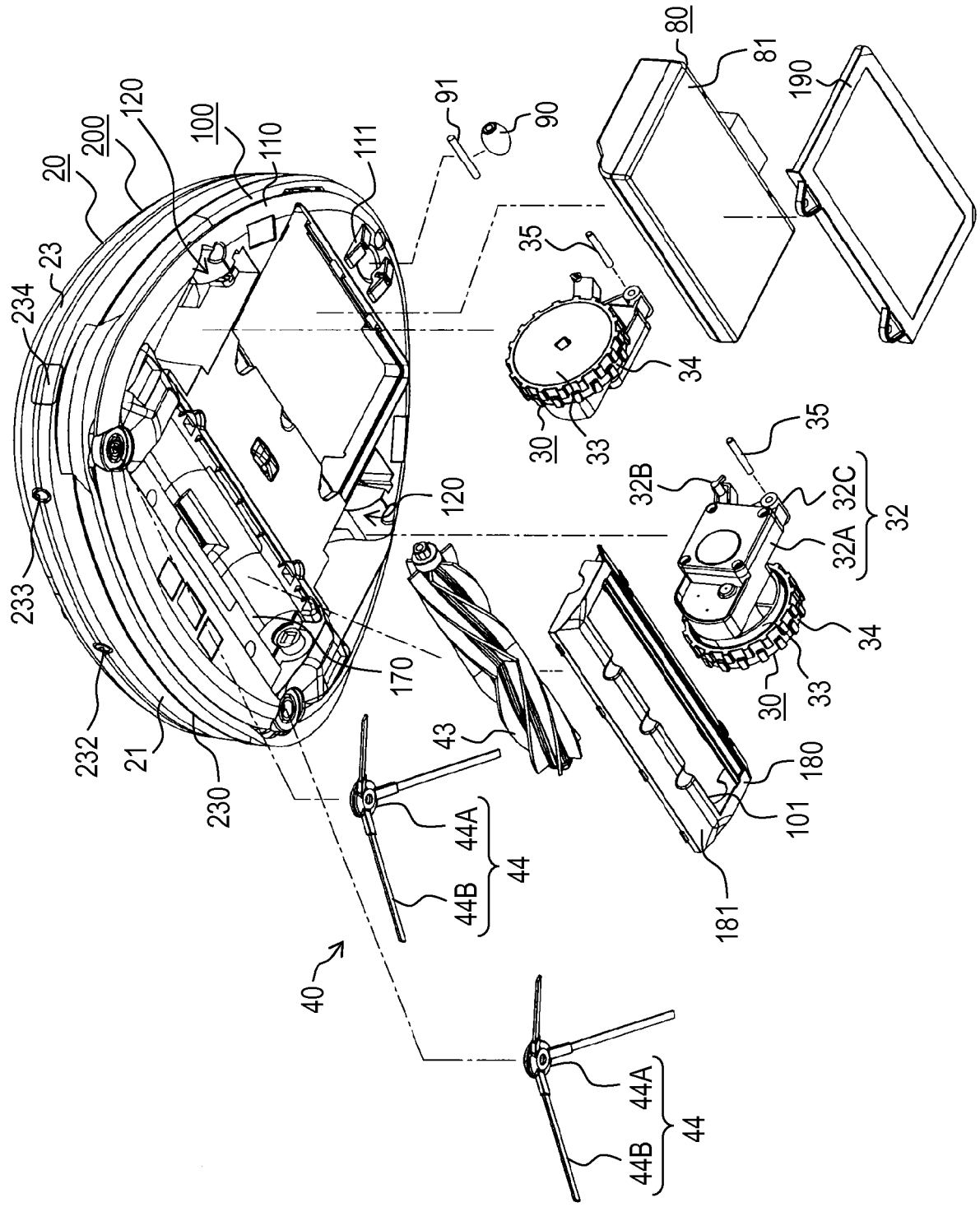
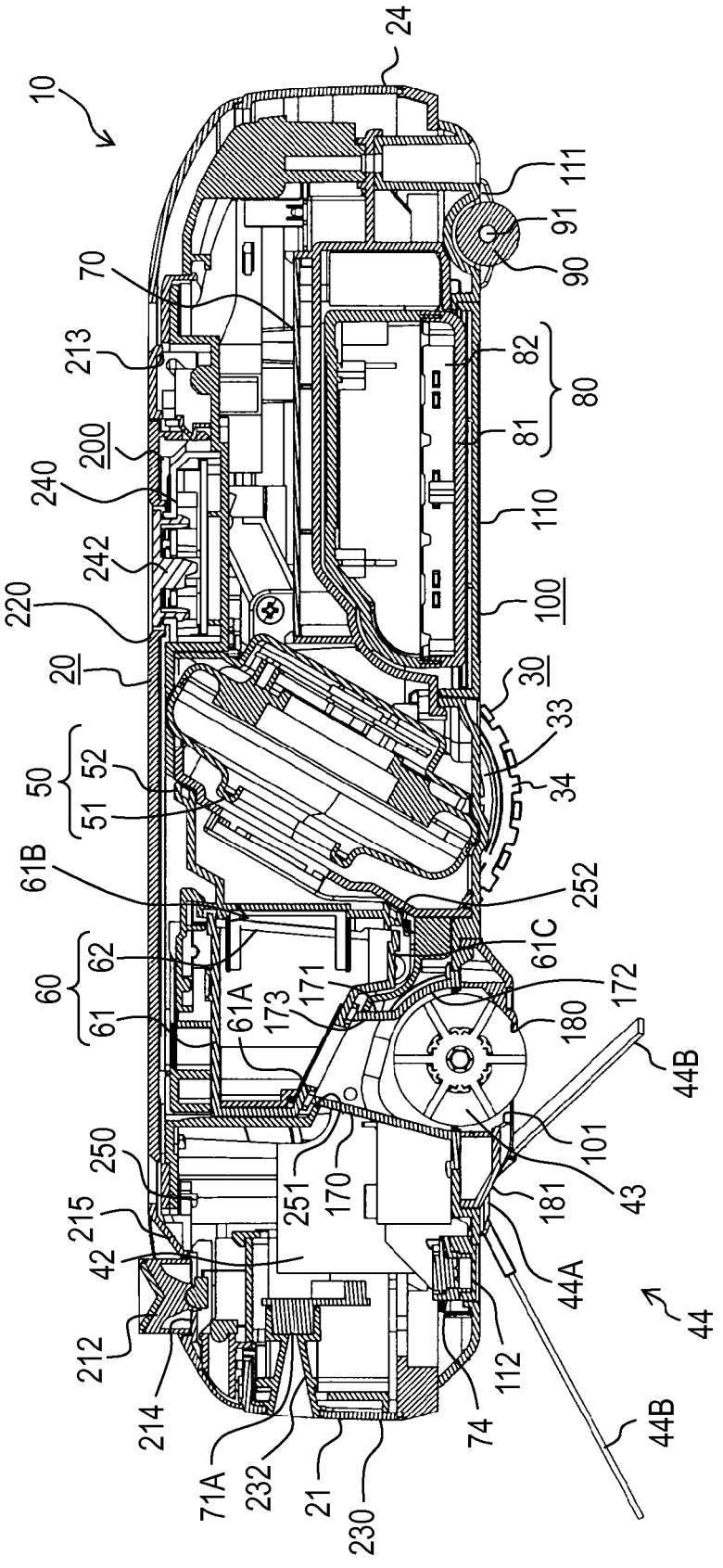

80
81
190
91
90
120
100
110
111
20
200
23
234
35
34
30
33
32B
32C
32A
32
233
232
21
230
170
43
44A
44B
44
40
180
101
181

FIG. 16

FIG. 17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24
111
91
90
70
213
82
80
81
200
240
110
242
220
100
20
30
33
34
50
52
51
61B
252
61C
62
60
61
61A
173
171
172
180
44B
250
101
251
170
181
43
215
42
44A
44
212
112
214
74
71A
232
21
230

FIG. 18

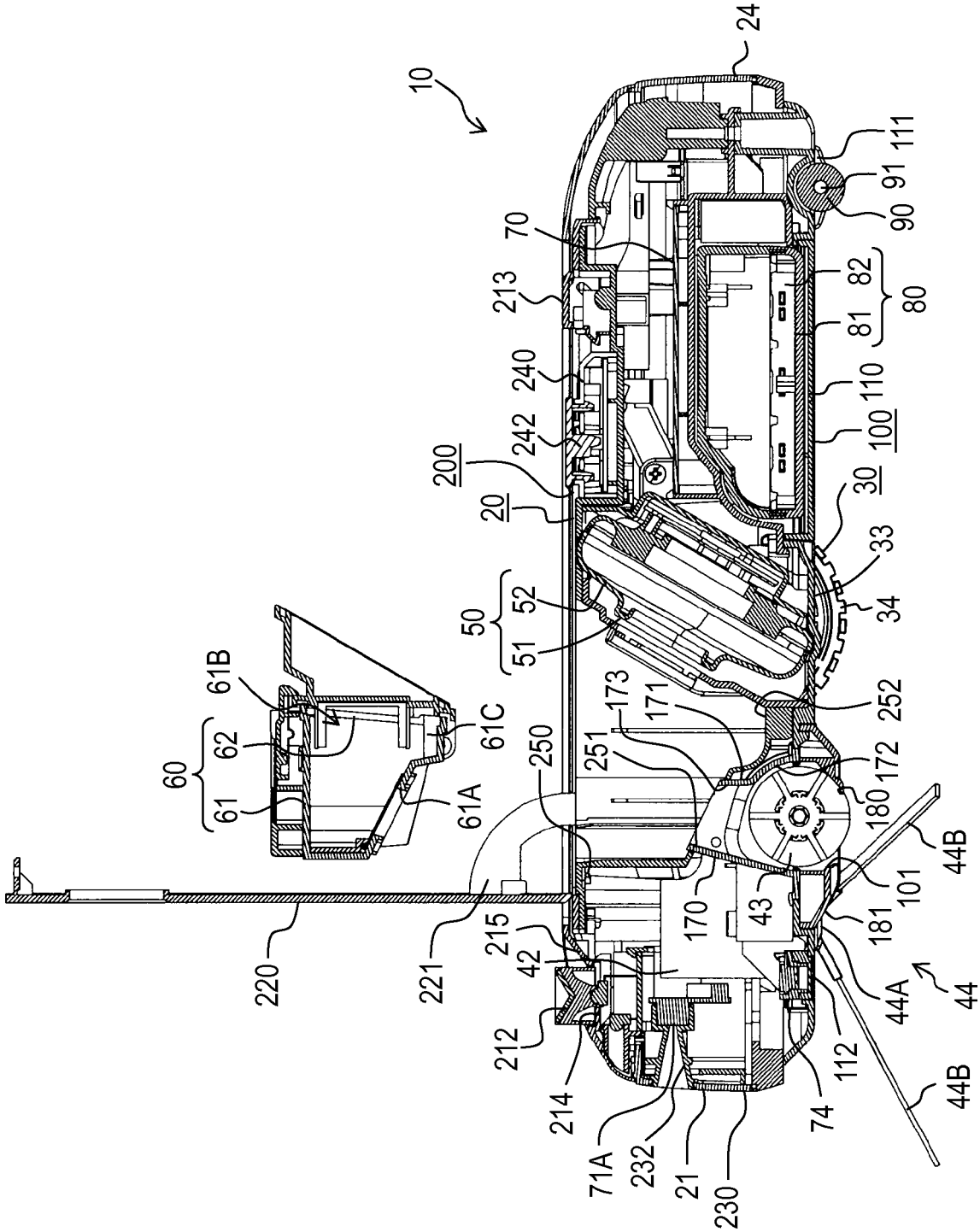
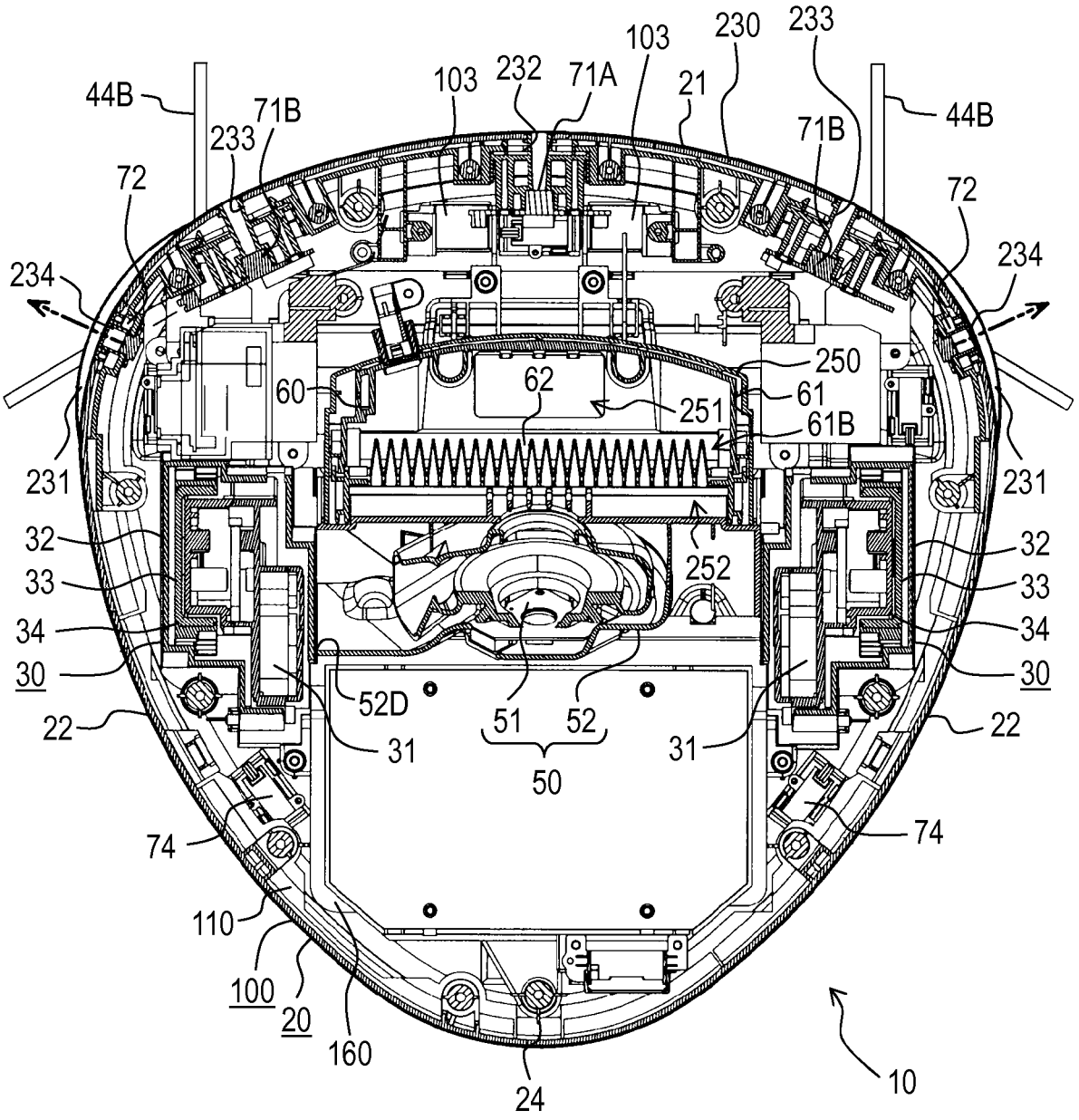

10
24
111
91
90
70
213
82
80
81
240
110
242
100
200
30
20
33
34
50
52
51
61B
173
171
252
62
61C
60
251
250
172
61
61A
180
44B
101
170
43
181
220
221
215
42
44A
44
212
112
214
44B
71A
232
21
230
74

FIG. 19


44B
71B
233
72
234
231
32
33
34
30
22
74
110
100
20
160
24
10
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71A
21
230
233
71B
44B
72
234
231
32
33
34
30
22
74
60
62
250
61
251
61B
252
52D
51
52
50
31
31

FIG. 20

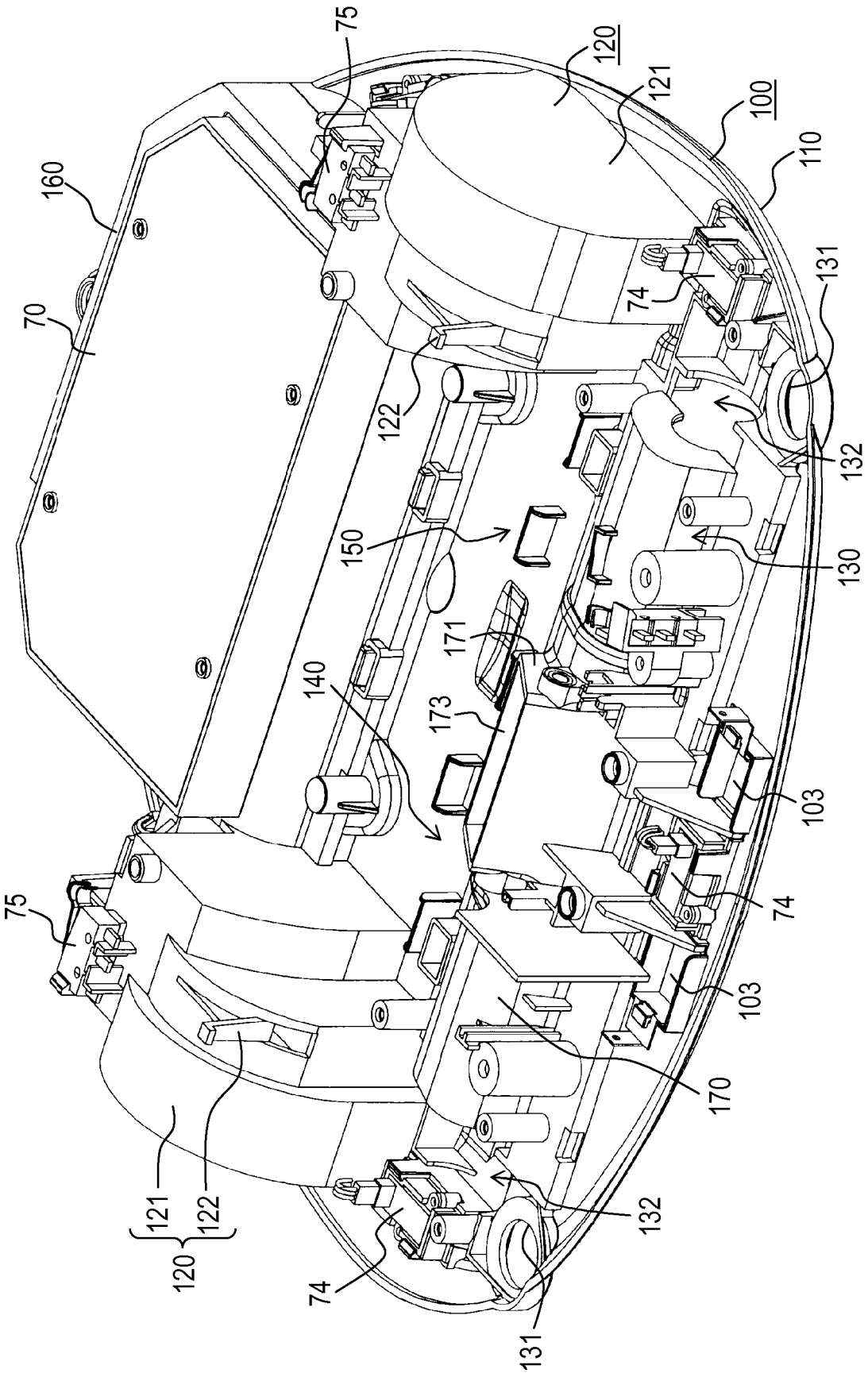

75
120
121
100
110
160
70
74
131
122
132
150
130
171
140
173
103
75
74
103
170
121
122
120
132
74
131

FIG. 21

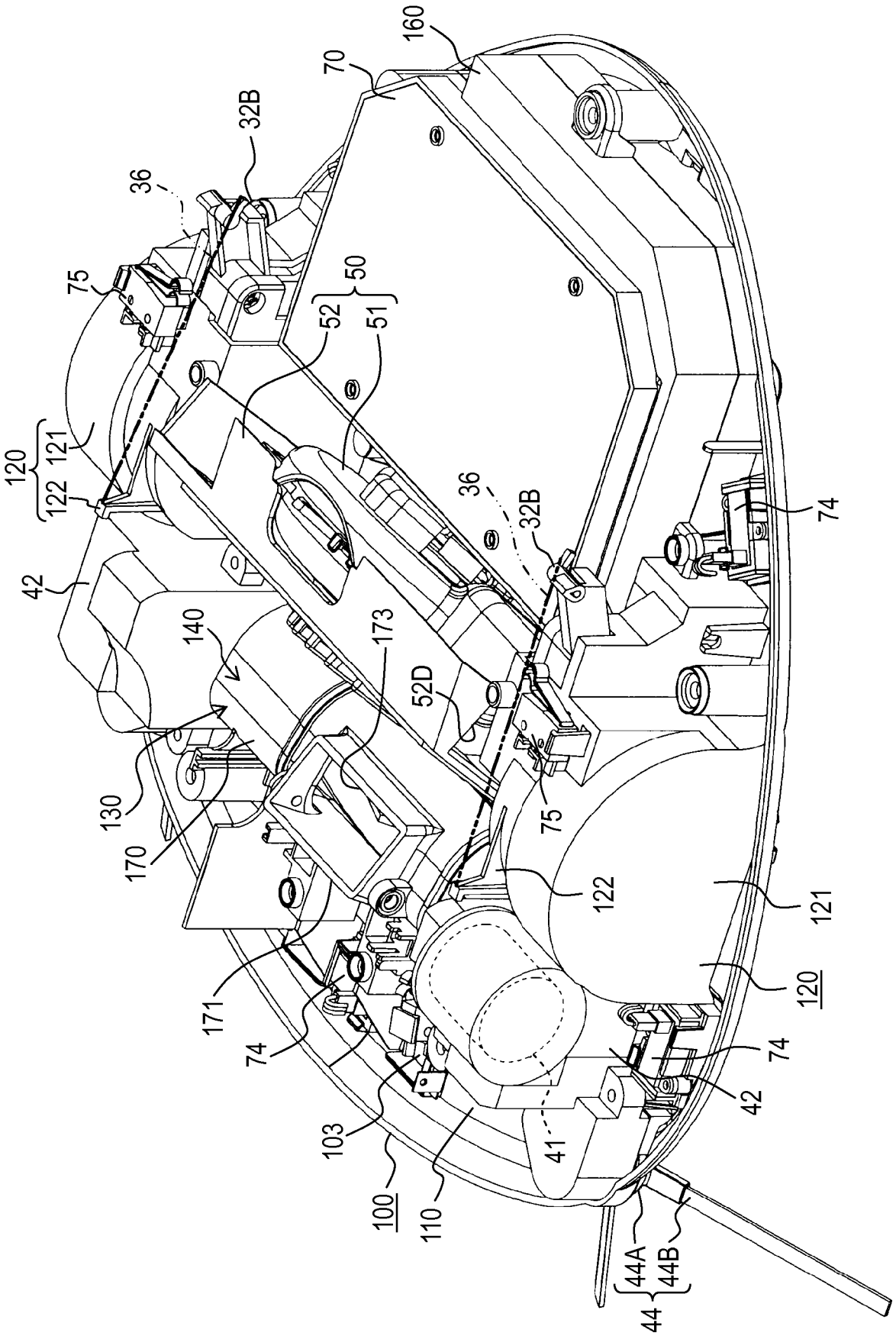
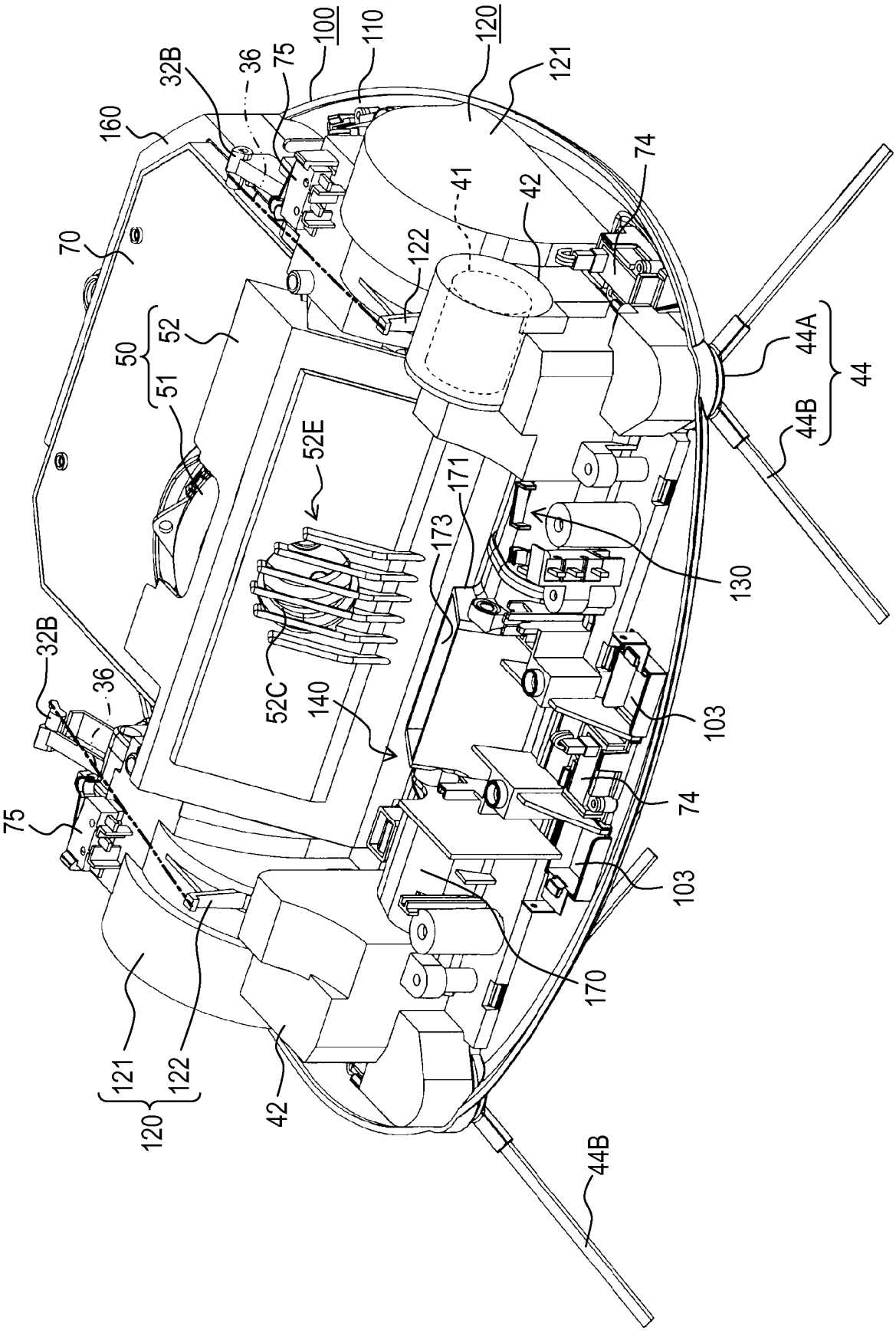

160
70
32B
36
75
50
52
51
120
121
122
36
32B
74
42
140
173
52D
130
170
75
122
121
171
74
120
74
42
103
41
100
110
44A
44B
44

FIG. 22


100
110
120
121
32B
36
75
160
70
74
41
42
122
50
52
51
52E
171
173
130
44A
44
44B
32B
36
52C
140
103
74
75
103
170
121
122
120
42
44B

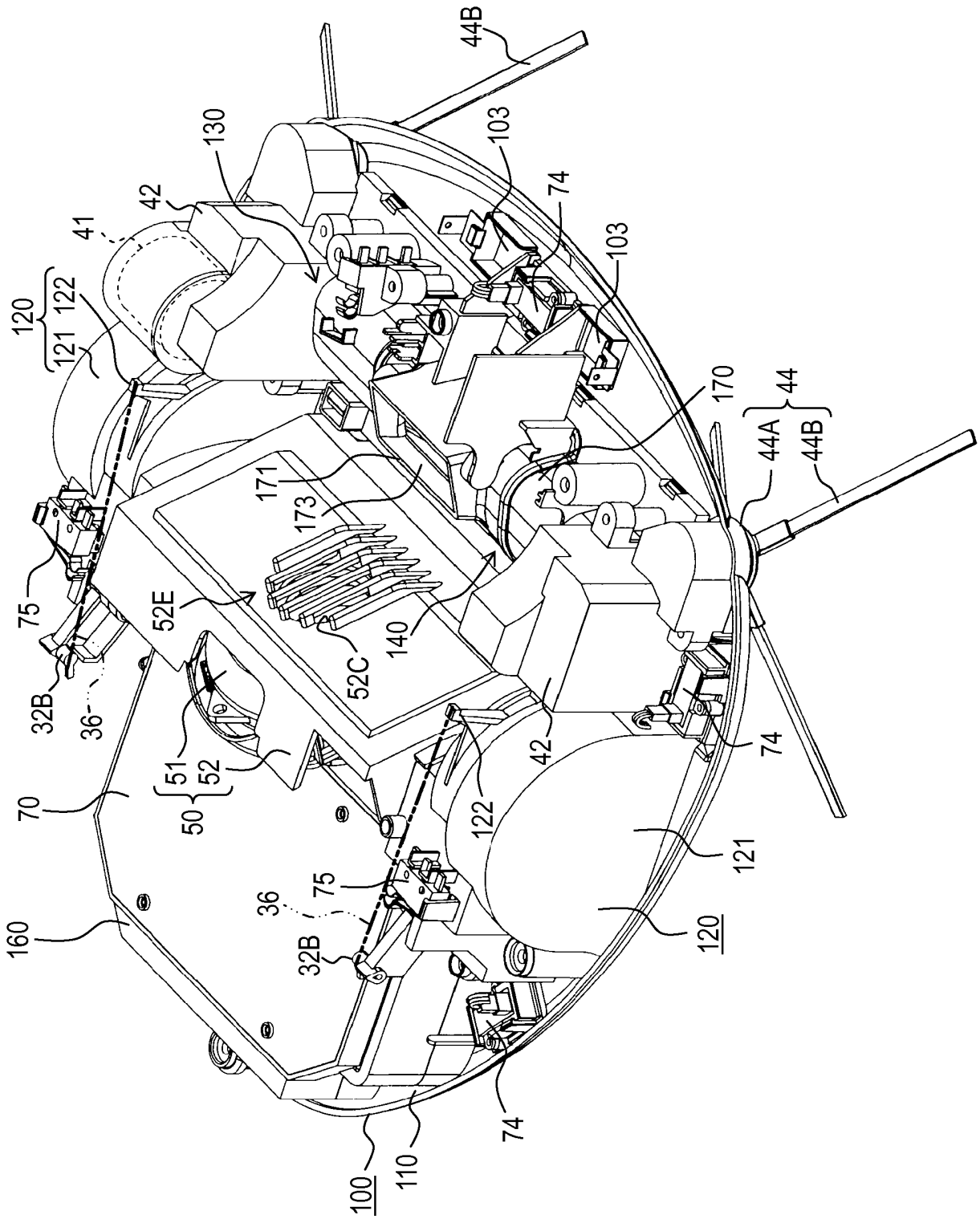

44B
130
103
74
42
41
120
122
121
103
170
44
44A
44B
171
173
75
52E
140
32B
36
52C
51
52
50
70
42
74
122
121
36
75
160
32B
120
74
100
110

FIG. 23

FIG. 24

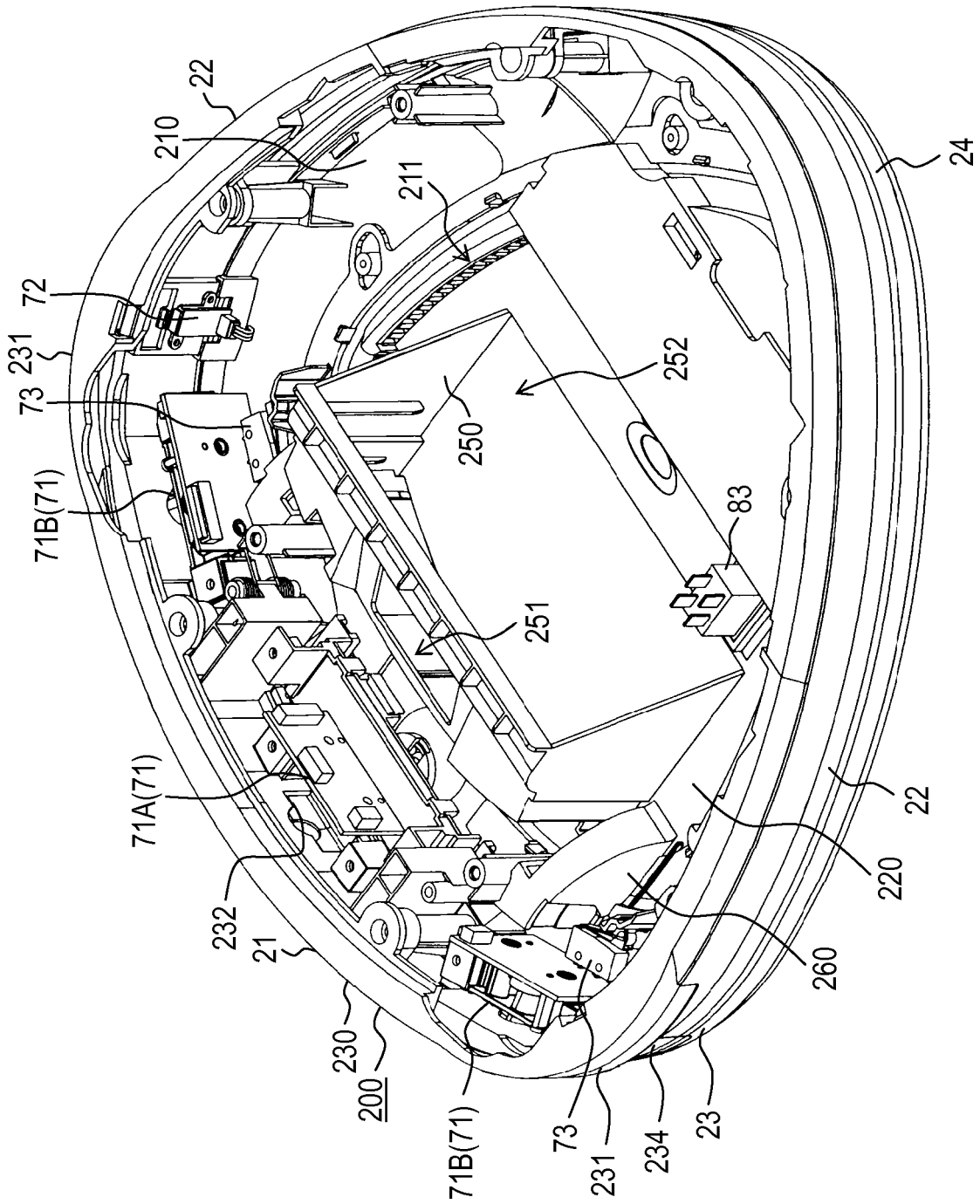

22
210
211
24
72
231
73
71B(71)
250
252
83
251
71A(71)
232
21
230
200
71B(71)
73
231
234
23
220
22
260

FIG. 25

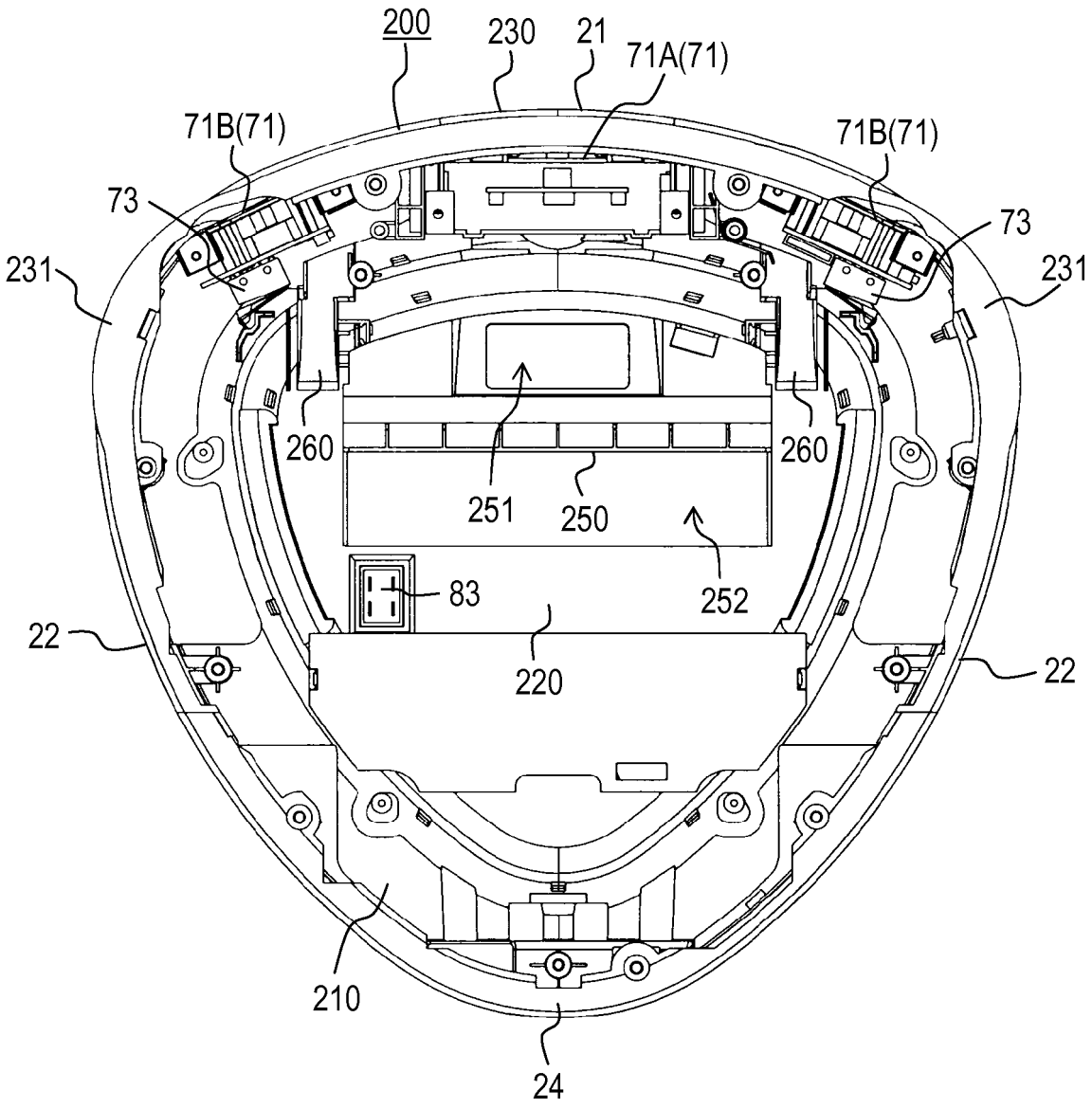

200
230
21
71A(71)
71B(71)
71B(71)
73
73
231
231
260
260
251
250
252
83
22
220
22
210
24

FIG. 26

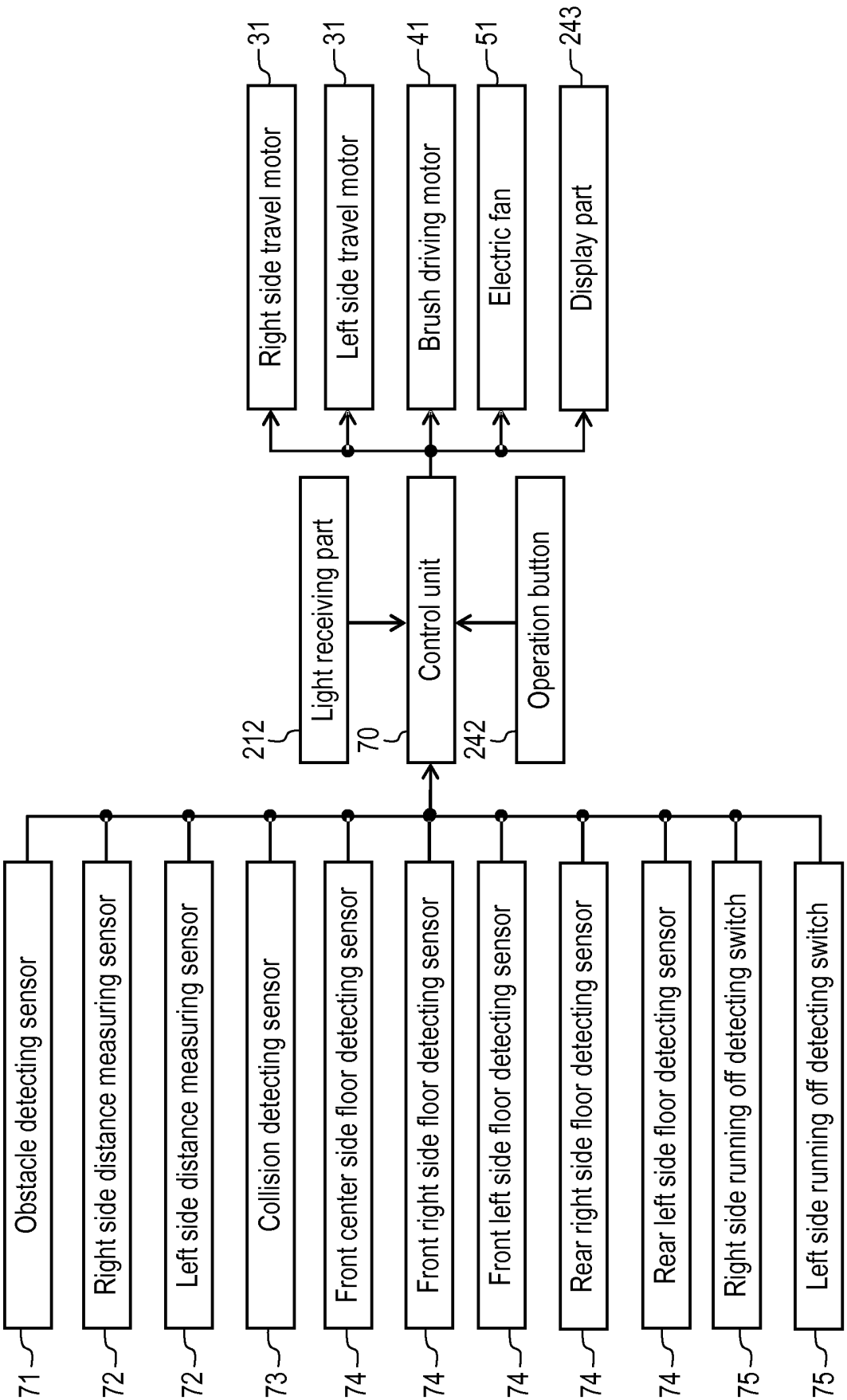
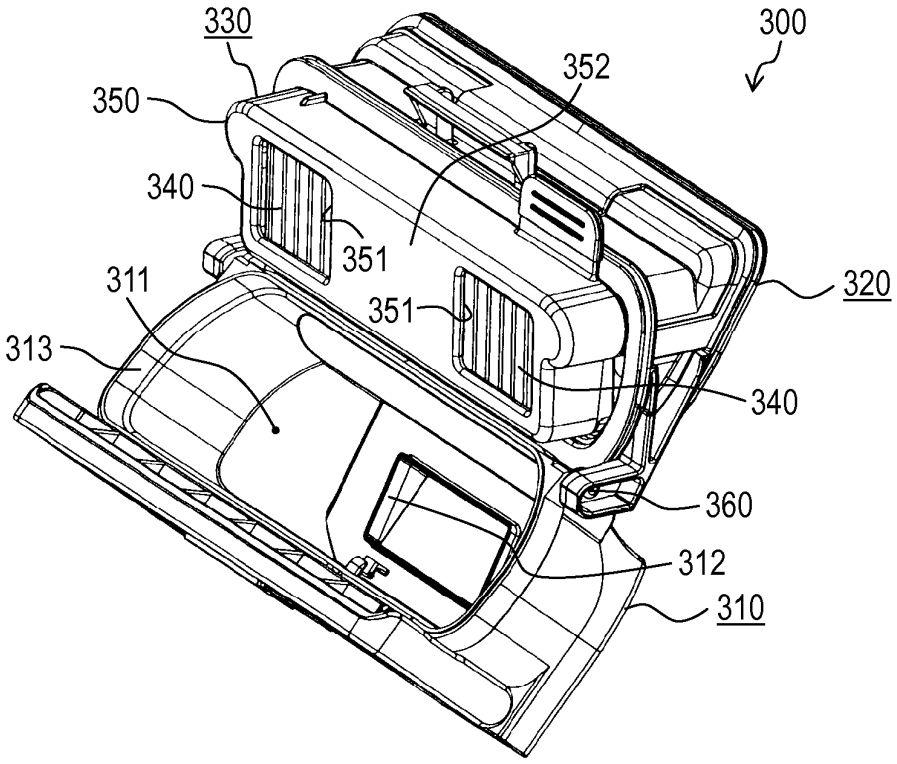

Obstacle detecting sensor
71
Right side distance measuring sensor
72
Left side distance measuring sensor
72
Collision detecting sensor
73
Front center side floor detecting sensor
74
Front right side floor detecting sensor
74
Front left side floor detecting sensor
74
Rear right side floor detecting sensor
74
Rear left side floor detecting sensor
74
Right side running off detecting switch
75
Left side running off detecting switch
75
212
Light receiving part
70
Control unit
242
Operation button
Right side travel motor
31
Left side travel motor
31
Brush driving motor
41
Electric fan
51
Display part
243

FIG. 27


330
300
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351
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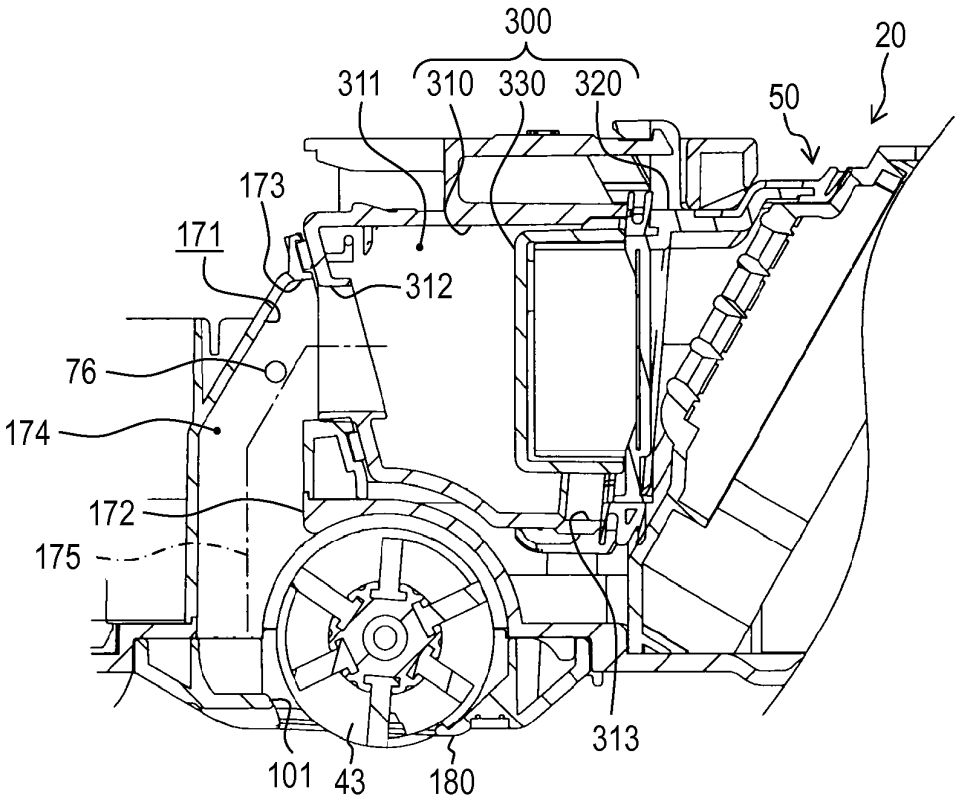
360
312
310

FIG. 28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330
320
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173
171
312
76
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172
175
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101
43
180

FIG. 29

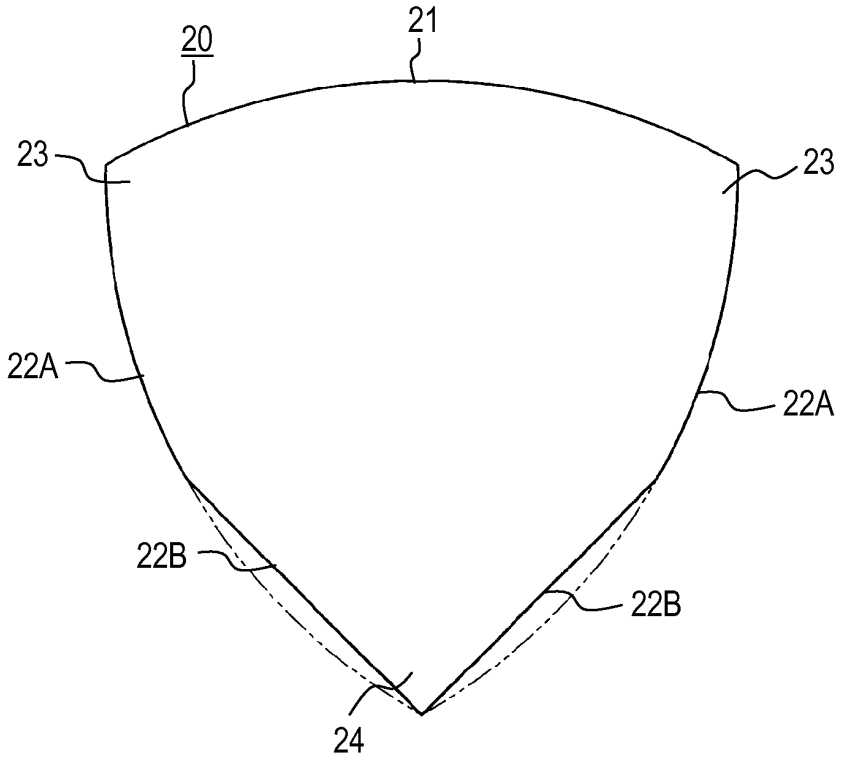

FIG. 30

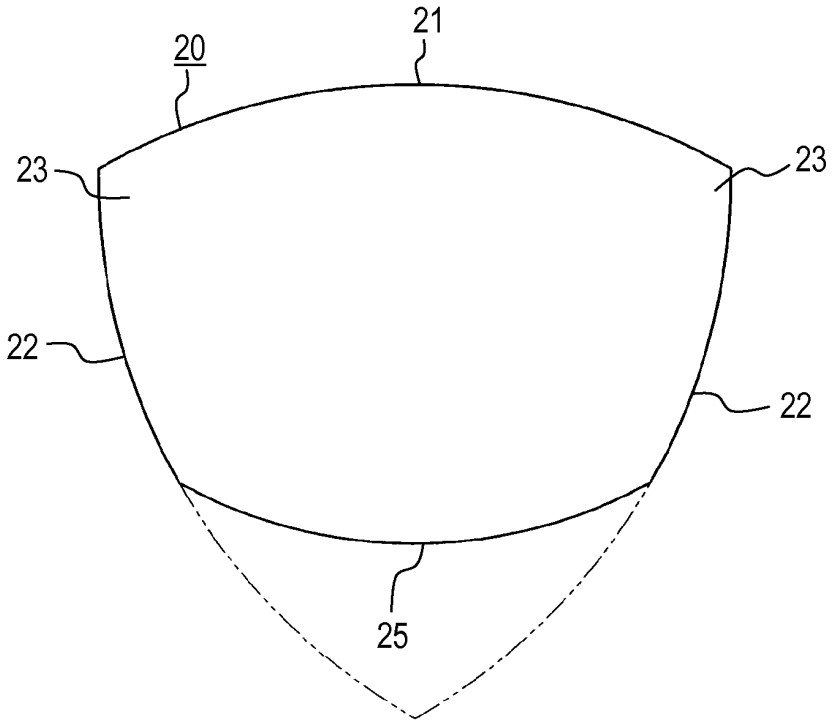

FIG. 31

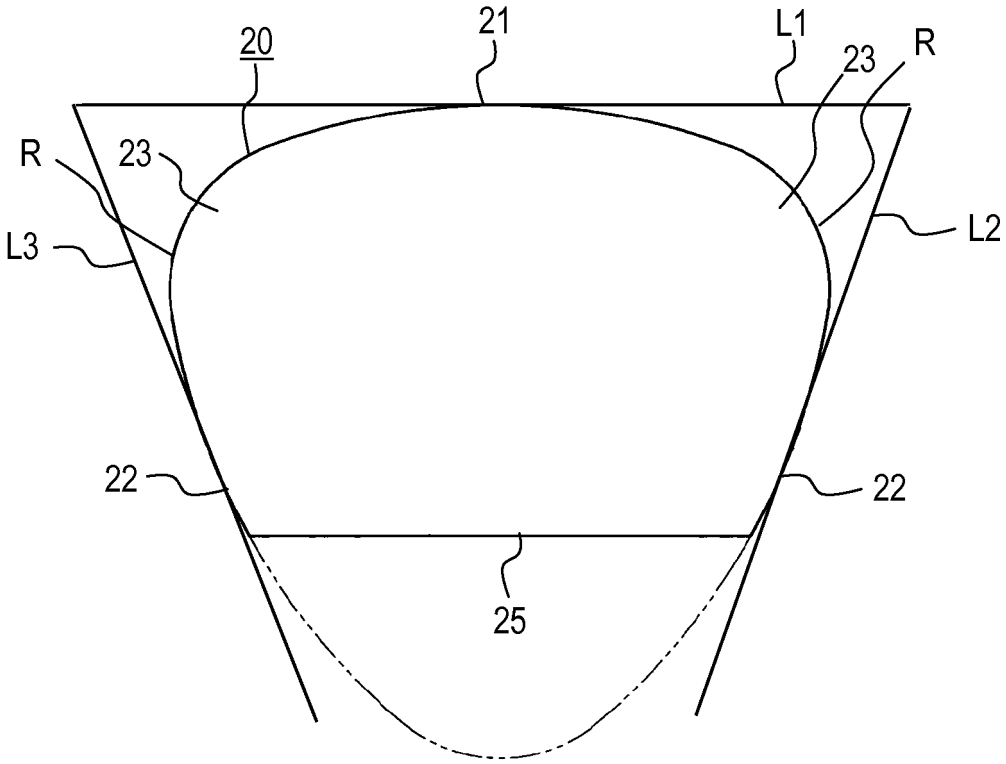

FIG.3

71 OBSTACLE DETECTING SENSOR

72 RIGHT SIDE DISTANCE MEASURING SENSOR

72 LEFT SIDE DISTANCE MEASURING SENSOR

73 COLLISION DETECTING SENSOR

74 FRONT SIDE FLOOR DETECTING SENSOR

74 REAR SIDE FLOOR DETECTING SENSOR

70 CONTROL UNIT

31 RIGHT SIDE TRAVEL MOTOR

31 LEFT SIDE TRAVEL MOTOR

41 BRUSH DRIVING MOTOR

51 ELECTRIC FAN

FIG. 26

71 OBSTACLE DETECTING SENSOR

72 RIGHT SIDE DISTANCE MEASURING SENSOR

72 LEFT SIDE DISTANCE MEASURING SENSOR

73 COLLISION DETECTING SENSOR

74 FRONT CENTER SIDE FLOOR DETECTING SENSOR

74 FRONT RIGHT SIDE FLOOR DETECTING SENSOR

74 FRONT LEFT SIDE FLOOR DETECTING SENSOR

74 REAR RIGHT SIDE FLOOR DETECTING SENSOR

74 REAR LEFT SIDE FLOOR DETECTING SENSOR

75 RIGHT SIDE RUNNING OFF DETECTING SWITCH

75 LEFT SIDE RUNNING OFF DETECTING SWITCH

212 LIGHT RECEIVING PART

70 CONTROL UNIT

242 OPERATION BUTTON

31 RIGHT SIDE TRAVEL MOTOR

31 LEFT SIDE TRAVEL MOTOR

41 BRUSH DRIVING MOTOR

51 ELECTRIC FAN

243 DISPLAY PART

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/003242

A. CLASSIFICATION OF SUBJECT MATTER
A47L9/28(2006.01)i, *A47L9/00*(2006.01)i, *A47L9/02*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A47L9/28, A47L9/00, A47L9/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015
Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2009-500741 A (AB. Electrolux), 08 January 2009 (08.01.2009), paragraphs [0036] to [0051]; fig. 1 to 8 & US 2009/0126143 A1 & WO 2007/008148 A1 & EP 1906807 A & KR 10-2008-0028988 A & CN 101217907 A & AT 542459 T	1-2,4-5 3
Y	JP 2014-79515 A (Sharp Corp.), 08 May 2014 (08.05.2014), paragraph [0011]; fig. 3 (Family: none)	3
A	JP 63-127310 A (Sanyo Electric Co., Ltd.), 31 May 1988 (31.05.1988), entire text; all drawings (Family: none)	1-5

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 July 2015 (28.07.15)	04 August 2015 (04.08.15)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/003242

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 63-158032 A (Sanyo Electric Co., Ltd.), 01 July 1988 (01.07.1988), entire text; all drawings (Family: none)	1-5
A	JP 2013-106820 A (Mitsubishi Electric Corp.), 06 June 2013 (06.06.2013), entire text; all drawings (Family: none)	1-5

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Patent documents cited in the description

- JP 2008296007 A **[0010]**
- JP 2011212444 A **[0010]**
- JP 2014073192 A **[0010]**
- JP 2014094233 A **[0010]**
- JP 2014061375 A **[0010]**