



(11) **EP 4 505 933 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.02.2025 Bulletin 2025/07

(51) International Patent Classification (IPC):
A47L 11/40 ^(2006.01) **A47L 7/02** ^(2006.01)
A47L 9/28 ^(2006.01)

(21) Application number: **23198584.7**

(52) Cooperative Patent Classification (CPC):
A47L 11/4025; A47L 7/02; A47L 9/2805;
A47L 2201/024

(22) Date of filing: **20.09.2023**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **WANG, Jian**
5656 AE Eindhoven (NL)
• **LI, Lavin**
5656 AE Eindhoven (NL)

(30) Priority: **11.08.2023 CN 202311014504**

(74) Representative: **Vollering, Stefanus Franciscus
Maria**
Versuni Holding B.V.
Microstad
Professor Doctor Dorgelolaan 2
5611 BA Eindhoven (NL)

(71) Applicant: **Versuni Holding B.V.**
5656 AE Eindhoven (NL)

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

(57) The present disclosure relates to a cleaning apparatus. The cleaning apparatus includes a housing, a dust box, and an air duct structure. The housing has a first housing opening and a second housing opening located in a side face. The dust box is disposed in the housing and has a dust box vacuuming air outlet and a dust collection suction opening. The air duct structure is provided in the housing and partially defined by the dust box. The air duct structure includes a first flow path leading from the dust box vacuuming air outlet to the first housing opening, and a second flow path leading from the first housing opening to the dust collection suction open-

ing. The two flow paths partially overlap. The present disclosure further relates to a cleaning system. The cleaning system includes the cleaning apparatus and a base station. The base station is provided with a base station suction opening matching the second housing opening, and a base station air outlet matching the first housing opening. According to the cleaning apparatus of the present disclosure, the first flow path used for the dust suction operation and the second flow path used for the dust collection operation partially overlap, thereby simplifying the air duct structure and improving space utilization while ensuring a desired dust collection effect.

Description

FIELD OF TECHNOLOGY

[0001] The present disclosure generally relates to a cleaning apparatus, in particular to a cleaning apparatus for sweeping surfaces and a cleaning system including the cleaning apparatus.

BACKGROUND

[0002] Existing cleaning apparatuses for sweeping surfaces, such as robot vacuum cleaners, have a dust collection function in addition to a conventional vacuuming function. When a cleaning apparatus operates in a vacuuming mode, the cleaning apparatus sucks up dust or other contaminants from a surface, such as a floor or ground, into a dust box of the cleaning apparatus. When the cleaning apparatus operates in a dust collection mode, the cleaning apparatus returns to a base station to cooperate with the base station, so that dust in the cleaning apparatus is collected into a collection device, such as a dust bag, of the base station.

[0003] In the existing cleaning apparatus and the base station, the cleaning apparatus is provided with a main body dust collection air outlet duct for dust collection, and the base station is correspondingly provided with a base station dust collection air inlet duct, so that in the dust collection mode, dust from the cleaning apparatus is sucked to the base station dust collection air inlet duct via the main body dust collection air outlet duct. In addition, the base station may alternatively be provided with a base station dust collection air outlet duct leading to the cleaning apparatus, and the cleaning apparatus is correspondingly provided with a main body dust collection air inlet duct for dust collection, thereby achieving more effective dust collection.

[0004] Therefore, in order to achieve different functions of the cleaning apparatus and to ensure a dust collection effect, a main body vacuuming air outlet duct and the main body dust collection air outlet duct of the cleaning apparatus are designed separately and independently, and the main body dust collection air inlet duct is also designed separately and independently from other air ducts. However, such a design leads to the existence of too many air ducts in the cleaning apparatus, making the internal structure of the cleaning apparatus very complicated and occupying a large available internal space, which is very unfavorable in the case where the space of a main body of an existing cleaning apparatus is very limited, and may still affect vacuuming and dust collection effects of the cleaning apparatus.

SUMMARY

[0005] Various exemplary embodiments of the present disclosure provide a cleaning apparatus and a cleaning system. Compared to existing cleaning apparatuses, the

cleaning apparatus of the present disclosure has an optimized air duct structure, which makes the layout of internal components thereof more reasonable and saves the space occupied by the air duct structure, thereby providing more available space for other important components such as a dust box and a water tank. Moreover, the cleaning apparatus of the present disclosure may further improve the dust collection efficiency by utilizing the air duct structure, improve a cleaning effect of the dust box while providing an excellent surface cleaning effect, and provide self-cleaning of the dust box and internal devices of the cleaning apparatus.

[0006] According to a first aspect of the present disclosure, a cleaning apparatus is provided. The cleaning apparatus includes a housing, a dust box, and an air duct structure. The housing has a first housing opening and a second housing opening located in a side face of the housing. The dust box is disposed in the housing and has a dust box vacuuming air outlet and a dust collection suction opening. The air duct structure is provided in the housing and partially defined by the dust box. The air duct structure includes a first flow path leading from the dust box vacuuming air outlet to the first housing opening, and the first flow path may be used as a main body vacuuming path of the cleaning apparatus in a vacuuming mode. The air duct structure further includes a second flow path leading from the first housing opening to the dust collection suction opening, and the second flow path may be used as a dust collection air intake path of the cleaning apparatus in a dust collection mode. The first flow path partially overlaps the second flow path.

[0007] By utilizing this arrangement of the present disclosure, a portion of the main body vacuuming path (i.e., the main body vacuuming air outlet duct) during normal dust suction operation of the cleaning apparatus shares the same passageway with a portion of the dust collection air intake path (i.e., the main body dust collection air inlet duct) when returning to the base station to collect the dust, thereby making full use of the limited space inside the cleaning apparatus, simplifying the structural design, and allowing the fluids to flow more efficiently through the various flow paths, thereby ensuring highly efficient vacuuming efficiency and dust collection efficiency.

[0008] According to one or more embodiments, the air duct structure further includes a third flow path leading from the first housing opening to the dust box vacuuming air outlet. In this way, the first flow path and the third flow path of the air duct structure are flow paths having opposite flow directions. Thus, the third flow path may serve as an additional dust collection air intake path in addition to the second flow path. Thus, in the dust collection mode, when a main body of the cleaning apparatus is not in operation (i.e., when a fan is stopped), dust collection intake air from a base station may drive an impeller of the main body to rotate reversely and then enter the dust box via the dust box vacuuming air outlet in order to further blow the inside of the dust box, thereby achieving more

comprehensive cleaning of the dust box as well as more complete dust collection.

[0009] According to one or more embodiments, the dust box further has a dust collection air outlet. The air duct structure further includes a fourth flow path leading from the dust collection air outlet to the second housing opening. Thus, the fourth flow path may be used as a dust collection return path from the cleaning apparatus to return to the base station for dust collection. Accordingly, both the second flow path and the third flow path of the air duct structure may lead to the fourth flow path, thereby more centrally and efficiently collecting dust accumulated in the dust box into a dust bag of the base station.

[0010] According to one or more embodiments, the dust box is provided with a blocking member at the dust collection suction opening. The blocking member is configured to close the dust collection suction opening when a fluid pressure at the dust collection suction opening is less than or equal to a threshold value, and to open the dust collection suction opening when the fluid pressure at the dust collection suction opening is greater than the threshold value. By providing the blocking member at the dust collection suction opening, the blocking member may selectively open or close the dust collection suction opening based on the preset fluid pressure threshold value in the dust collection mode, so as to select the optimal dust collection air intake path in coordination with an operating state of a fan of the cleaning apparatus in the dust collection mode to achieve the optimal dust collection effect.

[0011] According to one or more embodiments, the blocking member is provided with a resilient adjusting device to adjust closing or opening of the dust collection suction opening based on the above threshold value. In this way, the fluid pressure threshold value may be flexibly set through resilience of the resilient adjusting device, so that the dust collection suction opening is reliably sealed by the blocking member when the fluid pressure is not greater than the threshold value.

[0012] According to one or more embodiments, the dust box further has a dust box vacuuming dust inlet. The dust box vacuuming dust inlet and the dust box vacuuming air outlet are provided on a front surface of the dust box, and the dust box vacuuming air outlet is located above the dust box vacuuming dust inlet. In this way, a rational layout of an opening of the dust box is achieved, and the dust box and each fluid flow path associated therewith are compactly arranged within the cleaning apparatus, which saves the occupied space within the cleaning apparatus. Furthermore, efficient dust collection is ensured.

[0013] According to one or more embodiments, the dust collection suction opening and the dust collection air outlet are provided on a first side face and a second side face, opposite to each other, of the dust box, respectively. In this way, layout optimization of the opening of the dust box is further achieved, and the dust box and each fluid flow path associated therewith are more com-

pactly arranged within the cleaning apparatus, which further saves the occupied space within the cleaning apparatus. Furthermore, efficient dust collection is ensured.

[0014] According to one or more embodiments, the first housing opening and the second housing opening are provided in the side face of the housing and correspond to the dust collection suction opening and the dust collection air outlet, respectively. In this way, a rational layout of a lateral opening of the cleaning apparatus is achieved, and matching with an opening of the base station is also achieved.

[0015] According to one or more embodiments, the cleaning apparatus further includes a filter. The filter is mounted on a top of the dust box. In this way, the filter may be set up to capture solid substances such as sucked dust in the vacuuming mode of the cleaning apparatus, as well as liquid substances such as water droplets and oil droplets, and also harmful gaseous substances such as formaldehyde or benzene, thereby obtaining a better vacuuming effect.

[0016] According to one or more embodiments, the filter is a high efficiency particulate air (HEPA) filter. Thus, more efficient vacuuming may be achieved.

[0017] According to one or more embodiments, the cleaning apparatus further includes a fan. The fan may be controlled by a main body, a controller or a processor in the cleaning apparatus. The fan is disposed in the housing and located on the first flow path, and is configured to operate in a vacuuming mode to generate a suction fluid, such as air flow. In addition, the cleaning apparatus further includes a fifth flow path leading from the dust box vacuuming air outlet to the dust collection suction opening. In this way, during operation in the dust collection mode, the cleaning apparatus is configured to cause, when the fan operates, fluid from the first flow path and fluid from the second flow path to converge along the fifth flow path at the dust collection suction opening and flow to the second housing opening via the dust collection suction opening. Thus, the converged fluid generates a stronger and more concentrated fluid pressure, resulting in a better dust collection effect.

[0018] According to one or more embodiments, the cleaning apparatus is configured to cause, when the fan is not in operation, fluid from the third flow path to drive an impeller of the fan to rotate reversely and enter the dust box via the dust box vacuuming air outlet, and flow through the filter in the dust box. Therefore, by providing the filter in the dust box, effective self-cleaning of the HEPA filter and the like may be achieved.

[0019] According to one or more embodiments, the dust box is provided with a sensor. The sensor is configured to detect the amount of dust in the dust box. Thus, the power of the fan of the cleaning apparatus may be appropriately adjusted according to the amount of dust sensed by the sensor, thereby improving the dust collection effect.

[0020] According to the cleaning apparatus of the pre-

sent disclosure, the first flow path used for the dust suction operation and the second flow path used for the dust collection operation partially overlap, thereby simplifying the air duct structure and improving space utilization while ensuring a desired dust collection effect.

[0021] According to a second aspect of the present disclosure, a cleaning system is provided. The cleaning system includes the cleaning apparatus according to the first aspect of the present disclosure, and a base station. The base station is provided with a base station suction opening matching the second housing opening of the cleaning apparatus. The base station suction opening is used for sucking air from the dust collection air outlet of the dust box via the second housing opening. Thus, the cleaning system may collect dust from the cleaning apparatus that returns to the base station after the cleaning apparatus has completed the vacuuming operation, and collect dust accumulated in the dust box into a dust bag of the base station via the second housing opening of the cleaning apparatus and the base station suction opening. This operation may be automatically implemented by pre-programmed operation instructions configured by the cleaning system, thereby achieving efficient vacuuming and dust collection operations.

[0022] According to one or more embodiments, the base station is further provided with a base station air outlet matching the first housing opening of the cleaning apparatus. The base station air outlet is used for blowing air to the dust collection suction opening of the dust box via the first housing opening. As described above, with this arrangement, additional blowing of air from the base station to the dust box of the cleaning apparatus is achieved when the cleaning apparatus returns to the base station for dust collection, thereby obtaining more efficient dust collection.

[0023] The aspects and advantages previously described with respect to the cleaning apparatus are accordingly applicable to the cleaning system according to the present disclosure, which will not be repeated herein.

[0024] These and other elements will be readily understood and elucidated by reference to the accompanying drawings and the description of the various embodiments of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The above and other purposes, features, and advantages of the exemplary embodiments disclosed herein will become easier to understand by the detailed description below with reference to the accompanying drawings. In the accompanying drawings, a plurality of exemplary embodiments disclosed herein will be shown by way of example and not limitation, wherein:

FIG. 1 illustrates a three-dimensional view of a cleaning apparatus according to embodiments of the present disclosure;

FIG. 2 illustrates a cross-sectional top view of a

cleaning apparatus according to embodiments of the present disclosure;

FIG. 3 illustrates a three-dimensional view of a rear half portion of a cleaning apparatus according to embodiments of the present disclosure;

FIG. 4 illustrates a cross-sectional side view of a cleaning apparatus according to embodiments of the present disclosure;

FIG. 5A and FIG. 5B illustrate three-dimensional views of a dust box of a cleaning apparatus according to embodiments of the present disclosure at different angles, respectively;

FIG. 5C illustrates a cross-sectional three-dimensional view of a dust box of a cleaning apparatus according to embodiments of the present disclosure; FIG. 6 illustrates a cross-sectional top view of a cleaning apparatus according to embodiments of the present disclosure, which schematically illustrates an air duct structure and fluid flow paths in the cleaning apparatus;

FIG. 7 illustrates a cross-sectional side view of a cleaning apparatus according to embodiments of the present disclosure, which schematically illustrates an air duct structure and fluid flow paths in the cleaning apparatus;

FIG. 8A illustrates a cross-sectional top view of a cleaning apparatus according to embodiments of the present disclosure, which schematically illustrates a fluid flow path when the cleaning apparatus operates in a vacuuming mode;

FIG. 8B and FIG. 8C illustrate cross-sectional top views of a cleaning apparatus according to embodiments of the present disclosure, which schematically illustrate fluid flow paths when the cleaning apparatus operates in a first dust collection mode;

FIG. 8D illustrates a cross-sectional front view of a cleaning apparatus according to embodiments of the present disclosure, which schematically illustrates a fluid flow path when the cleaning apparatus operates in a first dust collection mode;

FIG. 8E illustrates a cross-sectional top view of a cleaning apparatus according to embodiments of the present disclosure, which schematically illustrates a fluid flow path when the cleaning apparatus operates in a second dust collection mode;

FIG. 8F illustrates a cross-sectional front view of a cleaning apparatus according to embodiments of the present disclosure, which schematically illustrates a fluid flow path when the cleaning apparatus operates in a second dust collection mode;

FIG. 9 illustrates a three-dimensional view of a base station of a cleaning system according to embodiments of the present disclosure; and

FIG. 10 illustrates a cross-sectional top view of a cleaning system according to embodiments of the present disclosure.

[0026] Throughout the accompanying drawings, the

same or corresponding reference numerals indicate the same or corresponding parts.

DESCRIPTION OF THE EMBODIMENTS

[0027] Corresponding numbers and symbols in different accompanying drawings generally refer to corresponding regions unless otherwise indicated. The accompanying drawings are drawn for the purpose of clearly illustrating relevant aspects of the embodiments and need not be drawn to scale. The edges of features drawn in the accompanying drawings do not necessarily indicate the end of the range of features.

[0028] In the ensuing description, various specific details are shown to provide insight into various examples of embodiments according to the description. Embodiments may be obtained in the absence of one or more specific details, or by utilizing other methods, components, materials, and the like. In other cases, known structures, materials, or operations are not shown or described in detail so as not to obscure aspects of the embodiments.

[0029] References to "an embodiment" or "an implementation" in the framework of this specification are intended to indicate that a particular configuration, structure, or feature described with respect to that embodiment is included in at least one embodiment. Accordingly, phrases of "in embodiments," "in an embodiment," and the like that may appear in various aspects of this specification do not necessarily refer to the same embodiment exactly. Furthermore, particular configurations, structures, or features may be combined in one or more embodiments in any suitable manner.

[0030] Unless otherwise indicated, when reference is made to two elements joined together, this indicates a direct connection without any intermediate element, and when reference is made to two elements coupled together, this indicates that the two elements may be joined or that they may be coupled via one or more other elements.

[0031] The title/reference numerals used herein are provided solely for ease of reading and therefore do not limit the scope of protection or the scope of the embodiments. Identical or similar elements are identified using the identical reference numerals.

[0032] In a cleaning apparatus for use in, for example, sweeping a surface such as a floor, the cleaning apparatus typically has a dust collection mode of operation to facilitate cleaning of a dust box and to minimize user operation when the dust box of the cleaning apparatus has been filled with dust or the dust box needs to be cleaned according to pre-programmed operating conditions. In this design, the cleaning apparatus collaborates with a matching base station to accomplish the collection of dust from the dust box. The base station is provided with a dust bag for collecting dust from the dust box of the cleaning apparatus. After the cleaning apparatus has completed a regular cleaning operation, the cleaning

apparatus returns to the base station to operate in a dust collection mode, so that the dust in the dust box is collected into the dust bag of the base station. To this end, the cleaning apparatus is provided with a main body dust collection air outlet duct for dust collection, and the base station is correspondingly provided with a base station dust collection air inlet duct. In the dust collection mode, the base station sucks dust from the dust box of the cleaning apparatus via the base station dust collection air inlet duct to the dust bag of the base station via the main body dust collection air outlet duct.

[0033] In addition, the base station may alternatively be provided with a base station dust collection air outlet duct leading to the cleaning apparatus, and the cleaning apparatus is correspondingly provided with a main body dust collection air inlet duct for dust collection. By additionally blowing the airflow from the base station to the interior of the cleaning apparatus, more effective dust collection may be achieved.

[0034] In an existing cleaning apparatus, in order to achieve the vacuuming function and the dust collection function of the cleaning apparatus and to ensure the vacuuming effect and the dust collection effect in corresponding operating modes, a main body vacuuming air outlet duct for vacuuming and the main body dust collection air outlet duct for dust collection of the cleaning apparatus are designed separately and independently. Moreover, a main body dust collection air inlet duct of the cleaning apparatus is also designed separately and independently from other air ducts. However, such a design leads to the existence of a plurality of air ducts in the cleaning apparatus, making the internal structure of the cleaning apparatus very complicated and occupying a large internal space, which is very unfavorable in the case where the space of a main body of the existing cleaning apparatus is very limited, and may still affect vacuuming and dust collection effects of the cleaning apparatus.

[0035] Embodiments of the present disclosure provide a new structural design of a cleaning apparatus to solve the above problems in the cleaning apparatus. The cleaning apparatus of the present disclosure includes a housing, a dust box, and an air duct structure. The housing has two housing openings located in a side face thereof, that is, a main body air outlet and a dust collection air outlet, which correspond to an air outlet and a suction opening of the base station, respectively. The dust box is disposed in the housing and partially defines the air duct structure. The air duct structure includes a main body vacuuming path and a dust collection air intake path. The main body vacuuming path leads from a dust box vacuuming air outlet of the dust box to the main body air outlet, and the dust collection air intake path leads from the main body air outlet to a dust collection suction opening of the dust box. Therefore, in the air duct structure of the cleaning apparatus of the present disclosure, the main body air outlet may be used as an air outlet in the vacuuming mode or a suction opening in the dust collection mode, so that the main body vacuuming path and the

dust collection air intake path of the cleaning apparatus partially overlap, i.e., share the same section of a channel.

[0036] The structural design of the cleaning apparatus of the present disclosure takes into account that the vacuuming mode and the dust collection mode are independent of each other, which makes it possible that the main body vacuuming path originally used for the vacuuming mode may also be used as the dust collection air intake path of the dust collection mode. Therefore, by optimizing and testing the air duct structure, the present disclosure achieves that the air outlet of the cleaning apparatus in the vacuuming mode is also used as the suction opening in the dust collection mode, fully utilizes at least a portion of the main body vacuuming path as the dust collection air intake path, and at least eliminates a channel structure associated with a separately designed dust collection air intake path, thereby simplifying the air duct structure, saving the internal space of the cleaning apparatus, and making the layout of the components more reasonable. Accordingly, the saved internal space may be used to provide additional space for other components, for example, adding storage space of the dust box or adding space of a liquid container in the case of a wet cleaning function.

[0037] In addition, the cleaning apparatus with the optimized air duct structure according to embodiments of the present disclosure may further provide improved dust collection efficiency. As described above, as the air duct structure of the cleaning apparatus is simplified, unnecessary fluid flow paths are reduced, fluid flow resistance may be reduced, and accordingly the fluid may flow more efficiently in each flow path, thereby achieving higher dust collection efficiency in the dust collection mode.

[0038] Moreover, the cleaning apparatus of the embodiments of the present disclosure is capable of controlling the operation of a fan of the cleaning apparatus in the dust collection mode according to a predetermined operation mode, so as to cooperate with the base station to achieve a specific dust collection and cleaning effect. When the cleaning apparatus returns to the base station to operate in the dust collection mode, the fan of the cleaning apparatus may be activated or deactivated based on the fluid flow required for dust collection. Specifically, when the fan of the cleaning apparatus is deactivated, fluid (e.g., airflow) generated by a fan of the base station may flow into the cleaning apparatus along the dust collection air intake path (i.e., the vacuuming path), which in turn drives an impeller of the fan of the cleaning apparatus to rotate reversely, so as to cause the fluid to flow into the dust box at the dust box of the cleaning apparatus in a direction opposite to that of the vacuuming mode, thereby backblowing air to the interior of the dust box, and achieving a self-cleaning effect for the interior of the dust box. When the fan of the cleaning apparatus is activated, airflow from the main body vacuuming path and airflow from the dust collection air intake path may

converge at the dust collection suction opening of the dust box, thus enhancing the air volume of dust collection intake air, achieving fuller cleaning of the inside of the dust box, and obtaining a better dust collection effect.

[0039] The principle of the present disclosure is described in detail below in conjunction with the accompanying drawings.

[0040] FIG. 1 and FIG. 2 schematically illustrate a cleaning apparatus 10 according to embodiments of the present disclosure. In the illustrated embodiments, the cleaning apparatus 10 is, for example, a robot vacuum cleaner for sweeping floors. It should be understood that the cleaning apparatus 10 may also be an apparatus suitable for sweeping other types of surfaces. The cleaning apparatus 10 has a housing 20, a dust box 30, and an air duct structure 40. The housing 20 may have a structure with a cross-section being substantially circular, oval, or in other suitable shape. The housing 20 may be of a detachable structure including, for example, a front half portion (e.g., the upper half of the structure shown in FIG. 1 and FIG. 2) and a rear half portion (e.g., the lower half of the structure shown in FIG. 1 and FIG. 2) along the direction of movement of the cleaning apparatus. The dust box 30 is disposed in the housing 20, e.g. in the rear half portion of the housing 20, for storing contaminants such as dust. The air duct structure 40 is provided in the housing 20 and partially defined by the dust box 30.

[0041] In some embodiments, the housing 20 has a first housing opening 22 and a second housing opening 24 located in a side face of the housing. The two openings may be disposed, for example, in the side face of a rear half portion of the housing and are substantially symmetrically disposed on two sides at a regular interval. It should be understood that the location and size of the housing openings may be flexibly set as desired and are not limited to the illustrated example. The air duct structure 40 is arranged generally around the dust box 30 and, as described in detail below, includes a plurality of fluid flow paths suitable for different operating modes of the cleaning apparatus.

[0042] FIG. 3 to FIG. 5 illustrate the dust box 30 and the air duct structure 40 partially defined by the dust box. The dust box 30 has a dust box vacuuming dust inlet 32 and a dust box vacuuming air outlet 34, as well as a dust collection suction opening 36 and a dust collection air outlet 38.

[0043] In some embodiments, the dust box vacuuming dust inlet 32 and the dust box vacuuming air outlet 34 are provided on a front surface 302 of the dust box 30, and the dust box vacuuming air outlet 34 is located above the dust box vacuuming dust inlet 32. The dust box vacuuming dust inlet 32 is open toward a bottom of the cleaning apparatus, so that pollutants such as dust on a surface to be cleaned are sucked into the dust box 30 via the dust box vacuuming dust inlet 32. Considering the limited internal space of the cleaning apparatus, the dust box vacuuming air outlet 34 is provided above the dust box

vacuuming dust inlet 32. Thus, as shown in FIG. 3 and FIG. 4, in a vacuuming mode, a fan 60 provided near the dust box vacuuming air outlet 34 generates a suction fluid 31, such as airflow, and the suction fluid 31 flows upward from a bottom of the dust box 30 along the interior of the dust box 30 via the dust box vacuuming dust inlet 32, and flows out of the dust box 30 via the dust box vacuuming air outlet 34. Accordingly, dust on a surface (e.g. a floor) may be carried into the dust box 30 with the suction fluid 31 and may be retained in the dust box 30 due to the gravity thereof while the suction fluid 31 flows upward along the interior of the dust box, or may be further captured by a filter in the dust box 30. In this way, a reasonable layout of the openings of the dust box 30 may be achieved, so that the dust box 30 and the fluid flow paths associated with the dust box are compactly arranged within the cleaning apparatus 10, which saves the occupied space within the cleaning apparatus. Furthermore, efficient dust collection is ensured.

[0044] In some embodiments, the dust collection suction opening 36 and the dust collection air outlet 38 of the dust box 30 are provided on a first side face 304 and a second side face 306, opposite to each other, of the dust box 30, i.e., on two sides of the dust box vacuuming dust inlet 32 and the dust box vacuuming air outlet 34, respectively. A limiting member 37 for isolating a vacuuming path from a dust collection path may be provided in the interior of the dust box 30, as shown in FIG. 5A to FIG. 5C, so as to allow fluids to effectively flow in a predetermined flow direction in different operating modes. In one embodiment, as shown in FIG. 5C, in the dust box 30, in addition to generating the suction airflow 31 in the vacuuming mode, a dust collection airflow 33 flowing from the dust collection suction opening 36 to the dust collection air outlet 38, or a dust collection airflow 35 flowing from the dust box vacuuming air outlet 34 to the dust collection air outlet 38 may be generated in the dust collection mode. In this way, the layout of the openings of the dust box is further optimized, so that the dust box and the fluid flow paths associated with the dust box are more compactly arranged within the cleaning apparatus, which further saves the occupied space within the cleaning apparatus. Furthermore, efficient dust collection is ensured.

[0045] In some embodiments, the first housing opening 22 and the second housing opening 24 of the housing are provided corresponding to the dust collection suction opening 36 and the dust collection air outlet 38 of the dust box 30, respectively. As shown in FIG. 4, the first housing opening 22 and the dust collection suction opening 36 are provided on one side of the dust box 30, while the second housing opening 24 and the dust collection air outlet 38 are provided on the other side of the dust box 30. By utilizing the generally symmetrical arrangement, in the present disclosure, a reasonable layout of lateral openings of the cleaning apparatus is further achieved, and a reasonable match with the openings of the base station is also achieved.

[0046] In some embodiments, the dust box 30 may be provided with a blocking member 50, such as a baffle or a door, at the dust collection suction opening 36. The blocking member 50 is configured to close the dust collection suction opening 36 when a fluid pressure at the dust collection suction opening 36 is less than or equal to a threshold value, and to open the dust collection suction opening 36 when the fluid pressure at the dust collection suction opening 36 is greater than the threshold value. This arrangement may match with the dust collection intake air from the base station such that the dust collection suction opening 36 is selectively opened or closed in the dust collection mode based on the predetermined fluid pressure threshold value. Moreover, this arrangement may further match the fan operation state of the cleaning apparatus in the dust collection mode to select the optimal dust collection air intake path for optimal dust collection.

[0047] In some embodiments, the blocking member 50 is further provided with a resilient adjusting device to adjust closing or opening of the dust collection suction opening 36 based on the above threshold value. The resilient adjusting device is implemented, for example, with the aid of a spring. In this way, the fluid pressure threshold value may be flexibly set through resilience of the resilient adjusting device, so that the dust collection suction opening 36 is reliably sealed by the blocking member 50 when the fluid pressure is not greater than the threshold value.

[0048] Thus, according to embodiments of the present disclosure, the side faces of the dust box of the cleaning apparatus are reasonably designed to provide openings for the fluid flow paths, which may improve the dust collection efficiency while ensuring that the vacuuming efficiency is not affected.

[0049] FIG. 6 and FIG. 7 illustrate the air duct structure 40 and the fluid flow paths of the cleaning apparatus according to embodiments of the present disclosure, respectively. The air duct structure 40 generally surrounds the dust box 30 in order to achieve the shortest possible fluid flow path.

[0050] In some embodiments, the air duct structure 40 includes a first flow path 42 leading from the dust box vacuuming air outlet 34 to the first housing opening 22, and the first flow path may be used as the main body vacuuming path of the cleaning apparatus in the vacuuming mode. The air duct structure 40 further includes a second flow path 44 leading from the first housing opening 22 to the dust collection suction opening 36 of the dust box 30, and the second flow path may be used as the dust collection air intake path of the cleaning apparatus in the dust collection mode. The first flow path 42 and the second flow path 44 overlap each other, for example, on a portion of a channel that extends from the first housing opening 22 into the interior of the housing, i.e., share the portion of the channel. With this arrangement of the present disclosure, unnecessary channel structures, such as separately designed dust collection channels

and structural components associated therewith, are eliminated. Thus, full utilization of the limited internal space of the cleaning apparatus is achieved, thereby simplifying the structural design, allowing the fluid to flow more efficiently in the flow paths, and ensuring high vacuuming efficiency and dust collection efficiency.

[0051] In some embodiments, the air duct structure 40 further includes a third flow path 46 leading from the first housing opening 22 to the dust box vacuuming air outlet 34 of the dust box 30. It is to be understood that with this arrangement, the first flow path 42 and the third flow path 46 are flow paths having opposite flow directions, which is beneficial for different applications in the dust collection mode. The third flow path 46 may serve as an additional dust collection air intake path in addition to the second flow path 44. Thus, in the dust collection mode, when a main body of the cleaning apparatus is not in operation (i.e., when the fan is stopped), dust collection intake air from the base station may drive an impeller of the main body to rotate reversely and then enter the dust box 30 via the dust box vacuuming air outlet 34 to further blow the interior of the dust box, thereby achieving more comprehensive cleaning of the dust box as well as more complete dust collection.

[0052] In some embodiments, the air duct structure 40 further includes a fourth flow path 48 leading from the dust collection air outlet 38 of the dust box 30 to the second housing opening 24, and the fourth flow path may be used as a dust collection return path for the cleaning apparatus to return to the base station for dust collection. Accordingly, both the second flow path 44 and the third flow path 46 of the air duct structure may lead to the fourth flow path 48, for example, a flow path 54 along the interior of the dust box 30 leads to the fourth flow path 48 via the dust collection air outlet 38 of the dust box 30, thereby more centrally and efficiently collecting dust accumulated in the dust box 30 into the dust bag of the base station in the corresponding operating mode. The flow path 54 inside the dust box 30 includes, for example, flow paths of the dust collection airflow 33 and the dust collection airflow 35 described with reference to FIG. 5C.

[0053] Fluid flowing of the cleaning apparatus according to embodiments of the present disclosure in different operating modes is further described below in connection with FIG. 8A to FIG. 8F.

[0054] FIG. 8A illustrates a fluid flow path when the cleaning apparatus according to embodiments of the present disclosure operates in the vacuuming mode. When the cleaning apparatus 10 (also referred to herein as a main body) is used for cleaning a surface, such as a floor, the fan 60 in the cleaning apparatus 10 is disposed on the first flow path and may be controlled by the main body, a controller, or a processor in the cleaning apparatus. The fan 60 operates in a normal mode of operation, for example, generating a negative pressure of 1 to 2 kPa, specifically, 1.2 kPa, so that a suction fluid (e.g., a suction airflow) is generated. The suction fluid flows from the dust box vacuuming dust inlet 32 to the dust box vacuuming air

outlet 34, and, after carrying contaminants such as dust into the dust box 30, flows along the first flow path 42 to the first housing opening 22.

[0055] FIG. 8B to FIG. 8D illustrate fluid flow paths when the cleaning apparatus according to embodiments of the present disclosure operates in a first dust collection mode. When the cleaning apparatus returns to the base station to operate in the dust collection mode, the fan of the cleaning apparatus may be activated or deactivated based on the fluid flow required for dust collection. Specifically, when the fan 60 of the cleaning apparatus is deactivated, the cleaning apparatus 10 may operate in the first dust collection mode. In this case, a fluid (e.g., an airflow) generated by the fan of the base station may flow along the second flow path 44 or the third flow path 46 (as shown in FIG. 8B).

[0056] In some embodiments, the air volume of the fan of the base station may be preset by the control device, so that the fan of the base station operates in a pre-programmed mode, for example, collecting dust at constant wind power. With this configuration, dust collection intake air may flow along the second flow path 44 or the third flow path 46 according to the actual application.

[0057] In some embodiments, the dust collection intake air from the base station only flows along the third flow path 46. In this case, the dust collection suction opening 36 of the dust box 30 is closed, for example, by the blocking member 50, i.e. the air volume of the dust collection intake air is less than or equal to the fluid pressure threshold value preset for the blocking member 50. Therefore, the dust collection intake air drives the impeller of the fan 60 of the cleaning apparatus 10 to rotate reversely, causing the dust collection airflow 35 to flow into the dust box 30 via the dust box vacuuming air outlet 34 in a direction opposite to that of the vacuuming mode (as shown in FIG. 8D), thereby backblowing air to the interior of the dust box from top to bottom, and achieving a self-cleaning effect of the interior of the dust box 30.

[0058] In other embodiments, the dust collection intake air from the base station flows along both the third flow path 46 and the second flow path 44. In this case, the dust collection suction opening 36 of the dust box 30 is, for example, opened by the blocking member 50, i.e. the air volume of the dust collection intake air is greater than the fluid pressure threshold value preset for the blocking member 50. Therefore, the dust collection intake air not only drives the impeller of the fan 60 of the cleaning apparatus 10 to rotate reversely so as to backblow air to the interior of the dust box as described above, but also simultaneously blows air from the bottom of the dust box 30, as shown by the dust collection airflow 33 and the dust collection airflow 35 in FIG. 5C, thereby further achieving sufficient cleaning of the dust box 30.

[0059] Furthermore, in the various embodiments described above, since the first flow path 42 in the vacuuming mode has a relatively large channel cross-sectional area, by sharing a portion thereof as the air intake path

(e.g., a portion of the second flow path 44 or the third flow path 46) in the dust collection mode, the dust collection air intake path also has a relatively large channel cross-sectional area, thereby avoiding generating a large noise. Moreover, with the arrangement of the blocking member 50, reliable sealing of the dust collection suction opening 36 of the dust box 30 may also be ensured, thereby avoiding air leakage in the vacuuming mode.

[0060] FIG. 8E and FIG. 8F illustrate a fluid flow path when the cleaning apparatus according to embodiments of the present disclosure operates in the second dust collection mode. As described above, when the cleaning apparatus returns to the base station to operate in the dust collection mode, the fan of the cleaning apparatus may be activated or deactivated based on the fluid flow required for dust collection. Specifically, when the fan 60 of the cleaning apparatus is activated, the fan 60 generates a suction airflow that may converge with the airflow from the dust collection air intake path at the dust collection suction opening 36 of the dust box 30. As shown in FIG. 8E, the suction airflow generated by the fan 60 of the cleaning apparatus 10, that is, the airflow from the first flow path 42, may flow along the fifth flow path 52 leading from the dust box vacuuming air outlet 34 to the dust collection suction opening 36. In addition, the dust collection intake air from the base station may flow along the second flow path 44. Thus, the two airflows may converge at the dust collection suction opening 36 and flow into the dust box 30 via the dust collection suction opening 36 to form the dust collection airflow 35, so as to clean up dust inside the dust box 30, and then flow to the second housing opening 24. With this arrangement, the converged fluid is able to generate a stronger and more concentrated fluid pressure, thereby obtaining a better dust collection effect.

[0061] In addition, in some embodiments, the fan 60 of the cleaning apparatus 10 may be pre-programmed to operate in accordance with a fixed-speed mode, for example, gradually increasing the wind power from an initial gear (e.g., a negative pressure of 1 to 2 kPa) to a maximum gear (e.g., a negative pressure of 7 to 8 kPa), so that the cleaning apparatus may adaptively adjust the fan power according to the amount of dust inside the dust box to obtain the optimal dust collection effect.

[0062] Referring back to FIG. 5C, in some embodiments, the cleaning apparatus 10 further includes a filter 70. The filter 70 may be removably mounted on a top of the dust box 30. With this arrangement, when the cleaning apparatus 10 operates in the vacuuming mode, the filter 70 is able to further capture minute particles of dust entering the dust box 30 via the dust box vacuuming dust inlet 32, thereby obtaining a better vacuuming effect. In addition, the filter 70 may also be provided to capture liquid substances such as sucked water droplets and oil droplets. The filter 70 may also be provided to capture harmful gaseous substances such as formaldehyde or benzene. In one example, the filter 70 may, for example, be a high-efficiency particulate air (HEPA) filter, thereby

more efficiently capturing finer particles of dust.

[0063] In other embodiments, referring to FIG. 8B to FIG. 8D, as described above, during the return of the cleaning apparatus 10 to the base station to operate in the first dust collection mode, when the fan 60 of the cleaning apparatus is not in operation, the dust collection intake air from the base station may cause the airflow from the third flow path 46 to drive the impellers of the fan 60 to rotate reversely, enter the dust box 30 via the dust box vacuuming air outlet 34, and flow through the filter 70 in the dust box 30. Thus, when the filter 70 is mounted on the top of the dust box 30, the dust collection airflow 35 that enters the dust box 30 from the dust box vacuuming air outlet 34 via the third flow path 46 may be backblown to flow through the filter 70. As shown in FIG. 8D, the backblown dust collection airflow 35 flows downward from the top of the dust box 30 via the dust box vacuuming air outlet 34 to flow through the filter 70, such as an HEPA filter, so as to blow dust particles captured in the filter 70 down to the bottom of the dust box, and then the dust particles flow along the flow path 54 inside the dust box 30 to the dust collection air outlet 38. By means of airflow backblowing in the dust collection mode, a significant self-cleaning effect for the filter may be achieved.

[0064] In some embodiments, the dust box 30 may also be provided with a sensor (not shown). The sensor is configured to detect the amount of dust stored in the dust box 30. Thus, the cleaning apparatus 10 is able to appropriately adjust the power of the fan 60 of the cleaning apparatus 10 based on the amount of dust sensed by the sensor, thereby improving the dust collection effect in the corresponding dust collection mode. For example, when the cleaning apparatus 10 operates in the second dust collection mode, the cleaning apparatus 10 may adjust the power of the fan 60 based on a signal indicating the amount of dust sensed by the sensor to match the amount of dust collection intake air generated by the fan of the base station, so as to generate the optimal dust collection effect. It should be understood that other types of sensors, such as flow sensors or pressure sensors, may also be provided at suitable locations of the various flow paths of the cleaning apparatus to monitor fluid flow or pressure.

[0065] FIG. 9 illustrates a base station of a cleaning system according to embodiments of the present disclosure, and FIG. 10 illustrates a cleaning system according to embodiments of the present disclosure.

[0066] In some embodiments, the cleaning system 100 includes the cleaning apparatus 10 according to the present disclosure, and a base station 80. The base station 80 is provided with a base station suction opening 84 matching the second housing opening 24 of the cleaning apparatus 10. The base station suction opening 84 is used for sucking air from the dust collection air outlet 38 of the dust box 30 via the second housing opening 24. Thus, the cleaning system 100 may collect dust from the cleaning apparatus 10 that returns to the base station 80 after the cleaning apparatus 10 has completed the vacuuming

operation. The base station 80 is provided with a base station fan that generates a negative pressure typically in the range of 20 to 30 kPa, for example, a negative pressure of about 28 kPa, thereby achieving effective dust collection of the cleaning apparatus 10. As described above, the cleaning apparatus 10 may operate in the first dust collection mode and the second dust collection mode. Thus, the base station 80 collects dust accumulated in the dust box 30 into a dust bag of the base station 80 via the second housing opening 24 of the cleaning apparatus and the base station suction opening 84. This operation may be automatically implemented by pre-programmed operation instructions configured by the cleaning system, thereby achieving efficient vacuuming and dust collection operations.

[0067] In some embodiments, the base station 80 is further provided with a base station air outlet 82 matching the first housing opening 22 of the cleaning apparatus 10. The base station air outlet 82 is used for blowing airflow to the dust collection suction opening 36 of the dust box 30 via the first housing opening 22. As described above, with this arrangement, the base station 80 provides additional dust collection intake air to the dust box 30 of the cleaning apparatus 10 when the cleaning apparatus 10 returns to the base station 80 for dust collection, thereby obtaining more efficient dust collection.

[0068] In some embodiments, the dust collection process may be further optimized. For example, depending on a preset dust collection solution of the base station, the first dust collection mode and the second dust collection mode may be performed sequentially or alternately. The dust collection solution may be a code or program instruction pre-programmed in a controller or processor of a control device. The code or program instruction is configured to, when executed by the controller or processor, cause the cleaning apparatus and the base station to implement the preset dust collection solution.

[0069] In some embodiments, the dust collection process may be implemented in stages with different dust collection modes. In a first stage (i.e. an initial stage), the cleaning apparatus 10 is in the first dust collection mode, i.e. the fan 60 is deactivated. The dust collection intake air may be backblown along the third flow path 46 to pass through the dust box 30 and the filter 70 mounted therein, thereby achieving self-cleaning of the filter 70. Moreover, the dust collection suction opening 36 of the dust box 30 may, for example, be closed by the blocking member 50, thereby avoiding dust being blown out of the dust box vacuuming dust inlet 32, thereby ensuring dust collection efficiency. The first stage may, for example, be preset to a duration in the range of, for example, 1 to 10 seconds, and more specifically, 5 seconds. Afterwards, in a second stage, the cleaning apparatus 10 is in the second dust collection mode, i.e. the fan 60 is activated. In this case, the dust collection intake air may flow along the second flow path 44, the suction airflow generated by the fan 60 flows along the fifth flow path 52, and the blocking member 50 opens the dust collection suction opening 36.

Thus, the two airflows converge at the dust collection suction opening 36 and flow through the interior of the dust box 30 via the dust collection suction opening 36, thereby improving the overall dust collection performance. Depending on the amount of dust inside the dust box, the second duration may be flexibly adjusted, for example, in a time period in the range of 10 to 20 seconds. Moreover, as previously mentioned, the fan 60 of the cleaning apparatus 10 may gradually increase the wind power to the highest gear at a fixed gear to obtain matched optimal dust collection performance.

[0070] It should be understood that the base station 80 is capable of performing other auxiliary tasks for the cleaning apparatus 10 in addition to the dust collection function. For example, the base station may charge the cleaning apparatus 10 or refill a water tank of the cleaning apparatus 10 in the case of a mopping and washing function. These functions may be implemented according to a preset cleaning solution. For example, the base station 80 first collects dust from the dust box of the cleaning apparatus, then refills the water tank of the cleaning apparatus, and finally charges a battery of the cleaning apparatus.

[0071] Many of the modified forms and other implementations of the present disclosure given herein will be realized by those skilled in the art to which the present disclosure pertains through the teachings given in the foregoing description and the related accompanying drawings. Thus, it is to be understood that the implementations of the present disclosure are not limited to the specific implementations disclosed, and that the modified forms and other implementations are intended to fall within the scope of the present disclosure. Moreover, while the above description and the associated accompanying drawings describe exemplary implementations in the context of certain exemplary combination forms of components and/or functionality, it should be appreciated that different combination forms of components and/or functionality may be provided by alternative implementations without departing from the scope of the present disclosure. In this regard, for example, other combination forms of components and/or features that differ from those explicitly described above are also anticipated to fall within the scope of the present disclosure. Although specific terms are used herein, they are used in a general and descriptive sense only and are not intended to be limiting.

Claims

1. A cleaning apparatus (10), comprising:

a housing (20), having a first housing opening (22) and a second housing opening (24) located in a side face of the housing;
a dust box (30), disposed in the housing, the dust box having a dust box vacuuming air outlet (34)

- and a dust collection suction opening (36); and an air duct structure (40), disposed in the housing and partially defined by the dust box, wherein the air duct structure (40) comprises a first flow path (42) leading from the dust box vacuuming air outlet (34) to the first housing opening (22), and wherein the air duct structure (40) comprises a second flow path (44) leading from the first housing opening (22) to the dust collection suction opening (36), the first flow path (42) partially overlapping the second flow path (44).
2. The cleaning apparatus (10) according to claim 1, wherein the air duct structure (40) further comprises a third flow path (46) leading from the first housing opening (22) to the dust box vacuuming air outlet (34), and wherein the first flow path (42) and the third flow path (46) are flow paths having opposite flow directions.
 3. The cleaning apparatus (10) according to claim 2, wherein the dust box further has a dust collection air outlet (38); and the air duct structure (40) further comprises a fourth flow path (48) leading from the dust collection air outlet (38) to the second housing opening (24).
 4. The cleaning apparatus (10) according to any one of claims 1 to 3, wherein the dust box (30) is provided with a blocking member (50) at the dust collection suction opening (36), and the blocking member is configured to close the dust collection suction opening when a fluid pressure at the dust collection suction opening is less than or equal to a threshold value, and to open the dust collection suction opening when the fluid pressure at the dust collection suction opening is greater than the threshold value.
 5. The cleaning apparatus (10) according to claim 4, wherein the blocking member (50) is provided with a resilient adjusting device to adjust closing or opening of the dust collection suction opening based on the threshold value.
 6. The cleaning apparatus (10) according to any one of claims 1 to 3, wherein the dust box (30) further has a dust box vacuuming dust inlet (32), the dust box vacuuming dust inlet (32) and the dust box vacuuming air outlet (34) are provided on a front surface (302) of the dust box (30), and the dust box vacuuming air outlet (34) is located above the dust box vacuuming dust inlet (32).
 7. The cleaning apparatus (10) according to claim 3, wherein the dust collection suction opening (36) and the dust collection air outlet (38) are provided on a first side face (304) and a second side face (306), opposite to each other, of the dust box (30), respectively.
 8. The cleaning apparatus (10) according to claim 3, wherein the first housing opening (22) and the second housing opening (24) are provided in the side face of the housing and correspond to the dust collection suction opening (36) and the dust collection air outlet (38), respectively.
 9. The cleaning apparatus (10) according to any one of claims 1 to 3, further comprising a filter (70), the filter being mounted on a top of the dust box (30).
 10. The cleaning apparatus (10) according to claim 9, wherein the filter (70) is a high efficiency particulate air filter.
 11. The cleaning apparatus (10) according to any one of claims 2 to 3, further comprising:
 - a fan (60), the fan being provided in the housing and located on the first flow path (42); and
 - a fifth flow path (52) leading from the dust box vacuuming air outlet (34) to the dust collection suction opening (36);
 wherein during operation in a dust collection mode, the cleaning apparatus is configured to cause, when the fan (60) operates, fluid from the first flow path (42) and fluid from the second flow path (44) to converge along the fifth flow path (52) at the dust collection suction opening (36) and flow to the second housing opening (24) via the dust collection suction opening (36).
 12. The cleaning apparatus (10) according to claim 11, wherein when the fan (60) is not in operation, fluid from the third flow path (46) is capable of driving an impeller of the fan (60) to rotate reversely and entering the dust box (30) via the dust box vacuuming air outlet (34), and flows through the filter (70) in the dust box (30) to achieve self-cleaning of the filter (70).
 13. The cleaning apparatus (10) according to any one of claims 1 to 3, wherein the dust box (30) is provided with a sensor, and the sensor is configured to detect the amount of dust in the dust box.
 14. A cleaning system (100), comprising:
 - the cleaning apparatus (10) according to any one of claims 1 to 13; and
 - a base station (80), the base station being provided with a base station suction opening (84) matching the second housing opening (24) of the cleaning apparatus (10), the base station suction opening (84) being used for sucking fluid

from the dust collection air outlet (38) of the dust box (30) via the second housing opening (24).

15. The cleaning system (100) according to claim 14, wherein the base station (80) is further provided with a base station air outlet (82) matching the first housing opening (22) of the cleaning apparatus (10), and the base station air outlet (82) is used for blowing fluid to the dust collection suction opening (36) of the dust box (30) via the first housing opening (22).

5

10

15

20

25

30

35

40

45

50

55

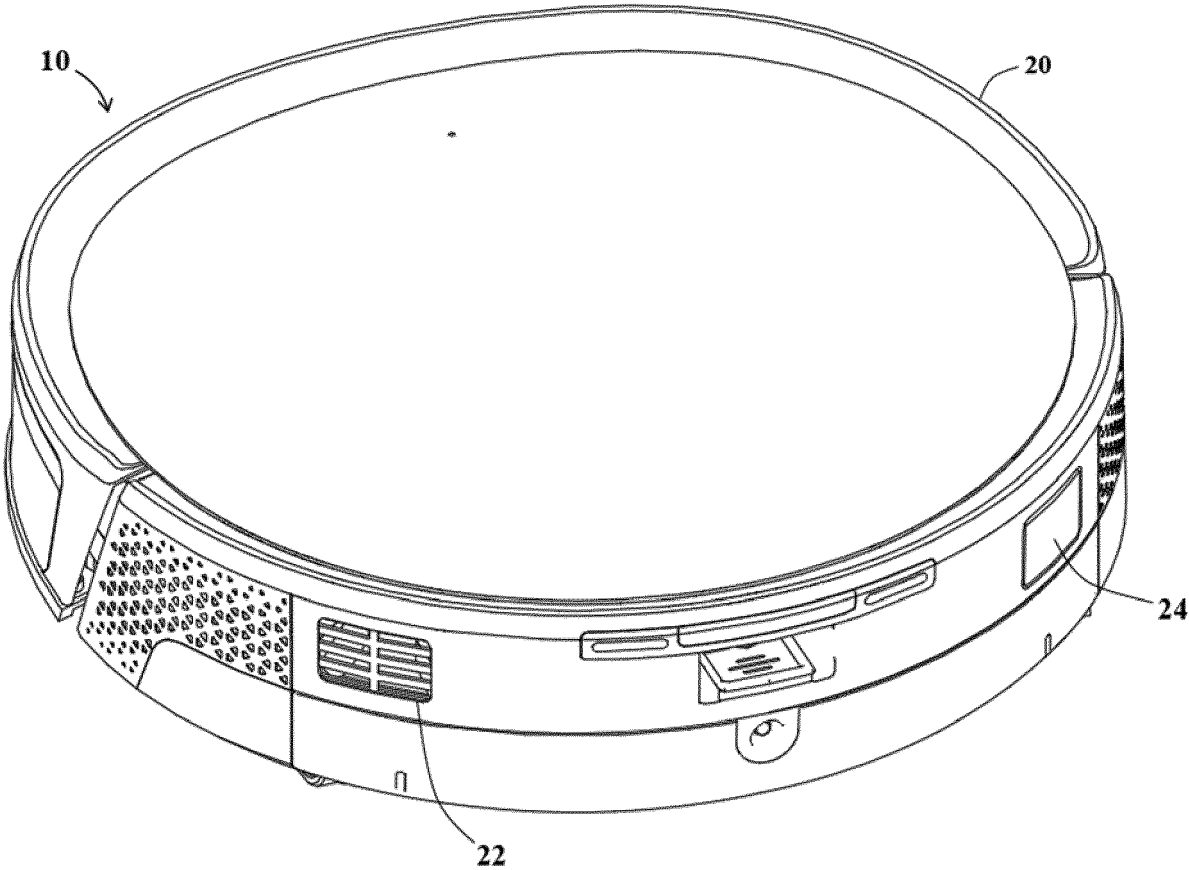


FIG. 1

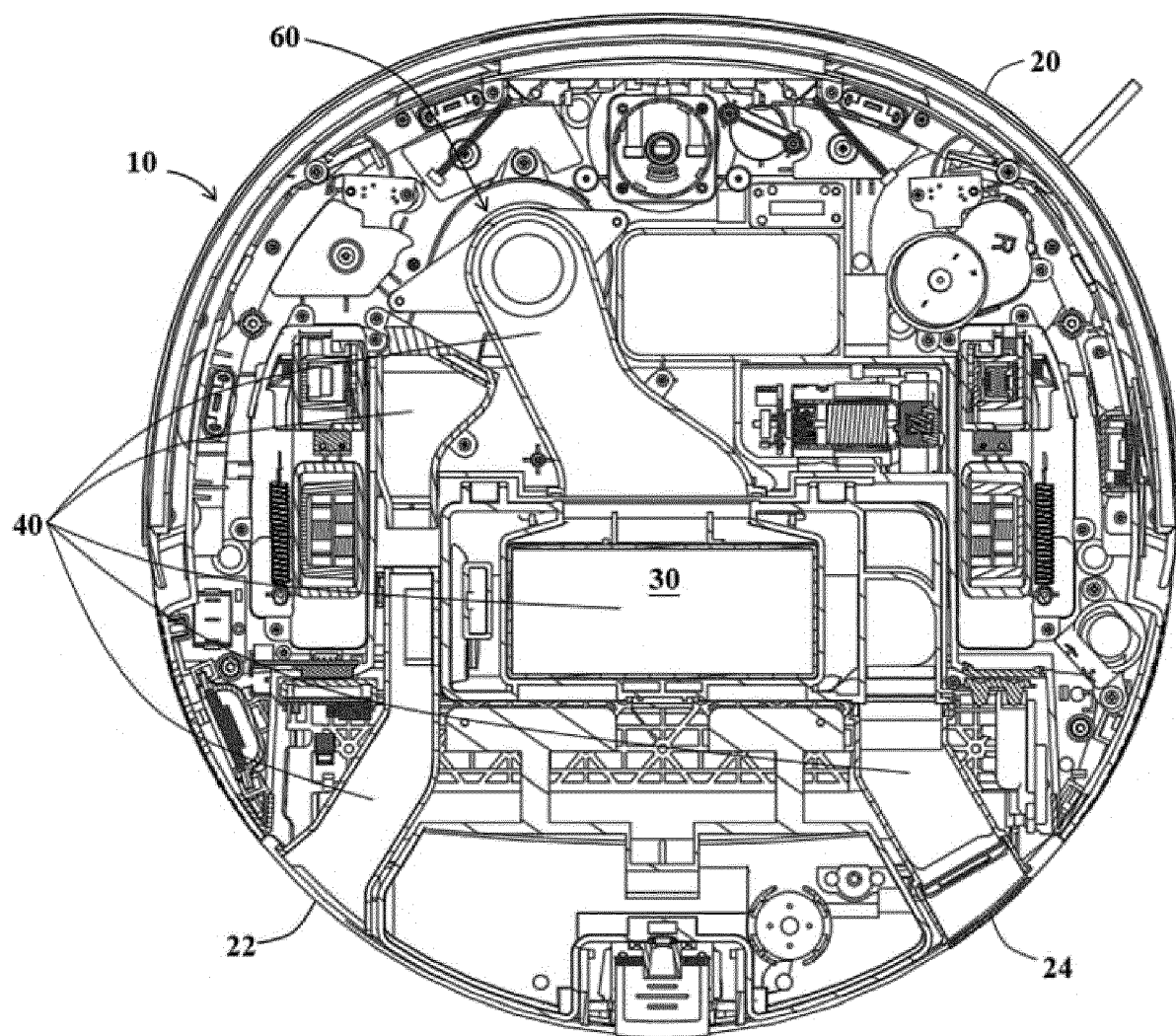


FIG. 2

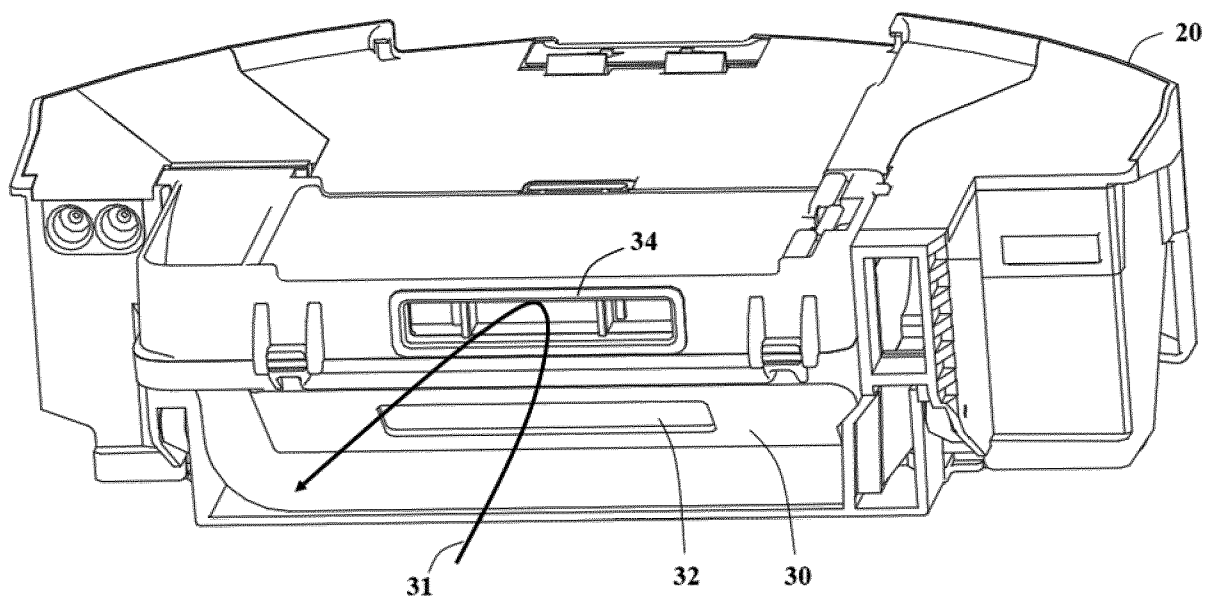


FIG. 3

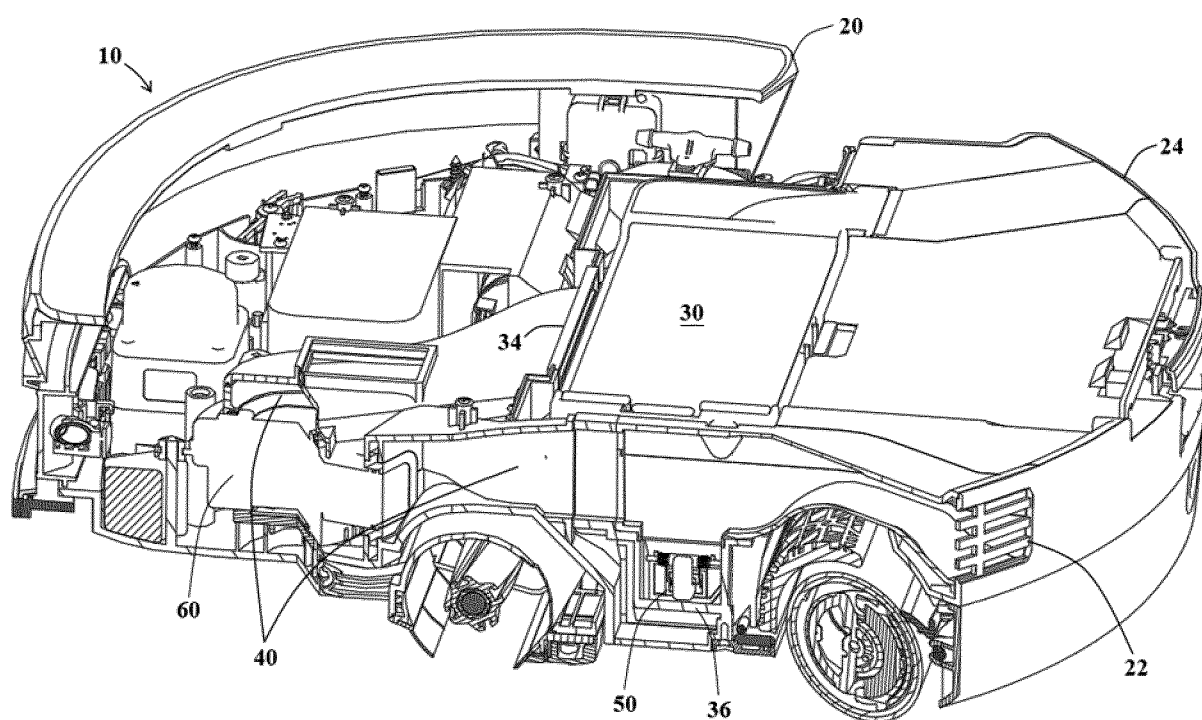


FIG. 4

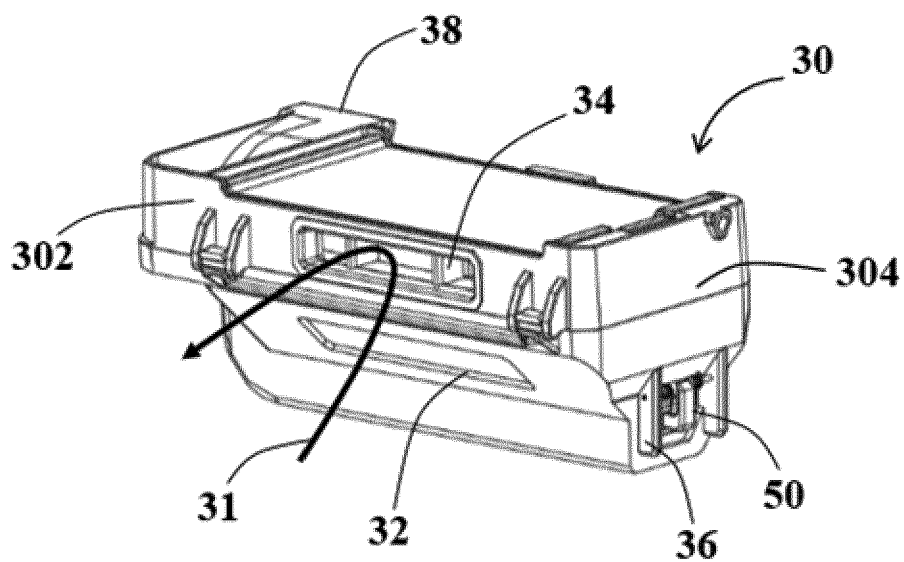


FIG. 5A

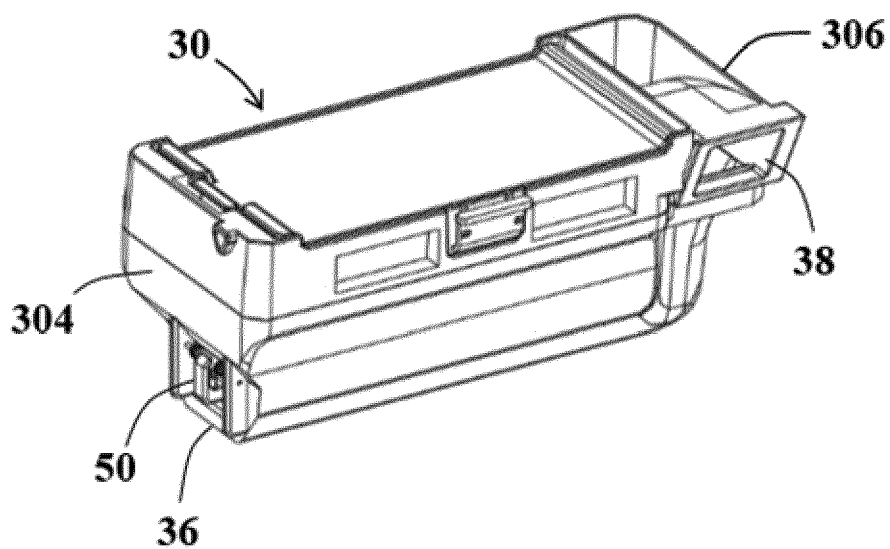


FIG. 5B

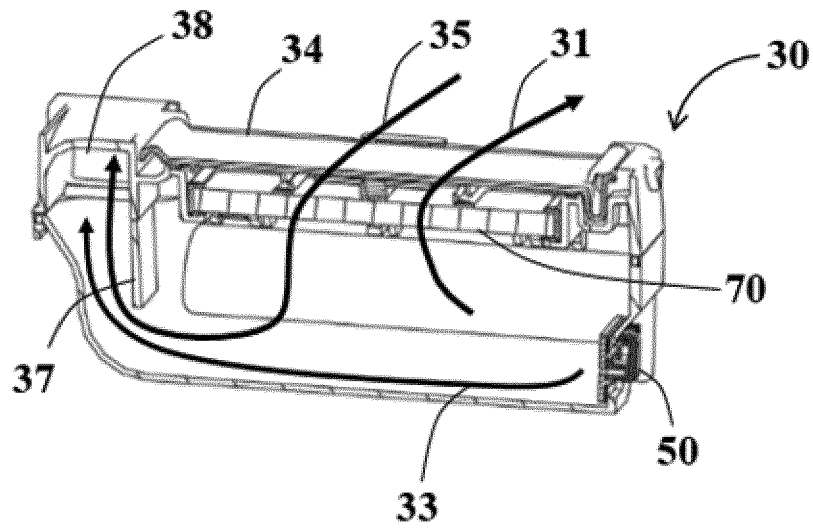


FIG. 5C

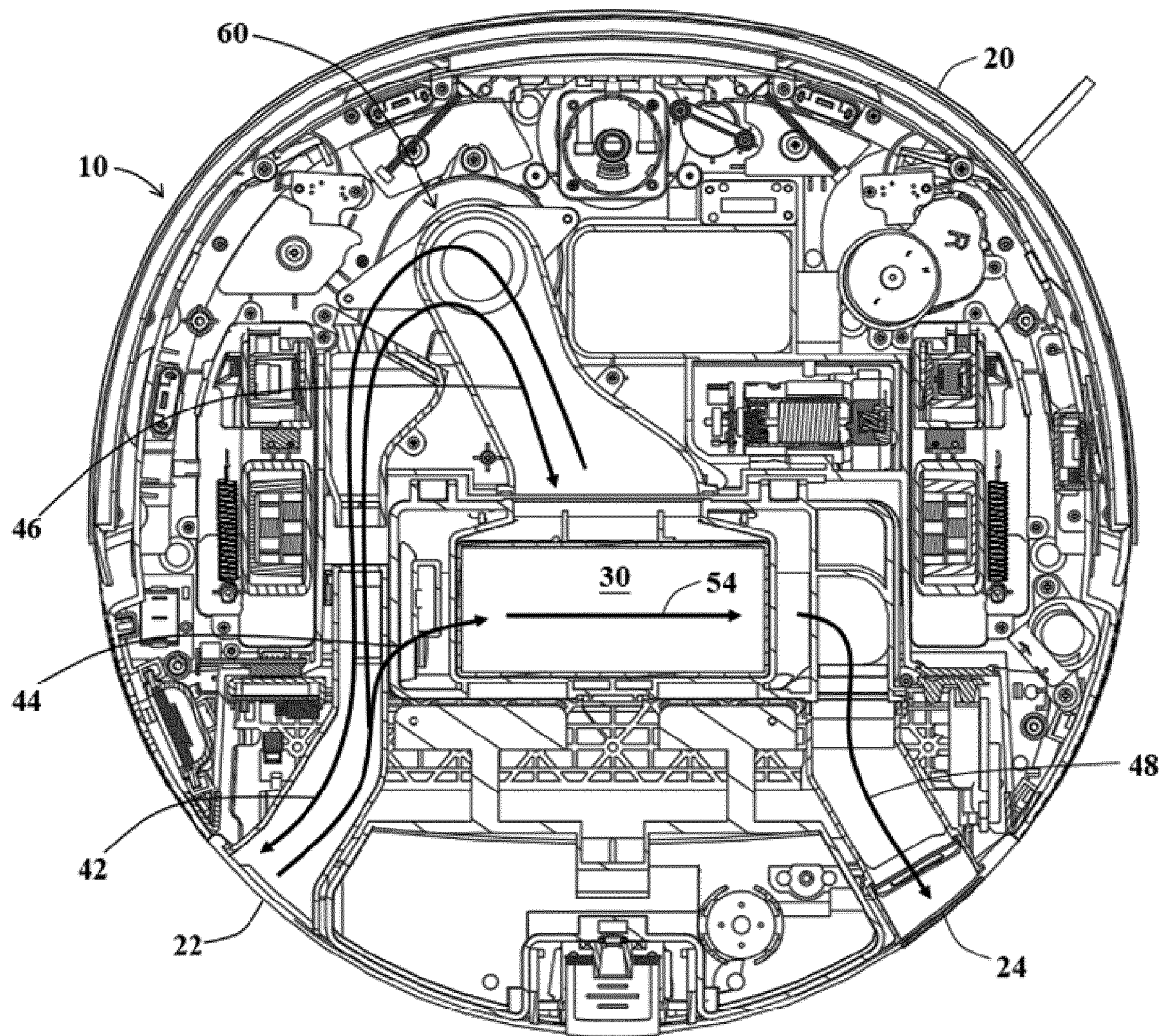


FIG. 6

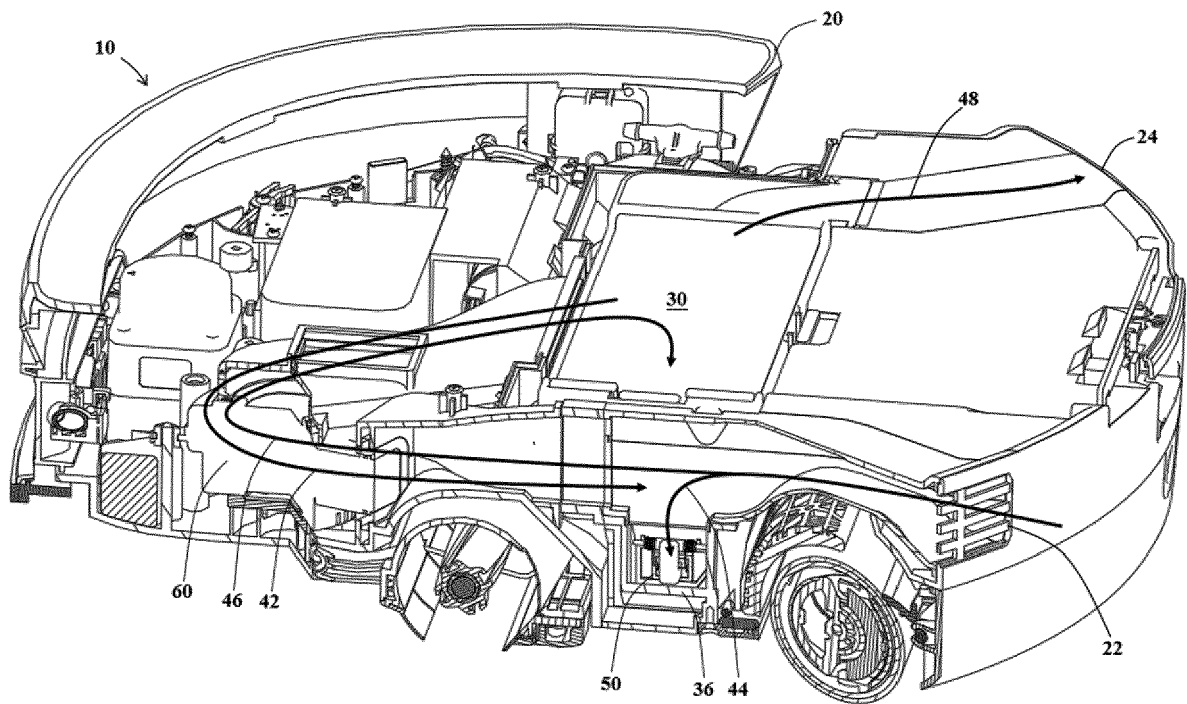


FIG. 7

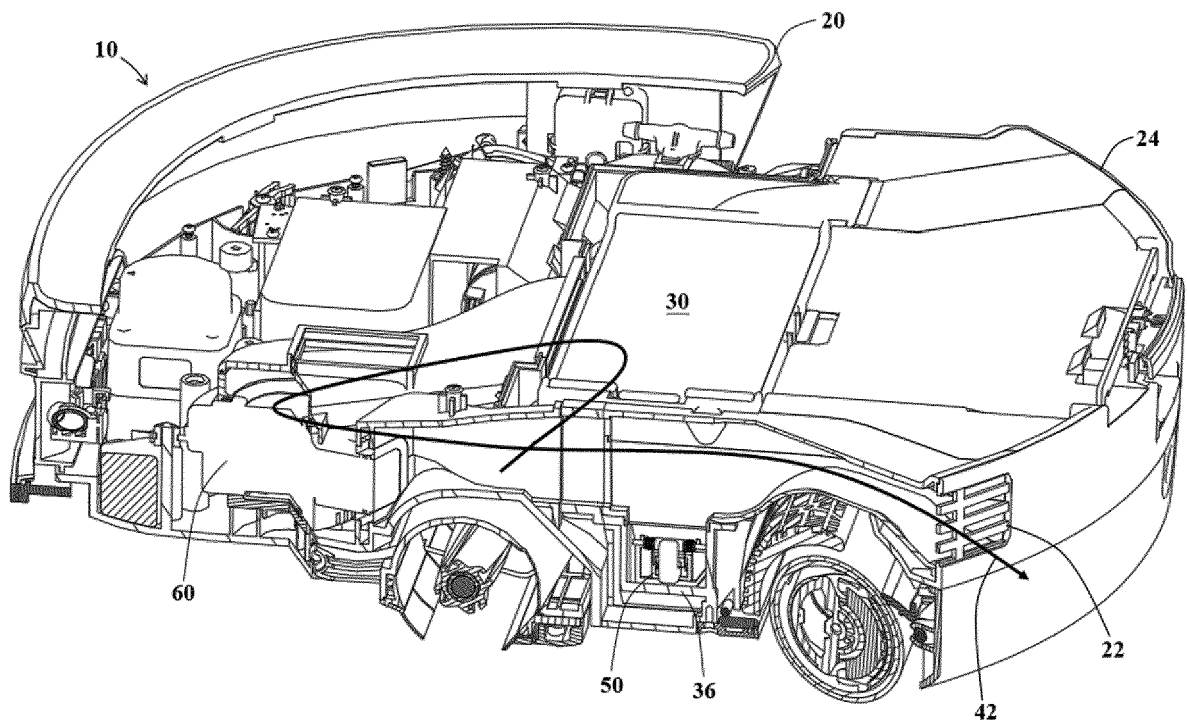


FIG. 8A

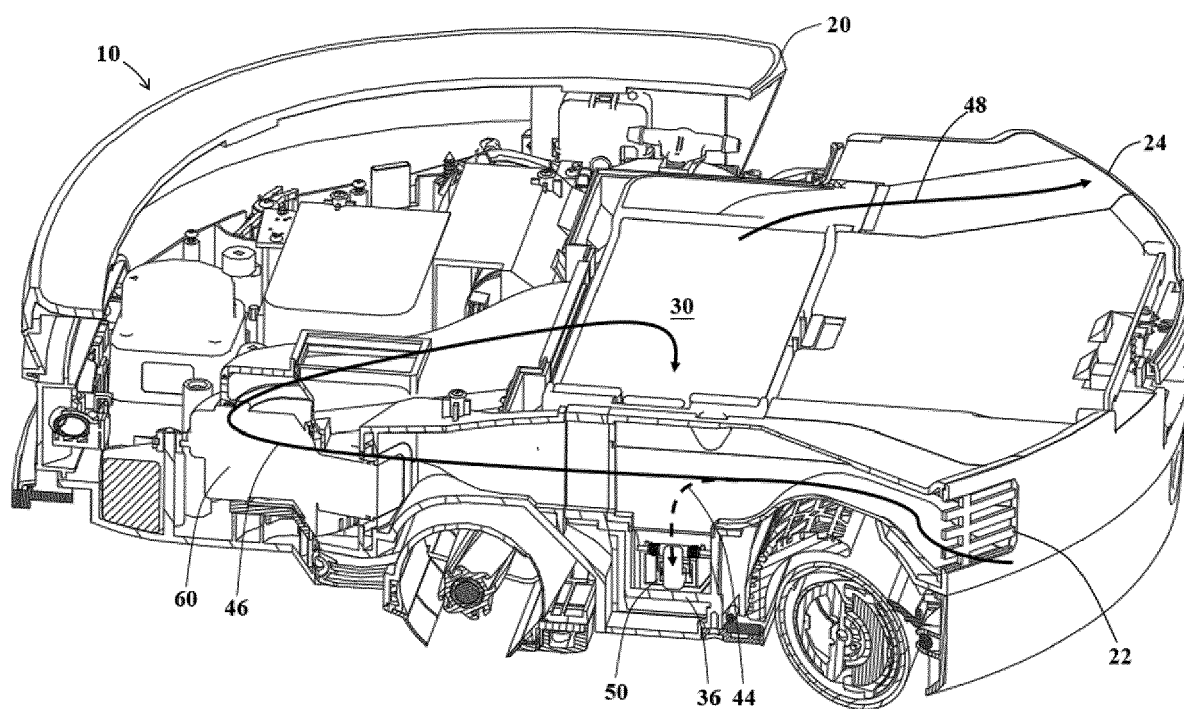


FIG. 8B

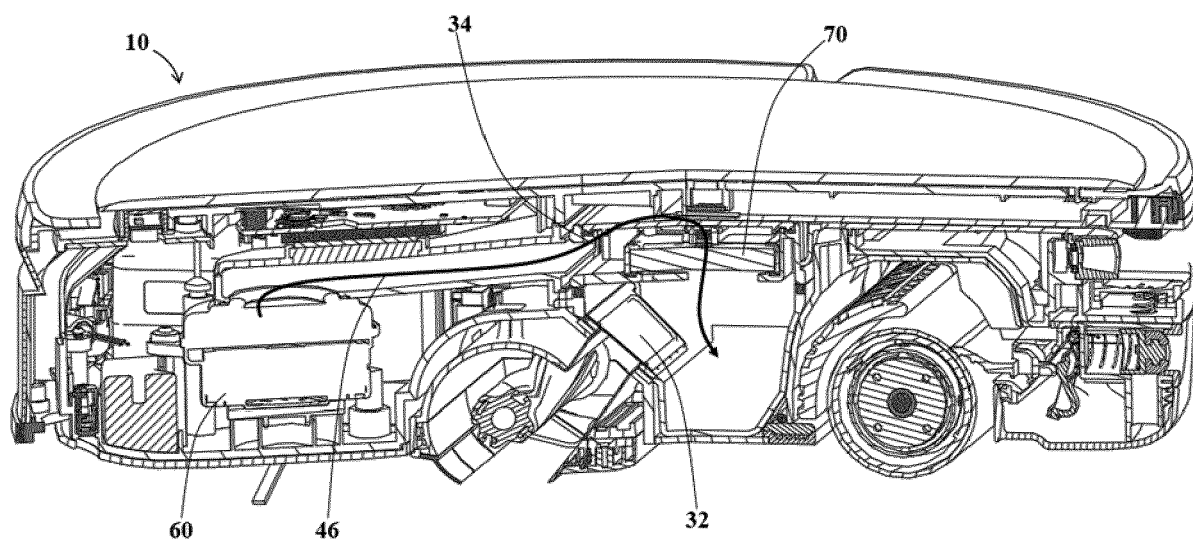


FIG. 8C

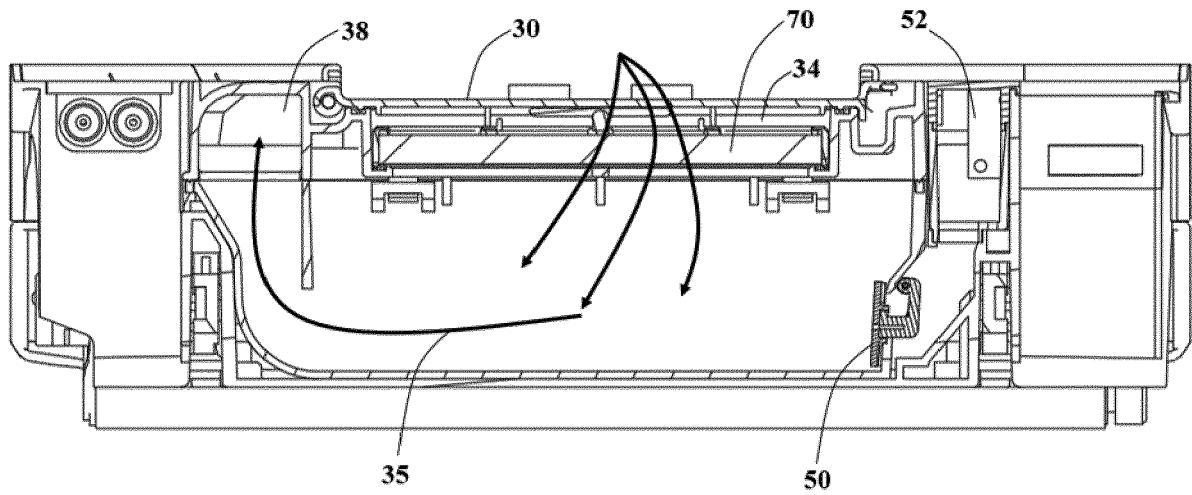


FIG. 8D

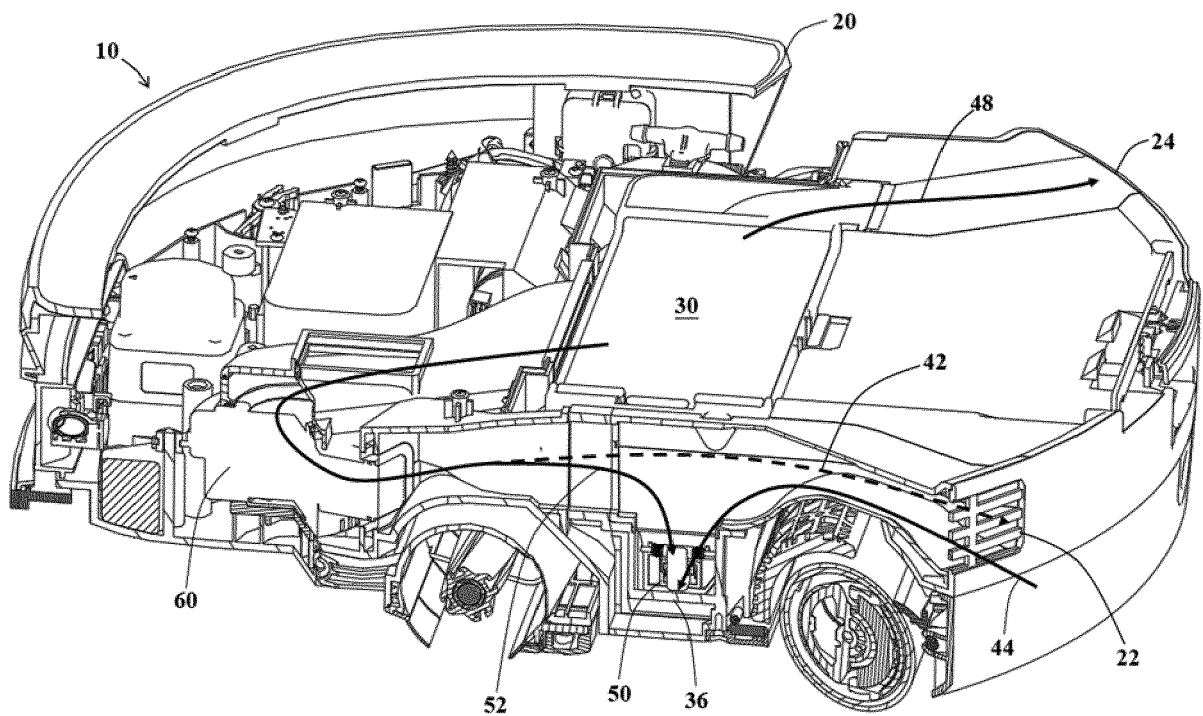


FIG. 8E

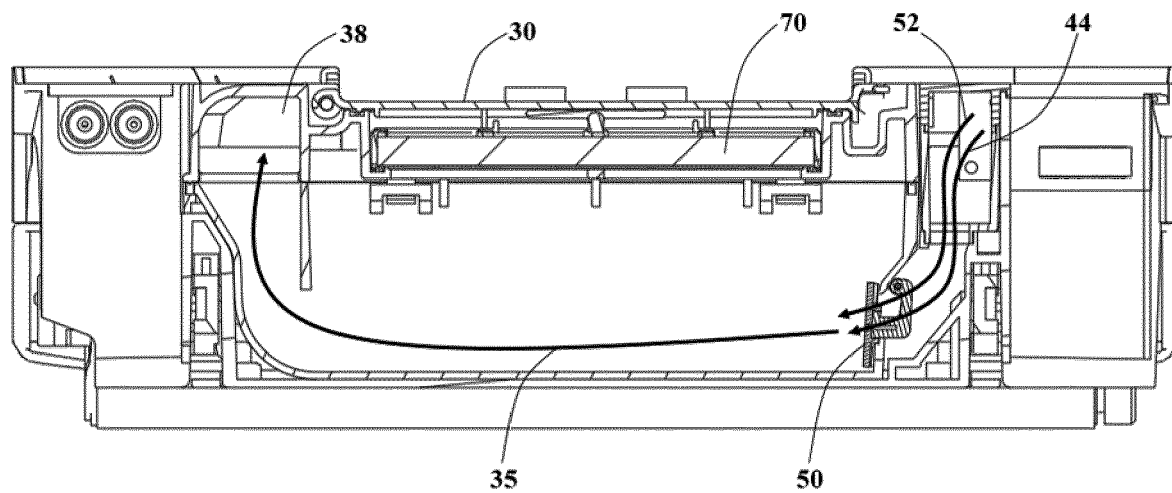


FIG. 8F

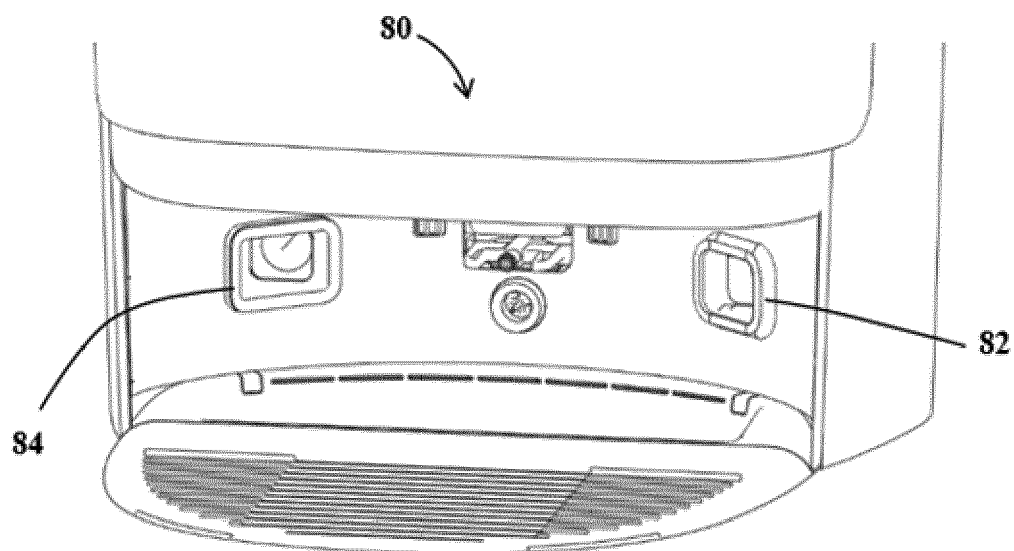


FIG. 9

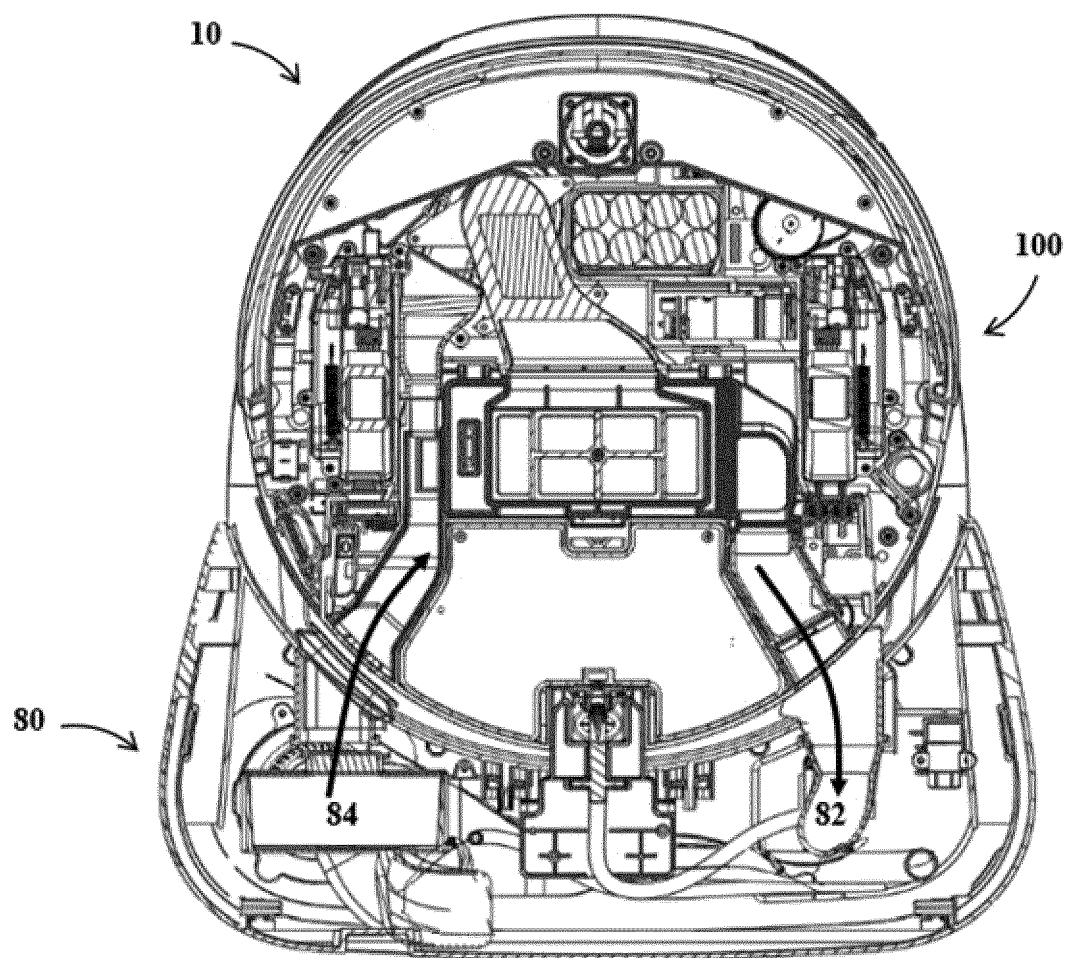


FIG. 10



EUROPEAN SEARCH REPORT

Application Number

EP 23 19 8584

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2018/078107 A1 (GAGNON MARTIN [CA] ET AL) 22 March 2018 (2018-03-22)	1, 2, 5, 6, 9, 13, 14	INV.
A	* paragraph [0027]; figures 1, 3, 10 * -----	11	A47L11/40 A47L7/02 A47L9/28
X	CN 218 899 339 U (JOYOUNG CO LTD) 25 April 2023 (2023-04-25)	1-10, 12, 14, 15	
A	* paragraphs [0038] - [0044]; figures 4, 7, 14 * -----	11	
			TECHNICAL FIELDS SEARCHED (IPC)
			A47L
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		5 March 2024	Rippel, Andreas
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

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

EP 23 19 8584

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

05-03-2024

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2018078107 A1	22-03-2018	CA 2979885 A1 US 2018078107 A1	22-03-2018 22-03-2018
CN 218899339 U	25-04-2023	NONE	

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82