(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 523 591 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
19.03.2025 Bulletin 2025/12

(21) Application number: **24194803.3**

(22) Date of filing: **15.08.2024**

(51) International Patent Classification (IPC):
A47L 11/34 *(2006.01)* ***A47L 11/40*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
A47L 11/4083; A47L 11/34; A47L 11/4016

(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:
GE KH MA MD TN

(30) Priority: **24.08.2023 US 202318237478**

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(54) **SURFACE CLEANING APPARATUS**

(57) A surface cleaning apparatus (10) includes a fluid delivery system and a recovery system and is operable to vacuum and/or mop a floor surface. The fluid delivery system has a supply tank (20) that may form a portion of a recovery pathway (48). A fluid dispenser (38) may dispense liquid through a mopping pad (28) to the surface to be cleaned. The surface cleaning apparatus (10) may include wheels (98, 100) fore and aft of the mopping pad (28). The recovery system may include a recovery tank (22) with a top-load mounting arrangement.

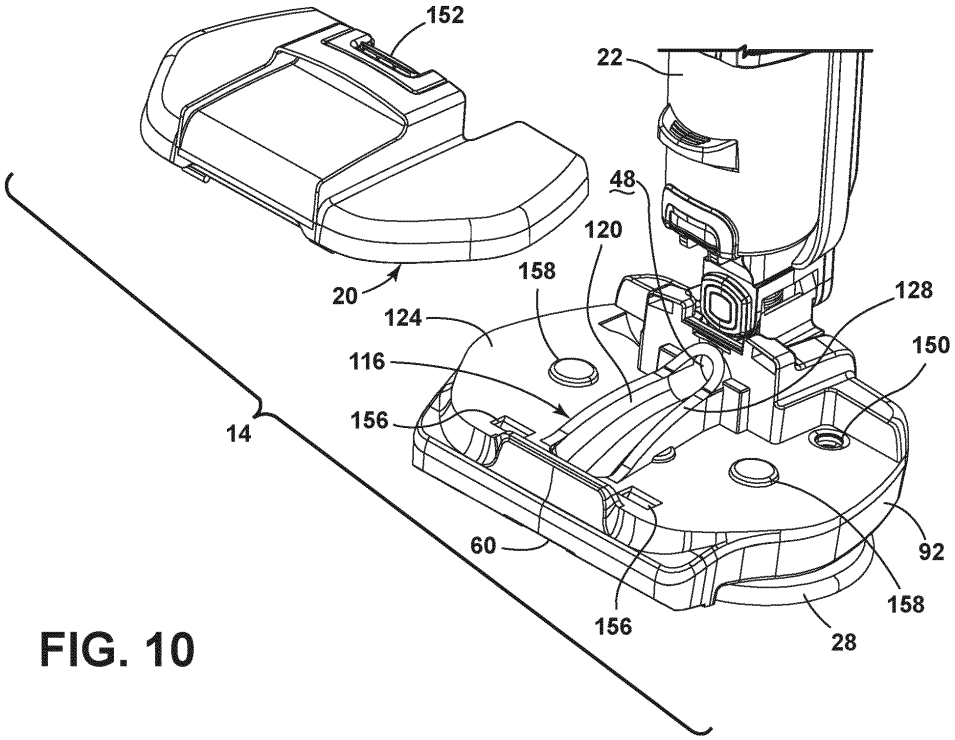


FIG. 10

EP 4 523 591 A2

Description

BACKGROUND

[0001] Surface cleaning apparatus such as wet vacuum cleaners or motorized mops can be used to clean hard floors, including tile, vinyl, linoleum, and hardwood floors by vacuuming and/or mopping the floor. Such floor cleaners can deliver cleaning fluid to the surface to be cleaned, and some are further configured to recover fluid and/or debris (which may include dirt, dust, stains, soil, hair, and other debris) from the surface to be cleaned using a suction source.

BRIEF SUMMARY

[0002] An improved surface cleaning apparatus is provided herein. In certain aspects, the surface cleaning apparatus is a wet vacuum cleaner that can be used to clean hard floors, by vacuuming and/or mopping the floor.

[0003] According to one aspect of the disclosure, a surface cleaning apparatus includes a base comprising a base housing, an upright body assembly pivotally attached to the base, a supply tank removably mounted on the base housing, a recovery system comprising a recovery path, a suction nozzle, a recovery tank, and a suction source, wherein a portion of the recovery path is formed by a bottom wall of the supply tank, and wherein removal of the supply tank from the base housing removes the portion of the recovery path.

[0004] In this and other embodiments, mopping pads are disposed on a lower side of the base.

[0005] In this and other embodiments, swivel casters are rearward of the rotating cleaning pads and support wheels are forward of the cleaning pads. The support wheels may be between the suction nozzle and the cleaning pads.

[0006] In this and other embodiments, a fluid dispenser is provided on the base above a mopping pad, wherein the fluid dispenser comprises at least one distributor outlet configured to spray fluid toward the surface to be cleaned through a cleaning fluid passage in the mopping pad.

[0007] In this and other embodiments, the surface cleaning apparatus is battery-powered, and comprises a battery pack for cordless operation.

[0008] In this and other embodiments, the surface cleaning apparatus is provided with multiple, user-selectable cleaning modes, including at least a vacuum/mop mode, a vacuum mode, and a mop mode.

[0009] In another aspect of the disclosure, a surface cleaning apparatus includes a base, an upright body assembly pivotally attached to the base, at least one mopping pad on a lower side of the base, and a plurality of wheels on the lower side of the base facilitating movement of the surface cleaning apparatus over a surface to be cleaned, wherein the plurality of wheels includes at least one first wheel forward of the at least one mopping pad and at least one second wheel rearward of the at least one mopping pad, wherein the at least one second wheel comprises a caster rotates about a first axis and swivels about a second axis that is non-parallel to the first axis.

[0010] In yet another aspect of the disclosure, a surface cleaning apparatus includes a base comprising a base housing moveable over a surface to cleaned, an upright body assembly pivotally attached to the base and comprising a tank receiver, a supply tank, at least one mopping pad on a lower side of the base, a fluid dispenser above the at least one mopping pad, the fluid dispenser in fluid communication with the supply tank via a fluid delivery pathway, wherein the fluid dispenser is configured to spray fluid toward the surface to be cleaned and/or the at least one mopping pad, and a recovery system comprising a recovery path, a suction nozzle, a recovery tank having an upper end and a lower end, and a suction source, wherein the recovery tank is mountable to the upright body assembly via the tank receiver, the upper end of the recovery tank being insertable into the tank receiver followed by insertion of the lower end.

[0011] In this and other aspects, the recovery tank includes a hook at the upper end of the recovery tank and the tank receiver includes a catch configured to be engaged by the hook.

[0012] In this and other aspects, the apparatus includes a spring-loaded latch at the lower end of the recovery tank for securing the recovery tank to the upright body assembly.

[0013] In this and other aspects, the recovery tank has an angled bottom surface, and the tank receiver has an angled support surface that is complementary to the angled bottom surface, wherein the recovery tank is received by the tank receiver with the angled bottom surface of the tank resting on the angled support surface of the receiver.

[0014] In this and other aspects, the recovery tank includes at least one of: a tank inlet at the lower end, a tank outlet at the upper end, a standpipe extending upwardly from the lower end, a lid at the upper end, and a filter at the upper end.

[0015] In still another aspect of the disclosure, a surface cleaning apparatus includes a base comprising a base housing, an upright body assembly pivotally attached to the base, a supply tank removably mounted on the base housing, a rotatable pad holder on a lower side of the base, a mopping pad attached to the pad holder and rotatable therewith, a pad drive motor operably coupled with the pad holder for rotation of the pad holder and the mopping pad, a fluid delivery nozzle located above the pad holder, and at least one cleaning fluid passage through the pad holder and mopping pad for the delivery of cleaning fluid from the fluid delivery nozzle directly to the surface to be cleaned beneath the base.

[0016] In this and other aspects, the the housing includes a notched portion though which a portion of the

fluid delivery nozzle and/or a conduit supplying the fluid delivery nozzle passes. The notched portion may be a notched portion in a drive casing housing at least a portion of the drive transmission coupling the pad drive motor to the pad holder.

[0017] In this and other aspects, the pad holder comprises a central hub having a shaft holder for coupling with a drive shaft, and the mopping pad comprises a center opening that is aligned with the central hub of the pad holder. The mopping pad and the pad holder may be disc-shaped.

[0018] In this and other aspects, the at least one cleaning fluid passage is a plurality of cleaning fluid passage openings through the pad holder, the plurality of cleaning fluid passage openings disposed radially outwardly of the central hub.

[0019] These and other features and advantages of the present disclosure will become apparent from the following description of particular embodiments, when viewed in accordance with the accompanying drawings and appended claims.

[0020] Before the aspects of the invention are explained in detail, it is to be understood that the invention is not limited to the details of operation or to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention may be implemented in various other embodiments and of being practiced or being carried out in alternative ways not expressly disclosed herein. Also, it is to be understood that the phraseology and terminology used herein are for the purpose of description and should not be regarded as limiting. The use of "including" and "comprising" and variations thereof is meant to encompass the items listed thereafter and equivalents thereof as well as additional items and equivalents thereof. Further, enumeration may be used in the description of various embodiments. Unless otherwise expressly stated, the use of enumeration should not be construed as limiting the invention to any specific order or number of components. Nor should the use of enumeration be construed as excluding from the scope of the invention any additional steps or components that might be combined with or into the enumerated steps or components. Any reference to claim elements as "at least one of X, Y and Z" is meant to include any one of X, Y or Z individually, and any combination of X, Y and Z, for example, X, Y, Z; X, Y; X, Z; and Y, Z.

DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a front perspective view of a surface cleaning apparatus, or floor cleaner, according to one embodiment of the disclosure;

FIG. 2 is a rear perspective view of the floor cleaner;

FIG. 3 is a schematic view of various functional systems of the floor cleaner;

FIG. 4 is a sectional view taken through line IV-IV of FIG. 1;

FIG. 5 is a side view of the floor cleaner in a lay-flat position;

FIG. 6 is a rear perspective view of a lower portion of the floor cleaner showing a joint assembly, with the floor cleaner in an upright storage position;

FIG. 7 is a view similar to FIG. 6 showing the floor cleaner in the lay-flat position;

FIG. 8 is a partially exploded view of a lower rear portion of the floor cleaner;

FIG. 9 is a bottom view of the floor cleaner showing mopping pads and wheels on an underside of the floor cleaner;

FIG. 10 is a front perspective view of a lower portion of the floor cleaner showing a supply tank exploded from the floor cleaner;

FIG. 11 is a rear bottom perspective view of the supply tank;

FIG. 12 is a close-up, sectional view of a lower portion of the floor cleaner taken through line IV-IV of FIG. 1;

FIG. 13 is a partially exploded view of a base of the floor cleaner, showing a mopping pad drive system;

FIG. 14 is a top perspective view of a mopping pad and pad holder of the floor cleaner;

FIG. 15 is a bottom perspective view of the pad holder;

FIG. 16 is a top view of the base with a portion of the base removed for clarity to show a fluid supply path in the base of the floor cleaner;

FIG. 17 is a close-up, sectional view taken through line XVII-XVII of FIG. 1, showing a cleaning fluid passage through the mopping pad;

FIG. 18 is a front perspective view showing a recovery tank exploded from the floor cleaner;

FIG. 19 is a close-up, sectional view taken through line IV-IV of FIG. 1, showing the recovery tank mounted to the floor cleaner;

FIG. 20 is a close-up, bottom perspective view showing a latch for mounting the recovery tank to the floor cleaner;

FIG. 21 is a view similar to FIG. 19 showing the recovery tank being mounted to the floor cleaner; and

FIG. 22 is a partially exploded perspective view of the recovery tank.

DETAILED DESCRIPTION

[0022] The invention generally relates to a surface cleaning apparatus. The surface cleaning apparatus, also referred to herein as the "surface cleaning apparatus" or the "floor cleaner" has a cleaning system, or multiple cleaning systems, for cleaning a surface, including floor surfaces like carpet, rugs, wood, tile, and the like, or above-floor surfaces like countertops, furniture, and the like. Aspects of the disclosure relate to an improved

floor cleaner with improved clean-out features, improved maneuverability, improved fluid dispensing, improved tank mounting, or improved cleaning modes, or any combination thereof. As such, certain features of the surface cleaning apparatus may be considered functional but may also be implemented in different aesthetic configurations.

[0023] At least some embodiments of the surface cleaning apparatus provided herein function through the various elements thereof, as described below, to provide improved clean-out of the recovery pathway. By forming a portion of the recovery pathway with a removable supply tank, the recovery pathway is easily accessible by simply removing the supply tank. This makes clean-out of the recovery pathway after a cleaning operation easier and more convenient for the user. This configuration can also reduce the number of parts and cost associated with the floor cleaner.

[0024] At least some embodiments of the surface cleaning apparatus provided herein function through the various elements thereof, as described below, to provide improved maneuverability by the provision of wheels fore and aft of the mopping pads. The provision of such wheels maintains consistent pad engagement with the surface to be cleaned in various use orientations of the floor cleaner, which improves the consistency of agitation and thus cleaning performance, as well as stabilizing the load on motor driving the mopping pads.

[0025] At least some embodiments of the surface cleaning apparatus provided herein function through the various elements thereof, as described below, to provide improved fluid dispensing and mopping. By dispensing liquid through a mopping pad directly to the surface to be cleaned, the mopping pad is more uniformly wetted, and cleaning time can be reduced. This fluid delivery configuration also improves streaking, e.g., uneven application and/or residual fluid left on the surface to be cleaned.

[0026] At least some embodiments of the surface cleaning apparatus provided herein function through the various elements thereof, as described below, to provide improved tank mounting. A tank, such as a recovery tank, has a top-load arrangement whereby the tank is mounted on the floor cleaner starting from its upper end, which can minimize the overall size (e.g., bulk and/or height) of the floor cleaner.

[0027] At least some embodiments of the surface cleaning apparatus provided herein function through the various elements thereof, as described below, to provide multiple, user-selectable cleaning modes, including at least a vacuum/mop mode, a vacuum mode, and a mop mode.

[0028] The floor cleaner can be a wet vacuum cleaner or a "vacuum mop" that can be used to clean hard floors, including tile, vinyl, linoleum, and hardwood floors by vacuuming and/or mopping the floor. The floor cleaner can include multiple cleaning systems, including a fluid delivery system and a recovery system. With both fluid delivery and recovery systems, the floor cleaner can deliver cleaning fluid to the surface to be cleaned and can recover debris (which may include dirt, dust, stains, soil, hair, and other debris) from the surface to be cleaned.

[0029] While various aspects illustrated herein are shown on a wet vacuum cleaner or a vacuum mop, aspects of the present disclosure may be used on other types of surface cleaning apparatus, including, but not limited to, "dry" vacuum cleaners that does not deliver liquid or "wet" mops that do not vacuum.

[0030] In an exemplary embodiment shown in Figures 1-2, wherein like numerals indicate corresponding parts throughout the several views, a surface cleaning apparatus is illustrated and generally designated at 10. The floor cleaner 10 can include a fluid delivery or supply pathway, including and at least partially defined by a supply tank 20, for storing cleaning fluid, e.g. cleaning liquid, and delivering the cleaning fluid to the surface to be cleaned and a recovery pathway, including and at least partially defined by a recovery tank 22, for removing debris from the surface to be cleaned and storing the debris until emptied by the user.

[0031] The floor cleaner 10 includes an upright handle assembly or body 12 and a cleaning foot or base 14 mounted to or coupled with the upright body 12 and adapted for movement across a surface to be cleaned. The various cleaning systems and components thereof can be supported by either or both the base 14 and the upright body 12.

[0032] The floor cleaner 10 can have a moveable joint assembly 26 that connects the base 14 to the upright body 12 for movement of the body 12 about at least one axis, alternative about at least two axes of rotation.

[0033] For purposes of description related to the figures, the terms "upper," "lower," "right," "left," "rear," "front," "vertical," "horizontal," "inner," "outer," and derivatives thereof shall relate to the disclosure as oriented in FIG. 1 from the perspective of a user behind the floor cleaner 10, which defines the rear of the floor cleaner 10. However, it is to be understood that the disclosure may assume various alternative orientations, except where expressly specified to the contrary.

[0034] The upright body 12 can comprise a handle 16 and a frame 18. The frame 18 can comprise a main support section at least partially supporting the recovery tank 22 and may further support additional components of the body 12, including, but not limited to, a user interface ("UI") 34. The handle 16 can include a hand grip 24 at an upper end thereof.

[0035] The base 14 can comprise a cleaning foot or housing at least partially supporting the supply tank 20 and may further support additional components of the base 14, including, but not limited to, at least one cleaning implement to agitate the surface to be cleaned. In one embodiment, the cleaning implement is a rotating cleaning pad 28 disposed on the base 14. Other examples of cleaning implements include, but are not limited to, one or

more horizontally-rotating pads, one or more rotating brushes, one or more stationary pads, or one or more stationary brushes.

[0036] Multiple cleaning pads 28 can be disposed on the base 14. For example, a pair of cleaning pads 28 may be arranged in a lateral direction, e.g., side-by-side. While reference to multiple cleaning pads 28 and/or a pair of cleaning pads 28 is made throughout the disclosure, it is understood that the floor cleaner 10 may comprise a single cleaning pad 28 or more than two cleaning pads 28, unless otherwise noted.

[0037] FIG. 3 is a schematic view of various functional systems of the floor cleaner 10. The delivery system includes the supply tank 20, which is configured to hold a cleaning fluid, at least one fluid dispenser 38 supplied with cleaning fluid from the supply tank 20, and a fluid supply path 40 from the supply tank 20 to the fluid dispenser 38. The delivery system can include suitable conduits, ducts, tubing, hoses, connectors, valves, etc. fluidly coupling the components of the delivery system together and providing the supply path 40.

[0038] The supply tank 20 can store cleaning fluid in liquid form. The cleaning fluid can comprise one or more of any suitable cleaning fluids, including, but not limited to, water, compositions, concentrated detergent, diluted detergent, other surface cleaning and/or treatment agents, and mixtures thereof. For example, the cleaning fluid can comprise water. In another example, the cleaning fluid can comprise a mixture of water and concentrated detergent. While reference to one supply tank 20 is made throughout the disclosure, it is understood that the floor cleaner 10 may comprise more than one source of cleaning fluid, e.g., multiple supply tanks, unless otherwise noted. For example, one tank can hold water and another tank can hold a detergent.

[0039] It is noted that while the floor cleaner 10 described herein is configured to deliver a cleaning liquid, aspects of the disclosure may be applicable to surface cleaning apparatus that deliver steam. Thus, the term "cleaning fluid" may encompass liquid, steam, or both, unless otherwise noted.

[0040] The delivery system can include a flow controller for controlling the flow of fluid from the supply tank 20 to the fluid dispenser 38. In one configuration, the flow controller can comprise a pump 44, which pressurizes the supply path 40 and controls the delivery of cleaning fluid to the fluid dispenser 38. In one example, the pump 44 can be a centrifugal pump. In another example, the pump 44 can be a solenoid pump having a single, dual, or variable speed. The release of cleaning fluid from the dispenser 38 can be controlled automatically by selection of a cleaning mode via the UI 34, or manually by the user, e.g., via a trigger (not shown) on the hand grip 24 or an actuator located elsewhere on the floor cleaner 10.

[0041] In another embodiment of the delivery system, instead of a pump, the flow controller can comprise a gravity-feed system having a valve (not shown) fluidly coupled with an outlet of the supply tank 20, whereby when the valve is open, fluid will flow under the force of gravity to the dispenser 38.

[0042] The dispenser 38 can comprise various structures, such as a nozzle, a spray tip, or a manifold, and can comprise at least one fluid outlet for dispensing cleaning fluid to the surface to be cleaned. The dispenser 38 can be positioned to deliver cleaning fluid directly to the surface to be cleaned, or indirectly by delivering cleaning fluid onto the mopping pad 28. In one non-limiting example, the dispenser 38 delivers cleaning fluid directly to the surface to be cleaned through an opening in the mopping pad 28, as described in further detail below.

[0043] Optionally, a heater 42 can be provided for heating the cleaning fluid prior to delivering the cleaning fluid to the surface to be cleaned. In one example, an in-line heater 42 can be located downstream of the supply tank 20, and upstream or downstream of the pump 44. Other types of heaters can also be used. In yet another example, the cleaning fluid can be heated using exhaust air from a motor cooling air path for a suction source of the recovery system. In yet another example, the cleaning fluid is unheated.

[0044] The recovery system can include a recovery path 48 through the floor cleaner 10 having a path inlet 50 and a path outlet 52, a suction source 54 including a vacuum motor 56 in fluid communication with the path inlet and configured to generate a working stream through a recovery path 48, and the recovery tank 22 for separating and collecting debris from a working stream for later disposal. A separator 58 can be formed in a portion of the recovery tank 22 for separating entrained debris from the working stream.

[0045] The debris collected in the tank 22 may be "dry" debris, which can include dry, substantially dry, and/or damp debris that is lifted from the surface to be cleaned by the recovery system. The recovery system may not be configured to collect liquid from the surface to be cleaned, e.g., liquid is not collected in the tank 22. Instead, liquid may be absorbed from the surface to be cleaned by the cleaning pad 28. The cleaning pad 28 is preferably made out of a material that absorbs liquid and loosens and traps debris on the floor surface. As the wetted pad 28 is wiped over the surface to be cleaned, excess liquid on the surface is absorbed by the pad 28 while debris on the surface is loosened or solubilized and then trapped by the pad 28.

[0046] In one embodiment, the path inlet 50 is disposed on the base 14 and can be defined by a suction inlet port and/or a suction nozzle 60 disposed on the base 14. The cleaning pads 28 are disposed outside the recovery path 48, such as by being disposed under and/or rearward of the suction nozzle 60, such that the recovery system does not apply suction to the cleaning pads 28.

[0047] In one embodiment, the path outlet 52 is disposed on a rear side of the upright body 12 and can be defined by an exhaust vent in the frame 18 (FIG. 2). In another embodiment, the path outlet 52 is disposed elsewhere on the floor cleaner 10.

[0048] A drive assembly including at least one pad motor 62 can drive the cleaning pads 28. In one embodiment, a drive transmission, described in further detail below, operably connects one motor 62 with both cleaning pads 28 for transmitting rotational motion of the motor 62 to the pads 28. In other embodiment, a pad motor 62 can be provided for each pad 28.

[0049] Electrical components of the floor cleaner 10, including the pump 44, vacuum motor 56, pad motor 62, or any combination thereof, are electrically coupled to a battery 30, which can comprise a battery pack, for cordless operation. The battery 30 is preferably rechargeable. In one example, the battery pack 30 comprises a lithium-ion battery pack.

[0050] The floor cleaner 10 can include a main controller 32 operably coupled with the various systems and components of the floor cleaner 10. In one embodiment the main controller 32 can comprise a printed circuit board ("PCB"). As used herein, unless otherwise noted, the term "PCB" includes a printed circuit board having a plurality of electrical and electronic components that provide operational control to the floor cleaner 10. The PCB includes, for example, a processing unit (e.g., a microprocessor, a microcontroller, or another suitable programmable device) and a memory (e.g., a read-only memory ("ROM"), a random-access memory ("RAM"), an electrically erasable programmable read-only memory ("EEPROM"), a flash memory, or another suitable magnetic, optical, physical, or electronic memory device). The processing unit is connected to the memory and executes instructions (e.g., software) that is capable of being stored in the RAM (e.g., during execution), the ROM (e.g., on a generally permanent basis), or another non-transitory computer readable medium such as another memory or a disc. Additionally or alternatively, the memory is included in the processing unit (e.g., as part of a microcontroller). Software stored in memory includes, for example, firmware, program data, one or more program modules, and other executable instructions. The processing unit is configured to retrieve from memory and execute, among other things, instructions related to the control processes and methods described herein. The PCB can also include, among other things, a plurality of additional passive and active components such as resistors, capacitors, inductors, integrated circuits, and amplifiers. These components are arranged and connected to provide a plurality of electrical functions to the PCB including, among other things, signal conditioning or voltage regulation. For descriptive purposes, a PCB and the electrical components populated on the PCB are collectively referred to as a controller. Thus, the main PCB and the electrical components populated on the main PCB may be referred to as main controller 32.

[0051] Through the UI 34, a user can interact with the floor cleaner 10 to accomplish one or more functions. In the illustrated embodiment, a UI 34 is provided on the frame 18 (FIG. 1), and in other embodiments can be disposed on the base 14 or elsewhere on the upright body 12. In one preferred embodiment, the UI 34 is a front side of the frame 18 for easy user access and may additionally be located at an upper end of the frame 18, above the recovery tank 22 and below the handle 16. While one UI 34 is shown, in other embodiments, the floor cleaner 10 can comprise multiple user interfaces.

[0052] Referring to FIG. 4, an architectural layout for the floor cleaner 10 according to one aspect of the disclosure is shown, including locations and relative positions for the tanks 20, 22, battery pack 30, and other components. Components including the recovery tank 22, the battery pack 30, and the suction source 54 can be included on the upright body 12. Components including the supply tank 20, pads 28, suction nozzle 60, and pad motor 62 can be included on the base 14. The dispenser 38 and pump 44 can also be included on the base 14 (see FIG. 13 and 16).

[0053] The components of the floor cleaner 10 are arranged with relative positioning that is well-balanced, comfortable for the user to operate, and/or provides protection for electronic components. For example, the battery pack 30 is disposed above the tanks 20, 22, which isolates the battery pack 30 from potential exposure to liquids, such as from leaks from the supply tank 20 or other components of the delivery system. As another example, all the components of the fluid delivery system, including the supply tank 20, are disposed on the base 14, which can reduce the size and weight of on the upright body 12. Other arrangements of the components of the floor cleaner 10 are possible, while maintaining a well-balanced and comfortably operable floor cleaner 10, and isolated electronic components.

[0054] The supply tank 20 can include at least one an externally-facing surface which forms an external surface of the base 14, including, but not limited to, an upper surface, a front side, a right lateral side and/or a left lateral side of the base 14. In forming an external surface of the base 14, the at least one an externally-facing surface of the supply tank 20 is visible from the exterior of the floor cleaner 10, e.g., visible to a user of the floor cleaner 10.

[0055] The recovery tank 22 can include at least one an externally-facing surface which forms an external surface of the upright body 12, including, but not limited to, a front side, a right lateral side and/or a left lateral side of the base 14.

[0056] The supply tank 20 and/or recovery tank 22 can be formed of a transparent or tinted translucent material, which permits a user to observe the contents of the tank 20, 22.

[0057] Referring to FIG. 5, in one aspect of the disclosure, the joint assembly 26 can enable a wide range of movement, including movement of the upright body 12 to a lay-flat position in which the upright body 12 is substantially horizontal to the surface to be cleaned. One example of the lay-flat position is shown in FIG. 5, with the floor cleaner 10 resting on a surface S. In the lay-flat position, the angle A between the base 14 and upright body 12 is substantially 180 degrees, where "substan-

tially" includes deviations of up to 5 degrees, alternatively up to 10 degrees. In one example, the angle A can alternatively be about 170-180 degrees. This minimizes the height of the floor cleaner 10 for easier cleaning under furniture and in hard-to-reach places.

[0058] The angle A can, in one example, be the angle between a handle axis and a base plane. The handle axis extends parallel to or through the elongated handle 16 and intersects the X-axis of the joint assembly 26. The base plane is parallel to the surface S to be cleaned and extends through the base 14 to intersect the X-axis of the joint assembly 26.

[0059] In the lay-flat position, the floor cleaner 10 can be supported, for example, by at least the cleaning pads 28, wheels 98, 100 on the base 14 (see FIG. 9), and a rearward-facing end 64 of the hand grip 24. In one embodiment, the rearward-facing end 64 of the hand grip 24 is configured to be the first and/or only point of contact between the surface S and the upright body 12 in the lay-flat position. The floor cleaner 10 may, in some embodiments, be supported by other portions of the lower side of the base 14 and/or other portions of the rear side of the upright body 12 in the lay-flat position.

[0060] Referring to FIGS. 6-8, in one embodiment, the joint assembly 26 can comprise a multi-axis joint that couples the base 14 to the upright body 12 for movement about at least two axes of rotation X, Y. In one embodiment, a rear housing cover 86 (FIG. 8) can enclose a portion of the joint assembly 26. In FIGS. 6-7, a rear housing cover 86 of the base 14 is not shown for clarity.

[0061] Referring to FIGS. 6-7, the upright body 12 is pivotable relative to the base 14 about the first axis X between the upright storage position (FIGS. 6) and the lay-flat position (FIG. 7). Between these positions, is at least one reclined use position (not shown) in which a user supports the upright body 12 at an angle, and the upright body 12 forms an acute angle with the surface to be cleaned and a user can partially support the floor cleaner 10 by holding the hand grip 24 (FIG. 1). The body 12 pivotable relative to the base 14 about the second axis Y to steer the base 14 as the base 14 moves over a surface. The body 12 can be pivoted about the axes X, Y by the user using the handle 16. In the reclined use position, the angle A between the base 14 and upright body 12 is substantially 138 degrees, where "substantially" includes deviations of up to 5 degrees, alternatively up to 10 degrees. In one example, the angle A can alternatively be about 128-147 degrees. In the reclined use position, the body 12 may, in one example, pivot about axis Y up to 44 degrees from vertical to each side.

[0062] In the upright or storage position, the upright body 12 is oriented substantially upright relative to the surface to be cleaned and the floor cleaner 10 is self-supporting, i.e., the floor cleaner 10 can stand upright without being supported by something else. In the upright or storage position, the angle A between the base 14 and upright body 12 is substantially 85 degrees, where "substantially" includes deviations of up to 5 degrees. In one example, the angle A can alternatively be about 83-88 degrees.

[0063] A joint lock (not shown) can selectively engage and lock the upright body 12 in the upright or storage position. When locked in the upright/storage position, the joint assembly 26 is locked-out and the upright body 12 is not moveable about either axis X, Y. When reclined, the joint assembly 26 is released and the upright body 12 can move relative to the base 14 about the axes X, Y, including, but not limited to, to the lay-flat position.

[0064] Referring to FIG. 8, in one embodiment, the joint assembly 26 permitting movement to the lay-flat position includes a base connector 66 pivotally coupled to the base 14 and defining the axis X about which the upright body 12 can rotate in a front-to-back direction and an upright connector 68 pivotally coupled to the base connector 66 and defining the axis Y about which the upright body 12 can rotate in a side-to-side direction. The upright connector 68 can be coupled to or formed with a lower end 70 of the frame 18.

[0065] The base 14 can comprise a cradle 72 that receives a portion of the base connector 66. The cradle 72 can be disposed at a rear portion of the base 14 and can include an upwardly-facing opening in a top side of the base 14 that is continuous with a rearwardly-facing opening in a read side of the base 14. Said cradle openings permits the upright body 12 to pivot to the upright storage position (FIGS. 6), and to the lay-flat position (FIG. 7), as well as to reclined use positions in between. The cradle 72 can also be large enough to accommodate the lower end 70 of the upright connector 68 in the upright storage position and in the lay-flat position, as well as in reclined use positions in between.

[0066] The cradle 72 can, in one embodiment, be formed at least partially by the upper rear housing cover 86. The cradle can further be formed, at least partially, by a lower rear housing cover 88 that mates with the upper rear housing cover 86. Various other structural configurations of the cradle 72 are possible.

[0067] The axis X can, for example, be defined by axles 74 extending in opposite directions from a lower end 76 of the base connector 66 and that are rotatably received in axle openings 78 of the cradle 72 on a rear side of the base 14.

[0068] To support the lay-flat position, the axle openings 78 are preferably located at a height from the bottom of the base 14, which rests on the floor surface, that is greater than the depth of the portion of the body 12 behind (i.e., rearward of) the X-axis. This allows the body 12 to lay completely flat and not have the rear of the body 12 contact the floor surface before reaching the lay-flat position.

[0069] An upper end 80 of the base connector 66 has outwardly-facing collars 82, only one of which is visible in FIG. 8, that pivotally couple with pivot connectors 84 on the interior of the upright connector 68 at the lower end 70 of the frame 18. The axis Y can be defined by the collars 82. The upper end 80 of the base connector 66 can be

coupled to or formed with the lower end 76 of the base connector 66 and disposed generally above the lower end 76 in at least the upright storage position.

[0070] Wiring and/or conduits supplying electricity, data, and/or working air between the upright body 12 and the base 14 can extend though the joint assembly 26. For example, a recovery conduit 90 fluidly couples the suction nozzle 60 to the recovery tank 22 (FIG. 3) and forms a portion of the recovery path 48. The conduit 90, which may be alternatively referred to herein as a suction conduit since it defines a portion of the recovery path 48, can pass through the joint assembly 26. At least a portion of the conduit 90 can be flexible to accommodate the movement of the joint assembly 26 and can comprise a flexible tube or hose.

[0071] Referring to FIG. 9, the base 14 can include a base housing 92 and the suction nozzle 60. The suction nozzle 60, which may be formed integrally with the base housing 92 or separately from the base housing 92 and attached thereto, is preferably disposed at a leading or forward edge of the base 14, in front of the mopping pads 28. By "leading," the forward edge of the base 14 is the edge that leads the movement of the floor cleaner 10 as a user pushes the floor cleaner 10 from behind the floor cleaner 10, which defines the rear of the floor cleaner 10. The suction nozzle 60 may comprise a narrow, laterally-elongated (e.g., extending in the lateral direction) inlet opening for the recovery path 48.

[0072] The mopping pads 28 may be arranged in the lateral direction on an underside 94 of the base housing 92 to engage the surface below the base 14. In some embodiments, the pads 28 can project beyond the lateral sides of the base housing 92 to clean along walls, baseboards, cabinetry, furniture, etc. The pair of cleaning pads 28 can be independently rotated and may counter-rotate or rotate in the same direction.

[0073] The pads 28 can be mounted for rotation about substantially vertical axes 96, relative to the surface over which the base 14 moves. In being substantially vertical, the rotational axis 96 of the pads 28 can deviate up to 5 degrees from vertical, up to 10 degrees from vertical, or up to 15 degrees from vertical. The pad axes 96 may be parallel to each other or may be non-parallel to each other.

[0074] The pads 28 may comprise one or more different agitation or cleaning elements configured to mop or otherwise agitate the surface to be cleaned. The pads 28 are preferably absorbent to absorb liquid. Some non-limiting examples of materials for the mopping pads 28 comprise microfiber material, cloth, fabric, and the like. The pad 28 can be disc-shaped or have another shape.

[0075] In one aspect of the disclosure, the base 14 includes multiple wheels 98, 100 to facilitate movement of the floor cleaner 10, including but not limited to when the upright body 12 is in the lay-flat position (FIG. 5 and 7) and in the reclined use position. At least one wheel 98 is provided forward or "fore" of the pads 28 and at least one wheel 100 is provided rearward or "aft" of the pads 28. The fore and aft wheels 98, 100 and the pads 28 may collectively support the floor cleaner 10 on the floor in the reclined use position, the upright storage position, and/or the lay-flat position. When the floor cleaner 10 is placed on the floor, the pads 28 may compress until the wheels 98, 100 touch the floor.

[0076] The first or fore wheel 98 can comprise a set of support wheels forward of the pads 28, and optionally between the pads 28 and the suction nozzle 60. The support wheels 98 can rotate about a single axis 102, and in some embodiments comprise cylindrical rollers 104 mounted to a hub or on axle 106 that rotate about the axis 102. The axles 106 can be fixed to the base housing 92, with the rollers 104 rotating about axis 102.

[0077] The second or aft wheel 100 can comprise a set of casters rearward of the pads 28. The casters 100 can rotate about more than one axis, including swiveling freely to allow for easy turning of the base 14. In some embodiments, the casters 100 comprise cylindrical rollers 108 that rotate about a first axis 110 and that are mounted within a yoke assembly 112 that swivels about a second axis 114. The second axis 114 is preferably non-parallel to the first axis 110, and in one embodiment can be substantially perpendicular to the first axis 110. In the orientation of FIG. 9, the second axis 114 extends normal to the page.

[0078] When the upright body 12 is reclined or laying flat, the center of gravity of the floor cleaner 10 is shifted rearward relative to its center of gravity when upright. The provision of wheels 98, 100 fore and aft of the pads 28 helps prevent tilting of the base 14 in reclined positions, including in the lay-flat position This maintains consistent pad engagement with the surface to be cleaned, which improves consistency of agitation and therefore the cleaning performance of the floor cleaner 10, as well as stabilizing the load on the motor driving the pads 28.

[0079] Referring to FIG. 10, in one aspect of the disclosure, the base 14 comprises the supply tank 20, and the supply tank 20 forms a portion of the recovery path 48. In one embodiment, the portion of the recovery path 48 is a portion between the suction nozzle 60 and the recovery tank 22 and can define a suction conduit 116 between the suction nozzle 60 and the recovery tank 22. In an alternative embodiment, the portion of the recovery path 48 includes, in addition to the portion of the suction conduit 116, at least a portion of the suction nozzle 60.

[0080] In some embodiments, the supply tank 20 is removable from the base housing 92. Removal of the supply tank 20 also removes the portion of the recovery path 48, e.g., the portion of the suction conduit 116 formed by the supply tank 20. By forming a portion of the recovery path 48 with the supply tank 20, the recovery path 48 is easily accessible by removing the supply tank 20. This makes clean-out of the recovery path 48 after a cleaning operation easier and more convenient for the user. Clogs can be cleaned-out from the path 48, including from the suction nozzle 60, without having to invert the floor cleaner 10. This configuration can also reduce the

number of parts and cost associated with the floor cleaner 10.

[0081] Referring to FIGS. 10-11, the suction conduit 116 can be constructed as two mating halves 118, 120 (first half 118 and second half 120) that are coupled to one another by the installation of the tank 20 on the base housing 92. The supply tank 20 comprises the first mating half 118 and the base housing 92 comprises the second mating half 120. The second half 120 is closed by the first half 118 when the tank 20 is installed on the base housing 92. The first mating half 118 is removed from the second mating half 120 by the action of removing the tank 20 from the base housing 92. The second mating half 120 may remain with the base housing 92 in a state where the tank 20 is removed from the base housing 92.

[0082] While referred to herein as "halves," it is understood that each mating half 118, 120 may define more or less than half of the conduit 116, e.g., more or less than half of the volume of the conduit 116. In one embodiment, the first mating half 118 can comprise an upper conduit section defining at least a top of the conduit 116 and the second mating half 120 can comprise a lower conduit section defining at least a bottom of the conduit 116. The mating halves 118, 120 may together form the lateral sides of the conduit 116. In another embodiment, the mating halves 118, 120 may form other sections or sides of the conduit 116.

[0083] In one embodiment, a portion of the tank 20, such as, but not limited to a lower wall 122 of the tank 20, can form the first mating half 118. The supply tank defines a liquid storage volume, and a portion of the liquid storage volume of the supply tank 20 can surround one or more sides of the first mating half 118 to maximize the capacity of the tank 20 within the available space on the base 14. For example, portions of the lower wall 122 of the tank 20 can surround the first mating half 118, such that the suction conduit 116 is at least partially nested within the tank 20. The supply tank 20 may preferably span an upper side 124 of the base housing 92, including being disposed to both sides of the joint assembly 26.

[0084] The lower wall 122 can form an internally-facing surface of the tank 20 which is internal to the base 14 when the supply tank 20 is seated on the base housing 92. The internally-facing surface can confront the upper side 124 of the base housing 92. The first mating half 118 is therefore formed in the internally-facing surface of the tank 20, to be internal to the base 14 when the supply tank 20 is seated on the base housing 92.

[0085] The second mating half 120 is coupled with or formed by the base housing 92, such as, but not limited to, on the upper side 124 of the base housing 92. The second mating half 120 may protrude upwardly relative to the upper side 124. The liquid storage volume of the supply tank 20 can surround one or more sides of the second mating half 120 to maximize the capacity of the tank 20 within the available space on the base 14. For example, portions of the lower wall 122 of the tank 20 can confront the upper side 124, such that the suction conduit 116 is at least partially nested within the tank 20. The supply tank 20 may preferably include portions of the liquid storage volume disposed to both lateral sides of the second mating half 120.

[0086] The two mating halves 118, 120 have mating edges 126, 128, respectively. The mating edges 126, 128 may be curved, planar, and a combination thereof. The mating edges 126, 128 may include features to permit sealing to one another to minimize air and/or fluid leakage between the halves. For example, at least one of the mating edges 126, 128 may comprise a compressible seal 130. In the embodiment shown, the compressible seal 130 is provided on some or all of the mating edge 126 of the first mating half 118. As such, the compressible seal 130 is provided on the tank 20. In another example, the mating edges 126, 128 may comprise a tongue-and-groove construction, sealant bead, interference fit, or other sealing technique to provide the desired sealing effect with the mating halves 118, 120 mating together in a fluid-tight manner to prevent air from escaping through the interfaces between the mating halves 118, 120.

[0087] While it is to be appreciated that the use of two mating halves 118, 120 is a preferred way to form the conduit 116, the conduit 116 may be formed with other pluralities of conduit sections that cooperate in a similar fashion.

[0088] Referring to FIG. 12, the suction conduit 116 has a first or inlet end 132 configured to be in fluid communication with the suction nozzle 60 or a portion of the suction nozzle 60 and a second or outlet end 134 configured to be in fluid communication with recovery tank 22, optionally via the recovery conduit 90. The conduits 116, 90 can together define the portion of the recovery path 48 connecting the suction nozzle 60 with the recovery tank 22, with the conduit 90 being fluidly downstream of the conduit 116. The suction conduit 116 can decrease in cross-sectional area between the inlet end and the outlet end 134 to increase airflow speed.

[0089] The upstream suction conduit 116 is preferably rigid and the downstream recovery conduit 90 is preferably flexible to accommodate for movement of the joint assembly 26. However, at least a portion of the suction conduit 116 can be flexible and at least a portion of the recovery conduit 90 can be rigid in other configurations.

[0090] The second mating half 120 can form the inlet and outlet ends 132, 134 of the suction conduit 116, with the first mating half 118 closing the open top of the second mating half 120 between the inlet and outlet ends 132, 134 to form the top side of the conduit 116. In another embodiment, the mating halves 118, 120 may together form the inlet end 132 and outlet end 134 of the conduit 116. In yet another embodiment, the first mating half 118 can form the inlet and/or outlet ends 132, 134.

[0091] The suction nozzle 60 can have a narrow, laterally-elongated opening defining a suction inlet port 136 at a lower end thereof and a suction outlet port 138 at an upper end thereof. The suction nozzle 60 preferably narrows in lateral width between the suction inlet port

136 and the suction outlet port 138 with the suction outlet port 138 having a lateral width that is less than that of the suction inlet port 136.

[0092] The suction outlet port 138 couples with the inlet end 132 of the suction conduit 116. In one embodiment, the suction outlet port 138 is mated to or integral with the second mating half 120. Thus, the suction nozzle 60 remains with the base housing 92 in a state where the tank 20 is removed from the base housing 92 and is opened to user access via the exposure of the outlet port 138. This is convenient for cleaning clogs in the suction nozzle 60 and can also reduce weight of the floor cleaner 10. In another embodiment, the suction nozzle 60 can be formed at least in part by the supply tank 20, such that removal of the supply tank 20 from the base 14 can remove a portion of the suction nozzle 60.

[0093] Referring to FIG. 11, the supply tank 20 can include a fill closure 140 receivable in a fill inlet 142 of the tank 20. The fill closure 140 is removable from the fill inlet 142 to open the tank 20, for instance to fill the tank 20 with cleaning fluid or to empty the tank 20. Various fill closures are possible, such as a screw in cap or a resilient plug. In one configuration, the fill closure 140 may be blocked when the tank 20 is installed on the base housing 92, such that the tank 20 must be removed to access the fill closure 140. In another configuration, the supply tank 20 is fillable when installed on the base housing 92, and/or is a disposable component that can be replaced when the tank 20 is empty.

[0094] The supply tank 20 can include a tank outlet 144 for cleaning fluid, whereby cleaning fluid passes through the tank outlet 144 to the supply path 40 (FIG. 3). The tank outlet 144 can be formed in one of the walls of the tank 20 and may preferably be formed in the lower wall 122 to encourage the flow of fluid through the tank outlet 144.

[0095] The tank outlet 144 may be open or closed by an outlet valve 148. The valve 148 may be disposed inside the tank 20. The valve 148 can be configured to open when the supply tank 20 is mounted on the base housing 92 and to close when the supply tank 20 is removed from the base housing 92.

[0096] A valve receiver 150 can be formed in the base housing 92, such as in the upper side 124 for fluidly coupling with the outlet valve 148. The valve receiver 150 is in fluid communication with the pump 44 (FIG. 3).

[0097] The floor cleaner 10 can include a tank latch 152 to retain the supply tank 20 on the base housing 92. A hook-and-catch coupling may be provided to aid in mounting the supply tank 20 to the base housing 92. For example, the tank 20 can include one or more hooks 154 extending from the lower wall 122 which engage one or more hook catches 156 on the upper side 124 of the base housing 92. In one arrangement, the hook-and-catch coupling is disposed forwardly of the tank latch 152, such that, to install the tank 20, the hooks 154 are first inserted into the catches 156 and then the rear portion of the tank 20 is pivoted downwardly toward the base housing 92 to engage the latch 152.

[0098] To aid in alignment of the tank 20 on the base housing 92, the base housing 92 can optionally comprise one or more protruding alignment elements or projections 158 that are received within corresponding recesses 160 on the tank 20.

[0099] To remove the tank 20, the latch 152 is actuated and the tank 20 is pivoted forwardly to move the hooks 154 out of the engagement with the catches 156 as the tank 20 is lifted away from the base housing 92. During this, the latch 152 may function as a hand grip for manipulating and carrying the tank 20. Other arrangements for mounting and/or retaining the supply tank 20 on the base housing 92 are possible.

[0100] Referring to FIG. 13, a partially exploded view of the base 14 shows details of a mopping pad drive system according to one aspect of the disclosure. The mopping pads 28 are mounted on rotation plates or rotatable pad holders 162 on the underside 94 of the base housing 92. The pad holders 162 are operably coupled to the pad motor 62, which is mounted in the base housing 92, optionally below the supply tank 20. Drive shafts 164, which are operably connected to the pad motor 62, extend though the base housing 92 to couple with the pad holders 162.

[0101] The pad motor 62 rotates the two drive shafts 164 via a suitable transmission, such as a worm gear assembly 166 that rotates the pad holders 162, and thereby the pads 28. While a single pad motor 62 is shown herein, it is understood that the motorized agitation system can comprise multiple pad motors, each of which is operably coupled with one mopping pad 28 via a suitable transmission for rotation of the pad 28.

[0102] In one embodiment, the base housing 92 can include a lower base cover 168 and an upper base cover 170 coupled to the upper side of the lower base cover 168. The upper base cover 170 can include the upper side 124 of the base housing 92 and the supply tank 20 can mount on the upper base cover 170. The upper and lower rear housing covers 86, 88 (FIG. 8) can be attached to one or both of the upper and lower base covers 168, 170. Other configurations for the base housing 92 are possible, including a base housing with more or fewer covers.

[0103] The drive transmission, such as worm gear assembly 166, coupling the motor 62 to the drive shafts 164 can be at least partially enclosed within a drive casing, such as a gear box. The drive casing can, in some embodiments, be formed by the lower base cover 168 and a drive cover 174. The drive cover 174 can be fastened or otherwise affixed to the lower base cover 168 and is disposed beneath the upper base cover 170 and helps maintain proper alignment of the gear assembly 166 and motor 62 and reduces noise.

[0104] In some embodiments, the lower base cover 168 can include a base plate 176 and a side wall 178 extending upwardly from the base plate 176, and the base plate 176 and side wall 178 can define the drive casing. The drive cover 174 can be fastened or otherwise

secured on top of the side wall 178.

[0105] FIG. 13 also shows the fluid dispenser 38 of the floor cleaner 10 according to one aspect of the disclosure, which can comprise a fluid delivery nozzle delivering cleaning fluid to at an approximate center of at least one mopping pad 28. Multiple nozzles 38 can be disposed on the base 14. For example, a pair of nozzles 38, one for each pad 28, may be arranged in a lateral direction. While reference to multiple nozzles 38 and/or a pair of nozzles 38 is made throughout the disclosure, it is understood that the floor cleaner 10 may comprise a single fluid delivery nozzle 38 or more than two nozzles 38, unless otherwise noted.

[0106] The fluid delivery nozzle 38 delivers a cleaning fluid to a floor surface to be cleaned and may deliver cleaning fluid directly to a floor surface to be cleaned. Delivering cleaning fluid directly to a floor surface to be cleaned may include delivering cleaning fluid substantially directly to a floor surface to be cleaned. By "substantially directly," a portion of the cleaning fluid delivered by the nozzle 38 may encounter the pad holder 162 and/or pad 28.

[0107] In one aspect of the disclosure, the assembled mopping pad 28 and pad holder 162 can have at least one cleaning fluid passage for the passage of cleaning fluid from the fluid dispenser 38 through the assembled pad and pad holder 162 to the surface to be cleaned.

[0108] Referring to FIG. 14, the mopping pad 28 and the pad holder 162 can be circular in shape or disc-shaped, with the pad 28 having a center opening 180 that is aligned with a central hub 182 of the pad holder 162. The diameter of the center opening 180 in the pad 28 may be larger than the diameter of the hub 182. The outer diameter of the pad holder 162 may be smaller than the outer diameter of the pad 28.

[0109] Each pad holder 162 can include an outer body 184 in the form of a circular ring around the hub 182. A shaft coupler 186 for coupling with the drive shaft 164 (FIG. 13) may be provided at an upper side of the hub 182.

[0110] At least one, and preferably multiple, cleaning fluid passage openings 188 can be defined between the hub 182 and outer body 184. The hub 182 is positioned at a central region of the outer body 184 and may be spaced apart from an inner peripheral surface 190 of the outer body 184 by one or more ribs 192 connecting the hub 182 and the outer body 184. The plurality of passage openings 188 can be defined by a plurality of ribs 192.

[0111] In one example, the pads 28 comprise microfiber pads which can be removed for cleaning when the pads 28 become soiled. The soiled pads 28 can be laundered and re-used. The pads 28 may be used for more than one mopping session prior to being laundered. Alternatively, the pads 28 can comprise disposable mopping pads 28 for one-time or limited use.

[0112] Referring to FIG. 15, the pad holders 162 can include fasteners 194 for removable attachment of the pads 28, such as hook and loop fasteners as illustrated, or snaps or magnets for example. Thus, the pads 28 can be removed from the base 14 for cleaning or replacement.

[0113] FIG. 16 shows a fluid supply path in the base 14. In FIG. 16, portions of the base 14 are removed for clarity. The supply path in one embodiment includes a first supply conduit 196 connected to the valve receiver 150 (which couples with the supply tank, see FIG. 10), the pump 44 connected to the first supply conduit 196 at an inlet side of the pump 44, and a second supply conduit 198 connected to an outlet side of the pump 44. The second supply conduit 198 can supply cleaning fluid directly to fluid dispenser 38, or as shown herein, may supply cleaning fluid to a T-connector 200 that divides the cleaning fluid between a third supply conduit 202 and a fourth supply conduit 204, each of which supplies one nozzle 38. The T-connector 200, supply conduits 202, 204, and nozzles 38 can also form the supply path.

[0114] In one aspect of the disclosure, a portion of the fluid supply path can pass through the drive casing for the drive transmission of the pads 28, so that fluid can be dispensed close to at the center of the pads 28 without adding extra height to the base 14. For example, the nozzles 38 and/or conduits 202, 204 supplying the nozzles 38 can pass through the drive casing. The entrance for the fluid supply path can, for example, be formed in the side wall 178 of the drive casing and can be defined as a notched portion 206 in the side wall 178.

[0115] In the embodiment shown, the notched portion 206 accommodates the supply conduits 202, 204, with the nozzles 38 being disposed within the drive casing and inwardly of the notched portion 206. The nozzles 38 can be mounted to the lower base cover 168 and positioned to deliver cleaning fluid to at an approximate center of each mopping pad 28. In one aspect of the disclosure, the nozzles 38 can be at least partially disposed above the base plate 176 and/or within the side wall 178 defining the drive casing. The nozzles 38 are thus integrated with the pad drive assembly.

[0116] A plurality of clips 208 secure the nozzles 38 within the drive casing, such as to base plate 176 of the lower base cover 168 and stabilize the position of the nozzles 38 within the drive casing. The clips 208 can be flexible features on the lower base cover 168, with ends permanently molded to, or otherwise secured to, the lower base cover 168. Various other securing configurations for the nozzles 38 are possible.

[0117] FIG. 17 is a section view taken through line XVII-XVII of FIG. 1, showing a cleaning fluid passage through the mopping pad 28. Each nozzle 38 can include a discharge port 210. The discharge port 210 extends downward toward the pad holder 162 and is disposed to face the passage openings 188. Cleaning fluid sprayed through the discharge port 210 is directed toward and through the passage openings 188 in the pad holder 162. By dispensing liquid through the mopping pad 28 directly to the surface to be cleaned, the mopping pad 28 is more uniformly wetted and cleaning time can be reduced. This

fluid delivery configuration also improves streaking, e.g., uneven application and/or residual fluid left on the surface to be cleaned.

[0118] The pad holder 162 can have a curb 212 spaced radially from the passage openings 188 on the upper surface of the outer body 184. The curb 212 may be in the form of an annular ring, for example, on an inner periphery of the outer body 184. A lower end of the discharge port 210 may be disposed at a position lower than the curb 212 and higher than the ribs 192 (FIG. 14) to not interfere with the rotation of the pad holder 162. As an example, the lower end of the discharge port 210 may be disposed to protrude into a space between the curb 212 and the shaft coupler 186.

[0119] At least a portion of the nozzle 38 can extend through the lower base cover 168. A nozzle opening can be formed in the lower base cover 168, and the discharge port 210 can extend downward through the nozzle opening. Accordingly, an inlet portion of the nozzle 38 is above the lower base cover 168 and disposed inside the drive casing for the drive transmission (e.g., above the base plate 176 and below the drive cover 174), and an outlet portion of the nozzle 38 including the discharge port 210 is disposed below the lower base cover 168 and disposed outside the drive casing. With the discharge port 210 outside the drive casing, cleaning fluid sprayed through the discharge port 210 can be prevented from being drawn into the drive casing and/or drive transmission for the pads 28.

[0120] The discharge port 210 is spaced inwardly of the side wall 178 and/or notched portion 206, such that the discharge port 210 is positioned closer to the center of the rotating pad 28 and pad holder 162.

[0121] Since the pad holders 162 are rotating, some cleaning fluid discharged from the discharge port 210 may not pass through the passage openings 188 and may hit against the ribs 192 or another portion of the pad holder 162. With the discharge port 210 disposed below the lower base cover plate 168 and at a position lower than the curb 212 on the pad holder 162, a majority of the cleaning fluid may pass through the passage openings 188 and any cleaning fluid that hits against the ribs 192 or another portion of the pad holder 162 can move through the passage openings 188.

[0122] FIG. 18 is a perspective view showing the recovery tank 22 exploded from the upright body 12. The tank 22 can be mounted to the frame 18 in any configuration. In the present embodiment, the tank 22 is removable from the frame 18 for emptying and/or cleaning.

[0123] The upright body 12 comprises a tank socket or receiver 216 for receiving the recovery tank 22. As shown herein, in one embodiment the tank receiver 216 can be defined by an opening or cavity in portions of the frame 18. The tank receiver 216 can be provided on a front side of the frame 18, for installation of the tank 22 from the front of the floor cleaner 10.

[0124] The recovery tank receiver 216 can include a recovery tank support 218 on which the tank 22 rests and a ceiling 220 generally opposite the support 218. The recovery tank receiver 216 can have open front and lateral sides, such that front and lateral walls of the recovery tank 22 are visible and form external surfaces of the apparatus 10 when the tank 22 is seated in the receiver 216. With this configuration, a user can easily observe the contents of the tank 22 from various perspectives and with the upright body 12 in various reclined use positions.

[0125] According to one aspect of the disclosure, the recovery tank 22 is loaded from the top, e.g., the top of the recovery tank 22 is inserted into the tank receiver 216 first, followed by the insertion of the bottom of the recovery tank 22 into the tank receiver 216. The top-load recovery tank 22 minimizes the bulk and/or height of the frame 18, which improves access of the floor cleaner 10 under furniture and other low obstacles, including, but not limited to, in the lay-flat position in which the upright body 12 is substantially horizontal to the surface to be cleaned (see FIG. 5).

[0126] The recovery tank 22 has an upper or first end 222 and a lower or second end 224. In one aspect of the disclosure, the recovery tank 22 includes a hook 226 at the upper end 222 of the tank 22 and the tank receiver 216 includes a catch 228 configured to be engaged by the hook 226.

[0127] To help hold the tank 22 during installation or removal, the tank 22 can have a hand grip 217 on a side of the tank 22, such as on a front side of the tank 22. The hand grip 217 can be disposed between the upper end 222 and the lower end 224 of the tank 22, such that the grip 217 is in an approximate middle of the tank 22.

[0128] Referring to FIG. 19, in one configuration, the hook 226 can be connected to a portion of the tank 22 at a connected end and can have a free end 230 opposite thereof that can be at least partially inserted into the catch 228. The catch 228 can include a cavity 232 in a face of the frame 18 bounded by at least one surface, including a bottom surface or ledge 234. In the mounted position, the free end 230 of the hook 226 projects into the cavity 232 and engages the ledge 234.

[0129] The recovery tank 22 is secured into place via a latch or other fastening mechanism. In one aspect of the disclosure, the floor cleaner 10 includes a spring-loaded latch 236 at the lower end 224 of the tank 22 for securing the recovery tank 22 to the frame 18. While described herein as secured to the frame 18, it is understood that the recovery tank 22 is generally secured to a housing of the floor cleaner 10.

[0130] Referring to FIG. 20, the latch 236 releases a spring biased tab 238 from a slot 240 formed in the frame 18. A spring 242 biases the tab 238 toward the slot 240.

[0131] The latch 236 can be configured to releasably lock the recovery tank 22 to the upright body 12, such that a user must actuate the latch 236 before pulling the tank 22 off the frame 18. The latch 236 may have a user-engageable portion 244 operably coupled with the tab 238 whereby pressing the portion 244 up moves the tab

238 out of engagement with the slot 240. In the embodiment shown, the user-engageable portion 244 is a latch button exposed at the lower end 224 of the tank 22, although other configurations for the user-engageable portion 244 are possible.

[0132] In one embodiment, the latch 236 comprises a latch body 246 mounted for translating or sliding movement relative to the lower end 224 of the tank 22. The latch body 246 can include or be connected with the tab 238 and the user-engageable portion or latch button 244. The latch body 246 can, for example, translate generally vertically or slide along a vertical latch axis 247, resulting in vertical movement of the tab 238. The spring 242 can press against an upper side 248 of the latch body 246 to bias the latch body 246 downwardly in a direction toward the lower end 224 of the tank 22. The tab 238 and the user-engageable portion or latch button 244 can be provided on an opposing lower side or sides of the latch body 246.

[0133] The latch body 246 can be mounted for translating or sliding movement relative to the lower end of the tank 22 using a bracket 250. The bracket 250 can be secured to the lower end 224 of the tank 22 using screws (not shown) or other suitable fastening means. The bracket 250 can mount the latch body 246 such that the user-engageable portion 244 is exposed and available to a user. Pressing upwardly on the user-engageable portion 244 raises the latch body 246 relative to the bracket 250.

[0134] The slot 240 can be formed across first and second slotted brackets 252 that project forwardly of the bottom support 218 of the tank receiver 216. The brackets 252 are spaced apart to define a gap therebetween through which the user-engageable portion or latch button 244 can be accessed. The brackets 252 can be cantilevered members projecting from the bottom support 218.

[0135] The brackets 252 can have lead-in surfaces 253 that engage the tab 238 and initiate movement of the latch body 246 upward. The lead-in surfaces 253 can be angled upwardly toward the slot 240, such that the tab 238 rides up the lead-in surfaces 253 before dropping into the slot 240.

[0136] The latch 236 facilitates the removable connection of the recovery tank 22 to the upright body 12. When the recovery tank 22 is removed for emptying and/or cleaning, a user depresses the latch 236 causing the tab 238 to release from the slot 240 in the frame 18. Emptying and/or cleaning of the tank 22 may entail removal of debris from the tank 22 by lifting a lid 294 off the tank 22 and/or inverting the tank 22 to dispose of collected debris therein.

[0137] Referring to FIG. 21, to mount the recovery tank 22 to the frame 18, the tank 22 is held in one hand by the grip 217 and the upper end 222 of the tank is tilted toward the receiver 216 at an angle at which the hook 226 can be engaged with the catch 228. Then, the lower end 224 of the tank 22 is rotated toward the receiver 216 until the latch 236 engages, e.g., the tab 238 is received in the slot 240. One example of the installed position of the tank 22 is shown in FIG. 19.

[0138] To aid in insertion of the recovery tank 22 from the top, the recovery tank 22 may have an angled bottom surface 254. The bottom surface 254 angles upwardly toward a rear wall 256 of the tank receiver 216. The rear wall 256 can generally extend between the bottom tank support 218 and the ceiling 220. The recovery tank support 218 of the tank receiver 216 can have a complementary angled surface 258.

[0139] The angled bottom surface 254 can extend across a portion of the bottom of the recovery tank 22 or across the entire bottom of the recovery tank 22. In the embodiment shown, the bottom of the recovery tank 22 includes flat sections 260 on opposing sides of the angled bottom surface 254. The flat sections 260 provide the recovery tank 22 with a substantially flat bottom end on which the tank 22 can be supported in a standing position on a surface when it is removed from the floor cleaner 10. Optionally, feet 262 can be provided on the flat sections 260 to support the tank 22 in the standing position.

[0140] A seal 264 can be disposed on the angled bottom surface 254, the seal 264 surrounding a recovery path port 266 in fluid communication with the recovery conduit 90. The seal 264 presses against the bottom of the recovery tank 22 to create a fluid-tight interface between the recovery path port 266 and an inlet 268 to the tank 22 (e.g., inlet to standpipe 274).

[0141] Referring to FIG. 19, the recovery tank 22 can include a recovery tank container 270, which forms a collection chamber 272 for the recovery system, with a hollow standpipe 274 therein. The standpipe 274 can be oriented such that it extends generally upwardly within the tank container 270 in the mounted position of the tank 22. The standpipe 274 forms a flow path between the tank inlet 268 formed at a lower end of the tank container 270 and an opening 276 at the upper end of the standpipe 274 within the interior of the tank container 270. When the recovery tank 22 is mounted to the frame 18 as shown in FIG. 19, the inlet 268 is aligned with the port 266 to establish fluid communication between the base 14 (FIG. 4) and the recovery tank 22. The standpipe 274 can be integrally formed with the tank container 270 or may be separately formed and attached thereto.

[0142] FIG. 22 is a partially exploded perspective view of one embodiment of the recovery tank 22. A filter assembly 278 is removably attached to the first end 222 of the recovery tank 22. The filter assembly 278 includes a filter cage 280 and a filter medium 282 within the filter cage 280. In this embodiment, the filter medium 282 can be made of a foam material, a pleated material, a porous cloth, or similar conventional material which can be inserted into or otherwise secured to the cage 280.

[0143] The tank 22 can include a separator in the form of a baffle 284 configured to separate debris from a working air stream entering the recovery tank 22. The baffle 284 is a diverter or other deflecting feature that

guides the working air stream towards the interior tank volume or collection chamber 272, for example to the rear and/or lateral side of the tank 22, where the velocity of the working air stream decreases such that at least some debris is separated out of the working air stream and collected in the collection chamber 272. The baffle 284 may include at least one wall that redirects the working air stream entering the bottom of the tank 22 to enter the collection chamber 272 horizontally.

[0144] As shown in FIG. 19, the baffle 284 can be aligned with the outlet opening 276 at the upper end of the standpipe 274, which that the working air stream exiting the standpipe 274 encounters the baffle 284 before being diverted into the collection chamber 272.

[0145] Referring to FIGS. 19 and 22, the tank 22 can include an exhaust grill 286 separating the interior tank volume or collection chamber 272 from the filter assembly 278. The exhaust grill 286 can at least partially surround the baffle 284 and comprises a plurality of vanes or louvers 288 that encourage separation of debris from the working air. The louvers 288 can extend longitudinally within the chamber 272 and are spaced from each other to define air gaps defining inlets leading to the interior of the grill 286. In one configuration, the louvers 288 can be vertically-oriented and extend generally parallel to a central axis 292 of the tank 22, where the central axis 292 is defined by the standpipe 274. It is noted that while the recovery tank 22 shown herein includes both baffle 284 and exhaust grill 286, in other embodiments, the tank 22 may include the baffle 284 only, the exhaust grill 286 only, or other separation means.

[0146] The recovery tank 22 can include a lid 294 sized for receipt on the tank container 270. The lid 294 at least partially encloses an open top of the tank container 270 and can further define an air outlet 296 of the recovery tank 22 leading to the downstream suction source 54 (FIG. 19).

[0147] The lid 294 can include the hook 226, with the hook 226 extending upwardly from the lid 294 and the free end 230 disposed above the air outlet 296.

[0148] The filter assembly 278 is downstream of the baffle 284 and/or grill 286 for separation of finer debris from the working air stream. The filter assembly 278 may in particular be provided on a downstream side of the air outlet 296. The air outlet 296 can be disposed within and/or defined by a filter receiver 298 of the lid 294.

[0149] The baffle 284 and exhaust grill 286 can be coupled with the lid 294 for removal therewith from the tank container 270. The tank lid 294 can include a support structure that holds the baffle 284 and grill 286 and may also include the filter receiver 298 that supports the filter assembly 278. Removal of the lid 294 to empty the container 270 thereby removes the baffle 284, grill 286, and filter assembly 278. The lid 294 may be further disassembled for cleaning of the baffle 284, grill 286, and filter assembly 278.

[0150] Referring to FIG. 19, a lower portion of the baffle 284 and/or grill 286 can comprise a standpipe receiver 300 that mates with an upper portion of the standpipe 274 when the lid 294 is seated on the container 270.

[0151] In operation, working air enters the recovery tank via the standpipe 274, and is deflected by the baffle 284 towards the interior tank volume or collection chamber 272, where the velocity of the working air stream decreases such that at least some debris is separated out of the working air stream and collected in the collection chamber 272. The working air stream, which is now substantially free of debris but may contain at least some fine (e.g., small) debris, next passes between the louvers 288 of the grill 286 and exits the tank 22 by passing through the filter assembly 278, which collects fine debris.

[0152] Referring to FIG. 3, in one aspect of the disclosure, the floor cleaner 10 can have a plurality of modes of operation, such as multiple, user-selectable cleaning modes. In one embodiment, the floor cleaner 10 has a vacuum/mop mode, a vacuum mode, and a mop mode. The cleaning mode can be selected via the UI 34 (FIG. 1), which can have at least one input control, alternatively multiple input controls, for selecting a cleaning mode. The cleaning modes can have associated operating parameters for the heater 42, pump 44, vacuum motor 56, and/or pad motor 62, such that execution of a cleaning mode will operate those components according to the associated operating parameters. The UI 34 can output status information regarding the selected cleaning modes to the user.

[0153] In the vacuum/mop mode, the floor cleaner 10 performs vacuuming and mopping at the same time, providing a one-step cleaning operation for floors. In one embodiment of the vacuum/mop mode, at least the pump 44, vacuum motor 56, and pad motor 62 are activated, such that suction is applied at the suction nozzle 60 while the pads 28 rotate and cleaning fluid is dispensed from the fluid dispenser 38. The heater 42 may, in some embodiments, also be activated.

[0154] In the vacuum mode, the floor cleaner 10 performs vacuuming only. In one embodiment of the vacuum mode, at least the vacuum motor 56 is activated, such that suction is applied at the suction nozzle 60. Cleaning fluid is not dispensed. The pads 28 may still rotate in the vacuum mode or may not rotate. Accordingly, the pad motor 62 may be activated in some embodiments of the vacuum mode.

[0155] In the mop mode, the floor cleaner 10 performs mopping only. In one embodiment of the mop mode, at least the pump 44 and pad motor 62 are activated, such that the pads 28 rotate and cleaning fluid is dispensed from the fluid dispenser 38. The heater 42 may, in some embodiments, also be activated. The vacuum motor 56 is not activated.

[0156] In the vacuum/mop and mop modes, the release of cleaning fluid can be automatic. Alternatively, release of cleaning fluid can be manually controlled by a trigger (not shown).

[0157] It is noted that throughout the figures, the floor

cleaner 10 is illustrated as an upright device. However, it is understood that the functional systems of the floor cleaner 10 can be arranged in other desired configurations, such as an upright device having a base and an upright body for directing the base across the surface to be cleaned, a portable device adapted to be hand carried by a user, a canister device having a cleaning implement connected to a wheeled base by a vacuum hose, an autonomous or robotic device having an autonomous drive system and an autonomously moveable housing, or a commercial device. Any of the aforementioned cleaners can be adapted to include a flexible vacuum hose, which can form a portion of a conduit between a nozzle and a suction source.

[0158] The terms "comprising" or "comprise" are used herein in their broadest sense to mean and encompass the notions of "including," "include," "consist(ing) essentially of," and "consist(ing) of. The use of "for example," "e.g.," "such as," and "including" to list illustrative examples does not limit to only the listed examples. Thus, "for example" or "such as" means "for example, but not limited to" or "such as, but not limited to" and encompasses other similar or equivalent examples.

[0159] The above description relates to general and specific embodiments of the disclosure. However, various alterations and changes can be made without departing from the scope as defined in the appended claims. As such, this disclosure is presented for illustrative purposes and should not be interpreted as an exhaustive description of all embodiments of the disclosure or to limit the scope of the claims to the specific elements illustrated or described in connection with these embodiments. Any reference to elements in the singular, for example, using the articles "a," "an," "the," or "said," is not to be construed as limiting the element to the singular.

[0160] Likewise, it is also to be understood that the appended claims are not limited to express and particular compounds, compositions, or methods described in the detailed description, which may vary between particular embodiments that fall within the scope of the appended claims. With respect to any Markush groups relied upon herein for describing particular features or aspects of various embodiments, different, special, and/or unexpected results may be obtained from each member of the respective Markush group independent from all other Markush members. Each member of a Markush group may be relied upon individually and or in combination and provides adequate support for specific embodiments within the scope of the appended claims.

Claims

1. A surface cleaning apparatus (10), comprising:

a base (14) comprising a base housing (92);
an upright body assembly (12) pivotally attached to the base (14);
a supply tank (20) removably mounted on the base housing (92);
a recovery system comprising a recovery path (48), a suction nozzle (60), a recovery tank (22), and a suction source (54);
wherein a portion of the recovery path (48) is formed by a bottom wall (122) of the supply tank (20); and
wherein removal of the supply tank (20) from the base housing (92) removes the portion of the recovery path (48).

2. The surface cleaning apparatus (10) of claim 1, wherein the bottom wall (122) of the supply tank (20) forms a portion of the recovery path (48) that:

extends from the suction nozzle (60) to the recovery tank (22); and/or
is fluidly downstream of the suction nozzle (60) and fluidly upstream of the recovery tank (22).

3. The surface cleaning apparatus (10) of any one of claims 1-2, wherein the recovery path (48) comprises a suction conduit (116) between the suction nozzle (60) and the recovery tank (22), and the bottom wall (122) of the supply tank (20) forms a portion of the suction conduit (116).

4. The surface cleaning apparatus (10) of claim 3, wherein the suction conduit (116) comprises a first mating half (118) and a second mating half (120), and the supply tank (20) comprises the first mating half (118), wherein removal of the supply tank (20) from the base housing (92) removes the first mating half (118) of the suction conduit (116) and the second mating half (120) remains with the base housing (92), and optionally comprising a compressible seal (130) between the first mating half (118) and the second mating half (120)..

5. The surface cleaning apparatus (10) of claim 4, wherein the first mating half (118) comprises an upper conduit section defining at least a top of the suction conduit (116) and the second mating half (120) comprises a lower conduit section defining at least a bottom of the suction conduit (116).

6. The surface cleaning apparatus (10) of claim 4, wherein the supply tank (20) defines a liquid storage volume, and a portion of the liquid storage volume can surround a portion of the first mating half (118).

7. The surface cleaning apparatus (10) of any one of claims 1-6, wherein the base housing (92) comprising an upper side (124), the supply tank (20) comprises at least one an externally-facing surface that forms an external surface of the base (14), and the bottom wall (122) comprises an internally-facing sur-

face that forms an internal surface of the base (140) and confronts the upper side (124) of the base housing (92).

8. The surface cleaning apparatus (10) of any one of claims 1-7, comprising:

a hook-and-catch coupling between the supply tank (20) and the base housing (92), the hook-and-catch coupling comprising hooks (152) on the supply tank (20) and catches (156) on the base housing (92); and
a tank latch (152) to retain the supply tank (20) on the base housing (92);
wherein the hook-and-catch coupling is disposed forwardly of the tank latch (152).

9. The surface cleaning apparatus (10) of any one of claims 1-8, comprising a joint assembly (26) connecting the base (14) to the upright body assembly (12) for movement of the upright body assembly (12) about at least one axis (X, Y), wherein the surface cleaning apparatus (10) comprises a lay-flat position in which an angle (A) between the base (14) and the upright body assembly (12) is substantially 180 degrees.

10. The surface cleaning apparatus (10) of any one of claims 1-9, comprising at least one mopping pad (28) disposed on an underside of the base (14), optionally wherein the suction nozzle (60) is disposed at a forward edge of the base (14), in front of the at least one mopping pad (28).

11. The surface cleaning apparatus (10) of claim 10, comprising a fluid dispenser (38) provided on the base (14) above the at least one mopping pad (28), the fluid dispenser (38) in fluid communication with the supply tank (20) via a fluid delivery pathway (40), wherein the fluid dispenser (38) comprises at least one distributor outlet configured to spray fluid toward a surface to be cleaned through a cleaning fluid passage (188) in the at least one mopping pad (28); and
optionally comprising at least one rotatable pad holder (162) provided on the base housing (92), wherein the at least one mopping pad (28) is provided on the at least one rotatable pad holder (162) for rotation therewith and the cleaning fluid passage (188) extends through the at least one rotatable pad holder (162), and a drive motor (62) operably coupled with the at least one rotatable pad holder (162) for rotation of the at least one rotatable pad holder (162) and the at least one mopping pad (28).

12. The surface cleaning apparatus (10) of any one of claims 10-11, wherein the base (14) comprises a plurality of wheels (98, 100) facilitating movement of the surface cleaning apparatus (10) over a surface to be cleaned, wherein the plurality of wheels comprises at least one first wheel (98) forward of the at least one mopping pad (28) and at least one second wheel (100) rearward of the at least one mopping pad (28).

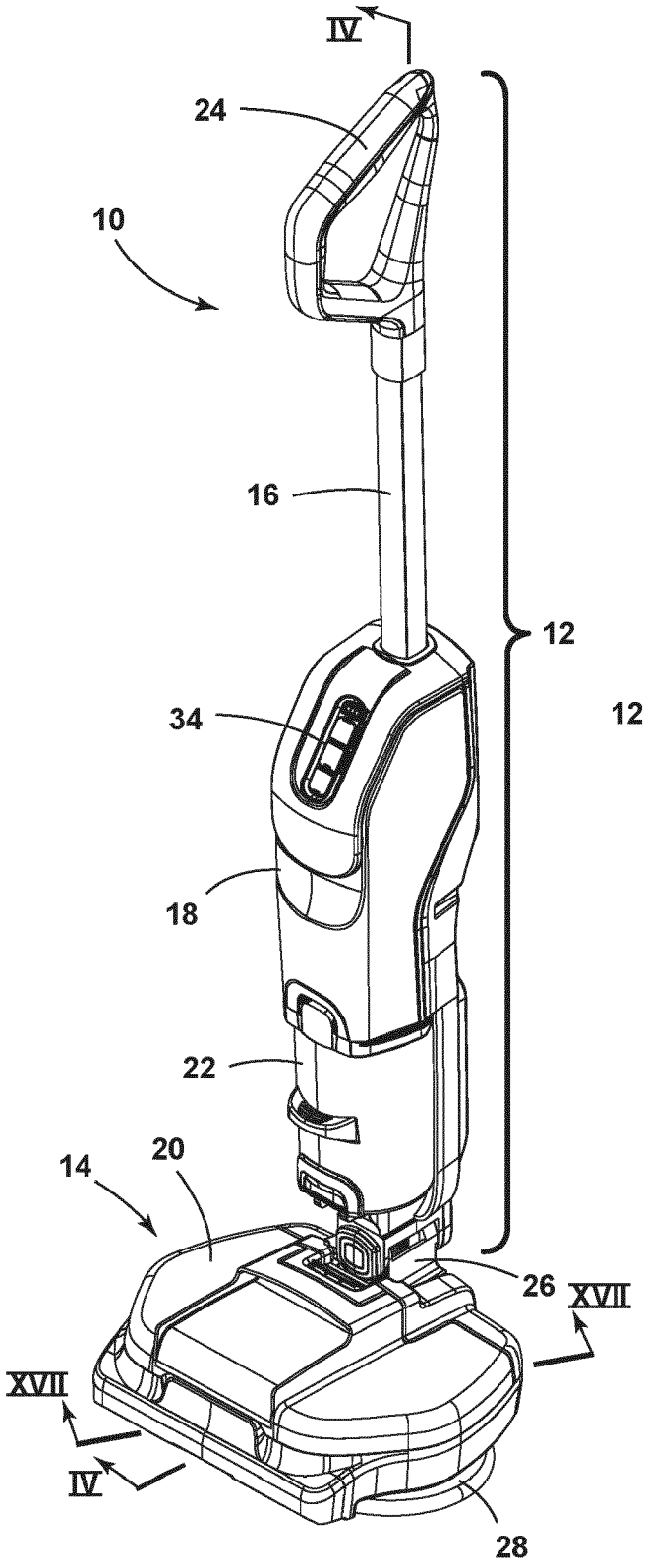
13. The surface cleaning apparatus (10) of any one of claims 1-12, wherein the upright body assembly (12) comprises a tank receiver (216), the recovery tank (22) comprises an upper end (222) and a lower end (224), and the recovery tank (22) is mountable to the upright body assembly (12) via the tank receiver (216), the upper end (222) of the recovery tank (22) being insertable into the tank receiver (216) followed by insertion of the lower end (224).

14. A surface cleaning apparatus (10), comprising:

a base (14);
an upright body assembly (12) pivotally attached to the base (14);
at least one mopping pad (28) on a lower side of the base (14); and
a plurality of wheels (98, 100) on the lower side of the base (14) facilitating movement of the surface cleaning apparatus (10) over a surface to be cleaned, wherein the plurality of wheels comprises:

at least one first wheel (98) forward of the at least one mopping pad (28); and
at least one second wheel (100) rearward of the at least one mopping pad (28);
wherein the at least one second wheel (100) comprises a caster that rotates about a first axis (110) and swivels about a second axis (114) that is non-parallel to the first axis (110).

15. The surface cleaning apparatus (10) of claim 14, comprising a joint assembly (26) connecting the base (14) to the upright body assembly (12) for movement of the upright body assembly (12) about at least one axis (X, Y), wherein the surface cleaning apparatus (10) comprises a lay-flat position in which an angle (A) between the base (14) and the upright body assembly (12) is substantially 180 degrees, wherein the at least one first wheel (98), the at least one second wheel (100), and the at least one mopping pad (28) are in contact with the surface to be cleaned in the lay-flat position.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XVII
XVII
IV
28

FIG. 1

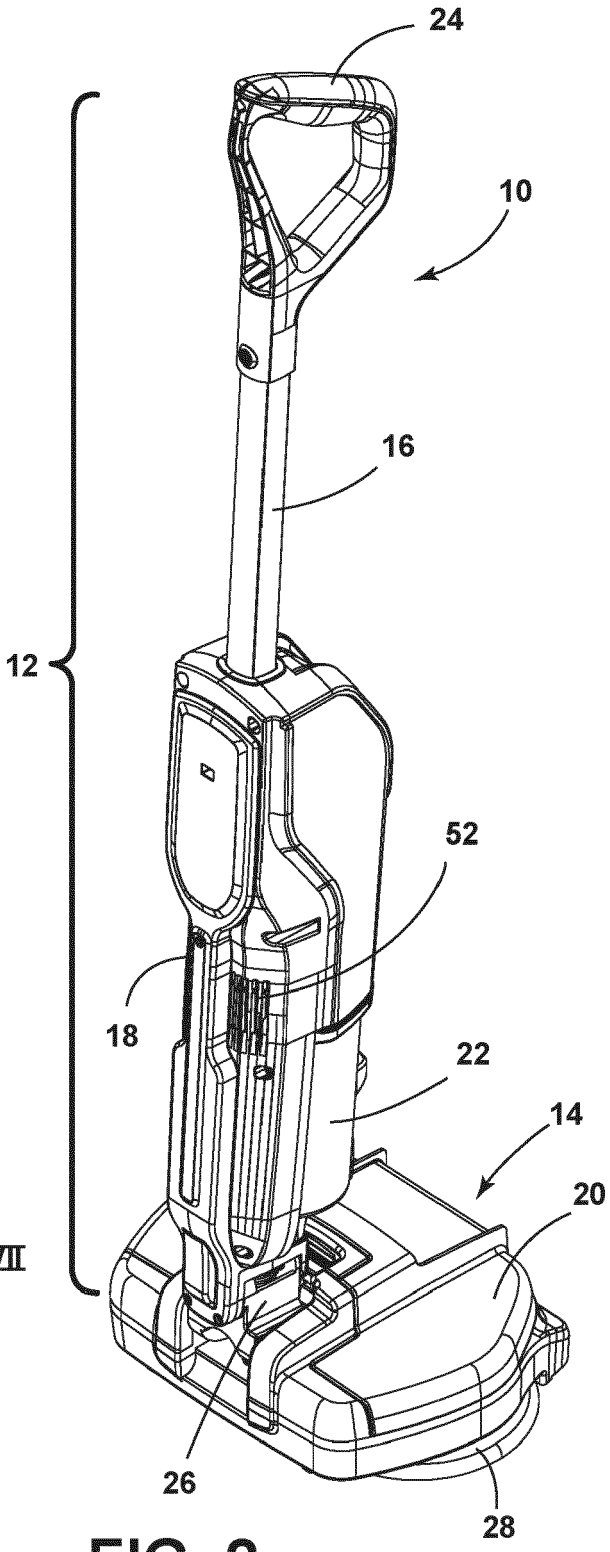
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FIG. 2

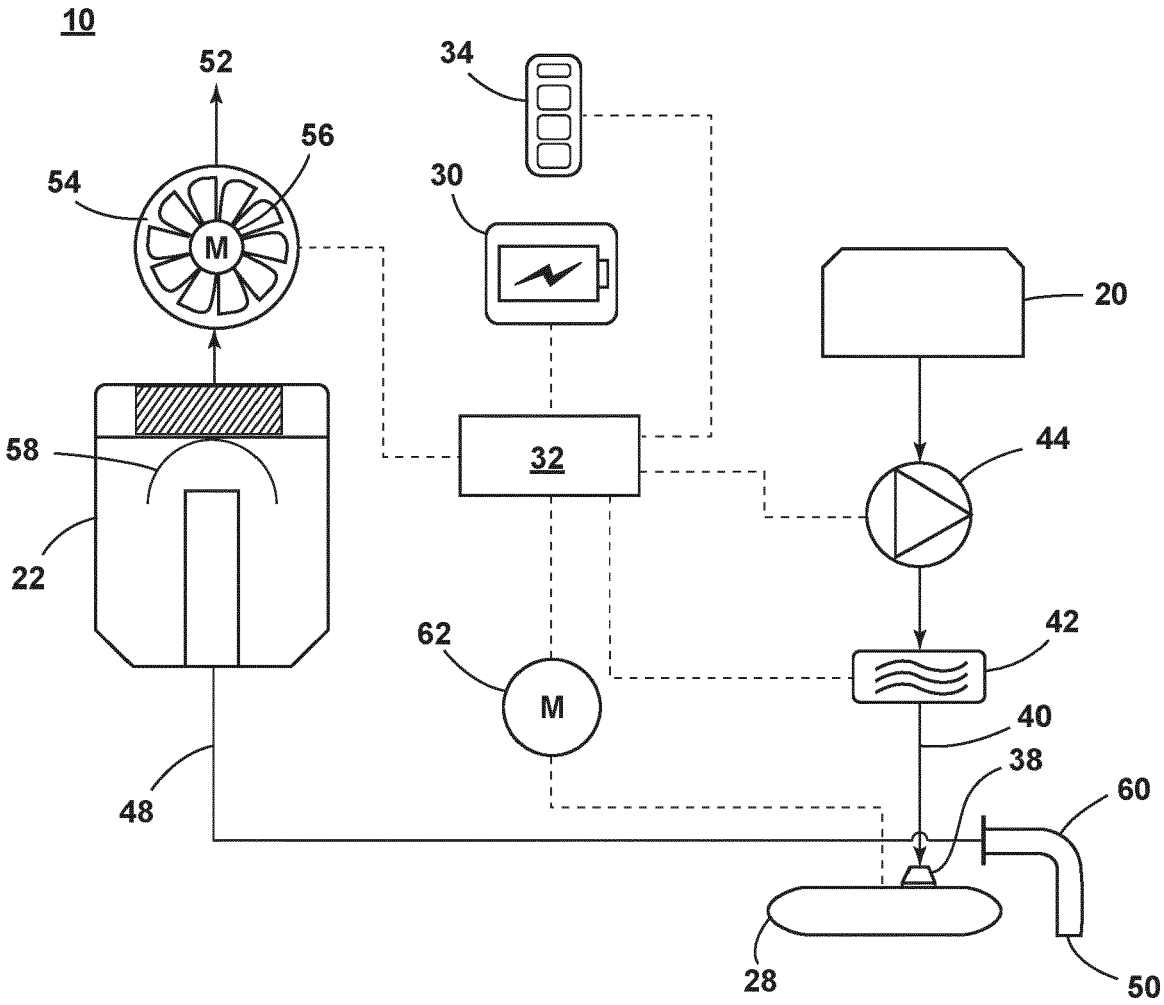

FIG. 3

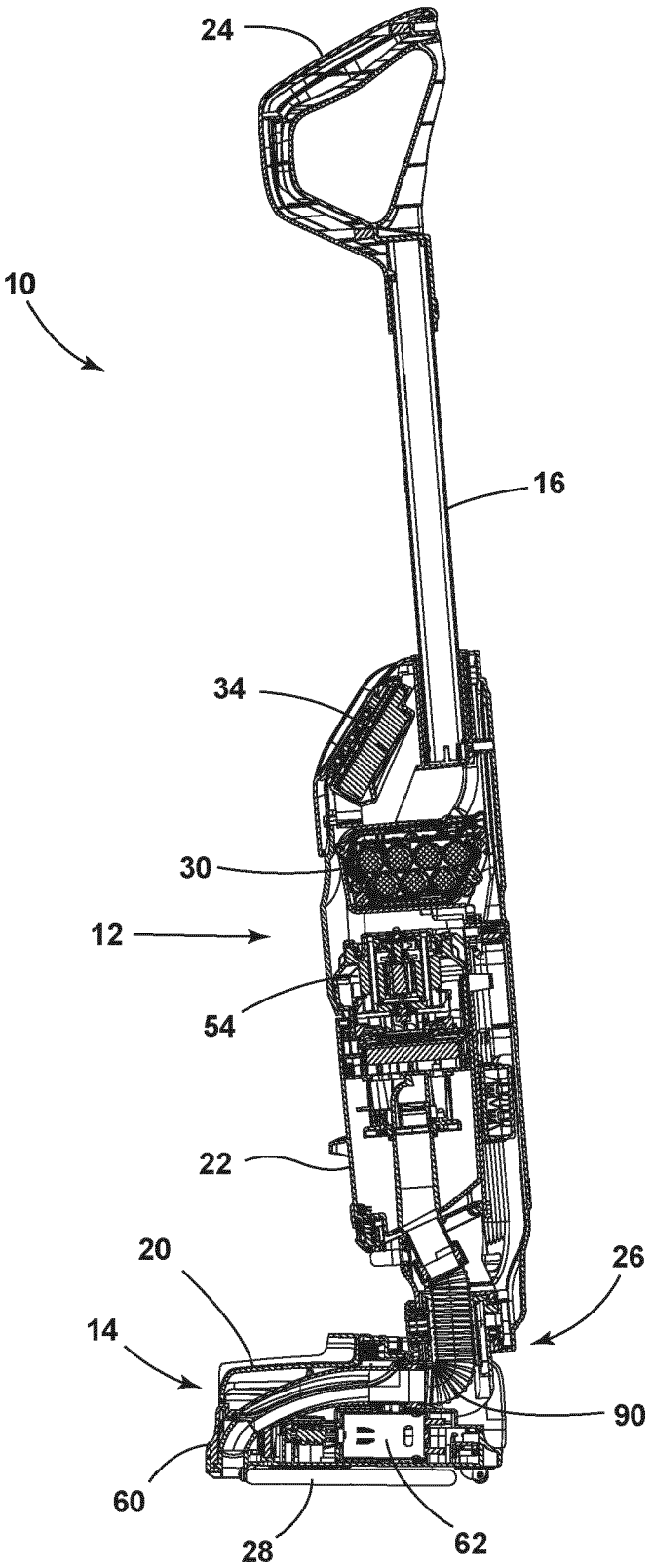

FIG. 4

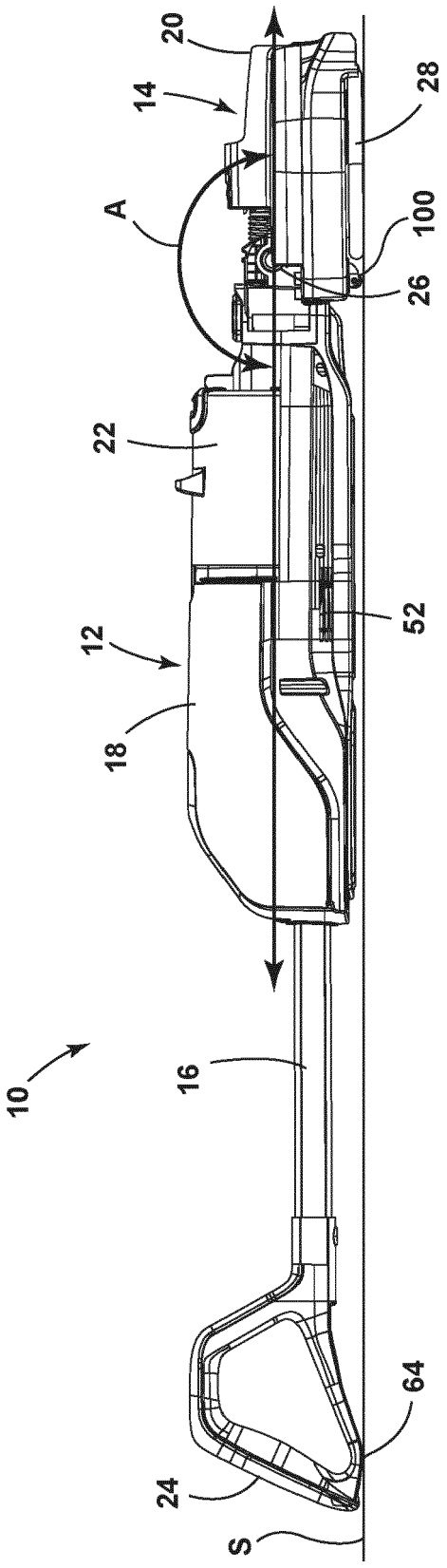

FIG. 5

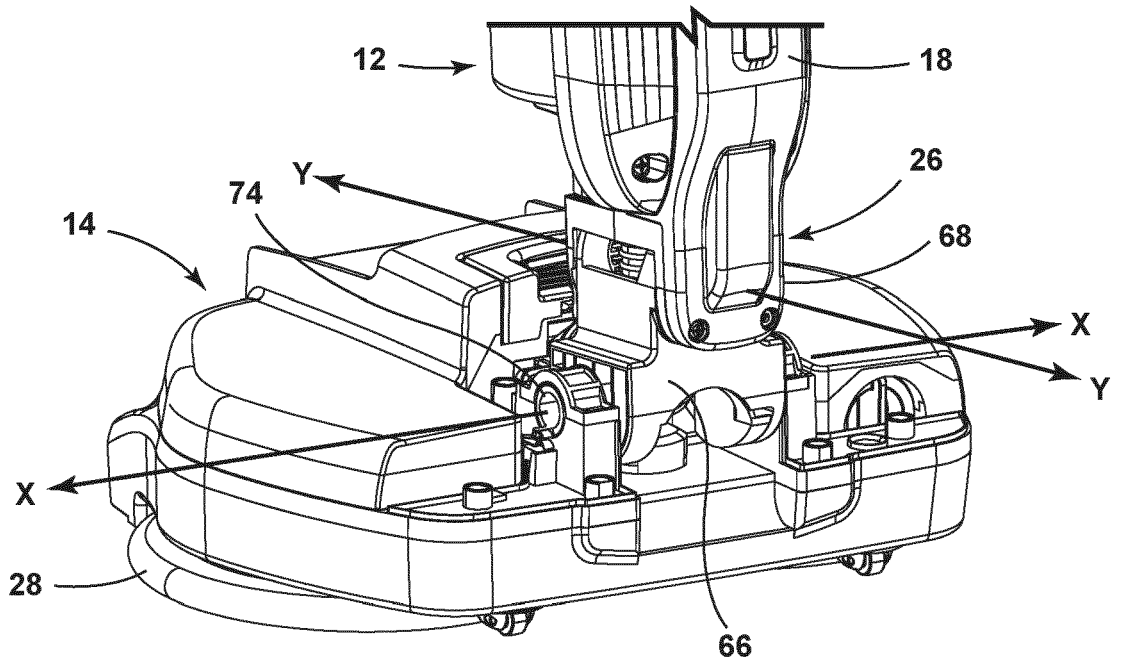

FIG. 6

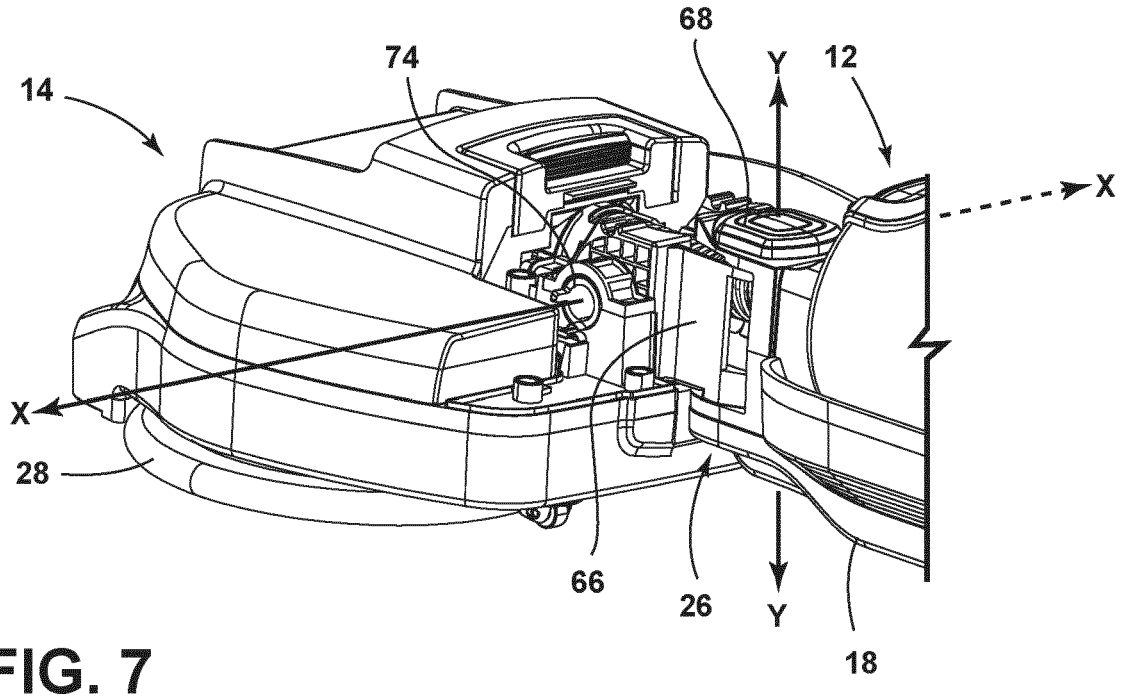

FIG. 7

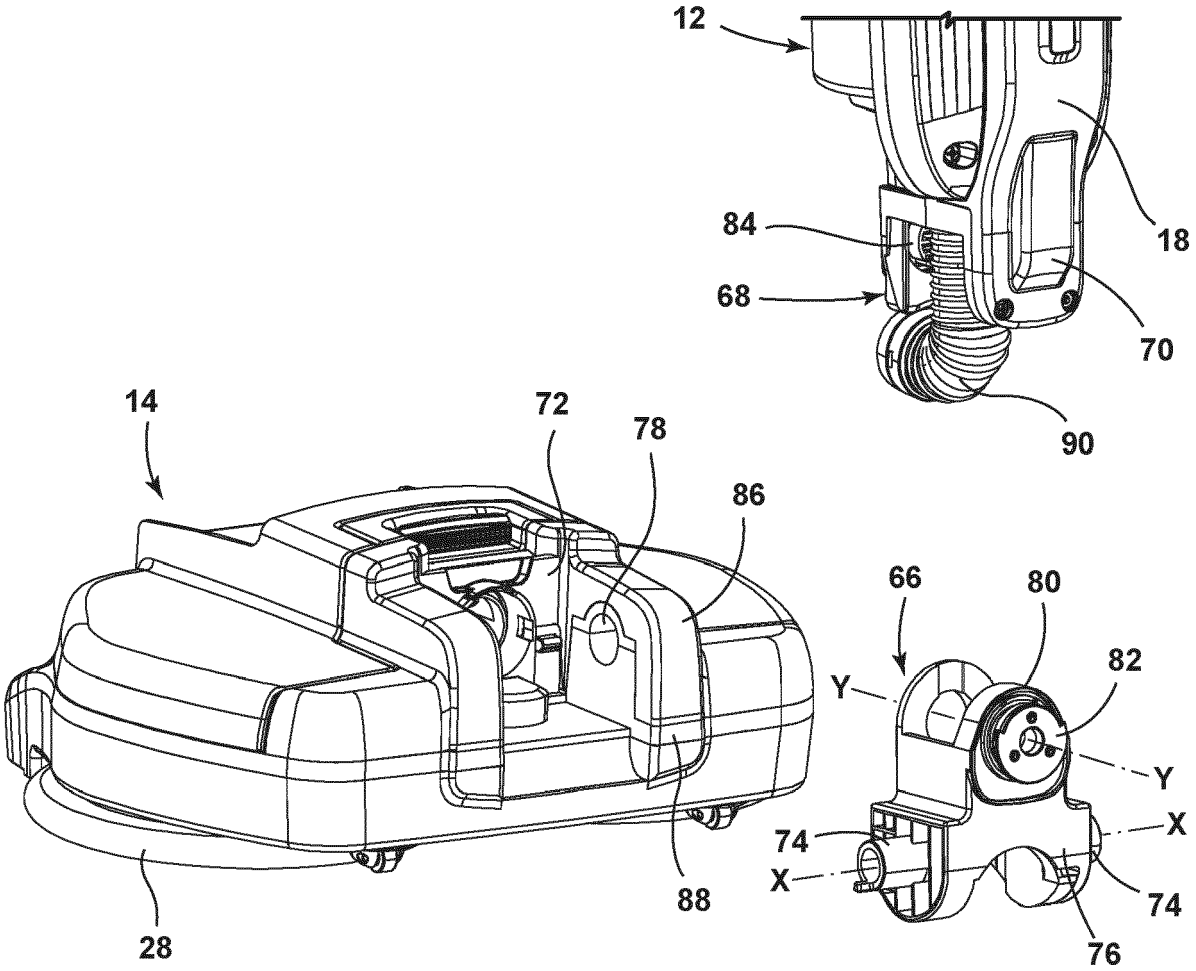

FIG. 8

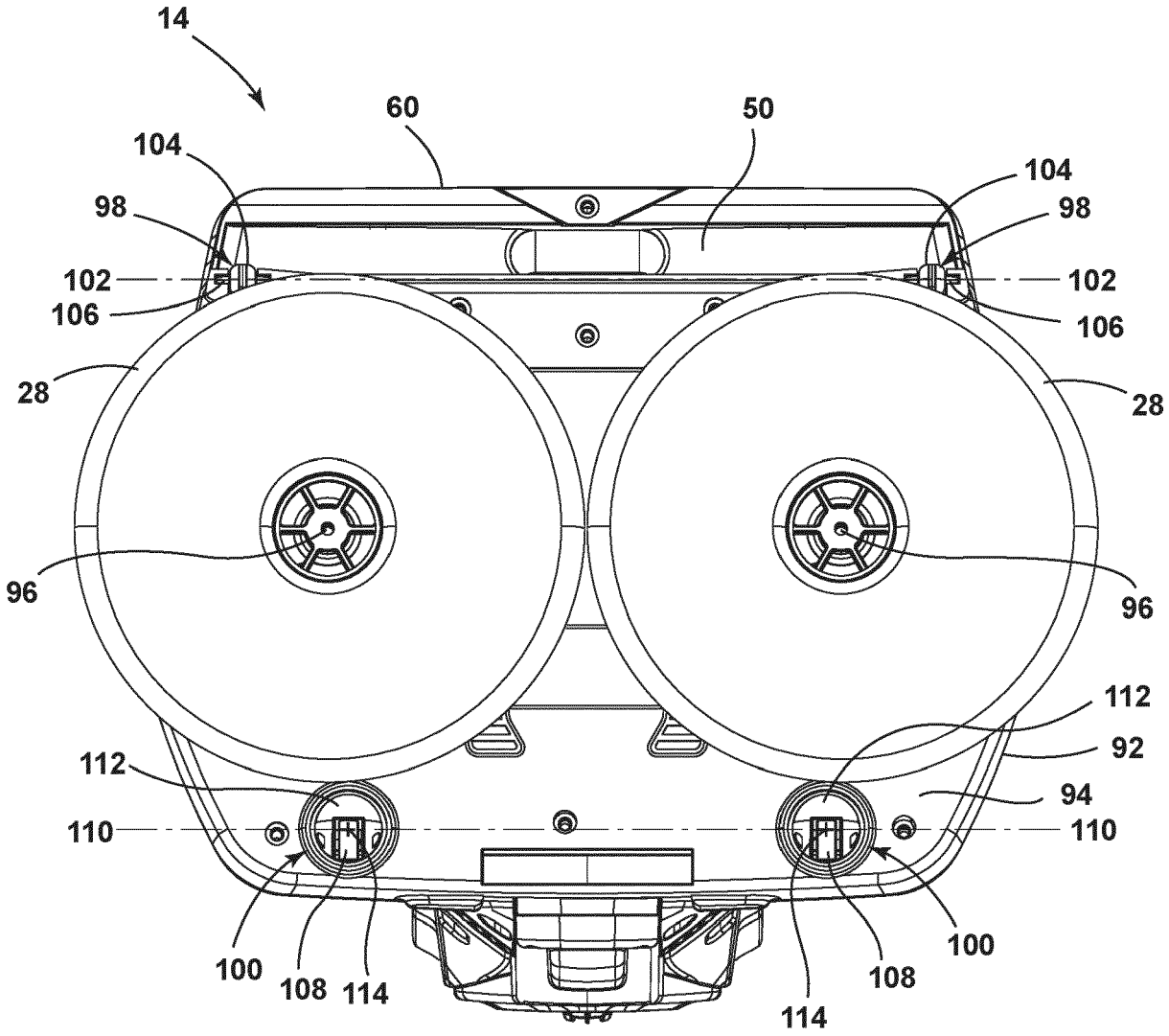
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FIG. 9

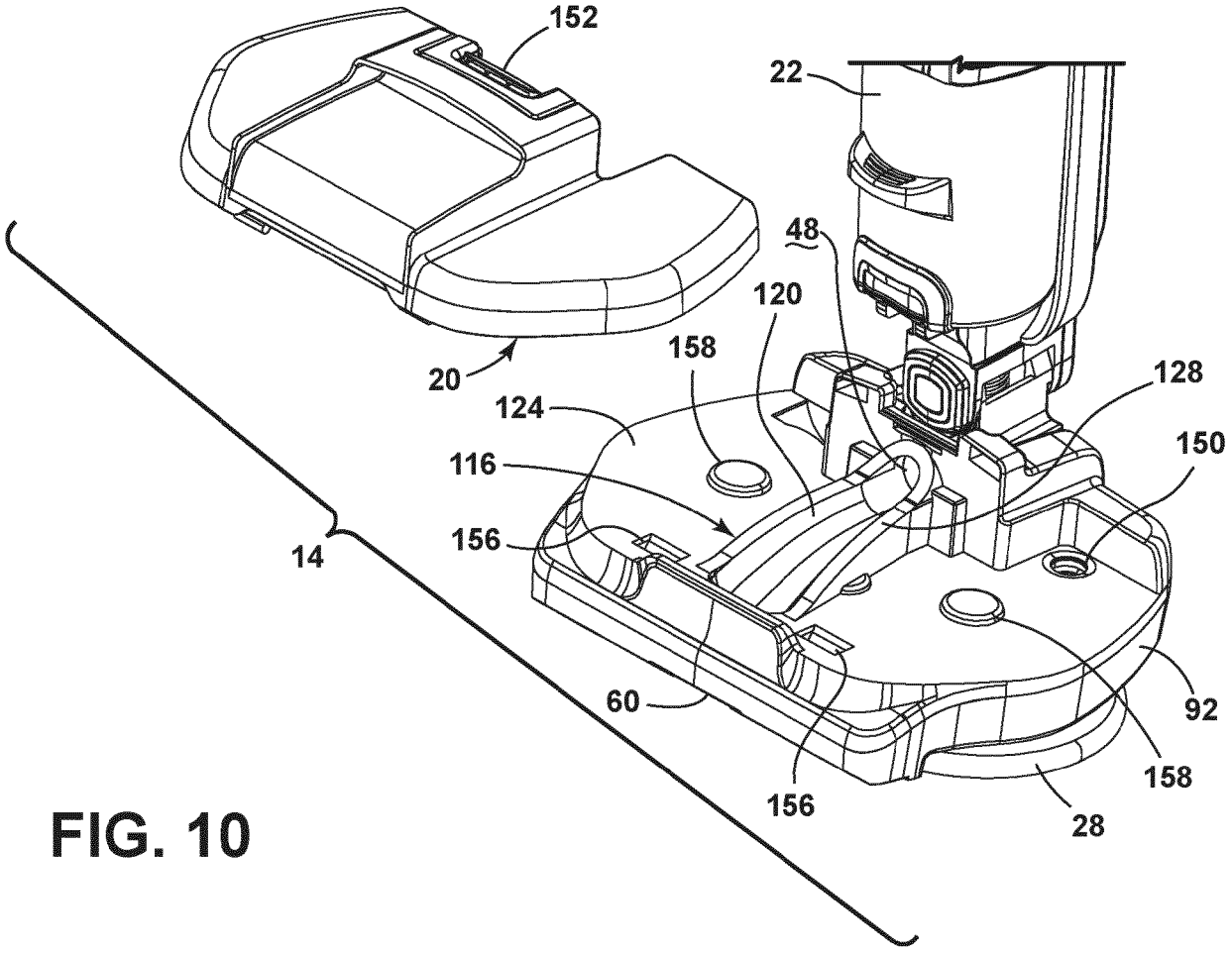
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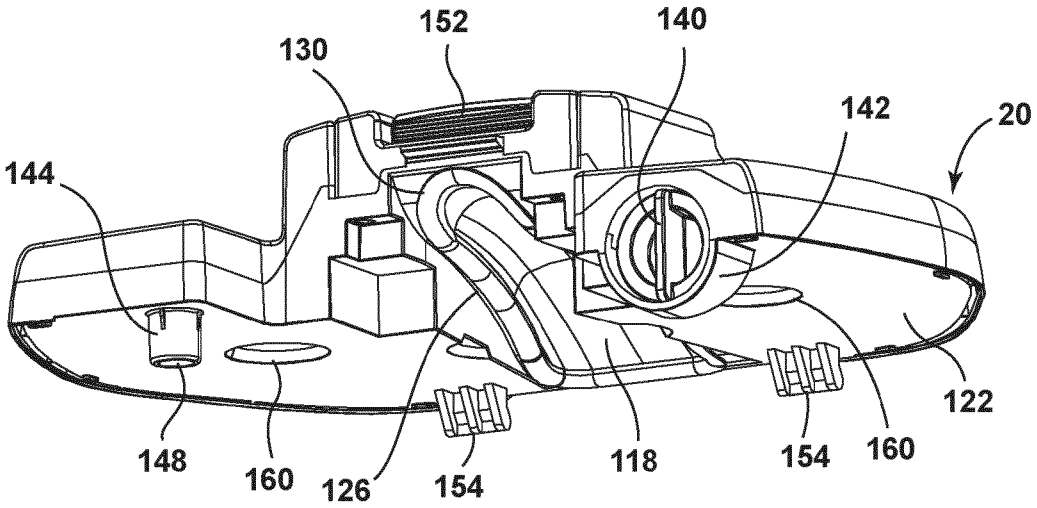
FIG. 10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122

FIG. 11

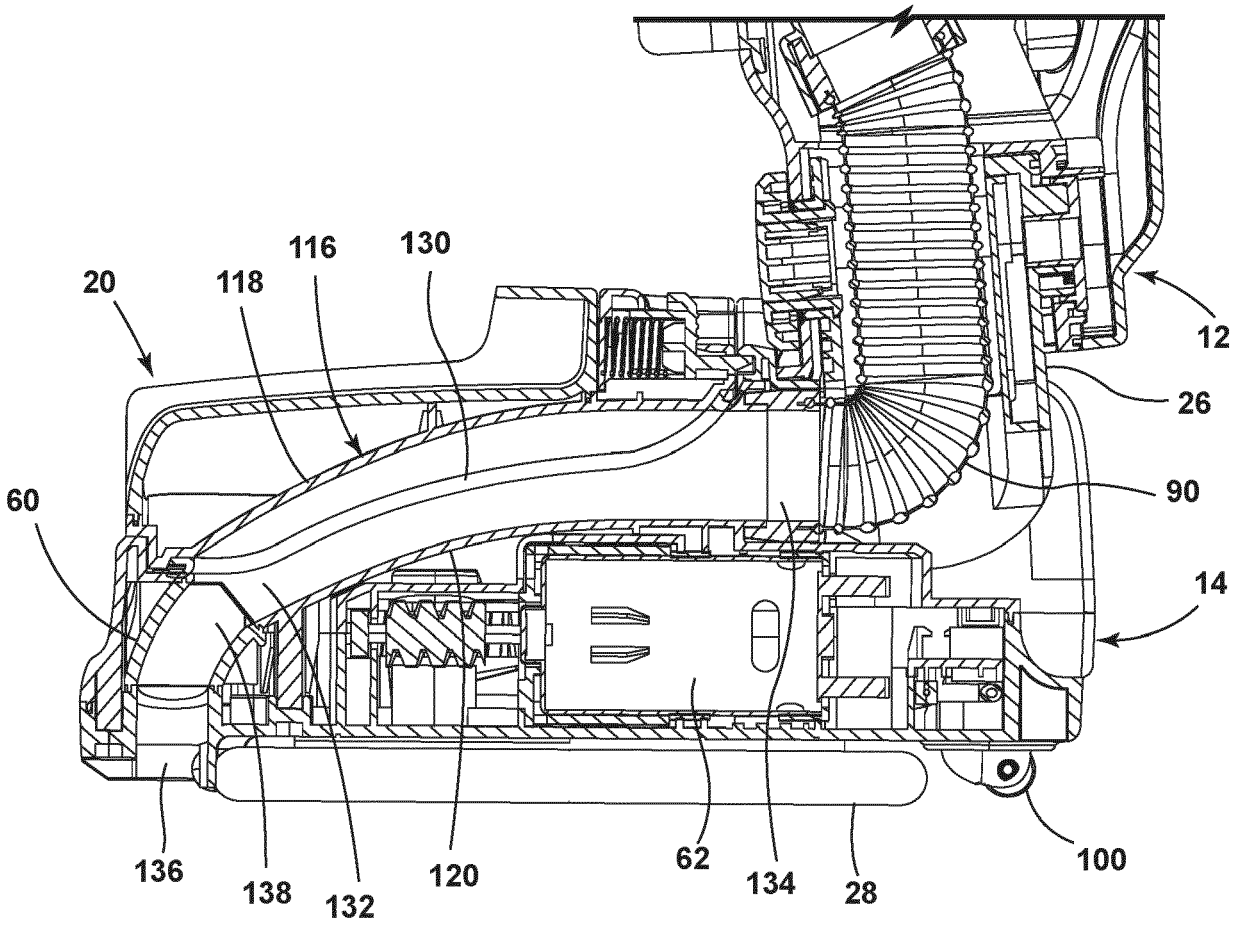

FIG. 12

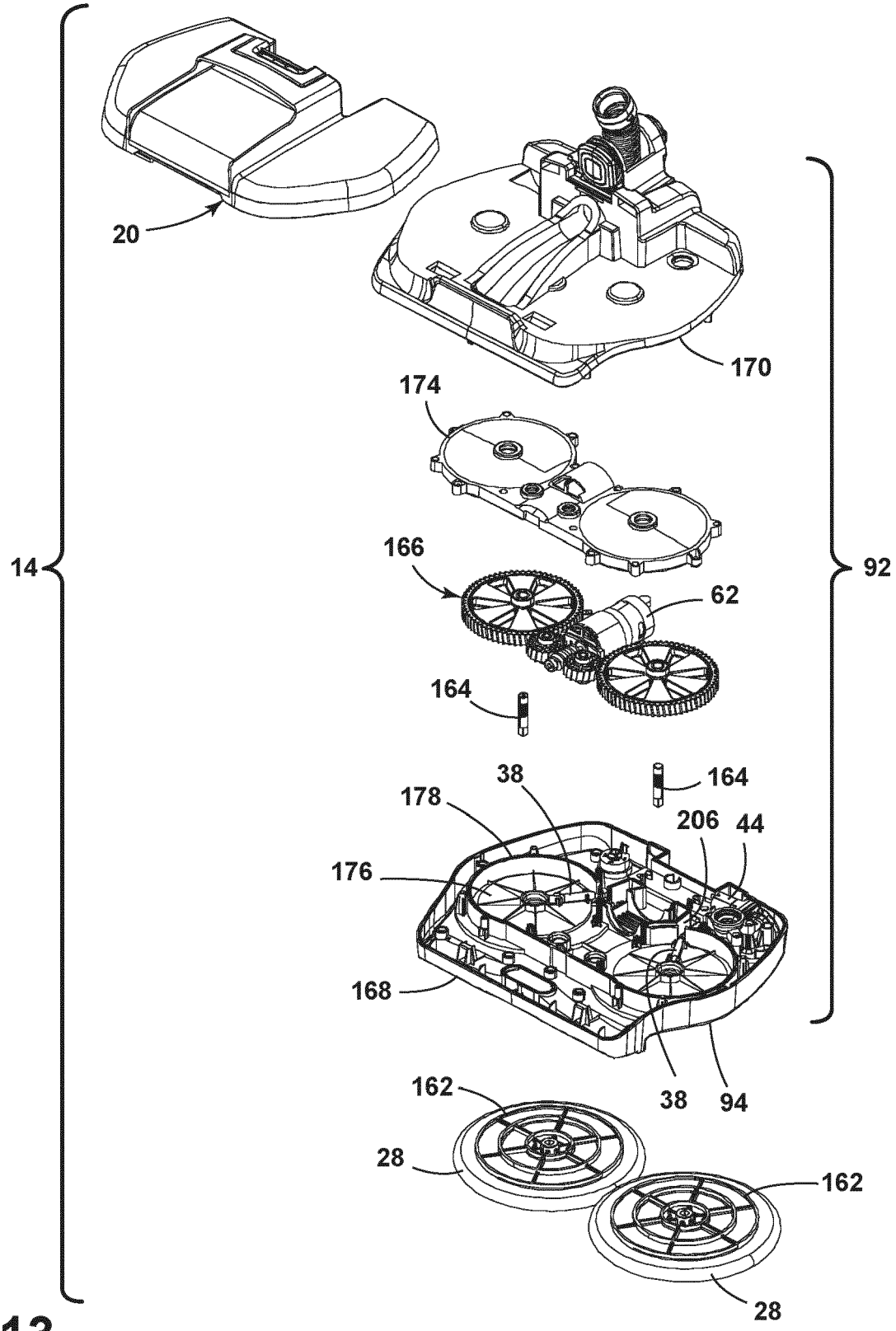
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FIG. 13

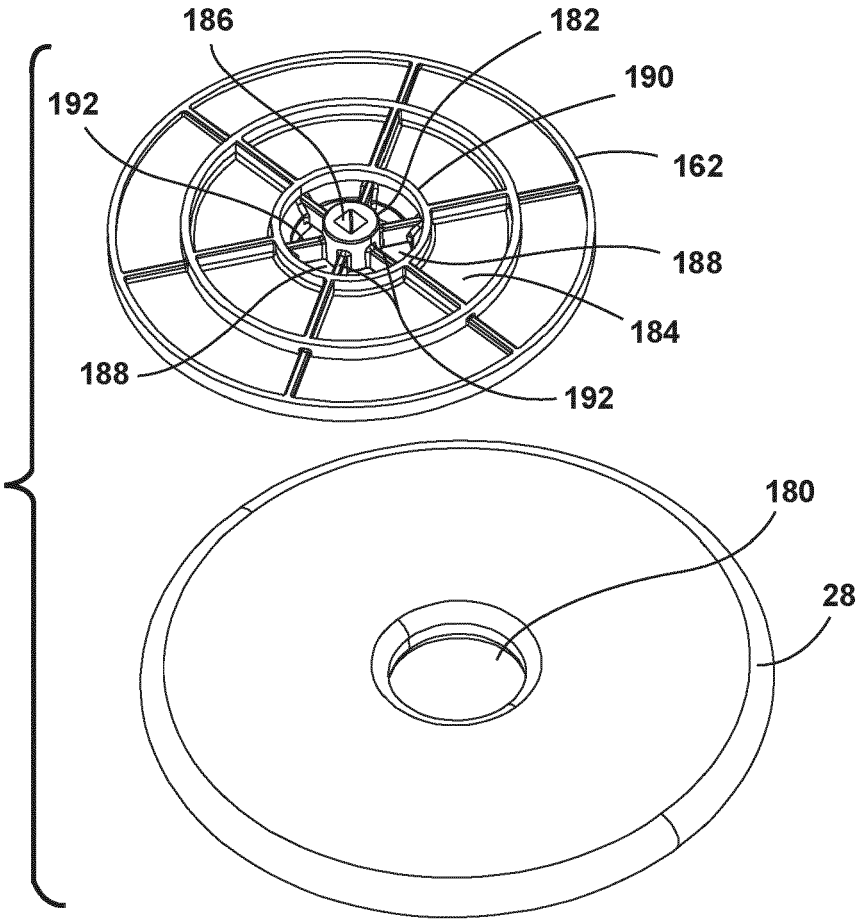
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FIG. 14

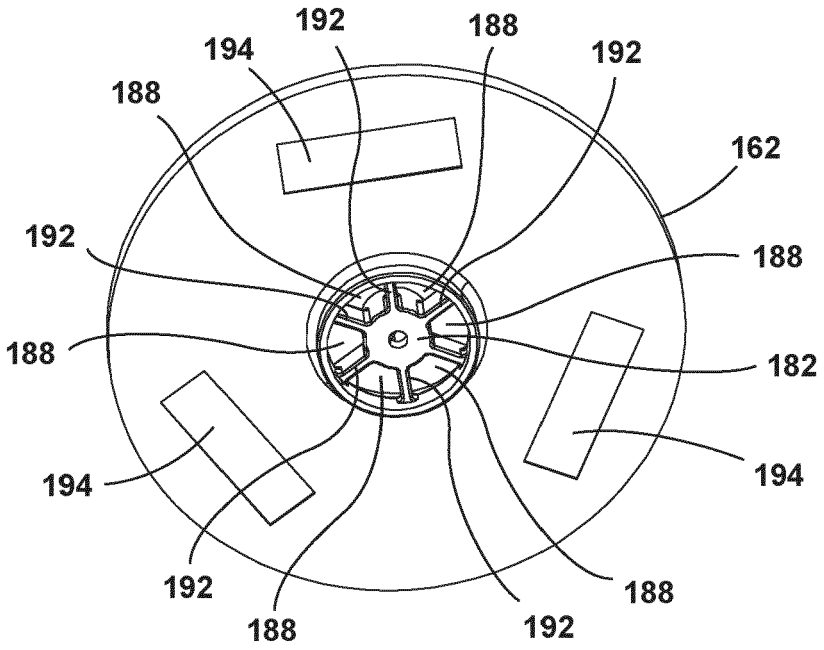
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FIG. 15

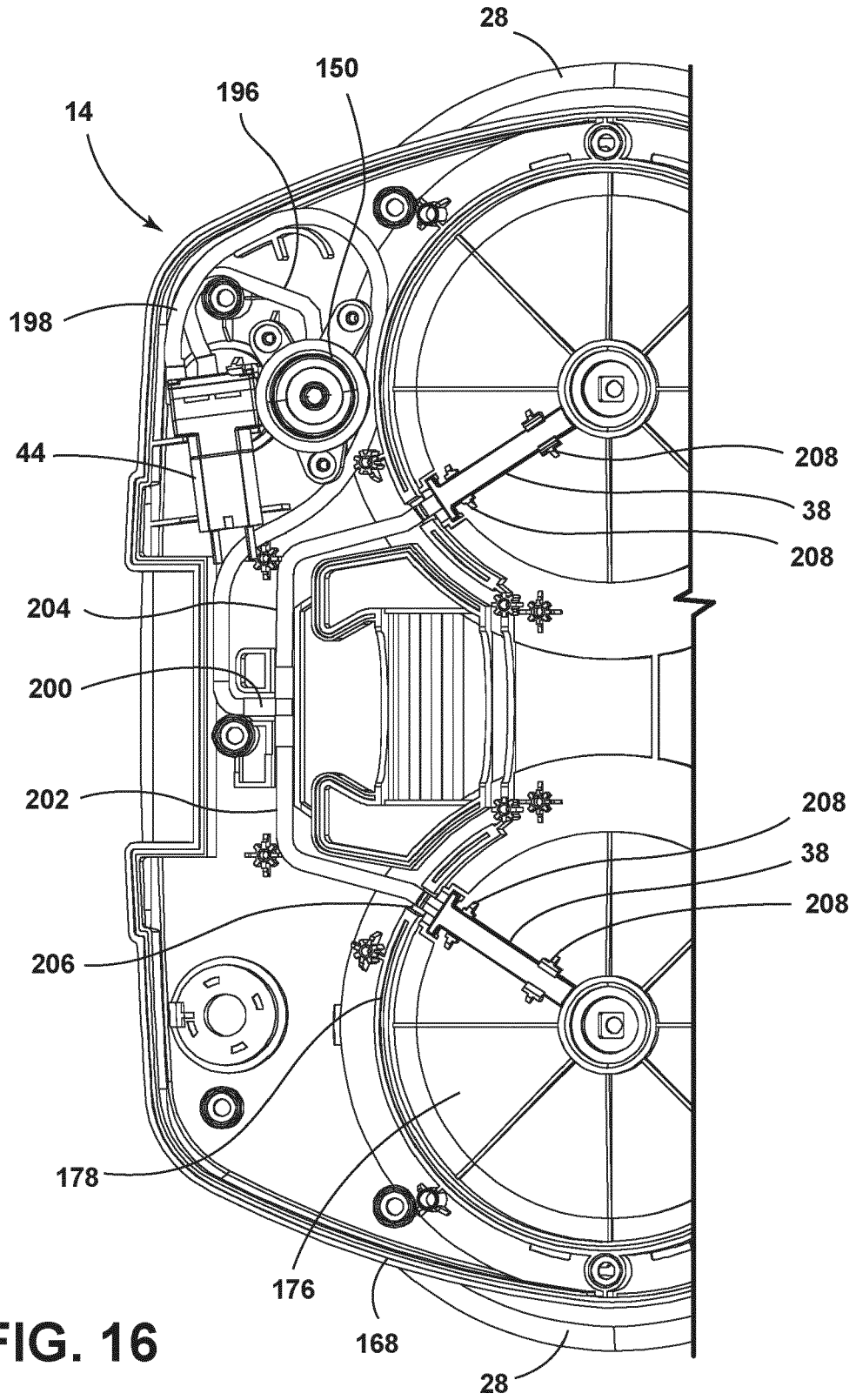
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FIG. 16

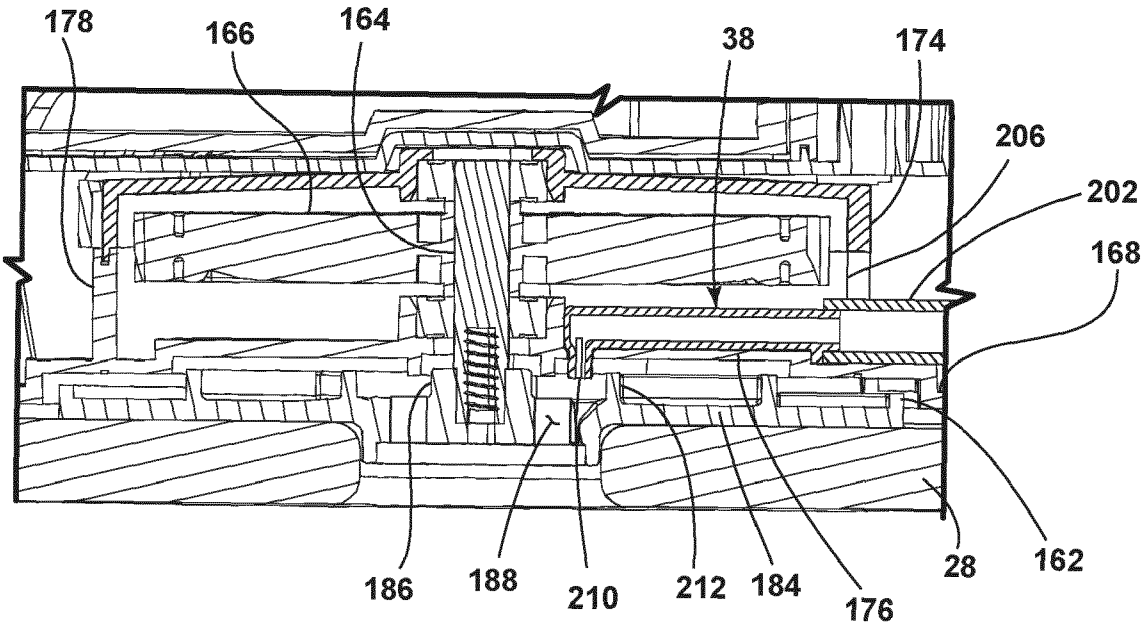

FIG. 17

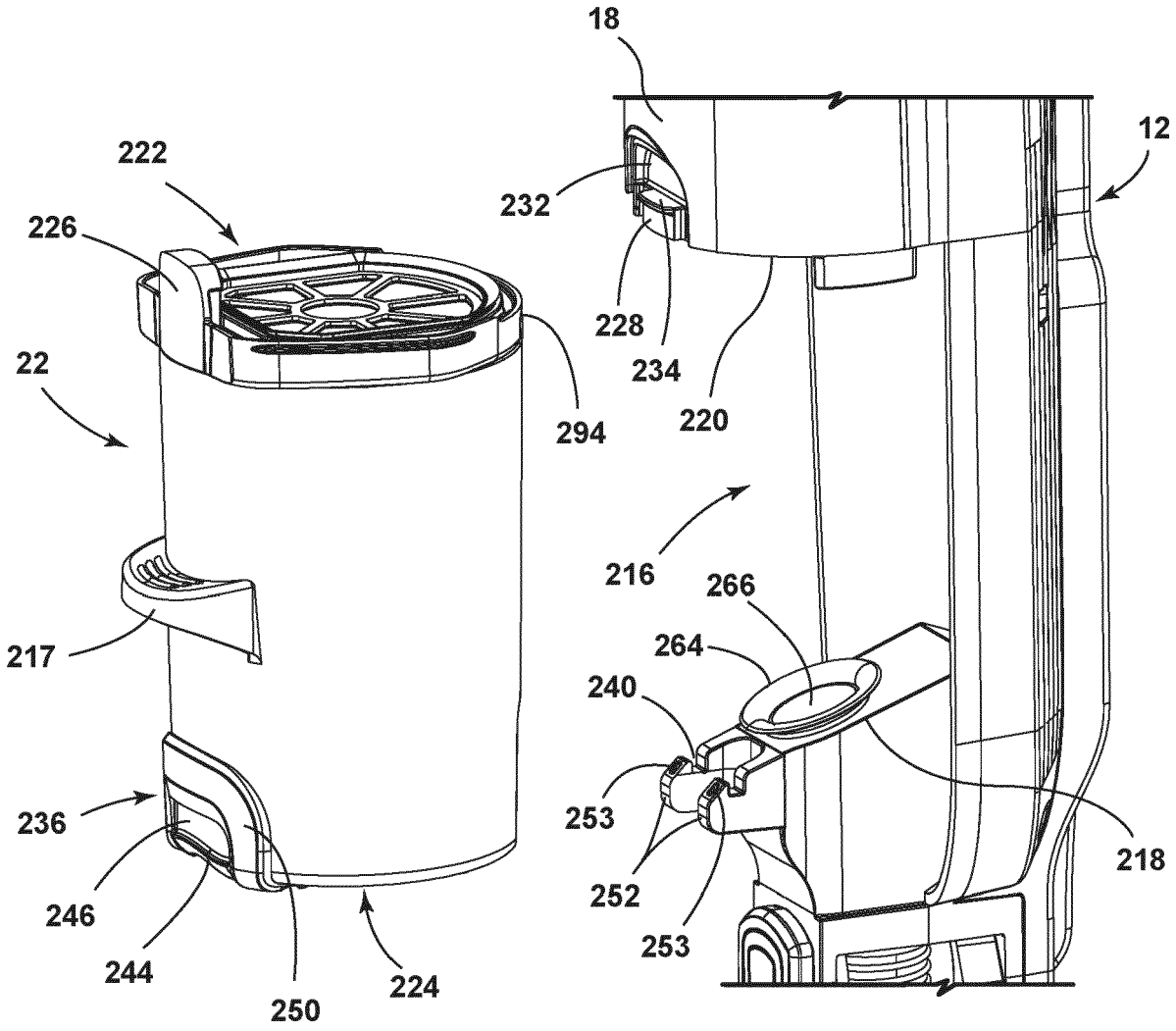
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FIG. 18

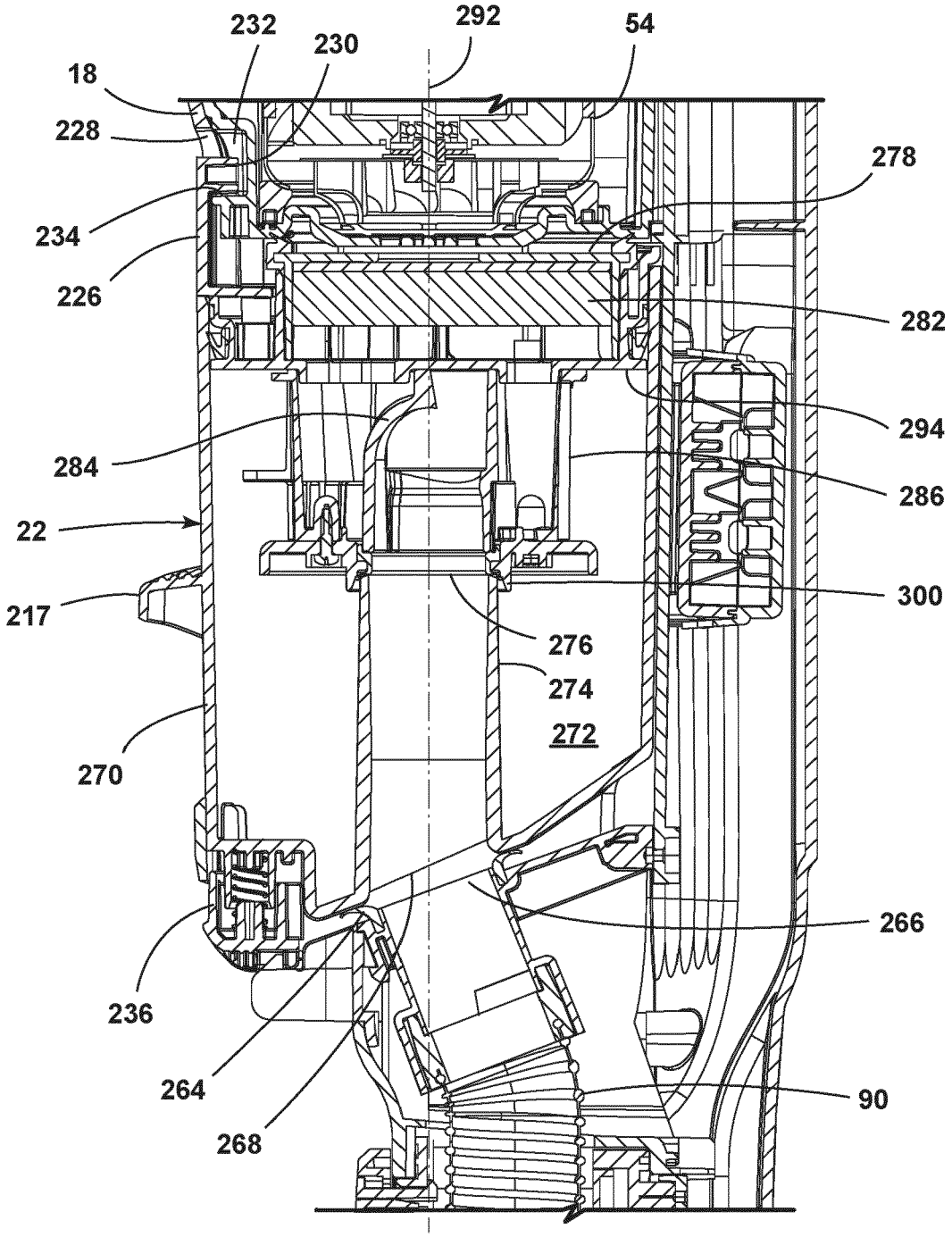
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FIG. 19

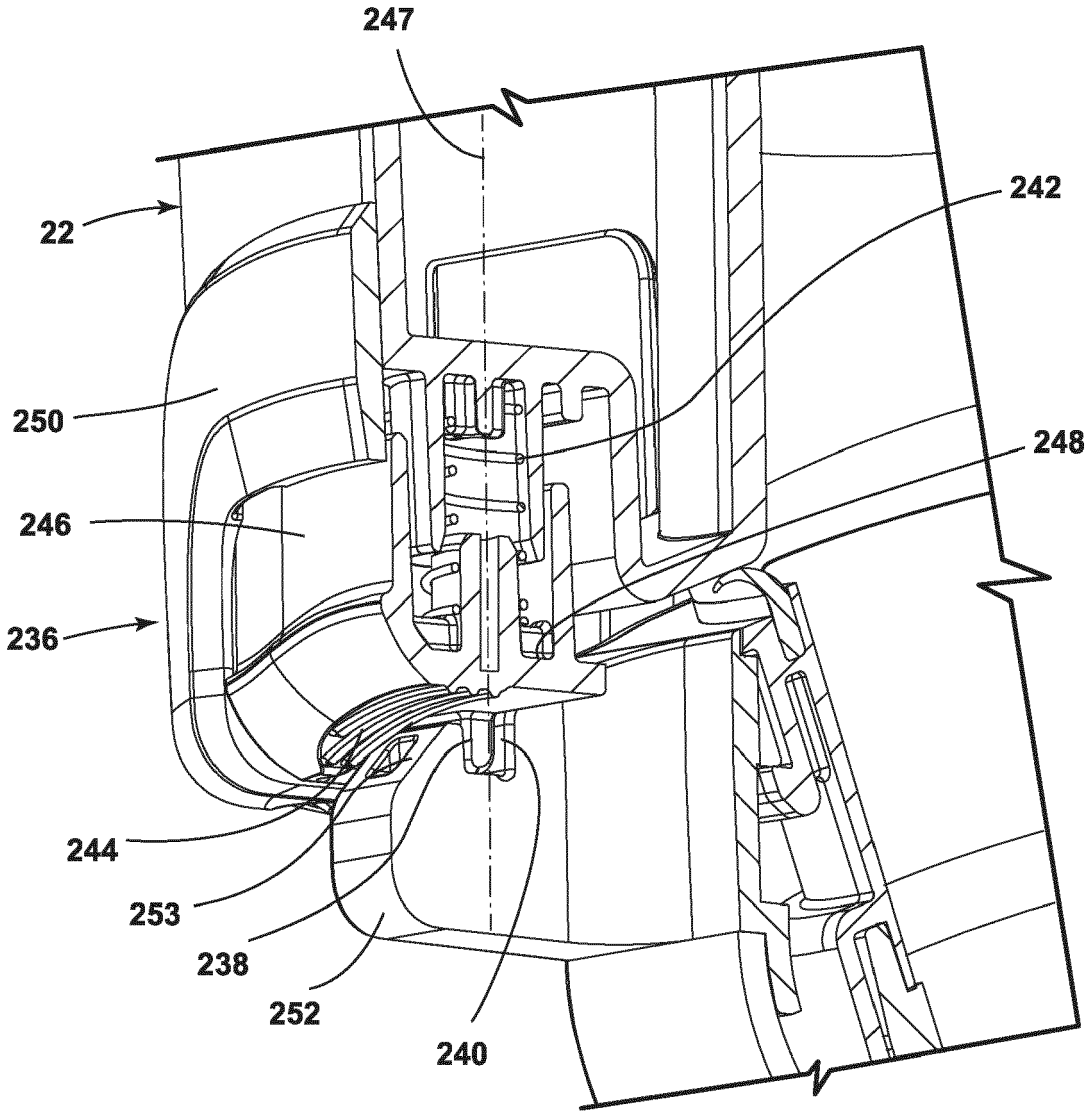

FIG. 20

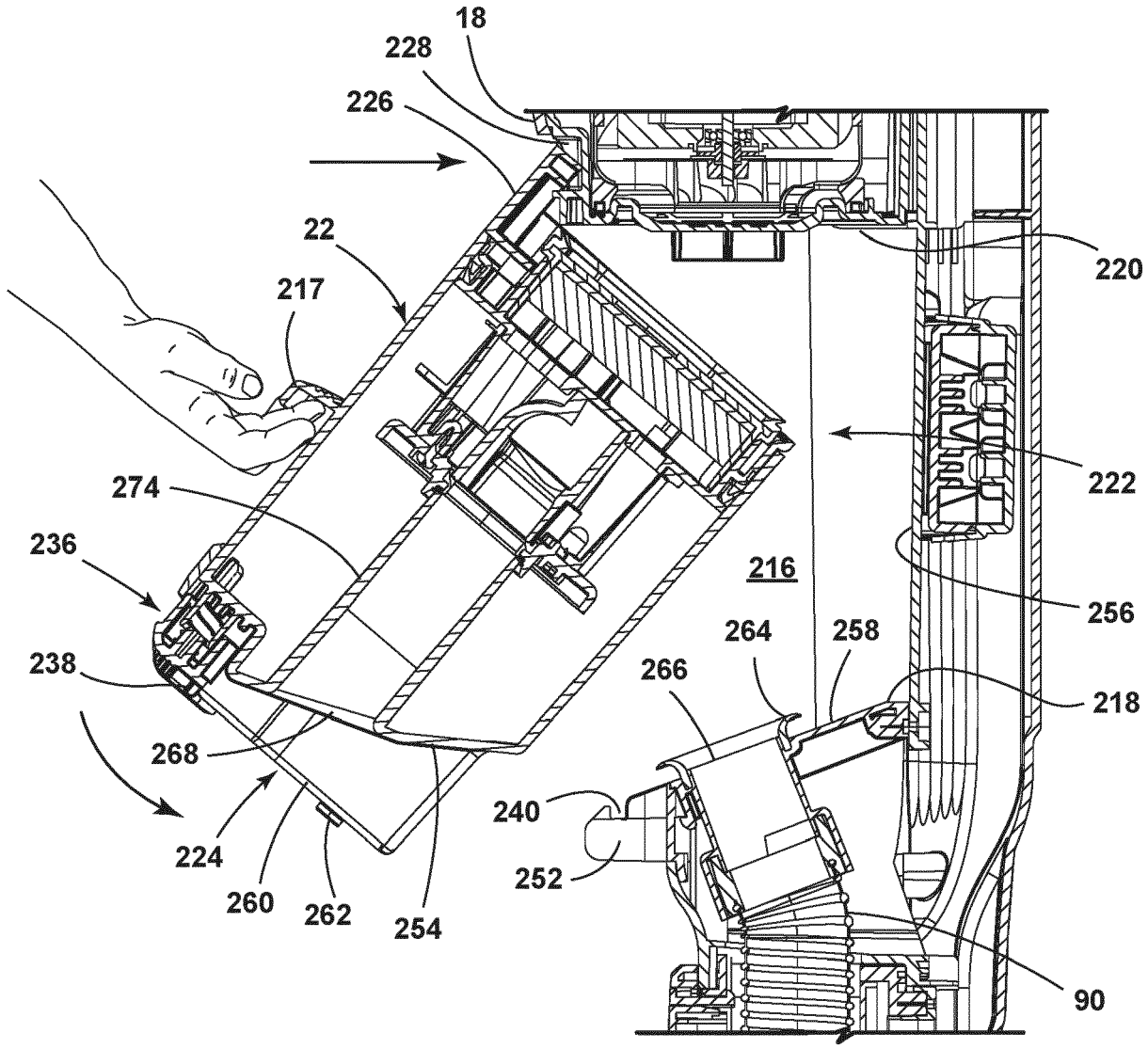
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FIG. 21

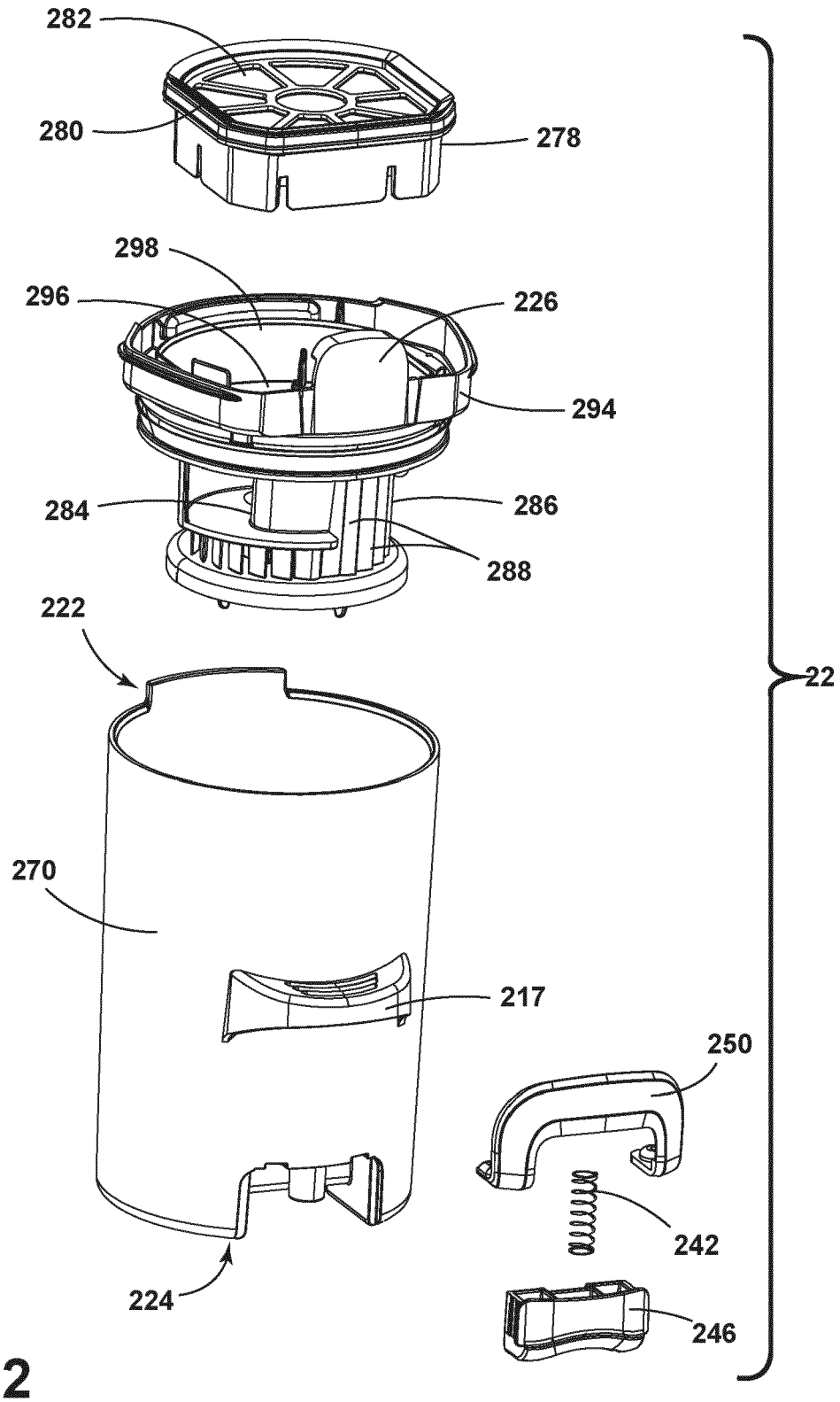
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FIG. 22