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(54) METHOD FOR CONTROLLING SUCTION BASED ON DETECTED OPERATION ANGLES

(57) A handheld cleaner (10) includes a housing (14) that at least partially defines an air pathway (18) and a suction nozzle (22) that defines a nozzle inlet (26) in communication with a suction pathway (30). The suction pathway (30) is configured to extract at least one of debris or liquid from a surface (5) to the air pathway (18). An exhaust (34) defines an outlet to the air pathway (18). A suction source (38) is in fluid communication with the suction nozzle (22) via the suction pathway (30). The suction source (38) is configured to generate a working air stream. An operation angle sensor (42) is configured to detect an operation angle of the handheld cleaner (10) relative to the surface (S). A controller (46) is in electrical communication with the suction source (38) and the operation angle sensor (42) via an electrical pathway. The controller (46) is configured to control an amount of suction generated by the suction source (38) based on the detected operation angle.

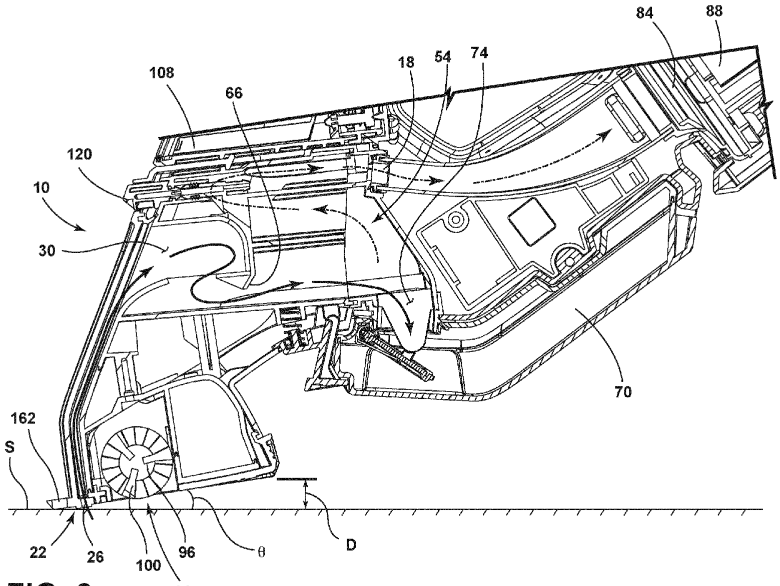

FIG. 3

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Description

FIELD OF THE DISCLOSURE

[0001] The present disclosure generally relates to a handheld cleaner, and more particularly to a handheld surface cleaning apparatus.

BACKGROUND OF THE DISCLOSURE

[0002] Handheld surface cleaners, such as vacuum cleaners, use suction to collect debris and/or fluid to clean soft surfaces, such as carpets, flooring, rugs, upholstery, and the like, as well as hard surfaces including wood, vinyl, tile, composites, etc. Handheld cleaners can be in the form of extraction cleaners. Extraction cleaners are used to clean surfaces by applying a cleaning solution and then extracting the cleaning solution and entrained debris.

SUMMARY OF THE DISCLOSURE

[0003] According to one aspect of the present disclosure, a handheld cleaner includes a housing that at least partially defines an air pathway and a suction nozzle that defines a nozzle inlet in communication with a suction pathway. The suction pathway is configured to extract at least one of debris or liquid from a surface to the air pathway. An exhaust defines an outlet to the air pathway. A suction source is in fluid communication with the suction nozzle via the suction pathway. The suction source is configured to generate a working air stream. An operation angle sensor is configured to detect an operation angle of the handheld cleaner relative to the surface. A controller is in electrical communication with the suction source and the operation angle sensor via an electrical pathway. The controller is configured to control an amount of suction generated by the suction source based on the detected operation angle.

[0004] According to one aspect of the present disclosure, a surface cleaning apparatus for cleaning a surface includes a suction nozzle that is in fluid communication with an air pathway and an exhaust that defines an outlet to the air pathway. A suction source is in fluid communication with the suction nozzle via the air pathway. The suction source is configured to generate a working air stream. An operation angle sensor is configured to determine an operation angle relative to the surface to be cleaned. A controller is in electrical communication with the suction source and the operation angle sensor via an electrical pathway. The controller is configured to control an amount of suction generated by the suction source based on the determined operation angle.

[0005] According to one aspect of the present disclosure, a handheld cleaner includes a suction nozzle that defines a suction channel. The suction channel is configured to extract at least one of debris or liquid from a surface through an air pathway. An exhaust defines an outlet to the air pathway. A suction source includes a vacuum motor and an impeller that is driven by the vacuum motor. The suction source is in fluid communication with the suction nozzle via the suction channel and is configured to generate a working air stream. An operation angle sensor is configured to detect an operation angle of the handheld cleaner relative to the surface. A controller is in electrical communication with the suction source and the operation angle sensor via an electrical pathway. The controller is configured to control an amount of power to the vacuum motor to execute a high suction mode or a low suction mode based on the detected operation angle.

[0006] These and other features, advantages, and objects of the present disclosure will be further understood and appreciated by those skilled in the art by reference to the following specification, claims, and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] In the drawings:

FIG. 1 is a front perspective view of a handheld cleaner, according to the present disclosure;

FIG. 2 is a cross-sectional view of the handheld cleaner of FIG. 1, taken through line II-II of FIG. 1;

FIG. 3 is a cross-sectional view of the handheld cleaner of FIG. 1, taken through line II-II of FIG. 1, in one example of a desirable use position;

FIG. 4 is a side elevational view of a handheld cleaner shown in one example of a non-desirable use position, according to the present disclosure;

FIG. 5 is a side elevational view of a handheld cleaner shown in another example of a non-desirable use position, according to the present disclosure;

FIG. 6 is a block diagram of a handheld cleaner, according to the present disclosure; and

FIG. 7 is a flow diagram of a method of operating a handheld cleaner, according to the present disclosure.

DETAILED DESCRIPTION

[0008] The present illustrated embodiments reside primarily in combinations of method steps and apparatus components related to a handheld cleaner. Accordingly, the apparatus components and method steps have been represented, where appropriate, by conventional symbols in the drawings, showing only those specific details that are pertinent to understanding the embodiments of the present disclosure so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein. Further, like numerals in the description and drawings represent like elements.

[0009] For purposes of description herein, the terms "upper," "lower," "right," "left," "rear," "front," "vertical," "horizontal," and derivatives thereof, shall relate to the disclosure as oriented in FIG. 1. Unless stated otherwise, the term "front" shall refer to a surface closest to an intended viewer, and the term "rear" shall refer to a surface furthest from the intended viewer. However, it is to be understood that the disclosure may assume various alternative orientations, except where expressly specified to the contrary. It is also to be understood that the specific structures and processes illustrated in the attached drawings and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions and other physical characteristics relating to the embodiments disclosed herein are not to be considered as limiting, unless the claims expressly state otherwise.

[0010] The terms "including," "comprises," "comprising," or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus. An element preceded by "comprises a ... " does not, without more constraints, preclude the existence of additional identical elements in the process, method, article, or apparatus that comprises the element.

[0011] Referring to FIGS. 1-6, reference numeral 10 generally designates a handheld cleaner that includes a housing 14 that at least partially defines an air pathway 18. A suction nozzle 22 defines a nozzle inlet 26 that is in communication with a suction pathway 30. The suction pathway 30 is configured to extract at least one of debris or liquid from a surface S to the air pathway 18. An exhaust 34 defines an outlet to the air pathway 18. A suction source 38 is in fluid communication with the suction nozzle 22 via the suction pathway 30 and is configured to generate a working air stream. An operation angle sensor 42 is configured to detect an operation angle of the handheld cleaner 10 relative to the surface. A controller 46 is in electrical communication with the suction source 38 and the operation angle sensor 42 via an electrical pathway. The controller 46 is configured to control an amount of suction generated by the suction source 38 based on the detected operation angle.

[0012] Handheld cleaners, such as the handheld cleaner 10 set forth herein, are configured to be carried by a user and are, therefore, portable. Portable surface cleaning apparatuses may perform the same, or similar, functions as upright surface cleaning apparatuses. Portable surface cleaning apparatuses, such as handheld cleaners, and upright surface cleaning apparatuses can provide a suction effect to extract debris that is on or in an underlying surface. In general, portable surface cleaning apparatuses are smaller and lighter than upright surface cleaning apparatuses.

[0013] In some aspects, a cleaning fluid is provided, and the portable and upright surface cleaning apparatuses can be configured to extract the cleaning solution and entrained debris. The term "debris," as used herein, may include dirt, dust, soil, hair, other loose material, etc. The term "cleaning fluid," as used herein, primarily encompasses liquids, and may include steam, water, compositions, concentrated detergent, diluted detergent, fragrances, deodorizers, etc., or mixtures thereof. Further, portable and upright surface cleaning apparatuses may include an accessory or tool operable to provide suction and/or deliver the cleaning fluid to the surface to be cleaned. Therefore, while various aspects of the disclosure are described with respect to the handheld cleaner 10, it is within the scope of the disclosure for the surface cleaning apparatus to include any suitable cleaner, including, but not limited to, various portable surface cleaning apparatuses and upright surface cleaning apparatuses. It is also within the scope of the disclosure for the surface cleaning apparatus to include the use of accessories or tools (e.g., a wand). Specifically, aspects of the handheld cleaner 10 that relate to the operation angle and a corresponding amount of suction are equally applicable to the operation of other accessories or tools.

[0014] As illustrated in FIG. 1, the housing 14 of the handheld cleaner 10 is in the form of a unitary body that includes a handle 50. The handle 50 is designed to be gripped with the user's hand to support the handheld cleaner 10 during transportation (e.g., carrying the handheld cleaner 10) and movement (e.g., during a cleaning procedure). The housing 14 accommodates various components and functional systems of the handheld cleaner 10. A recovery system 54 is provided for removing and temporarily storing debris and/or excess cleaning fluid from the surface. A fluid delivery system 58 may be provided for distributing cleaning fluid to the surface S to be cleaned (FIGS. 3-5). In this way, the recovery system 54 is configured to direct debris and fluid into the housing 14, while the fluid delivery system 58 is configured to direct fluid out of the housing 14.

[0015] Referring now to FIGS. 1-3, the recovery system 54 can define the air pathway 18 (e.g., a recovery path) through the housing 14 that is in fluid communication with the suction pathway 30. In some aspects, the suction pathway 30 forms at least a portion of the air pathway 18. The recovery system 54 can include a suction assembly 62, a separator 66, a recovery tank 70, and the exhaust 34, which may be in the form of exhaust vents. The air pathway 18 can include a dirty air inlet and a clean air outlet. The suction pathway 30 is configured to extract the debris or fluid from the surface S via a working air stream that transfers the debris or fluid to the dirty air inlet of the air pathway 18. The suction pathway 30 includes the working air stream, which can be generated by the suction assembly 62 and is in fluid communication with the separator 66. The separator 66 separates fluid and entrained debris from the working air stream. In this way, the working air stream is filtered, and clean air can flow toward the clean air outlet. The separator 66 can include a debris outlet 74 to transfer debris and liquid that are separated from the working air stream into the recovery tank 70. The recovery tank 70 may be in the form of a compartment that defines a collection chamber to hold the recovered liquid and debris. In some aspects, the recovery tank 70 may be selectively removed from the housing 14 to dispose of the fluid and debris captured by the suction assembly 62.

[0016] As illustrated, the suction assembly 62 includes the suction nozzle 22 positioned at a forward portion of the housing 14. The suction nozzle 22 can define a nozzle inlet 26 (e.g., an opening to the suction nozzle) of the suction pathway 30, or suction channel. The nozzle inlet 26 can include any suitable configuration that forms a narrow opening to the suction pathway 30. In some examples, the nozzle inlet 26 is a single opening that extends substantially the width of the suction nozzle 22. In other examples, the nozzle inlet 26 is a plurality of smaller openings partitioned by dividers (e.g., ribs). The dividers may reinforce the suction nozzle 22 as it may be engaged with the surface S to be cleaned.

[0017] The suction source 38 is in fluid communication with the suction nozzle 22 to generate the working air stream. The nozzle inlet 26 may define the dirty air inlet, while the exhaust vents 34 in the housing 14 may define the clean air outlet. The suction source 38 can include a fan assembly 80 that is configured to generate the working air stream (e.g., produce a vacuum effect) to draw the debris and fluid from the suction pathway 30, or suction channel, and into the recovery tank 70 within the housing 14. In some aspects, the suction pathway 30 is fluidly coupled to the recovery tank 70 via a conduit or a molded feature but is not limited to such configurations. The fan assembly 80 may include a fan, or impeller 84, that is driven (e.g., rotated) by a vacuum motor 88. An inlet of the impeller 84 is in fluid communication with an air outlet of the separator 66. In this way, the impeller 84 draws the working air stream through the separator 66 (e.g., from an inlet to the outlet). In some implementations, the air pathway 18 can be a tortuous air pathway, and may include baffles, guides, and other air-turning features that guide the working air stream and increase a length of the air pathway 18 to facilitate air/liquid separation and sound attenuation.

[0018] In some implementations, an agitator 92 can be provided adjacent the suction nozzle 22 to agitate the surface S to be cleaned. The agitator 92 may dig into the surface S to be cleaned and loosen debris to facilitate introduction of the debris into the nozzle inlet 26. As illustrated, the agitator 92 is disposed behind the suction nozzle 22 but is not limited to such a position. The agitator 92 may be rotatable and/or stationary (e.g., fixed in position and non-rotating). The agitator 92 may include a brush or a brushroll that has a plurality of bristles 100. The bristles 100 can include any pattern, shape, and bristle type, based on the application for the handheld cleaner 10. The bristles 100 can be constructed of nylon, or any other suitable synthetic or natural fiber. The bristles 100 may be arranged in a plurality of tufts or in a continuous strip. Further, the bristles 100 can be arranged in a single row or multiple rows, optionally with tufts staggered between rows to maximize a density of the bristles 100.

[0019] As illustrated in FIGS. 2 and 3, the agitator 92 is in the form of a powered, rotating brushroll 96, that is driven (e.g., rotated) by a brush motor 102. In some aspects, the brushroll 96 may be in the form of a hybrid brushroll 96 that includes more than one type of agitation material to effectively clean various surfaces in a variety of ways (e.g., hard and soft surfaces, wet and dry vacuuming). The brushroll 96 can include a plurality of the bristles 100. In some aspects, a microfiber material can be arranged between the bristles 100. In other aspects, the brushroll 96 includes a plurality of flexible paddles or wipers arranged at an angle to a longitudinal axis of the brushroll 96. In still other aspects, the brushroll 96 may include a twist-wire brush with a continuous helix of bristles bound together by a twist-wire spindle. While illustrated as the brushroll 96, it is within the scope of the disclosure for the agitator 92 to include any suitable configuration of brushes and brushrolls with any type of configuration of bristles, and may include multiple agitators that are interchangeably mounted to the housing 14.

[0020] Referring again to FIGS. 2-4, the fluid delivery system 58 can include a flow control system 104 to direct the cleaning fluid from a supply tank 108 to an exterior of the housing 14. The flow control system 104 can include any combination of pumps, valves, conduits, ducts, tubing, hoses, and/or connectors, etc., to transport the cleaning fluid along a supply path 112 to one or more fluid distributors 116. In some aspects, the supply tank 108 is in the form of a compartment that defines a supply chamber to hold a supply of cleaning fluid. A fill opening may be provided to deposit cleaning fluid into the supply tank 108. The one or more fluid distributors 116 can include at least one fluid outlet 120 to deliver the cleaning fluid to the surface S to be cleaned. The at least one fluid outlet 120 can include any suitable configuration, such as a nozzle or spray tip, that delivers cleaning fluid directly to the surface S to be cleaned. In some examples, cleaning fluid can be targeted in front of the suction nozzle 22, applied onto the brushroll 96, or targeted behind the suction nozzle 22. In some implementations, the cleaning fluid can be heated prior to being delivered to the surface S to be cleaned, which may include the use of a heater or by the vacuum motor 88 or exhaust vent 34 prior to being expelled from the handheld cleaner 10.

[0021] Referring now to FIGS. 1 and 6, the handheld cleaner 10 can include various electronic components to perform the functions described herein. The handheld cleaner 10 may include one or more input controls 124, which can be in the form of buttons, triggers, toggles, keys, switches, a touch screen, etc., to control the operation of the handheld cleaner 10. The handheld cleaner 10 may also include at least one status indicator 128 visible to a user during use of the handheld cleaner 10. The status indicator 128 can communicate information about an event or a change related to the operation of the handheld cleaner 10 or its operating environment, such as the operation angle, status, diagnostic information, and/or various error and fault codes. Electrical power can be provided to the handheld cleaner 10 by a source of mains electricity or by a battery or battery pack, which may be rechargeable.

[0022] The input controls 124 may be disposed adjacent the handle 50, at a distal end thereof, such that the input controls 124 may be actuated by a thumb of the user's hand that is gripping the handle 50. The input controls 124 are electrically coupled to various electronic components of the handheld cleaner 10, such as the recovery system 54 and the fluid delivery system 58. For example, a power button 132 may be in the form of a momentary pushbutton switch, or toggle switch, etc., which can selectively power the vacuum motor 88 between "off" and "on" states. In another example, a cleaning fluid control 136 can control an emission of the cleaning fluid via the flow control system 104 (e.g., a pump is activated). The fluid control 136 may be in the form of a momentary pushbutton switch where cleaning fluid can be expelled when the momentary pushbutton switch is depressed. A brush drive control 140 may be provided and in the form of a momentary pushbutton switch, or toggle switch, etc., which can selectively power the brush motor 102 between "off" and "on" states.

[0023] The handheld cleaner 10 includes one or more sensors for sensing, or measuring, physical phenomena related to the handheld cleaner 10. The sensors can include any suitable technology and can be configured to sense pressure, temperature, position, distance, tilt, load, vibration, optics, force, conductivity, humidity, and the like. In some aspects, the sensors are in the form of microsensors (e.g., microelectromechanical systems (MEMs) devices), but are not limited to such. The handheld cleaner 10 includes at least one operation angle sensor 42 that is configured to detect an operation angle of the handheld cleaner 10 relative to the surface S. In some implementations, the operation angle sensor 42 may be a single sensor or a combination of one or more sensors. Specifically, the operation angle sensor 42 may include a tilt sensor (e.g., an accelerometer), a proximity sensor, an optical sensor, a pressure sensor (e.g., a strain gauge), a piezoelectric sensor, etc., but is not limited to these examples. The operation angle sensor 42 may also include a combination of any of the aforementioned sensors or possibly even other sensors configured to aid a user in properly orienting the suction nozzle 22 relative to the surface S so that a desired cleaning operation can be achieved. Optionally, the handheld cleaner 10 may include a suction nozzle engagement sensor 150 configured to detect a nozzle engagement position of the suction nozzle 22. It will be understood that other sensor types such as those listed above may also be incorporated into the suction nozzle engagement sensor 150. For example, an optical sensor may be used that is configured to detect whether the suction nozzle is in contact with, or within a contact range of the surface S. In another exemplary instance, the suction nozzle engagement sensor 150 may be a mechanical switch that, upon being depressed, sends a signal to the controller 46 that may be used alone or in combination with a signal from the operation angle sensor 42 to indicate the operating angle of the handheld cleaner 10 is within a desired cleaning angle range.

[0024] The input controls 124, including the power button 132, the cleaning fluid control 136, and the flow control system 104, the operation angle sensor 42, the suction nozzle engagement sensor 150, and other various hardware of the handheld cleaner 10 are in electrical communication with the controller 46 via electrical pathways. The electrical pathways may be arranged, at least in part, on a printed circuit board assembly (PCBA). The controller 46 may include a processor 154, memory 158, and various control circuitry. Instructions or routines may be stored in the memory 158 and are executable by the processor 154. The controller 46 is generally configured to gather inputs from the various electronic components, process the inputs, and generate an output response to the gathered input. The processor 154 may include any type of processor capable of performing the functions described herein. The processor 154 may be in the form of a dual-core processor, a multi-core or multi-threaded processor, a digital signal processor, a microcontroller, or any other processor or processing/controlling circuit with multiple processor cores or other independent processing units. The memory 158 may include any type of volatile or nonvolatile memory (e.g., RAM, ROM, PSRAM), or data storage devices (e.g., hard disk drives, solid-state drives, etc.) capable of performing the functions described herein. In operation, the memory 158 may store various data and software used during operation of the handheld cleaner 10 such as operating systems, applications, programs, libraries, databases, and drivers. The memory 158 includes a plurality of instructions that, when read by the processor 154, cause the processor 154 to perform the functions described herein.

[0025] Referring now to FIG. 3, the handheld cleaner 10 is illustrated in one example of a desired use position relative to the surface S to be cleaned. In operation, a user may grasp the handle 50 of the handheld cleaner 10 and position the suction nozzle 22 adjacent to the surface S to be cleaned. The controller 46 is configured to detect the operation angle θ at which the handheld cleaner 10 or the suction nozzle 22 is oriented with respect to the surface S, utilizing input from the operation angle sensor 42. The controller 46 determines whether the operation angle of the handheld cleaner 10 satisfies a desired cleaning angle or angle range based on the output from the operation angle sensor 42. In one example, the controller 46 may control one or more aspects of the handheld cleaner 10 based on a determination that the operation angle satisfies the desired cleaning angle or angle range. In another example, the controller 46 may control one or more aspects of the handheld cleaner 10 based on a determination that the operation angle does not satisfy the desired cleaning angle or angle range.

The desired cleaning angle may be defined as a cleaning angle or range of cleaning angles at which debris and/or cleaning fluid is recovered, or extracted, most effectively. Optionally, the desired cleaning angle may correspond to an angle, or range of angles, selected to balance a desired suction efficiency, and one or more additional parameters of the handheld cleaner 10, such as a desired run time. In another example, the desired cleaning angle may correspond to an angle or range of angles in which cleaning fluid may be delivered effectively. Optionally, the desired use position relative to the surface S may include a desired nozzle engagement position that places the suction nozzle 22 at the desired cleaning angle. The orientation of the handheld cleaner 10 can be defined by multiple parameters. Notably, the surface angle is one of the parameters. Another parameter is the distance of the suction nozzle 22 from the surface S.

[0026] While FIG. 3 depicts the handheld cleaner 10 in relation to a horizontal (e.g., parallel to the horizon) surface S to be cleaned, the handheld cleaner 10 may also be used to clean surfaces which are not generally horizontal. For example, the handheld cleaner 10 may be positioned for operation at various angles with respect to the horizon to clean surfaces, such as stairs, upholstered furniture, drapery, car seats, and the like. A liquid level in the supply tank 108 or recovery tank 70 can move depending on the operation angle θ. For example, when the handheld cleaner 10 is tipped (e.g., rearward as depicted in FIG. 5, or forward), gravitational forces may cause the cleaning fluid to move to a position that hinders the cleaning fluid from being usable (e.g., pumped from the supply tank 108). Likewise, the operation angle θ may cause the cleaning fluid to move to a position that is sufficient, or advantageous for supplying the cleaning fluid along the supply path 112. As such, the desired cleaning angle may include an operation angle that facilitates movement of the cleaning fluid from the supply tank 108. Likewise, a non-desired cleaning angle may include operation angles which inhibit movement of the cleaning fluid from the supply tank 108.

[0027] The desired cleaning angle may vary based on parameters detected by the controller 46 of the handheld cleaner 10. In this way, the desired cleaning angle can be adjusted during operation of the handheld cleaner 10. In some implementations, the controller 46 can utilize input with regard to a liquid level in the supply tank 108 to reset the desired cleaning angle(s) to include angle(s) at which the cleaning fluid can be removed from the supply tank 108. For example, a level of cleaning fluid in the supply tank 108 may diminish during use of the handheld cleaner 10. Therefore, the controller 46 may reset the desired cleaning angle(s) to include operation angles where the nozzle inlet 26 is disposed below the supply tank 108. Moreover, the desired cleaning angle may vary depending on a relative disposition of the components (e.g., handle 50, nozzle inlet 26, supply tank 108, recovery tank 70, exhaust vents 34, etc.) of the handheld cleaner 10 to one another.

[0028] In the desired use position, the handheld cleaner 10 is disposed with the suction nozzle 22 adjacent the surface S. In the desired use position, the desired cleaning angle may include angles such that a portion of the nozzle inlet 26 is spaced a predetermined distance D (FIG. 3), relative to the surface. The predetermined distance D may include a maximum distance. Likewise, it is within aspects of the disclosure for the desired cleaning angle to include angles such that the fluid delivery outlet 120 is spaced the predetermined distance D relative to the surface S. The predetermined distance D that a portion of the nozzle inlet 26 is spaced relative to the surface S may be in a range of approximately 1 centimeter (cm) to approximately 5 cm, approximately 1 cm to approximately 4 cm, approximately 1 cm to approximately 3 cm, approximately 1 cm to approximately 2 cm, approximately 2 cm to approximately 5 cm, approximately 3 cm to approximately 5 cm, approximately 4 cm to approximately 5 cm, or any and all ranges therebetween. In some aspects, the suction nozzle 22, or a portion thereof, abuts or is engaged with the surface S. In this way, the predetermined distance D between the surface S and the nozzle inlet 26 is limited.

[0029] The desired cleaning angle may include a desired suction nozzle engagement position. The suction nozzle engagement position may include a fully engaged position where a determined suction nozzle engagement position corresponds to the nozzle inlet 26 in a sealing arrangement with the surface S, partially engaged positions, or in a disengaged position where the suction nozzle 22 does not contact the surface S. However, the desired suction nozzle engagement position may include any and all positions therebetween. Optionally, a floating suction lens 162, or rotatable "foot," may be provided and configured to continuously engage the nozzle inlet 26 with the surface S throughout a wide range of operation angles.

[0030] In some implementations, the handheld cleaner 10 may need to be sufficiently uplifted with respect to the surface S to yield efficient recovery rates. The desired cleaning angle may include the nozzle inlet 26, in a sloped, or tilted, position such that the desired cleaning angle may be in a range of approximately 3 degrees to 30 degrees relative to the surface S (e.g., not "sealed" with the surface S), which may be especially beneficial when the handheld cleaner 10 is also an extraction cleaner. In other examples, the desired cleaning angle may also be in a range approximately 5 degrees to 30 degrees, approximately 7 degrees to 30 degrees, approximately 10 degrees to 30 degrees, approximately 15 degrees to 30 degrees, approximately 3 degrees to 25 degrees, approximately 3 degrees to 20 degrees, approximately 3 degrees to 15 degrees, approximately 5 degrees to 15 degrees, approximately 10 degrees to 15 degrees, or any and all ranges therebetween, relative to the surface S. However, in some aspects, the desired cleaning angle may be an angle in which the nozzle inlet 26 and/or suction pathway 30 is oriented approximately less than 3 degrees relative to the surface S, or approximately zero degrees relative to the surface S, such that the nozzle inlet 26 is generally flush with the surface S, sufficiently flat against the surface S, or "sealed" with the surface S. For example, the desired cleaning angle of approximately zero degrees relative to the surface S may be optimal in the implementation where the handheld cleaner 10 is not also an extraction cleaner (e.g., configured to recover fluids).

[0031] As previously discussed, the handheld cleaner 10 may be used to clean non-flat surfaces, such as stairs, upholstered furniture, drapery, car seats, and the like. During operation, the handheld cleaner 10 may be repositioned to a variety of angles while the user conducts cleaning of these surfaces of various sizes and shapes, including furniture, window coverings etc., which may cause the liquid level of the supply tank 108 and/or the recovery tank 70 to slosh about. Therefore, it may be beneficial to optimize the desired cleaning angle based on a detected use event to cause the cleaning fluid to move to a position that is sufficient, or advantageous to supply the cleaning fluid along the supply path 112. As such, the desired cleaning angle may include an operation angle that facilitates movement of the cleaning fluid from the supply tank 108. The handheld cleaner 10 controller 46 may determine that a user is cleaning surfaces of a variety of planes with respect to horizontal. The detection may be based upon a predetermined number of reposition movements of the handheld cleaner 10, which may include a number of reposition movements of the handheld cleaner 10 within a predetermined amount of time. In some aspects, upon determination that a user is cleaning surfaces that have a variety of planes, the desired cleaning angle can be adjusted to include a wider range of angles (e.g., approximately 3 degrees to 30 degrees) to accommodate the various movements to prevent continually detecting a non-desired cleaning angle. In this way, the desired cleaning angle can include a larger tolerance for detection of non-desired cleaning angles. In other implementations, the controller 46 may determine that a user is cleaning surfaces that are substantially vertical. In some aspects, upon determining that a user is cleaning surfaces that are substantially vertical, the desired cleaning angle can be adjusted to include a detection of the suction nozzle 22 position. For example, the desired cleaning angle may include a positon where a front portion of the suction nozzle 22 is positioned generally below a rear portion of the suction nozzle 22 to effectively capture debris and/or liquid from the vertical surfaces.

[0032] Referring now to FIGS. 4 and 5, the handheld cleaner 10 is depicted in flat and tilted back positions, respectively. A user may not comprehend, or intuitively understand the desired cleaning angle. Therefore, the user may operate the handheld cleaner 10 at non-desired or non-optimal angles, which do not allow for an efficient recovery rate of the debris and/or cleaning fluid. For example, the user may not tip the handheld cleaner 10 far enough forward to position the handheld cleaner 10 within the desired cleaning angle range. In some examples, placement of the handheld cleaner 10 at a generally flat angle (an example of which is shown in FIG. 4) or a tilted back angle (an example of which is shown in FIG. 5) will not position the handheld cleaner 10 within the desired cleaning angle. For example, in the flat position depicted in FIG. 4, cleaning fluid, and/or debris may be displaced away from the suction pathway 30 and not be extracted from the surface S. In the tilted back position depicted in FIG. 5, cleaning fluid in the supply tank 108 may not easily reach the tank outlet. Particularly, when the liquid level is less than a specific level and/or when the handheld cleaner 10 is tilted to a certain degree.

[0033] The handheld cleaner 10, according to the present disclosure, may provide feedback to a user when the handheld cleaner 10 is positioned in the desired cleaning angle. In some implementations, the controller 46 is configured to control an amount of suction generated by the suction source 38 based on the determined, or detected, operation angle. Likewise, the amount of suction generated by the suction source 38 may be based on the detected nozzle engagement position, such as the desired nozzle engagement position. The amount of suction generated may correspond to a speed of the impeller 84. For example, the speed of the impeller 84 can change (e.g., increase or decrease) based on a change to the detected operation angle. A volume of sound generated by the working air stream exiting the exhaust vents 34 can depend on the speed of the impeller 84. For example, the volume of the working air stream may increase with increasing speeds of the impeller 84. A lower volume (e.g., approximately 10-40 decibels (dB)) is typically generated by the working air stream in non-desired cleaning angles. This may encourage the user to re-position the handheld cleaner 10 at the desired cleaning angle, which may be associated with volumes of approximately 50-80 dB generated by the working air stream in such angles. In this way, the amount of suction generated by the suction source 38 based on the desired cleaning angle and/or the desired nozzle engagement position may be audibly distinct from the amount of suction generated by the suction source 38 based on a non-desired cleaning angle. This way, a noticeable and positive reinforcement that the handheld cleaner 10 is being used properly can be implemented.

[0034] The amount of suction generated may be regulated by the controller 46 to manage an amount of power provided to the suction source 38, which may include the amount of power provided to the vacuum motor 88. The amount of power provided to the suction source 38 can correspond to a high suction mode, a low suction mode, a medium suction mode, etc. In one example, in the low suction mode, the suction source 38 receives approximately 10% of the amount of power provided to the suction source 38 in the high suction mode. In some aspects, the high suction mode corresponds to a normal operation power. When the handheld cleaner 10 is positioned at the desired cleaning angle, the high suction mode (e.g., a higher suction fan rotation rate) may be executed by the processor 154. Conversely, when the handheld cleaner 10 is positioned at the non-desired cleaning angle, the low suction mode (e.g., a lower suction fan rotation rate) may be executed by the processor 154. In the same way, when the handheld cleaner 10 is disposed in the desired engagement position, the high suction mode (e.g., a higher suction fan rotation rate) may be executed by the processor 154. When the handheld cleaner 10 is disposed in the non-desired engagement position, the low suction mode (e.g., a lower suction fan rotation rate) may be executed by the processor 154. Accordingly, the amount of power provided to the vacuum motor 88 may be higher in the desired engagement position than the amount of power provided to the vacuum motor 88 in the non-desired engagement position.

[0035] In some implementations, the low suction mode corresponds to a first power set point and the high suction mode corresponds to a second power set point. In the first power set point, the controller 46 may control the supply of power to provide stronger current to the suction source 38 than in the second power set point. In the event that an angle within the desired cleaning angle range is detected, the controller 46 may receive input from an activation mechanism or switch (for example, operation angle sensor 42 and/or suction nozzle engagement sensor 150), such that the controller 46 is configured to switch the handheld cleaner 10 from the low suction mode to the high suction mode. In this way, a user may not notice sufficient suction until the desired cleaning angle and/or desired nozzle engagement is achieved.

[0036] Therefore, benefits of the handheld cleaner 10, according to the present disclosure, include the ability to operate the handheld cleaner 10 in the low suction mode during situations where suction is not necessary, such as scrubbing and cleaning fluid delivery operations, and transporting the handheld cleaner 10 that can result in the handheld cleaner 10 being positioned in a non-desired cleaning angle. In the low suction mode, fan speed is reduced, thereby increasing battery life (e.g., or decreasing a power draw). As the fan continues to rotate in the low suction mode (e.g., as opposed to discontinuing power to the fan) the lower, or idle, speed can provide an audible cue that the handheld cleaner 10 is in an "on" state. Thus, it may be clear that the handheld cleaner 10 is "on" despite the handheld cleaner 10 being positioned in a non-desired cleaning angle. Thus, effective use of the handheld cleaner 10 may be encouraged by various aspects of the disclosure to improve recovery efficiency of debris and/or cleaning fluid and to extend a battery life of the handheld cleaner 10. It will also be understood that the features outlined herein may also be beneficial when incorporated into other portable cleaning units that include a suction nozzle disposed at the end of a wand, not just those when the whole device is held in a user's hand during use.

[0037] Referring now to FIG. 7, a flow diagram of a method 200 of operating the handheld cleaner 10 is illustrated. The method 200 may begin at step 204 where a user turns the handheld cleaner 10 to the "on" state, which may include actuating the power button 132. Next, at step 208, the controller 46 receives input from the operation angle sensor 42 and/or the suction nozzle engagement sensor 150. At step 212 the controller 46 of the handheld cleaner 10 makes a determination regarding the selection of a desired cleaning angle. Step 212 of the method 200 may include additional input received from a variety of electrical components, such as additional sensors regarding a state or environment of the handheld cleaner 10, as previously discussed. The method 200 makes a decision at step 216 as to whether the operation angle is within or equates to a desired cleaning angle or a non-desired cleaning angle. In the case where the decision in step 216 is "yes," or it is determined that the operation angle is within or equal to an angle within the desired cleaning angle range, the method moves on to step 220, where the high suction mode is implemented by the handheld cleaner 10. In the case where the decision in step 216 is "no," or it is determined that the operation angle is not within or equal to a desired cleaning angle, the method 200 instead moves on to step 224, where the low suction mode is implemented by the handheld cleaner 10. From step 224, the method 200 can continue, return to step 208, and execute the proceeding steps in a continuous manner until the desired cleaning angle is detected, and the method 200 ends in step 220, with the handheld cleaner operating in the high suction mode. In some aspects, the method 200 may include periodically re-evaluating input from the operation angle sensors 42 and/or the suction nozzle engagement sensor 150 to ensure the desired cleaning angle is obtained. In some aspects, periodically re-evaluating these inputs may include re-evaluation every one second, every three seconds, every ten seconds, etc. It will be understood that the method 200 may be implemented with additional or fewer steps which may correspond to a variety of functions described herein.

[0038] The device disclosed herein is further summarized in the following paragraphs and is further characterized by combinations of any and all various aspects described herein.

[0039] According to another aspect of the present disclosure, a handheld cleaner includes a housing that at least partially defines an air pathway and a suction nozzle that defines a nozzle inlet in communication with a suction pathway. The suction pathway is configured to extract at least one of debris or liquid from a surface to the air pathway. An exhaust defines an outlet to the air pathway. A suction source is in fluid communication with the suction nozzle via the suction pathway. The suction source is configured to generate a working air stream. An operation angle sensor is configured to detect an operation angle of the handheld cleaner relative to the surface. A controller is in electrical communication with the suction source and the operation angle sensor via an electrical pathway.

The controller is configured to control an amount of suction generated by the suction source based on the detected operation angle.

[0040] According to another aspect of the present disclosure, a controller is configured to control an amount of suction generated by a suction source based on a determined suction nozzle engagement position.

[0041] According to another aspect of the present disclosure, an operation angle sensor is configured to detect a desired cleaning angle. The desired cleaning angle is an angle in which a portion of a nozzle inlet is spaced a predetermined distance relative to a surface.

[0042] According to still another aspect of the present disclosure, a desired cleaning angle is in a range of approximately 3 degrees to 30 degrees relative to a surface.

[0043] According to another aspect of the present disclosure, an amount of suction generated by a suction source based on a desired cleaning angle is audibly distinct from an amount of suction generated by the suction source based on a non-desired cleaning angle.

[0044] According to yet another aspect of the present disclosure, an amount of suction generated corresponds to a speed of an impeller. The speed of the impeller changes based on a detected operation angle.

[0045] According to another aspect of the present disclosure, an amount of suction generated is regulated by adjusting an amount of power provided to a suction source. The amount of power provided corresponds to a high suction mode or a low suction mode.

[0046] According to still another aspect of the present disclosure, a low suction mode corresponds to a first power set point and a high suction mode corresponds to a second power set point. The first power set point provides stronger current to a suction source than the second power set point.

[0047] According to another aspect of the present disclosure, in a low suction mode, a suction source receives approximately 10% of an amount of power provided to the suction source in a high suction mode.

[0048] According to another aspect of the present disclosure, a handheld cleaner includes a recovery tank that is in fluid communication with a suction nozzle through a conduit. A suction source draws at least one of debris or liquid from a surface through the suction nozzle and the conduit to the recovery tank.

[0049] According to another aspect of the present disclosure, a surface cleaning apparatus for cleaning a surface includes a suction nozzle in fluid communication with an air pathway and an exhaust that defines an outlet to the air pathway. A suction source is in fluid communication with the suction nozzle via the air pathway. The suction source is configured to generate a working air stream. An operation angle sensor is configured to determine an operation angle relative to the surface to be cleaned. A controller is in electrical communication with the suction source and the operation angle sensor via an electrical pathway. The controller is configured to control an amount of suction generated by the suction source based on a determined operation angle.

[0050] According to still another aspect of the present disclosure, an operation angle is an angle of a suction nozzle relative to a surface and an operation angle sensor is configured to detect a desired cleaning angle.

[0051] According to another aspect of the present disclosure, a suction nozzle engagement sensor is configured to detect a desired nozzle engagement position that places a suction nozzle at a desired cleaning angle.

[0052] According to yet another aspect of the present disclosure, an amount of suction generated by a suction source is based on a detection of a suction nozzle being in a desired nozzle engagement position.

[0053] According to another aspect of the present disclosure, an amount of power provided corresponds to a high suction mode and a low suction mode. The low suction mode corresponds to a first power set point and the high suction mode corresponds to a second power set point.

[0054] According to another aspect of the present disclosure, a first power set point provides stronger current to a suction source than a second power set point.

[0055] According to another aspect of the present disclosure, a surface cleaning apparatus includes a recovery tank that is in fluid communication with a suction nozzle through a conduit. A suction source is in fluid communication with the conduit to draw at least one of debris or liquid from a surface, through the suction nozzle and the conduit to the recovery tank.

[0056] According to another aspect of the present disclosure, a handheld cleaner includes a suction nozzle that defines a suction channel. The suction channel is configured to extract at least one of debris or liquid from a surface through an air pathway. An exhaust defines an outlet to the air pathway. A suction source includes a vacuum motor and an impeller that is driven by the vacuum motor. The suction source is in fluid communication with the suction nozzle via the suction channel. The suction source is configured to generate a working air stream. An operation angle sensor is configured to detect an operation angle of the handheld cleaner relative to the surface. A controller is in electrical communication with the suction source and the operation angle sensor via an electrical pathway. The controller is configured to control an amount of power to the vacuum motor to execute a high suction mode or a low suction mode based on the detected operation angle.

[0057] According to another aspect of the present disclosure, a handheld cleaner includes a recovery tank that is in fluid communication with a suction nozzle through a conduit. A suction source is in fluid communication with the conduit to draw at least one of debris or liquid from a surface, through the suction nozzle and the conduit to the recovery tank.

[0058] According to yet another aspect of the present disclosure, an operation angle sensor is configured to detect a desired cleaning angle. The desired cleaning angle is an angle such that a portion of a suction channel is spaced a predetermined distance relative to a surface.

[0059] According to another aspect of the present disclosure, an operation angle sensor is configured to detect a non-desired cleaning angle. The non-desired cleaning angle is an angle in which a suction channel is oriented approximately less than 3 degrees relative to a surface.

[0060] According to another aspect of the present disclosure, a suction nozzle engagement sensor is configured to detect a desired nozzle engagement position, and an amount of power provided to a vacuum motor is based on the detection of the desired nozzle engagement position.

[0061] According to still another aspect of the present disclosure, an amount of power provided to a vacuum motor based on a desired nozzle engagement position is higher than an amount of power provided to the vacuum motor based on a non-desired nozzle engagement position.

[0062] It will be understood by one having ordinary skill in the art that construction of the described disclosure and other components is not limited to any specific material. Other exemplary embodiments of the disclosure disclosed herein may be formed from a wide variety of materials, unless described otherwise herein.

[0063] For purposes of this disclosure, the term "coupled" (in all of its forms, couple, coupling, coupled, etc.) generally means the joining of two components (electrical or mechanical) directly or indirectly to one another. Such joining may be stationary in nature or movable in nature. Such joining may be achieved with the two components (electrical or mechanical) and any additional intermediate members being integrally formed as a single unitary body with one another or with the two components. Such joining may be permanent in nature or may be removable or releasable in nature unless otherwise stated.

[0064] It is also important to note that the construction and arrangement of the elements of the disclosure, as shown in the exemplary embodiments, is illustrative only. Although only a few embodiments of the present innovations have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited. For example, elements shown as integrally formed may be constructed of multiple parts, or elements shown as multiple parts may be integrally formed, the operation of the interfaces may be reversed or otherwise varied, the length or width of the structures and/or members or connector or other elements of the system may be varied, the nature or number of adjustment positions provided between the elements may be varied. It should be noted that the elements and/or assemblies of the system may be constructed from any of a wide variety of materials that provide sufficient strength or durability, in any of a wide variety of colors, textures, and combinations. Accordingly, all such modifications are intended to be included within the scope of the present innovations.

[0065] It will be understood that any described processes or steps within described processes may be combined with other disclosed processes or steps to form structures within the scope of the present disclosure. The exemplary structures and processes disclosed herein are for illustrative purposes and are not to be construed as limiting.

Claims

1. A handheld cleaner (10), comprising:

   A housing (14) at least partially defining an air pathway (18);
   a suction nozzle (22) defining a nozzle inlet (26) in communication with a suction pathway (30), the suction pathway (30) configured to extract at least one of debris or liquid from a surface (S) to the air pathway (18);
   an exhaust (34) defining an outlet to the air pathway (18);
   a suction source (38) in fluid communication with the suction nozzle (22) via the suction pathway (30), the suction source (38) configured to generate a working air stream;
   an operation angle sensor (42) configured to detect an operation angle of said handheld cleaner (10) relative to the surface; and
   a controller (46) in electrical communication with the suction source (38) and the operation angle sensor (42) via an electrical pathway, wherein the controller (46) is configured to control an amount of suction generated by the suction source (38) based on the detected operation angle.

2. The handheld cleaner (10) of claim 1, wherein the controller (46) is configured to control the amount of suction generated by the suction source (38) based on a determined suction nozzle engagement position.

3. The handheld cleaner (10) of claim 1 or claim 2, wherein the operation angle sensor (42) is configured to detect a desired cleaning angle, and wherein the desired cleaning angle is an angle in which a portion of the nozzle inlet (26) is spaced a predetermined distance relative to the surface (S).

4. The handheld cleaner (10) of claim 3, wherein the desired cleaning angle is in a range of approximately 3 degrees to 30 degrees relative to the surface (S).

5. The handheld cleaner (10) of claim 3, wherein the

amount of suction generated by the suction source (38) based on the desired cleaning angle is audibly distinct from the amount of suction generated by the suction source (38) based on a non-desired cleaning angle.

6. The handheld cleaner (10) claim 5, wherein the non-desired cleaning angle is an angle in which the suction channel (30) is oriented approximately less than 3 degrees relative to the surface (S).

7. The handheld cleaner (10) of any one of claims 1-6, wherein the amount of suction generated corresponds to a speed of an impeller (84), and wherein the speed of the impeller (84) changes based on the detected operation angle.

8. The handheld cleaner (10) of any one of claims 1-7, wherein the amount of suction generated is regulated by adjusting an amount of power provided to the suction source (38), and wherein the amount of power provided corresponds to a high suction mode or a low suction mode.

9. The handheld cleaner (10) of claim 8, wherein the low suction mode corresponds to a first power set point and the high suction mode corresponds to a second power set point, and wherein the first power set point provides stronger current to the suction source (38) than the second power set point.

10. The handheld cleaner (10) of claim 8 or claim 9, wherein, in the low suction mode, the suction source (38) receives approximately 10% of an amount of power provided to the suction source (38) in the high suction mode.

11. The handheld cleaner (10) of any one of claims 1-10, further comprising:
a recovery tank (70) in fluid communication with the suction nozzle (22) through a conduit, wherein the suction source (38) draws the at least one of the debris or liquid from the surface (S), through the suction nozzle (22) and the conduit to the recovery tank (70).

12. The handheld cleaner (10) of claim 2, further comprising:
a suction nozzle engagement sensor (150) configured to detect the desired nozzle engagement position that places the suction nozzle (22) at the desired cleaning angle.

13. The handheld cleaner (10) of claim 12, wherein an amount of power provided to the suction source (38) based on the desired nozzle engagement position is higher than an amount of power provided to the suction source (38) based on a non-desired nozzle engagement position.

14. The handheld cleaner (10) of any one of claims 1-13, further comprising:
a supply tank (108) defining a supply chamber that holds a supply of cleaning fluid.

15. The handheld cleaner (10) of claim 14, wherein the desired cleaning angle includes angles where the nozzle inlet (26) is disposed below the supply tank (108).

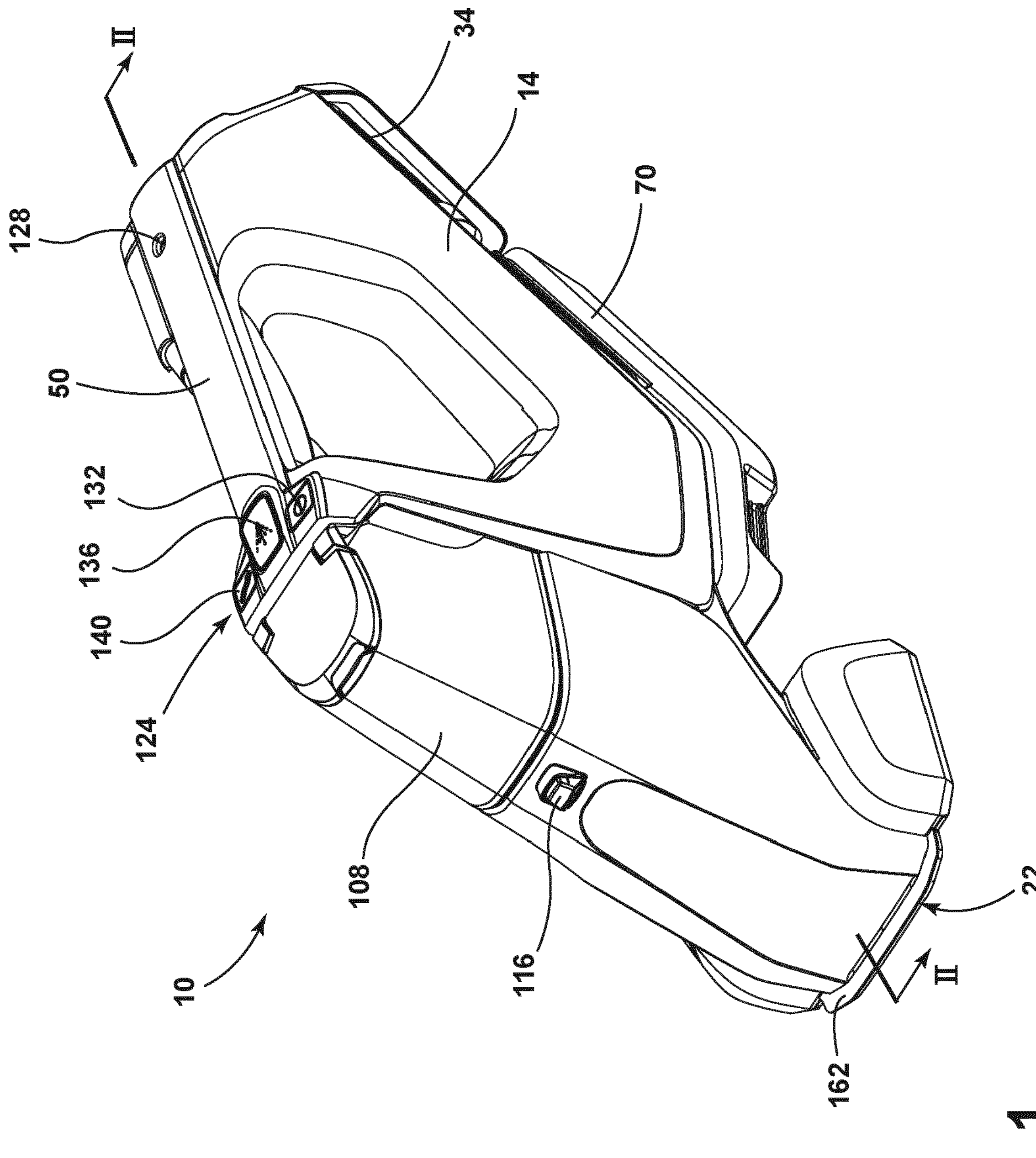

FIG. 1

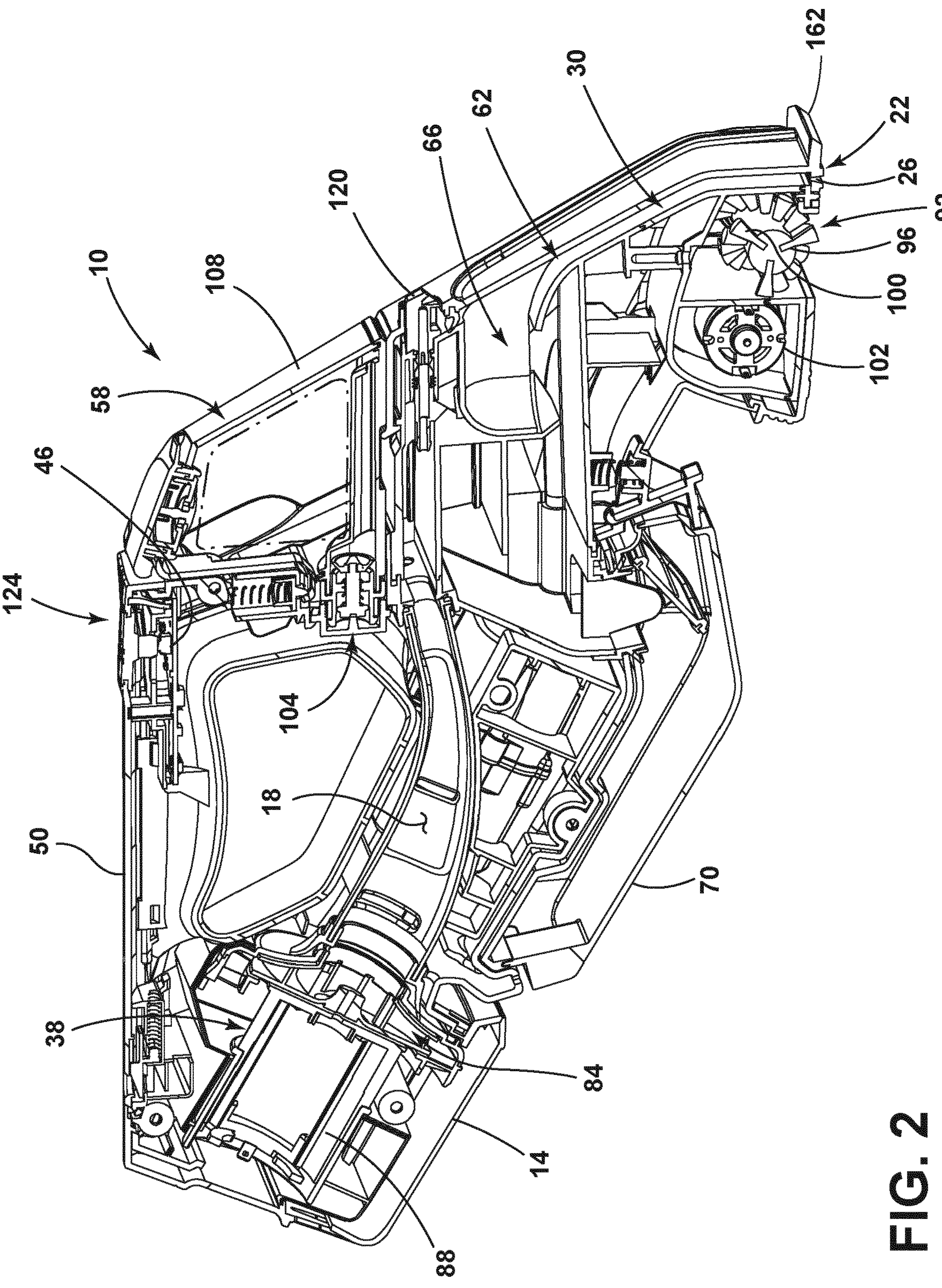
10
108
120
66
62
30
162
22
26
92
96
100
102
58
46
124
104
18
50
70
38
84
14
88

FIG. 2

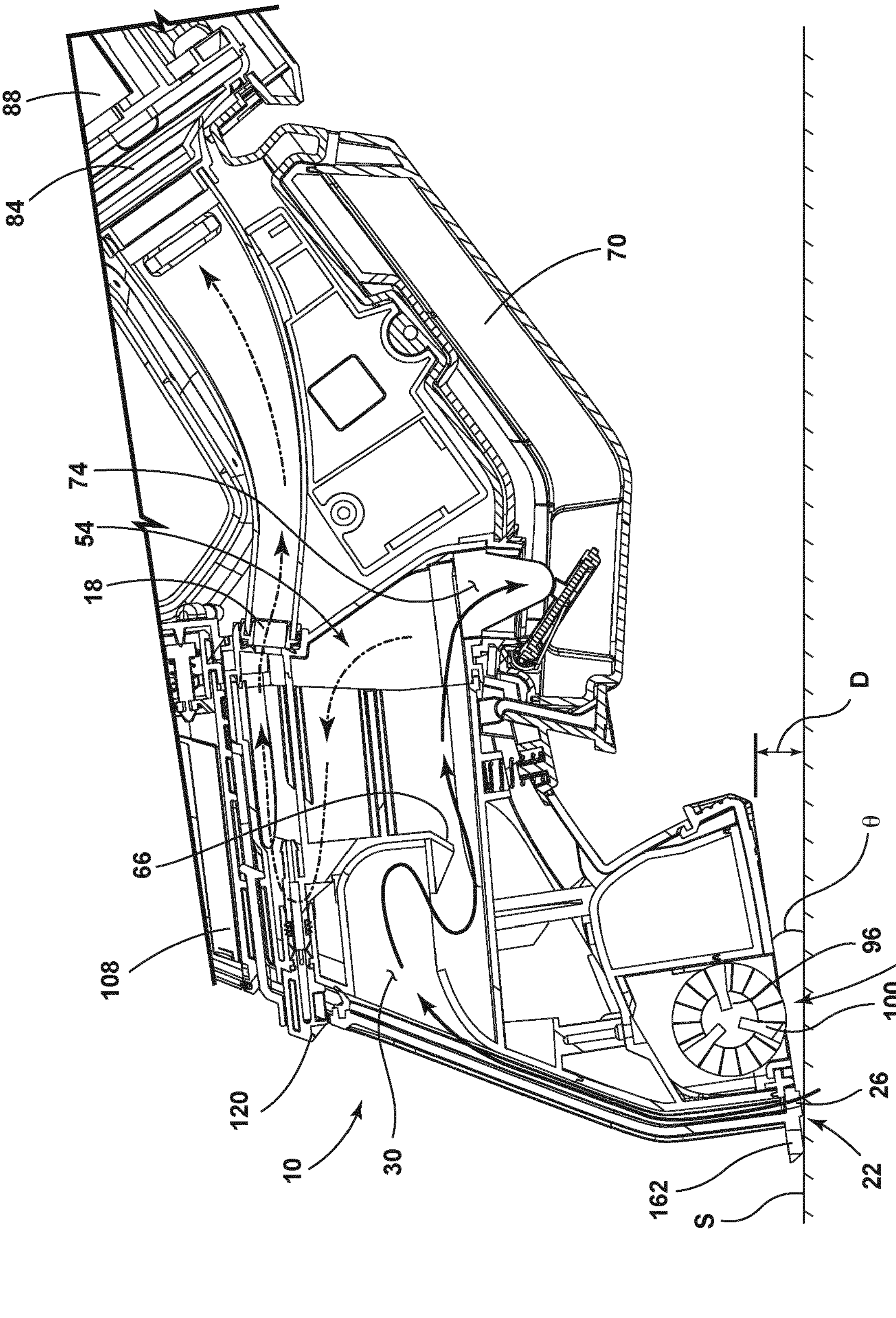

FIG. 3

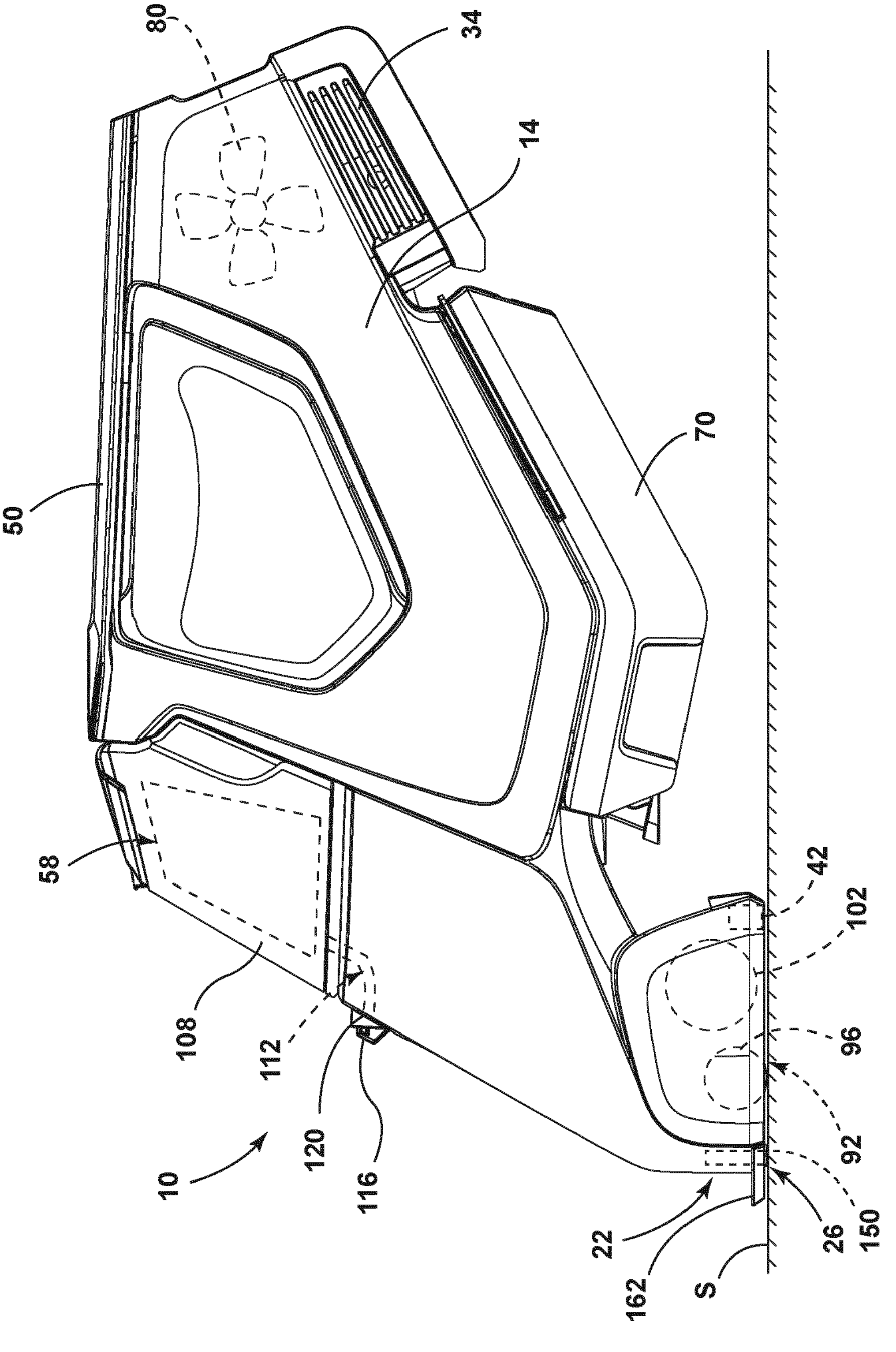

FIG. 4

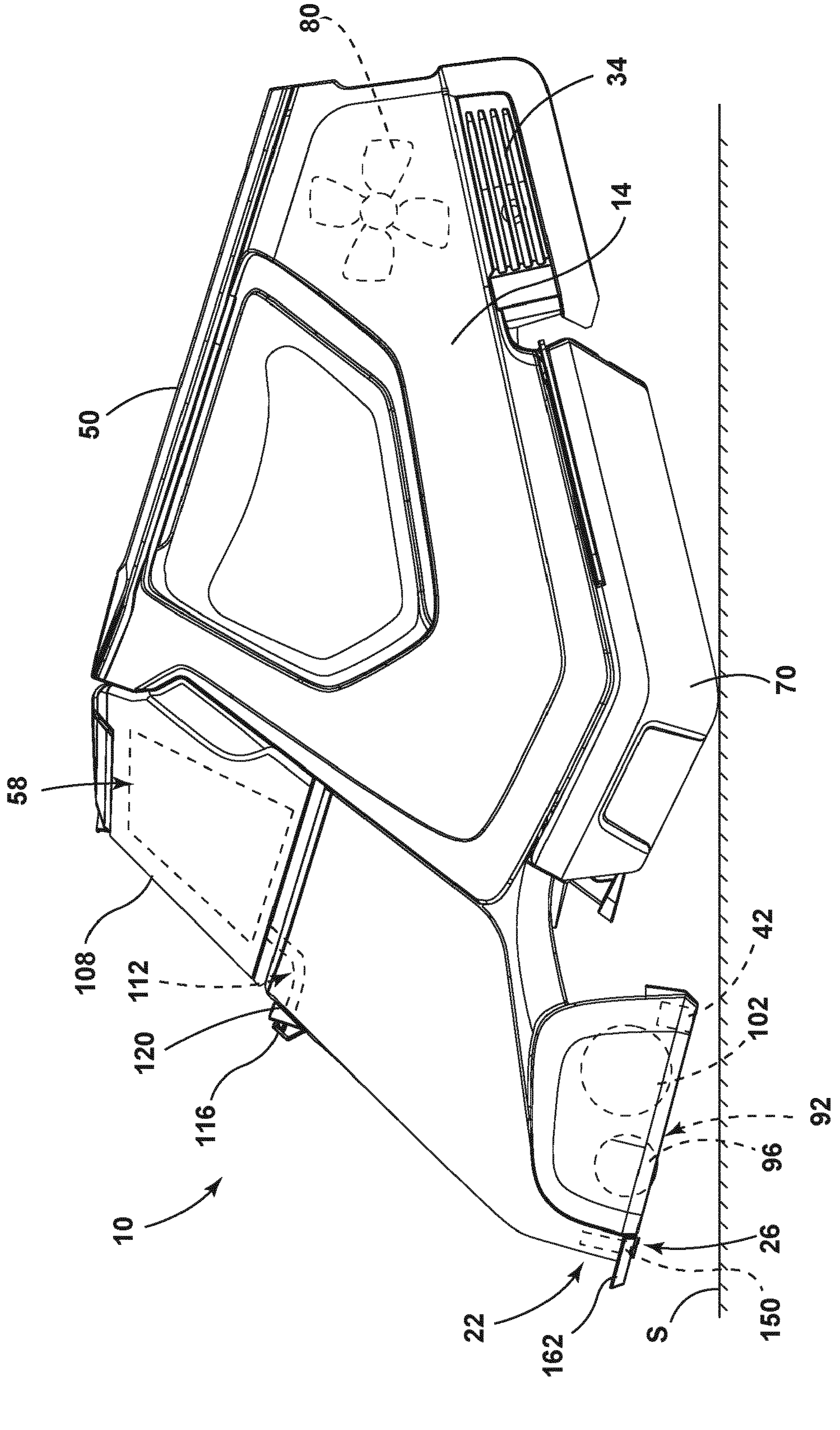

FIG. 5

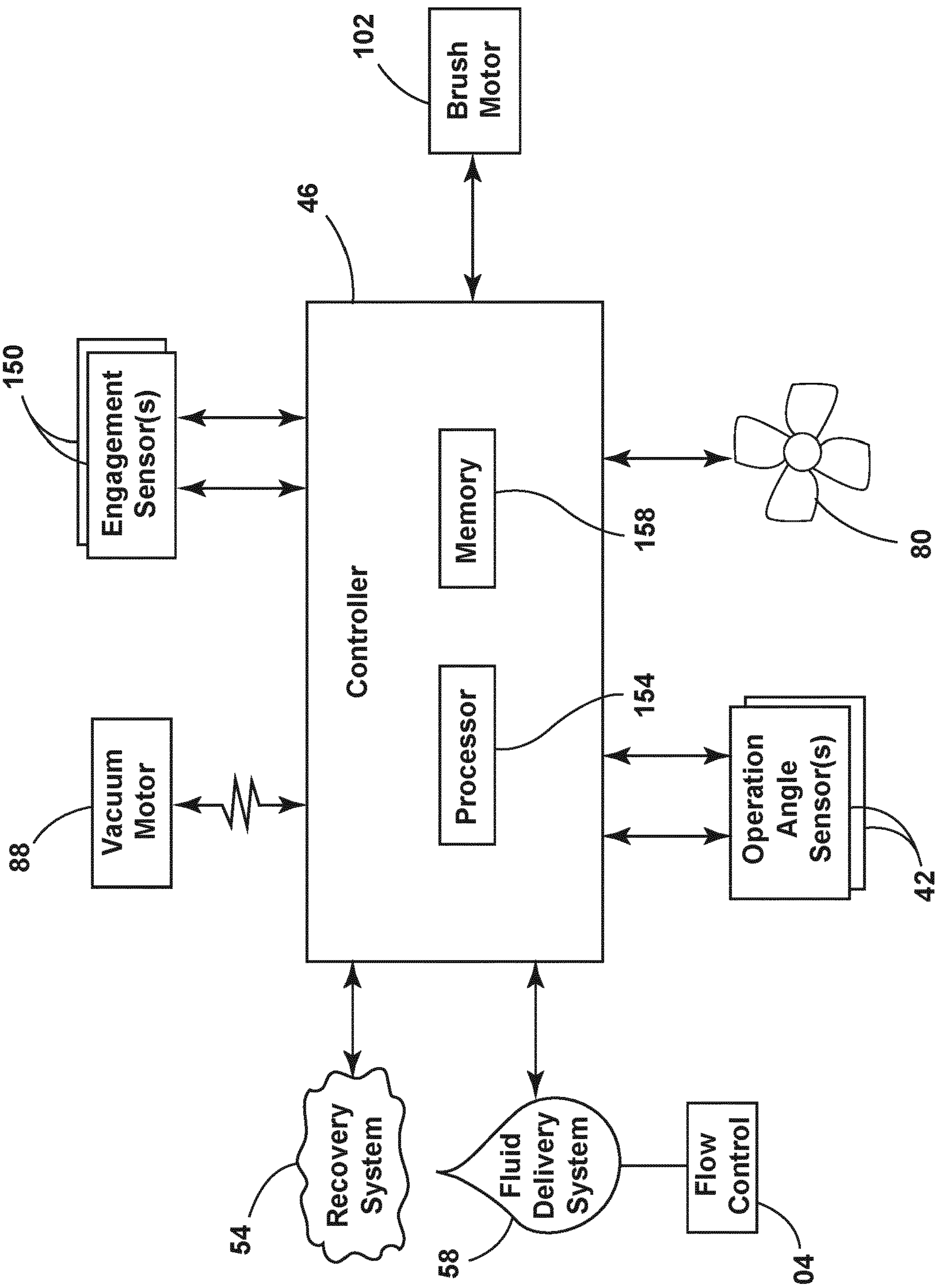
102
Brush Motor
46
150
Engagement Sensor(s)
Controller
Memory
158
80
88
Vacuum Motor
Processor
154
Operation Angle Sensor(s)
42
54
Recovery System
Fluid Delivery System
58
Flow Control
104

FIG. 6

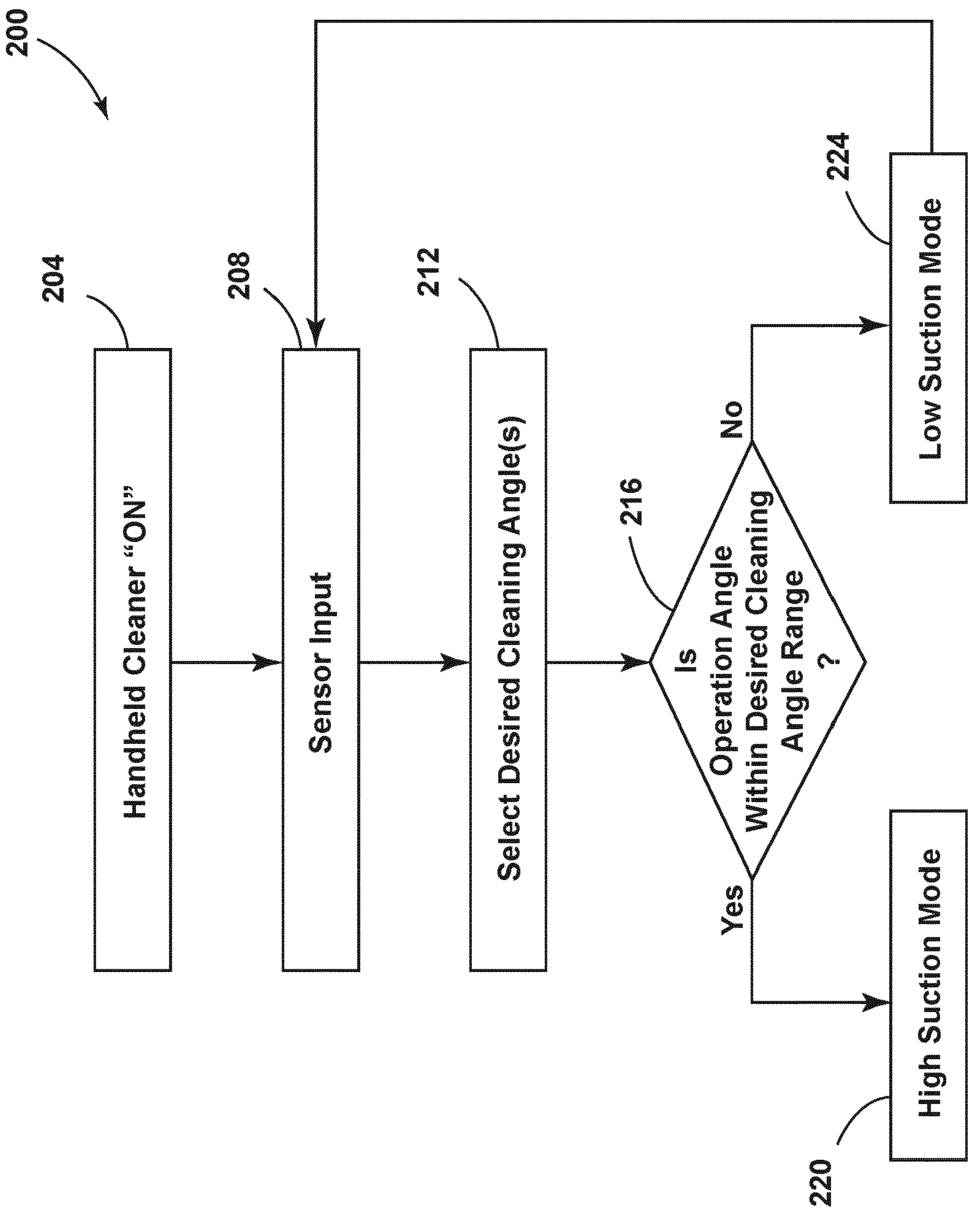
200
204
Handheld Cleaner "ON"
208
Sensor Input
212
Select Desired Cleaning Angle(s)
216
Is Operation Angle Within Desired Cleaning Angle Range ?
Yes
No
220
High Suction Mode
224
Low Suction Mode

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 24 15 0245

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	US 11 229 338 B2 (BISSELL INC [US]) 25 January 2022 (2022-01-25) * abstract; figures 1-31 *	1-15	
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A47L

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	23 May 2024	Hubrich, Klaus

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EP 24 15 0245

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