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(54) **SURFACE CLEANING APPARATUS**

(57) A surface cleaning apparatus such as a vacuum cleaner (10) includes a suction source (18), a recovery container, and a base assembly (34) with at least one agitator (26) within an agitator chamber (74). The recovery container (20) can be coupled to a separator assembly (140) configured to remove dirt and debris from working fluid through the surface cleaning apparatus (10). In addition, a user interface (84) can be provided for selective operation of components of the surface cleaning apparatus (10).

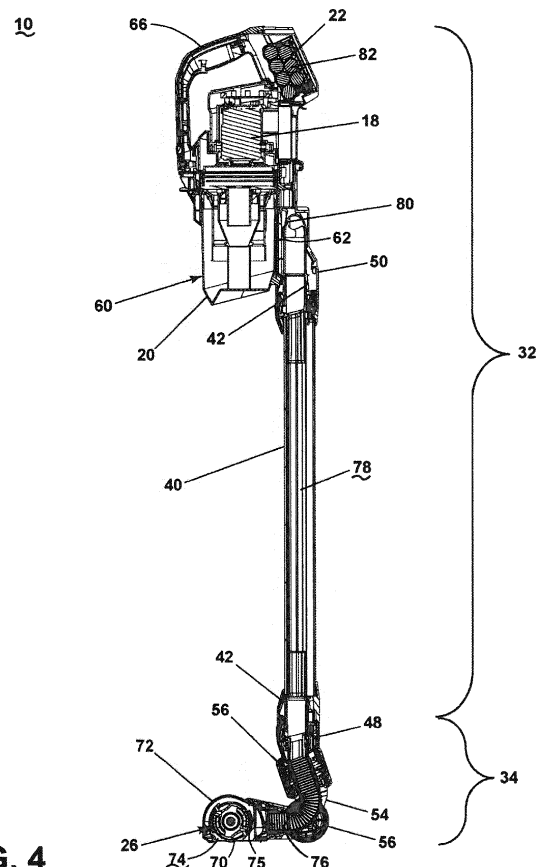


FIG. 4

Description

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 62/690,371, filed June 27, 2018 which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] Surface cleaning apparatuses such as vacuum cleaners are well-known devices for removing dirt and debris from a variety of surfaces such as carpets, hard floors, or other fabric surfaces such as upholstery. Such surface cleaning apparatuses typically include a recovery system including a recovery container, a nozzle adjacent the surface to be cleaned and in fluid communication with the recovery container through a conduit, and a source of suction in fluid communication with the conduit to draw debris-laden air from the surface to be cleaned and through the nozzle and the conduit to the recovery container.

BRIEF DESCRIPTION

[0003] In one aspect, the disclosure relates to a vacuum cleaner, including a base assembly including a suction nozzle and adapted for movement along a surface to be cleaned, a hand-held portion having a hand grip and a suction source in fluid communication with the suction nozzle and configured for generating a working air-stream, a working air path from the suction nozzle to an air outlet in the hand-held portion and including the suction source, and a headlight array located along a forward oriented portion of the base assembly, providing a beam that is substantially parallel to the surface to be cleaned and spaced above the surface to be cleaned at not more than 30 mm.

[0004] In yet another aspect, the disclosure relates to a vacuum cleaner, including a base assembly including a suction nozzle and adapted for movement along a surface to be cleaned, a hand-held portion having a hand grip, a recovery container with a collector axis defined through a center thereof, and a suction source in fluid communication with the suction nozzle and the recovery container and configured for generating a working air-stream, and a wand operably coupled between the base assembly and the hand-held portion and defining at least a portion of a working air path extending from the suction nozzle to an air outlet in the hand-held portion and including the suction source and wherein a wand axis is defined through a center of the wand and wherein the wand axis and the collector axis are parallel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] In the drawings:

FIG. 1 is a schematic view of a surface cleaning apparatus according to various aspects described herein.

FIG. 2 is a perspective view of the surface cleaning apparatus of FIG. 1 in the form of a hand-held vacuum cleaner including a base assembly and an upright assembly according to various aspects described herein.

FIG. 3 is a partially-exploded view of the vacuum cleaner of FIG. 2.

FIG. 4 is a side sectional view of the vacuum cleaner of FIG. 2 along line IV-IV.

FIG. 5 is a perspective view of a hand grip of FIG. 2 including a user interface according to various aspects described herein.

FIG. 6 is a partially-exploded view of the hand grip of FIG. 5 with a user interface in a first configuration. FIG. 7 is a sectional view of the hand grip and user interface of FIG. 6.

FIG. 8 is a sectional view of a hand-held vacuum cleaner portion of the upright assembly of FIG. 2 along line IV-IV.

FIG. 9 is a sectional view of a dirt separation and collection module in the hand-held vacuum cleaner portion of FIG. 8 according to various aspects described herein.

FIGS. 10A-10B illustrates an emptying process for the dirt separation and collection module of FIG. 9.

FIG. 11 is a partially-exploded view of a wand of the vacuum cleaner of FIG. 2 according to various aspects described herein.

FIG. 12 is a sectional view of the wand of FIG. 11 along line XII-XII.

FIG. 13 is a partially-exploded view of another wand that can be utilized in the vacuum cleaner of FIG. 2 according to various aspects described herein.

FIG. 14 is a sectional view of the wand of FIG. 13 along line XIV-XIV.

FIG. 15 is a partially-exploded view of the base assembly of FIG. 2 according to various aspects described herein.

FIG. 16 is a perspective view of a brushroll that can be utilized in the base assembly of FIG. 2 according to various aspects described herein.

FIG. 17 is a sectional view of the base assembly of FIG. 2.

FIG. 18 is a partially-exploded view of the base assembly of FIG. 2 illustrating an alternate brushroll that can be utilized in the base assembly.

FIG. 19 is a sectional view of the base assembly of FIG. 2.

DETAILED DESCRIPTION

[0006] The disclosure relates to a surface cleaning apparatus such as a hand-held surface cleaner that cleans debris from the surface. Such hand-held cleaners can be in the form of a stick vacuum or wand vacuum. The sur-

face cleaning apparatus also includes a hand grip with a user interface for selective operation of components of the surface cleaning apparatus. A base assembly can include an agitator chamber and an aperture. At least one agitator can be slidably received in the agitator chamber through the aperture.

[0007] FIG. 1 is a schematic view of various functional systems of a surface cleaning apparatus in the form of an exemplary vacuum cleaner 10. The functional systems of the exemplary vacuum cleaner 10 can be arranged into any desired configuration including as a portable cleaner adapted to be hand carried by a user for cleaning relatively small areas. The vacuum cleaner 10 can be adapted to include a hose or other conduit, which can form a portion of the working air conduit between a nozzle and the suction source.

[0008] The vacuum cleaner 10 can include a recovery system 14 for removing debris from the surface to be cleaned and storing the debris. The recovery system 14 can include a suction inlet or suction nozzle 16, a suction source 18 in fluid communication with the suction nozzle 16 for generating a working air stream, and a recovery container 20 for separating and collecting debris from the working airstream for later disposal.

[0009] The suction nozzle 16 can be provided on a base or cleaning head adapted to move over the surface to be cleaned. An agitator 26 can be provided adjacent to the suction nozzle 16 for agitating the surface to be cleaned so that the debris is more easily ingested into the suction nozzle 16. Some examples of agitators 26 include, but are not limited to, a horizontally-rotating brushroll, dual horizontally-rotating brushrolls, one or more vertically-rotating brushrolls, or a stationary brush.

[0010] The suction source 18 can be any suitable suction source and is provided in fluid communication with the recovery container 20. The suction source 18 can be electrically coupled to a power source 22, such as a battery or by a power cord plugged into a household electrical outlet. A suction power switch 24 between the suction source 18 and the power source 22 can be selectively closed by the user, thereby activating the suction source 18.

[0011] A separator 21 can be formed in a portion of the recovery container 20 for separating entrained debris from the working airstream.

[0012] The vacuum cleaner 10 shown in FIG. 1 can be used to effectively remove debris from the surface to be cleaned in accordance with the following method. The sequence of steps discussed is for illustrative purposes only and is not meant to limit the method in any way as it is understood that the steps may proceed in a different logical order, additional or intervening steps may be included, or described steps may be divided into multiple steps.

[0013] In operation, the vacuum cleaner 10 is prepared for use by coupling the vacuum cleaner 10 to the power source 22. During operation of the recovery system 14, the vacuum cleaner 10 draws in debris-laden working air

through the suction nozzle 16 and into the downstream recovery container 20 where the fluid debris is substantially separated from the working air. The airstream then passes through the suction source 18 prior to being exhausted from the vacuum cleaner 10. The recovery container 20 can be periodically emptied of collected fluid and debris.

[0014] FIG. 2 is a perspective view illustrating a vacuum cleaner 10 according to various aspects described herein. For purposes of description related to the figures, the terms "upper," "lower," "right," "left," "rear," "front," "vertical," "horizontal," "inner," "outer," and derivatives thereof shall be described from the perspective of a user behind the vacuum cleaner 10, which defines the rear of the vacuum cleaner 10. However, it is to be understood that the disclosure may assume various alternative orientations, except where expressly specified to the contrary.

[0015] In the illustrated example, the vacuum cleaner 10 can include a housing 30 with an upright assembly 32 and a base assembly 34. The upright assembly 32 can be pivotally connected to the base assembly 34 for directing the base assembly 34 across the surface to be cleaned. It is contemplated that the vacuum cleaner 10 can include any or all of the various systems and components described in FIG. 1, including a recovery system 14 for separating and storing dirt or debris from the surface to be cleaned. The various systems and components schematically described for FIG. 1 can be supported by either or both the base assembly 34 and the upright assembly 32 of the vacuum cleaner 10.

[0016] FIG. 3 illustrates a partially-exploded view of the vacuum cleaner 10 of FIG. 2. The upright assembly 32 includes a hand-held portion 36 supporting components of the recovery system 14, including, but not limited to, the suction source 18 and the recovery container 20. By way of non-limiting example, the suction source 18 can include a motor/fan assembly 124 (FIG. 8).

[0017] The hand-held portion 36 can be coupled to a wand 40 having at least one wand connector 42. In the illustrated example, both a first end 44 of the wand 40 and a second end 46 of the wand 40 include a wand connector 42. The wand connector 42 at the second end 46 of the wand 40 can be coupled to the base assembly 34 via a wand receiver 48. The wand connector 42 at the first end 44 of the wand 40 can couple to a second wand receiver 50 within the hand-held portion 36. It is contemplated that the wand connectors 42 can be the same type of connector or can vary. Any suitable type of connector mechanism can be utilized, such as a quick connect mechanism or a tubing coupler in non-limiting examples.

[0018] A pivotal connection between the upright assembly 32 and the base assembly 34 can be provided by at least one pivoting mechanism. In the illustrated example, the pivoting mechanism can include a multi-axis swivel joint assembly 52 configured to pivot the upright assembly 32 from front-to-back and side-to-side with respect to the base assembly 34. A lower portion 54 of the

swivel joint assembly 52 is located between the wand 40 and the base assembly 34. The lower portion 54 of the swivel joint assembly 52 provides for pivotal forward and backward rotation between the wand 40 and the base assembly 34. An upper portion 56 of the swivel joint assembly 52 is also located between the wand 40 and the base assembly 34 and provides for lateral or side-to-side rotation between the wand 40 and base assembly 34. More specifically, the lower portion 54 of the swivel joint assembly 52 is coupled between the base assembly 34 and the upper portion 56 of the swivel joint assembly 52. The upper portion 56 of the swivel joint assembly 52 is coupled to the wand receiver 48 at the second end 46 of the wand 40. Wheels 58 can be coupled to the lower portion 54 of the swivel joint assembly 52 or directly to the base assembly 34, and are adapted to move the base assembly 34 across the surface to be cleaned.

[0019] The hand-held portion 36 can also include the recovery container 20, illustrated herein as a dirt separation and collection module 60 fluidly coupled to the suction source 18 via an air outlet port 62. The dirt separation and collection module 60 can be removable from the hand-held portion 36 by a release latch 64 as shown so that it can be emptied of debris.

[0020] An upper end of the hand-held portion 36 can further include a hand grip 66 for maneuvering the vacuum cleaner 10 over a surface to be cleaned and for using the vacuum cleaner 10 in hand-held mode. At least one control mechanism 68 is provided on the hand grip 66 and coupled to the power source 22 (FIG. 1) for selective operation of components of the vacuum cleaner 10. In the contemplated example, the at least one control mechanism 68 is an electronic control that can form the suction power switch 24.

[0021] The agitator 26 of the illustrated embodiment includes a brushroll 70 (FIG. 4) configured to rotate about a horizontal axis and operatively coupled to a drive shaft of a drive motor via a transmission, which can include one or more belts, gears, shafts, pulleys, or combinations thereof. An example of which will be explained in more detail below. An agitator housing 72 is provided around the suction nozzle 16 and defines an agitator chamber 74 (FIG. 4) for the brushroll 70 (FIG. 4).

[0022] Referring now to FIG. 4, a recovery airflow conduit 75 can be formed between the agitator housing 72 and the dirt separation and collection module 60. For example, a hose conduit 76 in the base assembly 34 can be fluidly coupled to a wand central conduit 78 within the wand 40. The hose conduit 76 can be flexible to facilitate pivoting movement of the swivel joint assembly 52 about multiple axes. The wand central conduit 78 is fluidly connected to a dirt inlet 80 on the dirt separation and collection module 60 via the air outlet port 62.

[0023] In the illustrated example, the power source 22 is in the form of a battery pack 82 containing one or more batteries, such as lithium-ion (Li-Ion) batteries. Optionally, the vacuum cleaner 10 can include a power cord (not shown) to connect to a wall outlet. In still another

example, the battery pack 82 can include a rechargeable battery pack, such as by connecting to an external source of power to recharge batteries contained therein.

[0024] During operation of the vacuum cleaner 10, the power source 22 can supply power for the suction source 18, such as by way of non-limiting example a motor/fan assembly 124 (FIG. 8) to provide suction through the recovery airflow conduit 75. Debris-laden working air within the agitator housing 72 can be directed through the flexible hose conduit 76 and wand central conduit 78 before flowing into the dirt separation and collection module 60 by way of the dirt inlet 80 as shown. In addition, the swivel joint assembly 52 can provide for forward/backward and side-to-side pivoting motion of the upright assembly 32 with respect to the base assembly 34 when moving the base assembly 34 across the surface to be cleaned. Additional details of the motor/fan assembly 124 (FIG. 8) are described in US. Patent No. 10,064,530, issued Sep. 4, 2018, which is incorporated herein by reference in its entirety.

[0025] FIG. 5 illustrates an exemplary hand grip 66 that can be utilized in the vacuum cleaner 10. The hand grip 66 can include a user interface 84 with at least one status indicator for a component of the vacuum cleaner 10. The status indicator is illustrated in the form of a suction level indicator 86 and a battery level indicator 88. While not shown, other status indicators can be provided on the user interface 84. In non-limiting examples, an LED or text display (not shown) can also indicate that a filter is clogged, that the recovery container 20 needs emptying, or that a brushroll 70 needs cleaning or inspecting.

[0026] The suction level indicator 86 is illustrated as being positioned at lateral edges of the user interface 84 and can illuminate to show a current level of suction power. More specifically, three progressively-illuminated LEDs 90 can be positioned at each lateral edge to indicate a level of suction between "high," "medium," and "low" suction powers for the suction level indicator 86. For example, repeated pressing of a suction mode selector button 92 can cycle through the "high," "medium," and "low" suction power levels, and each LED 90 of the suction level indicator 86 can illuminate in sequence accordingly. In the illustrated example, the "medium" suction power level is shown wherein two of the three LEDs 90 are illuminated on the suction level indicator 86 of the user interface 84. It will be understood that, in the illustrated example, the suction mode selector button 92 is configured to operate the suction source 18 (FIG. 2) with low, medium, and high suction power, which in turn operates the suction source 18 including the motor/fan assembly 124 (FIG. 8) at predetermined low, medium and high rotational speeds. Further still, a power button 94 can be positioned adjacent the suction mode selector button 92 or elsewhere on the user interface 84 to selectively power the suction source 18.

[0027] The battery level indicator 88 is in the form of a series of lights, such as light-emitting diodes (LEDs) 96 that progressively illuminate to show a level of charge of

the battery pack 82. In an alternate example, the battery level indicator 88 can be in the form of a pre-drawn icon displayed on a screen to indicate a level of charge of the battery pack 82.

[0028] FIG. 6 illustrates an exploded view of the hand grip 66 of FIG. 5, which more clearly illustrates that the LEDs 90 and 96 can be provided within a substructure of the hand grip 66. An upper grip 100 with an aperture 102 configured to receive and surround the power button 94 and suction mode selector button 92. A lower grip 104 coupled to the upper grip 100 can include a reflective concave portion 106, such as a white-colored or reflective or mirrored surface. The lower grip 104 can also include a plurality of divider walls 108 to isolate light emitted by the LEDs 90 and 96. The LEDs 90 (FIG. 7) and 96 (FIG. 5 for the suction level indicator 86 and the battery level indicator 88, respectively, can be positioned on a printed circuit board (PCB) 110. In addition, an isolator 112 can be coupled to the PCB 110 and include a first seat 116a for the power button 94 and a second seat 116b for the suction mode selector button 92. The isolator 112 can include openings 118a, 118b along each lateral edge to permit light for the suction level indicator 86 to be emitted. The isolator 112 can further include additional openings 120 through which the LEDs 96 can shine for the battery level indicator 88.

[0029] FIG. 7 illustrates the assembled hand grip 66. As assembled within the hand grip 66, the PCB 110 defines a lower surface 114a and an upper surface 114b. The LEDs 90 for the suction level indicator 86 are positioned on the lower surface 114a of the PCB 110 and emit light downward, toward the lower grip 104 as illustrated by first arrows 123. The reflective concave portion 106 of the lower grip 104 reflects the emitted light upward, toward the upper grip 100. Overmolded portions 122 of the lower grip 104 can block or redirect emitted light from the LEDs 90 to shine upwardly toward the isolator 112. The openings 118a, 118b along each lateral edge of the isolator 112 permit the emitted light to shine through at the edges of the upper grip 100, as indicated via arrow 125, thereby forming the suction level indicator 86 at each lateral edge of the hand grip 66. It is further contemplated that the upper grip 100 can include molded or shaped portions to further direct or diffuse the emitted light, such as a translucent portion forming a viewing window for each LCD in the suction level indicator 86.

[0030] Turning to FIG. 8, the assembled hand-held portion 36 of the upright assembly 32 is shown including a portion of the wand 40, the battery pack 82, the hand grip 66, the motor/fan assembly 124, and the dirt separation and collection module 60.

[0031] As illustrated, a wand axis 126 can be defined through the center of the wand 40 (FIG. 4) and wand connector 42. In FIG. 8 the wand 40 is held upright, and thus the wand axis 126 is vertical. In this example, references to "a vertical axis" will be understood to also refer to the wand axis 126. It will be understood, that during use the wand 40 may be oriented in any suitable manner

including angled with respect to the vertical axis.

[0032] A collector axis 128 can be defined through the center of the dirt separation and collection module 60, and a motor axis 130 can be defined through the center of the motor/fan assembly 124. It is contemplated that the wand axis 126, the collector axis 128, and the motor axis 130 can all be parallel to one another as shown. Put another way, when the wand 40 is held upright such that the wand axis 126 is vertical, the collector axis 128 and the motor axis 130 are also vertical.

[0033] A grip axis 132 can be defined through the center of the hand grip 66 as shown. The grip axis 132 forms a grip angle 134 with respect to a vertical direction, such as 60 degrees in a non-limiting example. Further, a battery axis 136 can be defined through the center of the battery pack 82 and intersect the grip axis 132. The battery axis 136 can also define a battery angle 138 with respect to a vertical direction, such as 30 degrees in a non-limiting example. Optionally, the grip axis 132 can be orthogonal to the battery axis 136.

[0034] FIG. 9 illustrates additional details of the dirt separation and collection module 60. The dirt separation and collection module 60 can include a dirt cup in the form of recovery container 20 with an inlet port in the form of the dirt inlet 80, and a separator assembly 140 coupled to the recovery container 20. Working air can enter through the dirt inlet 80 and swirls around a first stage separator assembly chamber 144 for centrifugally separating debris from the working air flow. The separator assembly 140 includes a first stage separator 142, such as a grill, that, in combination with the swirling working air, removes relatively large debris out of the working air which collects at a lower portion of the recovery container 20 defining a first stage collection area 146.

[0035] The working air moves through an inlet to a second stage separator 148 in the separator assembly 140, such as a grill or a mesh configured to filter smaller debris, and enters a second stage separation chamber 150, which is shown as a cyclonic separator herein. Smaller debris removed from the working air collects in a second stage collector 152 near the bottom of the recovery container 20. The first stage collector 146 can surround the second stage collector 152 as shown.

[0036] An exhaust outlet 154 and filter housing 158 are fluidly coupled to an upper portion of the second stage separation chamber 150. With additional reference to FIG. 8, working air exits the second stage separation chamber 150 through the exhaust outlet 154 and at least one filter in the filter housing 158 and which is shown herein as a pre-motor filter 156 of the motor/fan assembly 124. The filtered working air flows into the motor/fan assembly 124 whereupon it can be exhausted into the surrounding atmosphere through an exhaust filter, i.e. a post-motor filter 155, and an air outlet of the working air pathway through the vacuum cleaner 10, which is shown herein as formed by an exhaust grill 153.

[0037] The outer surface of the first stage separator 142 can accumulate debris, such as hair, lint, or the like

that may become stuck thereon and may not fall into the first stage collection area 146. FIG. 10A shows the separator assembly 140 being removed and FIG. 10B shows the separator assembly 140 fully removed from the recovery container 20 to empty collected dirt and debris from the first and second stage collection areas 146 and 152.

[0038] The separator assembly 140 can further include a ring 161 slidably coupled to the recovery container 20. The ring 161 can be coupled to a wiper 160, such as an annular wiper, configured to contact the first stage separator 142. The separator assembly 140 can be lifted upwards with respect to the ring 161 and recovery container 20. During this lifting, the ring 161 temporarily remains coupled to the recovery container 20, either by friction fit or a mechanical coupling such as bayonet hook, for example, and the wiper 160 slides or scrapes along the first stage separator 142 to remove accumulated debris from the outer surface of the first stage separator 142 or grill, which falls down to the first stage collection area 146.

[0039] When the separator assembly 140 has been raised to a predetermined level, it can lift away from the recovery container 20 along with the ring 161 and wiper 160. The recovery container 20 can then be inverted to remove dirt and debris from the first and second stage collection areas 146 and 152. After emptying, the separator assembly 140 can be repositioned within the recovery container 20 and the ring 161 can once again be coupled to the recovery container 20 for additional use of the vacuum cleaner 10.

[0040] FIG. 11 shows additional details of an exemplary wand assembly, which can include a wand body 162 enclosing the wand central conduit 78. In one example, the wand body 162 can be formed from an extrusion of aluminum, and is illustrated as having an exterior rounded triangular geometric profile defining an outer periphery 168 (FIG. 12). Wand connectors 42 can couple to the wand body 162 at each end 44 and 46. A first wand connector 42 can couple the wand body 162 to the base assembly 34 and a second wand connector 42 can couple the wand body 162 to the hand-held portion 36 (FIG. 3).

[0041] A decorative insert 166 can be coupled to at least a portion of the wand body 162. In the illustrated example, the decorative insert 166 can be in the form of a flat plate and configured to couple to a recessed portion defining a face 164 of the triangular shaped wand body 162. Optionally, the decorative insert 166 can include rounded edges to form smooth surface transitions between an outer surface of the decorative insert and a second face of the wand body. It is contemplated that the decorative insert 166 can be formed of plastic, including transparent or translucent plastic. Optionally, the decorative insert 166 can include logos or other markings or indicators for operations of the vacuum cleaner 10, or locating features so as to couple a correct end of the wand body 162 to one of the base assembly 34 or hand-

held portion 36 of the upright assembly 32, for example.

[0042] FIG. 12 illustrates a sectional view of the wand 40. It is contemplated that the wand body 162 can include an outer wall defining the outer periphery 168 with at least one inner partition 170 defining the wand central conduit 78. The outer wall defining the outer periphery 168 is further illustrated as including a hook 172 defining a corresponding recess 174 on either side of the face 164. Protrusions 176 on either side of the decorative insert 166 can be received within the recesses 174. It is contemplated that the protrusions 176, or the entire decorative insert 166, can have material flexibility such that the protrusions 176 can be "snap-fit" into the recesses 174 of the wand body 162. In another non-limiting example, the protrusions 176 can be made of a material having higher elasticity than that of a remainder of the decorative insert 166, such as a plastic decorative insert having rubber hooked portions configured to snap-fit or snugly insert into the recesses 174 of the wand body 162.

[0043] FIG. 13 illustrates another embodiment of a wand assembly that can be utilized in the vacuum cleaner 10. In the illustrated example, the wand body 162a can have a generally V-shaped geometric profile with an open face 163 on one side, such as by forming a V-shaped extrusion of aluminum. A tubular member 165 can be coupled within the wand body 162a. The tubular member 165 can have an inner surface defining the wand central conduit 78a, and an outer surface shaped to form a smooth surface transition between the tubular member 165 and the wand body 162a.

[0044] FIG. 14 illustrates a sectional view with the tubular member 165a assembled within the wand body 162a. The wand body 162a can have an outer wall 168a with at least one projection 176a. The tubular member 165a can have a corresponding at least one recess 172c formed by spaced walls 172a and 172b. The at least one recess 172c is configured to surround the at least one projection 176a to securely fix the tubular member 165a in place. In one example, the at least one projection 176a can be formed from an elastic material to provide "snap-fit" coupling between the tubular member 165a and wand body 162a. In another example, the wand body 162a can have sufficient elasticity such that the tubular member 165a can be press-fit into the wand body 162a, and the at least one projection 176a can "snap" into place within the corresponding at least one recess 172c.

[0045] The tubular member 165a can be formed from a transparent material such as extruded thermoplastic or polycarbonate material. In such a case, the assembled wand would include a transparent face defined by the exposed face of the tubular member 165a when assembled within the wand body 162a. In this configuration, a transparent tubular member would provide visibility within the wand central conduit 78a, such that dirt and debris moving through the conduit would be visible to a user during operation of the vacuum cleaner 10. Additionally, potential obstructions or clogs within the tubular member could also be viewed in a facile manner through the trans-

parent tubular member. A transparent section 167 has been illustrated in the tubular member 165a by way of non-limiting example.

[0046] FIG. 15 illustrates one embodiment of a base assembly 34. The base assembly 34 can extend between a first side 180 and a second side 182 and a cover 184 can at least partially define the agitator chamber 74 therebetween. An aperture 186 is located in a portion of the second side 182 and allows for insertion and removal of the brushroll 70. A front bar 188 extends between the first side 180 and the second side 182 along a lower portion of the base assembly. The front bar 188 is configured to be located behind the cover 184 when the cover 184 is mounted. A headlight array 190 is illustrated as being located on the front bar 188 and extending along the width of the base assembly between the first side 180 and the second side 182. The headlight array 190 can be any suitable illumination assembly including an LED headlight array. Even though the headlight array 190 is positioned under the cover 184 it can be considered to be positioned along an outer portion of the base assembly 34. In one example, the cover 184 can include a transparent portion such that when installed, the transparent portion covers and protects the headlight array 190 and permits emitted light to shine through to the surface to be cleaned. In another example, the cover 184 can leave the headlight array 190 uncovered so as not to block emitted light from the headlight array 190.

[0047] A brushroll 70 can be positioned within the agitator chamber 74 by sliding a first end through the aperture 186 located at the second side 182 of the base assembly 34. When fully inserted, a second end 70b of the brushroll 70 can be flush with the aperture 186. In addition, the hose conduit 76 can fluidly couple the agitator chamber 74 to the wand central conduit 78 (FIG. 4).

[0048] The base assembly 34 can include a brush drive assembly 192 positioned opposite the aperture 186 and configured to drive rotational motion of the agitator 26 (e.g. brushroll 70) within the agitator chamber 74. The brush drive assembly 192 can have components including, but not limited to, a brush motor 226, a belt 228 within a belt housing 229, and a brush drive gear 220.

[0049] Additional details of the brushroll 70 are shown in FIG. 16. The first end of the brushroll 70 can include an end plate 194 having projections 196, such as teeth, configured to engage a portion of the brush drive assembly 192 (FIG. 15). The brushroll 70 further includes a central shaft 222 coupled to brush bearings 224 (FIG. 17) at each end. In the illustrated example, the brushroll 70 includes a bristled brushroll 70 with offset, swept tufts 202 extending along an outer surface of the brushroll 70. The bristle tufts 202 can be positioned offset from a center line 204 of a tufting platform 206, and the tufts 202 can also be non-orthogonal to the tufting platform 206. In this manner, the bristled brushroll 70 can be configured to prevent hair from wrapping around the brushroll 70 during operation. Additional details of a similar brushroll are described in U.S. Publication No. 2018-0125315, which is

incorporated herein by reference in its entirety.

[0050] The assembled base assembly 34 is shown in FIG. 17, where the projections 196 of the end plate are coupled with the brush drive gear 220. In this manner the brush drive gear 220 is also coupled to the shaft 222 by way of a drive gear bearing 229. With additional reference to FIG. 15, as the brush motor 226 drives rotation of the belt 228 and brush drive gear 220, the brushroll 70 can be rotated at a variety of speeds depending on the selected suction mode (FIG. 5). A brush removal endcap 230 at the second end of the brushroll 70 provides for unlocking or removal of the brushroll 70 from the agitator chamber 74, such as for cleaning of the bristle tufts 202.

[0051] It is contemplated that a variety of agitators 26 and brushrolls 70 can be utilized within the agitator chamber 74. FIG. 18 illustrates a microfiber brushroll 210 that can be utilized. The micro fiber brushroll 210 is similar to the bristled brushroll 70; one difference is the outer surface includes a microfiber layer instead of bristles. Whereas bristles can be utilized to lift hair and debris from carpet fibers, the microfiber layer can lift dirt and debris from hard surfaces such as wood or tile. Each of the brushrolls can include a brush removal endcap 198 including fasteners 212. In the illustrated example, the fasteners 212 include bayonet fasteners wherein a given brushroll is inserted through the aperture 186 and rotated, for example by 30 degrees, to lock the brushroll into place within the agitator chamber 74 (FIG. 19) via corresponding fastener receivers 214. It will be understood that other brushroll types not explicitly described can be utilized in the vacuum cleaner 10.

[0052] FIG. 19 illustrates the base assembly 34 sitting on a surface to be cleaned, the surface to be cleaned defining a first plane 230. As illustrated in cross-sectional view a center line of the headlight array 190 can be defined as a second plane 232. The second plane 232 is spaced above the first plane defined by the surface to be cleaned by a height 234. It has been determined that providing the headlight array 190 close to the first plane 230 and relatively low on the base assembly 34 provides unexpected benefits. The height can be any suitable small height that provides such benefits including, by way of non-limiting examples, spaced above the surface to be cleaned at not more than 30 mm, at less than 20 mm, and at 15.8 mm. Further still, by way of non-limiting example, the illuminance measurements as a delta from ambient values at 2 meters from the headlight array 190 can be 16 Lux and at 10 cm can be greater than 1000 Lux. In another example, the headlight array 190 can be aligned with the lower front edge of the front bar 188.

[0053] More specifically, during operation of the vacuum cleaner 10 when the headlight array 190 provides illumination it has been determined that the placement of the headlight array 190 in this very low position across the front of the base assembly 34 illuminates the surface to be cleaned very well, including that dust and/or debris are illuminated exceptionally well. It has been determined that performance is noticeably better as compared to

when LEDs are mounted higher up and pointing downwardly at the surface to be cleaned. Because of the low position of the headlight array 190 and because the headlight array 190 faces forward and projects illumination at substantially a horizontal projection along the second plane 232 shadows are cast by debris on the surface to be cleaned and these shadows are very obvious to a user of the vacuum cleaner 10. It will be understood that the beam provided by the headlight array 190 can be projected with a zero-degree angle that provides a beam that is parallel to the surface to be cleaned as defined by the first plane 230.

[0054] To the extent not already described, the different features and structures of the various embodiments of the present disclosure may be used in combination with each other as desired. Thus, the various features of the different embodiments may be mixed and matched as desired to form new embodiments, whether or not the new embodiments are expressly described.

[0055] For example, various characteristics, aspects, and advantages of the present invention may also be embodied in the following technical solutions defined by the following clauses and may include any combination of the following concepts:

A vacuum cleaner, comprising:

- a base assembly including a suction nozzle and adapted for movement along a surface to be cleaned;
- a hand-held portion having a handle grip and a suction source in fluid communication with the suction nozzle and configured for generating a working airstream;
- a working air path from the suction nozzle to an air outlet in the hand-held portion and including the suction source; and
- a headlight array located along a forward oriented portion of the base assembly, providing a beam that is substantially parallel to the surface to be cleaned and spaced above the surface to be cleaned at not more than 30 mm.

2. The vacuum cleaner of clause 1 wherein the headlight array includes a plurality of LEDs spaced along a width of the base assembly.

3. The vacuum cleaner of clause 2 wherein the plurality of LEDs have a centerline that is less than 20 mm above a plane defined by the surface to be cleaned.

4. The vacuum cleaner of clause 2 wherein the plurality of LEDs provide an illuminance measurement as a delta from ambient values of at least 16 Lux at 2 meters and greater than 1000 Lux at 10 cm.

5. The vacuum cleaner of any permutation of the clauses 1-4 wherein the beam is at a zero-degree beam angle.

6. The vacuum cleaner of any permutation of

the clauses 1-5 wherein the working air path is at least partially defined by a wand operably coupled between the base assembly and the hand-held portion.

7. The vacuum cleaner of clause 6 wherein the wand comprises an outer periphery having a triangular profile.

8. The vacuum cleaner of clause 7 wherein the wand includes a decorative insert operably coupled to a recess within a wand body and the decorative insert and the wand body together form the outer periphery or wherein the wand includes a tubular insert operably coupled within a recess of a wand body and the tubular insert and the wand body together form the outer periphery.

9. The vacuum cleaner of clause 6, further comprising a swivel joint moveably coupling a lower end of the wand to the base assembly.

10. The vacuum cleaner of clause 6 wherein the hand-held portion further comprises a debris removal assembly including a recovery container provided in fluid communication with the suction source.

11. The vacuum cleaner of clause 10 wherein the suction source includes a motor/fan assembly operably coupled to the debris removal assembly to form a single, hand-carriable unit.

12. The vacuum cleaner of clause 11 wherein the hand grip extends away from at least one of the motor/fan assembly or the recovery container to define a handle opening and where the handle grip is adapted to be gripped by a user.

13. The vacuum cleaner of clause 11, further comprising a pre-motor filter assembly mounted to the hand-held portion and defining a portion of the working air path, the pre-motor filter assembly comprising at least one pre-motor filter received within a filter chamber at an upper end of the recovery container.

14. The vacuum cleaner of clause 10 wherein the debris removal assembly comprises a cyclonic separator chamber for separating contaminants from the working air path and a collection chamber for receiving contaminants separated in the separator chamber, the collection chamber defined at least in part by the recovery container.

15. The vacuum cleaner of clause 14 wherein the debris removal assembly further comprises a second downstream cyclonic separator chamber and a second collection chamber for receiving contaminants separated in the second separator chamber.

16. The vacuum cleaner of clause 15 wherein the second downstream cyclonic separator chamber is located concentrically within the cyclonic separator chamber.

17. The vacuum cleaner of clause 16 wherein an inner housing is selectively receivable within the recovery container and the inner housing defines the second downstream cyclonic separator chamber and the second collection chamber.

18. The vacuum cleaner of clause 17, further comprising an annular wiper configured to slidably contact a portion of the inner housing.

19. The vacuum cleaner of any permutation of the clauses 1-18 wherein the base assembly further comprises an agitator chamber at the suction nozzle and a removable brushroll selectively located therein.

20. A vacuum cleaner, comprising:

a base assembly including a suction nozzle and adapted for movement along a surface to be cleaned;

a hand-held portion having a handle grip, a recovery container with a collector axis defined through a center thereof, and a suction source in fluid communication with the suction nozzle and the recovery container and configured for generating a working airstream; and

a wand operably coupled between the base assembly and the hand-held portion and defining at least a portion of a working air path extending from the suction nozzle to an air outlet in the hand-held portion and including the suction source and wherein a wand axis is defined through a center of the wand and wherein the wand axis and the collector axis are parallel.

21. The vacuum cleaner of clause 20 wherein the suction source includes a motor/fan assembly operably coupled to the recovery container to form a single, hand-carriable unit and the motor/fan assembly defines a motor axis that is parallel to the wand axis and the collector axis.

22. The vacuum cleaner of any permutation of the clauses 20-21 wherein a grip axis is defined through a center of the handle grip and forms an acute angle with respect to the collector axis.

23. The vacuum cleaner of clause 22, further comprising a battery pack located on the hand-held portion and wherein a battery axis is defined through the center of the battery pack and intersects the grip axis at an orthogonal angle.

[0056] While aspects of the present disclosure have been specifically described in connection with certain specific embodiments thereof, it is to be understood that this is by way of illustration and not of limitation. Reasonable variation and modification are possible within the scope of the forgoing disclosure and drawings without departing from the spirit of the present disclosure which

is 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.

Claims

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

a base assembly (34) including a suction nozzle (16) and adapted for movement along a surface to be cleaned;

a hand-held portion (36) having a hand grip (66), a recovery container (20) with a collector axis (128) defined through a center thereof, and a suction source (18) in fluid communication with the suction nozzle (16) and the recovery container (20) and configured for generating a working airstream; and

a wand (40) operably coupled between the base assembly (34) and the hand-held portion (36) and defining at least a portion of a working air path extending from the suction nozzle (16) to an air outlet in the hand-held portion (36) and including the suction source (18) and wherein a wand axis (126) is defined through a center of the wand (40) and wherein the wand axis (126) and the collector axis (128) are parallel.

2. The surface cleaning apparatus (10) of claim 1 wherein the suction source (18) includes a motor/fan assembly (124) operably coupled to the recovery container (20) to form a single, hand-carriable unit (36) and the motor/fan assembly (124) defines a motor axis (130) that is parallel to the wand axis (126) and the collector axis (128).

3. The surface cleaning apparatus (10) of any of claims 1-2 wherein a grip axis (134) is defined through a center of the hand grip (66) and forms an acute angle with respect to the collector axis (128).

4. The surface cleaning apparatus (10) of claim 3, further comprising a battery pack (82) located on the hand-held portion (36) and wherein a battery axis (136) is defined through the center of the battery pack (82) and intersects the grip axis (134) at an orthogonal angle.

5. The surface cleaning apparatus (10) of any of claims 1-4 wherein the wand (40) comprises an outer periphery (168, 168a) having a triangular profile wherein the wand (40) includes a decorative insert (166) operably coupled to a recess (174) within a wand body (162) and the decorative insert (166) and the wand body (162) together form the outer periphery

- (168) or wherein the wand (40) includes a tubular insert (165) operably coupled within a recess (163) of a wand body (162a) and the tubular insert (165) and the wand body (162a) together form the outer periphery (168a).
6. The surface cleaning apparatus of any of claims 1-5, further comprising a headlight array (190) located along a forward oriented portion of the base assembly (34), providing a beam that is substantially parallel to the surface to be cleaned and spaced above the surface to be cleaned at not more than 30 mm.
 7. The surface cleaning apparatus (10) of any of claims 1-6, further comprising a swivel joint (52) moveably coupling a lower end of the wand (40) to the base assembly (34).
 8. The surface cleaning apparatus (10) of any of claims 1-7 wherein the hand grip (66) extends away from at least one of the suction source (18) or the recovery container (20) to define a handle opening and where the hand grip (66) is adapted to be gripped by a user.
 9. The surface cleaning apparatus (10) of any of claims 1-8, further comprising a pre-motor filter assembly mounted to the hand-held portion (36) and defining a portion of the working air path, the pre-motor filter assembly comprising at least one pre-motor filter (156) received within a filter chamber at an upper end of the recovery container (20).
 10. The surface cleaning apparatus (10) of any of claims 1-9 wherein the hand-held portion (36) further comprises a debris removal assembly (60), the debris removal assembly comprising a cyclonic separator chamber (144) for separating contaminants from the working air path and a collection chamber (146) for receiving contaminants separated in the separator chamber (144), the collection chamber (146) defined at least in part by the recovery container (20).
 11. The surface cleaning apparatus (10) of claim 10 wherein the debris removal assembly further comprises a second cyclonic separator chamber (150) that is downstream from the collection chamber (146) and a second collection chamber (152) for receiving contaminants separated in the second cyclonic separator chamber (150).
 12. The surface cleaning apparatus (10) of claim 11 wherein the second cyclonic separator chamber (150) is located concentrically within the cyclonic separator chamber (144).
 13. The surface cleaning apparatus (10) of any of claims 11-12 wherein an inner housing is selectively receivable within the recovery container (120) and the inner housing defines the second cyclonic separator chamber (150) and the second collection chamber (152).
 14. The surface cleaning apparatus (10) of claim 13, further comprising an annular wiper (160) configured to slidably contact a portion (142) of the inner housing.
 15. The surface cleaning apparatus (10) of any of claims 1-14 wherein the base assembly (34) further comprises an agitator chamber (74) at the suction nozzle (16) and a removable brushroll (70) selectively located therein.

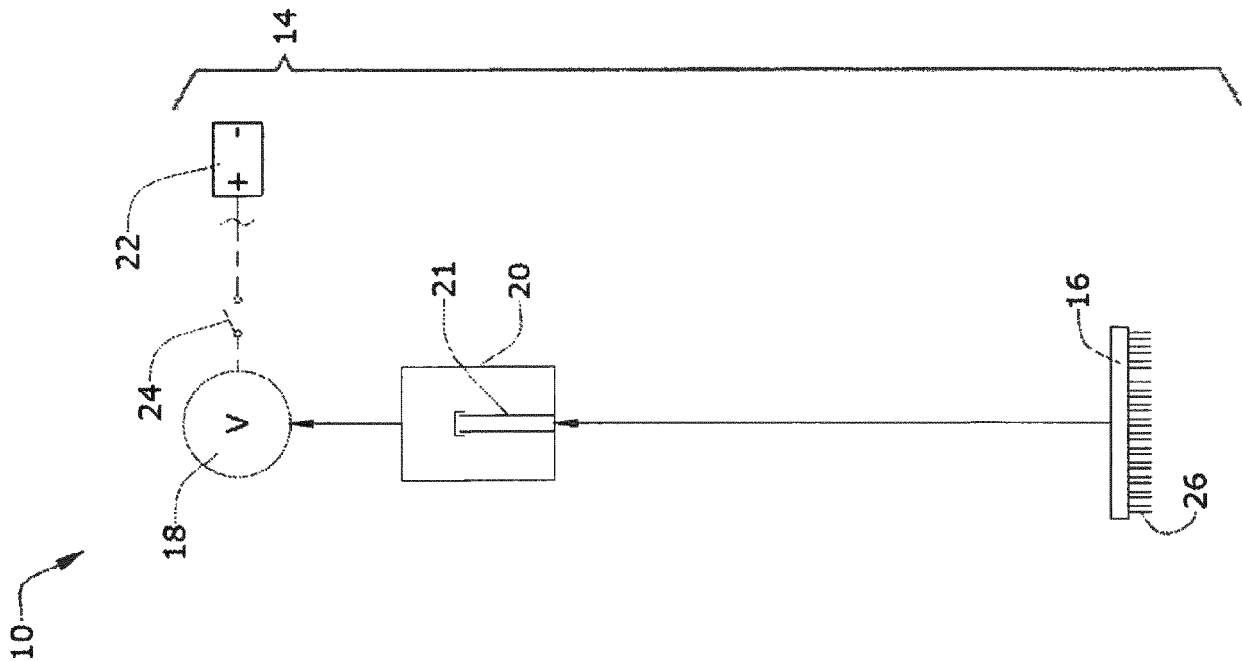


FIG. 1

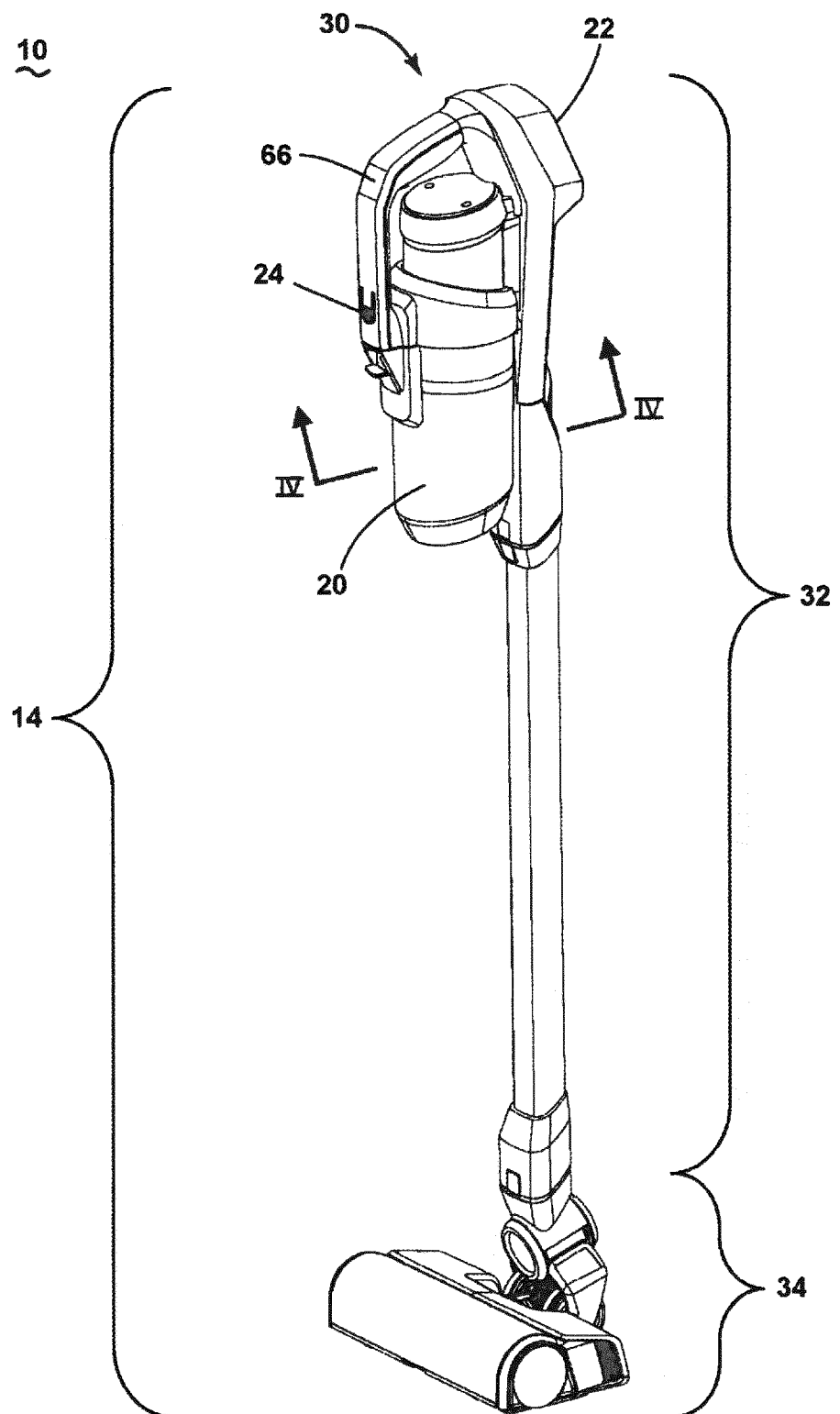


FIG. 2

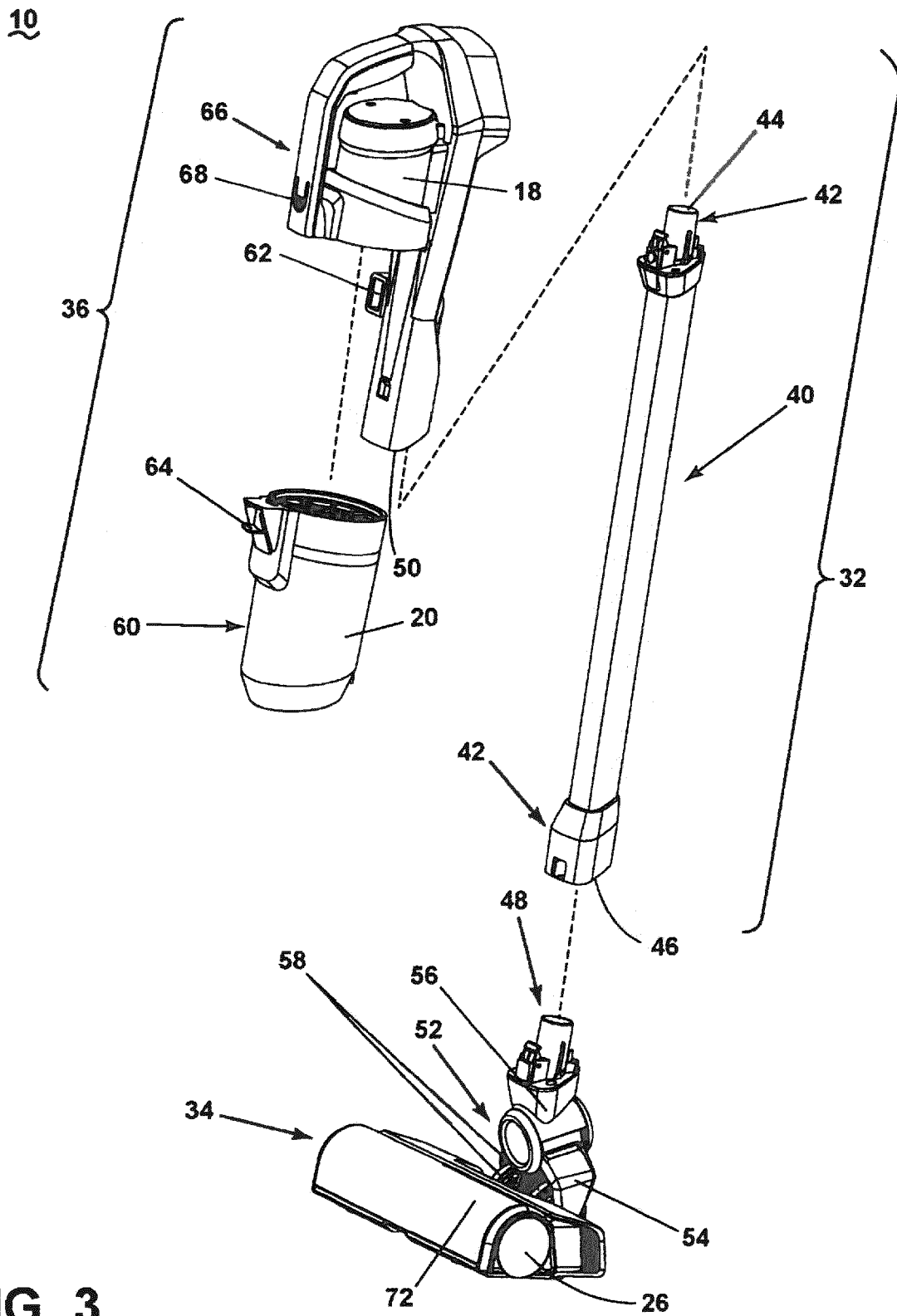
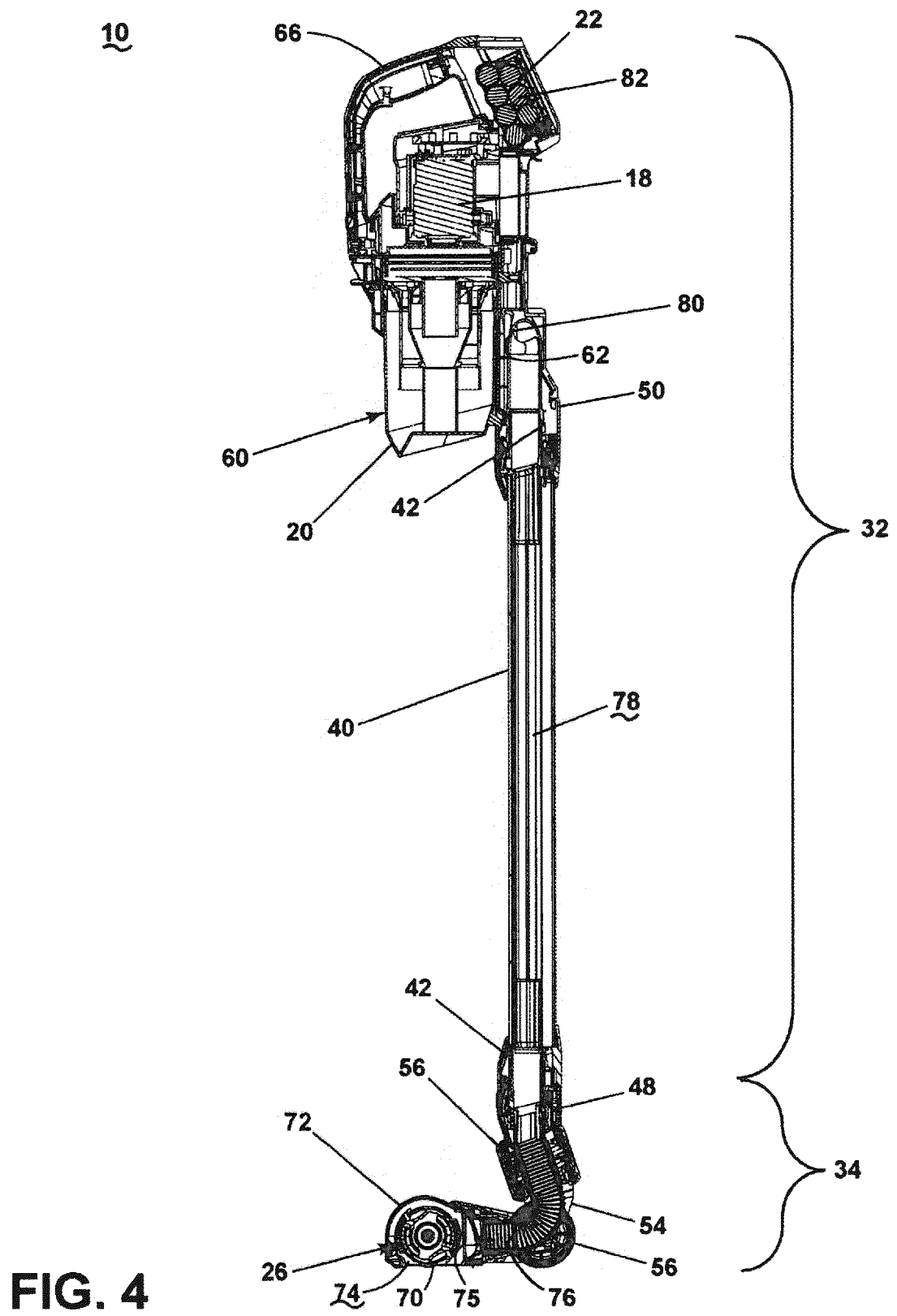


FIG. 3



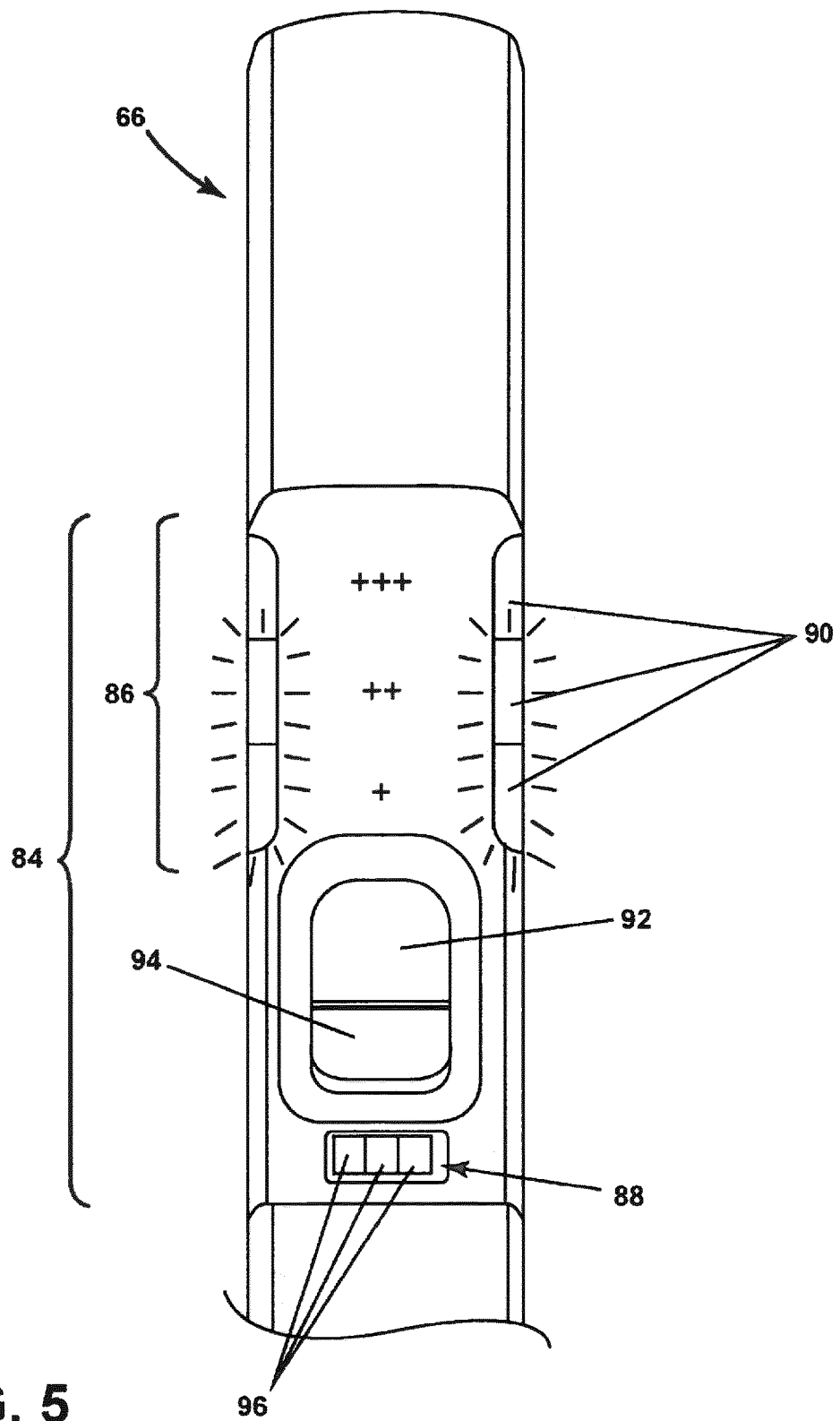


FIG. 5

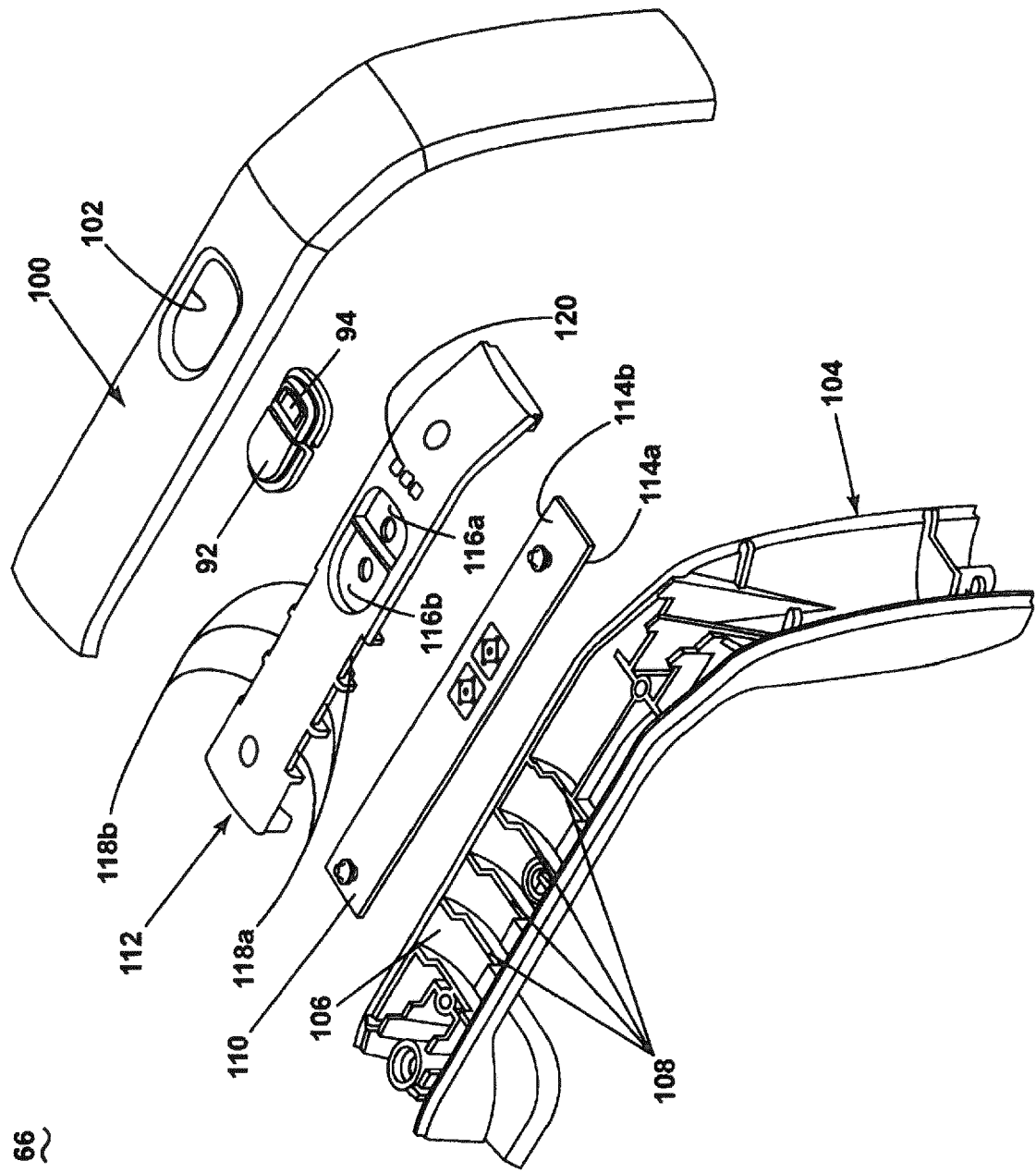


FIG. 6

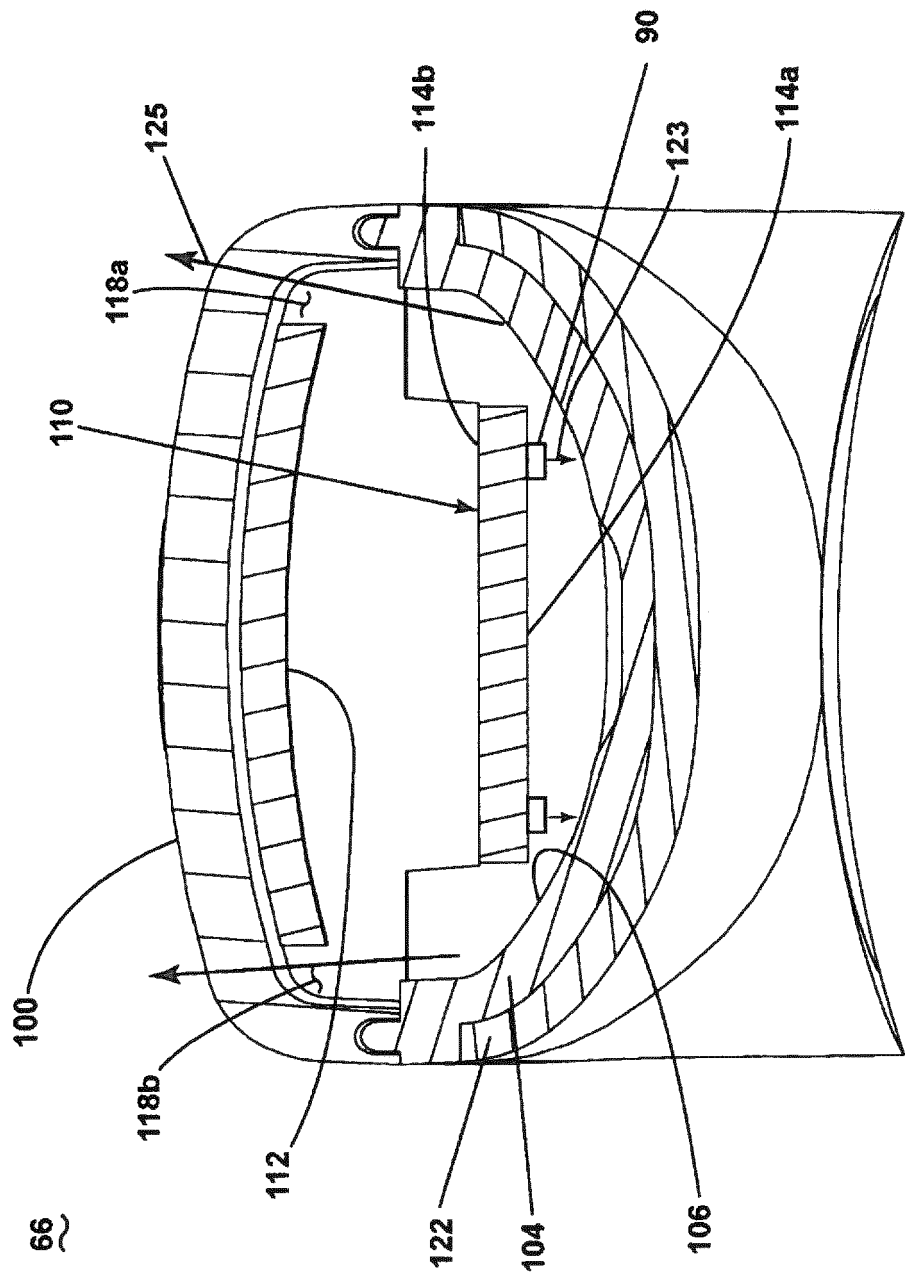


FIG. 7

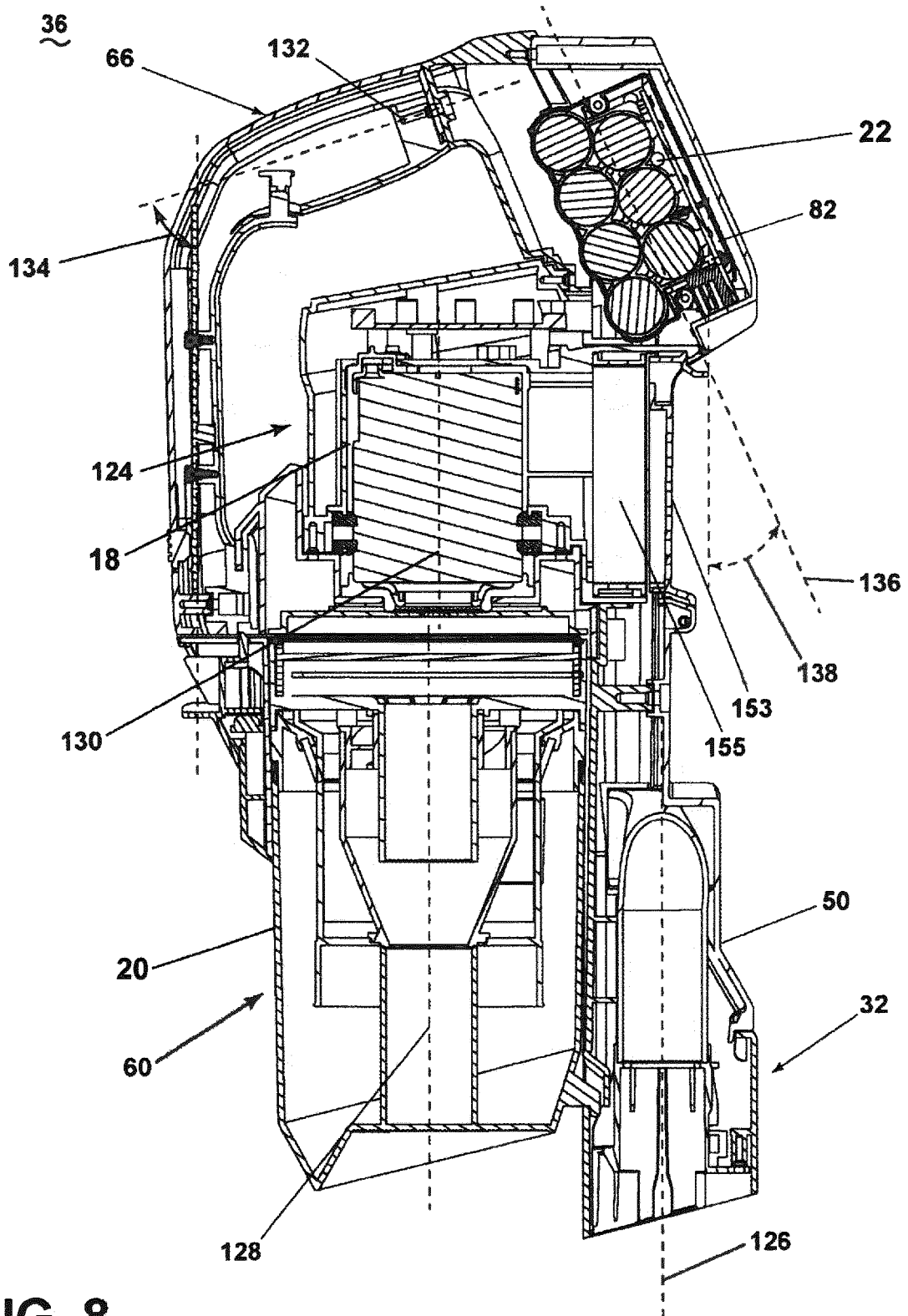


FIG. 8

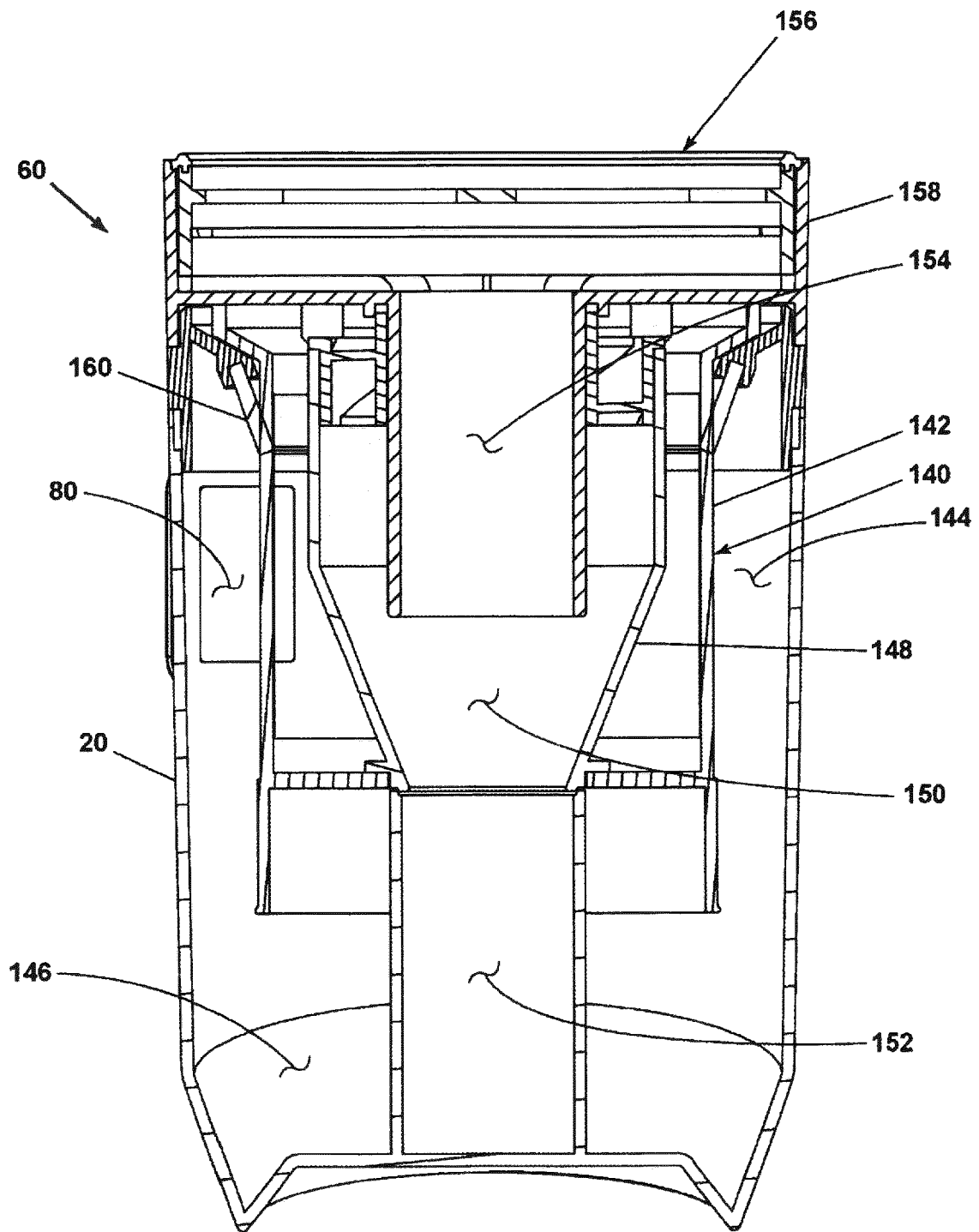


FIG. 9

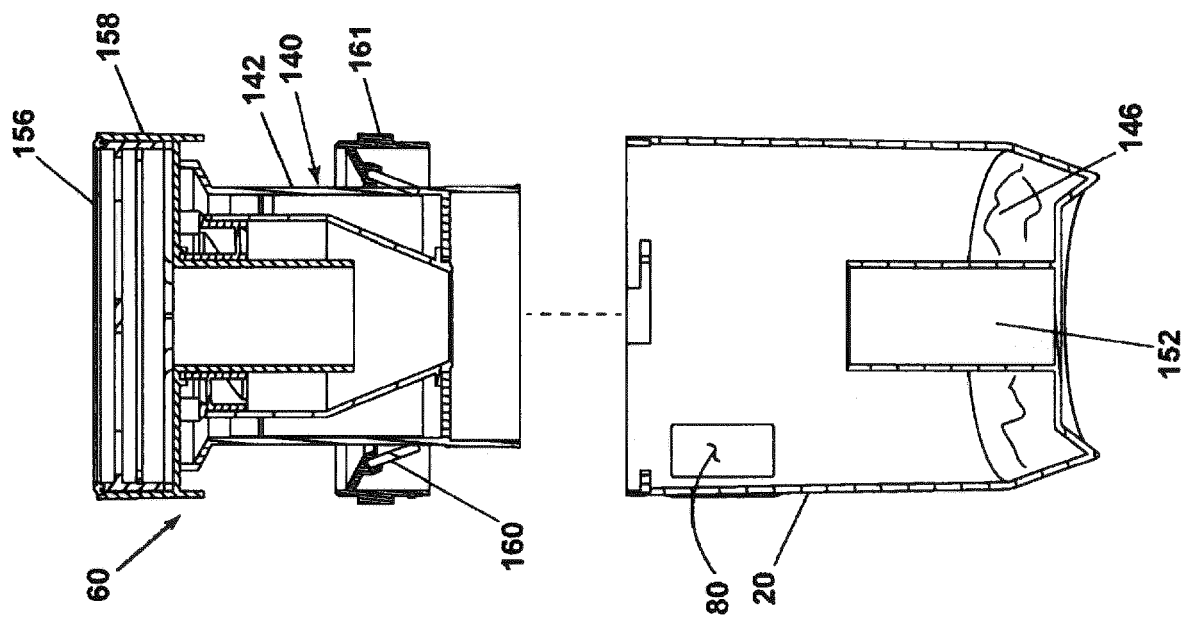


FIG. 10B

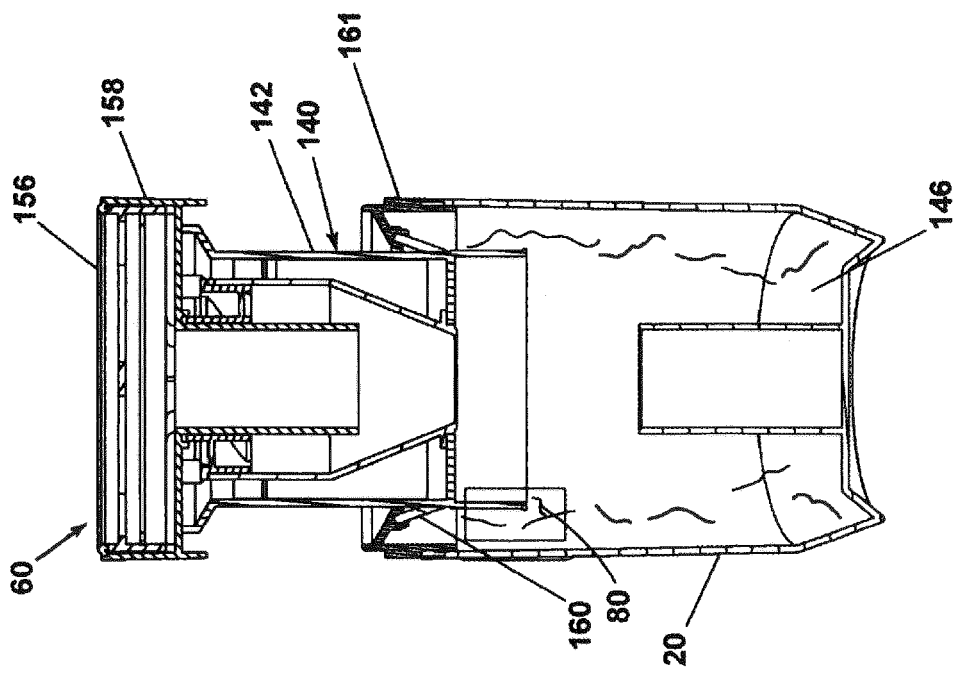


FIG. 10A

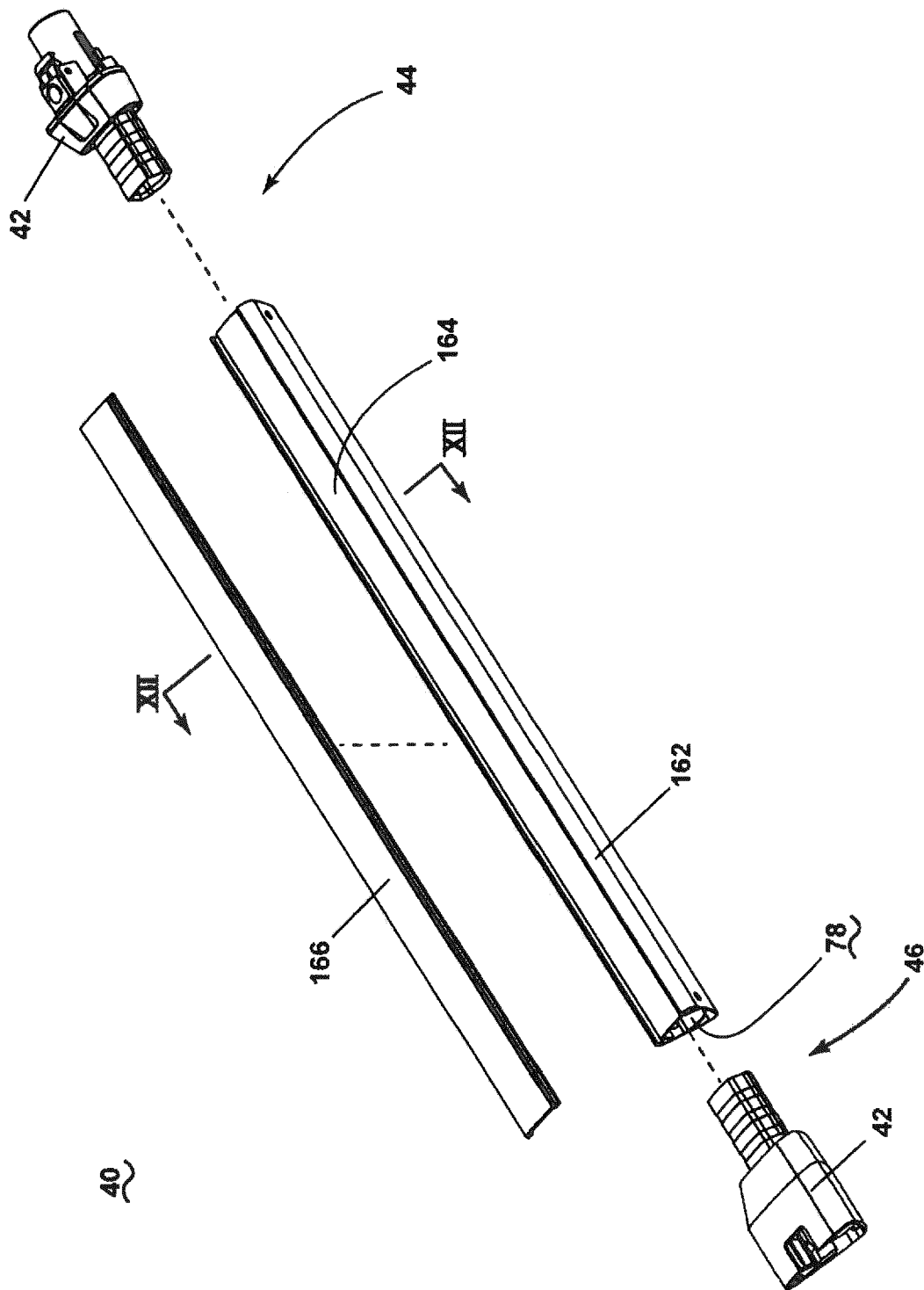


FIG. 11

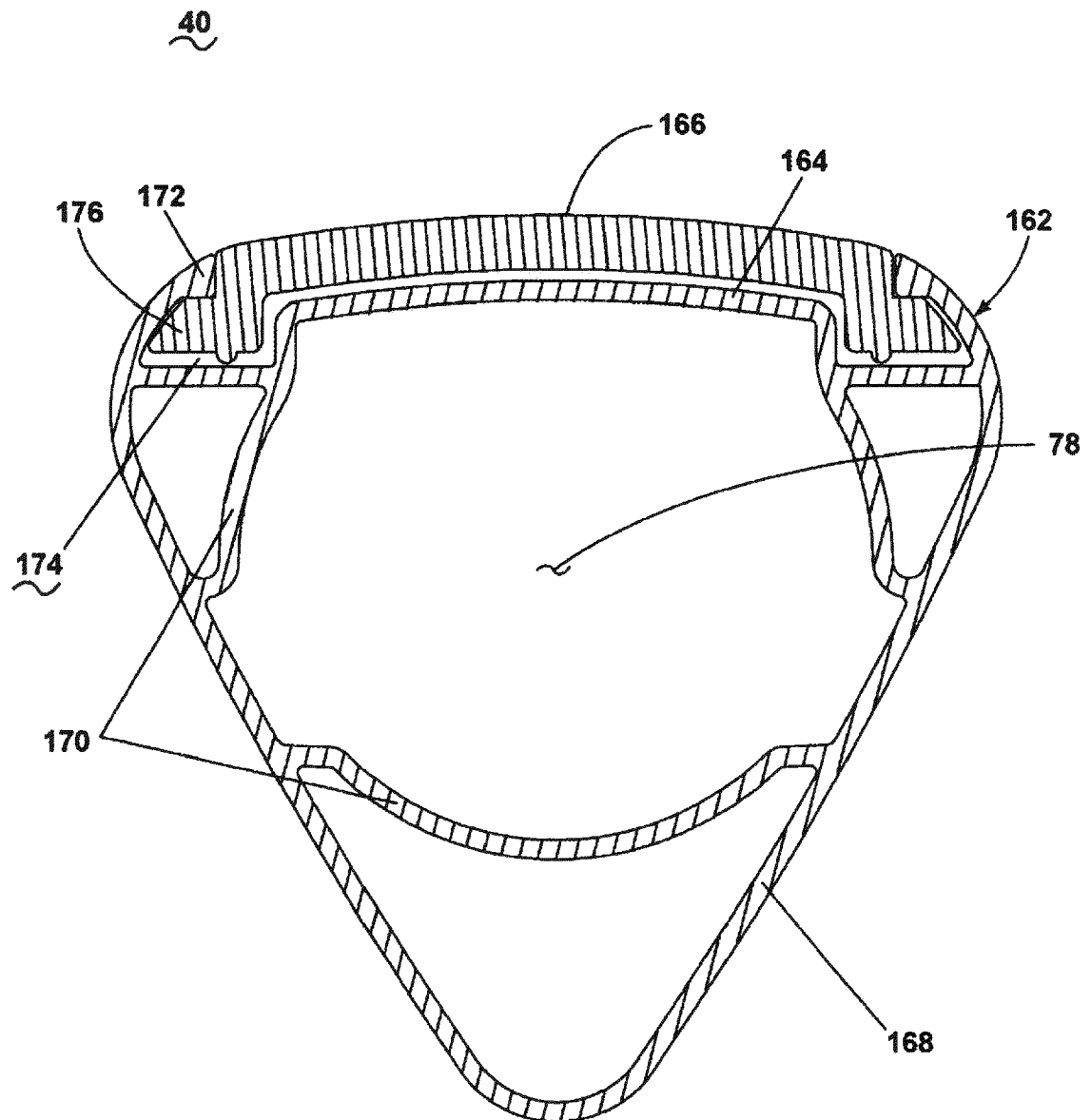


FIG. 12

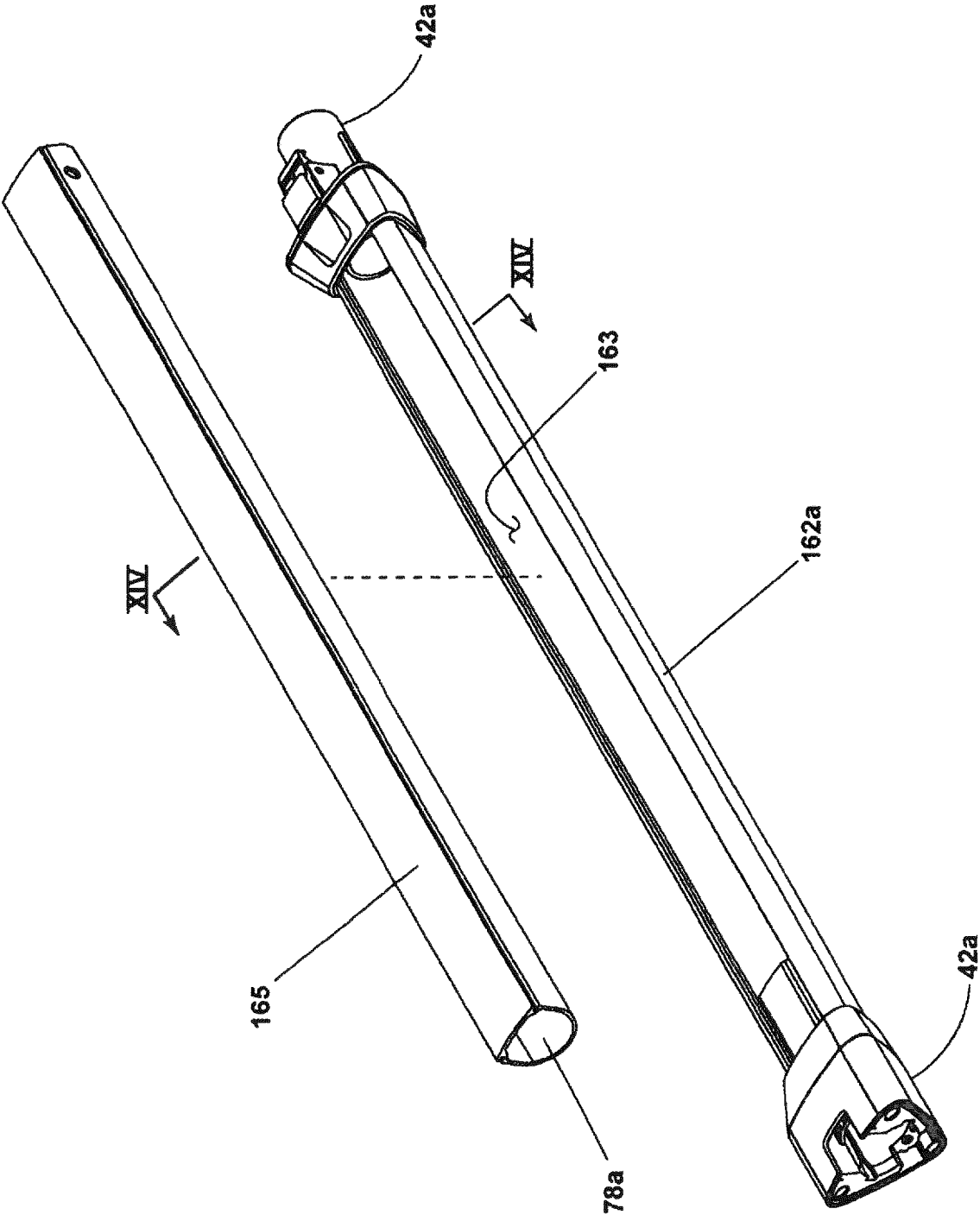


FIG. 13

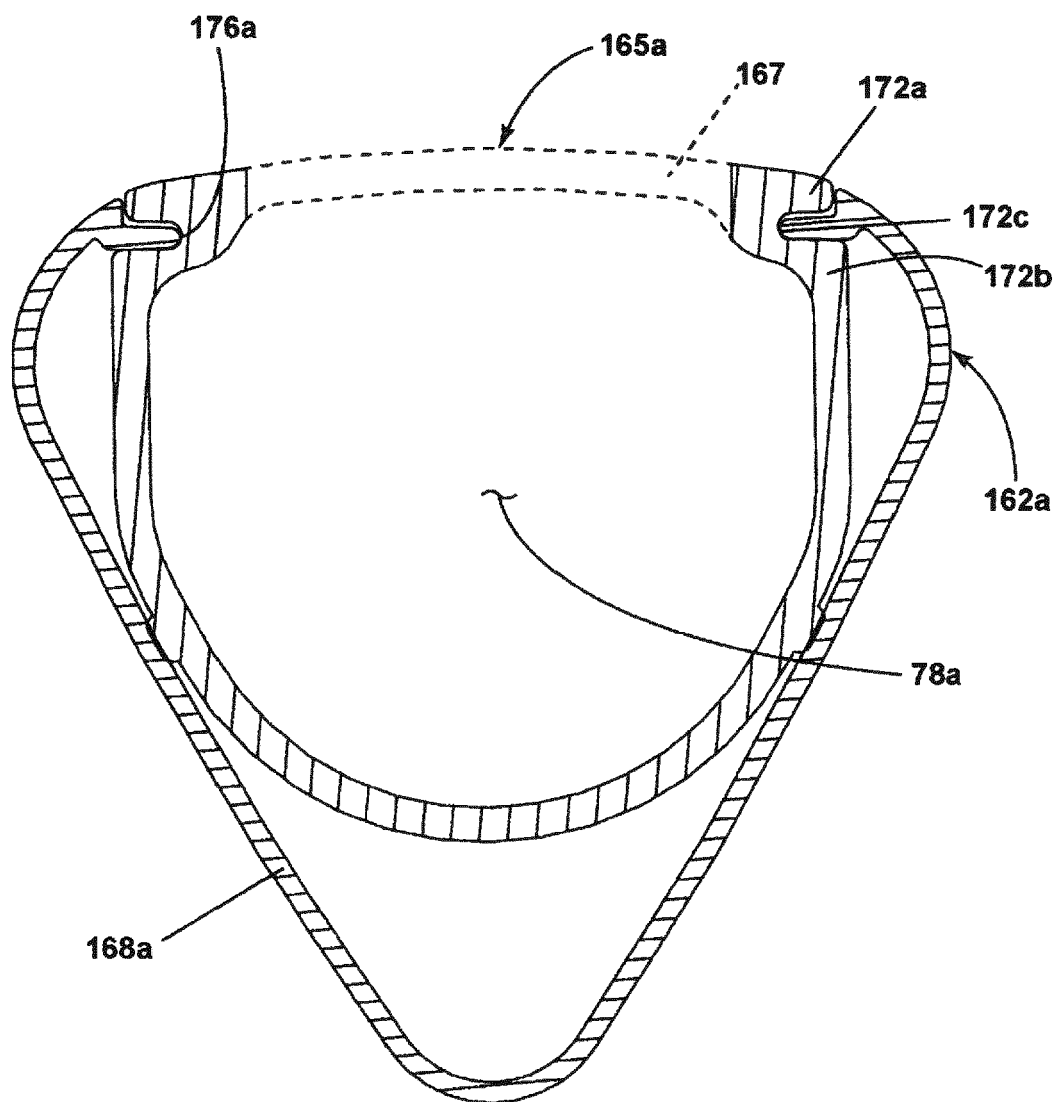


FIG. 14

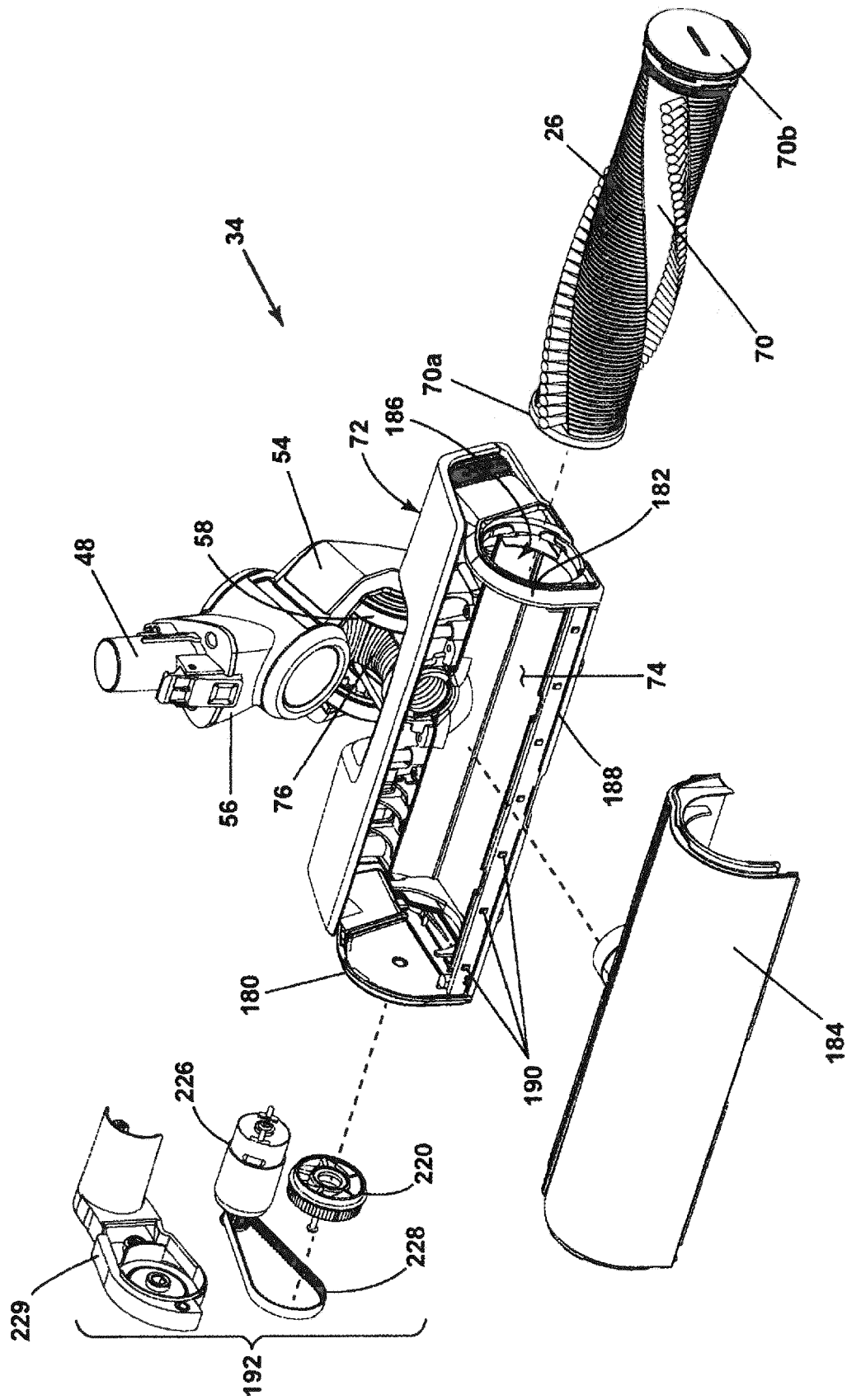
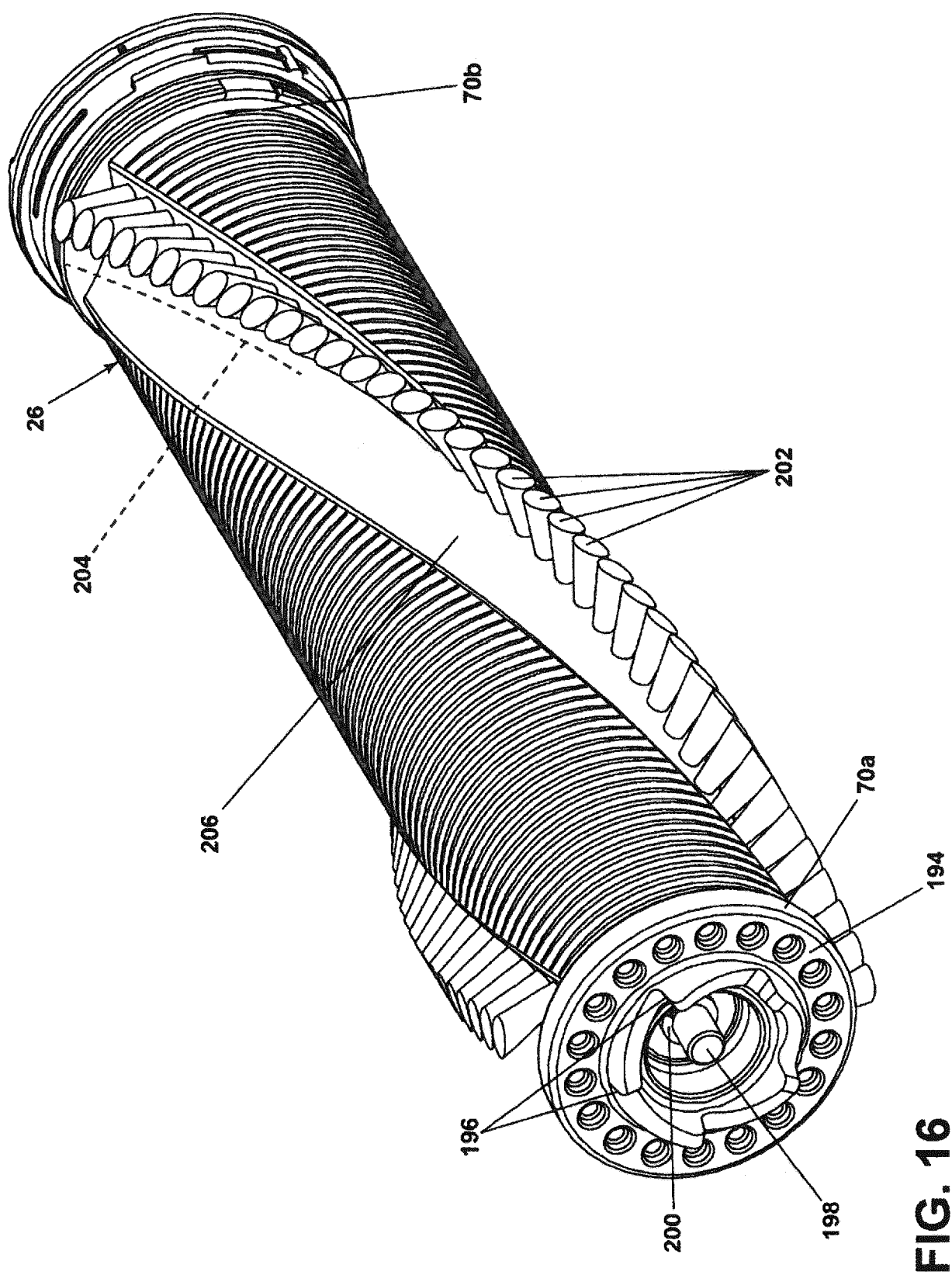


FIG. 15



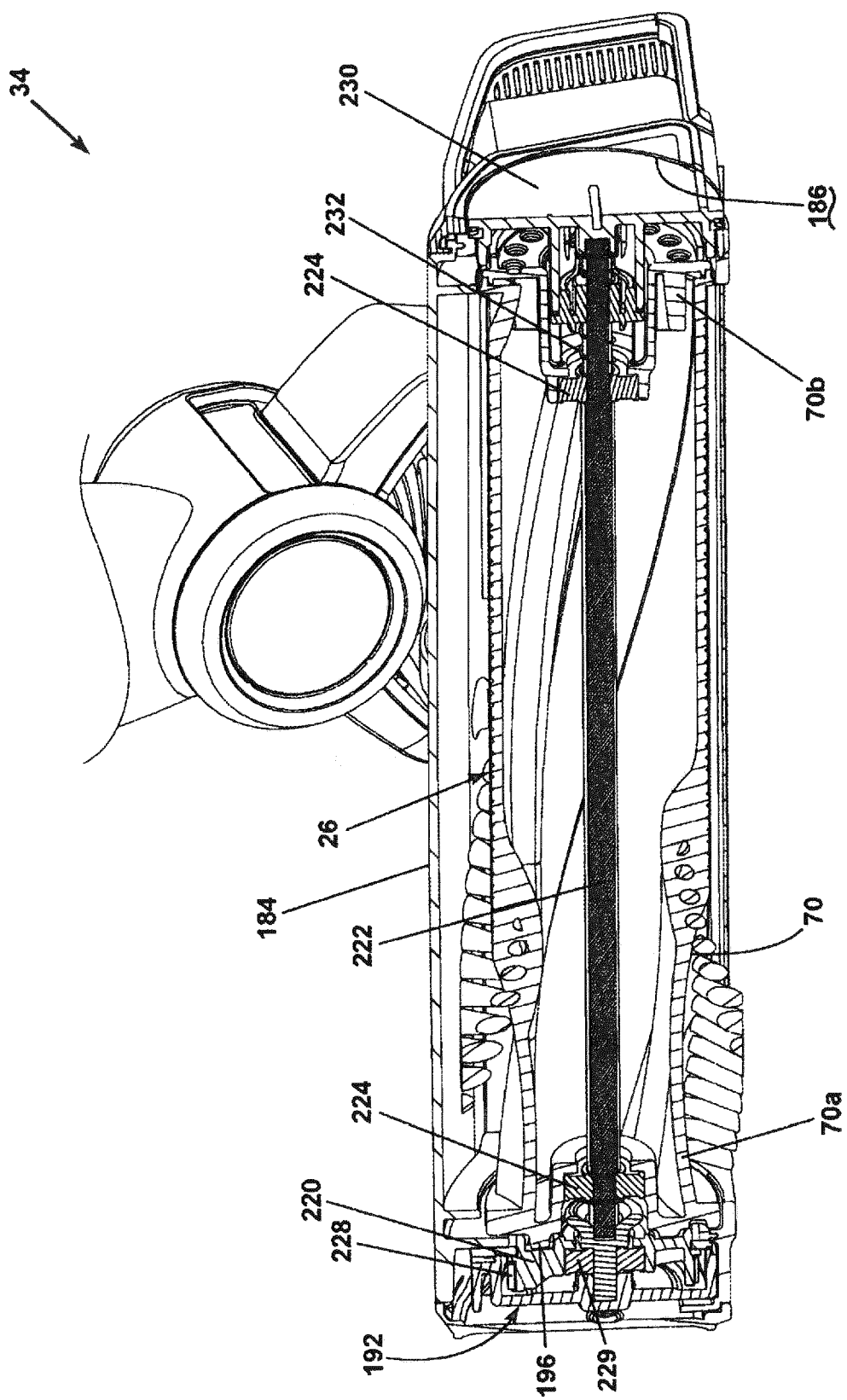


FIG. 17

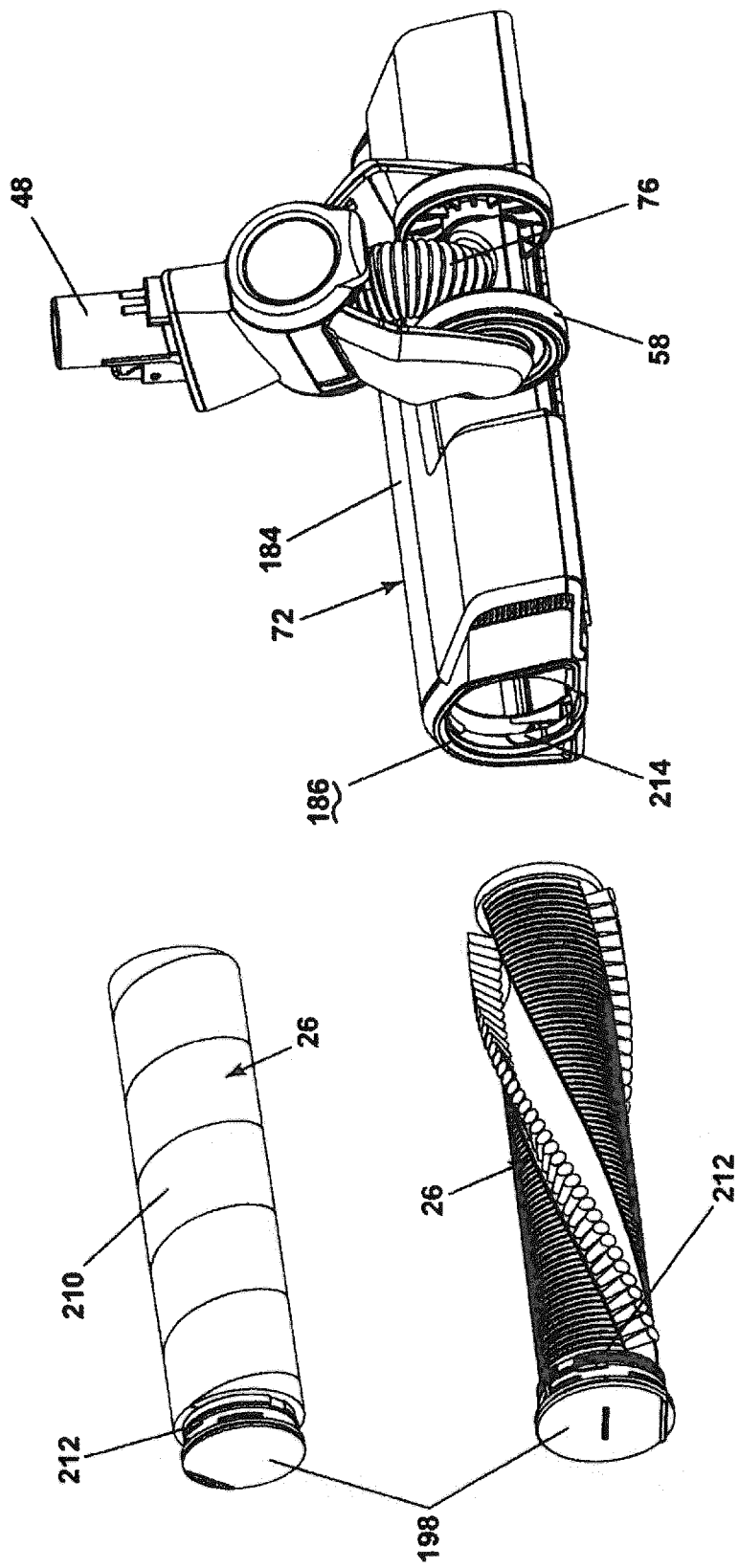


FIG. 18

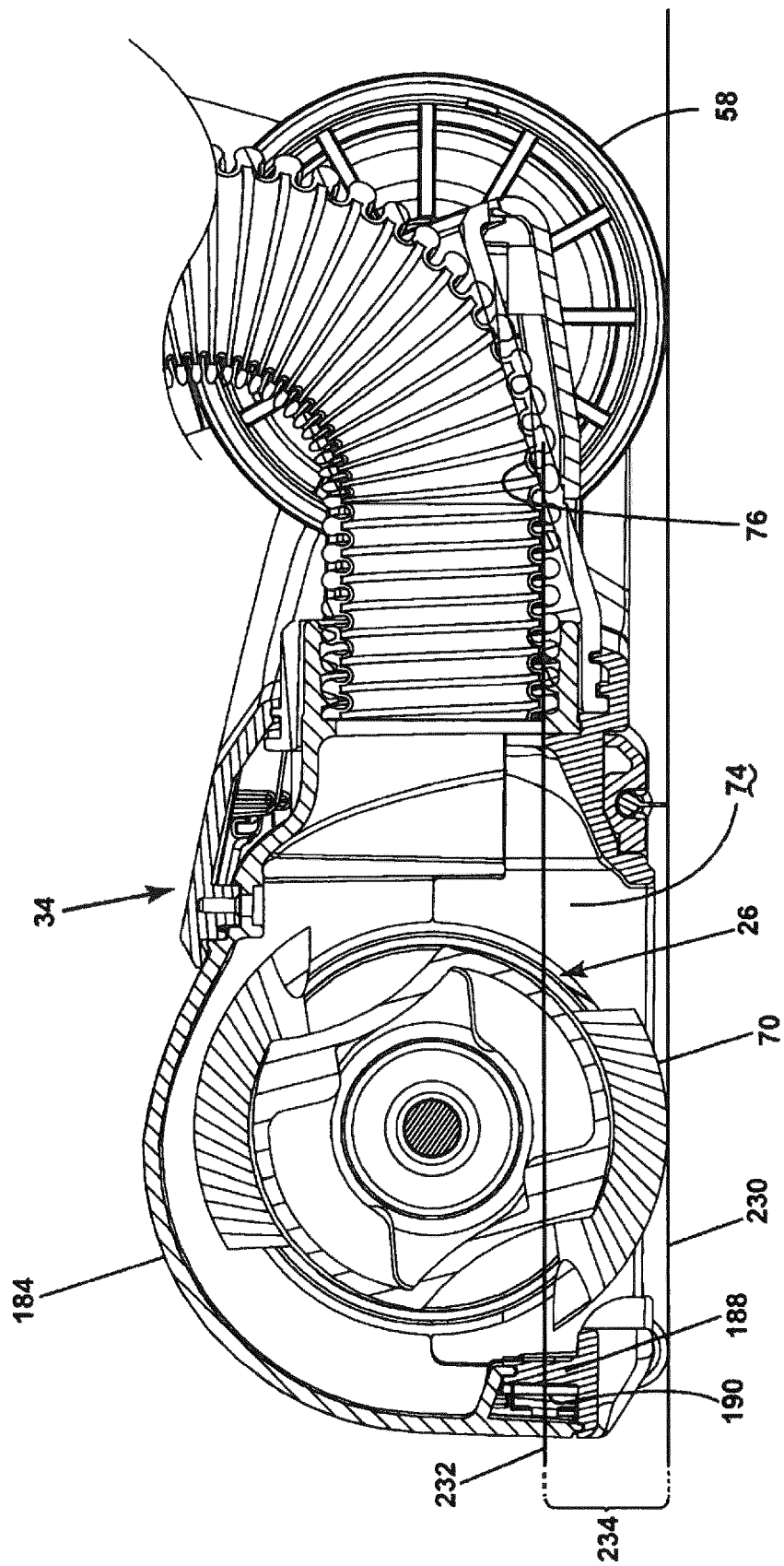


FIG. 19



EUROPEAN SEARCH REPORT

 Application Number
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A	* abstract; figures 1-7 * -----	5	A47L9/28 A47L9/32
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 9 July 2021	Examiner Hubrich, Klaus
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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