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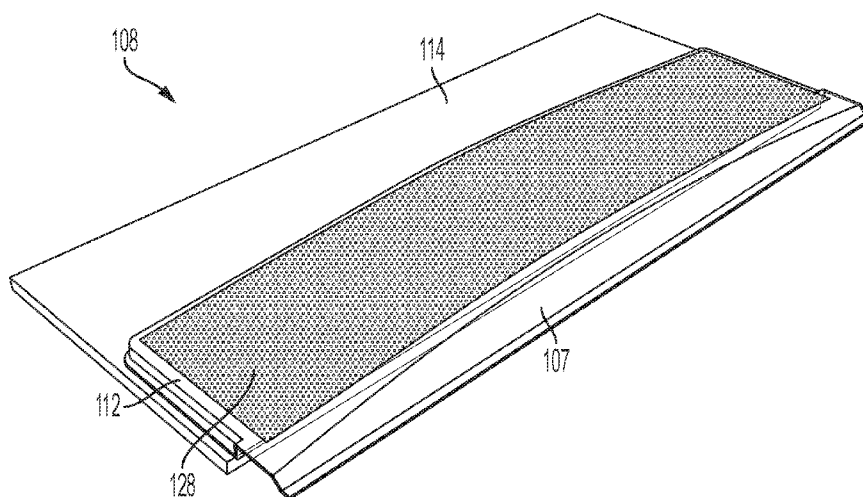


FIG. 2

(57) Abstract: Apparatus and method for receiving and holding debris in a collection chamber of a vacuum cleaner. The collection chamber has an inlet opening through which debris-entrained air enters the collection chamber. When the vacuum cleaner is off, an internal valve prevents debris from leaving the collection chamber through the inlet opening. The internal valve is movable from a first sealed position, in which the internal valve covers the chamber inlet opening, to a second unsealed position in which the internal valve does not cover the chamber inlet opening.



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CLEANING DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority under 35 U.S.C. § 119(e) to U.S. Provisional App. No. 62/781,436, entitled “CLEANING DEVICE” and filed December 18, 2018, U.S. Provisional App. No. 62/816,867, entitled “CLEANING DEVICE” and filed March 11, 2019, and U.S. Provisional App. No. 62/931,516, entitled “CLEANING DEVICE” and filed November 6, 2019, the entirety of each of which is incorporated herein by reference.

FIELD

Embodiments disclosed herein related generally to cleaning devices, and more specifically to vacuums and cleaning heads for vacuums.

DESCRIPTION OF THE RELATED ART

Cleaning devices are used in the home and office to clean floors and other surfaces. Various types of cleaning devices are known, such as vacuums with disposable bags, and vacuums with dirt bins that can be emptied and re-used.

SUMMARY

According to one embodiment, a cleaning head includes a debris collection chamber, an air filter, and a cleaning sheet including a retention layer, an acquisition layer, a face layer, and a strip arranged for at least one of scrubbing and providing friction. The layers are attached together.

According to another embodiment, a method of forming a cleaning sheet is disclosed. The method includes adhering an acquisition layer of a first material to a retention layer of a second material, joining together a strip of a third material, the strip arranged for at least one of scrubbing and providing friction, a face layer of a fourth material, and the acquisition layer to form a cleaning sheet, and sealing a forward edge and a rear edge of the cleaning sheet.

According to another embodiment, an apparatus includes a debris collection chamber, an air filter configured to allow air to pass through the air filter while inhibiting debris from passing through the air filter, and a collection chamber inlet opening configured to allow debris-entrained air to flow into the collection chamber. The air filter includes an elongated strip that is

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movable from a first sealed position, in which the elongated strip covers the chamber inlet opening, to a second unsealed position in which the elongated strip does not cover the chamber inlet opening.

According to another embodiment, an apparatus adapted to be attached to a vacuum cleaner includes a debris collection chamber and a collection chamber inlet opening configured to allow debris-entrained air to flow into the debris collection chamber. The apparatus also includes an air filter configured to allow air to pass through the air filter while inhibiting debris from passing through the air filter. An internal valve is provided which is movable from a first position in which the internal valve covers the chamber inlet opening, to a second position in which the internal valve does not cover the chamber inlet opening. The internal valve is attached to the air filter, and the air filter is arranged such that when the air filter is under no negative pressure, the internal valve is in the first position. The internal valve is also arranged such that when negative pressure is applied to the air filter to draw air through the chamber inlet opening, the air filter moves the internal valve to the second position.

According to yet another embodiment, an apparatus adapted to be attached to a cleaning device having a suction source is provided. The apparatus includes a debris collection chamber and a collection chamber inlet opening configured to allow air to flow into the debris collection chamber when negative pressure is applied to the debris collection chamber. The apparatus also includes an internal valve movable from a first position, in which the internal valve covers the chamber inlet opening, to a second position in which the internal valve does not cover the chamber inlet opening. The internal valve includes multiple layers. At least a first layer of the multiple layers is configured to selectively move the internal valve from the first position to the second position at a pleat formed in the first layer.

According to a further embodiment, an apparatus includes a main body including a suction source, and a debris collection chamber removably attachable to the main body. A suction nozzle is fluidically connected to the debris collection chamber and positioned forwardly of the debris collection chamber. The apparatus includes a liquid applicator and a sheet connected to an underside of the debris collection chamber. A surface of the sheet is arranged to contact the floor when the apparatus is in use, and the surface includes an embossed pattern configured to at least temporarily capture debris from the floor.

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It should be appreciated that the foregoing concepts, and additional concepts discussed below, may be arranged in any suitable combination, as the present disclosure is not limited in this respect.

The foregoing and other aspects, embodiments, and features of the present teachings can be more fully understood from the following description in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

The accompanying drawings are not intended to be drawn to scale. In the drawings, each identical or nearly identical component that is illustrated in various figures is represented by a like numeral. For purposes of clarity, not every component may be labeled in every drawing. In the drawings:

FIG. 1 is a perspective view of a cleaning device according to embodiments of the present disclosure;

FIG. 2 is a top, front perspective view of a cleaning head according to some embodiments;

FIG. 3 is an enlarged perspective view of a second connector of the cleaning head of FIG. 2;

FIG. 4 is an exploded view of the cleaning head of FIG. 2;

FIG. 5 is a top, rear perspective view of the cleaning head of FIG. 2 with the air filter shown removed;

FIG. 6 shows the cleaning head of FIG. 2 in a state where negative pressure is being applied to the collection chamber;

FIG. 7 is an exploded view of a cleaning head and sheet assembly;

FIG. 8 is a cross-sectional front view of a cleaning head and a partially lifted top chamber wall according to some embodiments;

FIG. 9 is a cross-sectional front view of a cleaning head and a partially lifted top chamber wall according to alternative embodiments;

FIG. 10 is a perspective view of a cleaning head with a cover stabilizer according to some embodiments;

FIG. 11 is a cross-sectional side view of a cleaning head with a chamber inlet cover arrangement according to some embodiments;

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FIG. 12 is a top, front perspective view of a cleaning head according to some embodiments;

FIG. 13 is a cutaway view of the cleaning head of FIG. 12;

FIG. 14 is a partially exploded view of the cleaning head of FIG. 12;

5 FIG. 15 is an enlarged view of an inlet of the cleaning head of FIG. 12;

FIG. 16 is a schematic cross-sectional side view of the cleaning head of FIG. 12 showing a valve in a closed position and an opened position;

FIG. 17 is a partially exploded view of an air filter of the cleaning head of FIG. 12 according to some embodiments;

10 FIG. 18 shows the cleaning head of FIG. 12 with an air filter removed from the cleaning head;

FIG. 19 is an enlarged view of an inlet opening and an inlet valve of the cleaning head of FIG. 12;

15 FIG. 20 is a cutaway view of a collection chamber and suction nozzle of the cleaning head of FIG. 12;

FIGS. 21 and 22 show a top, front perspective view of a cleaning head and a bottom, rear perspective view of the cleaning head, respectively, according to some embodiments;

FIG. 23 is an exploded view of the cleaning head of FIG. 21;

FIGS. 24A-24F shows a manufacturing process of the cleaning head of FIGS. 12 and 21;

20 FIG. 25 is a bottom perspective view of a first connector of a cleaning device according to some embodiments;

FIG. 26 shows a portion of a cleaning head engageable with the connector of FIG. 25;

FIG. 27 is another view of the cleaning head of FIG. 26;

FIG. 28 shows a group of stacked cleaning heads according to some embodiments;

25 FIG. 29 is an exploded view of a cleaning head and sheet assembly according to a further embodiment;

FIG. 30 illustrates a process of manufacturing a cleaning sheet according to some embodiments; and

FIG. 31 is a bottom view of a cleaning sheet according to some embodiments.

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DETAILED DESCRIPTION

Conventional bag vacuums typically require the user to remove a bag from a housing interior, dispose of the bag, and insert a new bag. Removing the bag can put dust in the air and/or result in spilled debris. Cyclonic vacuum cleaners often have a debris collection chamber that can be removed from the body of the vacuum, emptied, and reused.

For cleanup jobs that do not require a full-size vacuum cleaner, the inventors have appreciated that a debris collection container which remains closed upon removal from the vacuum can be helpful. Disclosed herein are debris collection chamber arrangements which allow debris-entrained air to enter a collection chamber through an inlet opening when the vacuum cleaner is turned on. The collection chamber arrangements may be arranged to cover the inlet opening when the vacuum cleaner is turned off, which may limit undesirable release of debris from the collection chamber. In some embodiments, the collection chamber is disposable. In some embodiments, the collection chamber is attached to a cleaning head, and the entire cleaning head is disposable.

To facilitate covering the collection chamber inlet opening, a cover for the inlet opening may be arranged to move in response to the presence of negative pressure in the vacuum cleaner. For example, a planar piece of filter material may cover the inlet opening when the vacuum cleaner is off. When the vacuum cleaner is turned on and negative pressure is applied to the filter material, the filter material may pull away from the inlet opening, thereby allowing air and debris to enter the collection chamber. The inflow of air may substantially prevent dirt from exiting the collection chamber through the inlet opening. When the vacuum cleaners turned off, the filter material may return to its position covering the inlet opening. Such an arrangement may provide for covering the inlet opening without user intervention.

In some embodiments, the filter material is attached to the debris collection chamber with an elastic connector. In such embodiments, the elastic connector may allow the filter material to be pulled away from the inlet opening when the filter material is subjected to a negative pressure by a suction source. In other embodiments, no elastic connection is provided, and the inherent flexibility of the filter material allows the filter material to move away from the inlet opening.

In some embodiments, the cover for the inlet opening is not a filter material. For example, a piece of filter material may form substantially the entire top wall of a collection

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chamber, but include an air impermeable portion which covers and uncovers the inlet opening. In still other embodiments, an entire top wall of the collection chamber may be formed of a flexible material other than an air filter. The top wall may move to cover and uncover the inlet opening, while a separate portion of the collection chamber has an air outlet that applies a
5 negative pressure to the collection chamber.

By automatically closing the chamber inlet opening when the vacuum cleaner is turned off, the collection chamber may be completely enclosed to limit release of debris. The arrangement can also be helpful to limit spillage or egress of collected debris from the collection chamber when the user removes and/or transports the collection chamber for debris disposal. In
10 some embodiments, the collection chamber may be adapted for reuse and include an aperture which is selectively openable to discard debris from the chamber. In other embodiments, the collection chamber may be adapted to be disposed of once the chamber is full. For example, in some embodiments the collection chamber may have no openings other than the inlet opening. In some embodiments, the collection chamber is not openable by a user to dispose of debris
15 from the debris collection chamber without damaging the debris collection chamber. The collection chamber may be permanently attached to, and form at least a portion of, a disposable cleaning head in some embodiments, such that the entire head is disposed of after use.

For purposes herein, debris being suctioned into the debris collection chamber may include dry and/or wet media. For example, in some embodiments, a liquid applied to the
20 surface may be absorbed by a cleaning sheet and/or suctioned by the vacuum into the debris collection chamber. In some embodiments, the wet media may be absorbed by at least a portion of the material used to form the debris collection chamber. In some embodiments, the debris collection chamber may be formed of a material which allows for fluid absorption into the material but does not allow for liquid transfer through the material. In such embodiments, liquid
25 may not travel through the debris collection chamber. For example, the material used to form the debris collection chamber may be absorptive on an inner side of the debris collection chamber, but liquid impermeable.

In some embodiments, advantages may be realized if the user does not have to handle the wet or dirty cleaning head after operation of the cleaning device. For example, the cleaning
30 device may be arranged to release the cleaning head after using the cleaning device such that the user does not have to grasp the cleaning head to discard it. In some embodiments, with a

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permanently attached debris collection chamber, and a release arrangement that does not require the user to touch the cleaning head, the cleaning head can be disposed of with limited or no user contact.

In some embodiments, the cleaning head includes a support structure to which the debris collection chamber is attached. In such embodiments, the user may simply attach the cleaning head to the cleaning device, operate the cleaning device to move dirt from the surface and into the debris collection chamber, remove the cleaning head, and dispose of the cleaning head in a trash receptacle.

In some embodiments, the cleaning heads are arranged for space-efficient stacking for ease of storage and transport. In some embodiments, the dirt collection chambers are arranged to be collapsible. For example, the dirt collection chamber may include a bag.

FIG. 1 shows a cleaning device 100 according to embodiments of the present disclosure. The cleaning device 100 includes a body 102 with a handle 104, a first connector 106, and a cleaning head 108 which is removably attachable to the body, such as via the first connector 106. For example, as will be described, the body may have a corresponding second connector 109 (see FIG.3) that engages with the first connector to attach the cleaning head to the body. In some embodiments, the handle may have a length that is adjustable to allow a user to adjust the height of the cleaning device.

As shown by way of example in FIGS. 2-5, the cleaning head 108 may include a suction nozzle 107 to remove debris from a surface, and a debris collection chamber 112, also referred to herein as a collection chamber, to collect the debris removed from the surface. In some embodiments, as shown in these views, the suction nozzle 107 may extend laterally along a front portion of the cleaning head 108. As will be appreciated, the suction nozzle 107 may have any suitable shape and size. For example, the suction nozzle 107 may extend along an entire width of the cleaning head 108 in some embodiments, although in other embodiments, the nozzle may extend along only a portion of the width of the cleaning head.

As shown in these views, in some embodiments, the nozzle is attached, such as integrally formed with, the debris collection chamber. In other embodiments, instead of being attached to the debris collection chamber 112, the suction nozzle 107, or at least a portion of the suction nozzle, may be formed on part of the vacuum cleaner device 100, such as on the first connector.

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In such embodiments, once the collection chamber 112 is attached to the vacuum cleaner 100, the suction nozzle 107 forms a flow path to the collection chamber inlet opening 116.

As will be appreciated, the debris collection chamber 112 may be any suitable type of container for collecting debris such as dirt, dust, food, or wet media. In some embodiments, the debris collection chamber 112 may be permanently or removably attached to a cleaning sheet 114. For example, the collection chamber 112 may be glued, heat sealed, or otherwise permanently affixed to cleaning sheet 114. As will be further, the cleaning sheet and the collection chamber need not be the same shape or size. For example, the cleaning sheet may be larger than the collection chamber in some embodiments.

In some embodiments, an additional support structure may be provided to attach the cleaning sheet to the collection chamber. For example, a substantially planar support frame may be provided between the collection chamber 112 and the cleaning sheet 114, although the support structure may have other suitable arrangements. In some embodiments, as shown in FIG. 2, for example, the collection chamber 112 may protrude upwardly from the cleaning sheet 114 and/or from the support structure. For purposes herein, the term “protruding upwardly” means that the collection chamber 112 protrudes away from the support structure and/or cleaning sheet, in a direction away from the surface being cleaned.

In some embodiments, as illustrated in FIG. 4, the collection chamber 112 includes an inlet 115 having an inlet opening 116. In some embodiments, the inlet opening 116 may be located at a top portion of the collection chamber 112. For example, the inlet opening 116 may be formed by a top rim 118 of an upwardly extending wall 120. In some embodiments, the inlet 115 may have a ramp 122 extending from a suction inlet 124 into the collection chamber 112 to aid in moving debris from the suction inlet 124 into collection areas 126a, 126b of the collection chamber 112. Though, in some embodiments, the area below the inlet opening 116 may have a floor that is coplanar with a bottom 127 of the collection areas 126a, 126b of the collection chamber 112.

In some embodiments, a divider 160 may be provided, such as behind the suction inlet to stiffen the collection chamber 112. In such embodiments, the divider may separate the collection chamber into collection areas, as will be described. As will be appreciated, the collection chamber need not include such a divider. In some embodiments, additional walls

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similar to the divider 160 may be positioned in the collection chamber 112, in some cases to guide air flow within the collection chamber 112.

In some embodiments, an air filter 128 may form a top wall of the collection chamber 112. The filter material may be attached to the collection chamber 112 such that in a first position, as shown in FIG. 2, the air filter 128 covers inlet opening 116. In this position, the air filter 128 inhibits debris that has already been collected in collection areas 126a, 126b from moving over wall 120 and through the inlet opening 116. In some embodiments, the air filter 128 and the collection chamber 112 are arranged such that the air filter 128 is in this first position when negative pressure is not being applied to the air filter 128 (e.g., from the vacuum source).

In some embodiments, when negative pressure is applied to the air filter 128, the air filter 128 moves upwardly (see FIG.6) and separates from the inlet opening 116. In this second position, debris-entrained air can flow through suction inlet 124, up and over wall 120, and into the debris collection areas 126a, 126b.

As mentioned above, the air filter 128 may be attached to the collection chamber 112 with an elastic connection. For example, as shown in FIG. 6, an elongated strip 136 of elastic material may connect the air filter 128 to a top portion of the collection chamber 112 along a front wall of the collection chamber 112. A similar elongated elastic strip (not visible in FIG. 6) may connect the air filter 128 to the top portion of the collection chamber 112 along the rear wall of the collection chamber. In such examples, the stretchability of the elongated strips 136 allows the air filter 128 to move away from the inlet opening 116. In some embodiments, elastic connectors also may be used on one or both walls at the lateral sides of the collection chamber 112.

In some embodiments, only a portion of the air filter 128 may rise from the collection chamber 112 when negative pressure is applied to the cleaning head 108. For example, elastic connectors may be provided along only certain portions of the air filter 128. The elastic portions also may be provided in an area of the air inlet opening 116 such that the air filter 128 lifts only in the area at or near the air inlet opening 116, while the remaining areas of the air filter 128 are not substantially lifted.

In still further embodiments, the air filter 128 may be connected to the collection chamber without any elastic connectors such that the air filter 128 does not move at the

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connection points. In such an embodiment, the air filter 128 may have a size and shape which allows the air filter 128 to sufficiently lift away from the air inlet opening 116 when under negative pressure such that the cover lifts away from the air inlet opening 116. For example, adhesive strips 123 may be provided on the filter material 128, to secure the filter material to the collection chamber 112, as shown by way of example in FIG. 4. In some embodiments, materials other than an air filter 128 may be used to cover the inlet opening 116. For example, as shown in FIG. 7, a section of air impermeable material may be used in the area of the top wall of the collection chamber 112 as a cover 134 for the inlet opening 116. In some embodiments, the cover 134 may have the same shape as a perimeter of the chamber inlet opening 116, or it may have a different shape. In some embodiments, an underside of cover 134 may be provided with an additional material layer. For example, a layer of material which conforms easily to the rim 118 forming the air inlet may be adhered to an underside of the air filter. Such a layer may act to seal the inlet opening against passage of debris. The cover also may be formed as an additional material layer that is adhered to the underside of an air filter material used to form the top of the collection chamber..

Although the portions of the top wall outside of the cover 134 are shown as being an air filter 128 in the embodiment of FIG. 7, other materials may be used to form the top wall of the collection chamber 112. In some embodiments, the entire top wall may be air impermeable, , with one or more air filters being provided elsewhere in the arrangement. For example, the air filter material may be limited to specific sections of the collection chamber.

In some embodiments, a top chamber wall similarly arranged to the air filter 128 shown in FIG. 7 may have air permeable sections only at or near lateral ends of the top chamber wall, with an air impermeable material in the remaining section(s). In other embodiments, air permeable sections may be positioned close to a centered inlet opening 116. Air permeable sections also may be positioned on one or more sides, such as on both sides, of a centered inlet opening 116. As will be appreciated, one or more inlet opening may be formed in any suitable portion of the collection chamber, with air permeable material in corresponding locations on the top of the collection chamber. In some embodiments, a collection chamber 112 may include more than one inlet opening 116 and a cover for each of the openings.

In some embodiments, as also shown in FIG. 7, for example, the collection chamber 112 may include stiffening ridges 137 along a bottom of the collection chamber 112. In some

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embodiments, the stiffening ridges 137 may allow for less material to be used in forming the collection chamber 112. In some embodiments, the stiffening ridges 137 may extend between the front and back of the collection chamber, as is shown. As will be appreciated, stiffening ridges may be positioned and sized in any suitable manner. For example, stiffening ridges may extend only part way between the front and back of the collection chamber. Stiffening ridges also may extend at least part way between the lateral sides of the collection chamber, or between the sides of the collection chambers. The stiffening ridges may extend substantially perpendicular to a suction nozzle of the cleaning head, although they instead may be angled relative to the suction nozzle. The shape and size of each of the stiffening ridges may be the same as one another, though the shape and size may vary from ridge to ridge.

Stiffening ribs or grooves also may be used instead of, or in addition to, stiffening ridges. In some embodiments, the same material used to forming the collection chamber 112 may be used to form the stiffening ribs or grooves. In such embodiments, a different material may be used to form the stiffening ridges.

In some embodiments, the collection chamber 112 may be formed via a plastic thermoforming process, although collection chamber 112 may be manufactured using any suitable process. For example, the collection chamber 112 may be injection molded or compression molded. In some embodiments, the collection chamber 112, the suction nozzle 107, and the suction inlet 115 may be formed as a unitary piece. In some embodiments, the collection chamber 112, the suction nozzle 107, and the inlet 115 may be integrally formed, such as by thermoforming. In other embodiments, one or more of the collection chamber 112, the suction nozzle 107, and the suction inlet 115 may be separately formed and later attached to one another. For example, the suction nozzle and suction inlet may be integrally formed, with the collection chamber being separately formed and later attached.

As mentioned above, a cleaning sheet 114 may be attached to the collection chamber 112. The cleaning sheet 114 may be formed of any suitable material, and may be made of a single layer or multiple layers. In the embodiment shown in FIG. 7, the cleaning sheet 114 may include multiple layers such as a multifunctional strip 138, a face layer 139, and first and second absorbent layers 140 and 141. The face layer 139 and absorbent layers 140, 141 may be made from various non-woven materials, woven materials, and/or plastics, or any other suitable materials. The absorbent layers 140, 141 may be configured to wick moisture away from the

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face layer 139. The multifunctional strip 138 may be used for scrubbing in some embodiments. In some embodiments, the multifunctional strip 138 may provide friction to help prevent the cleaning device 100 from slipping when propped against a wall.

As described above, and as shown in FIG. 7, a cover 134 may be used to cover the inlet opening 116 of the collection chamber. In some embodiments, as shown in Figs. 8 and 9, the cover may include one or more portions which extend downwardly into the inlet opening 116 and/or around the outside of the inlet opening 116. For example, a collar may be attached to an underside of the air filter 128 such that when the vacuum is turned off (e.g., the negative pressure applied the air filter is released) and the air filter 128 returns to a home position, (see FIGS. 8 and 9), the collar covers some or all of the perimeter of the inlet opening 116.

As will be appreciated, in the home position, the air filter is no longer subject to negative pressure and, thus, moves in a direction toward the collection chamber. In some embodiments, the home position is the same as the first position described above, with the air filter and/or cover being placed and/or held against the inlet opening to block debris from exiting the collection chamber. In other embodiments, in the home position, the air filter and/or cover may be at least partially spaced from a top surface of the inlet opening, although the air filter may contact or be attached to other portions of the collection chambers. As will be appreciated, even though the air filter and/or cover may be at least partially spaced from a top surface of the inlet opening, the inlet opening may still be closed such that debris may not escape when the vacuum is turned off. For example, as will be described, the air filter and/or cover, along with the portions that extend into and/or around the outside of the inlet opening, may cooperate to close the inlet opening when the cleaning device is in the off position.

In some embodiments, a collar 142 may be connected to an underside of the air filter 124, as shown in FIG. 8. When the air filter 124 is moved to the home position, the collar 142 may be positioned next to, and/or in contact with, an outside portion of wall 120. As shown in this view, air filter 124 is shown slightly higher than the inlet opening when the filter is in the home position of FIG. 8. In some embodiments, the collar 142 may be made of a rigid material, although the collar may be made of a flexible material.

Referring to FIG. 9, in some embodiments, a downwardly extending member may be positioned inside the inlet opening 116 when the air filter 124 is in the home position. In such embodiments, a collar 144 is adapted to be positioned next or in contact with an inside portion

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of wall 120. As with the embodiment illustrated in FIG. 8, the collar 144 may be made of a rigid material or a flexible material.

As will be appreciated, the downwardly extending cover structures shown in FIGS. 8 and 9 may be used in addition to or instead of a substantially horizontal cover portion of the air filter
5 124.

In some embodiments, a cover stabilizer may be implemented to help maintain contact between the cover and a rim of the inlet opening 116. For example, as shown in FIG. 10, a cover stabilizer 150 may be used with a similar shape to the rim 118 of the outlet opening shown in FIGS. 4 and 5. In some embodiments, the stabilizer 150 is pivotally attached to the air filter
10 124, 128 at a pivot joint 152, and is biased downwardly by a torsion spring 154. In other embodiments, the stabilizer may be formed with or otherwise attached to the first connector 106A. The force applied by the stabilizer 150 may press the underside of air filter 124, 128 to secure contact with the rim 118 of the air inlet opening. The weight of the stabilizer 150 and the strength of the torsion spring 154 may be configured such that when the air filter 124, 128 is
15 lifted from the collection chamber 112, the stabilizer 150 does not overly deform the shape of the air filter 124, 128. In some embodiments, a mechanical limit to the rotation of the stabilizer 150 may be implemented, for example at the pivot joint 152.

A conduit end does not have to be fully exposed to be considered to be an inlet opening 116 that is not covered by a cover. For example, if the air inlet opening 116 for a debris
20 collection chamber 112 is formed by an upright cylindrical column with a top circular rim, and the air filter 128 is removed from a sufficient portion of the circular rim during vacuuming to permit flow of air and debris into the collection chamber 112, the air inlet opening 116 may be considered to be not covered by the air inlet opening cover.

As mentioned above, the air filter 128 (or other collection chamber wall) may be
25 connected to the collection chamber 112 without any elastic connectors. FIG. 11 shows one embodiment where the air filter 128 is attached to the collection chamber with a pleated material 129. The air filter 128 is shown slightly lifted from the collection chamber in FIG. 11. In some embodiments, when negative pressure is applied to the air filter 128, the air filter 128 pulls on and unfolds the pleats. In some embodiments, the pleats may be biased toward the folded
30 position, such that when the negative pressure is released, the pleats may return toward the folded position such that the air filter 128 covers the chamber inlet opening 116. In some

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embodiments, a cover stabilizer, such as the stabilizer 150 shown in FIG. 10, may be used in conjunction with a pleated arrangement or other non-elastic arrangement.

Instead of, or in addition to, using air filter 128 as the top wall of the collection chamber 112, the pleated material 129 may be formed of an air filter material. For example, the top wall may be formed of an air impermeable material, and the vacuum cleaner may be configured to encompass at least the top wall and the pleated sides 129. When negative pressure is applied, the top wall may be lifted upwardly and away from the inlet open, exposing the air filter material of the pleated sides 129. Air may then be withdrawn from the collection chamber 112 via the pleated sides 129.

While the embodiments illustrated herein show the inlet opening facing upward and the air filter 128 positioned such that the air filter 128 acts as a top wall of the collection chamber 112, the air filter 128 may be positioned elsewhere on the collection chamber 112 and still function as a removable cover for the chamber inlet opening 116. For example, instead of facing upwardly as shown in FIGS. 4 and 5, the chamber inlet opening 116 may face rearwardly, and the air filter 128 may be positioned at the back of the collection chamber 112. In the home position, the air filter 128 may be held against the chamber inlet opening 116, for example with elastic connectors, to cover the inlet opening 116. When negative pressure is applied, the air filter 128 be moved away from the chamber inlet opening 116.

Although embodiments have been shown and described with only the top wall of the collection chamber moving in response to negative pressure, in some embodiments, more than one wall of the collection chamber 112 may move in response to negative pressure. For example, in some embodiments, a top wall and one or more side walls of the collection chamber may move in response to an applied pressure. In some embodiments, a movable wall may include a flexible bag structure. As will be appreciated, in some embodiments, the entire debris collection chamber 112 may be formed as a flexible bag attached to the chamber inlet opening 116. In some embodiments, a portion of the bag may be positioned against the chamber inlet opening 116 when no negative pressure is applied. In such embodiments, the bag may expand from the application of negative pressure such that the portion of the bag covering the chamber inlet opening 116 moves away to allow debris-entrained air to enter the bag. As described herein, walls may be planar and/or rigid in some embodiments, although the walls, or at least a

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portion of the walls may be flexible in other embodiments such that the collection chambers 112 may have a combination of rigid and flexible walls.

For purposes herein, applying a negative pressure to a collection chamber 112 may include applying a negative pressure to the outside of an air permeable portion of the chamber 112 and/or applying a negative pressure to an opening in the collection chamber 112.

In some embodiments, such as those shown in FIGS. 12-15, the collection chamber 112 may include a lip and internal valve 145 that keeps dust, dry media, and/or wet media within the collection chamber 112 once the dirt has been moved into the chamber, thereby preventing dust and dry media from exiting via the chamber inlet opening 116 of the inlet 115, such as when the vacuum is powered off. In some embodiments, as shown in FIGS. 13-15, the internal valve 145 of the collection chamber 112 may be selectively openable and closeable at or near the chamber inlet opening 116. For example, as shown in FIG. 16, the internal valve 145 may be pivotable between an open position *O* when the vacuum is turned on and a closed position *C* when the cleaning device 100 is turned off.

In some embodiments, as shown in FIGS. 13-15 and 17-20, the internal valve 145 may be integrally or attachably formed with at least a portion of the cleaning head 108. For example, the internal valve 145 may be integrally formed with or protrude from a top rim 118 of an upwardly extending wall 120 that forms a perimeter of the collection chamber 112. The internal valve 145 also may protrude downwardly from the top rim 118 of the upwardly extending wall 120 to block or otherwise obscure the chamber inlet opening 116 when, for example, the vacuum is powered off. In other embodiments, the internal valve 145 may be attachably received at, an elongated strip or other portion of the air filter 128. In some embodiments, the elongated strip may be at least partially formed by the air filter 128 or may be attachably received at the air filter and, in some embodiments, protrude downwardly from the air filter 128. For purposes herein, the term “protrudes downwardly” means that the internal valve 145 and/or elongated strip protrudes away from the air filter 128 in a direction toward the surface being cleaned.

Referring to FIGS. 17-20, in some embodiments, the internal valve 145 may be permanently or removably attached to the top rim 118 of the upwardly extending wall 120, the elongated strip, and/or at least a portion of the air filter 128. For example, the internal valve 145 may be glued, heat sealed, or otherwise permanently affixed to the top rim 118, the elongated strip, and/or the air filter 128. In some embodiments, the internal valve 145 may include or be

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formed of one or more flaps 146, 147, 148. In some embodiments, the one or more flaps may include the elongated strip or at least a portion of the air filter 128. In some embodiments, the flaps 146, 147, 148 together aid in moving debris from the suction inlet 107 of the cleaning head 108 into the collection areas 126a, 126b of the collection chamber 112 and inhibit debris that has
5 already been collected in collection areas 126a, 126b from moving over wall 120 (see FIG. 3) and through the inlet opening 116 of inlet 115.

The internal valve 145 and/or the one or more flaps 146, 147, 148 may be formed of any suitable material, and may be made of a single layer or multiple layers of, for example, non-woven materials, woven materials, and/or plastics, or any other suitable materials. The one or
10 more flaps 146, 147, 148 may be glued, heat sealed, or otherwise permanently affixed to each other 146, 147, 148, the top rim 118, the elongated strip, and/or the air filter to form the internal valve 145. For example, in some embodiments, the internal valve 145 may be formed of multiple layers including a first layer made of a lightweight, non-woven material 146, 148 and at least a second layer made of a stiff, non-porous material 147. An adhesive strip may be provided
15 on the filter material of the air filter 128 or elongated strip 146 protruding downwardly from the filter material 128 to secure the internal valve 145 to the air filter 128. In some embodiments, during a manufacturing process, the first layer 146, 148 of the internal valve 145 may be heat sealed or otherwise adhered to the adhesive strip provided on the filter material or elongated strip 146 of the air filter 128. A single fold or pleat 149 may be made in the first layer 146, 148
20 causing a first side of the first layer 146, 148 to move in a first direction toward the air filter 128 during the manufacturing process. The second layer 147 may be heat sealed or otherwise adhered to a second side opposite the first side of the first layer 146, 148.

In some embodiments, when a negative pressure is applied to or released from the air filter 128, the negative pressure via the air filter 128 may pull on or release the internal valve
25 145 causing the internal valve 145 to pivot at the single fold or pleat 149 (see FIG. 17) between an open position when the vacuum is turned on and a closed position when the cleaning device 100 is turned off. As shown in FIG. 16, in the closed position *C*, the internal valve 145 may be fully sealed against the chamber inlet opening 116 of inlet 115 of the collection chamber 112. For example, as shown in FIG. 15, a frame portion may extend along a perimeter edge of the
30 chamber inlet opening 116 of inlet 115 and be positioned 2 ± 0.5 mm from the perimeter edge of the chamber inlet opening 116. In the closed position *C*, when the cleaning device 100 is turned

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off, the internal valve 145 may rest on the frame portion such that the internal valve 145 is fully sealed against the chamber inlet opening 116 of inlet 115.

In some embodiments, as shown in FIGS. 21-23 and 24A-F and as noted above, the cleaning sheet 114 may be attached to the collection chamber 112 and be positioned behind the suction nozzle 107 such that debris may be suctioned into the nozzle 107 and collection chamber 112 before the cleaning sheet 114 reaches the debris. In the embodiment illustrated in FIGS. 22 and 23, the cleaning sheet 114 includes multiple layers including a multifunctional strip 138, a face layer 139, and first and second absorbent layers 140 and 141. The face layer and absorbent layers may be made from various non-woven materials, woven materials, and/or plastics, or any other suitable materials. The absorbent layers may be configured to wick moisture away from the face layer. The multifunctional strip 138 may be used for scrubbing in some embodiments. In some embodiments, the multifunctional strip 138 may provide friction to help prevent the cleaning device from slipping when propped against a wall. In some embodiments, the debris collection chamber 112 may be permanently or removably attached to the cleaning sheet 114.

Referring to FIGS. 17 and 24A-F, in some embodiments, the air filter 128 may include a first side and a second side. An adhesive strip may be provided on the first side of the air filter 128 or on an elongated strip 146 protruding downwardly from the first side of the air filter. During a manufacturing process, as shown in FIG. 24A-24C, the internal valve 145 may be removably or fixedly secured to the air filter 128 at the first side of the air filter 128. After the internal valve 145 is secured to the first side of the air filter 128, the air filter 128 may be rotated or flipped to a second side, as shown in FIG. 24E, such that the first side of the air filter 128 faces a top side of the dirt collection chamber 112. The first side of the air filter 128 may be glued, heat sealed, or otherwise permanently affixed to the top side, including the top rim 118, of the dirt collection chamber 112, as shown in FIG. 24F. As described above, the internal valve 145 may be arranged pivot at the single fold or pleat 149 between an open position when the vacuum is turned on and a closed position *C* (see, e.g., FIG. 16) when the cleaning device 100 is turned off.

In some embodiments, when the cleaning head 108 is attached to the cleaning device 100, at least a portion of the debris collection chamber 112 may be covered by the cleaning device 100. For example, in some embodiments, the debris collection chamber 112 may be

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covered by the first connector 106 used to connect the cleaning head 108 to the cleaning device 100.

As described above, the cleaning head 108 may be attachable to the first connector 106 of the cleaning device via a corresponding second connector on the cleaning head. As shown in FIG. 25, in some embodiments, the first connector 106 includes an engagement element 170 that engages with a corresponding engagement element or portion 171 of the cleaning head 108 (see FIG. 26). For example, in the embodiments illustrated in FIGS. 25-27, the engagement element 170 may include clip portions that selectively engage and disengage an undercut bump, lip feature, or other recess 171 formed in a side wall 120 of the debris collection chamber 112. In some embodiments, the undercut bump 171 may include a V-shaped feature used to align and hold the cleaning head 108 and cleaning sheet 114 relative to the first connector 106. In some embodiments, clip portions of the engagement element 170 may be moveable between an engaged position (e.g., into engagement with the undercut bump 171) and a released position (e.g., out of engagement with the undercut bump 171). In some embodiments, the engagement element(s) 170 may be separately movable between the released and engaged positions. In other embodiments, the engagement element(s) 170 move simultaneously between the engaged and released positions. As will be appreciated, the engagement element(s) 170 may be biased toward the engaged position such that when the user releases an actuator, the clip portions of the engagement element(s) 170 engage with a corresponding undercut bump, lip feature, or other recess formed on an engagement element 171 of the cleaning head 108.

In some embodiments, once the cleaning sheet has been attached to the cleaning device, such as via the first and second connectors, the user may operate a vacuum or suction source to clean a surface. In some embodiments, the vacuum cleaner 100 may include one or more actuators for actuating the suction source. As described above, upon actuation of the suction source, at least a portion of the air filter may move away from the inlet opening to allow debris entrained air to enter into the collection chambers. The suction source may be an electric motor in some embodiments. In some embodiments, the cleaning device also may include one or more actuators for actuating liquid application. For example, the user may actuate the one or more liquid applicators to apply a cleaning solution to the surface to be cleaned. As will be appreciated, the user may actuate the liquid actuators at the same time that the vacuum source is

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being applied to the surface, although the user may actuate the suction source before and/or after actuating the liquid applicators.,

Cleaning heads 108 described herein may be constructed and arranged to permit efficient packing in some embodiments. For example, as shown in FIG. 28, the debris collection chamber 112 and suction nozzle 107 may be sized and positioned on a cleaning sheet 114 and/or support structure such that an inverted cleaning head 108 is stackable on an upright cleaning head in such a manner that the upwardly-facing surface is substantially level. As can be seen in this view, eight cleaning heads 108 are stackable, with the cleaning heads alternating between an upright position and an inverted position. In some embodiments, the suction nozzles 107 are sized and position so as to not interfere with the adjacently stacked cleaning heads. In other embodiments, the engagement elements 171 may be sized and positioned such that multiple cleaning heads 108 are stackable in such a manner as to reduce an overall stack height.

An alternative embodiment of a cleaning head with an attached cleaning sheet is shown in FIG. 29. As shown in this view, the cleaning head may include a debris collection chamber 212 and a non-return valve 214. As with the above, the non-return valve may be arranged to keep dust, dry media, and/or wet media within the debris collection chamber once the dirt has been moved into the chamber, such that dust and dry media may be prevented from exiting via the chamber inlet opening of the inlet, such as when the cleaning device is powered off. In some embodiments, the debris collection chamber may be formed as part of a tray 216, which may be constructed of a thermoformed plastic in some embodiments. In some embodiments, the non-return valve 214 opens when the suction is turned on, and returns to a closed position when the suction is turned off. In some embodiments, the non-return valve may be formed of a polypropylene.

An air filter 218 covers the debris collection chamber 212 in some embodiments. The air filter may be made with a hydrophobic material to impede liquid penetration. In some embodiments, the filter may be made of a polypropylene.

A cleaning sheet may be attached to the underside of the tray in some embodiments. The cleaning sheet may include one or more layers. For example, in the illustrated embodiment, a multifunctional strip 220 is attached to a face layer 222, which is backed by an acquisition layer 224 and a retention layer 226.

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As shown in FIGS. 29 and 31, for example, the multifunctional strip may include a long, narrow piece of material that is attachable to a surface-facing side of the face layer. As will be appreciated, the multifunctional strip may be placed on any suitable portion of the face layer, although it is shown as being located in a central portion of the face layer. For example, the multifunctional strip may be located in between a forward edge and a rear edge of the face layer. In some embodiments, the multifunctional strip may extend along an entire width of the cleaning sheet, although the strip may extend along only a portion of the width of the cleaning sheet in other embodiments.

In some embodiments, each of the face layer, the acquisition layer, and the retention layer are the same shape and same size, although the shape and size may vary from layer to layer. As shown in FIGS. 29 and 31, in some embodiments, each of the layers may be substantially rectangular in shape. In some embodiments, each of the face layer, the acquisition layer, and the retention layer include a cutout 231 (see, e.g., FIG. 31) in a central portion of the front edge of the layer. In some embodiments the cutout is adjacent to a central portion of the suction nozzle 107 when the cleaning sheet is attached to the tray.

The face layer 222 may be made with a hydrophobic material. The hydrophobic material may be arranged such that the weight of the unit puts a pressure on the layer such that liquid is allowed to penetrate the layer from the floor, but the material is able to help hold acquired liquid within the sheet. The face layer 222 may be treated with paraffin. In some embodiments, the paraffin improves the retention of solid particles on the sheet when the sheet is wetted, thereby reducing the potential for redeposit.

The face layer 222 may include a texture to aid with capturing debris from the floor. For example, the face layer 222 may include an embossed three-dimensional pattern with crevices in which debris can be held. The use of a vacuum cleaner in combination with the sheet reduces the amount of solid debris reaching the embossed face layer, thereby allowing the face layer to be used on a wet surface. The face layer may include a PET spunlace that is hydroentangled.

The acquisition layer 224 may be formed of thermal bonded airlaid. A density may be used which permits liquid to be absorbed from the floor and desorbed into the retention layer 226. The acquisition layer may be formed with a suitable percentage of bi-component to increase mechanical stability and reduce wet collapse. For example, in some embodiments, the

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thermal bonded air laid may be formed with 70% pulp and 30% bi-component. In some embodiments, the material may be formed with at least 30% of bi-component.

The retention layer 226 may have a higher density airlaid than the acquisition layer 224 to promote liquid migration from the acquisition layer into the retention layer. The higher density airlaid provides mechanical structure to reduce compression and retain liquid. In some embodiments, the retention layer material may be formed with 80% pulp and 20% bi-component. The retention layer material may be formed with 20% or less bi-component in some embodiments.

The multifunctional strip 220 may be formed with hydrophilic meltblown polypropylene in some embodiments. By using a hydrophilic material, the sheet may provide a more even wipe to reduce streakiness. The strip may help to break up stains in some embodiments. Additionally, in some embodiments, by providing a source of friction that is higher than the face layer, the multifunctional strip can provide feedback to the user indicating when more liquid as needed.

FIG. 30 illustrates a method of manufacturing 300 the cleaning sheet of FIG. 29. For example, in some embodiments, as shown in this view, an adhesive may be applied between the acquisition layer and the retention layer to adhere the layers to one another 380. Next, the multifunctional strip, the face layer, and the acquisition layer may be ultrasonically joined and/or welded together 382. As will be appreciated, prior to joining the layers together, the face layer may be placed on top of the acquisition layer, and the multifunctional strip may be placed on top of the face layer. As will be further appreciated, the layers may be stacked on top of one another such that the surface-facing sides of each layer are facing in the same direction (e.g., are upwardly facing).

In some embodiments, as shown in FIG. 31 the layers may be ultrasonically joined and/or welded via weld lines 228. In some embodiments, the weld lines may form a diamond pattern on the surface-facing side of the cleaning sheet, although the weld lines may form other suitable patterns in other embodiments.

In some embodiments, as shown in FIG. 30, the forward 229 and rear 230 edges of the cleaning sheet may then be sealed. For example, the face layer, the acquisition layer, and the retention layer may be ultrasonically welded and/or heat sealed to one another at the forward and rear edges. For purposes herein, the forward edge of the cleaning sheet includes the leading edge of the cleaning sheet when the cleaning head is attached to the cleaning device and the

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cleaning device is moved for cleaning (e.g., with the nozzle leading the direction of travel). In some embodiments, sealing the forward and rear edges of the cleaning sheet may prevent lamination of the of the cleaning sheet (e.g., peeling of one layer of the cleaning sheet from another layer of the cleaning sheet) during use.

5 In some embodiments, once the cleaning sheet has been prepared, an adhesive may be applied between the tray and the retention layer to attach the cleaning sheet to the tray and to the debris collection chamber.

Although the cleaning sheet is described as having some layers joined via adhesive and others via welding and/or sealing, it will be appreciated that all of the layers may be joined to one another via an adhesive. In such examples, an adhesive may be applied between each adjacent layer (e.g., between the acquisition layer and face layer, and via the face layer and multifunctional strip). The layers also may be joined together via other suitable arrangements.

While the present teachings have been described in conjunction with various embodiments and examples, it is not intended that the present teachings be limited to such 15 embodiments or examples. On the contrary, the present teachings encompass various alternatives, modifications, and equivalents, as will be appreciated by those of skill in the art. Accordingly, the foregoing description and drawings are by way of example only.

Various aspects of the present invention may be used alone, in combination, or in a variety of arrangements not specifically discussed in the embodiments described in the foregoing and is therefore not limited in its application to the details and arrangement of 20 components set forth in the foregoing description or illustrated in the drawings. For example, aspects described in one embodiment may be combined in any manner with aspects described in other embodiments.

Also, embodiments of the invention may be embodied as a method, of which an example 25 has been provided. The acts performed as part of the method may be ordered in any suitable way. Accordingly, embodiments may be constructed in which acts are performed in an order different than illustrated, which may include performing some acts simultaneously, even though shown as sequential acts in illustrative embodiments.

Use of ordinal terms such as “first,” “second,” “third,” etc., in the claims to modify a 30 claim element does not by itself connote any priority, precedence, or order of one claim element

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over another or the temporal order in which acts of a method are performed, but are used merely as labels to distinguish one claim element having a certain name from another element having a same name (but for use of the ordinal term) to distinguish the claim elements.

Also, the phraseology and terminology used herein is for the purpose of description and
5 should not be regarded as limiting. The use of “including,” “comprising,” or “having,”
“containing,” “involving,” and variations thereof herein, is meant to encompass the items listed
thereafter and equivalents thereof as well as additional items.

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CLAIMS

What is claimed is:

1. A cleaning head comprising:
5 a debris collection chamber;
an air filter; and

a cleaning sheet including a retention layer, an acquisition layer, a face layer, and a strip
arranged for at least one of scrubbing and providing friction, wherein the layers are attached
together.

- 10 2. The cleaning head of claim 1, wherein the strip is attached to the face layer.

3. The cleaning head of claim 2, wherein the face layer is backed by the acquisition layer
and the retention layer.

- 15 4. The cleaning head of claim 2, wherein the strip is arranged to contact a surface to be
cleaned.

5. The cleaning head of claim 4, wherein at least a portion of the face layer is arranged to
20 contact the surface, and wherein the strip is attached to a surface-facing side of the face layer.

6. The cleaning head of claim 5, wherein the strip is attached to a central portion of the
surface-facing side of the face layer.

- 25 7. The cleaning head of claim 6, wherein the strip extends along at least a portion of a
width of the cleaning sheet.

8. The cleaning head of claim 1, wherein the strip is formed of a hydrophilic material.

- 30 9. The cleaning head of claim 1, wherein the face layer is formed of a hydrophobic
material.

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10. The cleaning head of claim 9, wherein the face layer includes an embossed three-dimensional pattern.

11. The cleaning head of claim 1, wherein each of the acquisition layer and the retention
5 layer is formed of a thermal bonded airlaid.

12. The cleaning head of claim 11, wherein the retention layer is formed of an airlaid with a higher density than an airlaid of the acquisition layer.

10 13. The cleaning head of claim 1, wherein the face layer is formed of a hydrophobic material.

14. The cleaning head of claim 1, wherein the air filter is arranged to cover a top of the debris collection chamber and the cleaning sheet is disposed on an underside of the debris
15 collection chamber.

15. The cleaning head of claim 1, further comprising a suction nozzle.

16. The cleaning head of claim 1, further comprising a non-return valve arranged to keep
20 dust, dry media, and/or wet media within the debris collection chamber.

17. The cleaning head of claim 1, wherein the debris collection chamber is formed as part of a tray.

25 18. The cleaning head of claim 17, wherein the tray is formed of a thermoformed plastic.

19. A method of forming a cleaning sheet, the method comprising:
adhering an acquisition layer of a first material to a retention layer of a second material;
joining together a strip of a third material, the strip arranged for at least one of scrubbing
30 and providing friction, a face layer of a fourth material, and the acquisition layer to form a cleaning sheet; and
sealing a forward edge and a rear edge of the cleaning sheet.

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20. The method of claim 19, wherein adhering includes applying an adhesive between the acquisition layer and the retention layer.

5 21. The method of claim 19, wherein joining includes ultrasonically joining the strip, the face layer, and the acquisition layer.

22. The method of claim 21, wherein ultrasonically joining includes ultrasonically welding.

10 23. The method of claim 21, further comprising, before the step of joining, placing the face layer on top of the acquisition layer and placing the strip on top of the acquisition layer.

24. The method of claim 22, wherein joining includes joining the strip, the face layer, and the acquisition layer via weld lines.

15 25. The method of claim 19, wherein joining includes applying an adhesive between the strip and the face layer and between the face layer and the acquisition layer.

20 26. The method of claim 19, wherein sealing includes at least one of ultrasonically welding and heat sealing together a forward edge of each of the face layer, the acquisition layer, and the retention layer.

25 27. The method of claim 26, wherein sealing includes at least one of ultrasonically welding and heat sealing together a rear edge of each of the face layer, the acquisition layer, and the retention layer.

28. The method of claim 15, further comprising adhering the retention layer to a tray, wherein a dirt collection chamber is formed as part of the tray.

30 29. An apparatus comprising:
a debris collection chamber;

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an air filter configured to allow air to pass through the air filter while inhibiting debris from passing through the air filter;

a collection chamber inlet opening configured to allow debris-entrained air to flow into the collection chamber;

5 wherein the air filter includes an elongated strip that is movable from a first sealed position, in which the elongated strip covers the chamber inlet opening, to a second unsealed position in which the elongated strip does not cover the chamber inlet opening.

10 30. An apparatus as in claim 29, wherein the air filter forms at least a portion of a wall of the debris collection chamber, and the air filter allows air to pass out of the debris collection chamber.

15 31. An apparatus as in claim 29, wherein the elongated strip forms at least a portion of an internal valve.

32. An apparatus as in claim 31, wherein the internal valve is adapted to be maintained in the first sealed position when no negative pressure is applied to the air filter.

20 33. An apparatus as in claim 32, wherein the internal valve is adapted to be moved to the second unsealed position when negative pressure is applied to the air filter to draw air through the chamber inlet opening.

25 34. An apparatus as in claim 33, wherein in the first sealed position the internal valve is configured to rest on a frame portion of the collection chamber inlet opening.

35. An apparatus as in claim 29, wherein the collection chamber comprises inlet walls extending upwardly from a chamber bottom, wherein the inlet opening is formed at least in part by a top rim of the inlet walls.

30 36. An apparatus as in claim 29, further comprising a cleaning head for a vacuum cleaner, wherein the collection chamber is attached to the cleaning head.

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37. An apparatus as in claim 36, wherein the cleaning head is removably attachable to a vacuum cleaner.

38. An apparatus as in claim 37, further comprising the vacuum cleaner.

5

39. An apparatus as in claim 36, wherein the collection chamber is permanently attached to the cleaning head.

40. An apparatus as in claim 36, wherein the cleaning head includes a suction nozzle, and an air flow path connects the suction nozzle to the chamber inlet opening.

10

41. An apparatus as in claim 40, wherein the suction nozzle and the collection chamber are integrally formed as a unitary piece.

42. An apparatus as in claim 36, further comprising a cleaning sheet attached to the cleaning head.

15

43. An apparatus as in claim 36, wherein the cleaning sheet includes a first layer which is arranged to contact the floor, and the first layer includes an embossed pattern with crevices to hold debris.

20

44. An apparatus adapted to be attached to a vacuum cleaner, the apparatus comprising:
a debris collection chamber;
a collection chamber inlet opening configured to allow debris-entrained air to flow into the debris collection chamber;

25

an air filter configured to allow air to pass through the air filter while inhibiting debris from passing through the air filter;

an internal valve movable from a first position in which the internal valve covers the chamber inlet opening, to a second position in which the internal valve does not cover the chamber inlet opening;

30

wherein the internal valve is attached to the air filter, and the air filter is arranged such that when the air filter is under no negative pressure, the internal valve is in the first position,

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and the air filter is arranged such that when negative pressure is applied to the air filter to draw air through the chamber inlet opening, the air filter moves the internal valve to the second position.

5 45. An apparatus adapted to be attached to a cleaning device having a suction source, the apparatus comprising:

a debris collection chamber;

a collection chamber inlet opening configured to allow air to flow into the debris collection chamber when negative pressure is applied to the debris collection chamber;

10 an internal valve movable from a first position, in which the internal valve covers the chamber inlet opening, to a second position in which the internal valve does not cover the chamber inlet opening;

wherein the internal valve includes multiple layers, at least a first layer of the multiple layers being configured to selectively move the internal valve from the first position to the
15 second position at a pleat formed in the first layer.

46. An apparatus comprising:

a main body including a suction source;

a debris collection chamber removably attachable to the main body;

20 a suction nozzle fluidically connected to the debris collection chamber and positioned forwardly of the debris collection chamber;

a liquid applicator; and

a sheet connected to an underside of the debris collection chamber, wherein a surface of the sheet is arranged to contact the floor when the apparatus is in use, and the surface includes
25 an embossed pattern configured to at least temporarily capture debris from the floor.

47. An apparatus as in claim 46, wherein the sheet is permanently attached to the debris collection chamber.

30 48. An apparatus as in claim 46, wherein the sheet is removably attached to the debris collection chamber

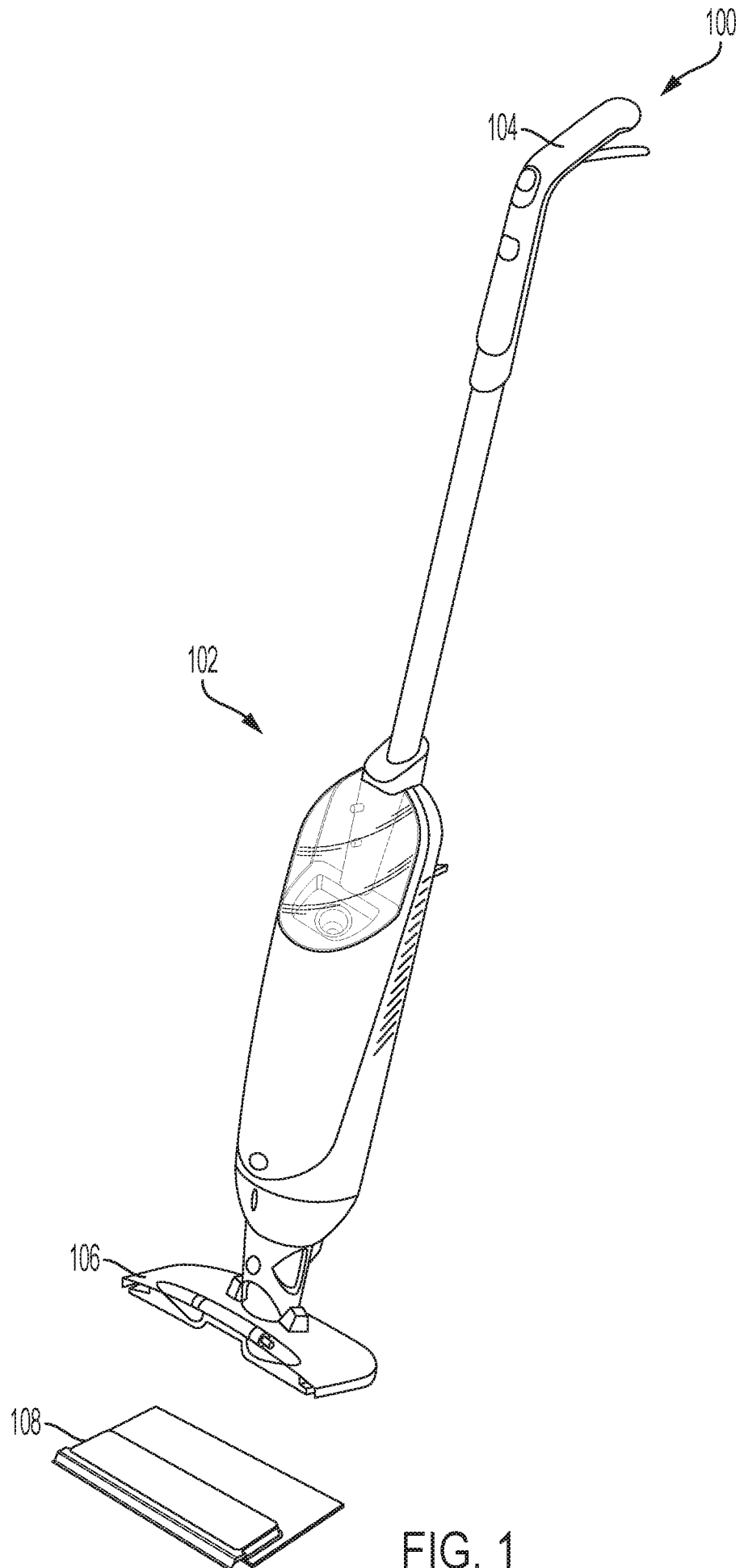


FIG. 1

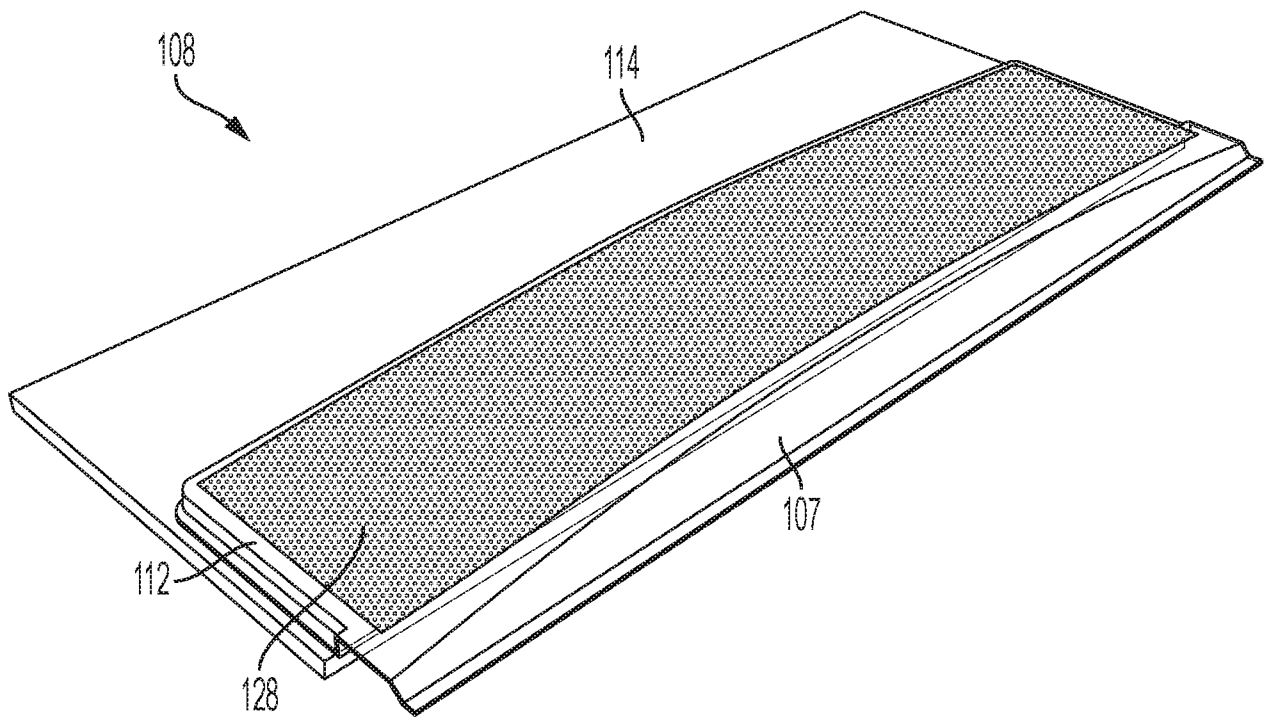


FIG. 2

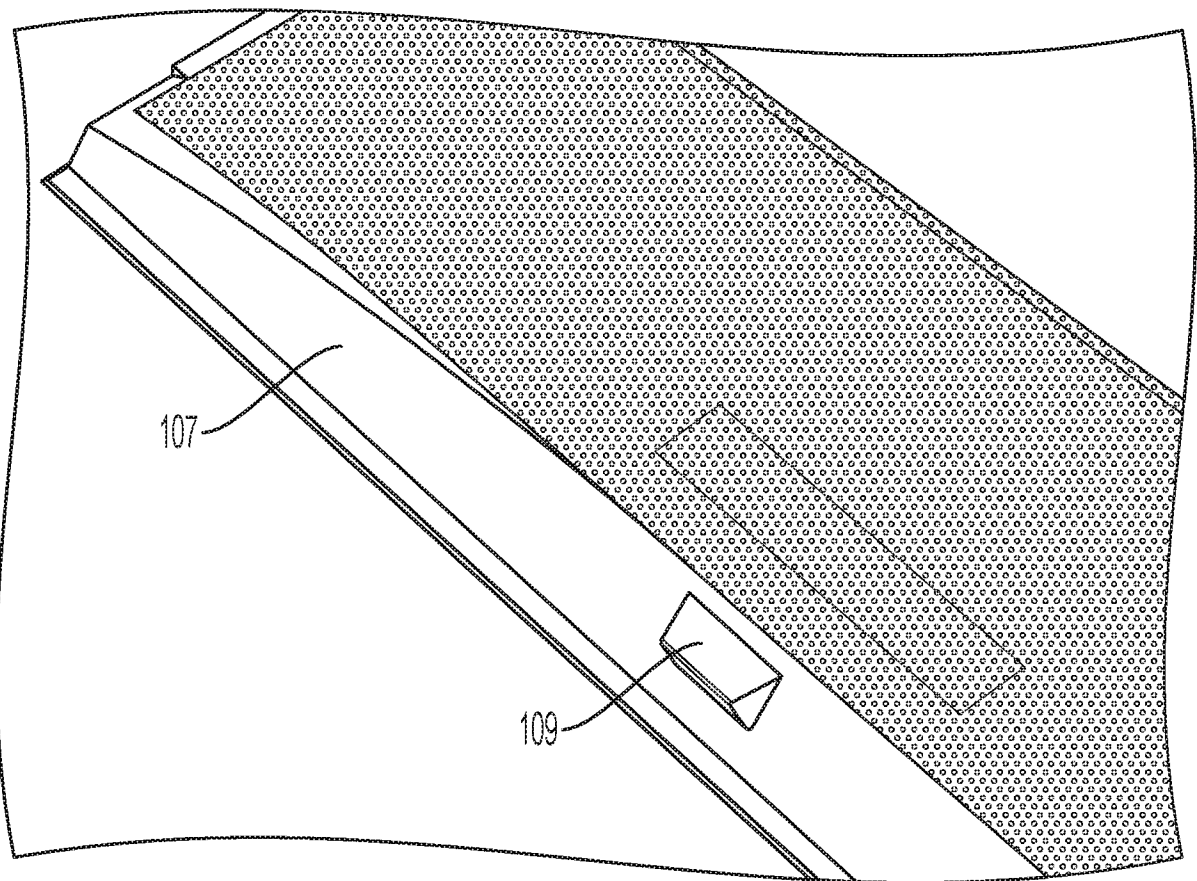


FIG. 3

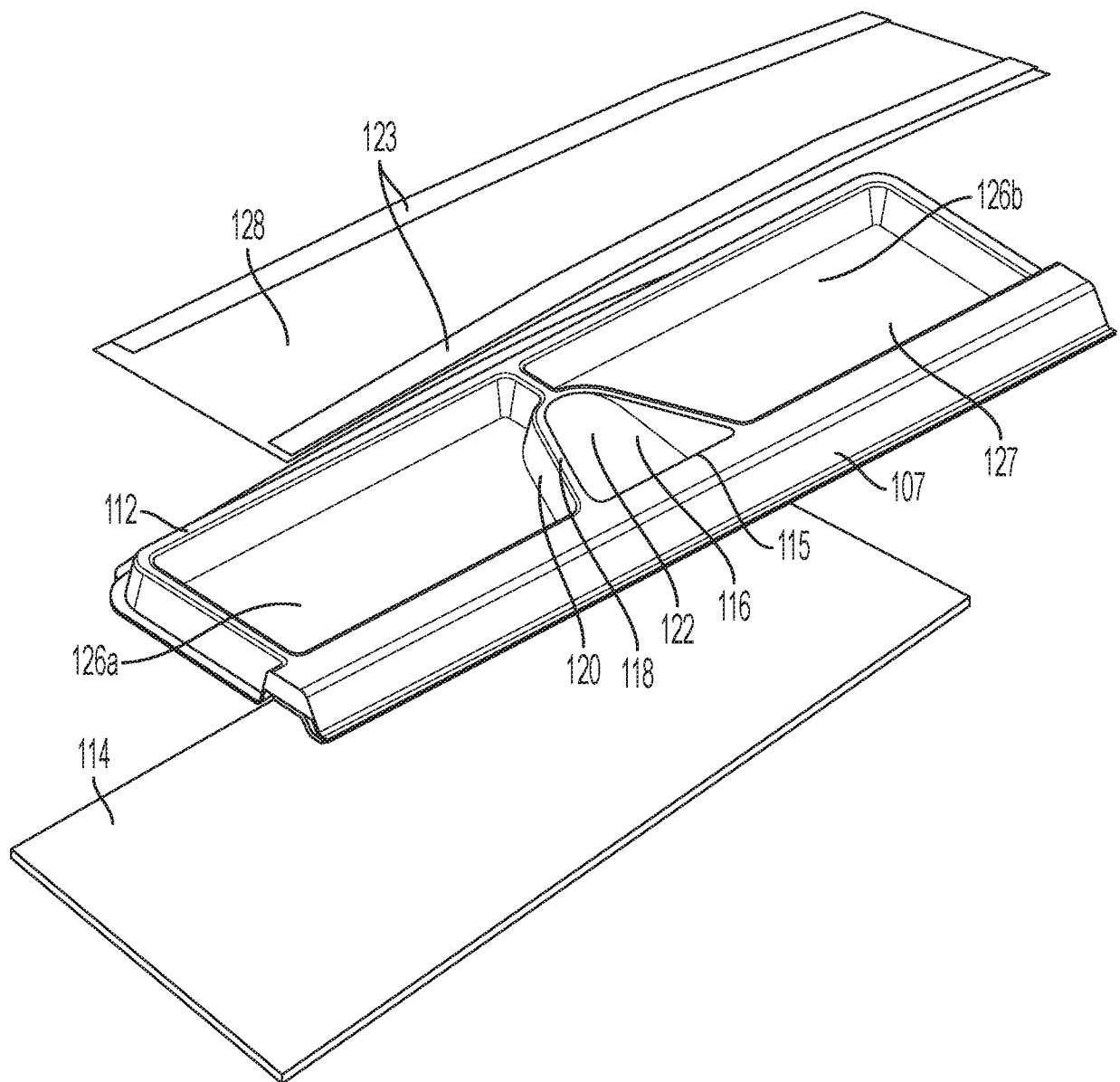


FIG. 4

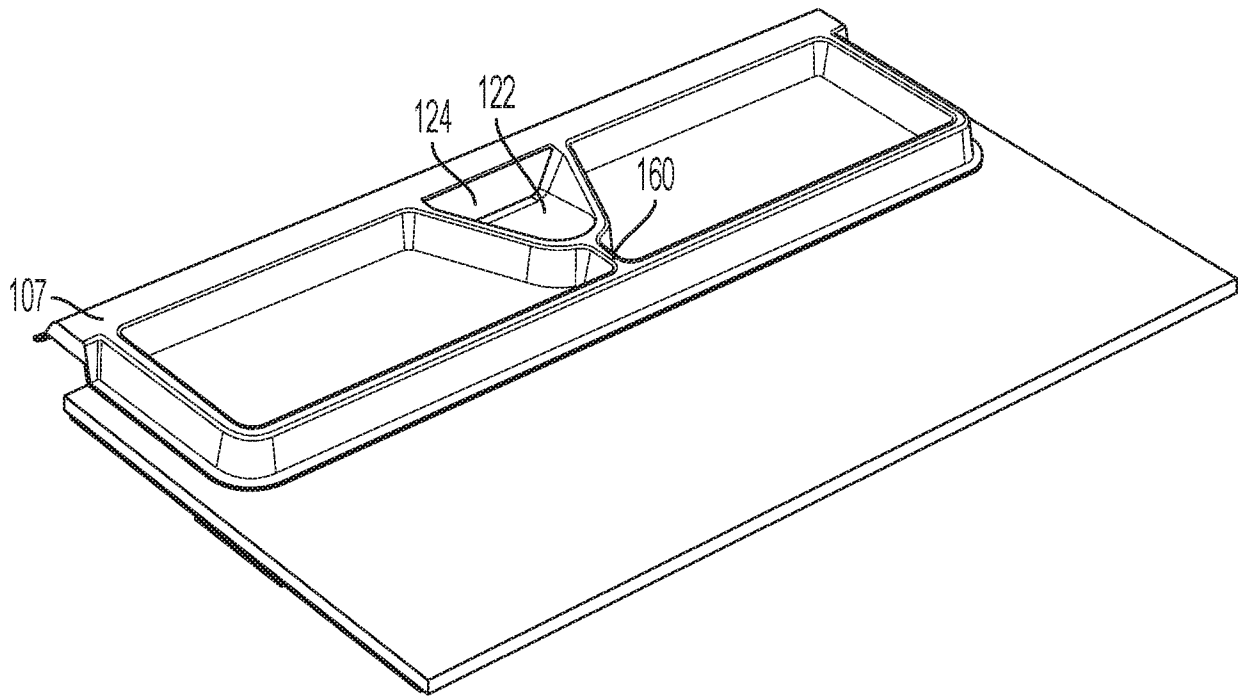


FIG. 5

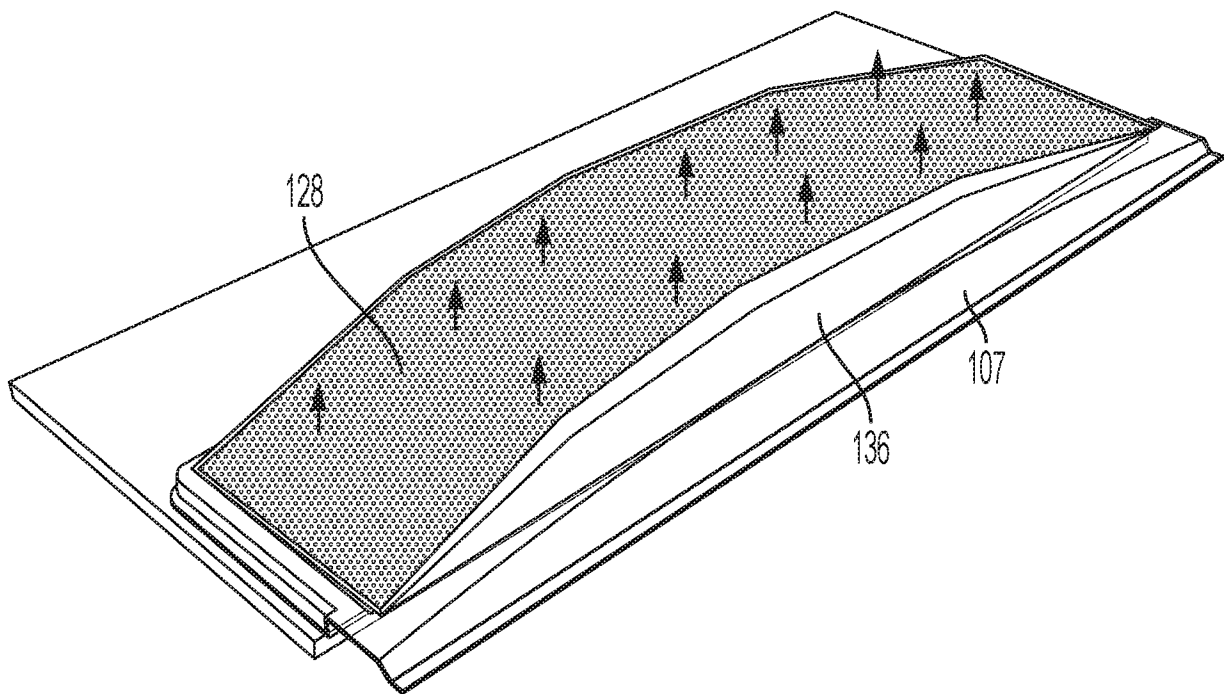


FIG. 6

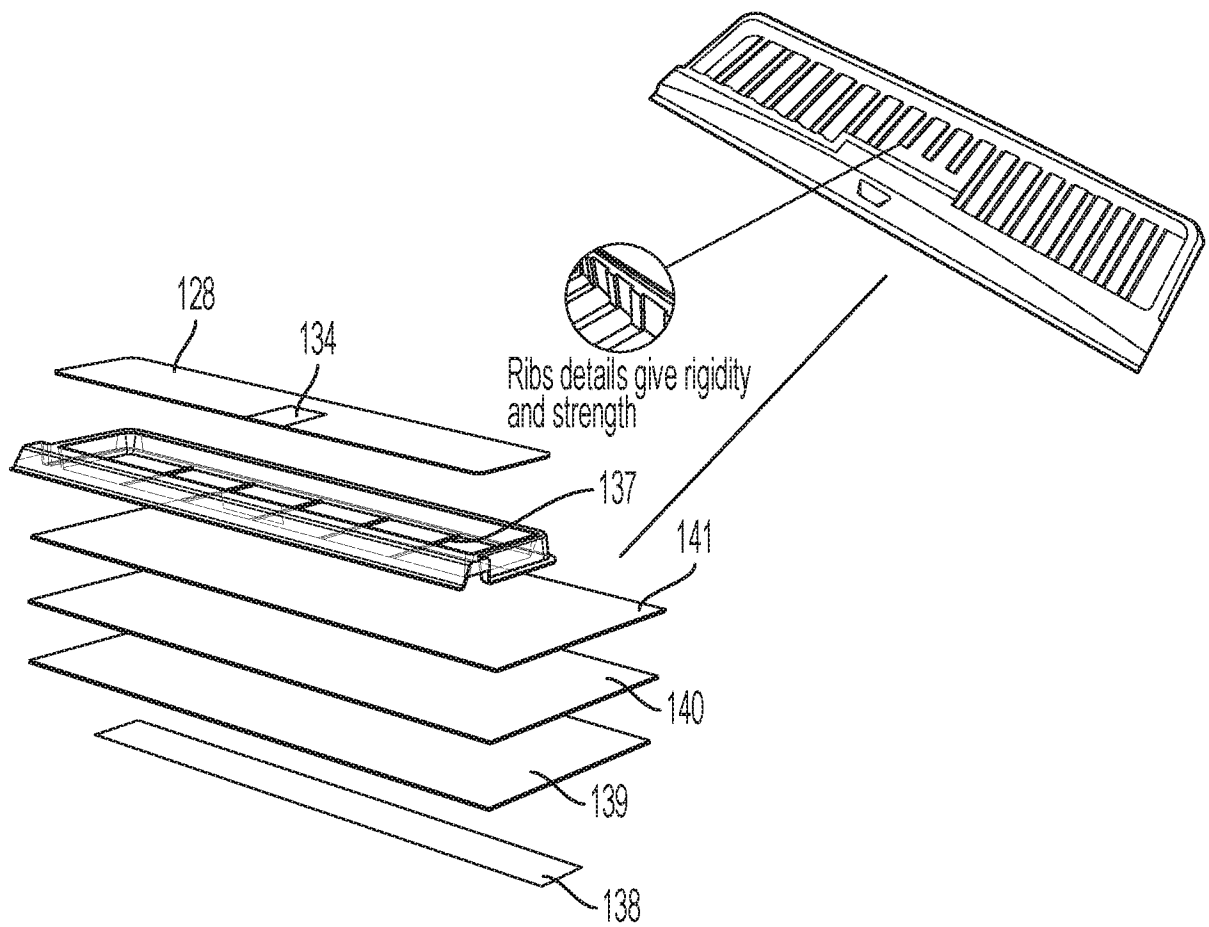


FIG. 7

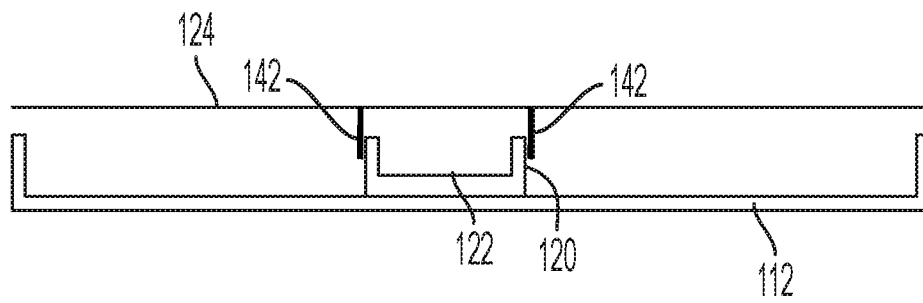


FIG. 8

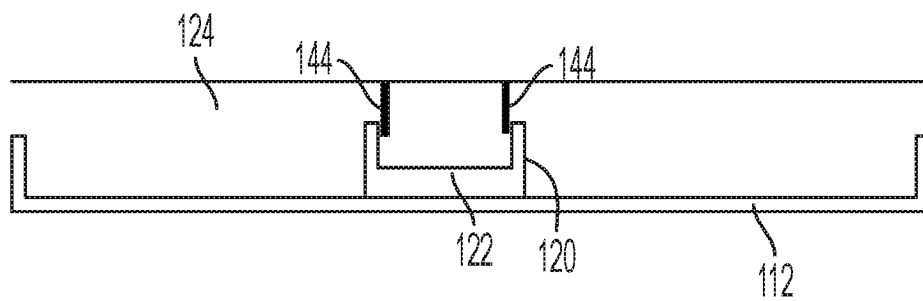


FIG. 9

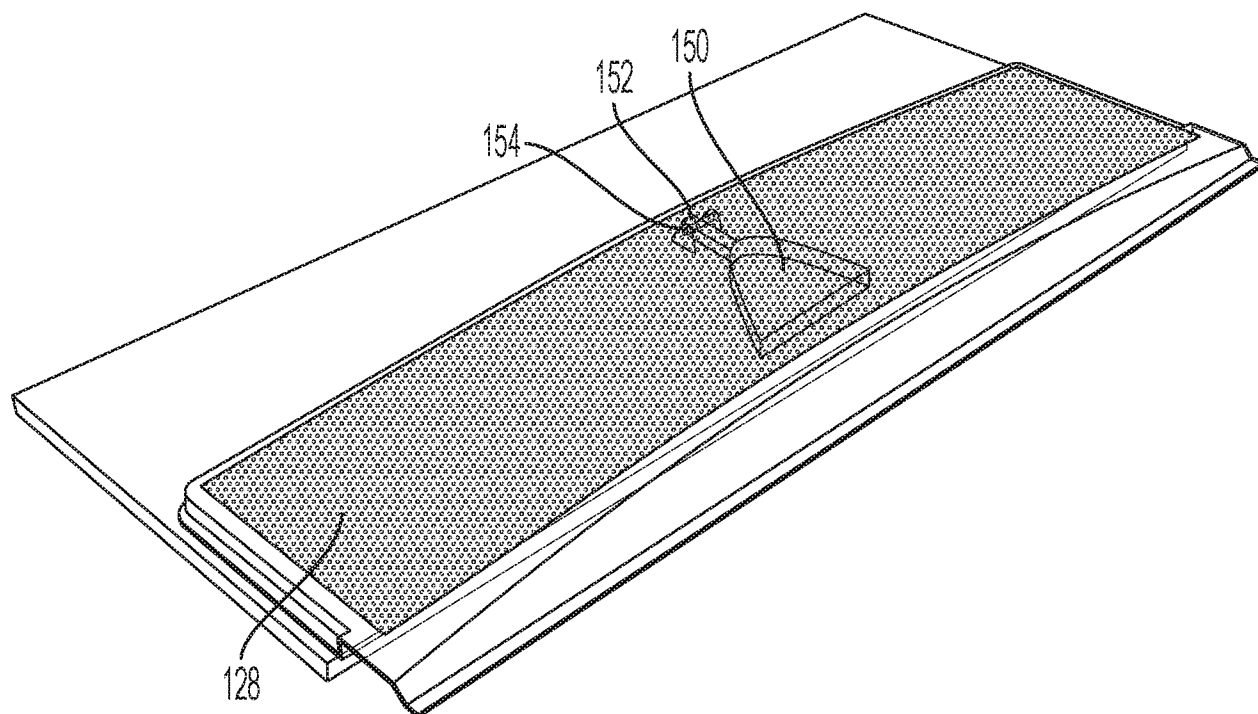


FIG. 10

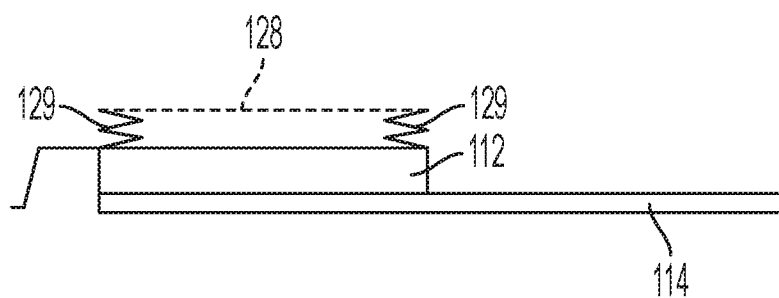


FIG. 11

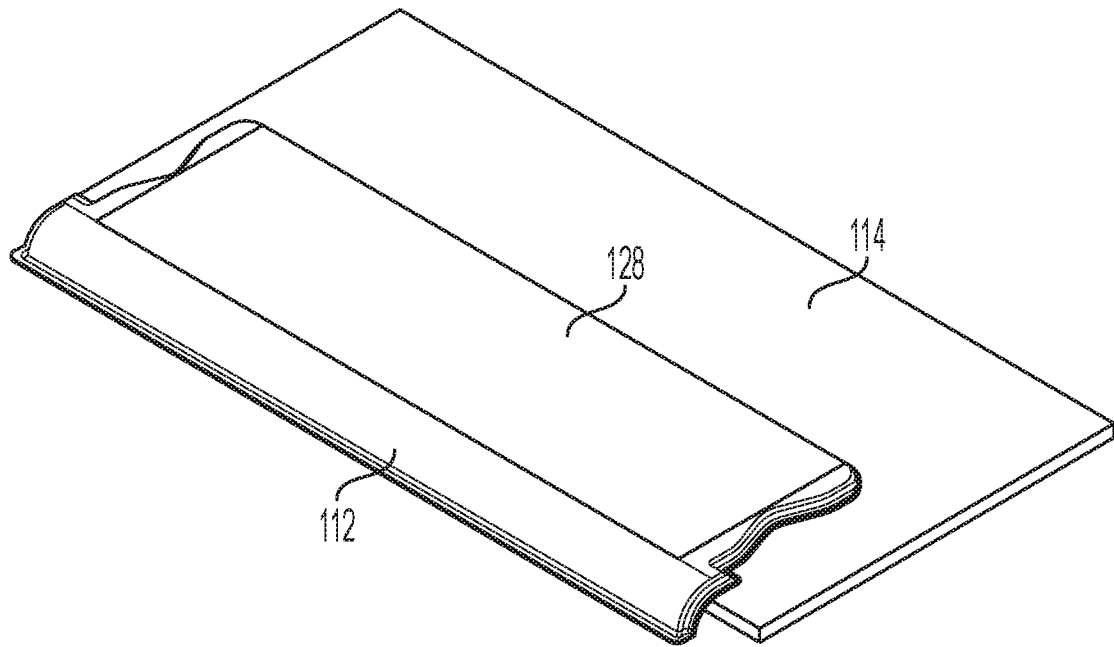


FIG. 12

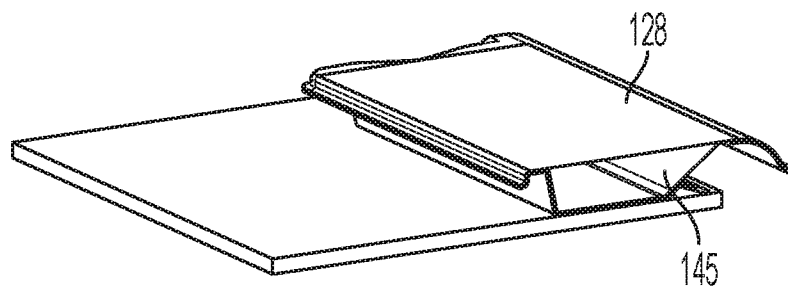


FIG. 13

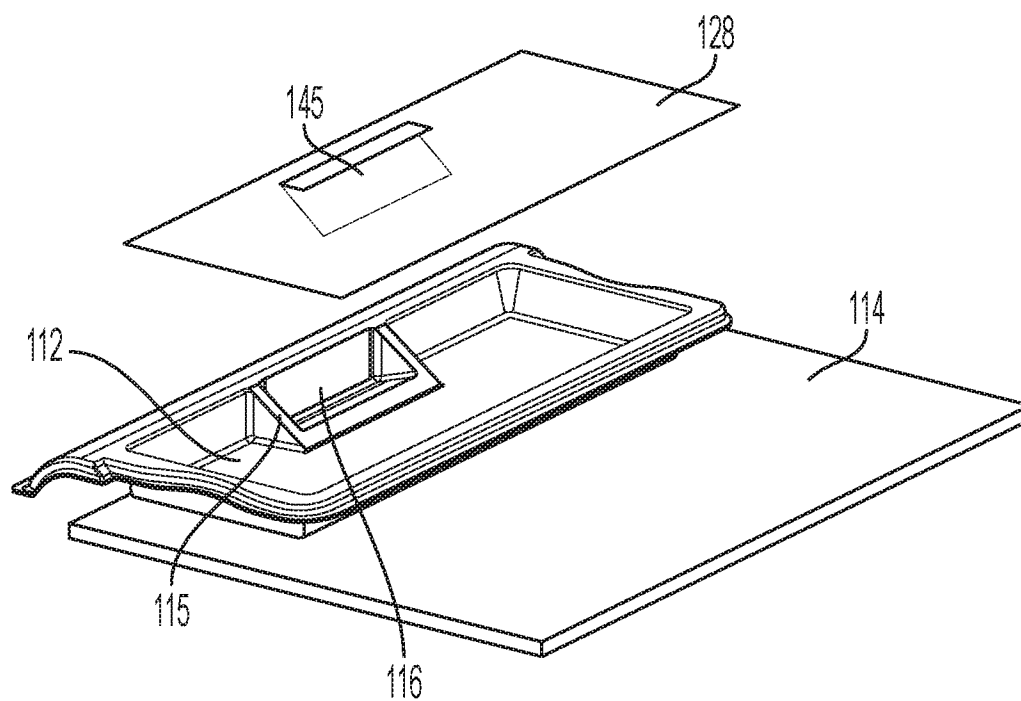


FIG. 14

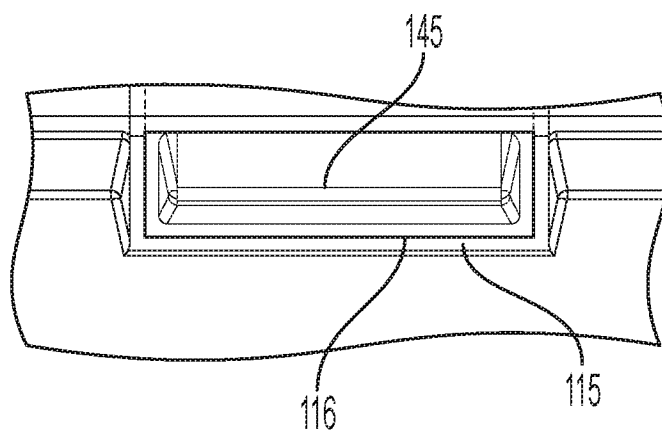


FIG. 15

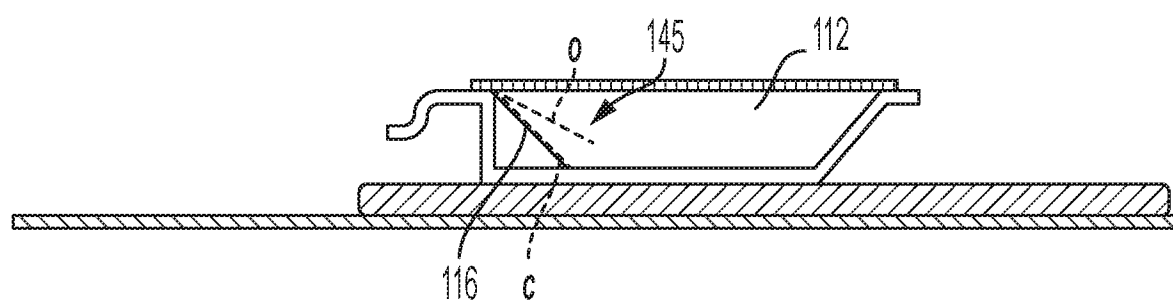


FIG. 16

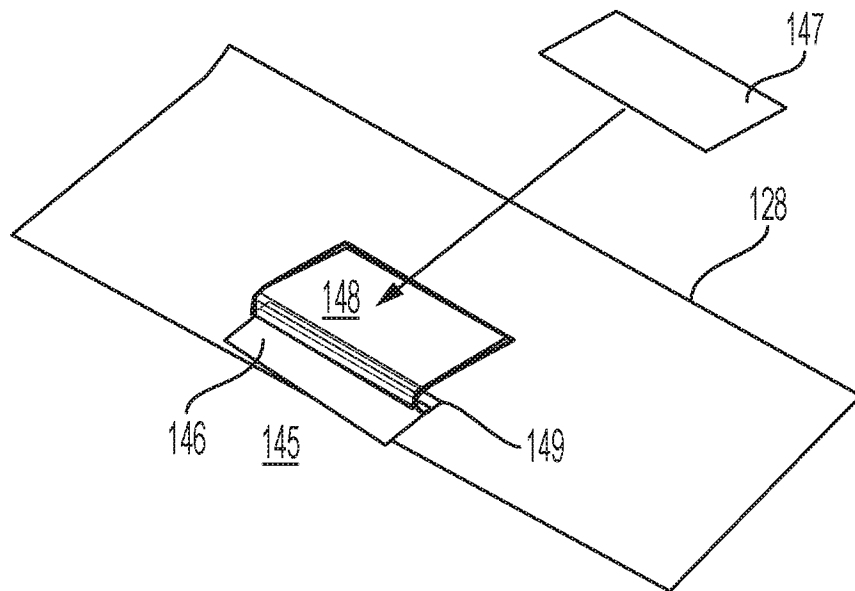


FIG. 17

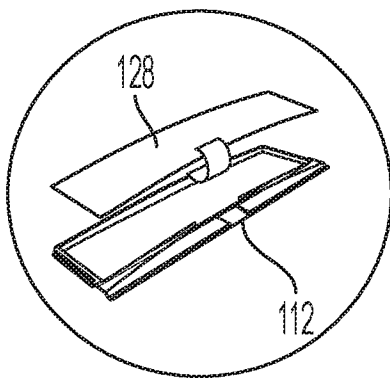


FIG. 18

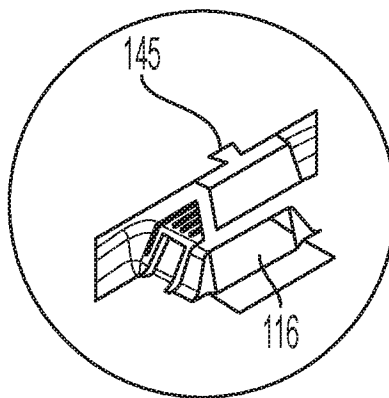


FIG. 19

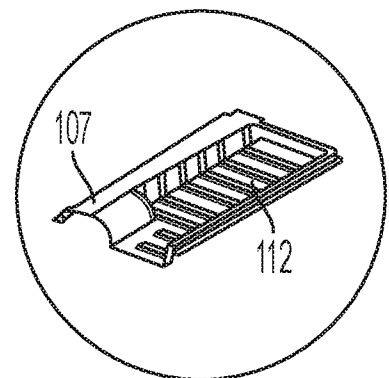


FIG. 20

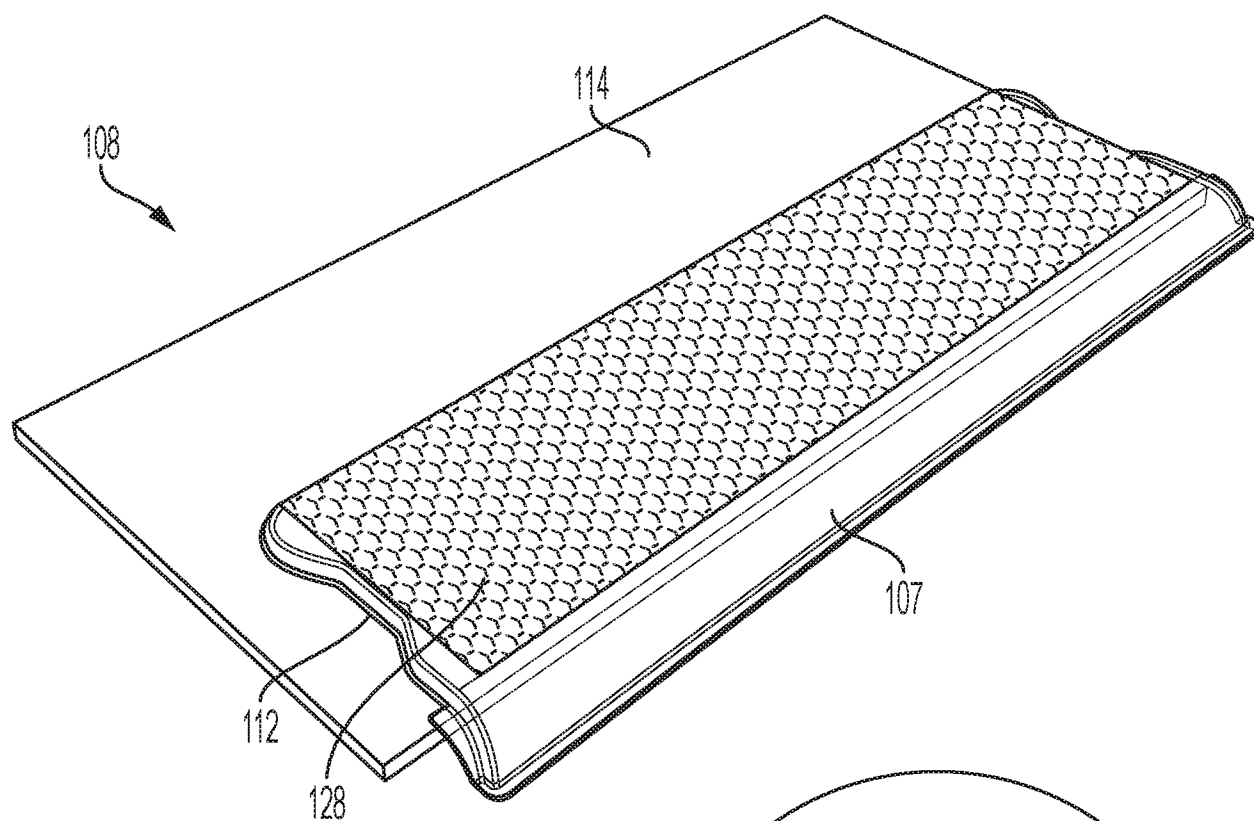


FIG. 21

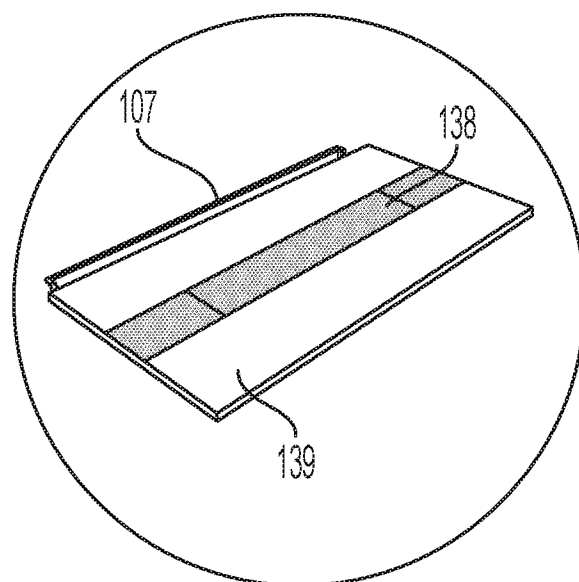


FIG. 22

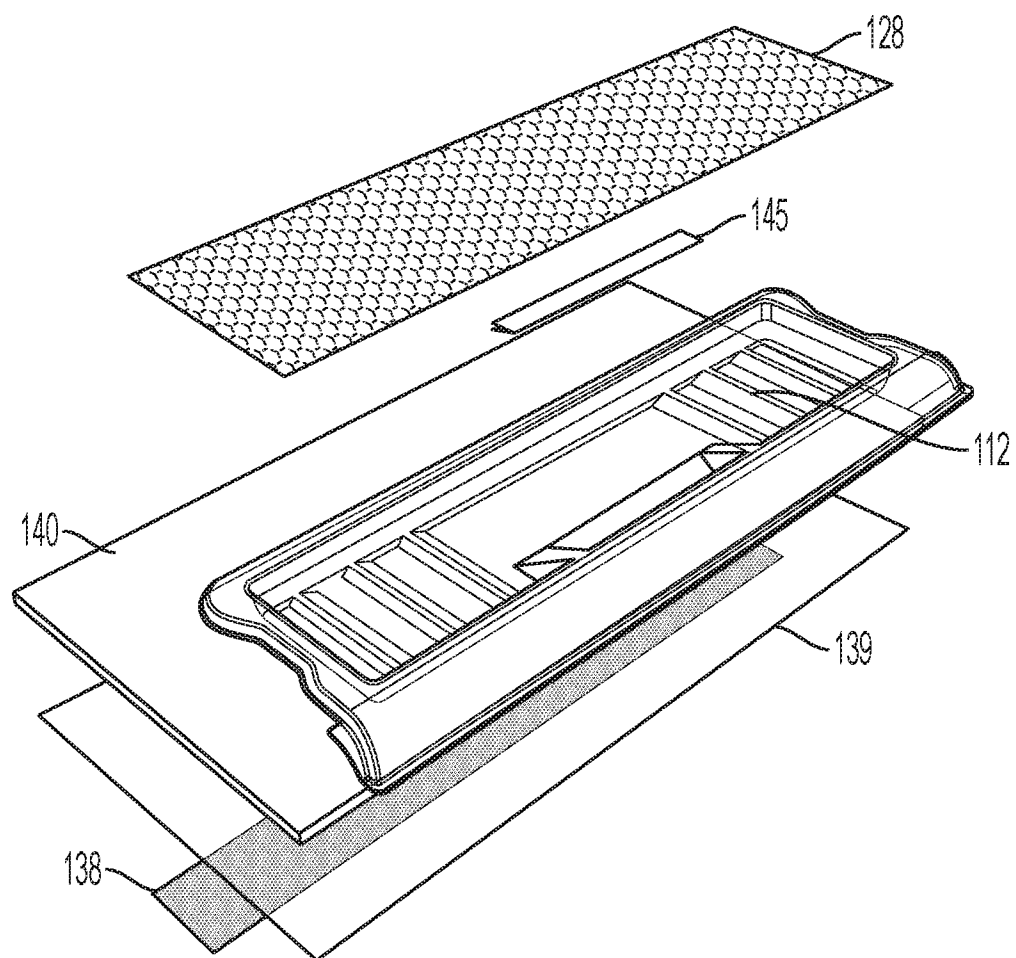


FIG. 23

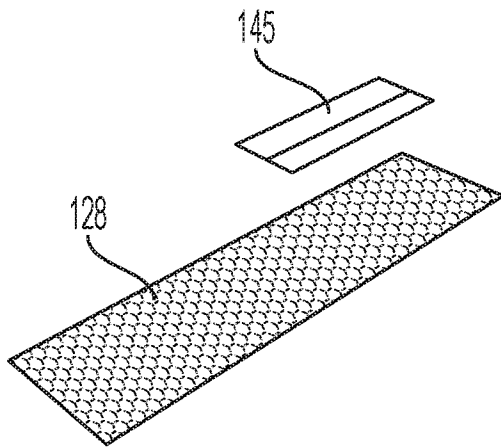


FIG. 24A

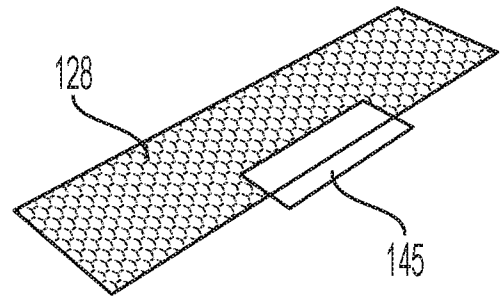


FIG. 24B

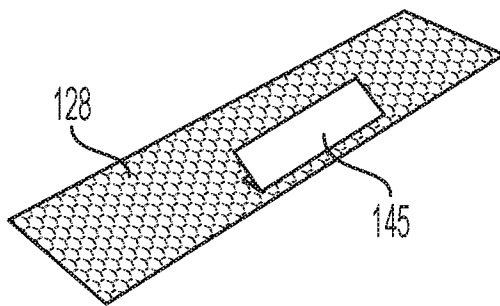


FIG. 24C

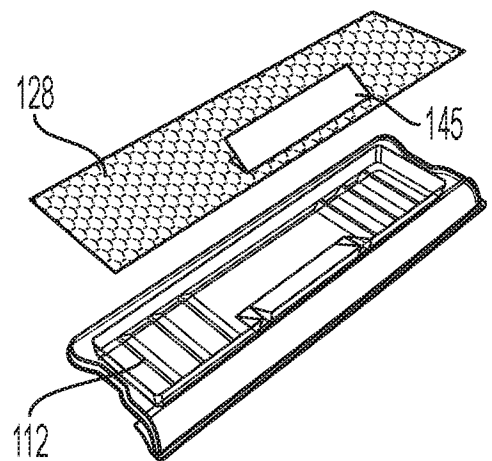


FIG. 24D

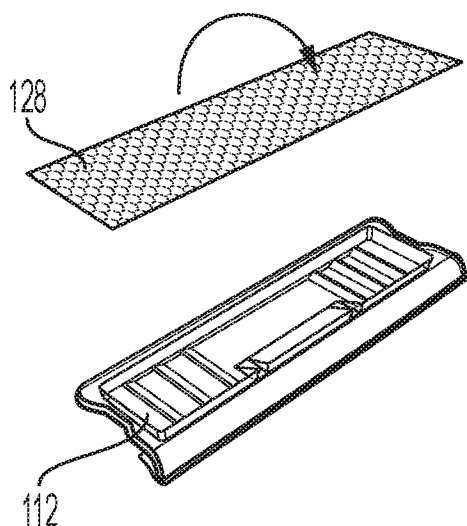


FIG. 24E

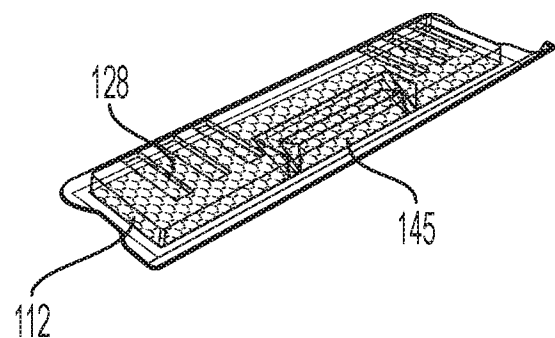


FIG. 24F

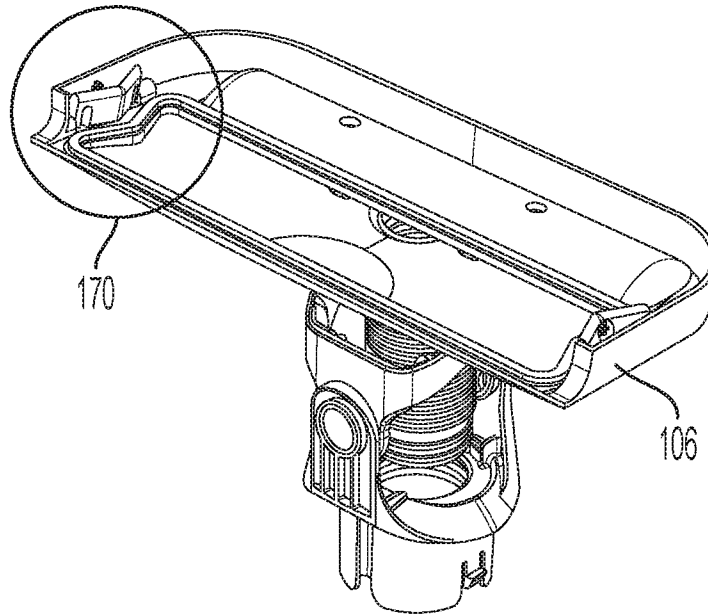


FIG. 25

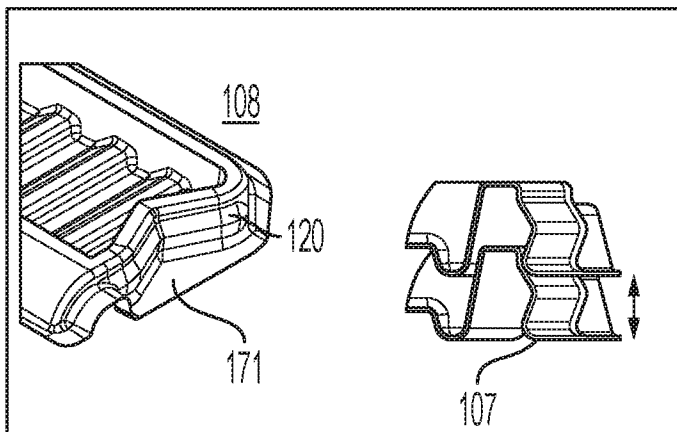


FIG. 26

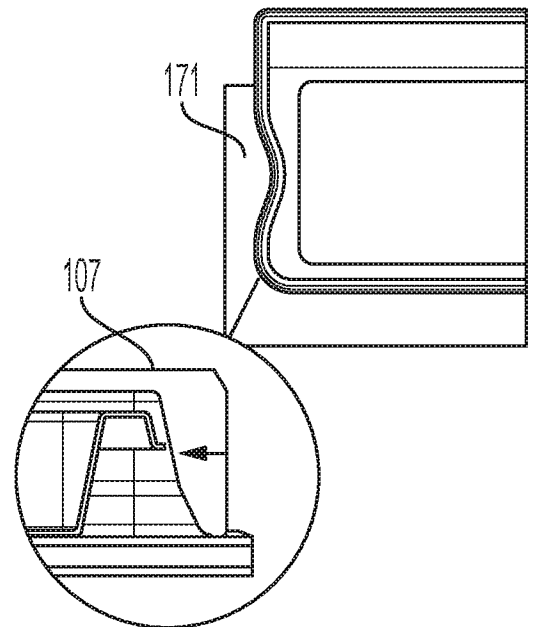


FIG. 27

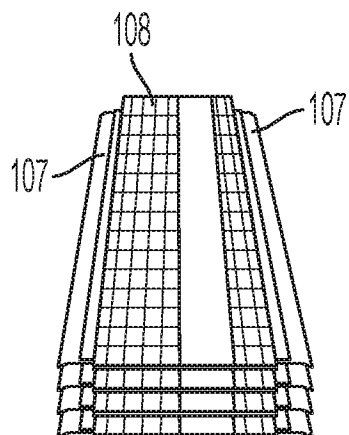


FIG. 28

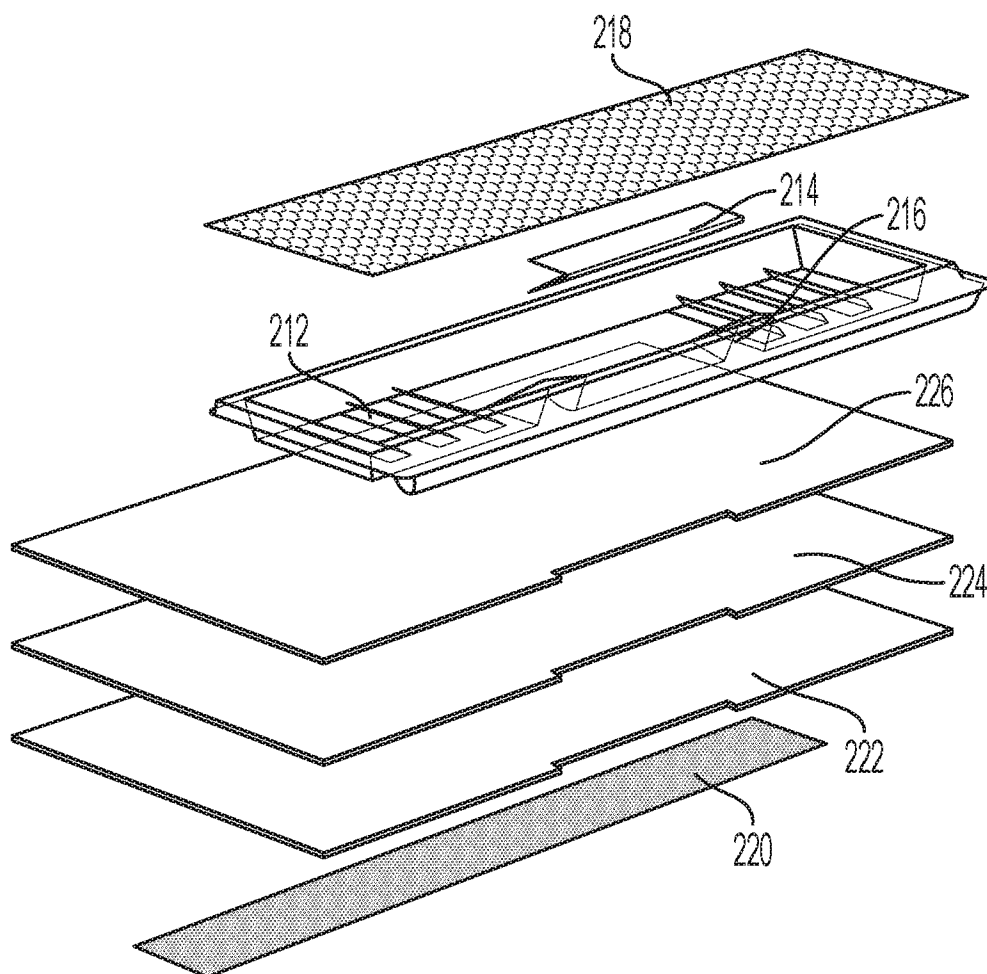


FIG. 29

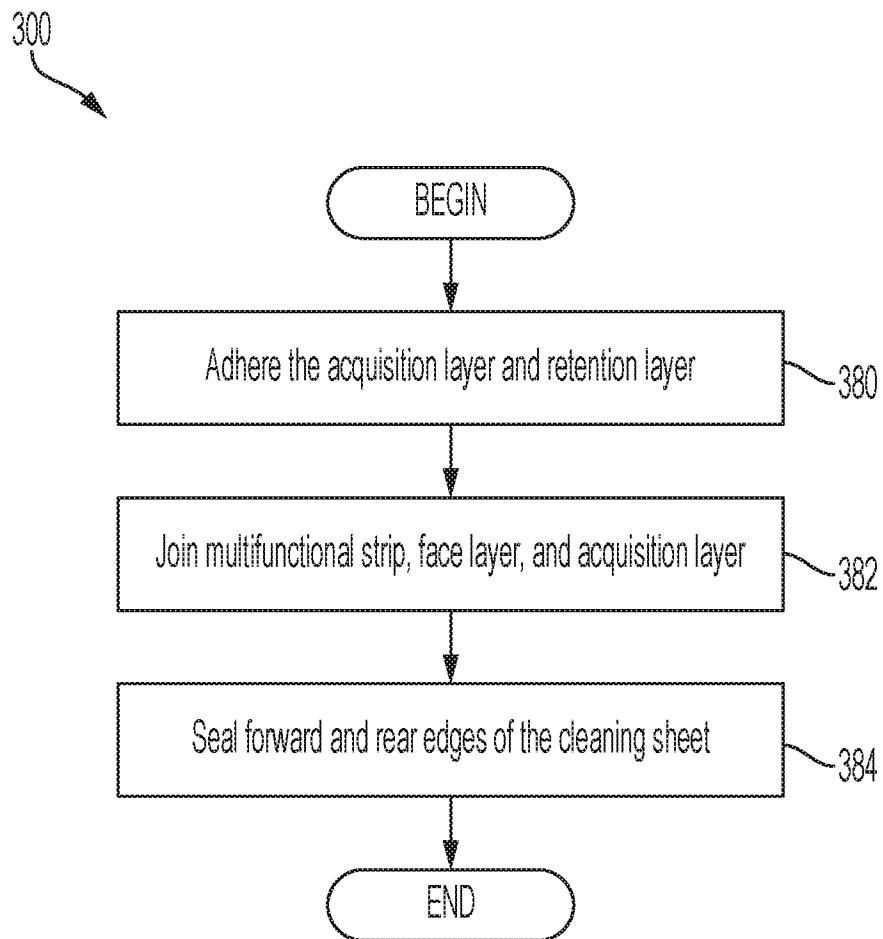


FIG. 30

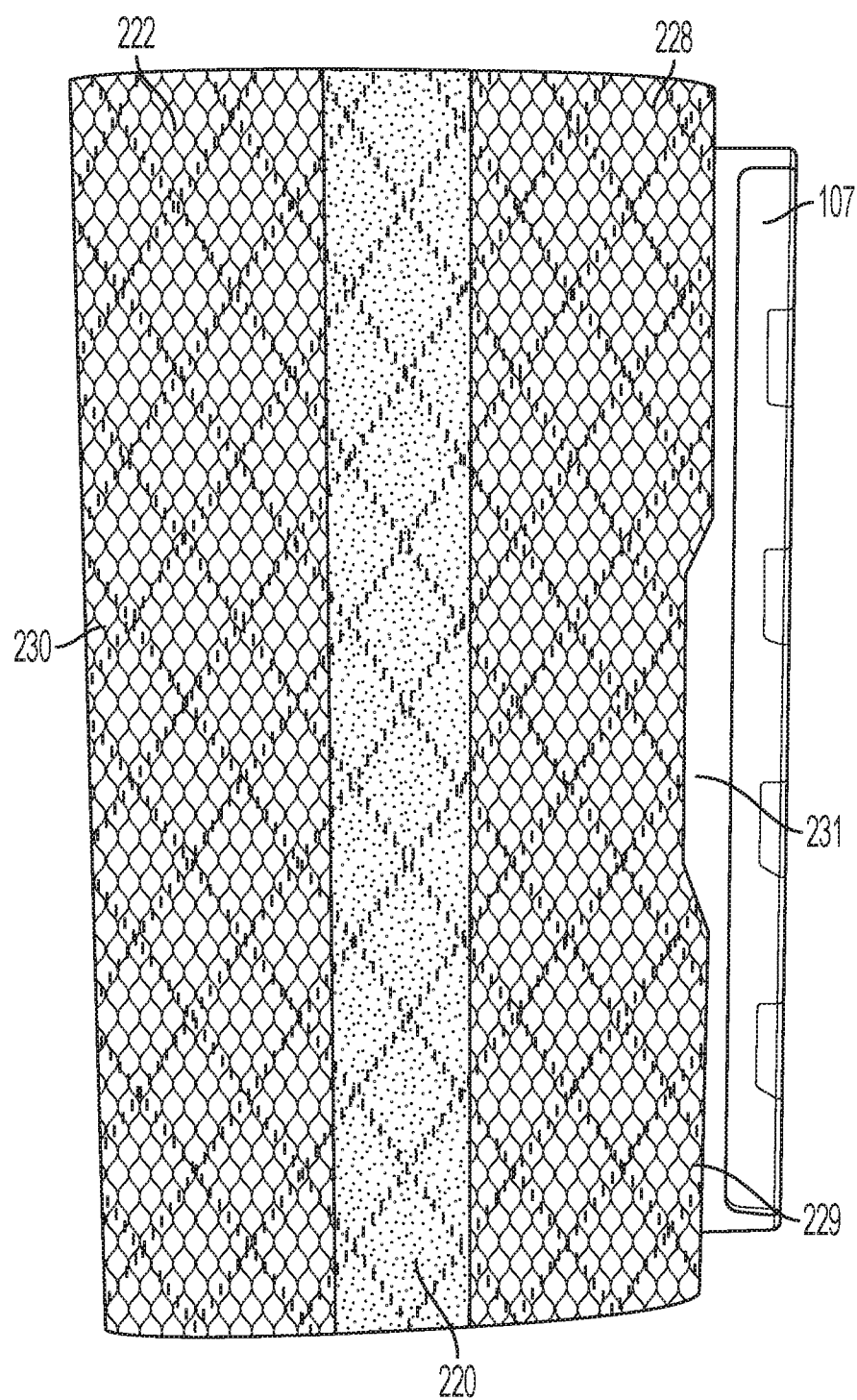


FIG. 31

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US19/67121

A. CLASSIFICATION OF SUBJECT MATTER

IPC - A47L 5/24, 5/28, 13/20; B08B 5/04 (2020.01)

CPC - A47L 5/24, 5/28, 13/20; B08B 5/04

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History document

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---	US 2004/0134016 A1 (KISELA D et al.) 15 July 2004; figures 6, 7, 13, 14; paragraph [0044], [0049], [0076]	1, 14-18 ---
Y		9, 10-13
X	US 2007/0061040 A1 (AUGENBRAUN J et al.) 15 March 2007; figures 5A, 8B; paragraphs [0111], [0119]	1-8
Y	US 2012/0159728 A1 (SUDA T et al.) 28 June 2012; figures 22, 23; paragraphs [0125], [0128]	9, 10, 13
Y	US 2015/0128364 A1 (iROBOT CORPORATION) 14 May 2015; figure 1C; paragraphs [0089], [0094]	11, 12
A	US 2015/0223662 A1 (THE PROCTER & GAMBLE COMPANY) 13 August 2015; entire document	1-18

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

06 March 2020 (06.03.2020)

Date of mailing of the international search report

07 MAY 2020

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Shane Thomas

Telephone No. PCT Helpdesk: 571-272-4300

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US19/67121

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

-Continued Within the Next Supplemental Box-

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
Group I: Claims 1-18

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/US19/67121

---Continued from Box No. III Observations where unity of invention is lacking---

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-18 are directed toward: a cleaning head comprising: a cleaning sheet.

Group II: Claims 19-28 are directed toward: a method of forming a cleaning sheet, the method comprising: adhering an acquisition layer.

Group III: Claims 29-43 are directed toward: an apparatus comprising: wherein the air filter includes an elongated strip.

Group IV: Claim 44 is directed toward: an apparatus adapted to be attached to a vacuum cleaner, the apparatus comprising: wherein the internal valve is attached to the air filter.

Group V: Claim 45 is directed toward: an apparatus adapted to be attached to a cleaning device having a suction source, the apparatus comprising: wherein the internal valve includes multiple layers.

Group VI: Claims 46-48 are directed toward: an apparatus comprising: a suction nozzle.

The inventions listed as Groups I-VI do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical features of Group I include: a cleaning head comprising: a cleaning sheet, which are not present in Groups II-VI.

The special technical features of Group II include: a method of forming a cleaning sheet, the method comprising: adhering an acquisition layer of a first material to a retention layer of a second material; joining together a strip of a third material, a face layer of a fourth material, and the acquisition layer to form a cleaning sheet; and sealing a forward edge and a rear edge of the cleaning sheet, which are not present in Groups I and III-VI.

The special technical features of Group III include: an apparatus comprising: wherein the air filter includes an elongated strip that is movable from a first sealed position, in which the elongated strip covers the chamber inlet opening, to a second unsealed position in which the elongated strip does not cover the chamber inlet opening, which are not present in Groups I-II and IV-VI.

The special technical features of Group IV include: an apparatus adapted to be attached to a vacuum cleaner, the apparatus comprising: wherein the internal valve is attached to the air filter, and the air filter is arranged such that when the air filter is under no negative pressure, the internal valve is in the first position, and the air filter is arranged such that when negative pressure is applied to the air filter to draw air through the chamber inlet opening, the air filter moves the internal valve to the second position, which are not present in Groups I-III and V-VI.

The special technical features of Group V include: an apparatus adapted to be attached to a cleaning device having a suction source, the apparatus comprising:
a collection chamber inlet opening configured to allow air to flow into the debris collection chamber when negative pressure is applied to the debris collection chamber; wherein the internal valve includes multiple layers, at least a first layer of the multiple layers being configured to selectively move the internal valve from the first position to the second position at a pleat formed in the first layer, which are not present in Groups I-IV and VI.

The special technical features of Group VI include: an apparatus comprising: a main body including a suction source; a debris collection chamber removably attachable to the main body; a suction nozzle fluidically connected to the debris collection chamber and positioned forwardly of the debris collection chamber; a liquid applicator; and a sheet connected to an underside of the debris collection chamber, wherein a surface of the sheet is arranged to contact the floor when the apparatus is in use, and the surface includes an embossed pattern configured to at least temporarily capture debris from the floor, which are not present in Groups I-V.

The common technical features of Groups I-VI are: an apparatus comprising: a debris collection chamber; an air filter configured to allow air to pass through the air filter while inhibiting debris from passing through the air filter; a collection chamber inlet opening configured to allow debris-entrained air to flow into the collection chamber; and a cleaning sheet including a retention layer, an acquisition layer, a face layer, and a strip arranged for at least one of scrubbing and providing friction, wherein the layers are attached together; an internal valve movable from a first position in which the internal valve covers the chamber inlet opening, to a second position in which the internal valve does not cover the chamber inlet opening; move the internal valve from the first position to the second position.

However, these common technical features are disclosed by US 2004/0134016 A1 (KISELA). Kisela discloses an apparatus comprising: a debris collection chamber (208; figures 4, 13, 14); an air filter (220) configured to allow air to pass through the air filter while inhibiting debris from passing through the air filter (filter 220 permits passage of working air while trapping lighter particles; paragraph [0077]); a collection chamber inlet opening configured to allow debris-entrained air to flow into the collection chamber (air and dirt is drawn into the dirt cup 208 via dirt cup inlet 212; paragraph [0076]); and a cleaning sheet (70; figure 6; paragraph [0049]) including a retention layer (70A), an acquisition layer (70B), a face layer (70C), and a strip (73A) arranged for at least one of scrubbing and providing friction (hook material 73A attaches to the loop material of the layer 70A, i.e. via friction; paragraph [0049]), wherein the layers are attached together (as shown; figure 6; paragraph [0049]); an internal valve movable from a first position in which the internal valve covers the chamber inlet opening, to a second position in which the internal valve does not cover the chamber inlet opening (flap valve 244 is positioned at the dirt cup inlet 212 which is moved between a closed position and open position; paragraph [0076]); move the internal valve from the first position to the second position (flap valve 244 is moved between closed and open positions via operation of the fan motor; paragraph [0076]).

Since the common technical features are previously disclosed by the Kisela reference, the common features are not special and so Groups I-VI lack unity.