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AGITATOR WITH HAIR REMOVAL

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present disclosure claims the benefit of U.S. Provisional Patent Application Serial No. 62/385,572 filed Sep. 9, 2016, which is fully incorporated herein by reference.

TECHNICAL FIELD

[0002] This specification relates to surface cleaning apparatuses, and more particularly, to agitators for reducing and/or preventing hair from becoming entangled and for migrating hair along the agitator.

BACKGROUND INFORMATION

[0003] The following is not an admission that anything discussed below is part of the prior art or part of the common general knowledge of a person skilled in the art.

[0004] A surface cleaning apparatus may be used to clean a variety of surface. Some surface cleaning apparatuses include a rotating agitator (e.g., brush roll). One example of a surface cleaning apparatus includes a vacuum cleaner which may include a rotating agitator as well as vacuum source. Non-limiting examples of vacuum cleaners include upright vacuum cleaners, canister vacuum cleaners, stick vacuum cleaners, and central vacuum systems. Another type of surface cleaning apparatus includes powered broom which includes a rotating agitator (e.g., brush roll) that collects debris, but does not include a vacuum source.

[0005] While the known surface cleaning apparatuses are generally effective at collecting debris, some debris (such as hair) may become entangled in the agitator. The entangled hair may reduce the efficiency of the agitator, and may cause damage to the motor and/or gear train that rotates the agitator. Moreover, it may be difficult to remove the hair from the agitator because the hair is entangled in the bristles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] These and other features advantages will be better understood by reading the following detailed description, taken together with the drawings wherein:

[0007] **FIG. 1** is a bottom view of one embodiment of a surface cleaning apparatus, consistent with the present disclosure;

[0008] **FIG. 2** is a cross-sectional view of the surface cleaning apparatus of **FIG. 1** taken along line II-II;

[0009] **FIG. 3** is another bottom view of one embodiment of the surface cleaning apparatus of **FIG. 1** with hair wrapped around the agitator;

[0010] **FIG. 3** is another bottom view of the surface cleaning apparatus of **FIG. 1** with hair wrapped around the agitator;

[0011] **FIG. 4** is another bottom view of the surface cleaning apparatus of **FIG. 1** with hair wrapped around the collection area;

[0012] **FIG. 5** is another bottom view of a surface cleaning apparatus with hair wrapped around the collection area;

[0013] **FIG. 6** is a cross-sectional view of one embodiment of the agitator of **FIG. 1** taken along lines C-C in region P;

[0014] **FIG. 7** is a cross-sectional view of another embodiment of the agitator of **FIG. 1** taken along lines C-C in region P;

[0015] **FIG. 8** is a cross-sectional view of a further embodiment of the agitator of **FIG. 1** taken along lines C-C in region P;

[0016] **FIG. 9** is a cross-sectional view of yet embodiment of the agitator of **FIG. 1** taken along lines C-C in region P;

[0017] **FIG. 10** is a cross-sectional view of an additional embodiment of the agitator of **FIG. 1** taken along lines C-C in region P;

[0018] **FIG. 11** is a cross-sectional view of another embodiment of the agitator of **FIG. 1** taken along lines C-C in region P;

[0019] **FIG. 12** is a cross-sectional view of a further embodiment of the agitator of **FIG. 1** taken along lines C-C in region P;

[0020] **FIG. 13** is a cross-sectional view of a yet a further embodiment of the agitator of **FIG. 1** taken along lines C-C in region P;

[0021] **FIG. 14** is a bottom view of another embodiment of the agitator of **FIG. 1**;

[0022] **FIG. 15** is a bottom view of the agitator of **FIG. 14** with hair wrapped around the collection area;

[0023] **FIG. 16** is a bottom view of another embodiment of the agitator of **FIG. 1**;

[0024] **FIG. 17** is a bottom view of the agitator of **FIG. 16** with hair wrapped around the collection area;

[0025] **FIG. 18** is a cross-sectional view of another embodiment of a cleaning apparatus consistent with the present disclosure;

[0026] **FIG. 19** is a bottom view of a further embodiment of a cleaning apparatus consistent with the present disclosure;

[0027] **FIG. 20** is a bottom view of yet a further embodiment of a cleaning apparatus consistent with the present disclosure;

[0028] **FIG. 21** is a bottom view of yet another embodiment of a cleaning apparatus including a split agitator consistent with the present disclosure;

[0029] **FIG. 22** is a side view of one embodiment of the split agitator of **FIG. 21**;

[0030] **FIG. 23** is a side view of the split agitator of **FIG. 22** with hair wrapped around the collection area;

[0031] **FIG. 24** is an exploded view of the split agitator of **FIG. 23**;

[0032] **FIG. 25** is an exploded view of the split agitator of **FIG. 22**; and

[0033] **FIG. 26** is an exploded, cross-sectional view of the split agitator of **FIG. 25** taken along lines XXVI-XXVI.

[0034] The drawings included herewith are for illustrating various examples of articles, methods, and apparatuses of the teaching of the present specification and are not intended to limit the scope of what is taught in any way.

DETAILED DESCRIPTION

[0035] Various apparatuses or processes will be described below to provide an example of an embodiment of each claimed invention. No embodiment described below limits any claimed invention and any claimed invention may cover processes or apparatuses that differ from those described below. The claimed inventions are not limited to apparatuses or processes having all of the features of any one apparatus or process described below or to features common to multiple or all of the apparatuses described below. It is possible that an apparatus or process described below is not an embodiment of any claimed invention. Any invention disclosed in an apparatus or process described below that is not claimed in this document may be the subject matter of another protective instrument, for example, a continuing patent application, and the applicants, inventors or owners do not intend to abandon, disclaim or dedicate to the public any such invention by its disclosure in this document.

[0043] By way of a general overview, one aspect of the present disclosure features systems and methods for migrating hair on a surface cleaning apparatus. As described herein, a surface cleaning apparatus may include an agitator/brush roll having an elongated body configured to rotate about a pivot axis at least partially within a cleaning head. The agitator includes one or more hair migration portions configured to prevent hair from becoming entangled in the bristles and to urge/migrate hair to a collection area and/or an end of the agitator. The hair migration portion includes at least one continuous row of bristles and at least one sidewall proximate to (e.g., immediately adjacent to and/or substantially parallel to) at least one of the continuous rows of bristles within the hair migration portion. The continuous row of bristles and sidewalls are at least partially revolved around and extend along at least a portion of the longitudinal axis/pivot axis of the elongated agitator body within the hair migration portion (i.e., from one of a collection area or

an end region of the agitator and either another collection area or another end region of the elongated agitator body). The continuous rows of bristles and continuous sidewall of the hair migration portions are configured to reduce hair from becoming entangled in the bristles of the agitator and configured to generate an Archimedes screw force that urges/causes the hair to migrate towards one or more collection areas and/or ends of the agitator. As a result, the agitator of the present disclosure may be configured to generally prevent the hair from excessively building up the agitator and reducing the efficiency of the agitator and/or causing damage to the surface cleaning apparatus (e.g., the rotation systems or the like). Additionally, the hair migration portions may cause the migrated hair to automatically fall off of (e.g., remove) from the agitator and/or may cause the hair to be migrated and collected in one or more collection areas, thereby simplifying the process for removing the hair from the agitator.

[0044] Turning now to **FIGS. 1** and **2**, one embodiment of a surface cleaning apparatus 10 is generally illustrated. In particular, **FIG. 1** generally illustrates a bottom view of a surface cleaning apparatus 10 and **FIG. 2** generally illustrates a cross-section of the surface cleaning apparatus 10 taken along lines II-II of **FIG. 1**. The surface cleaning apparatus 10 includes a cleaning head 12 and optionally a handle 14. In the illustrated embodiment, the handle 14 is pivotally coupled to the cleaning head 12 such that the user may grasp the handle 14 while standing to move the cleaning head 12 on the surface to be cleaned using one or more wheels 16. It should be appreciated; however, that the cleaning head 12 and the handle 14 may be an integrated or unitary structure (e.g., such as a handheld vacuum). Alternatively, the handle 14 may be eliminated (e.g., such as a robot-type vacuum).

[0045] The cleaning head 12 includes a cleaning head body or frame 13 that at least partially defines/includes one or more agitator chambers 22. The agitator chambers 22 include one or more openings 23 defined within and/or by a portion of the bottom surface/plate 25 of the cleaning head 12/cleaning head body 13. At least one rotating agitator or agitator 18 is configured to be coupled to the cleaning head 12 (either permanently or removably coupled thereto) and is configured to be rotated about a pivot axis 20 (e.g., in the direction and/or reverse direction of arrow A) within the agitator chambers 22 by one or more rotation systems 24. The rotation systems

24 may be at least partially disposed in the vacuum head 12 and/or handle 16, and may one or more motors 26 (either AC and/or DC motors) coupled to one or more belts and/or gear trains 28 for rotating the agitators 18.

[0046] The surface cleaning apparatus 10 includes a debris collection chamber 30 in fluid communication with the agitator chamber 22 such that debris collected by the rotating agitator 18 may be stored. Optionally, the agitator chamber 22 and debris chamber 30 are fluidly coupled to a vacuum source 32 (e.g., a vacuum pump or the like) for generating a partial vacuum in the agitator chamber 22 and debris collection chamber 30 and to suck up debris proximate to the agitator chamber 22 and/or agitator 18. As may be appreciated, the rotation of the agitator 18 may aid in agitating/loosening debris from the cleaning surface. Optionally, one or more filters 34 may be provided to remove any debris (e.g., dust particles or the like) entrained in the partial vacuum air flow. The debris chamber 30, vacuum source 32, and/or filters 34 may be at least partially located in the cleaning head 12 and/or handle 14. Additionally, one or more tubes, ducts, or the like 36 may be provided to fluidly couple the debris chamber 30, vacuum source 32, and/or filters 34. The surface cleaning apparatus 10 may include and/or may be configured to be electrically coupled to one or more power sources such as, but not limited to, an electrical cord/plug, batteries (e.g., rechargeable, and/or non-rechargeable batteries), and/or circuitry (e.g., AC/DC converters, voltage regulators, step-up/down transformers, or the like) to provide electrical power to various components of the surface cleaning apparatus 10 such as, but not limited to, the rotation systems 24 and/or the vacuum source 32.

[0047] The agitator 18 (**FIGS. 1 and 3**) includes an elongated agitator body 44 that is configured to extend along and rotate about a longitudinal/pivot axis 20. The agitator 18 (e.g., but not limited to, one or more of the ends of the agitator 18) is permanently or removably coupled to the vacuum head 12 and may be rotated about the pivot axis 20 by the rotation system 24. In the illustrated embodiment, the elongated agitator body 44 has a generally cylindrical cross-section, though other cross-sectional shapes (such as, but not limited to, oval, hexagonal, rectangular, octagonal, concaved, convex, and the like) are also possible.

[0048] With reference to **FIG. 3**, the surface cleaning apparatus 10, and specifically the agitator 18, may come into contact with elongated debris such as, but not limited to, hair, string, fibers, and the like (hereinafter collectively referred to as hair 38 for ease of explanation). The hair 38 may have a length that is much longer than the diameter of the agitator 18. By way of a non-limiting example, the hair 38 may have a length that is 2-10 times longer than the diameter of the agitator 18. Because of the rotation of the agitator 18 as well as the length and flexibility of the hair 38, the hair 38 will tend to wrap around the diameter of the agitator 18 as generally illustrated **FIG. 3**.

[0049] To address the problem of hair wrapping around the agitator 18, the agitator 18 of the present disclosure features one or more hair migration portions 41 and optionally one or more collection areas 42. In particular, each of the hair migration portions 41 of the agitator 18 includes a plurality of bristles 40 aligned in one or more continuous rows or strips 46a-n as well as one or more continuous sidewalls 50 adjacent to at least one row 46a-n of bristles 40. The continuous rows 46a-n of bristles 40 and continuous sidewall 50 of the hair migration portions 41 are configured to reduce hair 38 from becoming entangled in the bristles 40 of the agitator 18 and configured to generate an Archimedes screw force that urges/causes the hair 38 to migrate towards one or more collection areas 42 and/or ends of the agitator 18 as generally illustrated in **FIGS. 4** and **5**. As a result, the agitator 18 of the present disclosure may be configured to generally prevent the hair 38 from excessively building up the agitator 18 and reducing the efficiency of the agitator 18 and/or causing damage to the surface cleaning apparatus 10 (e.g., the rotation systems 24 or the like). Additionally, the hair migration portions 41 may cause the migrated hair to automatically fall off of (e.g., remove) from the agitator 18 and/or may cause the hair to be migrated and collected in one or more collection areas 42, thereby simplifying the process for removing the hair from the agitator 18.

[0050] Turning now to **FIGS. 6** and **7**, cross-sectional views of a first and a second embodiment of a hair migration area 41 of an agitator 18 taken along lines C-C of portion P of **FIG. 1** are generally illustrated. Each hair migration portion 41 includes a plurality of bristles 40 that extend outward (e.g., generally radial outward) from the elongated agitator body 44 (e.g., a base portion 52) to define one (**FIG. 6**)

or more (**FIG. 7**) continuous rows 46a-n. One or more of the continuous rows 46a-n of bristles 40 may be coupled (either permanently or removably coupled) to the elongated agitator body 44 (e.g., to a base region 52 of the body 44) using one or more form locking connections (such as, but not limited to, a tongue and groove connection, a T-groove connection, or the like), interference connections (e.g., interference fit, press fit, friction fit, Morse taper, or the like), adhesives, fasteners overmoldings, or the like.

[0051] As noted above, each hair migration portion 41 of the agitator 18 includes a plurality of bristles 40 that are aligned in and/or define at least one continuous row 46a-n. One or more of the continuous rows 46a-n of bristles 40 at least partially revolves around and extends along at least a portion of the longitudinal axis/pivot axis 20 of the elongated agitator body 44 of the agitator 18 within the hair migration portion 41 (i.e., from one of a collection area 41 or an end region 48a of the agitator 18 and either another collection area 42 or another end region 48b of the elongated agitator body 44). For example, one or more of the continuous rows 46a-n of bristles 40 extend from a collection area 42, **FIG. 1**, and either another collection area 42 or one of the end region 48a, 48b of the elongated agitator body 44. As defined herein, a continuous row 46a-n of bristles 40 is defined as a plurality of bristles 40 in which the spacing between adjacent bristles 40 along the axis of rotation 20 is less than or equal to 3 times the largest cross-sectional dimension (e.g., diameter) of the bristles 40.

[0052] As mentioned above, the plurality of bristles 40 are aligned in and/or define at least one continuous row 46a-n that at least partially revolves around and extends along at least a portion of the longitudinal axis/pivot axis 20 of the elongated agitator body 44 of the agitator 18 from one of a collection area 41 or an end region 48a of the agitator 18 and either another collection area 42 or another end region 48b of the elongated agitator body 44. For example, at least one of the continuous rows 46a-n of bristles 40 may be arranged in a generally helical, arcuate, and/or chevron configuration/pattern/shape. Optionally, one or more of the continuous rows 46a-n of bristles 40 (e.g., the entire row or a portion thereof) may have a constant pitch (e.g., constant helical pitch). Alternatively (or in addition), one or more of the continuous rows 46a-n of bristles 40 (e.g., the entire row or a portion thereof) may

have a variable pitch (e.g., variable helical pitch). For example, at least a portion of the continuous row 46a-n of bristles 40 may have a variable pitch that is configured to accelerate the migration of hair 38 as the hair 38 migrates towards a collection area 42 and/or an end region 48a, 48b of the agitator 18.

[0053] At least one continuous row 46a-n of bristles 40 is proximate to (e.g., immediately adjacent to) at least one sidewall 50. The sidewall 50 may be disposed as close as possible to the nearest continuous row 46a-n of bristles 40, while still allowing the bristles 40 to bend freely left-to-right. For example, one or more of the sidewalls 50 may extend substantially continuously within the hair migration portion 41. In one embodiment, at least one sidewall 50 extends substantially parallel to at least one of the continuous rows 46a-n of bristles 40 within the hair migration portion 41. As used herein, the term “substantially parallel” is intended to mean that the separation distance between the sidewall 50 and the continuous row 46a-n remains within 15% of the greatest separation distance along the entire longitudinal length of the hair migration portion 41. Also, as used herein, the term “immediately adjacent to” is intended to mean that no other structure feature or element having a height greater than the height of the sidewall 50 is disposed between the sidewall 50 and a closest continuous row 46a-n of bristles 40, and that the separation distance D between the sidewall 50 and the closest continuous row 46a-n of bristles 40 is less than, or equal to, 5 mm (for example, less than or equal to 3 mm, less than or equal to 2.5 mm, less than or equal to 1.5 mm, and/or any range between 1.5 mm to 3 mm).

[0054] One or more of the continuous sidewalls 50 may therefore at least partially revolve around and extend along at least a portion of the longitudinal axis/pivot axis 20 of the elongated agitator body 44 of the agitator 18 from one of a collection area 41 or an end region 48a of the agitator 18 and either another collection area 42 or another end region 48b of the elongated agitator body 44 (e.g., within the hair migration portion 41). For example, at least one of the continuous sidewalls 50 may be arranged in a generally helical, arcuate, and/or chevron configuration/pattern/shape. Optionally, one or more of the continuous sidewalls 50 (e.g., the entire row or a portion thereof) may have a constant pitch (e.g., constant helical pitch). Alternatively (or in addition), one or more of the continuous sidewalls

50 (e.g., the entire row or a portion thereof) may have a variable pitch (e.g., variable helical pitch).

[0055] According to one embodiment, one or more of the hair migration portions 41 may include a first and a second sidewall 50a, 50b. For example, a first and a second sidewall 50a, 50b may be substantially parallel to a single continuous row 46a-n of bristles 40 on generally opposite sides of the continuous row 46a-n as generally illustrated in **FIG. 6**. Alternatively (or in addition), a first and a second sidewall 50a, 50b may be substantially parallel to a plurality of continuous rows 46a-n of bristles 40 on generally opposite sides of two or more different continuous rows 46a-n as generally illustrated in **FIG. 7**. Put another way, a first and a second continuous row 46a, 46n of bristles 40 may be aligned substantially parallel to and immediately adjacent to a first and a second sidewall 50a, 50b on generally opposite sides of the first and second continuous rows 46a, 46n. One or more rows of bristles 40 (e.g., continuous row 46b) may be disposed between the first and second continuous rows 46a, 46b.

[0056] According to another embodiment, one or more of the hair migration portions 41 may include a single sidewall 50a, **FIGS. 8-11**). For example, a single sidewall 50 may be disposed immediately adjacent to a single continuous row 46a of bristles 40 as generally illustrated in **FIGS. 8** and **9**. In one embodiment, the single sidewall 50 may be disposed in front of the single continuous row 46a of bristles 40 as the agitator 18 rotates in the direction arrow A as generally shown in **FIG. 8**. Alternatively, the single sidewall 50 may be disposed behind the single continuous row 46a of bristles 40 as the agitator 18 rotates in the direction arrow A as generally shown in **FIG. 8**. Alternatively (or in addition), one or more of the hair migration portions 41 may include a single sidewall 50 disposed immediately adjacent to one of a plurality of adjacent continuous rows 46a-n of bristles 40 as generally illustrated in **FIGS. 10** and **11**. For example, the single sidewall 50 may be disposed in front of the plurality of continuous rows 46a-n of bristles 40 as the agitator 18 rotates in the direction arrow A as generally shown in **FIG. 10**. Alternatively, the single sidewall 50 may be disposed behind the plurality of continuous rows 46a-n of bristles 40 as the agitator 18 rotates in the direction arrow A as generally shown in **FIG. 11**.

[0057] One or more of the sidewalls 50 may extend outward from a portion of the elongated agitator body 44 as generally illustrated in **FIGS. 6-11**. For example, one or more of the sidewalls 50 may extend outward from the base 52 of the elongated agitator body 44 from which the row 46a-n of bristles 40 is coupled and/or may extend outward from a portion of an outer periphery 54 of the elongated agitator body 44. Alternatively (or in addition), one or more of the sidewalls 50 may extend inward from a portion of the elongated agitator body 44 as generally illustrated in **FIGS. 12-13**. For example, the radially distal-most portion 56 of the sidewall 50 may be disposed at a radial distance from the pivot axis 20 of the elongated agitator body 44 that is within 20 percent of the radial distance of the adjacent, surrounding periphery 54 of the elongated agitator body 44, and the proximal-most portion 58 of the sidewall 50 (i.e., the portion of the sidewall 50 which begins to extend away from the base 52) may be disposed at a radial distance that is less than the radial distance of the adjacent, surrounding periphery 54 of the elongated agitator body 44. As used herein, the term “adjacent, surrounding periphery” is intended to refer to a portion of the periphery 54 of the elongated agitator body 44 that is within a range of 30 degrees about the pivot axis 20. While the elongated agitator body 44 in **FIG. 12** is illustrated having a generally cylindrical cross-section and an outer periphery 54 that is disposed as substantially the same radial distance from the pivot axis 20, it should be appreciated that one or more portions of the elongated agitator body 44 may have a non-cylindrical cross section, e.g., and may include one or more regions 60 having either a concaved or recessed shape (as shown in **FIG. 13**) and/or a convex shape. As such, whereas the sidewalls 50 in **FIGS. 6-11** are considered to extend outward from and beyond the adjacent, surrounding periphery 54 of the elongated body 44, the sidewalls 50 in **FIGS. 12-13** are considered to extend inward from the adjacent, surrounding periphery 54 of the elongated agitator body 44 and into the elongated agitator body 44.

[0058] While the sidewalls 50 have been illustrated having a planar surface, it should be appreciated that this is not a limitation of the present disclosure unless specifically claimed as such. For example, all or a portion of one or more of the sidewalls 50 may have a nonplanar surface.

[0059] The hair migration portion 41 may therefore include at least one continuous row 46a-n of bristles 40 substantially parallel to at least one sidewall 50. At least a portion (e.g., all) of the bristles 40 in the at least one row 46a-n may have an overall height H_b (see, e.g., **FIGS. 6, 12, and 13**) that is in the range of 8 mm to 16 mm. The bristles 40 may have a height H_b that extends at least 2 mm. beyond the distal-most end D of the sidewall 50. The at least one sidewall 50 may have a height H_s of at least 2 mm from the base 52, and may up a height H_s that is 50% or less of the height H_b of the bristles 40. At least one sidewall 50 should be disposed close enough to the at least one row 46a-n of bristles 40 to increase the stiffness of the bristles 40 in at least one front-to-back direction as generally indicated by arrow F in **FIG. 1** (e.g., in a plane substantially perpendicular to the pivot axis 20) compared to at least one side-to-side direction as generally indicated by arrow S in **FIG. 1** (e.g., in a plane substantially parallel to the pivot axis 20). The sidewall 50 may therefore allow the bristles 40 to flex much more freely in at least one side-to-side direction compared to a front-to-back direction. For example, the bristles 40 may be 25%-40% (including all values and ranges therein) stiffer in the front-to-back direction compared to side-to-side direction.

[0060] Turning to **FIGS. 1 and 3**, the agitator 18 (e.g., the bristles 40) should be aligned within the agitator chamber 22 such that the bristles 40 are able to contact the surface to be cleaned. The bristles 40 should be stiff enough in at least one of the directions of arrows F to engage the surface to be cleaned (e.g., but not limited to, carpet fibers) without undesirable bending (e.g., stiff enough to agitate debris from the carpet), yet flexible enough to allow side-to-side bending in at least one direction of arrow S to allow hair 38 to migrate. Both the size (e.g., height H_s) and location of the sidewalls 50 relative to the at least one row 46a-n of bristles 40 may be configured to generally prevent and/or reduce hair 38 from becoming entangled around the base or bottom of the bristles 40. In addition, because the hair 38 can be prevented and/or reduced from becoming entangled about the bristles 40, the size and stiffness of the bristles 40 (in both directions F and S) as well as the size (e.g., height H_s) and location of the sidewalls 50 relative to the at least one row 46a-n of bristles 40 may be selected such that the bristles 40 engage hair 38 against the surface to be cleaned and bend in the direction of arrow T to generate an

Archimedes screw force which urges (e.g., migrates) the hair in direction of arrow T towards a collection area 42 and/or an end region 48a, 48b of the agitator 18.

[0061] As described herein, the agitator 18 may include one or more collection areas 42. For example, a collection area 42 may include a region of the agitator 18 that is adjacent to (e.g., abutting) a hair migration region 41 and extends along the longitudinal axis 20 in the direction of hair migration travel T (e.g., **FIG. 1**) associated with the adjacent hair migration region 41. The collection area 42 may be configured to allow hair 38 to be collected from the hair migration region 41. For example, the collection area 42 may be configured to allow hair 38 to wrap around a region of the agitator 18 (e.g., a region of the agitator body 44). The collection area 42 may be the same as, or a separate component of, the agitator body 44. In one embodiment, one or more of the collection areas 42 may have an outer periphery (e.g., cross-section) that is the same (or substantially the same) as one or more of the portions of the agitator body 44 (e.g., the agitator body 44) adjacent to the collection area 42 as generally illustrated in **FIG. 1**. Alternatively (or in addition), one or more of the collection areas 42 may have an outer periphery (e.g., cross-section) that is smaller than one or more of the portions of the agitator body 44 (e.g., the agitator body 44) adjacent to the collection area 42 as generally illustrated in **FIGS. 14-15**.

[0062] Optionally, one or more of any of the collection areas 42 consistent with the present disclosure may include a hair removal feature 61, **FIG. 16**. The hair removal feature 61 may include a groove, slot, opening, hole, recessed region, or the like that allows a portion of a cutting instrument (e.g., but not limited to, part of a pair of scissors or the like) to be at least partially inserted between the collected hair 38 (see, e.g., **FIG. 17**) and the agitator 18 (e.g., the agitator body 44). When migrated hair 38 is wrapped around the collection area 42, the hair removal feature 61 may form a generally unobstructed passage through which part of the cutting instrument (e.g., one of the blades) may be at least partially advanced (e.g., inserted) into (e.g., all the way through) to allow the user to remove (e.g., cut) the migrated hair 38. Because the migrated hair 38 within the collection area 42 is not entangled around the bristles 40, the migrated hair 38 may be easily removed from the collection area 42 once the migrated hair 38 is cut.

[0063] Turning now to **FIG. 18**, another embodiment of a surface cleaning apparatus 10 is generally illustrated. The cleaning head 12 includes one or more agitator chambers 22 including one or more agitators 18 as generally described herein. The agitator chamber 22 also includes one or more hair migration protrusions 62 that extend outward from a portion of the inner surface 64 of the agitator chamber 22 that is exposed to the agitator 18. The hair migration protrusion 62 may have a height H_p extending outward that is sufficient to engage the bristles 40 and/or sidewall 50 of the agitator 18 to generate the Archimedes screw force that urges/causes the hair 38 to migrate towards one or more collection areas 42 and/or ends 48 as described herein. One of the advantages of the surface cleaning apparatus 10 of **FIG. 18** is that the height H_s , H_b of the sidewalls 50 and/or bristles 40 may be shorter compared to the embodiment of **FIG. 2**. As a result, the likelihood of the sidewalls 50 and/or bristles 40 damaging the surface to be cleaned (e.g., carpet fibers) may be reduced. Optionally, a contact portion 66 of one or more of the hair migration protrusions 62 (e.g., but not limited to, a distal most portion) may include a high friction surface configured to increase the friction force between the hair 38 and the hair migration protrusion 62, thereby increasing the Archimedes screw force. The contact portion 66 may include any material having a coefficient of friction greater than the coefficient of friction of the material that forms the agitator chamber 22. For example, the contact portion 66 may include any material having a coefficient of friction greater than a coefficient of friction of acrylonitrile butadiene styrene (ABS) plastic. Non-limiting examples of the contact portion 66 include a felt material, lint fabric, or the like.

[0064] One or more of hair migration protrusions 62 may extend across the entire length of the hair migration portion 41 and/or one or more of the hair migration protrusions 62 may extend across only a portion of length of the hair migration portion 41. According to one embodiment, the hair migration protrusions 62 may have a continuous distal surface which engages/contacts the hair 38 and/or may include a comb configuration in which only certain sections of the hair migration protrusions 62 engage/contact the hair 38 and adjacent sections which do not. The hair migration protrusions 62 may extend toward the agitator 18 as close as possible to the sidewall 50 as possible while still allowing the agitator 18 to rotate without

damaging the bristles 40 or without excessive drag (which could damage the rotation system 24). Thus, the separation distance between the hair migration protrusions 62 and the sidewall 50 may be based on, at least in part, the thickness and flexibility of the bristles 40.

[0065] With reference now to **FIG. 19**, yet another embodiment of a surface cleaning apparatus 10 is generally illustrated. The cleaning head 12 includes one or more agitator chambers 22 including one or more agitators 18 as generally described herein. The cleaning head 12 may include agitator 18 may include one or more motors 26 (either AC and/or DC motors) coupled to one or more belts and/or gear trains 28 for rotating one or more agitators 18. According to one embodiment, the gear train 28 may be coupled to a first and a second agitator 18a, 18b. One or more of the first and second agitators 18a, 18b may be coupled to the gear train such that one or more of the ends 48a, 48b of the agitator 18a, 18b is free and suspended. As such, one or more hair migration portions 41 may be configured to migrate hair 38 in the direction of arrow T towards the free end 48a, 48b. The Archimedes screw force generated by the hair migration portion 41 may cause the migrated hair 38 to fall off of the free end 48a, 48b of the agitator 18. According to one embodiment, one or more agitators 18 may be coupled to and cantilevered from the gear train 28. For example, a first and a second agitator 18a, 18b may be cantilevered from the gear train 28. Alternatively (or in addition), a single agitator 18 may be coupled to the gear train 28 in a centralized region of the agitator 18, e.g., in a region disposed between the first and second ends 48a, 48b (such as, but not limited to, a middle region of the agitator 18). Additionally (or alternatively), a single agitator 18 may be coupled to and cantilevered from the gear train 28 at a single end 48a of the agitator 18, e.g., as generally illustrated in **FIG. 20**.

[0066] Turning now to **FIG. 21**, one embodiment of a surface cleaning apparatus 10 including a multi-piece agitator 18 (e.g., split roll brush/ agitator) is generally illustrated. As described herein, the agitator 18 may include one or more hair migration portions 41, an optionally one or more hair collection areas 42; however, the elongated body 44 of the agitator 18 may be formed from two or more pieces 66, 68 that are configured to be coupled together along the pivot axis 20, e.g., using two or more connections 70, 72.

[0067] With reference to **FIG. 22**, the split roll agitator 18 is shown alone (i.e., without the rest of the surface cleaning apparatus 10). In the illustrated embodiment, the split roll agitator 18 includes a first and a second hair migration portion 41 that urges hair 38 to a common hair collection area 42 (see, e.g., **FIG. 23**), though it should be appreciated that this is just an example and that other configurations of the hair migration portions 41 and/or hair collection areas 42 described herein may be used. In the illustrated embodiment, a first and second end 74a, 74b of two adjacent pieces 66, 68 each form a portion of a hair collection area 42, though it should be appreciated that the hair collection area 42 may be formed in only one of the pieces 66, 68.

[0068] In the embodiment illustrated in **FIG. 23**, the user may remove the split agitator 18 from cleaning head 12 and then pull the pieces 66, 68 apart from each other (e.g., in the direction of arrow R). The collected hair 38 may then be simply removed from the ends 74a, 74b of the pieces 66, 68.

[0069] As noted above, the pieces 66, 68 of the split agitator 18 may each include a connection 70, 72. With reference to **FIGS. 25** and **26**, one embodiment of the connections 70, 72 are shown for illustrative purposes. The connections 70, 72 may include a recess 80 and a corresponding protrusion 82. The recess 80 and protrusion 82 may fit together in a lock-and-key type form (e.g., a locking connection) that allows the two pieces 66, 68 to be releasable coupled together while also generally preventing rotation of one piece 66 relative to the other piece 68 along the pivot axis 20.

[0070] To assist in removing the hair 38 from the split agitator 18, the split agitator 18 may be separable in one or more locations (e.g., connections 70, 72). The split agitator 18 may have only a single split/connection (e.g., connections 70, 72) or may have multiple splits (e.g., connections 70, 72). In one embodiment, the split agitator 18 includes a split 70, 72 at each location that there's an adjacent cross bar on the soleplate 25 to prevent against the surface cleaning apparatus 10 from sucking up the power cord. For example, the split agitator 18 may be split in two places to correspond to the two cross bars, in which case the split agitator 18 includes three separable parts.

[0071] In use, the hair 38 may be directed into one or more collection areas 42 where the agitator splits (e.g., connections 70, 72). To remove hair 38 tangled up on the split agitator 18 at the collection area 42, the split agitator 18 is first removed from the head 12 and then split into one or more parts 66, 68, thus allowing the hair 38 to drop off or be easily removed. A wiping blade may be included on the end of the bosses to aid removal of the hair such that a user will not need to touch the hair.

[0072] In any one of the embodiments described herein, one or more of the rows 46a-n of bristles 40 may be replaced by a continuous rubber blade and/or felt. In at least one embodiment, the rubber blade may extend along adjacent to one or more rows 46a-n of bristles as described herein. One or more of the rows 46a-n may include soft bristles 40 having diameter 0.04mm and a length of 12mm, and may be oriented in a at least partially revolved strip along at least a portion of the agitator 18, e.g., the hair migration portion 41.

[0073] The bristles 40 may be sized so that when used on a hard floor, it is clear of the floor in use. However, when the surface cleaning apparatus 10 is on carpet, the wheels 16 will sink in and the bristles 40 will penetrate the carpet. The length of bristles 40 may be chosen so that it is always in contact with the floor, regardless of floor surface.

[0074] To ensure optimal performance of the agitator 18, the agitator 18 may be balanced. To balance the agitator 18, the center of mass may be aligned close to the center of rotation along pivot axis 20 so that the agitator 18 does not vibrate excessively or make too much noise. To balance the agitator 18, one option is to include a component, either a core running the full width or a central section with two cores running into either side and balance the component by adding screws. Preferably, the other sections are then fitted tightly and in the same orientation every time or if possible make them thin walled so that there is very little shrinkage and they stayed very well balanced and can fit in any orientation.

[0075] According to one aspect, the present disclosure features a surface clearing apparatus includes a cleaning head and an agitator. The cleaning head includes a cleaning head body that at least partially defines an agitator chamber. The agitator is configured to be coupled to the cleaning head at least partially within

the agitator chamber and is configured to be rotated about a pivot axis extending along a longitudinal axis. The agitator includes an elongated agitator body and at least one hair migration portion. The hair migration portion comprises at least one continuous row of bristles and at least one sidewall. The at least one continuous row of bristles is at least partially revolved around and extends outward from and along at least a portion of the longitudinal axis of the elongated agitator body from one of a collection area or a first end region of the agitator and either another collection area or a second end region of the agitator. The at least one sidewall is aligned substantially parallel and immediately adjacent to the at least one continuous row of bristles within the hair migration portion. The at least one sidewall has a height H_s that is 50% or less of the height H_b of the bristles.

[0076] According to another aspect, the present disclosure features an agitator for use with a surface cleaning apparatus. The agitator is configured to be coupled to the cleaning head of the surface cleaning apparatus at least partially within an agitator chamber of the cleaning head and is configured to be rotated about a pivot axis extending along a longitudinal axis. The agitator includes an elongated agitator body and at least one hair migration portion. The hair migration portion comprises at least one continuous row of bristles and at least one sidewall. The at least one continuous row of bristles is at least partially revolved around and extends outward from and along at least a portion of the longitudinal axis of the elongated agitator body from one of a collection area or a first end region of the agitator and either another collection area or a second end region of the agitator. The at least one sidewall is aligned substantially parallel to the at least one continuous row of bristles within the hair migration portion.

[0077] While the principles of the invention have been described herein, it is to be understood by those skilled in the art that this description is made only by way of example and not as a limitation as to the scope of the invention. Other embodiments are contemplated within the scope of the present invention in addition to the exemplary embodiments shown and described herein. It will be appreciated by a person skilled in the art that a surface cleaning apparatus and/or agitator may embody any one or more of the features contained herein and that the features may be used in any particular combination or sub-combination. Modifications and

substitutions by one of ordinary skill in the art are considered to be within the scope of the present invention, which is not to be limited except by the following claims.

CLAIMS

What is claimed is:

1. A surface clearing apparatus comprising:

a cleaning head including a cleaning head body, said cleaning head body at least partially defining an agitator chamber; and

an agitator configured to be coupled to said cleaning head at least partially within said agitator chamber and to be rotated about a pivot axis extending along a longitudinal axis, said agitator including an elongated agitator body and at least one hair migration portion, said hair migration portion comprising:

at least one continuous row of bristles at least partially revolved around and extending outward from and along at least a portion of said longitudinal axis of said elongated agitator body from one of a collection area or a first end region of said agitator and either another collection area or a second end region of said agitator; and

at least one sidewall substantially parallel and immediately adjacent to said at least one continuous row of bristles within said hair migration portion, said at least one sidewall having a height H_s that is 50% or less of a height H_b of said at least one row of bristles.

2. The surface cleaning apparatus of claim 1, wherein at least one continuous row of bristles and said at least one sidewall are configured to migrate hair towards at least one of said collection area or said first end region of said agitator.

3. The surface cleaning apparatus of claim 1, wherein at least one continuous row of bristles and said at least one sidewall are configured to reduce hair from becoming entangled in said bristles.

4. The surface cleaning apparatus of claim 2, wherein at least a portion of said at least one row of bristles has a constant pitch.

5. The surface cleaning apparatus of claim 2, wherein at least a portion of said at least one row of bristles has a variable pitch.
6. The surface cleaning apparatus of claim 2, wherein said variable pitch is configured to accelerate a migration of hair as said hair migrates towards either said collection area or said first end region of the agitator.
7. The surface cleaning apparatus of claim 1, wherein said at least one sidewall extends outward from a portion of said elongated agitator body.
8. The surface cleaning apparatus of claim 7, wherein said at least one sidewall extends outward from a portion of an outer periphery of the elongated agitator body.
9. The surface cleaning apparatus of claim 1, wherein said at least one sidewall extends outward from a base of said elongated agitator body from which said row of bristles is coupled.
10. The surface cleaning apparatus of claim 1, wherein said at least one sidewall extends inward from a portion of said elongated agitator body.
11. The surface cleaning apparatus of claim 1, wherein a radially distal-most portion of said at least one sidewall is disposed at a radial distance from said pivot axis of said elongated agitator body that is within 20 percent of a radial distance of adjacent, surrounding periphery of said elongated agitator body, and a proximal-most portion of said at least one sidewall is disposed at a radial distance that is less than said radial distance of said adjacent, surrounding periphery of said elongated agitator body.
12. The surface cleaning apparatus of claim 1, wherein said hair migration portion is configured to urge hair towards said first end of said elongated agitator body.

13. The surface cleaning apparatus of claim 1, wherein said elongated agitator body comprises a first and at least a second piece each including a connection configured to removably couple said first and said second piece together.
14. The surface cleaning apparatus of claim 15, wherein said agitator includes at least one collection area, and wherein at least one of said connections is disposed within said collection area.
15. The surface cleaning apparatus of claim 1, further comprising at least one collection area.
16. The surface cleaning apparatus of claim 15, wherein said hair migration portion is configured to urge hair towards said at least one collection area.
17. The surface cleaning apparatus of claim 15, wherein said at least one collection area further comprises at least one hair removal feature.
18. The surface cleaning apparatus of claim 17, wherein said at least one hair removal feature includes at least one of a groove, a slot, an opening, a hole, or a recessed region.
19. The surface cleaning apparatus of claim 1, wherein said agitator is coupled to only said first end of said cleaning head body, and wherein said at least one continuous row of bristles and said at least one sidewall are configured to migrate hair towards said second end of said agitator.
20. The surface cleaning apparatus of claim 1, further comprising at least one hair migration protrusion that extends outward from a portion of an inner surface of said agitator chamber that is configured to contact said at least one continuous row of bristles and generate an Archimedes screw force that urges said hair towards at least one of said collection area or said first end region of said agitator.

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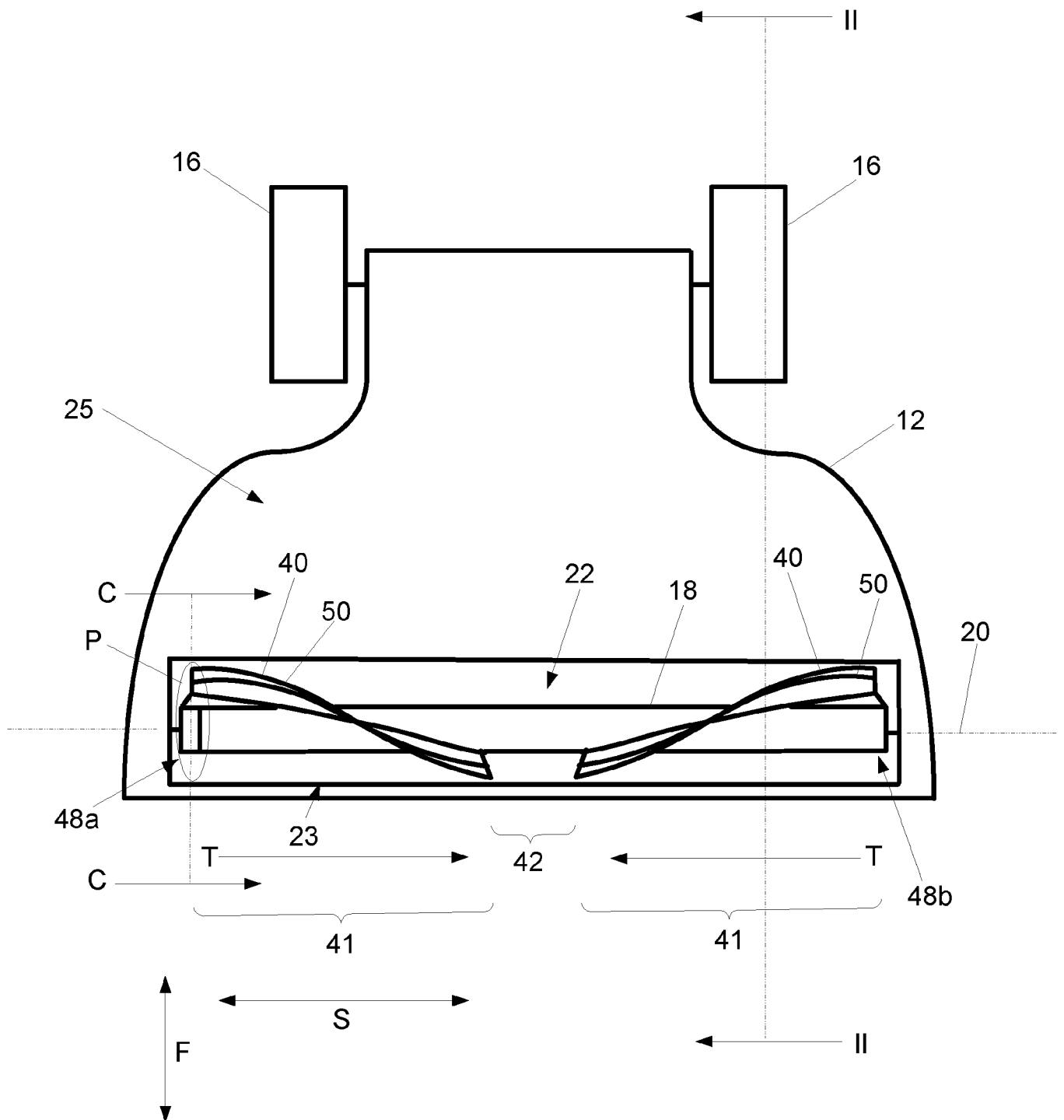


FIG. 1

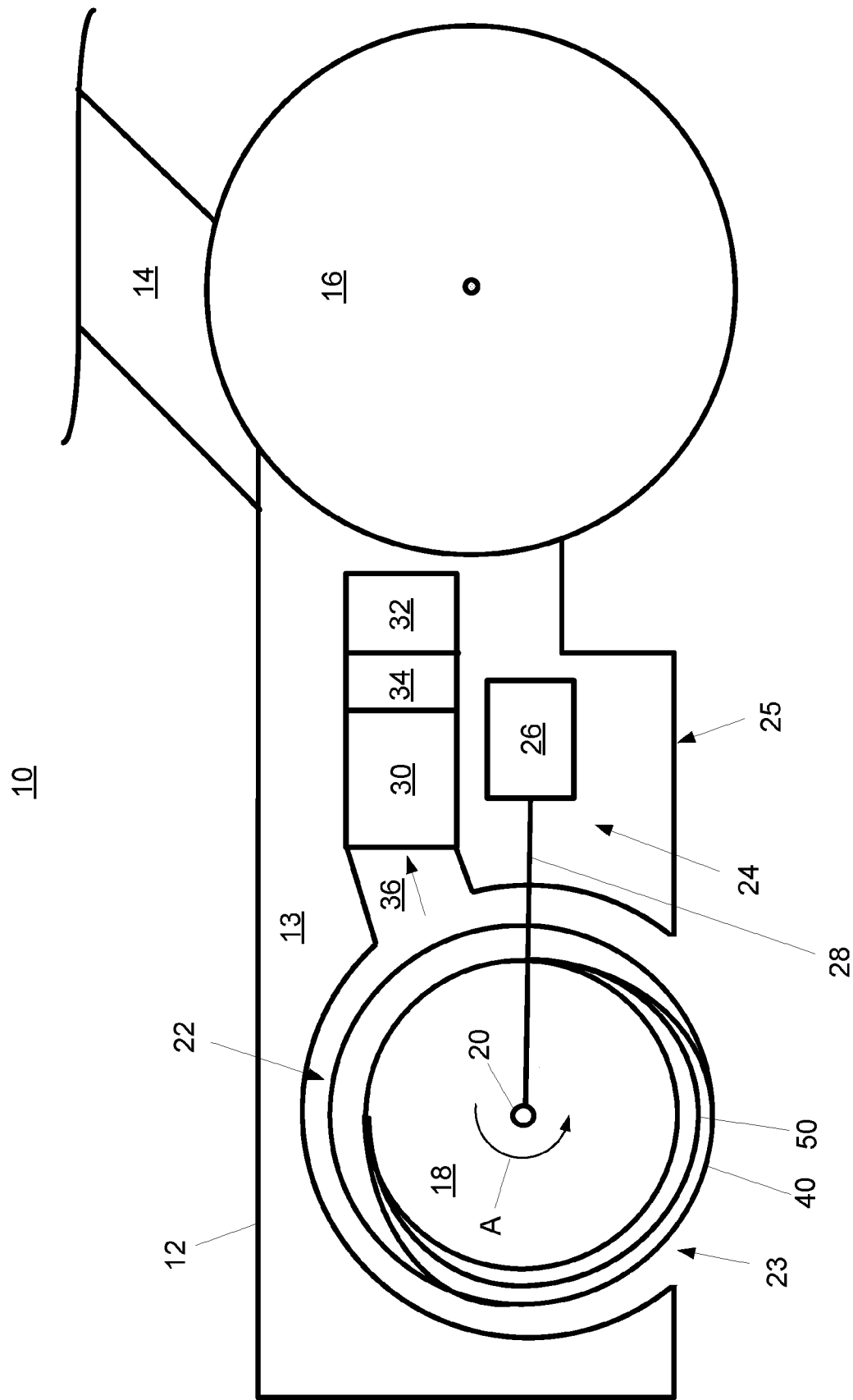
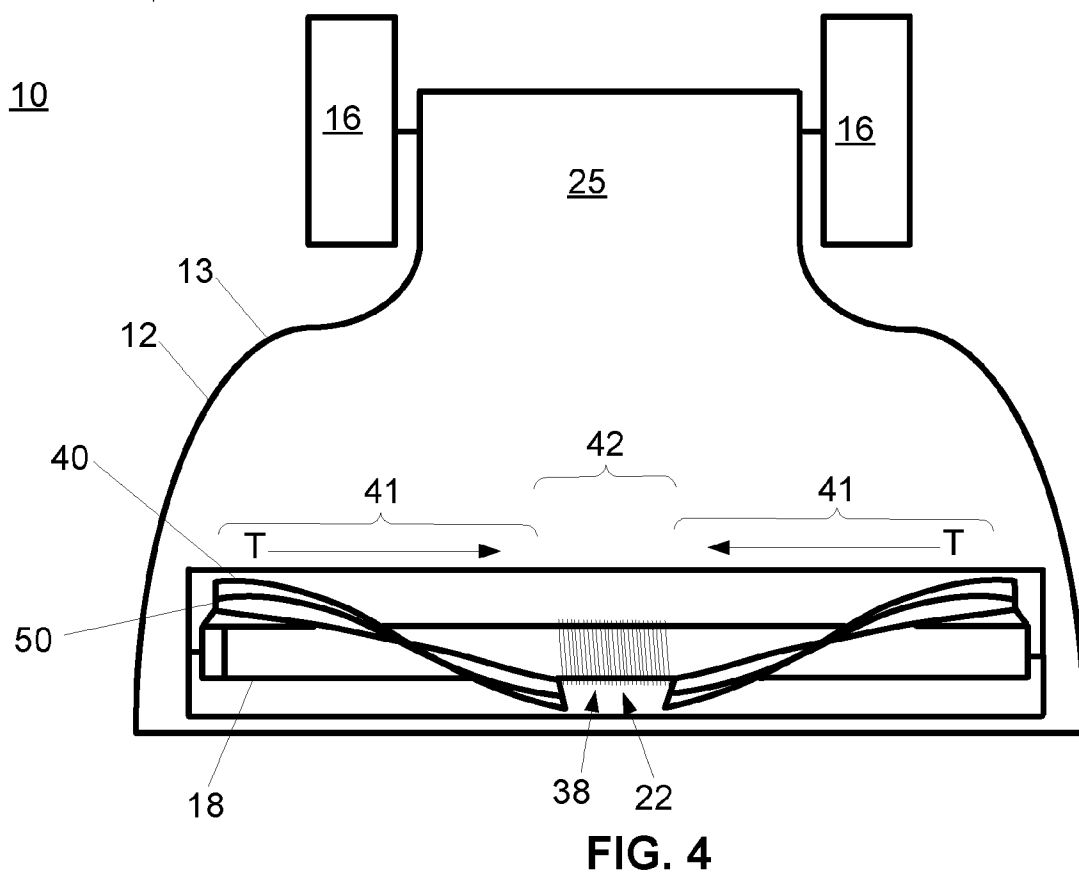
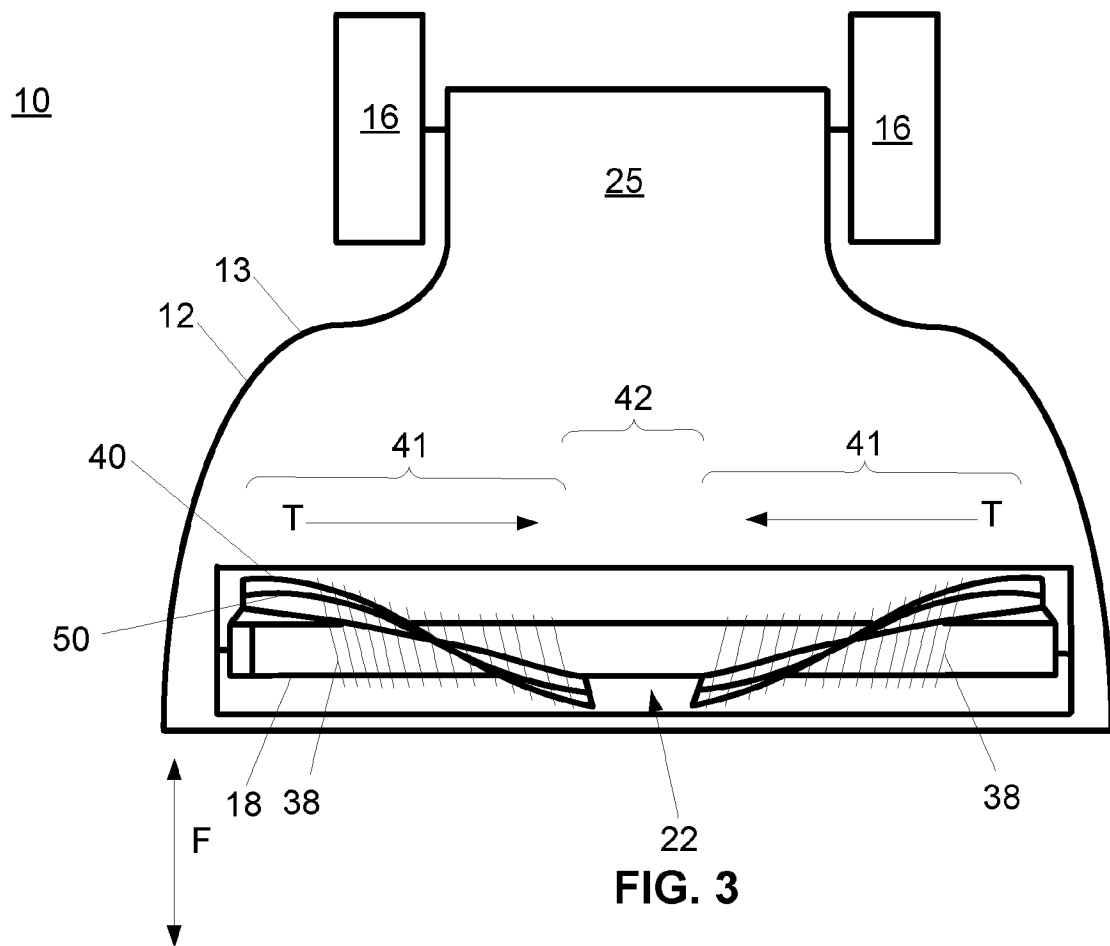


FIG. 2

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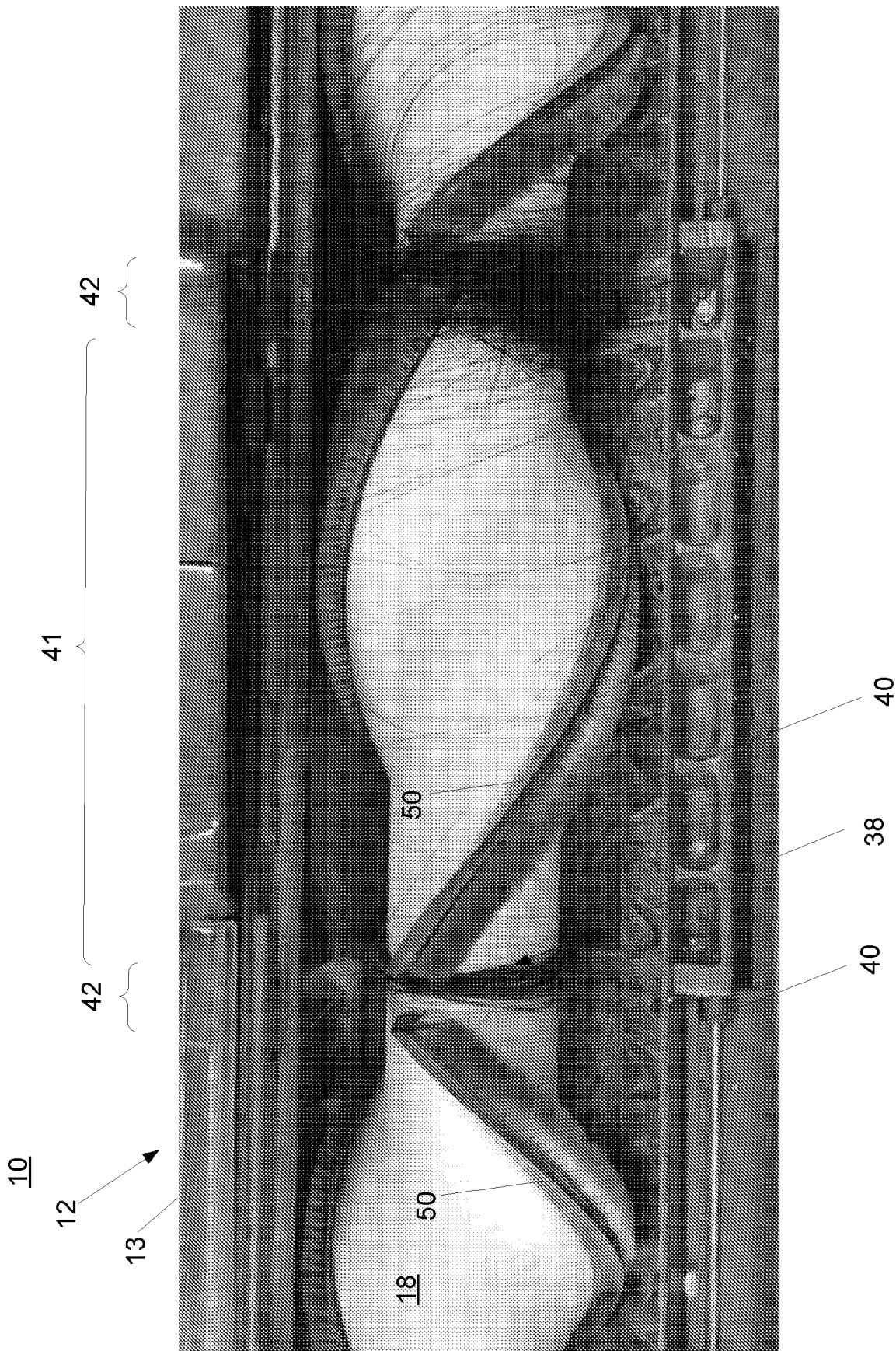


FIG. 5

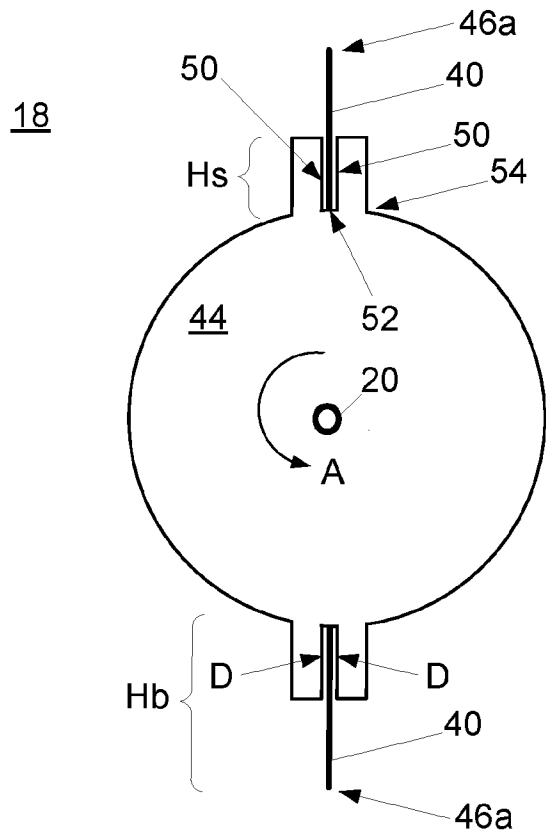


FIG. 6

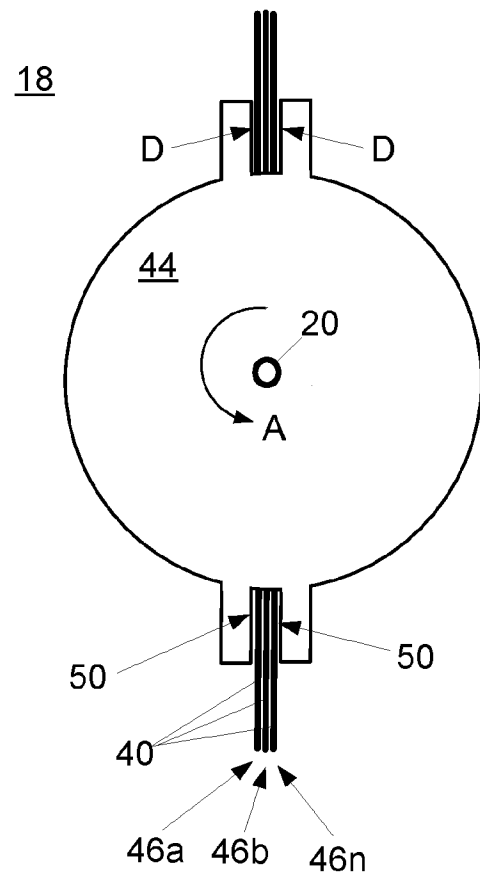


FIG. 7

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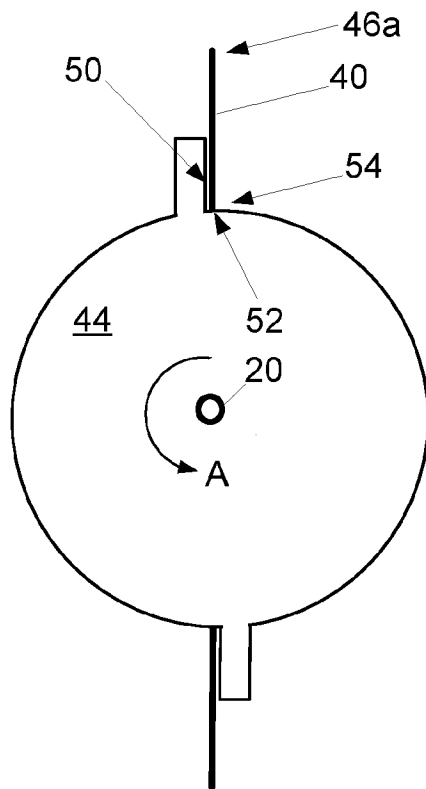


FIG. 8

18

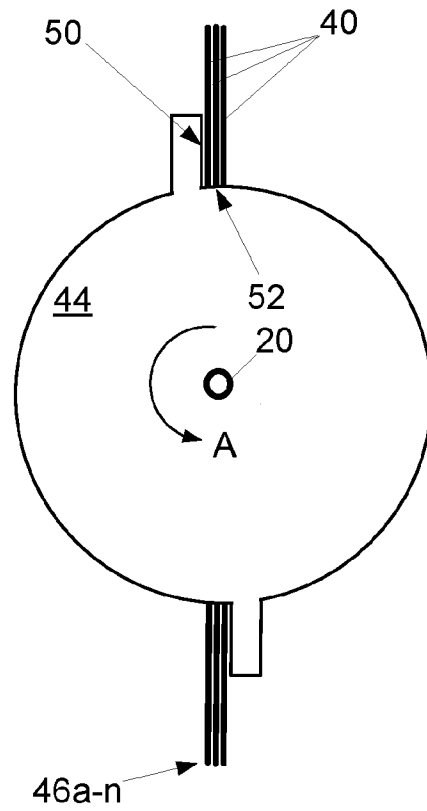


FIG. 10

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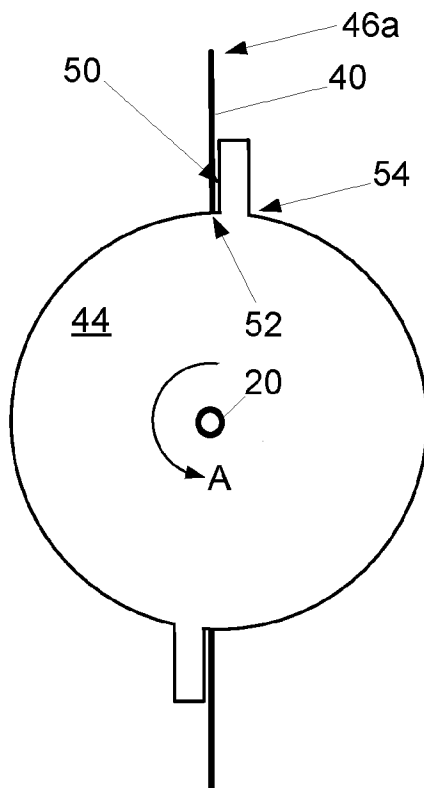


FIG. 9

18

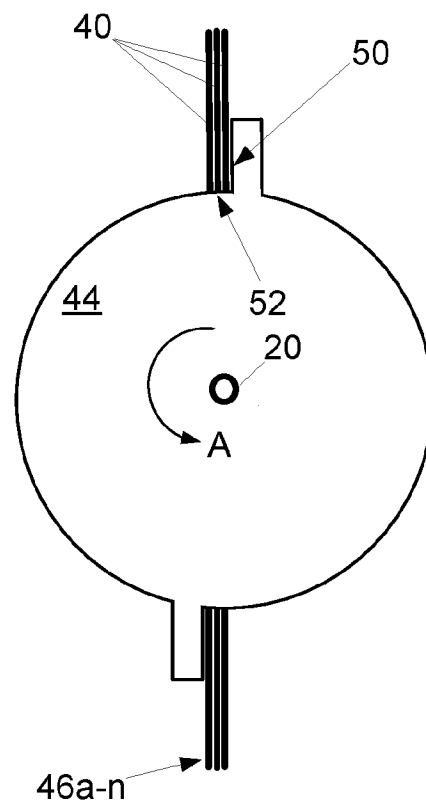


FIG. 11

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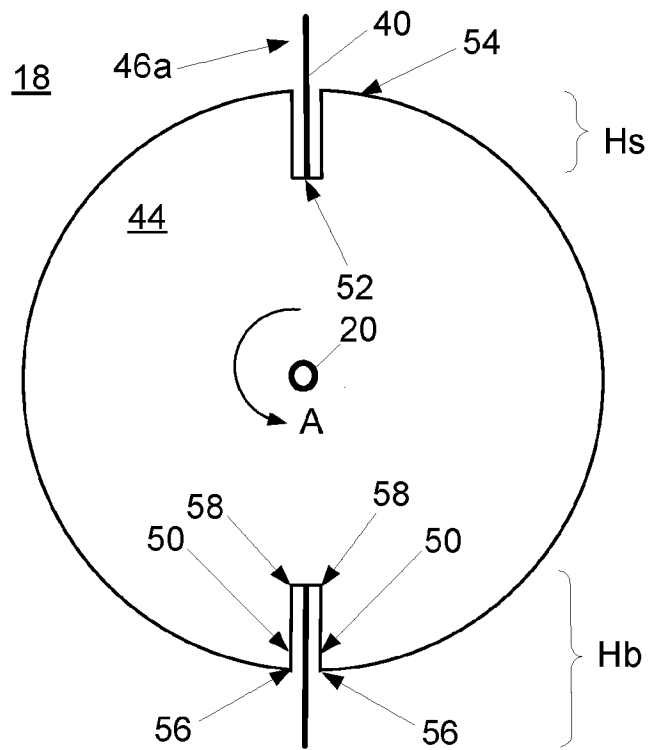


FIG. 12

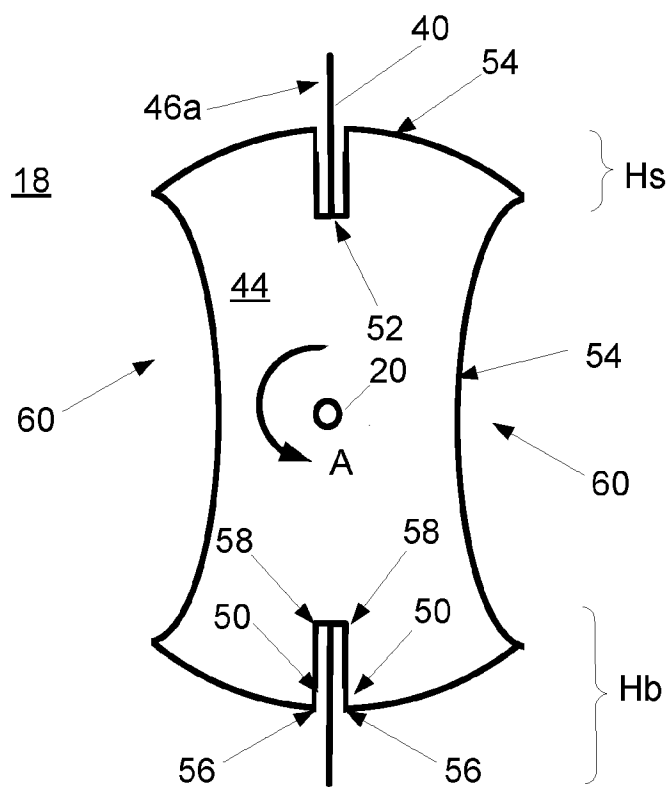
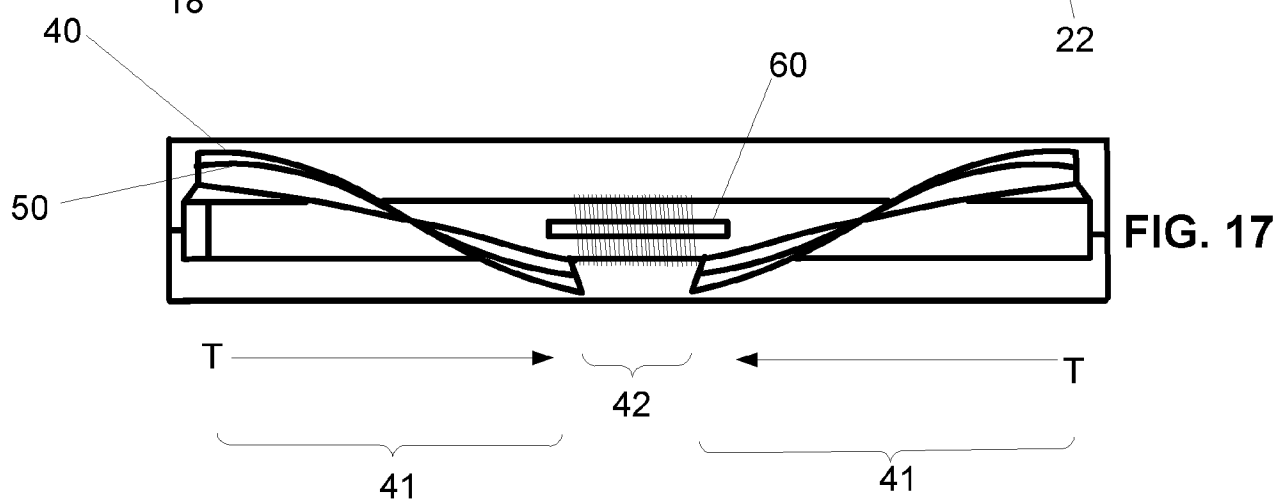
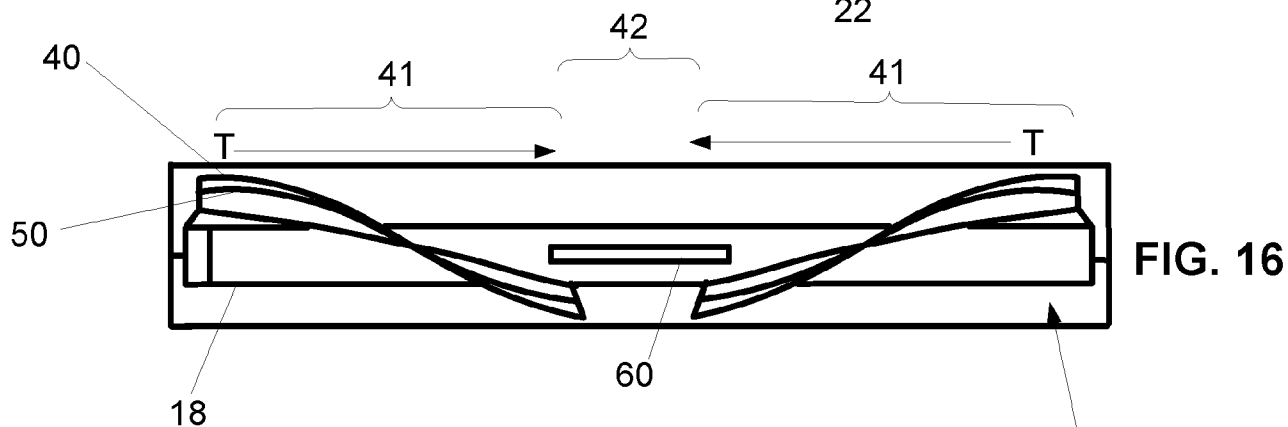
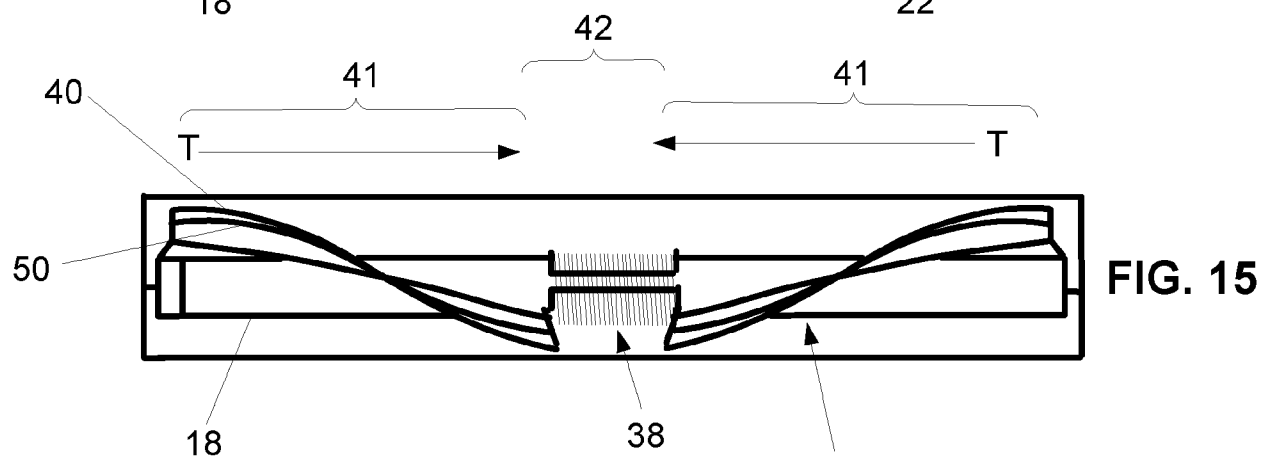
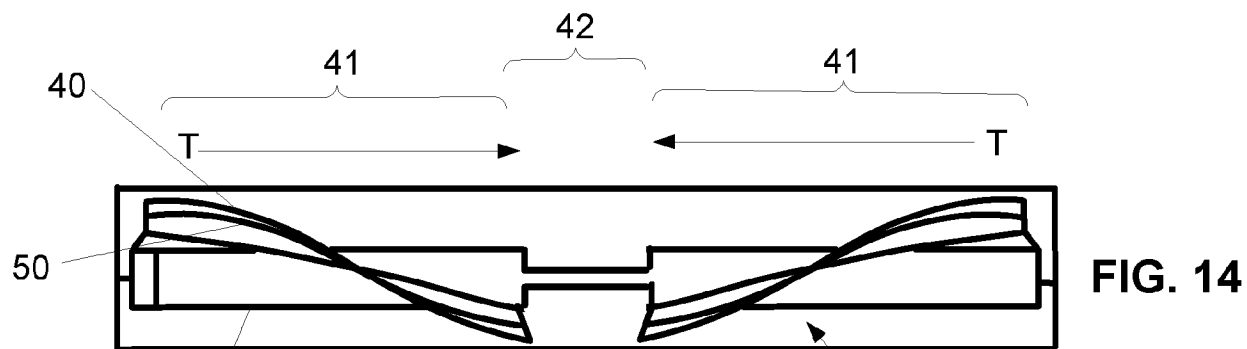


FIG. 13

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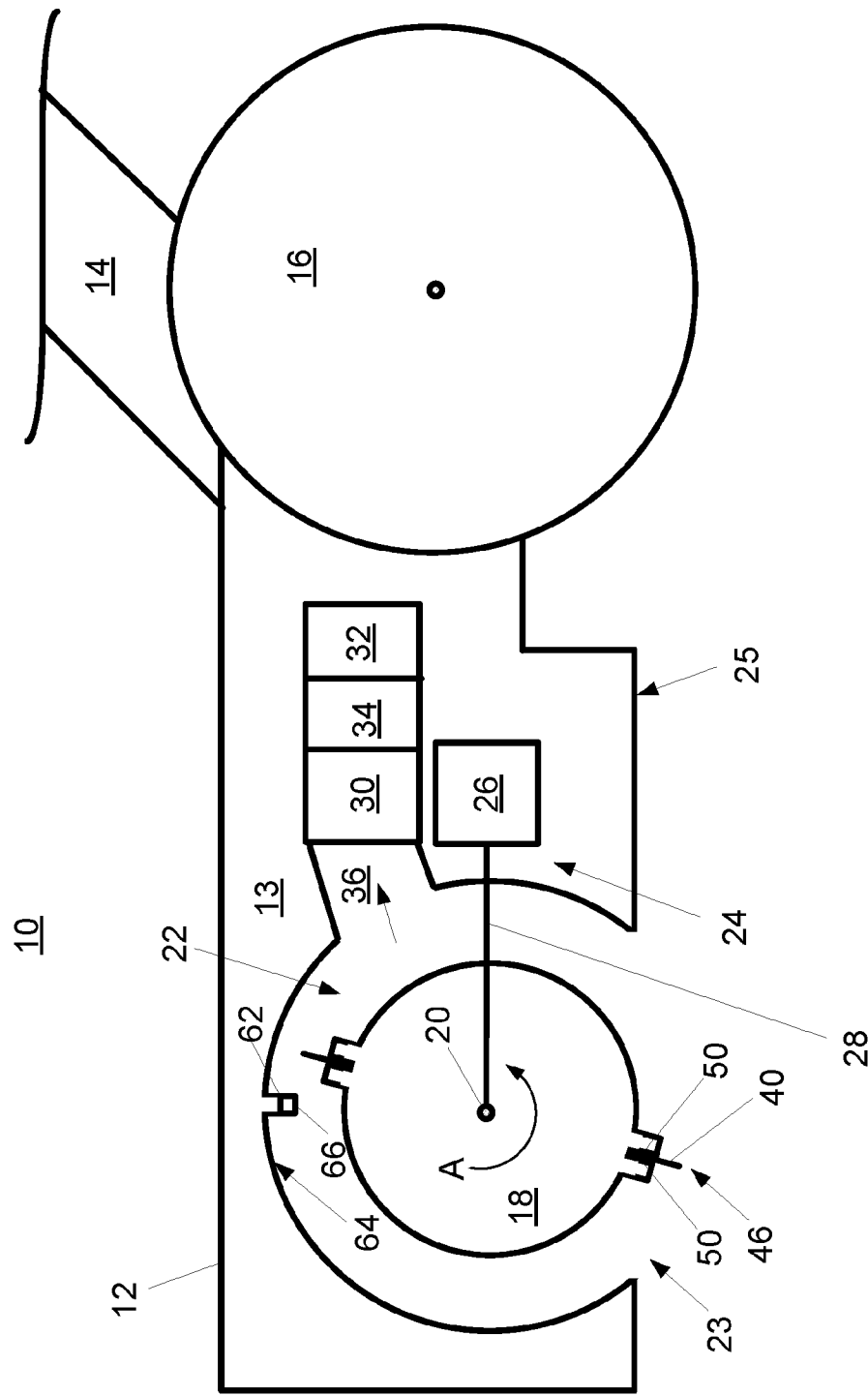


FIG. 18

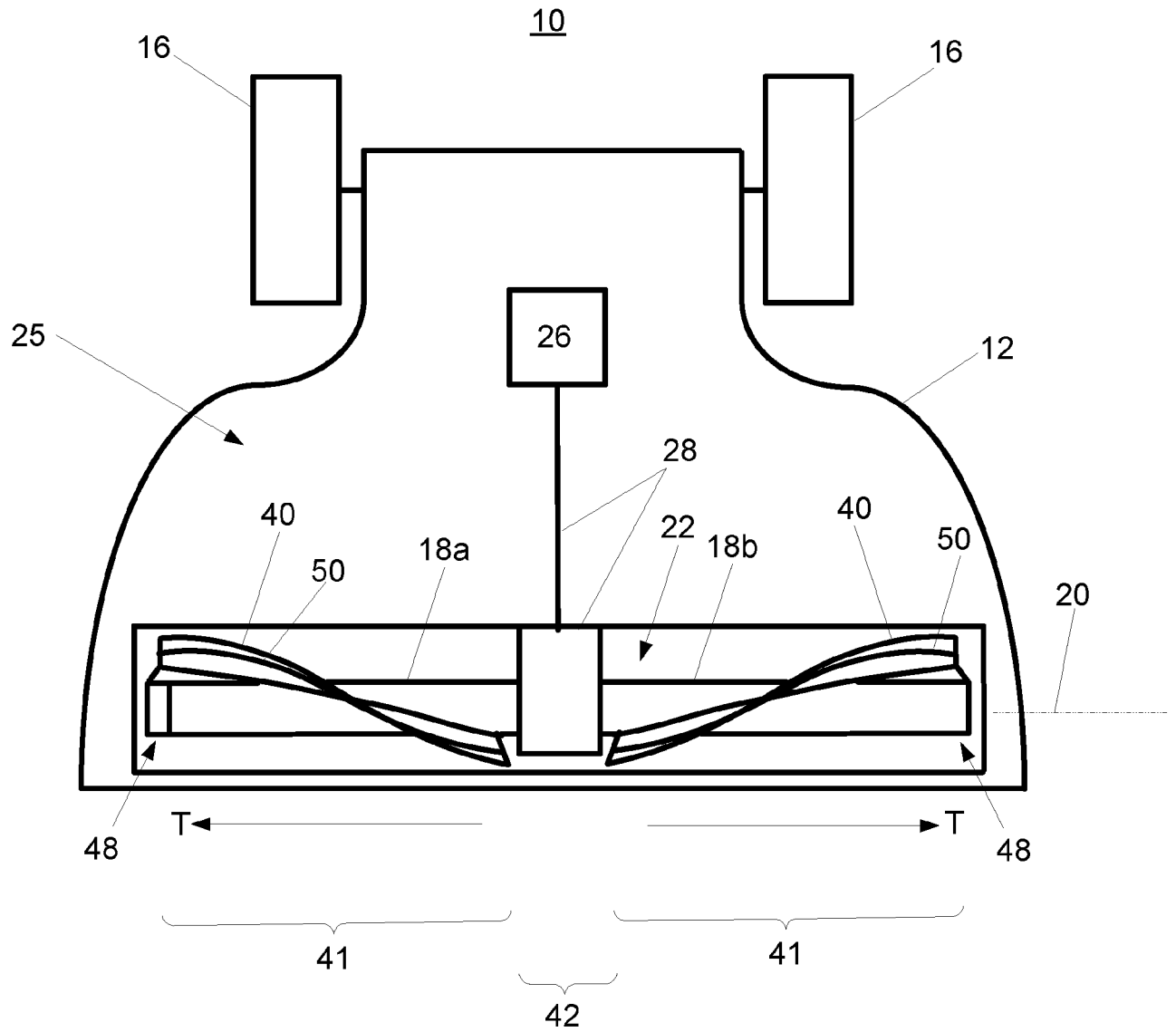


FIG. 19

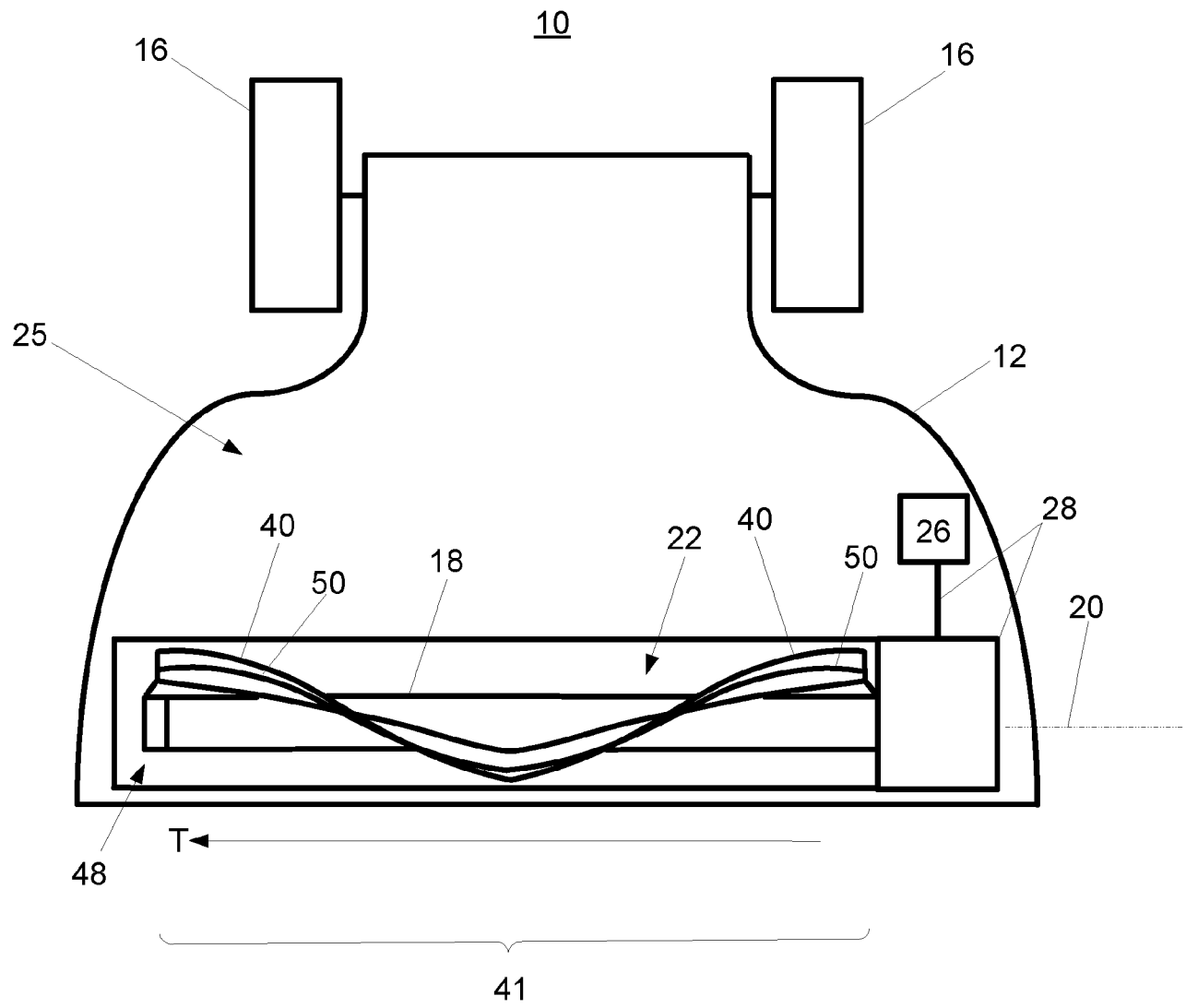


FIG. 20

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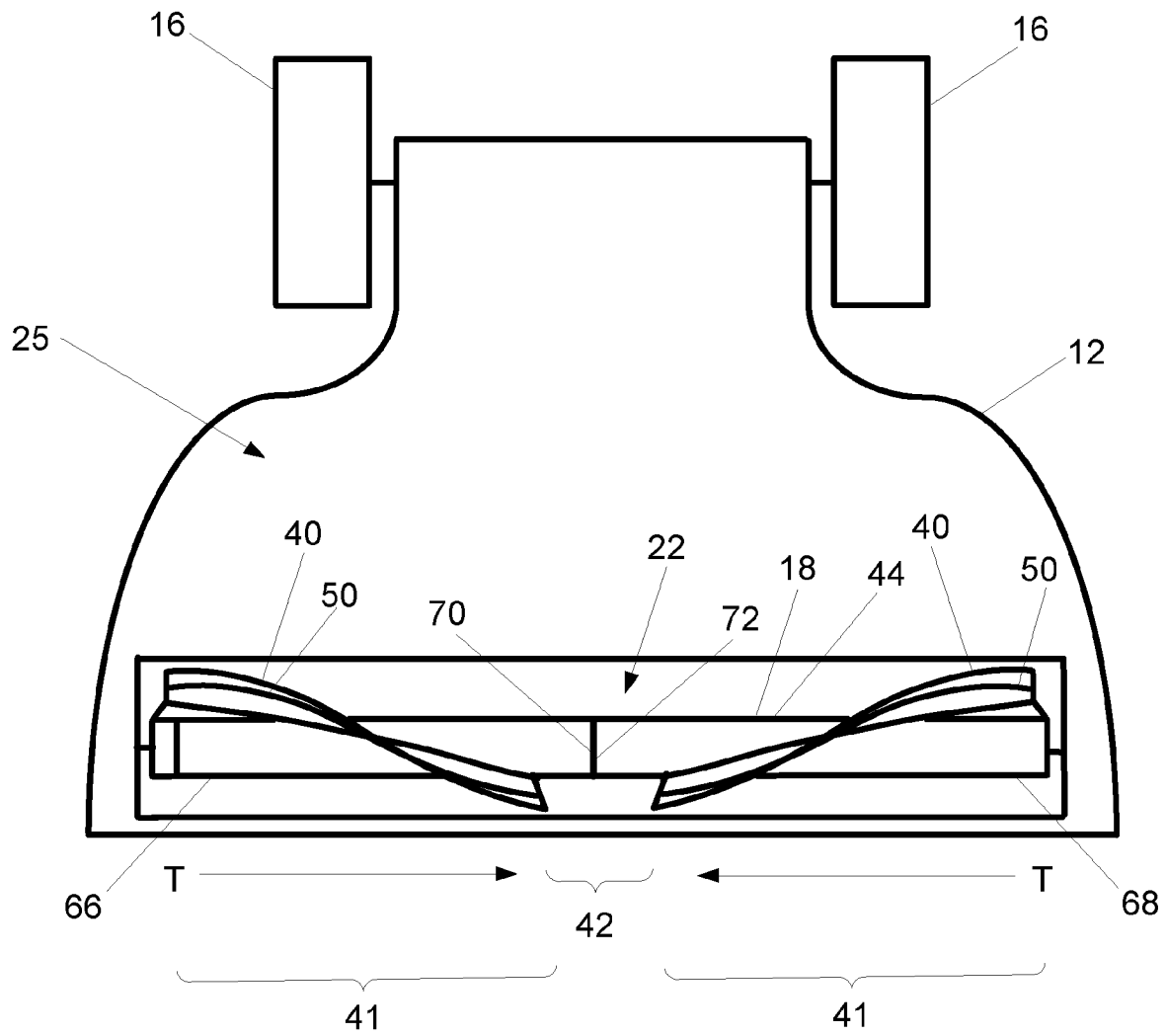


FIG. 21

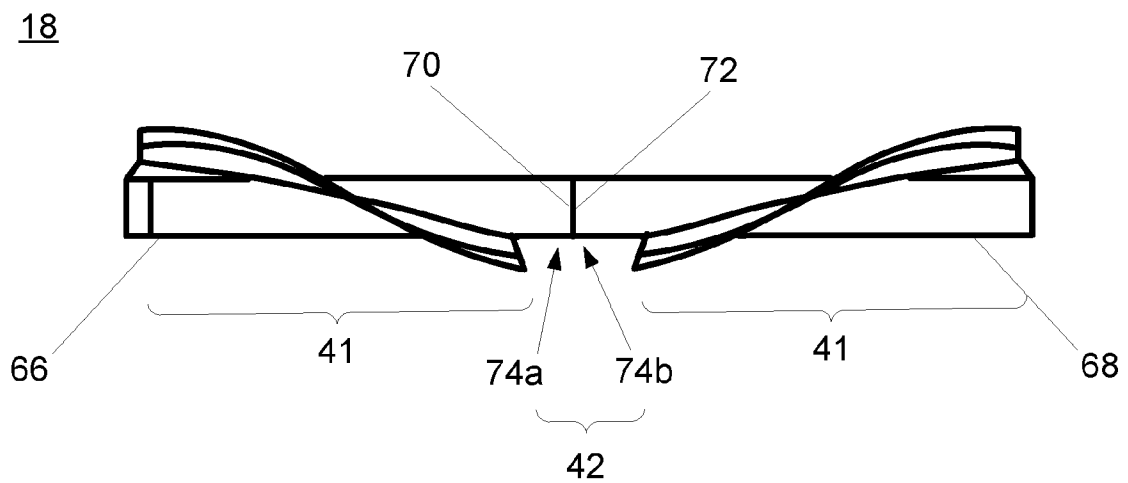


FIG. 22

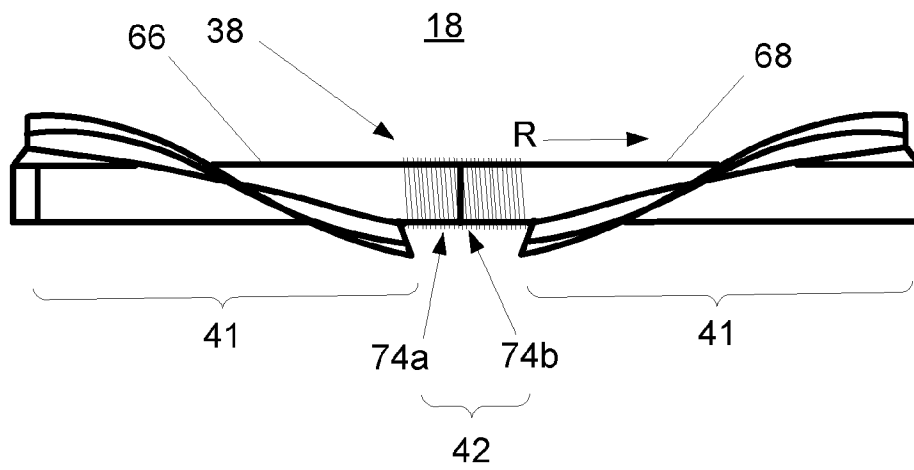


FIG. 23

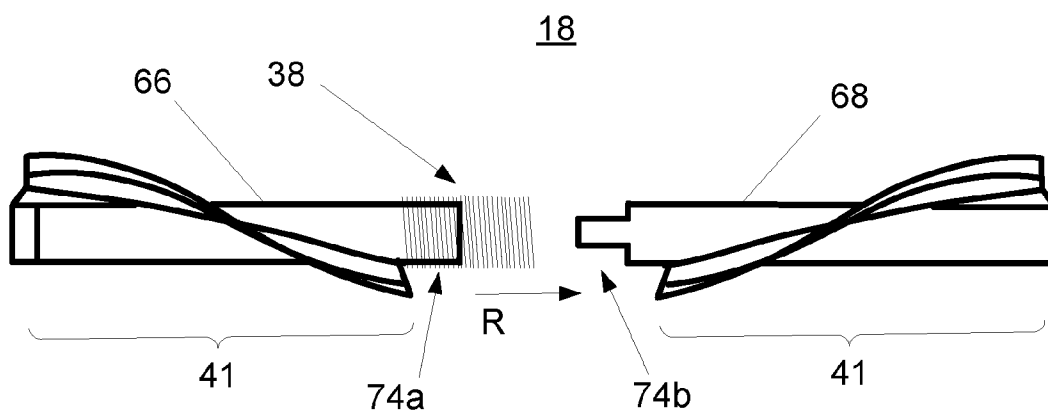


FIG. 24

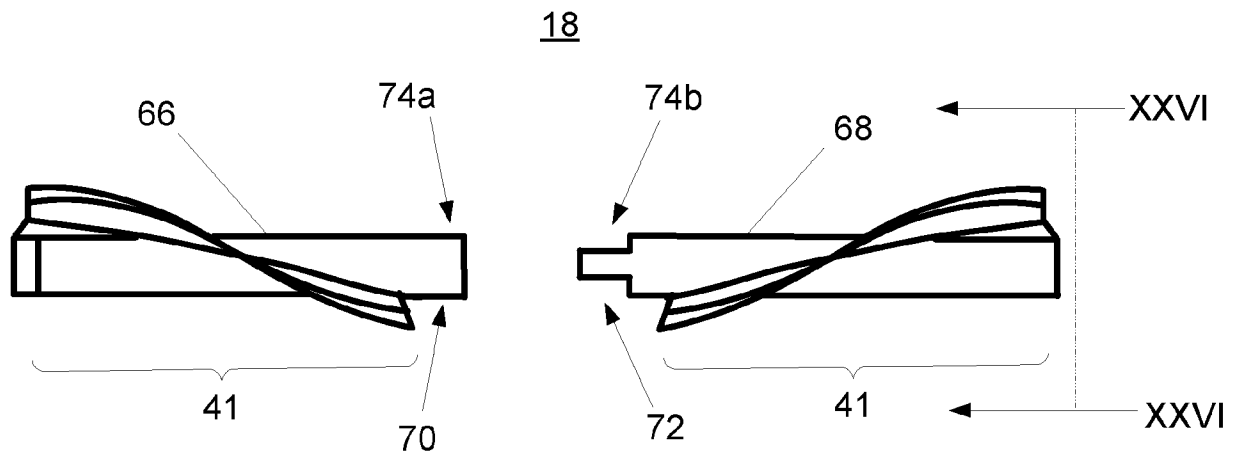


FIG. 25

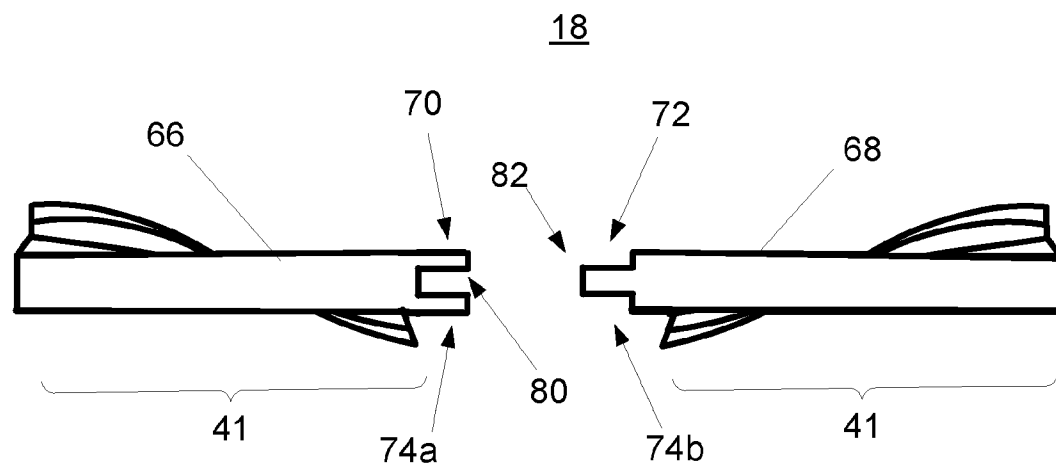


FIG. 26

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 17/50691

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A47L 9/04 (2017.01)

CPC - A47L 9/0613, A47L 9/0477

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 -- Y	US 2014/0143978 A1 (BISSELL Homecare, Inc.) 29 May 2014 (29.05.2014), entire document, especially fig. 1-5; para [0016]; para [0027-0028]; para [0031]	1-9, 12, 15-19 ----- 10-11, 13-14, 20
Y	US 5,495,634 A (Brundula et al.) 05 March 1996 (05.03.1996), entire document, especially fig. 1-2	10-11
Y	US 3,737,937 A (Nordeen) 12 June 1973 (12.06.1973), entire document, especially fig. 3-5; col. 2, ln 50- col. 3, ln 8	13-14
Y	US 2014/0053351 A1 (iRobot Corporation) 27 February 2014 (27.02.2014), entire document, especially fig. 10; para [0097]	20
A	US 2007/0209147 A1 (Krebs et al.) 13 September 2007 (13.09.2007), entire document	1-20
A	US 2015/0342430 A1 (BISSELL Homecare, Inc.) 03 December 2015 (03.12.2015), entire document	1-20
A	US 2016/0220084 A1 (SHARKNINJA OPERATING, LLC) 04 August 2016 (04.08.2016), entire document	1-20

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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"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

05 November 2017

Date of mailing of the international search report

20 DEC 2017

Name and mailing address of the ISA/US

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