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(54) **HAIR CURLER APPARATUS**

(57) A hair curler having an inlet end having an air inlet, a longitudinally spaced apart second end, a longitudinal axis and a plurality of axially spaced apart curler outlets. A land portion is located between adjacent curler outlets and an air flow passage from the air inlet to the curler outlets.

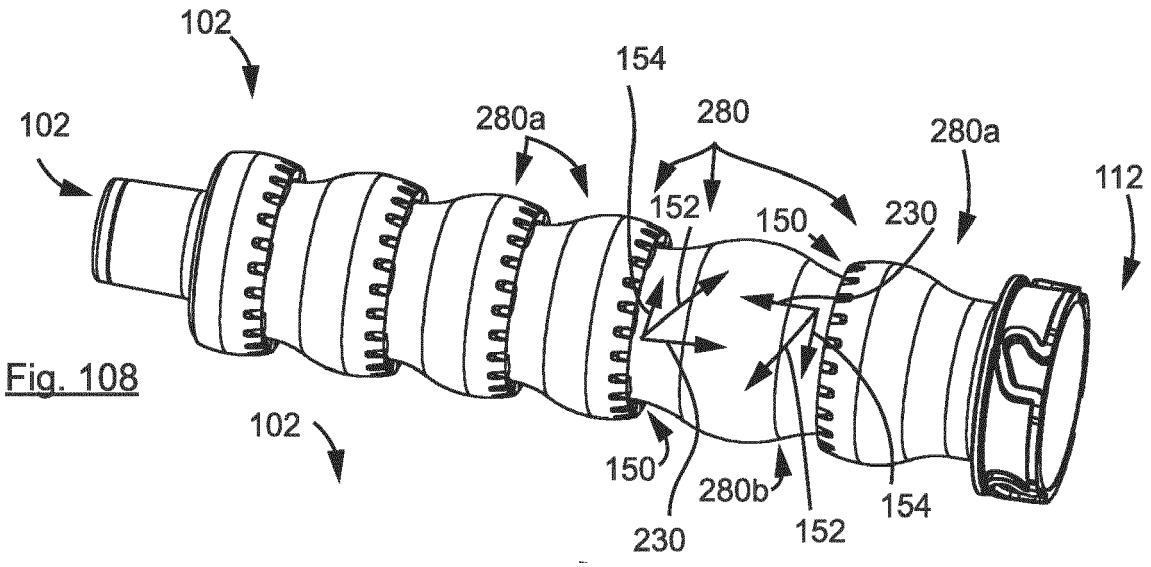

Fig. 108

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Description

FIELD

[0001] This disclosure relates generally to hair care, and particularly to hair curling.

INTRODUCTION

[0002] 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.

[0003] Conventional hair curlers employ a heating rod about which hair that is to be curled is manually wrapped by a user. Heat is transferred from the heating rod to the hair to set the hair in a curl while the hair is wrapped against the rod. A clip may be provided to hold the hair in position against the heating rod as the heat from the rod is transferred to the hair to set the hair in the curl.

[0004] Curlers are also known which use the Coanda effect to assist in wrapping hair on a curler. See for example EP 3 119 234, EP 3 119 235 and EP 3 119 236.

SUMMARY

[0005] The following introduction is provided to introduce the reader to the more detailed discussion to follow. The introduction is not intended to limit or define any claimed or as yet unclaimed invention. One or more inventions may reside in any combination or sub-combination of the elements or process steps disclosed in any part of this document including its claims and figures.

[0006] A hair curling apparatus includes an air flow path which includes an air moving member, such as a motor and fan assembly, and extends between an air inlet and an air outlet. The air outlet is formed in a curler head. The curler head is also referred to herein as a hair curler. The curler head is elongated along a longitudinal axis to support hair wrapped about the longitudinal axis. In some examples, the curler head extends longitudinally between a first end and a second end, and the air inlet is in the first end which is then also referred to as the inlet end herein. Optionally, the curler head is a removable accessory, removably attached to a main body (e.g., a hair dryer or hair curler) which includes an air moving member (e.g., a blower). The air outlet formed in the curler head includes one or more curler outlets. A curler outlet is located and shaped to provide an air flow stream for positioning a user's hair in a curling operation.

[0007] In accordance with an aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, alternately or in addition to the hair dryer or hair curler including an air moving member, an air moving member may be included in the curler head.

[0008] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, a curler head has one or more curler outlets that direct air exiting the curler outlet to flow around the longitudinal axis of the curler head so as to cause or assist in causing hair to wrap hair around the curler head. A curler outlet comprises a duct that extends from an inlet port, which may be in an outer wall of an air flow passage internal of the curler head, to an outlet port. The inlet port may be a slot-shaped inlet port. A long dimension of the slot shaped port may extend angularly partially or fully around a longitudinal axis of the curler head. A plurality of slot-shaped inlet ports may be arranged in one or more axially spaced apart annular rings opening to one or more curler outlet ducts, each annular ring including a plurality of slot-shaped ports angularly spaced from one another. The curler outlet(s) may be arranged to provide airflow at multiple locations around the longitudinal axis to, e.g., encourage hair into a curl about the longitudinal axis. Alternately, or in addition, the curler outlet(s) may also be arranged to provide airflow at multiple locations along the length of the longitudinal axis to, e.g., provide the user with a larger work surface to receive the user's hair than if the airflow is restricted to only a single longitudinal portion of head.

[0009] In accordance with this or any other embodiment, the curler outlet(s) may be tangential air outlets and/or direct air tangentially to the longitudinal axis of the curler head to wrap hair about the longitudinal axis. Alternately or in addition, the curler outlet(s) may direct air across a surface to attach air flow to the surface (the Coanda effect).

[0010] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, curler outlets of the curler head are arranged in annular sets of angularly positioned curler outlets. The curler outlets may include outlet ports that extend generally parallel to the longitudinal axis of the curler head. Each annular set may be axially spaced from other annular sets. Longitudinal axially spaced apart sequential sets may together form a plurality of rows of outlet ports, each row extending along the longitudinal axis. The rows may be generally linear or may take on another shape such as helical.

[0011] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, longitudinally sequential curler outlets, which may otherwise be arranged in an axially extending column, are shifted radially and/or angularly relative to one another. Angularly shifted outlets may form, e.g., a helical row of outlet ports extending along the longitudinal axis. The curler outlets may be arranged in a staggered formation. In a staggered formation, every other curler outlet along the longitudinal axis is axially aligned with intervening outlets relatively angularly or radially shifted. Some or all of the outlets may be axially spaced apart.

[0012] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, longitudinally sequential curler outlets are spaced longitudinally from one another by closed (non-porous) land portions of the body side-

wall. In some examples, the closed portions of the body sidewall are always-closed portions, such as continuous walls. Optionally, all curler outlets direct air in a common direction (e.g., the curler head is configured to direct air only clockwise or counter clockwise).

[0013] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head may be selectively reconfigurable to direct air clockwise or counter clockwise. Accordingly, a single curler may be useable to make right handed curls and left handed curls. Accordingly, the curler head may have some outlets to direct air counter clockwise and some outlets to direct air clockwise. The curler head may be reconfigurable whereby, in a right handed curls mode, air exits a first set of outlet ports that direct air in one direction and in a left handed curl mode, air exits a second set of outlet ports that direct air in the opposite direction. Accordingly, the curler head may be selectively reconfigurable between clockwise and counter clockwise (or right handed curls mode and left handed curls mode) configurations by opening one set of outlets while the other remains closed. Optionally, all curler outlets that are open at one time direct air in a common direction (i.e., clockwise or counter clockwise).

[0014] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, air flow from a curler outlet is longitudinally directed. The curler outlet is shaped such that the exit vector of air flow includes a longitudinal component in addition to the tangential component. The longitudinal component may make up at least 25%, at least 30%, or at least 40% of the exit vector.

[0015] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, a curler outlet is or comprises an annular band that extends part or all of the way around the longitudinal axis of the curler head. An annular band of curler air outlets may comprise a plurality of vanes that define outlet passages which direct the air flow exiting the curler outlets. The vanes direct the air flow along a desired exit vector that optionally includes a tangential component. The annular band of curler air outlets may generate a cone-shaped or cylindrical-shaped air flow.

[0016] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, an annular band of curler air outlets may produce air flow on one axial side (e.g., the side towards the inlet end of the curler head or the side towards the distal end of the curler head). Optionally, the annular band of curler air outlets may produce air flow on both axial sides. The air flow on each axial side may rotate in the same direction and exit at a similar angle to the longitudinal axis. Accordingly, the annular band of curler air outlets may produce an air flow that is bidirectional. The curler outlets may produce an air flow stream along a vector that includes a longitudinal component directed towards the inlet end of the curler head and another air flow stream along a vector that includes a longitudinal component directed towards an opposed distal end of the curler head.

[0017] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the longitudinal component of the air outlet vector from curler outlets nearest the inlet end of the curler head may be directed away from the inlet end. All curler outlets on the longitudinal curler segment nearest the inlet end may direct air generally away from the inlet end. Directing air away from the inlet end inhibits movement of hair past the inlet end, e.g., onto an integrated handle or a blower to which the curler head is attached. This may improve the user experience by keeping hair contained on the curler head. All of the curler outlets of a curler head located closest to the inlet end of the curler head may direct air along outlet vectors including a longitudinal component that is directed away from the inlet end. Similarly, all of the curler outlets of a curler head located closest to the distal end of the curler head which is opposed to the inlet end of the curler head may direct air along outlet vectors including a longitudinal component that is directed away from the distal end. The curler outlets located intermediate the outlets at the inlet end and the outlets at the distal end may direct air along outlet vectors having a longitudinal component that is directed towards the inlet end and/or towards the distal end. Accordingly, longitudinal segments may have curler outlets from which air is directed with opposite longitudinal components (towards the inlet end and towards the outlet end) and these longitudinal segments may be separated by a closed longitudinal segment (i.e. a segment without any air outlets) forming an intervening land portion.

[0018] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, curler outlets comprise an outlet passage or duct from an inlet port of the curler outlet to an outlet port of the curler outlet wherein the outlet passage has a transverse cross-sectional air flow area (in a direction transverse to air flow therethrough) which varies along the flow direction of the outlet passage. The variation may be due to diverging and/or converging inner and outer walls and/or sidewalls (e.g., formed by vanes as discussed previously). The diverging and/or converging walls produce an expansion zone and/or a compression zone. The expansion zone is a portion of the duct downstream of the inlet port and upstream of the outlet port in which the air flow area of the duct expands. The compression zone is a portion of the duct upstream of the outlet port and downstream of the inlet port in which the air flow area of the duct decreases. Including an expansion zone and/or a compression zone adjusts (e.g., increases and/or decreases) the air flow speed of an air jet generated by the outlet. A curler outlet duct may include an outlet end expansion zone at an outlet end of the duct. The outlet end expansion zone extends to and includes one or more outlet port(s) of the outlet duct

of the curler outlet. The transverse air flow area of the outlet end expansion zone may increase along the outlet end expansion zone towards the outlet port(s). In some examples, the transverse air flow area of the duct is at a maximum at the outlet port(s). The outlet end expansion zone may extend all the way from the inlet port(s) or from an intermediate point between the inlet port(s) and the outlet port(s).

[0019] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, land portions are textured to improve the adhesion of the air flow to the outer surface of the curler head. For example, some or all of the land portions may include a surface texture selected to improve air adhesion to the surface thereto. The textured land portions may comprise or consist of radially raised portions and/or radially lowered portions on the surface of the land portion, such a bumps or depressions which may be at point locations or which may extend as a band, such as a spiral. The transition between radially raised portions and radially lowered portions may be generally smooth or include small steps (e.g., less than 15%, less than 10%, or less than 5% of the diameter of the curler head).

[0020] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, hair receiving surfaces, e.g., the land portion, are textured to inhibit the movement of hair across the surface in a particular direction. In some examples, the textured hair-receiving surface is a directional grip surface. A directional grip surface is shaped to inhibit the movement of hair across the surface in a selected direction or directions. In some examples, the texture is selected to inhibit hair moving across the surface in the angular direction (i.e., unwrapping). In some examples, the texture is selected such that the texture does not inhibit the hair to be slid across the surface axially.

[0021] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, hair receiving surfaces (e.g., some or all of the land portions and/or the annular band of curler outlets) are formed of thermally conductive material to improve heat transfer to the hair (e.g., metal or a plastic having metal incorporated therein).

[0022] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, a land portion (which may be provided for use with the Coanda effect) has a cross sectional shape and/or size that varies along the longitudinal axis. The land portion forms a radially outer surface of the curler head, which radially outer surface varies in radial width in the axial direction of the curler head. Accordingly, the land portion forms an annular radially outer surface that has a varying diameter along the longitudinal axis. Optionally, the land portion forms a generally continuous land surface as it varies in shape and/or size to encourage air flow to remain attached to the land portion or include small steps (e.g., less than 15%, less than 10%, or less than 5% of the diameter of the curler head).

[0023] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the minimum transverse air flow area through a duct of the curler outlets may vary along the longitudinal length of the curler head. For example, the curler outlets may comprise a plurality of discrete curler outlets that are arranged from a first location that may be located at or towards an inlet end of the curler head to a second location that may be located at or towards an opposed end of the curler head that may be located distal to the inlet end of the curler head. The opposed end may optionally be closed. The minimum transverse air flow area through a duct of the curler outlets may be larger at the opposite end than the first end and may increase continually from the first end to the opposite end. Alternately, the minimum transverse air flow area through a duct of the curler outlets may be smaller at the opposite end than the first end and may decrease continually from the first end to the opposite end. A decrease in air flow area may be a result of smaller curler outlet ports. Alternately or in addition, the number of curler outlets in an annular band may increase or decrease from the first or inlet end to the opposite end.

[0024] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the air flow path through the interior of the curler head to the curler outlets has a path transverse air flow area that decreases from one end to the other. The decreasing size may be reflected in a narrowing diameter of the curler head, which reduces the internal open diameter of the curler head, and the curler head may narrow from one end to the other. The path transverse air flow area of the air flow path may decrease continuously or in a stepwise fashion. The body sidewall may narrow continuously or in stepwise fashion. In some examples, the curler head narrows from the first or inlet end to the second end. Alternately, the curler head may have an internal conduit which has a similar change in diameter.

[0025] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the magnitude of the exit vectors from the curler outlets may vary along part or all of the longitudinal length of the curler head. The magnitude may be smallest for curler outlets and/or a longitudinal curler segment nearest the inlet end of the curler head. This may reduce the force carrying hair past the inlet end of the curler head, e.g., onto an integrated handle or onto a blower to which the curler head is attached. The change in magnitude may be produced by varying the minimum transverse air flow area of the curler outlets transverse to a direction of flow through the outlet (e.g., choking the outlet ducts of the inlet end curler outlets). Accordingly, the cross-sectional area of the outlets may vary along part or all of the longitudinal length of the curler head. The

cross-sectional area may vary continuously, or in a stepped manner. The cross-sectional area may vary so as to produce a generally uniform flow of air out through the outlets along the longitudinal length of the curler head.

[0026] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head is reconfigurable between a clockwise configuration, in which air exits the curler outlets in a clockwise direction, and a counter clockwise configuration, in which air exits the curler outlets in a counter clockwise direction, by partially or fully opening or closing one or more valves. Adjusting one or more valves may reconfigure the flow path in the curler head to enable the curler head to be reconfigured between the clockwise configuration and the counter clockwise configuration and may allow the reconfiguration with minimal moving parts.

[0027] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head can also be used as a concentrator and/or diffuser. The curler head may include one or more secondary air outlets in addition to the curler outlets, the secondary air outlet(s) are arranged to direct air flow as a concentrator and/or a diffuser. Optionally, the curler head is selectively reconfigurable between all three of a concentrator configuration, a diffuser configuration, and a curler configuration. The diffuser and/or concentrator may be provided at the second end of the curler head.

[0028] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head includes an inlet bleed valve and/or an outlet bleed valve. The inlet bleed valve and/or an outlet bleed valve is selectively openable while the curler outlets remain open, and opens into a common portion of the air flow path from which some or all of the curler outlets open. Any such bleed valve may be located at any suitable location. The bleed valve may be an inlet bleed valve or bleed air inlet, such as a venturi inlet to draw air into the curler head. In use, the bleed air inlet provides additional air to the curler outlets. The additional air may be cooler air which, when combined with air already flowing through the curler head, may reduce the temperature of the air exiting the curler outlets to, e.g., set a curl. The air exiting through the bleed air inlet my bypass a heating member of the curler head and/or of a blower used in cooperation with the curler head and/or be introduced downstream thereof. The bleed valve may be an outlet bleed valve or bleed air outlet, which is an outlet that is selectively openable while the curler outlets are open and opens from a common portion of the air flow path from which the curler outlets open. In use, the bleed air outlet siphons air flow from the curler outlets to reduce the amount of air flow exiting the curler outlets, thereby reducing the curling force to allow for easier removal of hair after, e.g., a curl is set. The bleed air inlet and/or outlet may be in the curler head and/or in a blower used in cooperation with the curler head. If the bleed valve is an inlet bleed valve in the curler head, it may be located at the inlet end to provide additional air upstream of any curler outlet. The bleed air outlet may be upstream of all or some of the curler outlets.

[0029] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head may include a venturi at an inlet end of the curler head. The venturi produces a pressure drop, and the curler head includes one or more air inlets opening into the venturi to draw air into the curler head at an inlet end of the curler head. Drawing air into the curler head at the inlet end of the curler head may draw hair down against the curler head at the inlet end of the curler head. This inhibits the movement of hair past the inlet end of the curler head, e.g., onto an integrated handle or onto a blower to which the curler head is attached.

[0030] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head includes axially extending surface dimples on the surface of the curler head. The curler outlets are provided in the axially extending dimples to direct air on an exit vector that includes a tangential component. The curler outlets may consist of an outlet port opening through the body sidewall, such as when the port opens through a generally radially extending portion of the sidewall formed by the lateral sides of the dimple.

[0031] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head has a longitudinally extending segment at the first end that is free of curler outlets. The portion of the curler head at the first end has a closed or non-porous body sidewall extending from, e.g., the first end for an axial extent. The axial extent may be at least 10%, at least 20%, or at least 30% of the total axial extent of the curler head. The head air inlet is in the first end, and the air flow path extends from the inlet through the closed end portion of the sidewall. An air moving member such as a motor and fan assembly (e.g., blower) and/or a heater may be provided in the non-porous portion.

[0032] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head includes supplementary second end heating. In examples in which the curler head receives heated air from a blower at a first end, the first end may receive more heat energy from the air than the opposite second end of the curler head. Accordingly, supplementary second end heating provides a more even heating along the length of the curler head between the first and second ends. Accordingly, a heating member may be provided downstream of at least a first annular band of curler outlets.

[0033] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head includes

an air moving member. Including the air moving member in the curler head may allow for more control over the air flow (e.g., volume or speed) to allow the air flow to be optimized for the curler head. In examples in which the curler head includes an air moving member, the hair dryer or hair curler need not include an air moving member (e.g., a blower).

[0034] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head includes a heating member. The heating member of the curler head may be in addition to, or instead of, a heating member in a hair dryer or hair curler. The heating member includes a powered heating element and, if the heating member produces infrared (IR) radiation, the heating member may include an infrared absorption member. An infrared emission source may include a radiative element encased in an infrared-transparent housing.

[0035] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head heats hair directly to reduce the amount of heat energy that is carried away by the air that is used to position the hair. Accordingly, the curler head includes a heated hair receiving surface, such as a land portion between annular bands of curler outlets. The heated surface may be formed by a heating member (e.g., a heating element and/or an infrared absorption member) and/or the heated surface may be in conductive thermal communication with the heating member. The heated surface conductively heats hair that is positioned against the surface. Alternately, or in addition, the heated surface acts as an infrared emission source to direct infrared radiation at adjacent hair. In some examples, the heated surface is thermally isolated from the air flow path through the curler head to reduce the transfer of heat energy to the air flow. For example, the heated surface may form an exterior surface of the curler head and overlies an insulative layer which extends between the heated surface and the air flow path within the curler head. The insulative layer inhibits the transfer of heat from the heated surface to the air flow. The heated surface may be metal of a metal filled plastic.

[0036] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head is an induction charged curler head. The curler head includes an on-board energy storage member (e.g., battery, capacitor such as an ultra capacitor), and the on-board energy storage member is charged through wireless charging via electromagnetic induction.

[0037] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the curler head is formed by manufacturing a main tube and a set of rings or bands separately and then arranging the rings on the main tube by sliding the rings axially onto the tube.

[0038] In accordance with another aspect of this disclosure, which may be used alone or in combination with any one or more other aspects, the rings or bands may be arranged along the main tube abutting one another longitudinally. The rings or bands may each be unitary wall bodies (e.g., formed in a single molding), and may each form one or more curler outlets opening through the unitary wall body. Abutting rings or bands may abut without overlapping. Abutting rings or bands may be secured to one another and/or the main tube, e.g., by welding.

[0039] It will be appreciated by a person skilled in the art that an apparatus or method disclosed herein 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.

[0040] These and other aspects and features of various embodiments will be described in greater detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] For a better understanding of the described embodiments and to show more clearly how they may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 is a longitudinal cross sectional view of a hair curling apparatus, according to an embodiment;

Figure 2 is a second or opposite end perspective view of a curler head, according to an embodiment wherein the second end includes a curler head air outlet;

Figure 3 is a first or inlet end perspective view of the curler head of Figure 2;

Figure 4 is a longitudinal cross sectional view of a portion of the curler head of Figure 2;

Figure 5 is a transverse cross sectional view, through one of the bands of curler outlets, of the curler head of Figure 2;

Figure 6 is a longitudinal cross sectional view of the curler head of Figure 2;

Figure 7 is a perspective view, from the portion of the curler head of Figure 5, of a portion of the curler head of Figure 2;

Figure 8 is a top cut away view of the curler head of Figure 2;

Figure 9 is a top view of the curler head of Figure 2;

Figure 10 is a top view of a curler head, according to another embodiment;

Figure 11 is a first end perspective view of the curler head of Figure 10;

Figure 12 is a transverse cross sectional view of the curler head of Figure 10;

Figure 13 is a longitudinal cross sectional view of the curler head of Figure 10;

Figure 14 is a top view of a curler head, according to another embodiment;

Figure 15 is a first end perspective view of the curler head of Figure 14;

Figure 16 is a transverse cross sectional view of the curler head of Figure 14;

Figure 17 is a first longitudinal cross sectional view of the curler head of Figure 14;

Figure 18 is a second longitudinal cross sectional view of the curler head of Figure 14;

Figure 19 is a longitudinal cross sectional view of a hair curler apparatus, according to another embodiment;

Figure 20 is a top view of a curler head, according to another embodiment;

Figure 21 is a first end perspective view of the curler head of Figure 20;

Figure 22 is a longitudinal cross sectional view of the curler head of Figure 20;

Figure 23 is a transverse cross sectional view of the curler head of Figure 20 with an internal valve removed;

Figure 24 is a transverse cross sectional view of the curler head of Figure 20 with the internal valve shown;

Figure 25 is a second end perspective view of a curler head, according to another embodiment;

Figure 26 is a first end perspective view of the curler head of Figure 25;

Figure 27 is a longitudinal cross sectional view of the curler head of Figure 25;

Figure 28 is a transverse cross sectional view of the curler head of Figure 25;

Figure 29 is a first end perspective view of a curler head, according to an embodiment;

Figure 30 is another first end perspective view of the curler head of Figure 29;

Figure 31 is a transverse cross sectional view of the curler head of Figure 29;

Figure 32 is a longitudinal cross sectional view of the curler head of Figure 29;

Figure 33 is a top view of the curler head of Figure 29;

Figure 34 is a cut away top view of the curler head of Figure 29;

Figure 35 is a schematic view of a curler head, according to another embodiment;

Figure 36 is a schematic view of a curler head, according to another embodiment;

Figure 37 is a schematic view of a curler head, according to another embodiment;

Figure 38 is a schematic view of a curler head, according to another embodiment;

Figure 39 is a longitudinal cross sectional view of a portion of a curler head, according to another embodiment;

Figure 40 is a longitudinal cross sectional view of a portion of a curler head, according to another embodiment;

Figure 41 is a longitudinal cross sectional view of a portion of a curler head, according to another embodiment;

Figure 42 is a longitudinal cross sectional view of a portion of a curler head, according to another embodiment;

Figure 43 is a longitudinal cross sectional view of a portion of a curler head, according to another embodiment;

Figure 44 is a longitudinal cross sectional view of a portion of a curler head, according to another embodiment;

Figure 45 is a longitudinal cross sectional view of a portion of a curler head, according to another embodiment;

Figure 46 is a longitudinal cross sectional view of a portion of a curler head, according to another embo-

diment;

Figure 47 is a second end perspective view of a curler head, according to another embodiment;

Figure 48 is a first end perspective view of the curler head of Figure 47;

Figure 49 is a longitudinal cross sectional view of a portion of the curler head of Figure 47;

Figure 50 is longitudinal cross sectional view of a curler head, according to another embodiment;

Figure 51 is a first end perspective view of the curler head of Figure 50;

Figure 52 is another first end perspective view of the curler head of Figure 50;

Figure 53 is a second end perspective view of the curler head of Figure 50;

Figure 54 is a top view of the curler head of Figure 50;

Figure 55 is a cut away top view the curler head of Figure 50;

Figure 56 is second end perspective view of a curler head, according to another embodiment;

Figure 57 is second end perspective view of a curler head, according to another embodiment;

Figure 58 is second end perspective view of a curler head, according to another embodiment;

Figure 59 is a schematic view of a curler head, according to another embodiment;

Figure 60 is a schematic view of a curler head, according to another embodiment;

Figure 61 is a second end perspective view of a curler head, according to another embodiment;

Figure 62 is a first end perspective view of the curler head of Figure 61;

Figure 63 is a transverse cross sectional view of the curler head of Figure 61;

Figure 64 is a longitudinal cross sectional view of the curler head of Figure 61;

Figure 65 is a second end perspective view of a curler head, according to another embodiment;

Figure 66 is a first end perspective view of the curler head of Figure 65;

Figure 67 is a transverse cross sectional view of the curler head of Figure 65;

Figure 68 is a longitudinal cross sectional view of the curler head of Figure 65;

Figure 69 is a first end perspective view of a curler head, according to another embodiment;

Figure 70 is a transverse cross sectional view of the curler head of Figure 69;

Figure 71 is a longitudinal cross sectional view of the curler head of Figure 69;

Figure 72 is a cut away perspective view of the curler head of Figure 69;

Figure 73 is a schematic diagram of a curler head, according to another embodiment;

Figure 74 is a schematic diagram of a hair curler apparatus, according to another embodiment;

Figure 75 is a schematic diagram of a hair curler apparatus, according to another embodiment;

Figure 76 is a schematic diagram of the hair curler apparatus of Figure 1 received in a charging stand;

Figure 77 is a flow chart of a method of manufacturing a curler head;

Figure 78 is a top perspective view of a curler head, according to another embodiment;

Figure 79 is a first end perspective view of the curler head of Figure 78;

Figure 80 is a transverse cross sectional view of the curler head of Figure 78;

Figure 81 is a longitudinal cross sectional view of the curler head of Figure 78;

Figure 82 is a second top perspective view of the curler head of Figure 78;

Figure 83 is a cut away top perspective view of the curler head of Figure 78;

Figure 84 is a top perspective view of a main tube of the curler head of Figure 78;

Figure 85 is a top perspective view of a curler head,

according to another embodiment;

Figure 86 is a first end perspective view of the curler head of Figure 85;

Figure 87 is a transverse cross sectional view of the curler head of Figure 85;

Figure 88 is a longitudinal cross sectional view of the curler head of Figure 85;

Figure 89 is a second top perspective view of the curler head of Figure 85;

Figure 90 is a cut away top perspective view of the curler head of Figure 85;

Figure 91 is a top view of a curler head, according to another embodiment;

Figure 92 is a top perspective view of a curler head, according to another embodiment;

Figure 93 is an expanded view of a portion of a transverse and longitudinal cross sectional view of the curler head of Figure 92;

Figure 94 is a longitudinal cross sectional view of the curler head of Figure 92;

Figure 95 is a second top perspective view of the curler head of Figure 92;

Figure 96 is a cut away top perspective view of the curler head of Figure 92;

Figure 97 is a perspective view of a curler head, according to another embodiment;

Figure 98 is a first end perspective view of the curler head of Figure 97;

Figure 99 is a transverse cross sectional view of the curler head of Figure 97;

Figure 100 is a longitudinal cross sectional view of the curler head of Figure 97;

Figure 101 is a second top perspective view of the curler head of Figure 97;

Figure 102 is a cut away top perspective view of the curler head of Figure 97;

Figure 103 is a top perspective view of a main tube of the curler head of Figure 97;

Figure 104 is a perspective view of a curler head, according to another embodiment;

Figure 105 is a first end perspective view of the curler head of Figure 104;

Figure 106 is a transverse cross sectional view of the curler head of Figure 104;

Figure 107 is a longitudinal cross sectional view of the curler head of Figure 104;

Figure 108 is a second top perspective view of the curler head of Figure 104;

Figure 109 is a cut away top perspective view of the curler head of Figure 104;

Figure 110 is a top perspective view of a main tube of the curler head of Figure 104;

Figure 111 is a perspective view of a curler head, according to another embodiment;

Figure 112 is a first end perspective view of the curler head of Figure 111;

Figure 113 is a transverse cross sectional view of the curler head of Figure 111;

Figure 114 is a longitudinal cross sectional view of the curler head of Figure 111;

Figure 115 is a second top perspective view of the curler head of Figure 111;

Figure 116 is a cut away top perspective view of the curler head of Figure 111; and,

Figure 117 is a top perspective view of a main tube of the curler head of Figure 111.

[0042] 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.

DESCRIPTION OF EXAMPLE EMBODIMENTS

[0043] Various apparatuses, methods and compositions are 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 apparatuses and methods that differ from those described below. The claimed inventions are not limited to apparatuses, methods and compositions having all of the features of any one apparatus, method or composition described below or to features common to multiple or all of the apparatuses,

methods or compositions described below. It is possible that an apparatus, method or composition described below is not an embodiment of any claimed invention. Any invention disclosed in an apparatus, method or composition 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 applicant(s), inventor(s) and/or owner(s) do not intend to abandon, disclaim, or dedicate to the public any such invention by its disclosure in this document.

[0044] The terms "an embodiment," "embodiment," "embodiments," "the embodiment," "the embodiments," "one or more embodiments," "some embodiments," and "one embodiment" mean "one or more (but not all) embodiments of the present invention(s)," unless expressly specified otherwise.

[0045] The terms "including," "comprising" and variations thereof mean "including but not limited to," unless expressly specified otherwise. A listing of items does not imply that any or all of the items are mutually exclusive, unless expressly specified otherwise. The terms "a," "an" and "the" mean "one or more," unless expressly specified otherwise.

[0046] As used herein and in the claims, two or more parts are said to be "coupled", "connected", "attached", or "fastened" where the parts are joined or operate together either directly or indirectly (i.e., through one or more intermediate parts), so long as a link occurs. As used herein and in the claims, two or more parts are said to be "directly coupled", "directly connected", "directly attached", or "directly fastened" where the parts are connected in physical contact with each other. None of the terms "coupled", "connected", "attached", and "fastened" distinguish the manner in which two or more parts are joined together.

[0047] Furthermore, it will be appreciated that for simplicity and clarity of illustration, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements. In addition, numerous specific details are set forth in order to provide a thorough understanding of the example embodiments described herein. However, it will be understood by those of ordinary skill in the art that the example embodiments described herein may be practiced without these specific details. In other instances, well-known methods, procedures, and components have not been described in detail so as not to obscure the example embodiments described herein. Also, the description is not to be considered as limiting the scope of the example embodiments described herein.

General Description of a Hair Curling Apparatus

[0048] Referring to Figure 1, an exemplary embodiment of a hair curling apparatus is shown generally as 100. The example hair curling apparatus 100 of Figure 1 is a hand-held hair curling apparatus which can be operated generally one-handedly to curl hair while its weight is held by the same one hand.

[0049] The hair curling apparatus 100 includes a curler head 102. The curler head 102 is also referred to as a hair curler herein. The curler head 102 includes a main body 104. The main body 104 may be any suitable shape, such as cylindrical, egg-shaped, or cone shaped. The main body has a centrally located longitudinally extending axis 110 extending between a head first end 112 and a head second end 114. The curler head is elongated along the longitudinally axis 110 to receive and support hair wrapped about the longitudinal axis 110.

[0050] Referring to Figures 2-9, in the example illustrated the main body 104 is a generally cylindrical housing extending along the longitudinal axis 110. The curler head 102 may be any suitable size. In some examples, the curler head has a diameter 124 (Figure 5) of between 12 mm and 50 mm, between 15 mm and 40 mm, or between 18mm and 35 mm. The main body 104 includes a body sidewall 120 extending between the head first end 112 and the head second end 114. It will be appreciated that the curler head may be of any shape and size.

[0051] Referring to Figures 2-9, the exemplary main body 104 includes an end wall 122 (Figure 6) closing the head second end 114. The end wall 122 may extend generally transverse to the longitudinal axis 110. The end wall 122 may be generally planar. In use, the second end 114 may be closed. In some examples, the second end 114 is selectively openable. Referring to Figure 81, the exemplary end wall 122 is selectively removeable to open the second end 114. Alternately, the end wall may be moveably mounted (e.g., translatably or rotatably) to open part or all of the second end or may have a moveable flap that is opened if an accessory tool is mounted to the second end of the curler head.

[0052] Referring to Figure 6, the exemplary curler head 102 includes a head air flow path 130 extending through the main body 104. The head air flow path 130 may take any suitable route through the curler head 102 between an inlet and an outlet, such as linear or non-linear and uniflow or reverse flow. Referring to Figures 2-9, the exemplary curler head has a head air flow path 130 that is a uniflow path. Referring to Figures 2-9, the exemplary curler head has a head air flow path 130 that is a generally linear air flow path. A uniflow and/or linear path reduces the back pressure generated by changes in air flow direction. The head air flow path 130 may extend generally parallel to the longitudinal axis 110. It will be appreciated that the head air flow path 130 may be provided by the hollow interior of the curler head or by one or one or more conduits located in the curler head or forming the curler head.

[0053] A head air inlet 132 opens into the head air flow path. The head air inlet may be at any suitable location on the main body and may be of any suitable type. In some examples, the head air inlet 132 is at an end of the main body 104. A head air inlet at an end of the main body allows a uniflow air flow path to extend through a greater length of the main body than an air flow inlet that is in a

mid-portion of the main body. Referring to Figures 2-9, the head air inlet 132 is at the first end 112 of the main body 104, which is also referred to as an inlet end 112 of the main body 104 herein. The head air inlet 132 may be any suitable type of inlet, such as a tangential inlet or an axial inlet. Referring to Figure 6, the exemplary head air inlet 132 is an axial inlet. Air entering the air inlet travels generally parallel to the longitudinal axis 110 while passing through the air inlet. An axial air inlet reduces back pressure and reduces turbulence.

[0054] A head air outlet 134 opens from the head air flow path. The head air outlet 134 includes an outlet port 136 (see Figure 4). It will be appreciated that the outlet port 136 may have any suitable shape, such as generally oval, generally circular, generally rectangular, generally square, or generally slot-shaped (having a width much larger than the height, such as at least 5 times larger). Referring now to Figures 10-18, the exemplary head air outlets 134 consist of the outlet port 136, and characteristics of the air flow through the air outlet (e.g., speed, direction and cross-sectional shape of the air stream exiting an outlet port 136 in a direction transverse to the direction of flow of the air) is determined by the orientation of the outlet port 136 and the shape of the air flow path 110 upstream of the outlet port and/or the outlet port 136.

[0055] A head air outlet 134 may be a curler outlet 150 or an outlet for a different purpose such as a vent or a diffuser outlet, in which case, such an outlet may be at the second end of the curler head, which may therefore be referred to as an outlet end of the curler head.

[0056] A curler outlet 150 is located and shaped to provide an air flow stream for positioning a user's hair in a curling operation. As exemplified in Figure 4, the head air outlet 134 also includes a duct 138 upstream of the outlet port 136 from which the outlet port 136 opens. The duct 138 directs air flow through the air outlet and/or shapes air flow exiting the outlet. Referring to Figure 4, the exemplary air outlet 134 comprises a duct 138 extending between an inlet port 140 and an outlet port 136.

[0057] Any suitable inlet port 140 and/or outlet port 136 may be used. In some examples, an inlet port 140 is a slot-shaped port. Referring to Figures 104-110, the exemplary inlet end segment 280 at the inlet end 112 includes slot-shaped inlet ports 140 (Figures 107 and 110). A slot-shaped port 140 includes a long dimension 141 and a short dimension 143, the long dimension 141 may be at least 3 times, at least 4 times, or at least 5 times the size of the short dimension 143. The long dimension of the slot-shaped port 140 may extend annually (angularly) about the longitudinal axis 110. The curler head 102 may include a plurality of slot-shaped ports 140 forming an annular ring. A curler outlet 150 or annularly arranged set 151 of outlets 150 may be fed by one or more annular rings of slot-shaped ports 140. Referring to Figures 104-110, the exemplary head 102 includes a plurality of slot-shaped ports 140 forming two annular rings of inlet ports 140. Slot-shaped inlet ports 140 may form any suitable number of annular rings of inlet ports for a given segment 280. Referring to Figures 111 to 117, the exemplary head 102 includes one ring of slot-shaped inlet ports 140 for the curler segment 280a nearest the inlet end 112, two rings of slot-shaped inlet ports 140 for the next curler segment 280a along the axis 110 towards the opposite (distal) end 114, and so on.

[0058] One or more air directing members or vanes 142 are located in the duct (see, e.g., vanes 142 of Figure 8 wherein the vanes 142 define opposed sidewalls of a duct 138). The air directing members or vanes 142 help to direct air flow through the duct and/or shape air flow exiting the air outlet.

[0059] Referring to Figures 2-9, and particularly Figure 7, the exemplary curler outlet 150 is located in the body sidewall 120 of the main body 104. The curler outlet 150 may produce an air flow that is directed at least partially radially around the outer surface of the curler head. The air flow may therefore be directed partially tangentially or tangentially and the curler outlet 150 may be a tangential outlet. A tangential outlet is shaped to direct air flow out of the air outlet along an exit vector 152 that includes a tangential component 154 that is tangential to the longitudinal axis 110. The tangential component 154 assists in positioning hair in a curl about the longitudinal axis 110. The tangential component 154 may make up at least 25%, at least 30% or at least 40% of the exit vector 152. In some examples, the tangential component 154 makes up at least 50% of the exit vector 152. In some examples, the tangential component 154 makes up substantially all of the exit vector 152.

[0060] In some examples, an air outlet of the curler head 102 has a radially outer side (e.g., outer wall 260, see Figure 42) that is located radially outward of an adjacent land portion 160 at the outlet port 136. The land portion (which may be referred to as a land surface) 160 is partially or fully air impermeable, such as a closed wall portion as exemplified in Figure 6. A radially outer side that is radially outward of an adjacent land 160 portion allows the air outlet to direct air along an outlet vector that has a tangential component along the land portion.

[0061] In some examples, the curler outlet 150 directs an air stream across a land surface 160 of the body sidewall 120. The outlet port 136 of the curler outlet 150 is radially outward of the land surface 160. In some examples, a radially inner end of the outlet port 136 touches the land surface 160, although it will be appreciated that the port may be adjacent the land surface without touching it in some examples (see, e.g., Figure 93 wherein it is located radially outward of the land portion 160). An air stream directed across a surface may flow along the surface (e.g., by the Coanda effect). Accordingly, hair drawn by the air stream is drawn across the surface. Drawing hair against the surface assists in positioning the hair against the body sidewall 120. In some examples, the land surface 160 is curved relative to the exit vector 152. Referring to Figures 2-9, the exemplary land surface 160 is a curved surface relative to the exit

vector 152 such that hair drawn by an air stream attached to the land surface 160 is drawn along the curvature of the land surface 160. As exemplified, the land portion 160 is curved in a plane transverse to the longitudinal axis 110. A curved land surface 160 assists in shaping the hair of a user in a curl for a curling operation. However, a curler outlet 150 may not direct air across a land surface. Referring now to Figures 10-18, the exemplary curler outlets 150 do not direct the air stream across a land surface.

[0062] Referring again to Figures 2-9, the one or more curler outlets are arranged to provide airflow at multiple locations around the longitudinal axis 110. As exemplified, a plurality of outlet ports 136 that are radially outward of the land portion 160, extend 360° around axis 110. Providing airflow at multiple locations around the longitudinal axis 110 may encourage hair into a curl about the longitudinal axis 110.

[0063] Referring to Figures 2-9, the one or more curler outlets are arranged to provide airflow at multiple locations along the length of the longitudinal axis 110. Providing airflow at multiple locations along the length of the longitudinal axis may provide the user with a larger work surface (e.g., multiple land portions 160) to receive the user's hair than if the airflow is restricted to only a longitudinal portion of the sidewall.

[0064] The airflow at multiple locations around the longitudinal axis and/or at multiple locations along the longitudinal axis may be provided by the same air outlet or by a plurality of discrete air outlets. In some examples, the curler head 102 includes only a single curler outlet 150, such as if the curler outlet 150 is a helical slot between the first end 112 and the second end 114 of the curler head 102. A slot may be interrupted by supports (e.g., to hold the slot edges in position) and/or vanes to direct air flow. In some examples the curler head 102 includes a plurality of curler outlets 150 (e.g., the outlets 150 of Figures 2-9). A plurality of curler outlets 150 may allow for greater air flow control than a single outlet. As described further elsewhere herein, the plurality of curler outlets 150 may be spaced apart from one another axially and or angularly and/or staggered radially, circumferentially, and/or longitudinally. The curler outlets 150 may be any of the curler outlets described herein.

[0065] Referring to Figures 2-9, in some examples the head air flow path 130 includes an air passage 170 within the main body 104. In some examples, the air passage 170 includes at least one passage inlet 172 and at least one passage outlet 174. It will be appreciated that the air passage 170 may be the hollow interior of the main body. Alternately, it may be one or more separate conduits provided in the curler head and/or which form the curler head. For examples, a curler head 102 includes more than one air passage 170, such as a plurality of primary air flow passages 290 and/or one or more primary air flow passages 290 and one or more secondary air flow passages 292 as described elsewhere herein (see for example Figure 17).

[0066] Each conduit or the hollow interior may have one or more air inlets 172 and one or more air outlets 174. The air outlets may be the curler outlets 150 and/or an outlet at the second end (See for Examiner Figure 6 if end wall 122 is not present).

[0067] Optionally, the minimum transverse air flow area (i.e., the air flow area perpendicular to air flow direction at the smallest point) of the passage outlets 174 may less than the minimum transverse air flow area of the passage inlets 172 to encourage pressure build up within the chamber. In such a case, the air passage 170 may also be referred to as a pressure chamber herein. Alternately, or in addition, the transverse air flow area of the curler outlets 150 may be sized to produce a generally constant amount of air flow (volume/minute in each ring 246 along the axial length of the curler head).

[0068] As exemplified in Figures 2-9, the air passage 170 includes one inlet at the first end 176 and the second end 178 opposite the first end is closed by second end wall 122 and the exemplary chamber inlet 172 is the open end of the first end 176. In some examples, the head air flow path consists of the air passage 170. Referring to Figures 2-9, particularly to Figure 6, the air passage air inlet 172 is the head air inlet 132 and the air passage air outlets 174 are the head air outlets 134.The air passage 170 may be a manifold that is upstream and in flow communication with a plurality of curler outlets 150. The air passage 170 may be any suitable shape, such as cylindrical, egg-shaped, or cone shaped. The air passage 170 may have a shape that is generally the same as the shape of the main body 104. Referring to Figures 2-9, the exemplary air pressure chamber 170 has a generally cylindrical shape extending between chamber first end 176 and a chamber second end 178.

[0069] Referring again to Figure 1, the hair curling apparatus 100 also includes an air moving member 180 in fluid communication with the head air flow path 130 of the curler head 102 when the hair curling apparatus 100 is in use. The air moving member 180 is provided to generate air flow through the air flow path and any air moving member may be used. The air moving member 180 may include a motor and fan assembly. The motor and fan assembly includes a motor and at least one fan in airflow communication with the head air flow path 130. As exemplified the air moving member is upstream of the curler outlets to drive air through the curler outlets. In other embodiments, the air moving member may be downstream of some or all of the air outlets 174.

[0070] The air moving member 180 may be part of the curler head 102 or in a separable blower 182 (e.g., a hair dryer). In some examples, the curler head 102 is an accessory removably attached to the blower 182. Referring to Figure 1, the exemplary blower 182 is a hair dryer operable to be used as a hair dryer with the curler head removed, and the curler head 102 is an accessory that is removably attachable to the hair dryer. It will be appreciated that in some examples, such as those described further elsewhere herein, the air moving member 180 is

provided as part of the curler head, e.g., within the main body 104 of the curler head 102, and the curler head 102 is operable to be used on its own as a curler.

[0071] An accessory curler head 102 and a separable blower 182 may be joined by a releasable coupling 184. Any releasable coupling 184 may be used. The releasable coupling includes releasable fasteners 186 on the head and/or on the blower. It will be appreciated that the fasteners 186 may be any suitable fasteners, such as a threaded fastener, a bayonet mount, magnetic fastener, clasp fastener, or snap fastener. Referring to Figures 2-9, the exemplary fasteners 186 on the curler head 102 are slots to receive projections (e.g., pins) on the blower to releasably secure the curler head to the blower. Referring to Figure 1, the first end of the exemplary accessory curler head is received within an outlet opening 188 of the separable blower 182. It will be appreciated that a coupling between the head and the blower may be a fluid-tight coupling. It will also be appreciated that the outlet of the blower may be the same as the air passage air inlet 172 of the curler head.

[0072] The hair curling apparatus 100 may alternately or in addition include one or more heating members 191. Any suitable member for providing heat energy to hair and/or air flow and/or one or more surfaces of the curler head itself may be used as a heating member 191. As exemplified in Figure 1, the heating member 191 is a powered heating element 190 which comprises a resistor to convert electrical energy into heat energy. The exemplary powered heating element 190 of Figure 1 is arranged in the air flow path of the hair dryer to heat air flowing past the resistor. Alternately, the heating element may be a thin film electrical heating element which could be adhered to an inner surface of the curler head.

[0073] Alternately, or in addition, a heating member 191 may include an infrared absorption member 370. A powered heating element 190 may be an infrared emission source arranged to direct infrared energy towards an infrared absorption member. Referring to Figure 88, the exemplary infrared absorption member 370 is arranged to receive infrared radiation from the powered infrared heating element 190. Using an infrared absorption member 370 allows for a greater variety of shapes and positions of the heating member 191 than using only powered heating elements 190, such as any of those described in greater detail elsewhere herein. The infrared absorption member 370 is heated by a powered infrared emission source 190, which source 190 may be part of the curler head 102 or may be a powered heating element 190 of a blower 182 used in cooperation with the curler head 102.

[0074] A heating member 191 may be in any suitable location and may be of any suitable shape. A heating element 190 or infrared absorption member 370 that heats the air directly may be at any suitable location in direct communication with the air flow path 130, such as radially underlying the curler outlets 150 or provided within a closed segment 222 of the body sidewall 120 in which no curler outlets are provided. For example, referring to Figures 73 and 74, the exemplary curler head 102 includes a heating element 190 radially underlying one or more curler outlets 150. The exemplary curler head of Figures 73 and 74 is still removably securable to a blower 182 in which an air moving member 180 is provided.

[0075] Alternately or in addition, the heating member 191, such as an infrared absorption member 370, may be in conductive thermal communication with hair wrapped against the curler head 102 (e.g., an infrared absorption member that includes a metal or metal-filled plastic forming a land portion 160, or a heating element 190 forming a land portion 160 or in direct conductive thermal communication with a land portion 160). Accordingly, the heating member 191, such as an infrared absorption member 370, may be in thermal communication with the curler head, such as an inner and/or outer surface of the curler head, to heat part or all of the curler head, in addition to or in lieu of heating the air in the air flow passage.

[0076] Alternately or in addition, the heating member 191 may be arranged to direct infrared energy directly to hair that is wrapped against the curler head (e.g., an infrared emission source on a surface of the curler head 102 or within the curler head 102 but overlaid only by infrared-transparent materials). It will be appreciated that an infrared heating element 190 that generates infrared emissions to provide heat may be within the air flow path 130 or outside the air flow path 130 (i.e., does not need to be in the air flow path 130). Removing the heating element 190 from the air flow path 130 reduces backpressure. A heating member 191 arranged for conductive thermal communication with hair wrapped against the curler head 102 may also act as an infrared emission source due to the temperature and material of the heating member 191.

[0077] The powered heating element 190 may be part of the curler head 102 or may be upstream of the curler head, such as in the blower 182 if the curler head 102 is removably attachable to a blower 182. Referring to Figure 1, the exemplary hair curling apparatus 100 includes a heating element 190 and an air moving member 180 in a blower 182. The blower 182 can accordingly be used for other purposes, such as used as a hair dryer without the curler head 102. However, in some examples, the curler head 102 includes a heating element 190, either instead of a heating element in a blower (e.g., where the blower includes no heating element or where the curler head 102 is useable without a blower) or in addition to the heating element in a blower. Including a heating element in a curler head 102 allows for greater control over heating. Referring to Figure 75, the exemplary curler head includes a heating element 190 and an air moving member 180 and is useable independently from a blower. It will be appreciated that a hair curling apparatus 100 and/or a curler head 102 may include more than one heating element 190 and may include different types of heating elements 190. As discussed subsequently, it will also be

appreciated that, if a curler head includes an electrically powered element, then the curler head may include electrical connectors (e.g., female electrical connectors) that engage electrical connectors (e.g., male electrical connectors) of the blower when the curler head is attached to the blower.

[0078] The hair curling apparatus 100 may optionally include a handle 192 with a hand grip portion 194. The handle may be any suitable handle to allow the user to apply the curler head to the user's hair. Referring to Figure 1, the exemplary handle 192 includes a hand grip portion 194 extending along a handle axis 196 that is generally parallel to the longitudinal axis 110 of the curler head 102. As exemplified, the hand grip portion is part of the outer surface of the blower. In some examples, the handle axis 196 is generally coaxial with the longitudinal axis 110. However, it will be appreciated that in some examples the handle axis 196 may be angled with respect to the longitudinal axis, such as with a pistol grip handle. For example, the handle may be a pistol grip handle that is attached to a sidewall of the blower (e.g., at a rear end thereof) or it may be attached to the rear end.

[0079] If the curler head 102 is an accessory, the handle 192 may be provided on another component of the hair curling apparatus 100 such as on the blower 182. Optionally, the handle 192 is on the member of the hair curling apparatus 100 that includes the heaviest component of the hair curling apparatus 100, which is generally the air moving member 180 and/or energy storage members. Referring to Figure 1, the exemplary handle 192 is part of a blower 182 and the curler head 102 is an accessory removably attached to the blower 182. However, in some examples, the handle 192 is on the curler head 102. Referring to Figure 75 the exemplary handle 192 is on the curler head 102 rather than a separate blower, and the curler head 102 includes the air moving member 180 within the head.

[0080] The air moving member 180 rotates about an axis of rotation 198 (e.g., a motor axis of rotation of the motor and fan assembly). Referring to Figure 1, the exemplary axis of rotation 198 is generally parallel to the longitudinal axis 110 of the curler head 102. An axis of rotation 198 generally parallel to the longitudinal axis of the curler head may improve the hand feel of the apparatus 100. The axis of rotation 198 may be generally coaxial with the longitudinal axis 110. An axis of rotation generally coaxial with the longitudinal axis may improve the hand feel of the apparatus 100. However, it will be appreciated that the axis of rotation 198 may be at any angle to the longitudinal axis 110.

[0081] The air moving member 180 and/or heating element 190 are powered. The curler apparatus 100 may also include one or more further powered components, such as a touch screen or other control interface. Power is supplied by one or more on board energy storage devices 200 (e.g., one or more batteries, one or more capacitors, and/or a removeable pack of a plurality of batteries or capacitors) and/or by an external source (e.g., via a power cord). Referring to Figure 1, the exemplary hair curling apparatus 100 includes a power cord 202 electrically coupled to the air moving member 180 and the heating element 190 to provide power thereto. The power cord 202 is connectable to household mains. It will be appreciated that the power cord and/or energy storage members may be provided at any suitable location. Optionally, the power cord 202 may enter into the blower 182 (e.g., be mounted or removably mounted thereto) and/or the energy storage members may be located in the blower. The coupling 184 between the blower 182 and the curler head 102 may include a power transfer coupling if the curler head 102 includes a powered component (e.g., where the blower includes the air moving member and the curler head includes the heating element). Optionally, e.g., if the curler head is operable to be used on its own, the power cord 202 may enter the curler head directly and/or the energy storage members may be located in the curler head.

[0082] The following is a discussion of a number of aspects, namely an annular set of curler outlets, shifted adjacent curler outlets, longitudinally spaced air outlets, longitudinally directed air flow, annular band of curler outlets, bi-directional curler outlets, a curler outlet with varying transverse air flow area, air flow textured land portions, grip textured hair receiving surfaces, thermally conductive hair receiving surfaces, a land surface with varying radial extent, longitudinally decreasing outlet air flow area, longitudinally narrowing head air flow path, a valve reconfigurable air flow direction, secondary application outlets, a bleed valve, axially extending surface dimples, a first end free of curler outlets, supplementary second end heating, an air moving member within the curler head, a heating member in the curler head, direct hair heating, induction charging, a manufacturing method using separately formed rings and a tube, a user interface and accessories, which are disclosed herein. Each aspect may be used by itself or in combination or sub-combination with one or more of the other aspects disclosed herein.

An Annular Set of Curler Outlets

[0083] The following is a description of a curler head 102 having curler outlets 150. In accordance with this aspect, any configuration of a curler outlet 150 may be used.

[0084] As exemplified in Figures 2-9, the outlets 150 may be arranged in one or more annular sets 151 or rings so as to form a band of outlets. An annular set includes a plurality of curler outlets 150 that are angularly positioned around part or all of the longitudinal axis 110. The curler outlets may be positioned one adjacent another (e.g., the outlet ports 136 may extend generally continuously around part or all of the longitudinal axis 110) or they may be spaced apart. For example, a single annular set of curler outlets may comprise 4, 5, 6, 7, 8 or more curler outlets 150.As exemplified in Figure 7, the outlet ports

136 are positioned adjacent each other and the outlets 150 extend continuously around the longitudinal axis 150.

[0085] The curler head 102 may include a single annular set or a plurality of annular sets. If a plurality of annular sets are provided, then the annular sets may be spaced apart along part or all of the length of the curler head. As exemplified in Figure 2, the curler head 102 comprises five annular sets of outlets that are separated by land portions 160. All of the outlets in a single annular set may be the same or some or all may differ. Alternately, or in addition, each annular set may be the same or some or all may differ.

[0086] As exemplified in Figure 3, the outlet ports 136 of each annular set may be generally aligned with outlet ports of some or all of the other annular sets to thereby form longitudinal sequential sets that together form a plurality of rows of outlet ports 136, each row extending along the longitudinal axis 110.

[0087] Alternately, the outlets may be arranged in rows that are generally linear or helical. The outlets 150 may be axially positioned without any land portion therebetween. As exemplified in Figures 20-24, the outlet ports 136 of annular sets 151 of curler outlets are angularly aligned so as to extend in a plurality of longitudinal rows 153 generally parallel to the longitudinal axis 110. As exemplified in Figure 20, the sets 151 includes a first set 151a of open curler outlets 150, a second set 151b of open curler outlets 150 and a third set 151c of open curler outlets 150. An outlet port 136 of the exemplary first set 151a is axially aligned with an outlet port 136 of the exemplary second set 151b and with an outlet port 136 of the exemplary third set 151c. Still referring to Figures 20-24, the exemplary first, second and third sets 151a, 151b, and 151c of curler outlets 150 define a plurality of axially extending rows 153 of outlet ports 136 that are axially aligned (e.g., linear rows 153).

[0088] Alternately, as exemplified in Figures 69 and 71 and as discussed subsequently under the heading Shifted Adjacent Curler Outlets, the outlet ports 136 may axially extend at an angle to the axis 110. Referring to Figure 91, the outlet ports 136 extend at an angle 137 to the axis 110. Referring to Figures 69 to 72, the exemplary curler head 102 includes rows 153 of outlet ports 136 that are not axially aligned. The exemplary rows 153 of Figures 69 to 72 are helical. For each row of outlet ports of the exemplary curler head 102 of Figures 69-72, the outlet ports 136 are angularly positioned around the longitudinal axis. For each row 153 of outlet ports 136, the outlet port 136 of the second set 151b of outlet ports is angularly positioned around the longitudinal axis 110 from the outlet port 136 of the first set 151a of outlet ports and the outlet port of the third set 151c of outlet ports is angularly positioned around the longitudinal axis 110 from the outlet port of the second set 151b of outlet ports.

Shifted Adjacent Curler Outlets

[0089] The following is a description of a curler head having a plurality of curler outlets wherein longitudinally sequential curler outlets are shifted radially and/or angularly relative to one another in accordance with this aspect. Any configuration of a curler outlet 150 may be used.

[0090] Radially shifter curler outlets 150 extend a different radial distance from the axial centre of the curler head. The radial distance may decrease or increase at a constant rate along part of all of the length of the curler hear and/or the radial distance may increase or decrease in a stepped pattern.

[0091] Referring to Figures 65-68, the exemplary curler outlets 150 are arranged such that longitudinal sequential curler outlets are shifted radially relative to one another. The curler head 102 includes a first curler outlet 150e and a second curler outlet 150f longitudinally sequential to the first (i.e., sequential along the longitudinal axis 110, directly adjacent or separated by a closed land portion 160 of the curler head 102). Referring to Figures 65-68, the exemplary first outlet 150e is at a first position a first radial distance from the longitudinal axis 110 and the exemplary second curler outlet 150f is at a second position a second radial distance from the longitudinal axis 110, the second radial distance being less than the first radial distance. In some examples, the curler head includes curler outlets at three or more radial distances from the longitudinal axis 110, with the radial distance of a curler outlet decreasing regularly along the longitudinal axis. Referring to Figures 65-68, the exemplary curler head includes curler outlets at five radial distances with the radial distance of a curler outlet decreasing regularly along the longitudinal axis.

[0092] Angularly shifted outlets may form, e.g., a helical row of outlet ports extending along the longitudinal axis. Optionally, the curler outlets may be arranged in a staggered formation. In a staggered formation, every other curler outlet along the longitudinal axis is axially aligned with intervening outlets relatively angularly or radially shifted.

[0093] Referring to Figures 69-72, the exemplary curler outlets are arranged such that longitudinally adjacent curler outlets are shifted angularly relative to one another, with the first exemplary curler outlet 150e at a first angular position and the second exemplary curler outlet 150f at a second angular position different from the first angular position. Referring to Figures 69-72, the exemplary curler head includes staggered curler outlets 150 with every other longitudinally sequential curler outlet longitudinally aligned.

Longitudinally Spaced Air Outlets

[0094] The following is a description of a curler head 102 having a plurality of curler outlets wherein longitudinally sequential open curler outlets are spaced long-

itudinally from one another by closed land portions of the body sidewall in accordance with this aspect. Any configuration of a curler outlet 150 may be used.

[0095] The curler outlets 150 may be arranged in sets, with the curler outlets of each set angularly positioned about the longitudinal axis or axially aligned as previously discussed.

[0096] As discussed previously, a curler head may include a plurality of land portions 160 arranged sequentially along the length of the curler head. The land portions 160 separate axially spaced apart curler outlets 150, such as the annular sets of curler outlets discussed previously. As exemplified in Figures 2-9, the land portions 160 of the body sidewall are always-closed portions, such as continuous walls.

[0097] Alternately, the closed portions of the body sidewall may comprise selectively openable curler outlets so that the sidewall of the curler head is selectively openable. As discussed subsequently, the curler head may be adjustable to direct air clockwise and counter clockwise. In such a case, the curler head 102 may include curler outlets 150 directed clockwise and separate curler outlets150 directed counter clockwise. The clockwise and counter clockwise outlets are selectively openable. The curler head may be selectively switchable between clockwise and counter clockwise configurations by opening one set of outlets or the other (e.g., via a valve assembly or selective reconfiguration of the curler head). For example, the clockwise outlets may be open and the counter clockwise outlets may be closed. The counter clockwise outlets therefore define closed portions of the body sidewall when they are closed.

[0098] Referring to Figures 2-9, longitudinal spacing between longitudinally spaced apart outlets 150 provides a hair-receiving surface 210 extending longitudinally between curler outlets. The hair-receiving surface allows hair that is wrapped around the body sidewall 120 to settle against the body sidewall. Longitudinally extending hair receiving surfaces may improve the user experience and/or allow for the body sidewall to interact more with the hair (e.g., for heat transfer or hair holding, at described further elsewhere herein). In some examples, longitudinal sequential curler outlets are longitudinally spaced by at least twice, at least three times, or at least four times the average longitudinal extent of the curler outlet 150. In some examples, longitudinal sequential curler outlets are longitudinally spaced by at least 4 mm, at least 6 mm, or at least 8 mm.

[0099] In some examples, the land portion or closed body sidewall adjacent a curler outlet is a closed longitudinal segment. For example, the closed longitudinal segment of a generally cylindrical body sidewall 120 is a closed annular portion of the body sidewall. A closed longitudinal segment allows hair to wrap against the body sidewall about the longitudinal axis. Referring to Figures 2-9, the exemplary curler head 102 has closed longitudinal segments 222. The closed longitudinal segment 222 of the exemplary curler head 102 of Figures 2-9 is an annular ring and forms a land portion 160 across which an adjacent curler outlet may direct an air flow.

[0100] Where the closed portions of the body sidewall include closed curler outlets, longitudinal spacing provides space for those closed outlets, such as to allow a user to switch between a clockwise and counter clockwise configuration of the curler head by closing one set of outlets and opening another for each configuration. Referring to Figures 20-24, the exemplary curler head 102 has open curler outlets 150 separated by closed portions 220 of the body sidewall. Curler outlets 150 are arranged in sets of curler outlets 150 angularly positioned about the longitudinal axis. The exemplary curler head 102 of Figures 20-24 includes a first set of clockwise directed curler outlets 150a and a second set of counter clockwise directed curler outlets 150b. The open curler outlets 150 are the outlets of one set, and the other set is closed. Accordingly, longitudinally sequential curler outlets of a common set are spaced from one another longitudinally and, when open, are separated by a closed portion 220 of the body sidewall which includes closed outlets of the other set. Referring to Figures 20-24, when one of the sets 150a, 150b is open and the other is closed, the land portions 160 comprise a first section 222a positioned between the first and second sets 151a, 151b of curler outlets 150 and a second section 222b positioned between the second and third sets 151b, 151c of curler outlets 150. It will be appreciated that further sets of open curler outlets and sections of land portions 160 may also be included.

Longitudinally Directed Air Flow

[0101] The following is a description of longitudinally directed curler outlet air flow. In accordance with this aspect, the curler outlets 150 are shaped such that the exit vector 152 of air flow includes a longitudinal component 230 yet optionally also includes a component directed angularly around the curler head. Any configuration of a curler outlet 150 may be used.

[0102] It will be appreciated that the exit vector 152 of a curler outlet 150 which includes a longitudinal component 230 optionally also includes a tangential or radial component. The tangential component provides a curling force which assists in hair wrapping around the curler head, or hair wrapping around the curler head without the user rotating the curler head to wrap hair therearound.

[0103] Referring to Figure 7, in some examples, the exit vector 152 has an angle 232 to a plane perpendicular to the longitudinal axis, and the angle is between 10° and 30°, between 15° and 25°, between 17° and 23° or about 20°. In some embodiments, the tangential component 154 of the exit vector of a curler outlet 150 may be at least 25%, at least 50%, or at least 60% of the exit vector 152 with the rest being the longitudinal component, while in others it may be less than 25%, less then 10%, or, in some examples, negligible (e.g., less than 5%). The longitudinal component 230 may make up at least 25%, at least

30%, or at least 40% of the exit vector 152. For example, the longitudinal component 230 may be between 15% and 75%, between 30% and 75%, or between 30% and 60%.

[0104] Referring to Figure 7, including a longitudinal component 230 in the exit vector 152 allows a curler outlet to at least assist in hair seating against a longitudinally adjacent portion of the curler head 102, such as a closed portion 220 of the body sidewall, such as a closed longitudinal segment 222 (which may be a land portion 160), and hair overlying the closed portion of the body sidewall may be positioned by the air flow from a longitudinally adjacent curler outlet.

[0105] Referring to Figures 2-9, the curler outlets 150 are shaped to direct exiting air along an exit vector 152 which includes a longitudinal component. Referring to Figure 4, the exemplary exit vector 152 is defined by the shape of the duct 138, such as by vanes 142. In some examples, the outlet end of the duct 138 extends in a direction that includes a tangential component and a longitudinal component relative to the longitudinal axis 110.

[0106] The longitudinal component 230 of the exit vector may be selected based on the air flow speed and/or volumetric rate of air flow in combination with the axial length of the longitudinal segment 222 around which it is intended for the user's hair to wrap. Optionally, the longitudinal component is sufficient such that the curling force of the air (resulting for the tangential component of the air exiting the outlet port 136) extends across all or substantially all of an adjacent longitudinal segment 222.

[0107] In some examples, the angle of the longitudinal component 230 is proportional to the size of the longitudinal spacing between curling outlets (e.g., spaced apart annular sets of curler outlets) and/or inversely proportional to the speed of air exiting the curler outlets and/or the volumetric rate of air flow. For example, the larger the axial length of a closed longitudinal segment 222, the larger the angle of the longitudinal component 230 may be. The greater the speed of air exiting the curler outlets and/or the volumetric rate of air flow, the smaller the angle of the longitudinal component 230 may be.

[0108] It will be appreciated that if air is directed over the closed longitudinal segment 222 from each axial end thereof, e.g., the closed longitudinal segment 222 is located between two axially spaced apart annular sets of bidirectional curler outlets 150c as exemplified in Figure 33 and as discussed subsequently, then air from each bidirectional curler outlets 150c is directed over the closed longitudinal segment 222 and the longitudinal component 230 may be reduced as, essentially, air exiting one of the bidirectional curler outlets 150c may extend across only about half of the axial length of the closed longitudinal segment 222. Alternately, if air is directed over the closed longitudinal segment 222 from only one annular set of curler outlets (e.g., unidirectional curler outlets 150d as exemplified in Figure 33 and as discussed subsequently), then air exiting unidirectional curler outlets 150d may extend across all of the axial length of the closed longitudinal segment 222.

Annular Band of Curler Outlets

[0109] The following is a description of an annular band or ring 246 of curler air outlets 150. In accordance with this aspect, a plurality of curler outlets 150 are arranged at least partially around the longitudinal axis 110 of the curler head (e.g., 50%, 60%, 75%) and, optionally all or essentially all the way around the longitudinal axis 110 of the curler head. The curler outlets 150 may be spaced apart or may be arranged adjacent each other. Any configuration of a curler outlet 150 may be used.

[0110] The curler outlets 150 of a band 246 may be flush with the outer surface of the curler head (e.g., the outlet port 136 may be flush with the outer surface as exemplified in Figure 63), or they may be positioned radially outward of the outer surface of an adjacent land portion 160 (e.g., some or all of the outlet port 136 may be radially outward of the outer surface of an adjacent land portion as exemplified in Figure 2).

[0111] As discussed subsequently, a band 246 of curler outlets 150 may be unidirectional or bidirectional. Alternately or in addition, the curler outlets 150 may direct the air axially, radially or a combination thereof as discussed previously. Accordingly, as discussed previously, the curler outlets 150 may direct the air flow along an exit vector with the tangential component, such that the band 246 generates a cone-shaped or cylindrical-shaped air flow.

[0112] A plurality of annular bands of curler air outlets may be separated from one another by a land portion 160 as discussed herein or they may be positioned adjacent each other.

[0113] Referring to Figures 2-9, the curler outlets of an annular band of curler air outlets 150 includes a duct 138 that extends between an inlet port 140 and outlet port 136. The duct 138 of the exemplary annular band of curler air outlets 150 of Figures 2-9 extends from an inlet port 140 to the longitudinally directed outlet port 136, and so redirects air flow.

[0114] As exemplified, the outlet port 136 is provided in the radially extending side(s) 246a, 246b of the annular band 246. For example, as exemplified in Figure 2, in a bidirectional band 246, outlet ports 246 are provided in the axially outwardly facing side 246a and in the axially inner facing side 246b.As exemplified, the outlet ports 136 face along the longitudinal axis 110. It will be appreciated the radially extending sides 246a, 246b may extend at an angle to the longitudinal axis and therefore the ports 136 need not face axially.

[0115] The curler outlets 150 are configured to produce air flow that exits the duct 138 in a desired direction. Accordingly, the duct is shaped to provide a selected direction of air flow. Accordingly, the curler air outlets 150 may include at least one tangentially angled vane 142 to

impart a tangential component to the exit vector. It will be appreciated that the vane may also include another angular component in addition to the tangential component. It will be appreciated that the vane may be the radially extending sidewalls of a duct 138.

[0116] As exemplified in Figures 2-9 and Figures 25-28, and particularly Figure 7, vanes 142 extends at an angle that includes a tangential component and a longitudinal component. Accordingly, vanes 142 may be radially spiralling vanes, they may spiral radially outwardly from the inlet port 140.

[0117] The curvature of a vane 142 may be constant along the length of the vane 142 from the inlet port 140 to the outlet port 136. Alternately, it may change along the length of the vane. For example, the curvature of a vane may transition towards an increasing longitudinal angle 236 from upstream to downstream or it may transition towards an increasing tangential angle 232 from upstream to downstream.

[0118] Referring to Figures 2-9, and particularly Figure 3, it will be appreciated that the vanes 142 may separate the ducts 138 of an annular band of curler air outlets from each other. The plurality of ducts 138 of an annular band of curler air outlets 150 are angularly positioned around the longitudinal axis 110. The number of vanes may be selected based on the desired angle and the optional longitudinal overlap of the vanes. In some examples, an annular band of curler air outlets includes between 4 and 15 vanes, between 5 and 12 vanes, between 6 and 12 vanes, between 6 and 10 vanes, between 7 and 11 vanes, or between 8 and 10 vanes.

[0119] As exemplified in Figure 55, the vanes 142 may overlap each other such air entering one duct 138 from an inlet port 140 (e.g., the left most duct in Figure 55 in which the line for reference numeral 262 terminates) may travel through the duct at a location that is axially spaced from adjacent duct 138 (the centre duct in which the line for reference numeral 250 terminates), which has an inlet port that is spaced clockwise around the longitudinal axis 110. Alternately, the ducts may not overlap.

[0120] Referring to Figures 2-9, annular band of curler air outlets 150 are each adjacent an annular closed (i.e., air impermeable) longitudinal segment 222. The exemplary annular closed longitudinal segment 222 forms an annular land surface 160. The exemplary curler outlets 150 direct airflow across the annular land surfaces 160 to draw hair around the annular land surfaces 160. The annular band of curler air outlets 150 has a longitudinal length 240 and the closed longitudinal segment 222 has a longitudinal length which may be at least 1.5 times, at least 2 times, or at least 3 times, the length 240 of the outlet 150.

[0121] Referring still to Figures 2-9, the curler head 102 includes a plurality of annular band of curler air outlets 150. The annular land surface 160 may be longitudinal flanked by annular band of curler air outlets 150, as they are in the exemplary embodiment of Figures 2-9.

[0122] Optional, as discussed subsequently, the curler head 102 may include at least one annular band of curler air outlets 150 directing air along an exit vector having a longitudinal component 230 towards the first end 112 of the head 102 and at least one annular band of curler air outlets 150 directing air along an exit vector having a longitudinal component 230 towards the second end 114 of the head 102 (a bidirectional band). The curler head 102 may include a plurality of annular bands of curler air outlets 150 each directing air along an exit vector having a longitudinal component 230 towards a common end of the head 102, such as towards the curler head 102 first end 112 as exemplified in Figure 3.

[0123] As exemplified, an annular band of curler air outlets may form a raised ring of or provided on the main body. The diameter 242 of the radially outer side of outlet 136 is greater than the diameter 244 of the adjacent land portion 160. Referring to Figures 2-9, and particularly to Figures 3 and 4, the exemplary curler head 102 includes a plurality of raised rings or bands 246 spaced apart longitudinally.

[0124] In some examples, a curler head 102 may include recessed land portions 160. The recessed land portions 160 may be annular portions. Annular recessed land portions 160 may be bordered on one or both ends by raised rings 246 formed by annular band of curler air outlets 150. Referring to Figures 2-9, all land portions 160 of the exemplary curler head 102 are recessed land portions 160.

[0125] Referring to Figure 4, the outlet port 136 has a height 248. The height 248 may be selected based on the desired air flow characteristics. For example, if the outlet port 136 is wide in the angular direction, then the height 248 may be reduced.

Bi-Directional Curler Outlets

[0126] The following is a description of curler outlets which produce an air flow stream along a vector that includes a longitudinal component directed towards the first end 112 and another air flow stream along a vector that includes a longitudinal component directed towards the second end 114. In accordance with this aspect, an annular band of curler air outlets may comprise a first set of curler outlets 150 that direct air towards the first end 112 and a second set of curler outlets 150 that direct air towards the second end 114. c

[0127] As exemplified in Figures 25-34, curler outlets 150c are provided as an annular band of curler outlets with outlet ports 136 facing in each direction along the longitudinal axis 110. Referring to Figures 29-34, and particularly to Figure 34, the exemplary bidirectional annular band of curler air outlets 150c includes vanes 142 which split the airflow into first and second components heading up and down the longitudinal axis 110, respectively.

[0128] In contrast, Figures 33 and 34, curler outlets 150d are provided as an annular band of curler outlets with outlet ports 136 facing in only one direction along the

longitudinal axis 110 (i.e.., a unidirectional band of curler outlets).

[0129] In some examples, a curler head includes a plurality of bidirectional outlets. In some examples a curler head includes a plurality of bidirectional outlets 150c and a plurality of unidirectional curler outlets 150d. Optionally, as exemplified, a curler head 102 may have a unidirectional band of curler outlets 150d at the axial ends of the portion of the curler having outlet ports 136 and one or more bidirectional annular bands of curler air outlets 150c therebetween.

[0130] Referring to Figures 29-34, each annular land portion 160 of the curler head may be a section that may be covered (have air flow introduced thereon) by one or two adjacent curler outlets 150. In the exemplary embodiment of Figures 29-34, and referring particularly to Figure 34, section 1A is covered by a unidirectional outlet 150d at the first end 112, section 1B is covered by one side of a bidirectional outlet 150c and section 2A is covered by the other side of the bidirectional outlet 150c, section 2B is covered by one side of another bidirectional outlet 150c and section 3A is covered by the other side of the bidirectional outlet 150c, section 3B is covered by one side of another bidirectional outlet 150c and section 4A is covered by the other side of the bidirectional outlet 150c, and section 4B is covered by a unidirectional outlet 150d at the second end 114.

[0131] As exemplified in Figure 34, an angularly extending wall 143 may separate two ducts 138a and 138b. Alternately, for example if a wall 143 is not provided, ducts 138a, 138b may be a single duct with two outlet ports 136 facing in opposed directions.

[0132] In some embodiments, each section is flanked by an annular band of curler outlets. The flanking annular band of curler air outlets may all be unidirectional, may all be bidirectional, or may include both unidirectional and bidirectional outlets. Referring to Figures 35-38, the exemplary curler heads 102 include four sections. It will be appreciated that a curler head may have more or less sections. In some examples, a curler head with annular land portions includes three sections. In some examples, a curler head with annular land portions includes five sections.

[0133] It will be appreciated that coverage of a section may be accomplished by different arrangements of curler outlets 150 in different embodiments. Figures 35-38 exemplify various embodiments. Referring to Figure 35, the exemplary curler head 102 has sections 1A and 1B covered by a first unidirectional outlet 150 at the first end 112, sections 2A and 2B covered by a second unidirectional outlet 150, sections 3A and 3B covered by a third unidirectional outlet 150, section 4A covered by a fourth unidirectional outlet 150, and section 4B covered by a fifth unidirectional outlet 150 at the second end 114, with all but the fifth outlet directed towards the second end 114. Referring to Figure 36, the exemplary curler head 102 has sections 1A and 1B covered by a first unidirectional outlet 150, sections 2A and 2B covered by a second unidirectional outlet 150, sections 3A and 3B covered by a third unidirectional outlet 150, and sections 4A and 4B covered by a fourth unidirectional outlet 150 at the second end 114, each of the outlets 150 directed towards the first end 112. Referring to Figure 37, the exemplary curler head 102 has section 1A covered by a first unidirectional outlet 150 at the first end 112, section 1B covered by a second unidirectional head, sections 2A and 2B covered by a third unidirectional outlet 150, sections 3A and 3B covered by a fourth unidirectional outlet 150, and sections 4A and 4B covered by a fifth unidirectional outlet 150 at the second end 114, with all but the first outlet directed towards the first end 112. Referring to Figure 38, the exemplary curler head 102 has section 1A covered by a first unidirectional outlet 150 at the first end 112, sections 1B and 2A covered by a first bidirectional outlet 150, sections 2B and 3A covered by a second bidirectional outlet 150, sections 3B and 4A covered by a third bidirectional outlet 150, and section 4B covered by a second unidirectional outlet 150 at the second end 114.

[0134] It will also be appreciated that two unidirectional band of curler outlets 150d may be positioned adjacent each other with the outlet ports 136 facing different axial directions to thereby essentially provide a bidirectional annual band of curler outlets 150.

Curler Outlet Nearest Head Inlet End Directed Away from Head Inlet End

[0135] The following is a description of a curler head having a curler outlet 150 at the inlet end 112 that is shaped to direct air away from the inlet end 112. Directing air away from the inlet end of the curler head 102 inhibits hair from being carried past the end 112, such as onto an integrated handle or onto the body of a blower to which the curler head 102 is attached. Any configuration of a curler outlet 150 may be used.

[0136] In accordance with this aspect, the curler outlet 150 nearest to the inlet end 112 is shaped to direct air along an outlet vector 152 which includes a longitudinal component 230 directed away from the inlet end 112. The outlet vector 152 may not include a component in the direction of the inlet end or it may have a small component directed towards the inlet end.

[0137] As discussed elsewhere herein, a curler head may include longitudinally sequential segments 280 of constant longitudinal extent. A segment 280 may be a curler segment 280a including one or more curler outlets 150 or a non-curler segment 280b which does not include any curler outlets 150. The non-curler segment 280b may be a closed segment (e.g., a closed segment 222). In some examples, a non-curler segment 280b includes one or more inlets (e.g., a venturi inlet). In some examples, a non-curler segment 280b includes an outlet that is not a curler outlet (e.g., a bleed air outlet). In some examples, each curler outlet 150 of the longitudinal curler segment 280a that is nearest to the inlet end 112 is shaped to direct air along an outlet vector 152 whose

only longitudinal component 230 is directed away from the inlet end 112. In some examples, the curler segment 280a nearest to the inlet end 112 is the segment 280 at the inlet end 112 (i.e., not separated from the inlet end 112 by one or more non-curler segments 280b).

[0138] Referring to Figures 104 to 110, the exemplary curler head 102 includes a plurality of longitudinal segments 280, including a curler segment 280a at the inlet end 112. The inlet end curler segment 280a directs outlet air away from the inlet end 112. The exemplary inlet end segment 280a of Figures 104-110 includes a set 151 of outlets 150, each shaped to direct air along an outlet vector 152 which includes a longitudinal component 230 directed away from the inlet end 112.

[0139] It will be appreciated that in some examples all curler outlets 150 of the curler head 102 direct air away from the inlet end 112 (i.e., towards the opposite end 114 with respect to the longitudinal axis). However, in some examples, a curler head 102 also includes one or more curler outlets 150 which direct air towards the inlet end 112 with respect to the longitudinal axis. In some examples, the curler head 102 includes curler segments 280a which direct airflow in opposite longitudinal directions. In such examples, the curler head 102 includes at least one segment 280a which directs air towards the inlet end 112 (i.e., vector 152 includes a longitudinal component 230 directed towards the inlet end) and another curler segment 280a which directs air towards the opposite end 114 (i.e., vector 152 includes a longitudinal component 230 directed towards the opposite end). The exemplary curler head 102 of Figures 104-110 includes an opposite or distal end curler segment 280a at the opposite end 114 of the head 102, and each curler outlet 150 of the opposite end curler segment 280a is shaped to direct air along an outlet vector 152 whose only longitudinal component 230 is directed towards the inlet end 112. According, the inlet end curler segment 280a and the opposite end curler segment 280a of the exemplary head 102 of Figures 104-110 direct air in generally opposite directions with respect to the longitudinal axis 110.

[0140] In some examples, more than one curler segment 280a directs air towards the inlet end 112 with respect to the longitudinal axis. In some examples, all but one of the curler segments 280a direct air towards the inlet end 112 with respect to the longitudinal axis. The exemplary head 102 of Figures 104-110 includes a plurality of curler segments 280a which direct air towards the inlet end 112 with respect to the longitudinal axis 110 and a single curler segment 280a at the inlet end 112 which directs air towards the opposite end 114 with respect to the longitudinal axis 110.

[0141] Curler segments 280a directing air in opposite directions with respect to the longitudinal axis may be separated by a non-curler segment 280b. The non-curler segment 280b may be a closed segment providing a land portion between the two curler segments 280a directing air in opposite directions. Referring to Figures 104-110, the exemplary head 102 includes an inlet end segment 281 which is a curler segment 280a at the inlet end 112 directing air towards the opposite end 114. The exemplary head 102 of Figures 104-110 includes an intervening non-curler segment 285 between the inlet end segment 281 and a further curler segment 283 which directs air towards the inlet end 112 with respect to the longitudinal axis 110. The exemplary non-curler intervening segment 285 of Figures 104-110 is a closed segment providing a land portion 160 between the segments 283, 281.

[0142] The intervening non-curler segment 285 of any curler head disclosed herein may any suitable shape. An intervening non-curler segment 285 may have a varying radial extent (e.g., gradually varying and/or stepwise varying), with a greatest radial extent in a mid-portion of the segment 285 (e.g., a portion that is spaced from each longitudinal end of the segment by at least 10%, 20% or 25% of the longitudinal length of the segment). The greatest radial extent of the intervening non-curler segment 285 may be generally in the longitudinal middle of the segment. Referring to Figures 104-110, the exemplary intervening non-curler segment 285 is generally bell-shaped along the longitudinal axis 110. A segment that is bell-shaped along the longitudinal axis 110 160 has a diameter that increases and then decreases smoothly along the longitudinal axis 110. The exemplary segment 285 of Figures 104-110 is generally bell shaped with a greatest radial extent in the longitudinal middle of the segment.

[0143] In the exemplary embodiment of Figures 104-110, the curler segments 280a adjacent longitudinal ends of the intervening non-curler segment 285 are shaped to direct air along outlet vectors 152 having tangential components 154 in opposite directions (i.e., clockwise or counterclockwise). This may assist in capturing hair on the curler head 102. In some embodiments, the curler segments 280a adjacent longitudinal ends of an intervening non-curler segment 285 are shaped to direct air along outlet vectors 152 having tangential components 154 in the same direction (i.e., clockwise or counterclockwise). This may reduce turbulence at the interface of airstreams.

Curler Outlet with Varying Transverse Air Flow Area

[0144] The following is a description of curler outlets 150 which have a transverse air flow area which varies along the length of the curler outlet. The variation may be due to diverging and/or converging inner and outer walls and/or diverging and/or converging angular sidewalls (e.g., formed by vanes 142). Any configuration of a curler outlet 150 may be used.

[0145] The curler outlets 150 may include an expansion zone and/or a compression zone. The expansion zone is a portion of the duct 138 downstream of the inlet port 140 and upstream of the outlet port 136 in which the air flow area of the duct expands. A compression zone is a portion of the duct upstream of the outlet port 136 and downstream of the inlet port 140 in which the air flow area

of the duct decreases. Including a compression zone increases the air flow speed of the air jet generated by the outlet. An expansion zone reduces back pressure and, in conjunction with a compression zone, may accelerate the air flow through the duct.

[0146] Referring to Figures 40, 43-46, and 54-55, the exemplary expansion zones 250 each have a minimum transverse air flow area that is larger than the air flow area of the inlet port 140 and/or the outlet port 136. In some examples, the expansion zone 250 is a portion of the duct 138 that extends for at least 3 mm, at least 5 mm, or at least 10 mm. The expansion zone 250 may be provided at any location along the length of a duct 138.

[0147] Referring to Figures 39-55, the exemplary compression zones 252 each have a maximum transverse air flow area that is less than the minimum transverse air flow area of at least one portion of the duct 138. In some examples, the compression zone 252 has a maximum transverse air flow area that is less than the air flow area of the inlet port 140 and/or the outlet port 136. In some examples, the compression zone 252 is a portion of the duct 138 of the outlet that extends for at least 3 mm, at least 5 mm or at least 10 mm. The compression zone 252 may be provided at any location along the length of a duct 138.In some examples, the compression zone extends all the way to the outlet port 136.

[0148] Referring to Figures 39-55, the exemplary duct 138 is formed by an outer wall 260 (e.g., of the raised ring or annular band 246) and an inner wall 262 radially underlying the outer wall 260. Referring to Figures 39-55, the exemplary duct 138 has an angular width defined by the vanes 142. The transverse air flow area of the duct 138 is defined by a combination of the spacing between sidewalls (e.g., vanes 142 in the example of Figures 39-55) and the spacing between the radially outer wall and the radially inner wall.

[0149] Increasing the spacing between the outer wall and the inner wall and/or increasing the spacing (e.g., angular spacing) between sidewalls increases the transverse air flow area of the duct 138, and may be used to, e.g., form an expansion zone 250. Referring to Figures 39-44 and 37-55, the exemplary duct 138 is formed radially outside the air passage 170. The inner wall 262 of the exemplary duct of Figures 39-44 and 37-55 has an inner diameter that is generally the same as the inner diameter of the adjacent land portion 160. Forming the duct outside of the air passage 170 may keep the duct walls from obstructing air flow through the air passage 170. Referring to Figures 45 and 46, the exemplary duct 138 is formed at least partially within the air passage 170. The inlet ports 140 of the curler outlet ducts are located in the passage 170. The exemplary radial inner side of the inlet ports 140 are located radially inward of the radial outlet wall 160 of the passage 170. The inner wall 262 of the exemplary duct of Figures 45 and 46 has an inner diameter that is less than the inner diameter of the adjacent land portion 160. The inlet ports extending the duct into the air passage 170 may reduce the overall diameter of the curler head.

[0150] Decreasing the spacing between the outer wall and the inner wall and/or decreasing the angular spacing between vanes decreases the transverse air flow area of the duct 138, and may be used to, e.g., form the compression zone 252. Referring to Figures 40, 43, 44, and 47-49, the exemplary compression zones 252 are formed by decreasing the diameter of the outer wall 260 towards a downstream end of the duct 138. Referring to Figures 44 and 45, the exemplary compression zones 252 are formed by increasing the diameter of the inner wall 262 towards a downstream end of the duct. Referring to Figures 54 and 55, the exemplary compression zone is formed by decreasing the angular spacing between vanes 142 towards the downstream end of the duct 138.

[0151] If both a compression zone 252 and an expansion zone 250 are provided in a single duct 138, then the compression zone 252 may be downstream and, optionally immediately downstream, of the expansion zone 250.

[0152] In some examples, an expansion zone 250 may be an outlet end expansion zone 250 at an outlet end of the duct 138. The outlet end expansion zone 250 extends to and includes the outlet port(s) 136. Referring to Figures 111-117, particularly Figure 114, the exemplary outlet 134a has an outlet end expansion zone 250 which extends to and includes the outlet port 136. The transverse air flow area of the outlet end expansion zone 250 may increase along the expansion zone towards the outlet port(s) 136.

[0153] The outlet end expansion portion may extend from the inlet port(s) 140 to the outlet port(s) 136 or from an intermediate location between the inlet port(s) 140 and the outlet port(s) 136. The exemplary outlet end expansion zone 250 of Figures 111-117 extends to the outlet port 136 from an intermediate location 144 between the inlet port 140 and the outlet port 136, however it will be appreciated that in other examples, the outlet end expansion zone 250 may extend all the way from the inlet port 140 to the outlet port 136. The transverse air flow area of the duct 138 transverse to the direction of air flow through the duct at the inlet port(s) 140 may be smaller than the transverse air flow area of the duct 138 at the outlet port(s) 136. Referring to Figures 111-117, the transverse air flow area of the inlet ports 140 of the exemplary outlet 134a is smaller than the transverse air flow area of the outlet port 136. In some examples, the transverse air flow area of the duct 138 is at a maximum at the outlet port(s) 136. In some examples, the transverse air flow area of the duct 138 is at a minimum at the inlet port(s) 140.

[0154] Referring to Figures 111-117, the transverse air flow area of the exemplary outlet end expansion zone 250 increases gradually along the length of the outlet end expansion zone 250. It will be appreciated that the transverse air flow area of an outlet end expansion zone 250 may increase gradually and/or stepwise. It will be appreciated that the increase in transverse air flow area may be

a combination of gradual and stepwise increases, such as a first gradual increase, followed by a stepwise increase, followed by a further gradual increase. Referring to Figures 111-117, the transverse air flow area of the exemplary outlet end expansion zone 250 increases continuously along the length of the outlet end expansion zone 250. It will be appreciated that the transverse air flow area of an outlet end expansion zone 250 may increase continuously or include one or more portions along which the transverse air flow area is unchanging (e.g., between steps in a stepwise increase in transverse air flow area). Referring to Figures 111-117, the transverse air flow area increases towards the outlet port 136 due to an increasing separation between the inner wall 262 and the outer wall 260. It will be appreciated that the increase in transverse air flow area may be due to any suitable increasing separation between walls forming the duct 138.

Air Flow Textured Land Portions

[0155] The following is a description of land portions which are textured to improve airflow (e.g.., Coanda air flow). The land portions include a surface texture selected to improve air adhesion to the surface.

[0156] In some examples, the textured land portions include radially raised portions and radially lowered portions. The transition between radially raised portions and radially lowered portions may be generally smooth or include small steps (e.g., less than 15%, less than 10%, or less than 5% of the diameter of the curler head).

[0157] The land portions 160 may include vanes or ridges 270 rising from the land portions 160. Referring to Figure 57, the exemplary land portions include a plurality of ridges 270 which are generally parallel to one another. The ridges 270 may extend generally transverse to the direction of air flow across the land portion 160 (i.e., generally transverse to the exit vector 152). The ridges may extend linearly as exemplified or they may be curved.

[0158] It will be appreciated that other surface textures could be used in addition or alternative to the vanes or ridges. For example, the land portions 160 may include discrete spaced apart raised surfaces such as dimples 272 (see for example Figure 56). It will be appreciated that the dimples 272 may be arranged in linear or curved rows and, if so, the rows may extend generally transverse to the direction of air flow across the land portion 160.

Grip Textured Hair Receiving Surface

[0159] The following is a description of hair receiving surfaces textured to inhibit the movement of hair across the surface. In some examples, the textured hair-receiving surface is a directional grip surface. A directional grip surface is shaped to inhibit the movement of hair across the surface in a selected direction or directions. In some examples, the texture is selected to inhibit hair moving across the surface in the angular direction (i.e., unwrapping). In some examples, the texture is selected such that the texture does not inhibit the hair to be slid across the surface axially.

[0160] The grip textured surface enables the use of an air flow providing a lower gripping force to hold hair in position in a curling operation. A directional gripping surface reduces the grip force needed from the air flow while allowing a user to remove their hair by moving it in a release direction. In some examples, part or all of the land surface is a grip textured hair-receiving surface (see for example Figure 58).

[0161] In some examples, the land portion has unidirectional mechanical hair engaging members 274 which engage hair when hair rotates around the land portion in a first direction 276 and which enables hair to rotate around the land portion in a second direction 278 that is opposite to the first direction 276. The grip texture surface of the exemplary curler head of Figure 58 comprises a plurality of scales or shingles which have a raised side. As exemplified, the scales are layered with the clockwise side below another scale and the counter clockwise side overlying another scale.

[0162] It will be appreciated that the grip textured surface could have any suitable texture.

Thermally Conductive Hair Receiving Surface

[0163] The following is a description of hair receiving surfaces which are formed of thermally conductive material to improve heat transfer to hair. The thermally conductive material has a high heat transfer coefficient. In accordance with this aspect, the hair receiving surfaces may be part or all of any portion of the outer surface of the curler head 102, such as the land portions 160 and/or the annular bands 246.

[0164] In some examples, the hair receiving surfaces are formed of thermally conductive material forming land portions across which the curler outlets direct air flow (i.e., Coanda surfaces). In some examples, the hair receiving surfaces are formed of thermally conductive material forming surfaces which overly the curler outlets.

[0165] Thermally conductive walls forming hair receiving surfaces improve heat transfer to hair, allowing a lower temperature curling operation and/or a faster curling operation. A greater amount of the heat needed to set a curl may be conductively transmitted to the hair from the body sidewall of the curler head.

[0166] The body sidewall may be formed of or covered by the thermally conductive material. In some examples, the hair receiving surfaces is formed of metal (e.g., aluminum or copper), ceramic, carbon, a metal filled plastic, a ceramic filled plastic or a carbon filled plastic. If the walls are covered, then the thermally conductive material may be provided by spraying, electrodeposition or the like.

[0167] Referring to Figures 2-9, the radially outer surface of the exemplary annular land portions 160 are metal

surfaces (e.g., an aluminum or copper sleeve) and the radially outer surfaces of the raised rings 246 are metal surfaces.

[0168] It will be appreciated that the presence or amount of thermally conductive material may be uniform along the length of the curler head 102 or it may vary. For example, thermally conductive material or more thermally conductive material may be provided towards the opposite end 114 than the inlet end 112.

Land Surface with Varying Radial Extent

[0169] The following is a description of a land portion which has a cross sectional shape and/or size (in a plane transverse to the longitudinal axis 110 that varies along the longitudinal axis. Such a land portion may be used with an air flow that extends angularly around the curler axis 110 and which may use the provided for use with the Coanda effect.

[0170] In accordance with this aspect, the land portion forms a radially outer surface of the curler head 102, which radially outer surface varies in radial extent along part or all of the axial length of the curler head 102. Accordingly, the annular radially outer surface has a varying diameter along part or all of the longitudinal axis.

[0171] In examples in which the land portion is provided for use with the Coanda effect, the land portion forms a generally continuous land surface as it varies in shape and/or size to encourage air flow to remain attached to the land portion or include small steps (e.g., less than 15%, less than 10%, or less than 5% of the diameter of the curler head).

[0172] A land portion with varying shape may improve air flow dynamics within or on the surface of the curler head. Referring to Figure 59, the exemplary land portion 160 has a diameter that increases smoothly and then remains constant along the longitudinal axis. Referring to Figure 60, the exemplary land portion 160 has a diameter that increases and then decreases smoothly along the longitudinal axis 110.

[0173] A curler head 102 may incorporate various types of land portions. As exemplified in Figures 78 to 84, the curler head 102 may include land portions 160a which have a varying radial extent, and land portions 160b which have a constant radial extent, and both portions 160a and potions 160b are adjacent at least one curler outlet 150.

[0174] It will be appreciated that, as exemplified, the land portions may comprise a series of axially positioned land portions that have a common profile. As exemplified in Figure 59, each land portion 160 has a wider end and a narrower end. The narrower end is located at the wider end of the next adjacent land portion. Alternately, the land portions may be separated by a land portion having a constant diameter.

[0175] It will be appreciated that the diameter of the land portion may vary along the portion of the curler head having air outlets and the diameter may vary at a constant rate or, as exemplified in Figures 59 and 60, in a repeating pattern.

[0176] It will be appreciated that the juncture of the narrower end of a land portion and the wider end of an adjacent land portion may form curler outlets 150 and may provide an annular band 246. See for example Figures 59, 87 and 88.

Longitudinally Decreasing Outlet Air Flow Area

[0177] The following is a description of a curler head in which the minimum transverse air flow area of the curler outlets of some or all of the curler outlets along some or all of the longitudinal length of the curler head decreases from one end of the curler head to the other. In accordance with this aspect, any configuration of a curler outlet 150 may be used.

[0178] In accordance with this aspect, the minimum transverse air flow area of the curler outlets may vary continuously along part or all of the length of the curler head. The minimum transverse air flow area of the curler outlets may vary at a constant rate in the axial direction or it may vary in increasing or decreasing amounts. It will be appreciated that the minimum transverse air flow area of some of the curler outlets that are arranged axially sequentially beside each other may be the same and need not all vary one to the next axial sequential curler outlet.

[0179] It will be appreciated that the minimum transverse air flow area of the curler outlets may decrease from the inlet end to the opposed end or from the opposed end to the inlet end.

[0180] It will be appreciated that if a single curler outlet is provided at a particular axial position along the curler head, then the minimum transverse air flow area may be that of the single curler outlet at that location. However, if the curler outlets are provided in a band 246 as discussed previously herein, then the minimum transverse air flow area may be the total transverse air flow area of all of the curler outlets in a band 246. Accordingly, the decreases in air flow area may be a result of using curler outlets that have a smaller minimum transverse air flow area and/or the result of providing less curler outlets in a segment of the same axial position along the curler head. Adjusting the size and/or number of the outlets in a band may produce a more even air flow out the outlets along the axial length of the curler head.

[0181] Referring to Figures 61-64, the exemplary curler head includes longitudinally sequential segments 280 of constant longitudinal extent. The exemplary curler head 102 of Figures 61-64 includes curler outlets 150 in each segment 280. The curler outlets 150 of a segment 280 together define a minimum transverse outlet air flow area of the segment 280. In the exemplary embodiment of Figures 61-64, the minimum transverse outlet air flow area of each segment 280 is less than the segment 280 longitudinally sequential towards the first end 112. The reduction in the transverse outlet air flow area in the exemplary curler head 102 of Figures 61-64 is due to

the decreasing size of the curler outlets 150 (i.e., decreasing longitudinal extent 282). However, it will be appreciated that in other examples it could also or alternatively be due to a decreasing number of curler outlets at the axial position of a segment 280. While the exemplary curler head 102 of Figures 61-64 has a steadily decreasing minimum transverse outlet air flow area of each segment along the length thereof, it will be appreciated that the decrease may be irregular in some examples.

[0182] The curler head 102 includes at least three segments 280 arranged along the longitudinal axis, with the first segment having a greater minimum transverse air flow area of the curler outlets of the first segment than the minimum transverse air flow area of the curler outlets of the second segment, and with the second segment having a greater minimum transverse air flow area of the curler outlets of the second segment than the minimum transverse air flow area of the curler outlets of the third segment. While the first, second, and third segments may be separated by intervening segments, in some examples the first, second, and third segments are directly adjacent to one another.

Longitudinally Narrowing Head Air Flow Path

[0183] The following is a description of a curler head with an air flow path along part or all of the axial length of the curler head that has a transverse air flow area that decreases in the axial direction. In accordance with this aspect, any configuration of a curler outlet 150 may be used.

[0184] In accordance with this aspect, the transverse air flow area of the curler head may vary continuously along part of all of the length of the curler head. The transverse air flow area of the curler head may vary at a constant rate in the axial direction or it may vary in increasing or decreasing amounts.

[0185] It will be appreciated that the transverse air flow area of the curler head may decrease from the inlet end to the opposed end or from the opposed end to the inlet end.

[0186] The decreasing size may be reflected in a narrowing diameter of the curler head, and the curler head may narrow from one end to the other. The transverse air flow area of the air flow path may decrease continuously or in a stepwise fashion. For example, the body sidewall may narrow continuously or in stepwise fashion. In some examples, the curler head narrows from the first or inlet end to the second end.

[0187] Referring to Figures 65-68, the exemplary curler head 102 has an air flow path 130 having a path transverse air flow area that decreases from the upstream end to the downstream end. The exemplary air flow path 130 of Figures 65-68 has a path transverse air flow area that narrows in stepwise fashion. A step narrowing air flow path may have any suitable number of steps, such as five steps as exemplified.

[0188] It will be appreciated that the air flow path through the curler head need not be defined by the sidewalls of the curler head but may be provided by one or more conduits located in the curler head and the air flow path through the curler.

[0189] It will be appreciated that this aspect may be used in conjunction with or alternately to longitudinally decreasing the outlet air flow area.

Varying Exit Vector Magnitude

[0190] The following is a description of a curler head in which the magnitude of the exit vector 152 varies from one longitudinal segment 280 to another. The magnitude of the exit vector 152 for a curler segment 280a closest to one longitudinal end of the curler head may be smaller than for a curler segment 280a at a midpoint and/or at the opposite longitudinal end. The exit vector may be at a minimum for the curler segment 280a closest to one or both of the longitudinal ends of the curler head. The variation of the magnitude of the exit vector 152 may be due to, e.g., longitudinally varying the minimum transverse outlet air flow area of the outlets.

[0191] The exit vector 152 for a curler segment 280a closest to the inlet end 112 may be smaller than for the segment nearest to, e.g., the opposite end 114 and/or at a midpoint between the inlet end 112 and the outlet end 114. A smaller exit vector 152 at the inlet end 112 may reduce the effect of the airflow on hair beyond the inlet end 112 of the curler head 102 off of the curler head 102. For example, a smaller exit vector 152 at the inlet end 112 may reduce the wrapping of hair around an integrated handle or a blower to which the curler head 102 is attached.

[0192] The exit vector 152 of a longitudinal segment 280 is a sum of the vectors of the curler outlets 150 of that segment 280. For example, a longitudinal segment 280 of the curler head 102 may include one or more annular ring outlets 150 or an annular set 151 forming a band of outlets 150. Referring to Figures 111-117, particularly Figure 111, the exemplary curler head 102 includes five longitudinal segment 280, including one non-curler segment 280b and four curler segments 280a. The exit vector 152 of the curler segment 280a nearest to the inlet end 112 of a curler head 102 may be smaller than at least one of the exit vectors 152 of the remaining curler segments 280a. The exit vector 152 of the curler segment 280a nearest to the inlet end 112 of the exemplary head 102 of Figures 111-117 is smaller than the exit vector 152 of each of the remaining curler segments 280a. The exit vector 152 of the curler segment 280a nearest to the inlet end 112 of the exemplary head 102 of Figures 111-117 includes a longitudinal component directed towards the inlet end 112, and the reduced magnitude of the exit vector 152 may reduce the effect of airflow on hair beyond the inlet end 112. The exemplary inlet end curler segment 280a of Figures 111-117 is spaced from the inlet end 112 by a non-curler segment 280b which does not include a curler outlet 150, however it will be appreciated that the inlet end curler segment 280a may alternatively be the

segment 280 closest to the inlet end 112 (i.e., not separated by a non-curler segment 280).

[0193] The magnitude of the exit vector 152 may be varied in any suitable way. In some examples, the magnitude of the exit vector 152 is varied by changing the minimum transverse air flow area for the segment 280 (e.g., choking the duct 138 of the inlet end curler segment 280). Referring to Figures 111-117, particularly Figure 114, the minimum transverse air flow area of the duct 138 of the inlet end curler segment 280a is smaller than the minimum transverse air flow area of the duct 138 of each of the other curler segments 280 (e.g., due to a number of inlet ports 140 that varies between segments 280). It will be appreciated that the magnitude of the exit vector 152 for a segment may also or alternatively be varied by, e.g., arranging the segment further from the inlet to the curler air flow path and/or varying the transverse air flow area of the curler head air flow path upstream of the duct 138.

Valve Reconfigurable Air Flow Direction

[0194] The following is a description of a curler head that is reconfigurable between a clockwise configuration and a counter clockwise configuration by reconfiguring part or all of the flow path through the curler head. Accordingly, a single curler head may be used to form curls on the right side and the left side of the head of a user.

[0195] In accordance with this aspect, the curler head 102 may be reconfigurable between a clockwise configuration and a counter clockwise configuration. In the clockwise configuration, some or all of the open curler outlets 150 direct air generally clockwise. In the counter clockwise configuration, some or all of the open curler outlets 150 direct air generally counter clockwise. A user may desire to switch between clockwise and counter clockwise air flow when switching between curling hair on different sides (right and left) of the user's head.

[0196] It will be appreciated that the curler head may be reconfigured in any suitable way. In some examples, the curler head 102 includes clockwise directed curler outlets 150 and counter clockwise directed curler outlets 150, and is selectively switchable between using the clockwise directed curler outlets 150 and using the counter clockwise directed curler outlets 150. For example, a valve may be used to switch between the outlets. It will be appreciated that in other examples the curler head may be reconfigured in other ways, such as by redirecting the curler outlets by, e.g., reangling vanes within the duct or shifting the location of an outlet port or inlet port along the length of the duct.

[0197] Accordingly, a curler head may have curler outlets that produce a clockwise flow and curler outlets that provide a counter clockwise flow. The curler head is reconfigurable to selectively open some or all of the curler outlets that produce the clockwise flow and/or some or a portion of the flow path leading to those curler outlets. Similarly, the curler head is reconfigurable to selectively open some or all of the curler outlets that produce the counter clockwise flow and/or some or a portion of the flow path leading to those curler outlets.

[0198] For example, one or more valves may be provided to reconfigure the curler head. This aspect allows the curler head to be reconfigured quickly and may allow the reconfiguration with minimal moving parts.

[0199] Referring to Figures 14-18 and 20-24, the exemplary curler heads 102 each include an air outlet directional valve 208 moveable between a first position in which the curler head 102 is in the clockwise configuration and a second position in which the curler head 102 is in the counter clockwise configuration. The air outlet directional valve 208 may control which of the clockwise 150a and contraclockwise 150b directed curler outlets is open.

[0200] Any suitable air outlet direction valve 208 may be used to selectively direct air to the curler outlets that direct air clockwise or the curler outlets that direct air counter clockwise. Referring to Figures 14-18, the exemplary air outlet direction valve 208 includes a rotating tube (angularly rotating) with openings selectively alignable with the counter clockwise directed curler outlets 150b and the clockwise directed curler outlets 150a. Referring to Figures 20-24, the exemplary air outlet direction valve 208 includes a sliding tube (longitudinally sliding) with openings selectively alignable with the counter clockwise directed curler outlets 150b and the clockwise directed curler outlets 150a.

[0201] It will be appreciated that the curler head may have a first flow path that extends to the clockwise directed curler outlets 150a and a second flow path that extends to the counter clockwise directed curler outlets 150b. The two flow paths may extend from, e.g., a header which may be at the inlet end of the curler head and a single valve (e.g., a gate valve) may be moveable to selectively open the first and second air flow paths.

Secondary Application Outlets

[0202] The following is a description of a curler head which can also be used as a concentrator and/or diffuser.

[0203] It will be appreciated that the concentrator and/or diffuser may be provided in any suitable way. For example, in accordance with this aspect, the curler head may have an accessory removably connectable thereto which functions as a concentrator and/or diffuser. Alternately, the curler head may have incorporated therein outlet(s) that functions as a concentrator and/or diffuser.

[0204] In accordance with this aspect, the curler head may include one or more secondary air outlets in addition to the curler outlets 150 wherein the secondary air outlet(s) direct air flow as a concentrator and/or a diffuser.

[0205] Optionally, the curler head is selectively reconfigurable between all three of a concentrator configuration, a diffuser configuration, and a curler configuration.

[0206] The diffuser and/or concentrator outlet(s) may be provided at any location on a curler head and are

optionally provided at the second end 114 of the curler head 102.

[0207] In some examples, the curler head includes two or more air flow paths, with a first air flow path for the curler outlets 150 and a second air flow path for the secondary air outlets 294. Referring to Figures 14-18, the air flow path 130 of the exemplary curler head 102 includes a primary branch 290 leading to curler outlets 150 and a secondary air flow branch 292 leading to secondary air outlets 294. The primary branch 290 may be referred to as a curling air axially extending passage 290 and the secondary air flow branch 292 may be referred to as a diffuser air axially extending passage 292 for examples in which the secondary air outlets are useable to provide a concentrator or diffuser air flow. The exemplary curler head of Figures 14-18 includes a single secondary air flow branch 292 extending between (i.e., internal of) a plurality of primary air flow branches 290. Referring to Figures 14-18, the exemplary secondary air flow branch 292 is formed by a longitudinally extending tube.

[0208] It will be appreciated that the secondary air flow branch(s) 292 may be provided internal of the primary air flow branch(s) 290 or extend axially there beside.

[0209] The secondary air outlets 294 are arranged in any suitable arrangement to form a desired styling tool. In some examples, the secondary air outlets 294 are arranged for use of the curler head 102 as a diffuser when the secondary air outlets 294 are open. Referring to Figure 14, the exemplary secondary air outlets 294 are arranged for use of the curler head 102 as a diffuser when the secondary air outlets 294 are open, as the secondary air outlets 294 are distributed generally evenly over a curved (domed as exemplified, but could be, e.g., cylindrical) surface.

[0210] In some examples, the curler head is selectively reconfigurable between a curler configuration and a secondary configuration. In the curler configuration some or all of the curler outlets 150 are open and some or all of the one or more secondary air outlets 294 are closed. In the secondary configuration at least some of the one or more secondary air outlets 294 are open and some or all of the curler outlets 150 are closed.

[0211] As discussed previously with respect to the clockwise and counter clockwise configurations, the curler head may be reconfigurable to selectively open some or all of the curler outlets 150 and/or some or a portion of the flow path leading to the curler outlets 150. Similarly, the curler head is reconfigurable to selectively open some or all of the secondary air outlets 294 and/or some or a portion of the flow path leading to secondary air outlets 294,

[0212] In some examples, the curler head 102 includes a valve moveable between a first position and a second position, in the first position the primary air flow branch 290 is open such that the curler outlets are open to the head inlet 132 and the secondary air flow branch 292 is closed. In the second position, the primary air flow branch 290 is closed and the secondary air flow branch 292 is open such that the secondary air outlets are open to the head air inlet 132. It will be appreciated that, similar to the mechanisms described with respect to the clockwise and counter clockwise configurations, a valve may also or alternatively selectively block or unblock air outlets directly (e.g., rather than blocking the branch as a whole), such as if curler and secondary air outlets open from a common air flow path.

Bleed Valve

[0213] The following is a description of a curler head which includes a bleed valve selectively openable to open a bleed air inlet and/or a bleed air outlet.

[0214] In use, a bleed air inlet introduces ambient air into the flow path through part or all of the curler and may thereby increase the volume of air in the air flow path 130. A greater volume of air may be used to, e.g., increase a curling force to position hair. Alternately or in addition, if the bleed air inlet is upstream of a curler outlet but downstream of a heating member, the bleed air may reduce the temperature of air that is provided to curler outlets 150. Cooler air may be used to, e.g., set a curl after the hair has been heated and the hair arranged in a suitable shape. Accordingly, the bleed valve may be operable at the end of a curling operation, e.g., after hair has been heated a sufficient time to form a curl, to introduce ambient air into the air flow passage whereby a temperature of air exiting the air outlet is reduced when the bleed valve is opened. For example, a user may operate an actuator to open the bleed inlet or the curler head may automatically open the bleed inlet after a sensor detects that the hair has reached a target temperate or the curling operation has occurred for a pre-set time.

[0215] Any valve may be used as a bleed air inlet. In some examples, a bleed air inlet includes a venturi to draw air into the curler head 102 when the inlet is open.

[0216] In use, a bleed air outlet reduces the volume of air exiting the curler outlets 150 by drawing off some of the air. A reduced volume of air exiting the curler outlets reduces the curling force acting on hair. Reducing the curling force may, e.g., allow a user to more easily release their hair from the curler head 102 after a curling operation. In some examples, the bleed air outlet is operable at an end of a curling operation whereby air is vented from the air flow passage upstream of some or all of the curler outlets 150 whereby a curling force produced by the curler outlets is reduced. It will be appreciated that if the curler head is operable as a concentrator or diffuser, the secondary air outlets 294 may be used as the bleed air outlets.

[0217] Accordingly, it will be appreciated that the outlet of a bleed air inlet and/or the inlet of an outlet bleed valve may be selectively openable while the curler outlets remain open, and when open are in flow communication with a common portion of the air flow path from which the curler outlets open.

[0218] The bleed valve may be located at any suitable location. In some examples, the bleed valve is located at the first end 112 of the curler head 102.

[0219] The bleed valve may be selectively openable by any suitable actuator. The bleed valve may be openable by a pressure differential across the valve (i.e., opening in response to a drop in pressure within the curler head 102). In some examples, the bleed valve is selectively openable in response to a user command, such as a command to reduce the heat of the air by letting in air that bypasses part or all of a heating member or a command to reduce the curling force by letting out air thereby reducing the flow through the curler outlets 150. Any suitable valve may be used, such as a valve that selectively closes an inlet or outlet duct or port directly or which selectively closes off a portion of an air flow path. The bleed valve may govern one inlet and/or outlet or may govern more than one inlet and/or more than one outlet.

[0220] Referring to Figures 14-18, the exemplary curler head 102 includes a bleed air inlet 300 downstream of the head inlet 132 and upstream of the curler outlets 150 selectively closed by a bleed valve 301. In use, the head inlet 132 is open to a blower 182 moving heated air, and the exemplary bleed air inlet 300 forms an air inlet that bypasses the heating element in the blower.

[0221] The exemplary bleed air outlets 302 of Figures 14-18 open from a common air flow branch with the curler outlets and are also selectively closed by bleed valves 301. In some examples, the bleed air outlet is one or more of the secondary outlets if the secondary air outlets 294 are openable while the curler outlets are open and from a common air flow branch with the curler outlets 150 (i.e., in addition to being openable while the curler outlets are closed to function as secondary air outlets). Referring to Figures 14-18, in the exemplary embodiment the secondary outlets 294 and the curler outlets 150 do not open from a common air flow branch, and the curler head 102 includes bleed air outlets 302 separate from the secondary outlets 294. A curler head may also or alternatively include separate bleed air outlets 302 if the head does not include secondary outlets 294 or if the secondary outlets 294 do open from the same air flow branch as the curler outlets 150 but are not openable while the curler outlets 150 are open.

[0222] A curler head 102 may have both a bleed air outlet and a bleed air inlet. A curler head 102 may have both a bleed air inlet and a bleed air outlet operable (e.g., sequentially operable) by a single toggle (e.g., a button). For example, a button or switch may be pushed part way of a full stroke for the bleed air inlet and all the way for the bleed air outlet or pushed once for the bleed air inlet and pushed again for the bleed air outlet.

Venturi with Air Inlets Drawing from the Inlet End

[0223] The following is a description of a curler head with a venturi into which air inlets open. The air inlets extend from an exterior of the curler head. The air inlets may open from a location in the sidewall of the curler head at the inlet end to draw air in toward the curler head. In use, drawing air in towards the sidewall of the curler head at the inlet end draws hair down against the curler head at the inlet end. This inhibits movement of hair past the inlet end, e.g., onto an integrated handle or onto a blower to which the curler head is attached.

[0224] The venturi may be at the inlet end, in which case the air inlets may be apertures in the sidewall forming the venturi. Alternately or in addition, it will be appreciated that the air inlets may include ducts extending from inlet ports at the inlet end to a location elsewhere along the curler head. In some examples, an inlet end venturi is in a segment 280 of the curler head at the inlet end 112 that includes a venturi with one or more inlets through a sidewall of the curler head opening into the venturi to draw air in through the sidewall of the curler head 102. Drawing air in through the sidewall of the curler head 102 at the inlet end 112 encourages hair to remain on the curler head 112, e.g., rather than moving past the end 112 onto an integrated handle or onto the body of a blower to which the head 102 is attached.

[0225] Referring to Figures 111-117, the exemplary head 102 includes a segment 280 at the inlet end 112 which includes a venturi 340. The venturi 340 may be formed in any suitable way. The exemplary venturi 340 of Figures 111-117 is formed by a gradual reduction and then increase in the diameter of the head air flow path 130. A gradual change in transverse air flow area may reduce turbulence within the air flow path in use. However, it will be appreciated that the venturi 340 may also or alternatively be formed using non-gradual changes in transverse air flow area, such as one or more stepwise reductions in the transverse air flow area followed by one or more stepwise increases in the transverse air flow area.

[0226] Inlets 300 open into the venturi 340. The venturi 340 is in the inlet end segment 280 (i.e., the segment nearest to the inlet end 112) such that, in use, the air flow drawn in through inlets 300 draws hair that is near the inlet end 112 down against the curler head 102, e.g., to inhibit the movement of the hair past the inlet end 112. Any suitable inlet shape may be used. The exemplary inlets 300 of Figures 111-117 are arranged in annular rings of discrete inlets 300 of generally constant size. The exemplary inlets 300 of Figures 111-117 are each rectangular with generally equal longitudinal and angular extents. However, the inlets 300 may be, e.g., slot-shaped or circular. The exemplary inlets 300 of Figures 111-117 are each simple apertures in the sidewall of the segment 280. However, the inlets 300 may include a duct extending between an outside end and an inside end, and the duct may have, e.g., one or more bends. It will be appreciated that the inlets 300 may also function as bleed air inlets, and are optionally selectively closeable.

[0227] In operation, air flowing axially through the core of the curler head (e.g., induced by a fan and motor assembly) draws air through the apertures in the side-

wall, which combines with air flowing through the air flow passage in the core of the curler head.

Axially Extending Surface Dimples

[0228] The following is a description of a curler head with axially extending surface dimples on the surface of the curler head (e.g., axially extending curved segments of the outer wall of a curler head). Accordingly, in accordance with his aspect, the dimples define axially extending lobes. Any curler outlet 150 may be used.

[0229] Accordingly, the curler head may include a plurality of parallel air flow branches. The plurality of air flow branches may be angularly adjacent or may be angularly spaced apart. The plurality of air flow branches may be formed by angularly adjacent longitudinally extending tubes. These tubes or conduits may be individually formed conduits that are secured together or they may be integrally formed.

[0230] Referring to Figures 10-18, the exemplary curler head 102 includes axially extending dimples 310 generally parallel to one another. The exemplary axially extending dimples 312 extend generally parallel to the longitudinal axis.

[0231] Referring to Figures 10-18, the exemplary curler head 102 includes a bundle of axially extending tubes 312 extending generally parallel to one another. The exemplary tubes each form an air flow branch between the head inlet 132 and outlets 134. In some examples, the dimples 310 are formed by abutting tubes of the bundle of tubes 312 although it will be appreciated that axially extending dimples 310 may be formed by raised portions of a single tube.

[0232] The outlets provided in the dimples may be curler outlets 150 and/or secondary air outlets 294. Curler outlets 150 are optionally provided in the axially extending dimples to direct air on an exit vector that includes a tangential component 154. The curler outlets 150 may consist of the outlet port 136 opening through the body sidewall, such as when the port opens through a generally radially extending portion of the sidewall formed by the lateral sides of the dimple.

First End Free of Curler Outlets

[0233] The following is a description of a curler head with a first end 112 having a non-curler segment 280b (e.g., a closed segment 222) that is free of curler outlets. In accordance with this aspect, the outlets 134 are provided axially spaced from the head air inlet 132 of the curler head 102.

[0234] The portion of the curler head at the first end 112 has a closed (air impermeable) body sidewall 120 extending from the first end 112 for an axial extent. The axial extent may be at least 10%, at least 20%, or at least 30% of the total axial extent of the curler head. The head air inlet 132 is in the first end 112, and the air flow path 130 extends from the inlet 132 through the closed end portion of the sidewall.

[0235] Referring to Figures 14-18, the exemplary curler head 102 includes a closed end portion 222 free of curler outlets 150. A closed end portion 222 may provide space for additional components axially spaced form the curler outlets 150, such as a heating element, an air moving member, and/or a valve assembly. The exemplary closed end portion 222 of Figures 14-18 includes a selectively openable bleed air inlet 300. A closed end portion provides a space within the curler head in which the curler outlets do not need to be accommodated.

Supplementary Second End Heating

[0236] The following is a description of providing supplementary heating at the head second end 114. Supplementary heating of the second end is used to provide a more uniform heating along the length of the curler head 102. In examples in which the curler head 102 is used with a blower 182 providing heated air, the heated air enters the curler head at the head first end 112 and subsequently travel towards the second end 114 along the air flow path 130. As the air travels to the head second end 114, energy is transferred to the walls of the curler head 102 and lost to the external environment. As a result, energy carried by the air entering the curler head 102 heats the head first end 112 more than the head second end 114.

[0237] Supplementary second end heating includes using a heating member 191 (e.g., a powered heating element 190 to heat air or a portion of the curler head itself and/or an infrared emission source in conjunction with an infrared absorption member 370) at the head second end 114. As discussed elsewhere herein, the heating member 191 may be provided in the air flow path to heat the air, may be provided in conductive thermal communication with hair wrapped against the head 102, and/or arranged to direct infrared energy directly to hair that is wrapped against the curler head.

[0238] It will be appreciated that the heating member may be positioned to heat air flowing through the internal air flow path in the curler head or it may be positioned to conductively heat part of the curler head itself.

[0239] It will be appreciated that the supplemental heating member 191 may be located only at the second end 114 or may be provided axially inwardly thereof. For example, the supplemental heating member 191 may be positioned and operable to provide additional heat downstream from inlet 132 such that a uniform or more uniform temperature is provided by the curler head along the axial length of the curler head with curler air outlets 150. Accordingly, the air exiting the curler outlets along the length of the curler head may be uniform or generally uniform (e.g., $\pm$ 5, 10, 15°C).

[0240] Referring to Figures 85 to 90, in the exemplary embodiment the curler head 102 includes a powered heating element 190 which generates infrared radiation. The exemplary heating element of Figures 85 to 90 is arranged to direct infrared radiation to the infrared ab-

sorption members 370 arranged along length of the curler head 102.

[0241] The exemplary infrared absorption members 370 of Figures 85 to 90 include iron and/or carbon, and form an outer surface of the head 102 (e.g., form the land portions 160) in conductive thermal communication with hair wrapped around the head 102.

[0242] The exemplary infrared emission source 190 of Figures 85 to 90 is at the head second end 114. In some examples, an infrared emission source 190 for supplementary second end heating is provided within the last 25% of the length of the curler head 102, within the last 20% of the length of the curler head 102, or within the last 10% of the length of the curler head. Providing the infrared emission source 190 at the second end 114 concentrates the heat energy that is generated by the emission source 190 at the second end 114 since the emission source 190 will provide more energy to the closer absorption members 370 (i.e., the absorption members 370 which are closer to the second end 114). It will be appreciated that additionally, or alternatively, the infrared absorption members 370 may be provided only at the second end 114.

Air Moving Member Within the Curler Head

[0243] The following is a description of a curler head 102 that includes one or more air moving members 180. Including an air moving member in the curler head 102 may allow for more control over the air flow (e.g., volume or speed) to allow the air flow to be optimized for the curler head. A curler head 102 that includes an air moving member may be independent of a blower, and may form a standalone curler apparatus 100.

[0244] The air moving member may be radially underlying one or more curler outlets 150 or may be provided within a closed segment 222 of the body sidewall 120 in which no curler outlets are provided. Referring to Figure 75, the exemplary curler head includes an air moving member 180 and is useable independently from a blower.

[0245] It will be appreciated that the air moving member may be supplemental to an air moving member in the blower and may be used concurrently therewith for part or all of the time the curler head is used. For example, the air moving member may be actuated when a higher flow rate is desired.

Heating Member in the Curler Head

[0246] The following is a description of a curler head 102 that includes a heating member 191.

[0247] In accordance with this aspect, the heating member may be positioned to heat air flowing through the internal air flow path in the curler head or it may be positioned to conductively heat part of the curler head itself. Accordingly, the heating member 191 may be a powered heating element 190 to heat air or a portion of the curler head itself and/or an infrared emission source in conjunction with an infrared absorption member 370.

[0248] Referring to Figures 85 to 90, the exemplary heating element 190 is an infrared heating element. The exemplary infrared heating element 190 of Figures 85 to 90 includes a radiative element 372 (e.g., a resistive filament) encased in a housing 374. The housing 374 is transparent to infrared radiation (i.e., includes at least one window formed of a material that is transparent to infrared radiation). In some examples, the housing 374 is formed of infrared-transparent aluminum.

[0249] An infrared emission source 190 of the curler head 102 may be used to heat hair directly (e.g., hair that is positioned against the head 102 by the air flow) and/or used to heat one or more infrared absorption members 370 of the curler head 102. All or parts of the curler head 102 may be lined with an infrared absorption material (e.g., iron and/or carbon) forming one or more infrared absorption members 370. Infrared absorption member(s) 370 may line an inside and/or outside surface of the curler head 102. The exemplary curler head 102 of Figures 85 to 90 is lined with infrared absorption members 370 forming the land portions 160.

[0250] Any suitable infrared absorption member 370 may be used. The infrared absorption member 370 may be a layer of infrared absorption material forming an exterior surface of the curler head 102 or covered by an insulating layer (e.g., plastic) to reduce the likelihood of contact burns.

[0251] An infrared absorption member 370 may be formed in the curler head 102 any suitable way. In some examples, an infrared absorption member 370 is assembled with a main body of the curler head 102. In some examples, an infrared absorption member 370 is formed by vapour deposition, such as vapour deposition of thermally conductive plastic (e.g., wherein an infrared absorbing material such as iron is in the plastic) or by applying a layer of infrared absorption material, such as carbon, by spray deposition.

[0252] An infrared heating element 190 may extend along all or part of the length of the curler head 102. As exemplified in Figures 85 to 90, the infrared heating element 190 may be provided at the head second end 114.

Direct Hair Heating

[0253] The following is a description of a curler head that heats hair directly to reduce the amount of heat energy that is carried away by the air that is used to position the hair.

[0254] In accordance with this aspect, the curler head includes a heated hair receiving surface of the curler head 102. The heated hair receiving surface is heated by a heating element 190 of the curler head 102 and/or a heating element 190 of a cooperating blower 182. In some examples, the heated hair receiving surface is separated from the air flow path 130 to inhibit the transfer of heat from the heated hair-receiving surface to the air

flow. The heated hair receiving surface may be separated from the air flow path 130 by an underlying insulative layer.

[0255] Providing a heated hair receiving surface allows heat energy to be transferred directly to the hair received on the surface via conductive transfer. This results in a reduced loss of energy to the ambient environment, allowing the curler 100 to use less energy to effectively raise the temperature of hair than if the heat energy is carried by the air. Separating the heated surface from the air flow reduces the amount of heat that is carried away from the curler head 102 by the air flow. Accordingly, the air flow may be used primarily or solely to position the hair around the curler without substantially heating the hair. Heat may be provided by the heated surface, via conductive transfer and/or infrared radiation of the hair positioned against the surface.

[0256] The heated surface may be heated in any suitable way. The curler head 102 may include a heating element 190 that is an infrared emission source directing infrared energy at an absorption member 370 that forms the surface or is in conductive thermal communication with the surface. Alternatively, or additional, the curler head 102 may include a heating element 190 that forms the surface itself or is itself in conductive thermal communication with the surface. Referring to Figures 92 to 96, the exemplary curler head 102 includes a plurality of powered heating elements 190. The exemplary heating elements 190 of Figures 92 to 96 are flat heating elements (e.g., thin film heating elements) forming the land portions 160 and optionally the radially outer surface of the curler outlet 150 closest to the first end 112, for direct conductive heat transfer to hair arranged against these surfaces.

[0257] Referring to Figures 92 to 96, the exemplary heating members 191 form heated surfaces 380. The heated surfaces 380 are separated from the air flow path 130. Separating the heated surfaces 380 from the air flow path reduces the transfer of heat energy to air, which heat energy may be largely lost to the ambient environment.

[0258] The heated surfaces 380 are separated from the air flow path 130 by an insulating layer 382. The insulating layer 382 underlies the heated surfaces 380 to inhibit thermal transfer from the heated surfaces 380 to the air in the air flow path 130. The insulating layer 382 may be formed of any suitable material, such as a thermoplastic. Referring to Figures 92 to 96, the exemplary insulating layer 382 underlies the heated surface and the heated surfaces 380 extend across the land portions 160 outside the curler outlets 150.

Induction Charging

[0259] The following is a description of an induction charged curler head 102. The curler head includes an on-board energy storage member 200, and the on-board energy storage member 200 is charged through wireless charging via electromagnetic induction.

[0260] Referring to Figure 77, the exemplary curler head 102 includes a receiver 320 (e.g., a receiver coil) that cooperates with a charging stand 322 to receive power. The charging stand is operable to create a magnetic field (e.g., via a coil in the stand) at the receiver 320 of the curler head to generate an electrical current in the receiver 320. The exemplary curler head is oriented with the longitudinal axis generally vertical when charging. The charging stand 322 includes a base 324 and a cradle 326 arranged relative to the base 324 to hold the curler head with the longitudinal axis generally vertical. In some examples, an end of the curler head is received into a recess 328 in an induction charging stand. The receiver 320 may be in the end that is received into the recess 328. The recess 328 may be encircled by a transmitting portion of the charging stand.

[0261] In some examples, a part 330 of the induction charging stand is received into a recess 332 in an end of the curler head 102. The part 330 may include a transmission portion of the charging stand. The recess 332 may be encircled by the receiver 320.

[0262] It will be appreciated that any induction charging member may be used and it may be of any configuration that may inductively change the curler head.

Manufacturing Method

[0263] The following is a description of a method of manufacturing the curler head 102.

[0264] In accordance with this aspect, the curler head 102 may be formed by manufacturing a main tube and a set of rings separately and then arranging the rings on the main tube by sliding the rings axially onto the tube.

[0265] Referring to Figure 77 and Figures 78 to 84, the curler head 102 may be formed by a manufacturing method 350. Method 350 includes forming a main tube 352 at step 354, such as by forming an aluminum tube from a sheet of aluminum or molding a plastic tube. In use, the main tube 352 may function as a framework to which further portions of the curler head 102 are secured.

[0266] The main tube 352 includes apertures 353 therethrough. The apertures 353 are provided to allow air to flow through the main tube 352 and out curler outlets 150 of the curler head 102. The apertures 353 may form inlet ports 140 of the curler outlets 150. Referring particularly to Figure 84, the exemplary tube 352 includes apertures 353 at regular intervals along the length of the tube 352.

[0267] The apertures are formed in the wall of the main tube 352 by any suitable method. In some examples, the apertures 353 are formed by molding the tube with apertures 353 formed therein, such as if the tube is injection molded or 3D printed plastic. In some examples, the apertures 353 are formed by cutting portions of the tube sidewall away, such as if the tube is formed of a rolled piece of metal (e.g., aluminum).

[0268] The method 350 includes at step 356 forming one or more rings 358. The exemplary rings 358 of

Figures 78 to 84 include vanes 142 and outer walls 260. Alternately or in addition, vanes 142 may be provided on the main tube 352. As exemplified in Figure 81, the curler head 102 may include different types of rings 358a, 358b, such as to form different types of outlets or different types of curler outlets 150. The rings 358 may be plastic and may be formed by, e.g., injection molding or 3D printing. The rings 358 may include infrared absorption members 370. At step 360, the rings 358 are slid onto the tube over the inlet ports 140 to complete the ducts 138.

[0269] The rings 358 may be secured to the main tube 352 in any suitable way. In some examples, the rings 358 are fastened using fasteners. For example, the rings may be snaped into place on the main tube 352 using snap-fit fasteners on the rings 358 and/or tube 352, the rings may be held by cooperating magnetic fasteners on the rings 358 and the tube 352, or the rings may be secured by separate fasteners such as threaded fasteners. Alternatively, or additionally, the rings 358 may be bonded to the tube 352 such as by adhesive or welding. Referring to Figure 77, the exemplary method 350 includes, at step 362, heating the curler head to set the rings onto the tube (e.g., to melt the plastic of the rings to meld the rings to the plastic or metal tube).

Abutting Segments

[0270] The following is a description of a curler head 280 in which outlets 150 are formed of a single unitary wall body, which adjacent wall bodies abutting one another longitudinally to form the outer wall 260 of the curler head. Adjacent wall bodies may abut without overlapping.

[0271] Referring to Figures 97 to 103, particularly Figure 100, the exemplary curler head 102 includes a main tube 352 and a plurality of rings 358 mounted to the tube. The rings 352 are formed of a single unitary body, and form one or more curler outlets 150 opening through the body. Adjacent rings 352 abut one another at seams 390. In use, the curler head 102 may be assembled by molding the tube 352, molding the rings 358, sliding the rings 358 onto the tube 352, and securing the rings 358 to the tube 352 and/or to adjacent rings 358.

[0272] The rings 358 may be secured to the tube 352 and/or to adjacent rings 358 in any suitable way, such as by fasteners, welding, or adhesive. In the exemplary embodiment of Figures 97 to 103, rings 352 are secured to the tube 352 and to adjacent rings 358 by welding an inner surface of the ring 352 to the tube 352 and welding a longitudinal end of the ring 352 to an adjacent ring 352 across seam 390. Welding may be accomplished, e.g., by heating the curler head to set the rings onto the tube (e.g., to melt the plastic of the rings to meld the rings to the plastic or metal tube).

User Interface

[0273] The following is a description of user interface 204. The hair curling apparatus 100 may include one or more user interfaces 204 to control one or more operations of the hair curling apparatus 100.

[0274] The user interface 204 may include at least an on/off actuator to control whether the air moving member 180 is on or off. In some examples, the user interface 204 also includes further controls, such as controls to set a rotation speed of the air moving member and/or to turn the heating element on and off and/or set a temperature of the heating element and/or to shift, open, or close a valve.

[0275] It will be appreciated that the actuator may be any suitable user interface such as a on/off toggle, a pressable button, a display screen, a touchscreen, a slidable switch or the like.

[0276] Referring to Figures 14-18 and 20-24, the exemplary user interface 204 includes a valve toggle 206 to control the position of a valve 208.

[0277] In some examples, the hair curling apparatus 100 includes a blower user interface 204 on the blower 182 and a head user interface 204 on the curler head 102. The user interface 204 may include a simple circuit to control a controllable element of the hair curling apparatus 100 or may include one or more computer processors and/or data storage systems storing instructions (e.g., to allow user to select between pre-programmed modes of operation). In some examples, the user interface 204 includes a user operable (i.e., manual) or powered actuator that is drivingly connected to an actuatable member, such as to a valve.

Accessory

[0278] As exemplified in Figure 19, in some examples the curler apparatus 100 includes one or more attachments 212. The attachment 212 may be a sprayer with a nozzle 214 directed towards hair receiving surfaces of the curler head 102. The sprayer may spray hair with a fluid, such as water. Damp hair may set more easily than dry hair. The sprayer may include a reservoir 216 in fluid communication with the nozzle 214 and a pump 218 operable to selectively move the fluid from the reservoir to the nozzle.

[0279] As used herein, the wording "and/or" is intended to represent an inclusive - or. That is, "X and/or Y" is intended to mean X or Y or both, for example. As a further example, "X, Y, and/or Z" is intended to mean X or Y or Z or any combination thereof.

[0280] While the above description describes features of example embodiments, it will be appreciated that some features and/or functions of the described embodiments are susceptible to modification without departing from the spirit and principles of operation of the described embodiments. For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other. Accordingly, what has been described above is intended to be illustrative of the claimed concept and non-

limiting. It will be understood by persons skilled in the art that other variants and modifications may be made without departing from the scope of the invention as defined in the claims appended hereto. The scope of the claims should not be limited by the preferred embodiments and examples, but should be given the broadest interpretation consistent with the description as a whole.

Clauses

Clause Set A

[0281]

1. A hair curler having an inlet end having an air inlet, a longitudinally spaced apart second end, a longitudinal axis and a plurality of axially spaced apart air outlets, wherein some of the air outlets direct air clockwise and other air outlets direct air counterclockwise.
2. The hair curler of clause 1 further comprising a valve operable to selectively direct air to the air outlets that direct air clockwise and the air outlets that direct air counterclockwise.
3. The hair curler of clause 1 wherein the air outlets comprise a plurality of sets of air outlets, each set of air outlets comprises a plurality of air outlets that are angularly positioned around the longitudinal axis.
4. The hair curler of clause 3 wherein the plurality of sets of air outlets comprises a first set of air outlets and a second set of air outlets, the first set of air outlets direct air clockwise and the second set of air outlets direct air counterclockwise.
5. The hair curler of clause 4 further comprising a valve operable to selectively direct air to the first set of air outlets that direct air clockwise and the second set of air outlets that direct air counterclockwise.
6. The hair curler of clause 3 wherein the plurality of sets of air outlets comprises a first set of air outlets and a second set of air outlets and a land portion is located between the first set of air outlets and the second set of air outlets.
7. The hair curler of clause 6 wherein the land portion is air impermeable.
8. The hair curler of clause 1 wherein the air outlets have a radial outer side that is located radially outwardly of the land portion at a location of the air outlets.
9. The hair curler of clause 1 wherein the land portion is positioned between adjacent air outlets.
10. The hair curler of clause 1 wherein the air outlets direct air generally along an outer surface of the hair curler whereby air which exist the air outlets travels along the outer surface.
11. The hair curler of clause 1 wherein each air outlet comprises an outlet duct that extends from an inlet port to an outlet port, the outlet port has a radial outer side that is located radially outwardly of the land portion at a location of the outlet port.
12. The hair curler of clause 1 wherein each air outlet comprises an outlet duct that extends from an inlet port to an outlet port, the air flow path incudes a passage interior the air curler and the inlet ports air located in the passage.
13. The hair curler of clause 12 wherein the passage has a radial outer wall and the inlet ports have a radial inner side that are located radially inwardly of the radial outer wall.
14. The hair curler of clause 1 wherein the air outlets comprise a plurality of sets of air outlets, each set of air outlets comprises a plurality of air outlets that are angularly positioned around the longitudinal axis, the plurality of sets of air outlets comprises a first set of air outlets and a second set of air outlets, each air outlet comprises an outlet duct that extends from an inlet port to an outlet port and an outlet port of the first set of air outlets is axially aligned with an outlet port of the second set of air outlets and an outlet port of the third set of air outlets.
15. The hair curler of clause 1 wherein the air outlets comprise a plurality of sets of air outlets, each set of air outlets comprises a plurality of air outlets that are angularly positioned around the longitudinal axis, the plurality of sets of air outlets comprises a first set of air outlets, a second set of air outlets and a third set of air outlets, each air outlet comprises an outlet duct that extends from an inlet port to an outlet port and the first, second and third sets of air outlets define a plurality of axially extending rows of outlet ports that are axially aligned.
16. The hair curler of clause 1 wherein the air outlets comprise a plurality of sets of air outlets, each set of air outlets comprises a plurality of air outlets that are angularly positioned around the longitudinal axis, the plurality of sets of air outlets comprises a first set of air outlets, a second set of air outlets and a third set of air outlets, each air outlet comprises an outlet duct that extends from an inlet port to an outlet port and the first, second and third sets of air outlets define a plurality of axially extending rows of outlet ports wherein, for each row of outlet ports, the outlet ports are angularly positioned around the longitudinal axis.
17. The hair curler of clause 1 wherein the air outlets comprise a plurality of sets of air outlets, each set of air outlets comprises a plurality of air outlets that are angularly positioned around the longitudinal axis, the plurality of sets of air outlets comprises a first set of air outlets, a second set of air outlets and a third set of air outlets, each air outlet comprises an outlet duct that extends from an inlet port to an outlet port wherein, for each row of outlet ports, the outlet port of the second set of outlet ports is angularly positioned around the longitudinal axis from the outlet port of the first set of outlet ports and the outlet port of the third set of outlet ports is angularly positioned around

the longitudinal axis from the outlet port of the second set of outlet ports.

Clause Set B

[0282]

1. A hair curler having an inlet end having an air inlet, a longitudinally spaced apart second end, a longitudinal axis, a plurality of curling air outlets, a diffuser air outlet and a valve operable between a first position in which the curling air outlets are in fluid flow communication with the air inlet and a second position in which the diffuser air outlet is in fluid flow communication with the air inlet.
2. The hair curler of clause 1 wherein the hair curler comprises a body extending between the inlet end and the second end, the curler air outlets are provided along a longitudinal extent of the body and the diffuser air outlet is provided at the second end.
3. The hair curler of clause 1 further comprising a removably attachable diffuser attachment, and the diffuser attachment is provided with the diffuser air outlet.
4. The hair curler of clause 3 wherein the diffuser attachment is provided at the second end.
5. The hair curler of clause 1 further comprising a user operable actuator that is drivingly connected to the valve.
6. The hair curler of clause 1 wherein the curling air outlets comprise a plurality of sets of curling air outlets, each set of curling air outlets comprises a plurality of curling air outlets that are angularly positioned around the longitudinal axis.
7. The hair curler of clause 6 wherein the plurality of sets of air curling outlets comprises a first set of curling air outlets and a second set of curling air outlets, the first set of curling air outlets direct air clockwise and the second set of air outlets direct air counterclockwise.
8. The hair curler of clause 7 further comprising a valve operable to selectively direct air to the first set of curling air outlets that direct air clockwise and the second set of curling air outlets that direct air counterclockwise.
9. The hair curler of clause 6 wherein the plurality of sets of curling air outlets comprises a first set of curling air outlets and a second set of curling air outlets and a land portion is located between the first set of air outlets and the second set of air outlets.
10. The hair curler of clause 9 wherein the land portion is air impermeable.
11. The hair curler of clause 1 wherein the curler comprises a curling air axially extending passage that is provided upstream of the curling air outlets and downstream of the valve, and a diffuser air axially extending passage that is provided upstream of the diffuser air outlet and downstream of the valve.
12. The hair curler of clause 11 wherein the diffuser air axially extending passage is provided internal of the curling air axially extending passage.
13. The hair curler of clause 11 wherein each curling air outlet comprises an outlet duct that extends from an inlet port to an outlet port, the outlet port has a radial outer side that is located radially outwardly of an air impermeable land portion at a location of the outlet port.
14. The hair curler of clause 13 wherein the inlet ports are located in the curling air axially extending passage.
15. The hair curler of clause 14 wherein the curling air axially extending passage has a radial outer wall and the inlet ports have a radial inner side that are located radially inwardly of the radial outer wall.
16. The hair curler of clause 1 wherein the curling air outlets comprise a plurality of axially spaced apart outlet ports and a land portion is located between adjacent outlet ports.
17. The hair curler of clause 13 wherein the land portion is air impermeable.
18. The hair curler of clause 11 further comprising a bleed valve in the curling air axially extending passage.
19. The hair curler of clause 11 further comprising a pressure relief valve in the curling air axially extending passage.
20. The hair curler of clause 19 further comprising a bleed valve in the curling air axially extending passage.

Clause Set C

[0283]

1. A hair curler having an inlet end having an air inlet, a longitudinally spaced apart second end, a bleed valve and an air flow passage from the air inlet to an air outlet.
2. The hair curler of clause 1 wherein the bleed valve is operable during a curling operation whereby ambient air is introduced into the air flow passage whereby a temperature of air exiting the air outlet is reduced when the bleed valve is opened.
3. The hair curler of clause 1 wherein the bleed valve is operable at an end of a curling operation whereby ambient air is introduced into the airflow passage whereby a curling force produced by the air outlet is reduced.
4. The hair curler of clause 1 wherein the bleed valve is located at the inlet end of the hair curler.
5. The hair curler of clause 1 wherein the bleed valve is located internal of the hair curler and is longitudinally located between the inlet end and the air outlet.
6. The hair curler of clause 1 wherein the air outlet comprises a first annular band of curler air outlets comprising a plurality of outlet ducts, each outlet duct

extends from an inlet port to an outlet port, wherein the outlet ports are angularly positioned around the hair curler.

7. The hair curler of clause 6 wherein air exiting the outlet ducts exits at an angle of 10° to 30° from a plane transverse a longitudinal axis of the hair curler.

8. The hair curler of clause 6 wherein air exiting the outlet ducts exits at an angle of 15 to 25° or 17 to 23° from a plane transverse a longitudinal axis of the hair curler.

9. The hair curler of clause 1 wherein the second end is closed.

10. The hair curler of clause 8 wherein the second end is openable.

11. The hair curler of clause 6 wherein a land portion extends away from the first annular band of curler air outlets and a longitudinal length of the land portion is about twice the longitudinal length of the first annular band of curler air outlets or more.

12. The hair curler of clause 6 wherein a land portion extends away from the first annular band of curler air outlets and, the outlet ports are located radially outwardly of an outer surface of the land portion.

13. The hair curler of clause 6 wherein a diameter of the first annular band of curler air outlets is greater than a diameter of the land portion at a location of the first annular band of curler air outlet.

14. The hair curler of clause 6 further comprising a second annular band of curler air outlets that is longitudinally spaced from the first annular band of curler air outlet, a land portion is positioned between the first annular band of curler air outlets and the second annular band of curler air outlet, wherein each of the first and second annular band of curler air outlets comprises a plurality of outlet ducts, the outlet ducts of the first annular band of curler air outlets produce a first Coanda air stream and outlet ducts of the second annular band of curler air outlets produce a second Coanda air stream.

15. The hair curler of clause 6 wherein a land portion extends away from the first annular band of curler air outlet, the land portion has a first portion that extends longitudinally outwardly from the first annular band of curler air outlets towards the second end of the hair curler and a second portion that extends longitudinally inwardly from the second annular band of curler air outlets towards the air inlet, the first Coanda air stream rotates around the first portion of the land portion and the second Coanda air stream rotates around the second portion of the land portion.

16. The hair curler of clause 1 wherein the air outlet comprises a plurality of outlet ducts and at least some of the outlet ducts have an upstream expansion zone and a downstream compression zone.

17. The hair curler of clause 1 wherein the air outlet comprises a plurality of outlet ducts and at least some of the outlet ducts have a smaller cross-sectional area in a direction of flow through the outlet port than a cross sectional area in a direction of flow through a respective inlet port.

18. The hair curler of clause 6 wherein a land portion extends away from the first annular band of curler air outlets and the land portion comprises metal.

19. The hair curler of clause 18 wherein the land portion is made of metal, a metal filled plastic or has an inner or outer surface that is coated with metal.

20. The hair curler of clause 6 wherein a first set of outlet ports of the outlet ducts of the first annular band of curler air outlets are provided on a first side of the first annular band of curler air outlets that faces longitudinally inwardly towards the air inlet of the hair curler and a second set of outlet ports of the outlet ducts of the first annular band of curler air outlets are provided on a second side of the first annular band of curler air outlets that faces longitudinally outwardly towards the second end of the hair curler.

21. The hair curler of clause 6 wherein a land portion extends away from the first annular band of curler air outlets and the land portion is smooth.

22. The hair curler of clause 6 wherein a land portion extends away from the first annular band of curler air outlets and the land portion is textured.

23. The hair curler of clause 22 wherein the land portion has a dimpled surface.

24. The hair curler of clause 22 wherein the land portion has ribs that extend generally perpendicular to a direction of air exiting the outlet ports.

25. The hair curler of clause 22 wherein the outlets ducts comprise angularly spaced apart vanes and the land portion has ribs that extend generally perpendicular to the vanes.

26. The hair curler of clause 1 wherein a land portion extends away from the first annular band of curler air outlets and the land portion has unidirectional mechanical hair engaging members which engage hair when hair rotates around the land portion in a first direction and which enable hair to rotate around the land portion in a second direction that is opposite to the first direction.

27. The hair curler of clause 1 wherein the hair curler is removably attachable to a hair dryer.

28. The hair curler of clause 1 further comprising a heating element provided internal of the hair curler.

29. The hair curler of clause 6 wherein a land portion extends away from the first annular band of curler air outlets and the land portion is air impermeable.

30. The hair curler of clause 6 wherein the first annular band of curler air outlets comprises a raised ring that extends around the longitudinal axis.

31. The hair curler of clause 1 wherein the bleed valve comprises a venturi.

Clause Set D

[0284]

1. A hair curler having an inlet end, a longitudinally spaced apart second end and a longitudinal axis, the inlet end having an air inlet, the hair curler comprising:

(a) a first annular band of curler air outlets comprising a plurality of first outlet ducts, each first outlet duct extends from an inlet port to an outlet port, the first annular band of curler air outlets is located a first distance from the inlet end, the first outlet ports are angularly positioned around the longitudinal axis;

(b) a second annular band of curler air outlets comprising a plurality of second outlet ducts, each second outlet duct extends from an inlet port to an outlet port, the second annular band of curler air outlets is located a second distance from the inlet end, the second outlet ports are angularly positioned around the longitudinal axis, wherein the second distance is greater than the first distance;

(c) an air flow passage from the air inlet to the first and second annular band of curler air outlets; and,

(d) an air impermeable land portion extending between the first annular band of curler air outlets and the second annular band of curler air outlet, wherein the land portion has a longitudinal length that is greater than a longitudinal length of the first annular band of curler air outlet.

2. The hair curler of clause 1 wherein the second end is closed.

3. The hair curler of clause 1 wherein the second end is openable.

4. The hair curler of clause 1 wherein the longitudinal length of the land portion is about twice the longitudinal length of the first annular band of curler air outlets or more.

5. The hair curler of clause 1 wherein each of the first outlet ducts extends from an inlet port, which is in air flow communication with the air inlet, and an outlet port wherein the outlet ports are located radially outwardly of an outer surface of the land portion.

6. The hair curler of clause 1 wherein a diameter of the first annular band of curler air outlets is greater than a diameter of the land portion at a location of the first annular band of curler air outlet.

7. The hair curler of clause 1 wherein the first outlet ducts produce a first Coanda air stream and the second outlet ducts produce a second Coanda air stream.

8. The hair curler of clause 7 wherein the land portion has a first portion that extends longitudinally outwardly from the first annular band of curler air outlets towards the second end of the hair curler and a second portion that extends longitudinally inwardly from the second annular band of curler air outlets towards the air inlet, the first Coanda air stream rotates around the first portion of the land portion and the second Coanda air stream rotates around the second portion of the land portion.

9. The hair curler of clause 7 wherein air exiting each of the first and second outlet ducts exits at an angle of 10° to 30° from a plane transverse a longitudinal axis of the hair curler.

10. The hair curler of clause 7 wherein air exiting each of the first and second outlet ducts exits at an angle of 15 to 25° or 17 to 23° from a plane transverse a longitudinal axis of the hair curler.

11. The hair curler of clause 1 wherein at least some of the first and second outlet ducts have an upstream expansion zone and a downstream compression zone.

12. The hair curler of clause 1 wherein at least some of the first and second outlet ducts have a smaller cross-sectional area in a direction of flow through the outlet port than a cross-sectional area in a direction of flow through a respective inlet port.

13. The hair curler of clause 1 wherein the land portion comprises metal.

14. The hair curler of clause 13 wherein the land portion is made of metal, a metal filled plastic or has an inner or outer surface that is coated with metal.

15. The hair curler of clause 1 wherein a first set of the outlet ports of the second outlet ducts of the second annular band of curler air outlets are provided on a first side of the second annular band of curler air outlets that faces longitudinally inwardly towards the air inlet of the hair curler and a second set of the outlet ports of the second outlet ducts of the second annular band of curler air outlets are provided on a second side of the second annular band of curler air outlets that faces longitudinally outwardly towards the second end of the hair curler.

16. The hair curler of clause 1 further comprising a bleed valve.

17. The hair curler of clause 16 wherein the bleed valve is operable during a curling operation whereby ambient air is introduced into the air flow passage whereby a temperature of air exiting the outlet ports is reduced when the bleed valve is opened.

18. The hair curler of clause 16 wherein the bleed valve is operable at an end of a curling operation whereby ambient air is introduced into the airflow passage whereby a curling force produced by the outlet ducts is reduced.

19. The hair curler of clause 16 wherein the bleed valve is located at the first end of the hair curler.

20. The hair curler of clause 16 wherein the bleed valve is located internal of the hair curler and is longitudinally located between the inlet end and the first annular band of curler air outlet.

21. The hair curler of clause 1 wherein the land portion is smooth.

22. The hair curler of clause 1 wherein the land

portion is textured.

23. The hair curler of clause 22 wherein the land portion has a dimpled surface.

24. The hair curler of clause 22 wherein the land portion has ribs that extend generally perpendicular to a direction of air exiting the outlet ports.

25. The hair curler of clause 22 wherein the outlets ducts comprise angularly spaced apart vanes and the land portion has ribs that extend generally perpendicular to the vanes.

26. The hair curler of clause 1 wherein the land portion has unidirectional mechanical hair engaging members which engage hair when hair rotates around the land portion in a first direction and which enable hair to rotate around the land portion in a second direction that is opposite to the first direction.

27. The hair curler of clause 1 wherein the hair curler is removably attachable to a hair dryer.

28. The hair curler of clause 1 further comprising a heating element provided internal of the hair curler.

29. The hair curler of clause 1 wherein the land portion is air impermeable.

30. The hair curler of clause 1 wherein each of the first and second annular band of curler air outlets comprises a raised ring that extends around the longitudinal axis.

Clause Set E

[0285]

1. A hair curler having an inlet end, a longitudinally spaced apart second end and a longitudinal axis, the inlet end having an air inlet, a first annular band of curler air outlet, a land portion extending away from the first annular band of curler air outlets and an air flow passage from the air inlet to the first annular band of curler air outlet, the first annular band of curler air outlets comprising a plurality of outlet ducts, each outlet duct extends from an inlet port to an outlet port, the outlet ports are angularly positioned around the longitudinal axis, wherein the outlet ducts produce a Coanda air stream.

2. The hair curler of clause 1 wherein air exiting the outlet ports exits at an angle of 10° to 30° from a plane transverse a longitudinal axis of the hair curler.

3. The hair curler of clause 1 wherein air exiting the outlet ducts exits at an angle of 15 to 25° or 17 to 23° from a plane transverse a longitudinal axis of the hair curler.

4. The hair curler of clause 1 wherein the second end is closed.

5. The hair curler of clause 1 wherein the second end is openable.

6. The hair curler of clause 1 wherein the longitudinal length of the land portion is about twice the longitudinal length of the first annular band of curler air outlets or more.

7. The hair curler of clause 1 wherein each of first outlet ducts extends from an inlet port, which is in air flow communication with the air inlet, and an outlet port wherein the outlet ports are located radially outwardly of an outer surface of the land portion.

8. The hair curler of clause 1 wherein a diameter of the first annular band of curler air outlets is greater than a diameter of the land portion at a location of the first annular band of curler air outlet.

9. The hair curler of clause 1 further comprising a second annular band of curler air outlets that is longitudinally spaced from the first annular band of curler air outlet, the land portion is positioned between the first annular band of curler air outlets and the second annular band of curler air outlet, wherein the outlet ducts of the first annular band of curler air outlets produce a first Coanda air stream and outlet ducts of the second annular band of curler produce a second Coanda air stream.

10. The hair curler of clause 9 wherein the land portion has a first portion that extends longitudinally outwardly from the first annular band of curler air outlets towards the second end of the hair curler and a second portion that extends longitudinally inwardly from the second annular band of curler air outlets towards the air inlet, the first Coanda air stream rotates around the first portion of the land portion and the second Coanda air stream rotates around the second portion of the land portion.

11. The hair curler of clause 1 wherein at least some of the outlet ducts have an upstream expansion zone and a downstream compression zone.

12. The hair curler of clause 1 wherein at least some of the outlet ducts have a smaller cross-sectional area in a direction of flow through the outlet port than a cross sectional area in a direction of flow through a respective inlet port.

13. The hair curler of clause 1 wherein the land portion comprises metal.

14. The hair curler of clause 13 wherein the land portion is made of metal, a metal filled plastic or has an inner or outer surface that is coated with metal.

15. The hair curler of clause 1 wherein a first set of the outlet ports of the outlet ducts of the first annular band of curler air outlets are provided on a first side of the first annular band of curler air outlets that faces longitudinally inwardly towards the air inlet of the hair curler and a second set of the outlet ports of the outlet ducts of the first annular band of curler air outlets are provided on a second side of the first annular band of curler air outlets that faces longitudinally outwardly towards the second end of the hair curler.

16. The hair curler of clause 1 further comprising a bleed valve.

17. The hair curler of clause 16 wherein the bleed valve is operable during a curling operation whereby ambient air is introduced into the air flow passage whereby a temperature of air exiting the outlet ports

is reduced when the bleed valve is opened.

18. The hair curler of clause 16 wherein the bleed valve is operable at an end of a curling operation whereby ambient air is introduced into the airflow passage whereby a curling force produced by the outlet ducts is reduced.

19. The hair curler of clause 16 wherein the bleed valve is located at the first end of the hair curler.

20. The hair curler of clause 16 wherein the bleed valve is located internal of the hair curler and is longitudinally located between the inlet end and the first annular band of curler air outlet.

21. The hair curler of clause 1 wherein the land portion is smooth.

22. The hair curler of clause 1 wherein the land portion is textured.

23. The hair curler of clause 22 wherein the land portion has a dimpled surface.

24. The hair curler of clause 22 wherein the land portion has ribs that extend generally perpendicular to a direction of air exiting the outlet ports.

25. The hair curler of clause 22 wherein the outlets ducts comprise angularly spaced apart vanes and the land portion has ribs that extend generally perpendicular to the vanes.

26. The hair curler of clause 1 wherein the land portion has unidirectional mechanical hair engaging members which engage hair when hair rotates around the land portion in a first direction and which enable hair to rotate around the land portion in a second direction that is opposite to the first direction.

27. The hair curler of clause 1 wherein the hair curler is removably attachable to a hair dryer.

28. The hair curler of clause 1 further comprising a heating element provided internal of the hair curler.

29. The hair curler of clause 1 wherein the land portion is air impermeable.

30. The hair curler of clause 1 wherein the first annular band of curler air outlets comprises a raised ring that extends around the longitudinal axis.

Clause Set F

[0286]

1. A hair curler having an inlet end, a longitudinally spaced apart second end and a longitudinal axis, the inlet end having an air inlet, an first annular band of curler air outlet, a land portion extending away from the first annular band of curler air outlets and an air flow passage from the air inlet to the first annular band of curler air outlet, the first annular band of curler air outlets comprising a plurality of outlet ducts, each outlet duct extends from an inlet port to an outlet port and comprises angularly spaced apart vanes, the outlet ports are angularly positioned around the hair curler wherein, at the outlet port, the vanes extend at an angle of 10° to 30° from a plane transverse a longitudinal axis of the hair curler.

2. The hair curler of clause 1 wherein at the outlet port, the vanes extend at an angle of 15 to 25° from a plane transverse a longitudinal axis of the hair curler.

3. The hair curler of clause 1 wherein at the outlet port, the vanes extend at an angle of 17 to 23° from a plane transverse a longitudinal axis of the hair curler.

4. The hair curler of clause 1 wherein the second end is closed.

5. The hair curler of clause 1 wherein the second end is openable.

6. The hair curler of clause 1 wherein the longitudinal length of the land portion is about twice the longitudinal length of the first annular band of curler air outlets or more.

7. The hair curler of clause 1 wherein each of first outlet ducts extends from an inlet port, which is in air flow communication with the air inlet, and an outlet port wherein the outlet ports are located radially outwardly of an outer surface of the land portion.

8. The hair curler of clause 1 wherein a diameter of the first annular band of curler air outlets is greater than a diameter of the land portion at a location of the first annular band of curler air outlet.

9. The hair curler of clause 1 further comprising a second annular band of curler air outlets that is longitudinally spaced from the first annular band of curler air outlet, the land portion is positioned between the first annular band of curler air outlets and the second annular band of curler air outlet, wherein the outlet ducts of the first annular band of curler air outlets produce a first Coanda air stream and outlet ducts of the second annular band of curler air outlets produce a second Coanda air stream.

10. The hair curler of clause 9 wherein the land portion has a first portion that extends longitudinally outwardly from the first annular band of curler air outlets towards the second end of the hair curler and a second portion that extends longitudinally inwardly from the second annular band of curler air outlets towards the air inlet, the first Coanda air stream rotates around the first portion of the land portion and the second Coanda air stream rotates around the second portion of the land portion.

11. The hair curler of clause 1 wherein at least some of the outlet ducts have an upstream expansion zone and a downstream compression zone.

12. The hair curler of clause 1 wherein at least some of the outlet ducts have a smaller cross-sectional area in a direction of flow through the outlet port than a cross-sectional area in a direction of flow through a respective inlet port.

13. The hair curler of clause 1 wherein the land portion comprises metal.

14. The hair curler of clause 13 wherein the land portion is made of metal, a metal filled plastic or has an inner or outer surface that is coated with metal.

15. The hair curler of clause 1 wherein a first set of the

outlet ports of the outlet ducts of the first annular band of curler air outlets are provided on a first side of the first annular band of curler air outlets that faces longitudinally inwardly towards the air inlet of the hair curler and a second set of the outlet ports of the outlet ducts of the first annular band of curler air outlets are provided on a second side of the first annular band of curler air outlets that faces longitudinally outwardly towards the second end of the hair curler.

16. The hair curler of clause 1 further comprising a bleed valve.

17. The hair curler of clause 16 wherein the bleed valve is operable during a curling operation whereby ambient air is introduced into the air flow passage whereby a temperature of air exiting the outlet ports is reduced when the bleed valve is opened.

18. The hair curler of clause 16 wherein the bleed valve is operable at an end of a curling operation whereby ambient air is introduced into the airflow passage whereby a curling force produced by the outlet ducts is reduced.

19. The hair curler of clause 16 wherein the bleed valve is located at the first end of the hair curler.

20. The hair curler of clause 16 wherein the bleed valve is located internal of the hair curler and is longitudinally located between the inlet end and the first annular band of curler air outlet.

21. The hair curler of clause 1 wherein the land portion is smooth.

22. The hair curler of clause 1 wherein the land portion is textured.

23. The hair curler of clause 22 wherein the land portion has a dimpled surface.

24. The hair curler of clause 22 wherein the land portion has ribs that extend generally perpendicular to a direction of air exiting the outlet ports.

25. The hair curler of clause 22 wherein the outlets ducts comprise angularly spaced apart vanes and the land portion has ribs that extend generally perpendicular to the vanes.

26. The hair curler of clause 1 wherein the land portion has unidirectional mechanical hair engaging members which engage hair when hair rotates around the land portion in a first direction and which enable hair to rotate around the land portion in a second direction that is opposite to the first direction.

27. The hair curler of clause 1 wherein the hair curler is removably attachable to a hair dryer.

28. The hair curler of clause 1 further comprising a heating element provided internal of the hair curler.

29. The hair curler of clause 1 wherein the land portion is air impermeable.

30. The hair curler of clause 1 wherein the first annular band of curler air outlets comprises a raised ring that extends around the longitudinal axis.

Clause Set G

[0287]

1. A hair curler having an inlet end, a longitudinally spaced apart second end and a longitudinal axis, the inlet end having an air inlet, a first annular band of curler air outlet, a land portion extending away from the first annular band of curler air outlets and an air flow passage from the air inlet to the first annular band of curler air outlet, the first annular band of curler air outlets comprising a plurality of outlet ducts, each outlet duct extends from an inlet port to an outlet port, the outlet ports are angularly positioned around the hair curler, wherein at least some of the outlet ducts have an upstream expansion zone and a downstream compression zone.

2. The hair curler of clause 1 wherein at least some of the outlet ducts have a smaller cross-sectional area in a direction of flow through the outlet port than a cross sectional area in a direction of flow through a respective inlet port.

3. The hair curler of clause 1 wherein air exiting the outlet ducts exits at an angle of 10° to 30° from a plane transverse a longitudinal axis of the hair curler.

4. The hair curler of clause 1 wherein air exiting the outlet ducts exits at an angle of 15 to 25° or 17 to 23° from a plane transverse a longitudinal axis of the hair curler.

5. The hair curler of clause 1 wherein the second end is closed.

6. The hair curler of clause 1 wherein the second end is openable.

7. The hair curler of clause 1 wherein the longitudinal length of the land portion is about twice the longitudinal length of the first annular band of curler air outlets or more.

8. The hair curler of clause 1 wherein each of first outlet ducts extends from an inlet port, which is in air flow communication with the air inlet, and an outlet port wherein the outlet ports are located radially outwardly of an outer surface of the land portion.

9. The hair curler of clause 1 wherein a diameter of the first annular band of curler air outlets is greater than a diameter of the land portion at a location of the first annular band of curler air outlet.

10. The hair curler of clause 1 further comprising a second annular band of curler air outlets that is longitudinally spaced from the first annular band of curler air outlet, the land portion is positioned between the first annular band of curler air outlets and the second annular band of curler air outlet, wherein the outlet ducts of the first annular band of curler air outlets produce a first Coanda air stream and outlet ducts of the second annular band of curler air outlets produce a second Coanda air stream.

11. The hair curler of clause 10 wherein the land portion has a first portion that extends longitudinally

outwardly from the first annular band of curler air outlets towards the second end of the hair curler and a second portion that extends longitudinally inwardly from the second annular band of curler air outlets towards the air inlet, the first Coanda air stream rotates around the first portion of the land portion and the second Coanda air stream rotates around the second portion of the land portion.

12. The hair curler of clause 1 wherein the land portion comprises metal.

13. The hair curler of clause 12 wherein the land portion is made of metal, a metal filled plastic or has an inner or outer surface that is coated with metal.

14. The hair curler of clause 1 wherein a first set of the outlet ports of the outlet ducts of the first annular band of curler air outlets are provided on a first side of the first annular band of curler air outlets that faces longitudinally inwardly towards the air inlet of the hair curler and a second set of the outlet ports of the outlet ducts of the first annular band of curler air outlets are provided on a second side of the first annular band of curler air outlets that faces longitudinally outwardly towards the second end of the hair curler.

15. The hair curler of clause 1 further comprising a bleed valve.

16. The hair curler of clause 15 wherein the bleed valve is operable during a curling operation whereby ambient air is introduced into the air flow passage whereby a temperature of air exiting the outlet ports is reduced when the bleed valve is opened.

17. The hair curler of clause 15 wherein the bleed valve is operable at an end of a curling operation whereby ambient air is introduced into the airflow passage whereby a curling force produced by the outlet ducts is reduced.

18. The hair curler of clause 15 wherein the bleed valve is located at the first end of the hair curler.

19. The hair curler of clause 15 wherein the bleed valve is located internal of the hair curler and is longitudinally located between the inlet end and the first annular band of curler air outlet.

20. The hair curler of clause 1 wherein the land portion is smooth.

21. The hair curler of clause 1 wherein the land portion is textured.

22. The hair curler of clause 21 wherein the land portion has a dimpled surface.

23. The hair curler of clause 21 wherein the land portion has ribs that extend generally perpendicular to a direction of air exiting the outlet ports.

24. The hair curler of clause 21 wherein the outlets ducts comprise angularly spaced apart vanes and the land portion has ribs that extend generally perpendicular to the vanes.

25. The hair curler of clause 1 wherein the land portion has unidirectional mechanical hair engaging members which engage hair when hair rotates around the land portion in a first direction and which enable hair to rotate around the land portion in a second direction that is opposite to the first direction.

26. The hair curler of clause 1 wherein the hair curler is removably attachable to a hair dryer.

27. The hair curler of clause 1 further comprising a heating element provided internal of the hair curler.

28. The hair curler of clause 1 wherein the land portion is air impermeable.

29. The hair curler of clause 1 wherein the first annular band of curler air outlets comprises a raised ring that extends around the longitudinal axis.

Clause Set H

[0288]

1. A hair curler having an inlet end having an air inlet, a longitudinally spaced apart second end, a pressure relief valve and an air flow passage from the air inlet to an air outlet.

2. The hair curler of clause 1 wherein the pressure relief valve is operable during a curling operation whereby some air is exhausted from the air flow passage through the pressure relief valve whereby a curling force produced by the air outlet is reduced.

3. The hair curler of clause 1 wherein the pressure relief valve is located at the inlet end of the hair curler.

4. The hair curler of clause 1 wherein the pressure relief valve is located internal of the hair curler and is longitudinally located between the inlet end and the air outlet.

5. The hair curler of clause 1 wherein the air outlet comprises a first annular band of curler air outlets comprising a plurality of outlet ducts, each outlet duct extends from an inlet port to an outlet port, wherein the outlet ports are angularly positioned around the hair curler.

6. The hair curler of clause 5 wherein air exiting the outlet ducts exits at an angle of 10° to 30° from a plane transverse a longitudinal axis of the hair curler.

7. The hair curler of clause 5 wherein air exiting the outlet ducts exits at an angle of 15 to 25° or 17 to 23° from a plane transverse a longitudinal axis of the hair curler.

8. The hair curler of clause 1 wherein the second end is closed.

9. The hair curler of clause 1 wherein the second end is openable.

10. The hair curler of clause 9 wherein the pressure relief valve is provided at the second end.

11. The hair curler of clause 5 wherein a land portion extends away from the first annular band of curler air outlets and a longitudinal length of the land portion is about twice the longitudinal length of the first annular band of curler air outlets or more.

12. The hair curler of clause 5 wherein a land portion extends away from the first annular band of curler air outlets and, the outlet ports are located radially out-

wardly of an outer surface of the land portion.

13. The hair curler of clause 5 wherein a diameter of the first annular band of curler air outlets is greater than a diameter of the land portion at a location of the first annular band of curler air outlet.

14. The hair curler of clause 5 further comprising a second annular band of curler air outlets that is longitudinally spaced from the first annular band of curler air outlet, a land portion is positioned between the first annular band of curler air outlets and the second annular band of curler air outlet, wherein each of the first and second annular band of curler air outlets comprises a plurality of outlet ducts, the outlet ducts of the first annular band of curler air outlets produce a first Coanda air stream and outlet ducts of the second annular band of curler air outlets produce a second Coanda air stream.

15. The hair curler of clause 5 wherein a land portion extends away from the first annular band of curler air outlet, the land portion has a first portion that extends longitudinally outwardly from the first annular band of curler air outlets towards the second end of the hair curler and a second portion that extends longitudinally inwardly from the second annular band of curler air outlets towards the air inlet, the first Coanda air stream rotates around the first portion of the land portion and the second Coanda air stream rotates around the second portion of the land portion.

16. The hair curler of clause 1 wherein the air outlet comprises a plurality of outlet ducts and at least some of the outlet ducts have an upstream expansion zone and a downstream compression zone.

17. The hair curler of clause 1 wherein the air outlet comprises a plurality of outlet ducts and at least some of the outlet ducts have a smaller cross-sectional area in a direction of flow through the outlet port than a cross sectional area in a direction of flow through a respective inlet port.

18. The hair curler of clause 5 wherein a land portion extends away from the first annular band of curler air outlets and the land portion comprises metal.

19. The hair curler of clause 18 wherein the land portion is made of metal, a metal filled plastic or has an inner or outer surface that is coated with metal.

20. The hair curler of clause 5 wherein a first set of outlet ports of the outlet ducts of the first annular band of curler air outlets are provided on a first side of the first annular band of curler air outlets that faces longitudinally inwardly towards the air inlet of the hair curler and a second set of outlet ports of the outlet ducts of the first annular band of curler air outlets are provided on a second side of the first annular band of curler air outlets that faces longitudinally outwardly towards the second end of the hair curler.

21. The hair curler of clause 5 wherein a land portion extends away from the first annular band of curler air outlets and the land portion is smooth.

22. The hair curler of clause 5 wherein a land portion extends away from the first annular band of curler air outlets and the land portion is textured.

23. The hair curler of clause 22 wherein the land portion has a dimpled surface.

24. The hair curler of clause 22 wherein the land portion has ribs that extend generally perpendicular to a direction of air exiting the outlet ports.

25. The hair curler of clause 22 wherein the outlets ducts comprise angularly spaced apart vanes and the land portion has ribs that extend generally perpendicular to the vanes.

26. The hair curler of clause 1 wherein a land portion extends away from the first annular band of curler air outlets and the land portion has unidirectional mechanical hair engaging members which engage hair when hair rotates around the land portion in a first direction and which enable hair to rotate around the land portion in a second direction that is opposite to the first direction.

27. The hair curler of clause 1 wherein the hair curler is removably attachable to a hair dryer.

28. The hair curler of clause 1 further comprising a heating element provided internal of the hair curler.

29. The hair curler of clause 5 wherein a land portion extends away from the first annular band of curler air outlets and the land portion is air impermeable.

30. The hair curler of clause 5 wherein the first annular band of curler air outlets comprises a raised ring that extends around the longitudinal axis.

Clause Set I

[0289]

1. A hair curler having an inlet end having an air inlet, a longitudinally spaced apart second end, a longitudinal axis and a curler outlet shaped to direct air flow along an outlet vector that includes a tangential component and an air flow passage from the air inlet to the curler outlet, the curler outlet including an outlet duct extending from the air flow passage to an exterior, the outlet duct including an outlet end expansion zone.

2. The hair curler of clause 1 comprising a first plurality of the curler outlets spaced apart from a second plurality of the curler outlets and a land portion located between the first and second plurality of the curler outlets.

3. The hair curler of clause 2 wherein the land portion is air impermeable.

4. The hair curler of clause 1 wherein the curler outlet comprises a set of the outlet ducts, each outlet duct including an outlet end expansion zone terminating at an outlet port, the plurality of outlet ports of the set are angularly positioned around the longitudinal axis.

5. The hair curler of clause 4 wherein the outlet end expansion zone is formed between a radially inner

wall and a radially outer wall, a spacing between the radially inner wall and the radially outer wall increasing along the outlet end expansion zone.

6. The hair curler of clause 4 comprising a first plurality of the curler outlets, a second plurality of the curler outlets, and a third plurality of the curler outlets, a first land portion positioned between the first and second plurality of the curler outlets and a second land portion positioned between the second and third plurality of the curler outlets.

7. The hair curler of clause 6 wherein the land portions are air impermeable.

8. The hair curler of clause 1 wherein the curler outlet directs air generally angularly along an outer surface of the hair curler whereby air which exits the curler outlet travels generally angularly along the outer surface.

9. The hair curler of clause 1 wherein the outlet duct extends from an inlet port to an outlet port, the outlet port has a radial outer side that is located radially outwardly of an adjacent land portion.

10. The hair curler of clause 9 wherein the air flow path incudes a passage interior the air curler and the inlet port is provided in a wall of the passage.

11. The hair curler of clause 1 wherein a transverse air flow area of the duct is at a maximum at the outlet end of the outlet end expansion zone.

12. The hair curler of clause 6 wherein the first plurality of the curler outlets is the plurality of the curler outlet closest to the inlet end of the hair curler, and the first plurality of the curler outlet directs air along an outlet vector whose only longitudinal component is directed away from the inlet end.

13. The hair curler of clause 12 wherein the second and third plurality of the curler outlets direct air along an outlet vector which includes a longitudinal component directed towards the inlet end.

14. The hair curler of clause 13 wherein the first land portion is bell-shaped along the longitudinal axis.

15. The hair curler of clause 6 wherein the first plurality of the curler outlets is the plurality of the curler outlets closest to the inlet end of the hair curler, the first plurality of the curler outlets directs air along a first outlet vector, the second plurality of the curler outlets directs air along a second outlet vector, the third plurality of the curler outlets directs air along a third outlet vector, and the first outlet vector has a magnitude that is less than at least one of the magnitude of the second outlet vector and the magnitude of the third outlet vector.

16. The hair curler of clause 15, wherein the magnitude of the second outlet vector is greater than the magnitude of the first outlet vector, and the magnitude of the third outlet vector is greater than the magnitude of the first outlet vector.

17. The hair curler of clause 16 wherein the outlet ducts of the second plurality of the curler outlets have a minimum transverse air flow area that is greater than a minimum transverse air flow area of the outlet ducts of the first plurality of the curler outlets, and the outlet ducts of the third plurality of the curler outlets have a minimum transverse air flow area that is greater than the minimum transverse air flow area of the outlet ducts of the second plurality of the curler outlets.

18. The hair curler of clause 1 wherein the air flow path includes a venturi and a plurality of air inlets opening into the venturi from an exterior of the hair curler, the plurality of air inlets opening from a location at the inlet end of the hair curler.

19. The hair curler of clause 18 wherein the venturi is upstream of any of the curler outlets.

20. The hair curler of clause 19 wherein the venturi is at the inlet end of the hair curler.

Claims

1. A hair curler having an inlet end having an air inlet, a longitudinally spaced apart second end, a longitudinal axis and a plurality of axially spaced apart curler outlets, a land portion located between adjacent curler outlets and an air flow passage from the air inlet to the curler outlets.

2. The hair curler of claim 1 wherein the air outlets have a radial outer side that is located radially outwardly of the land portion at a location of the air outlets.

3. The hair curler of claims 1 or 2 wherein the air outlets comprise a plurality of sets of air outlets, each set of air outlets comprises a plurality of air outlets that are angularly positioned around the longitudinal axis.

4. The hair curler of claim 3 wherein the land portion is positioned between adjacent sets of air outlets.

5. The hair curler of claim 3 wherein the plurality of sets of air outlets comprises a first set of air outlets, a second set of air outlets and a third set of air outlets, the land portion comprises a first section positioned between the first and second sets of air outlets and a second section positioned between the second and third sets of air outlets.

6. The hair curler of any one of claims 1-5 wherein the land portion is air impermeable.

7. The hair curler of claim 1 wherein the air outlets direct air generally along an outer surface of the hair curler whereby air which exits the air outlets travels along the outer surface.

8. The hair curler of claim 1 wherein each air outlet comprises an outlet duct that extends from an inlet port to an outlet port, the outlet port has a radial outer

side that is located radially outwardly of the land portion at a location of the outlet port.

9. The hair curler of claim 8 wherein the air flow path incudes a passage interior the air curler and the inlet ports are located in the passage.

10. The hair curler of claim 8 wherein the passage has a radial outer wall and the inlet ports have a radial inner side that is located radially inwardly of the radial outer wall.

11. The hair curler of claim 1 wherein the air outlets direct air in a common direction.

12. The hair curler of claim 1 wherein some of the air outlets direct air clockwise and other air outlets direct air counterclockwise and, optionally, a valve is operable to selectively direct air to the air outlets that direct air clockwise and the air outlets that direct air counterclockwise.

13. The hair curler of claim 3 wherein the plurality of sets of air outlets comprises a first set of air outlets and a second set of air outlets, the first set of air outlets direct air clockwise and the second set of air outlets direct air counterclockwise and, optionally a valve is operable to selectively direct air to the air outlets that direct air clockwise and the air outlets that direct air counterclockwise.

14. The hair curler of claim 4 wherein each air outlet comprises an outlet duct that extends from an inlet port to an outlet port and an outlet port of the first set of air outlets is axially aligned with an outlet port of the second set of air outlets and an outlet port of the third set of air outlets.

15. The hair curler of claim 4 wherein each air outlet comprises an outlet duct that extends from an inlet port to an outlet port and the first, second and third sets of air outlets define a plurality of axially extending rows of outlet ports wherein the plurality of axially extending rows of outlet ports are axially aligned or wherein, for each row of outlet ports, the outlet ports are angularly positioned around the longitudinal axis, or wherein, for each row of outlet ports, the outlet port of the second set of outlet ports is angularly positioned around the longitudinal axis from the outlet port of the first set of outlet ports and the outlet port of the third set of outlet ports is angularly positioned around the longitudinal axis from the outlet port of the second set of outlet ports.

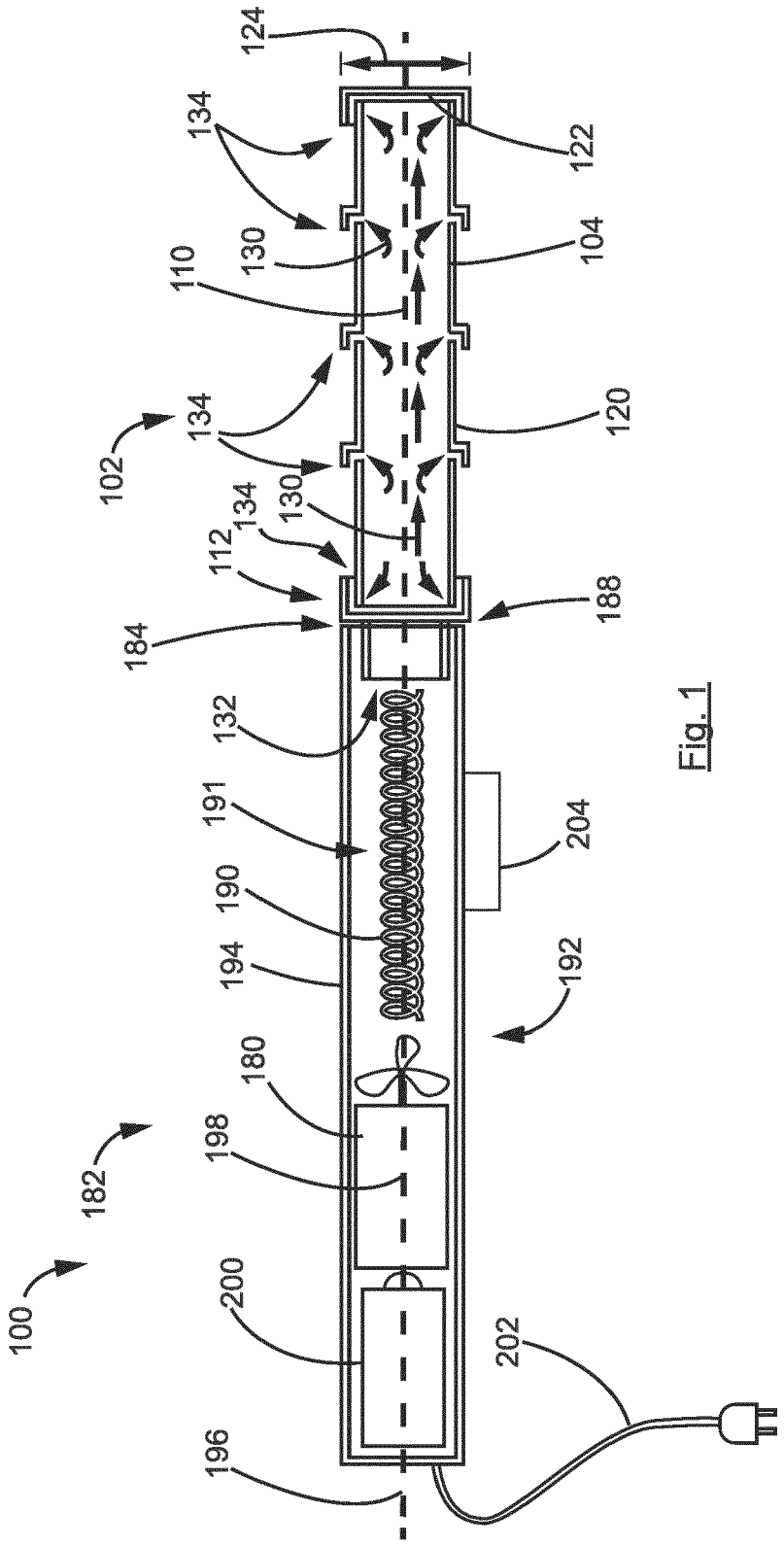
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Fig. 1

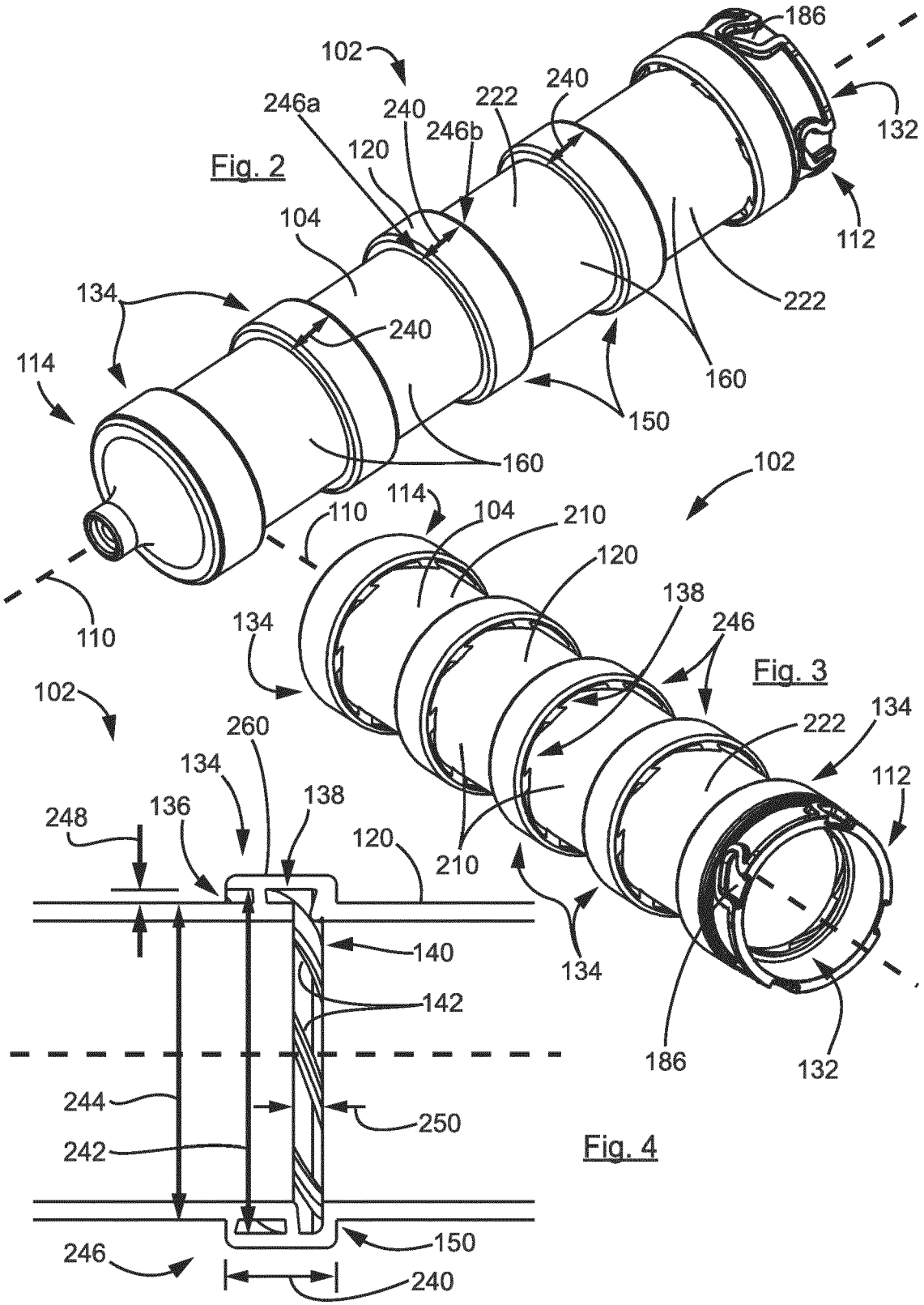


Fig. 2

Fig. 3

Fig. 4

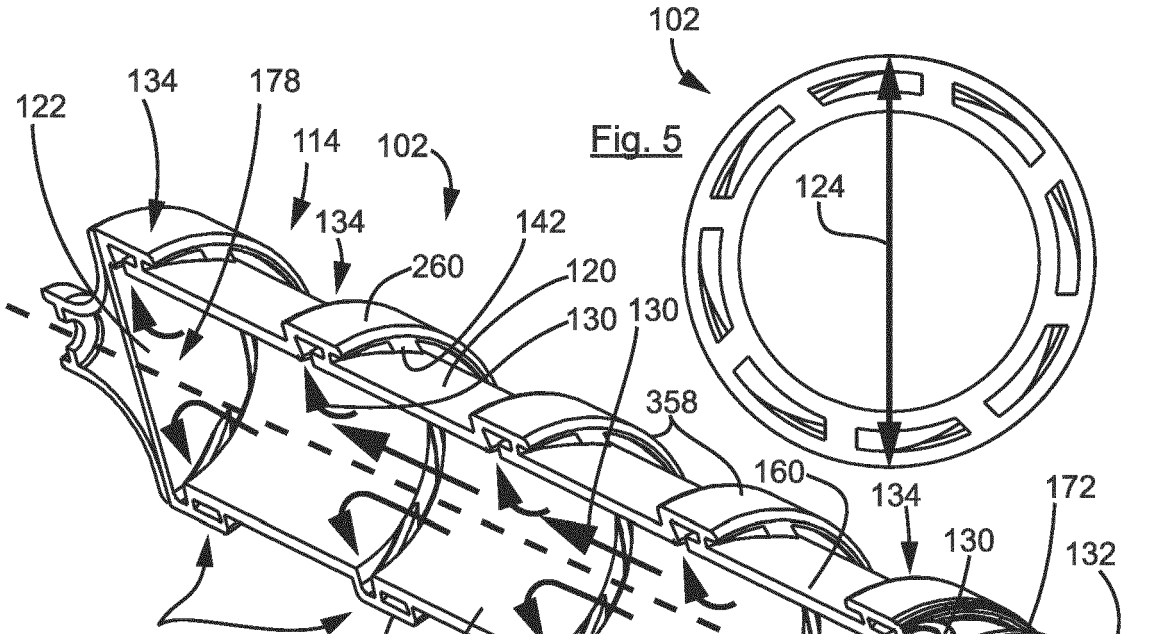
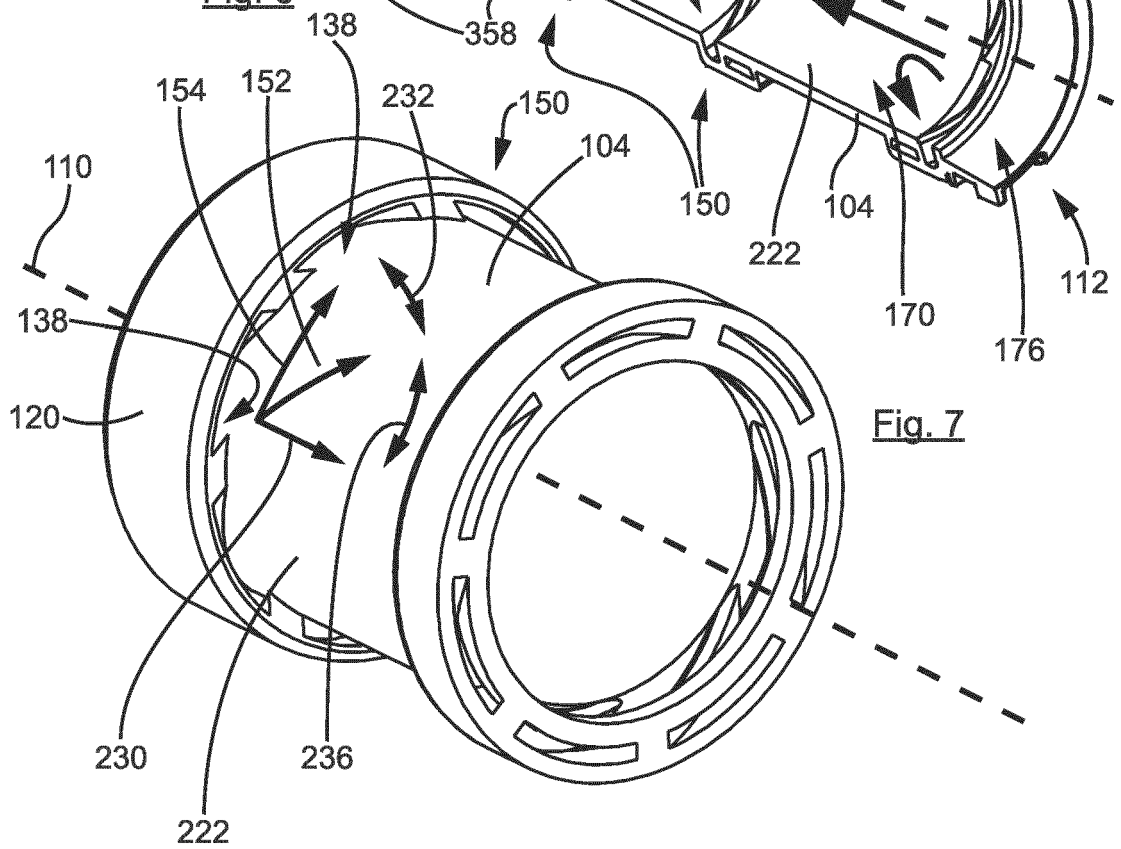


Fig. 5

Fig. 6



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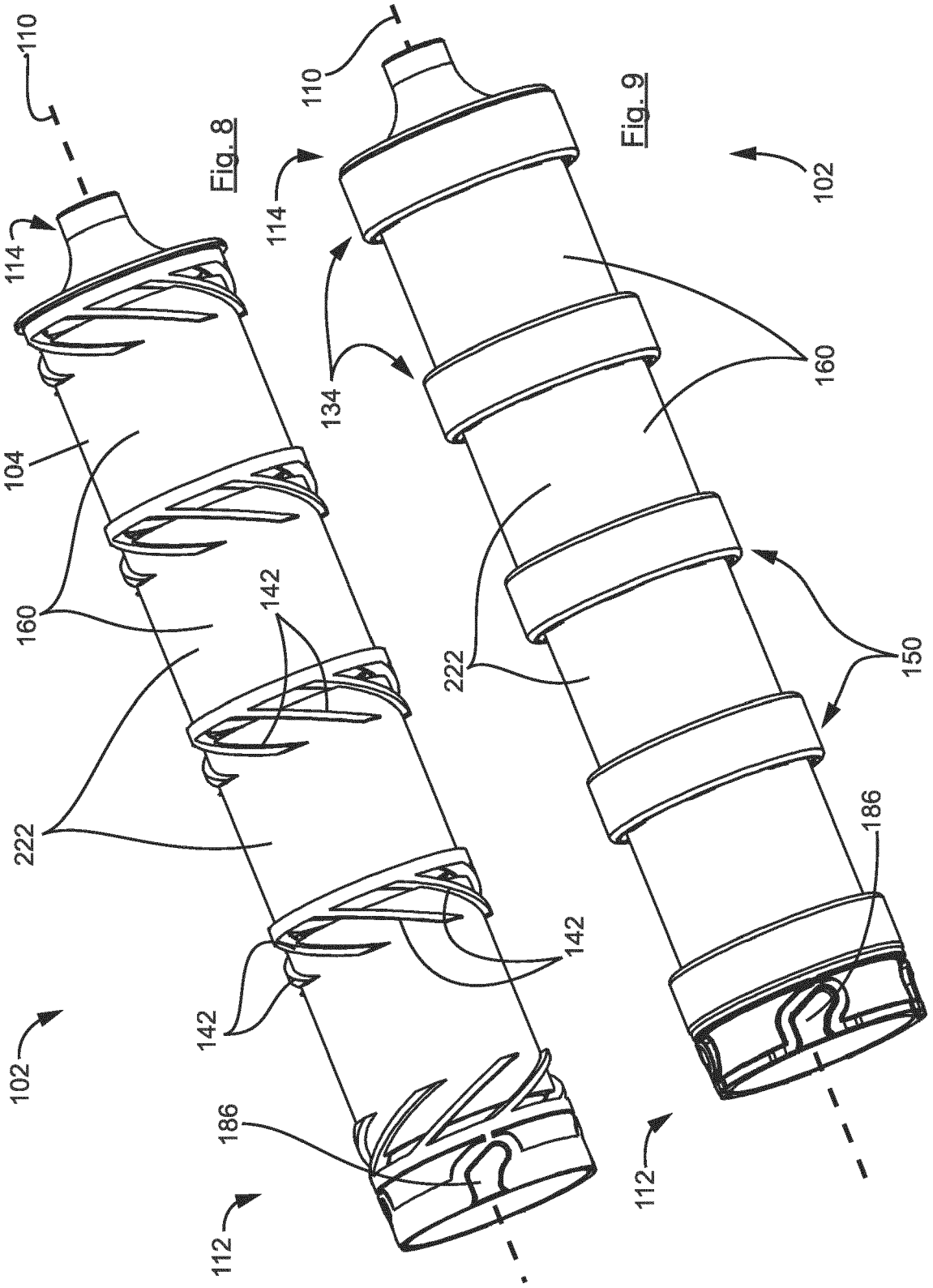
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Fig. 8
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Fig. 9

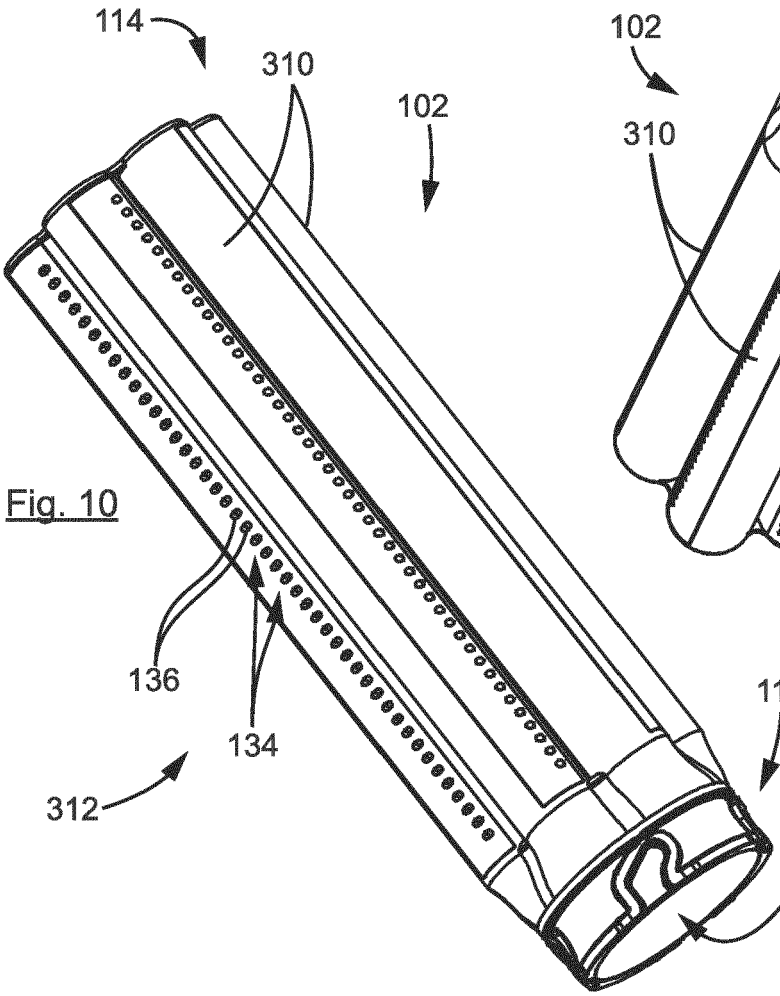


Fig. 10

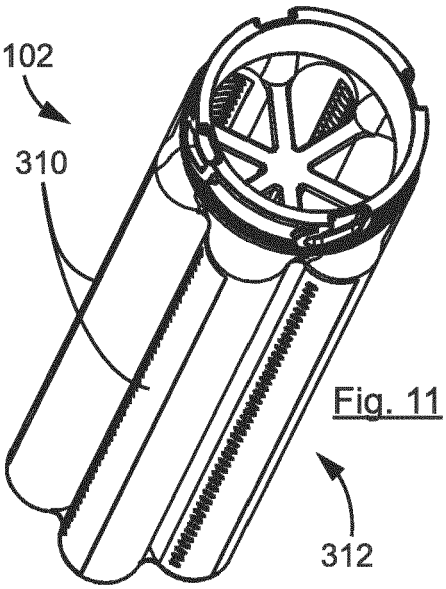
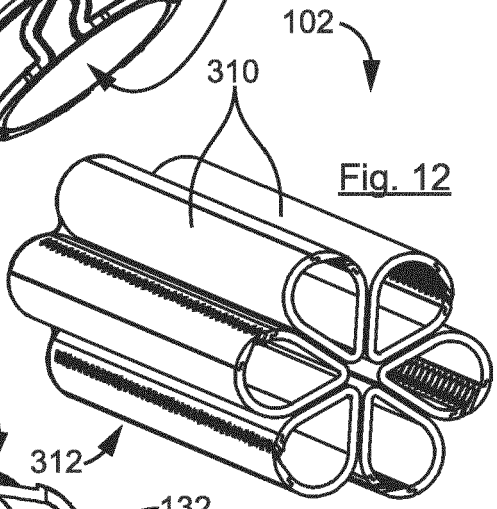


Fig. 11



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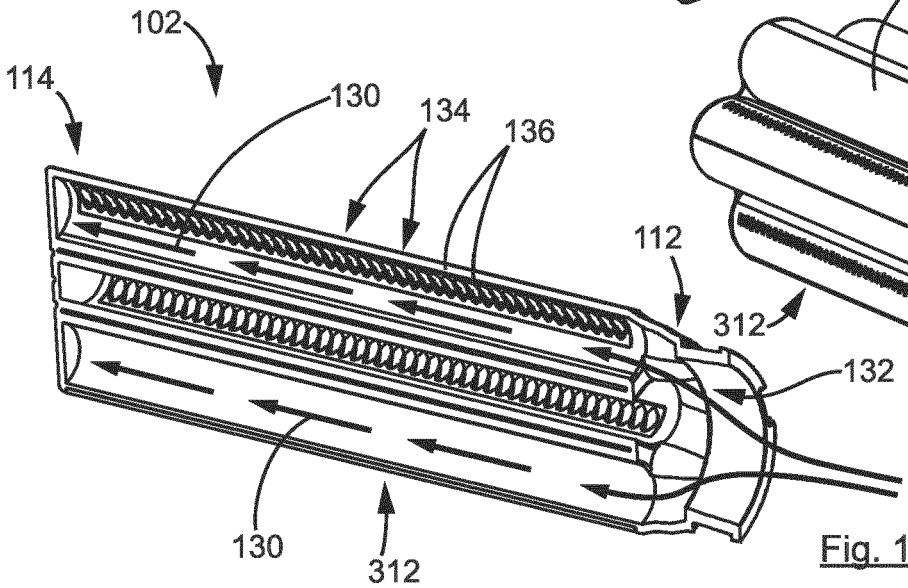

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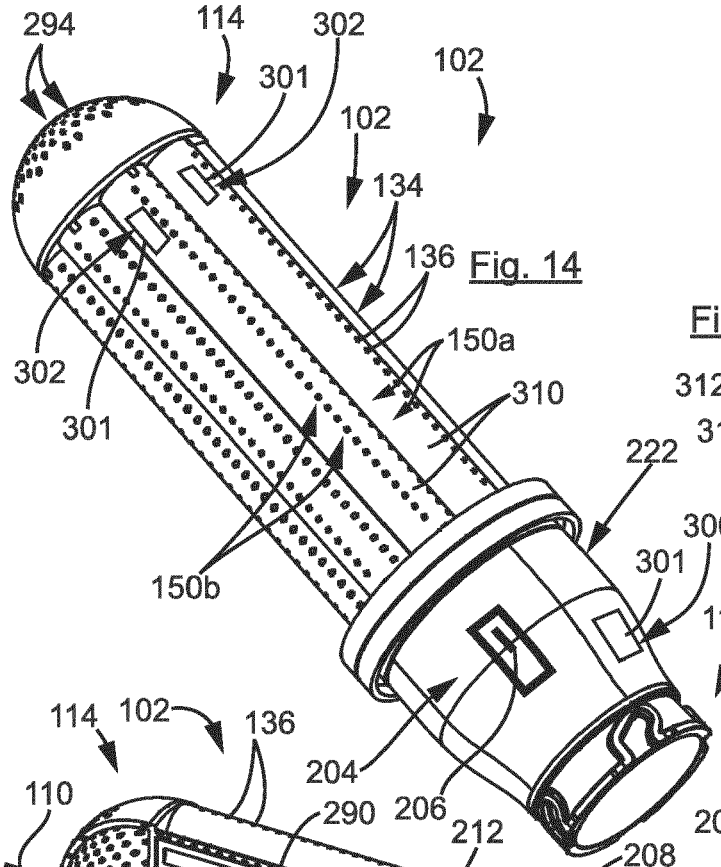

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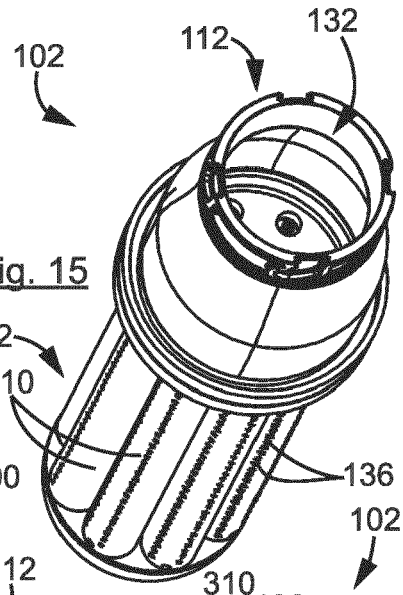

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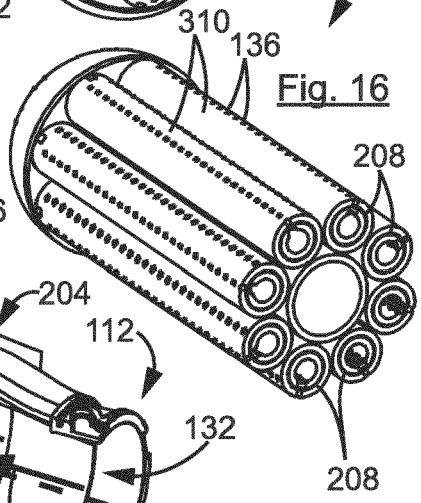

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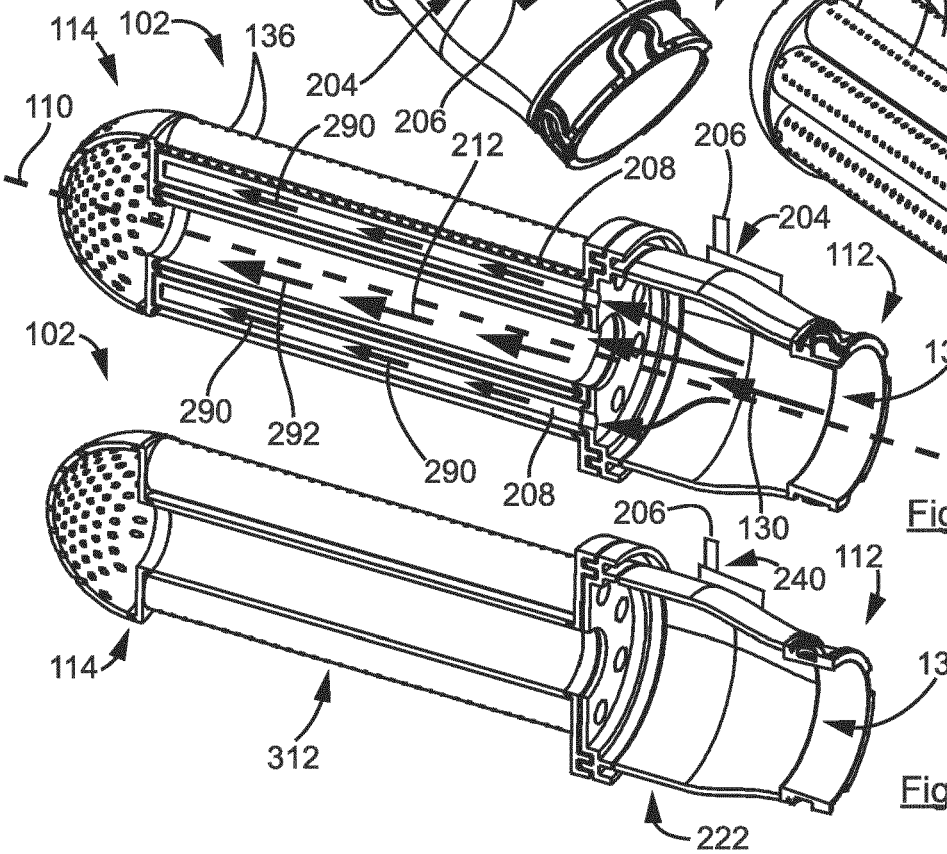
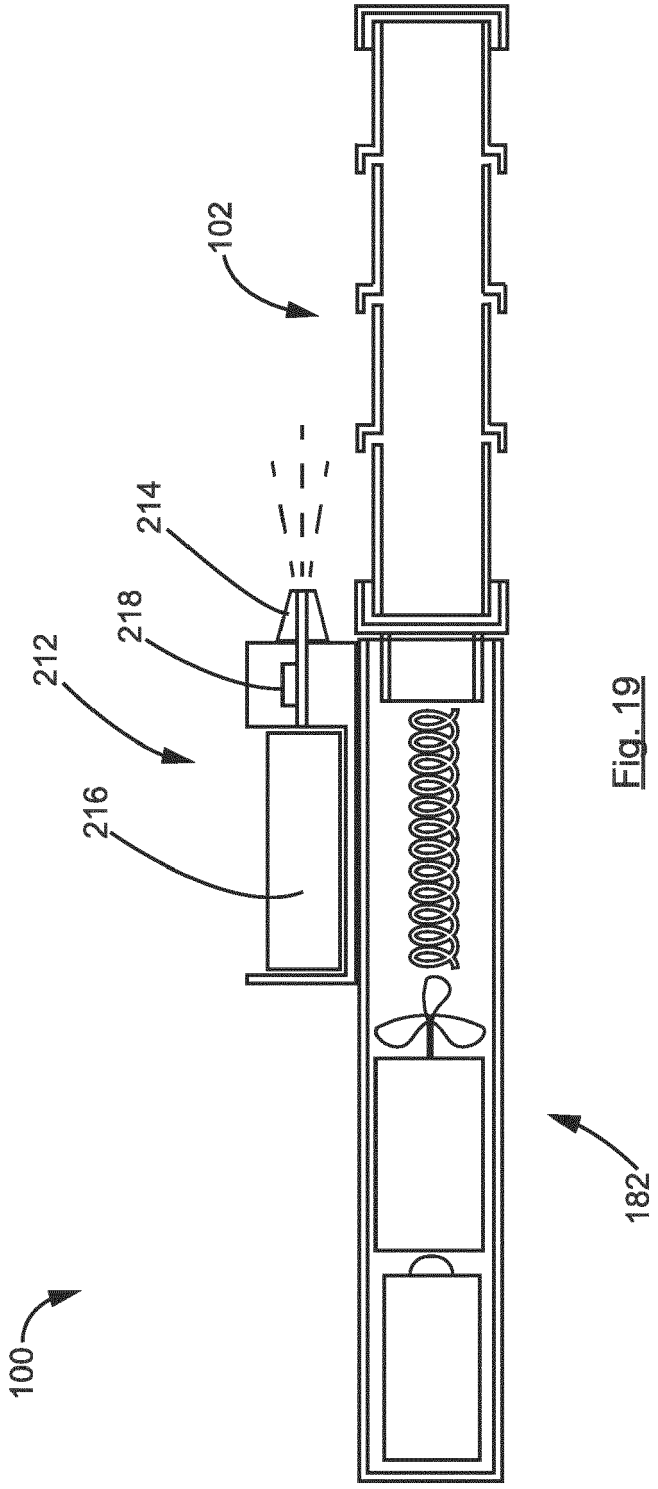


Fig. 17

Fig. 18



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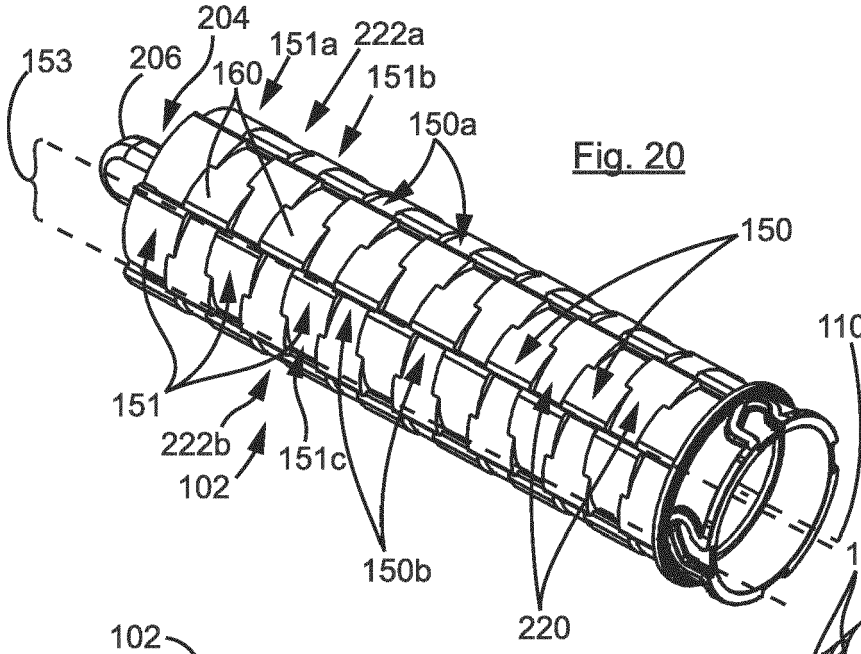

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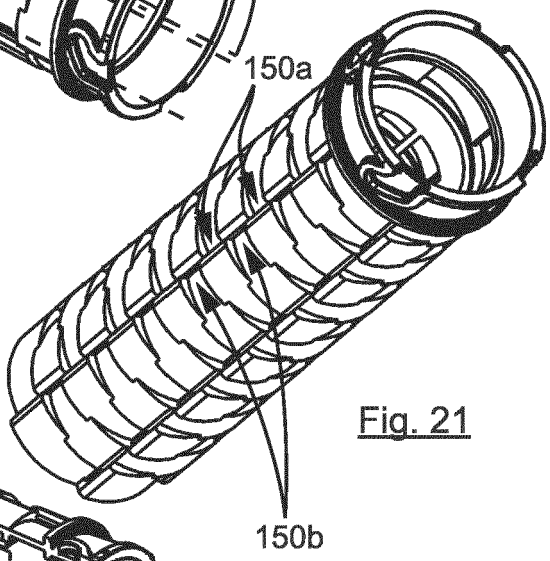

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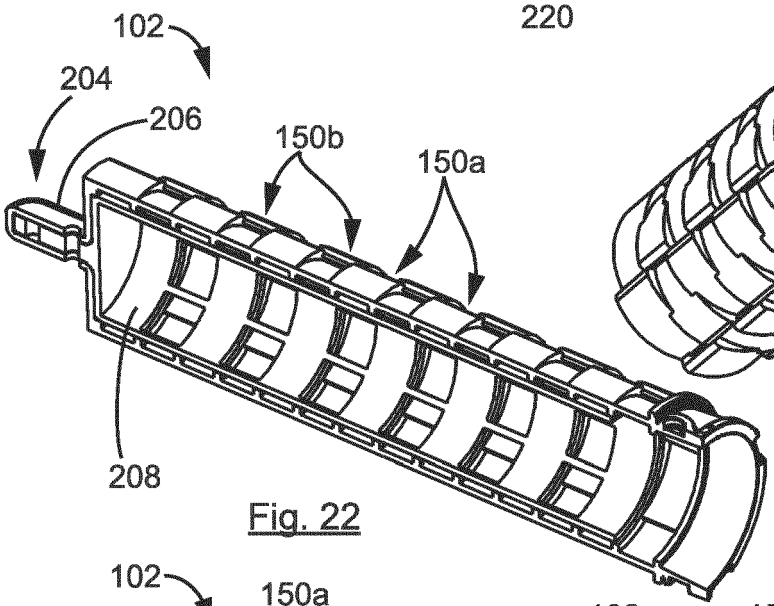

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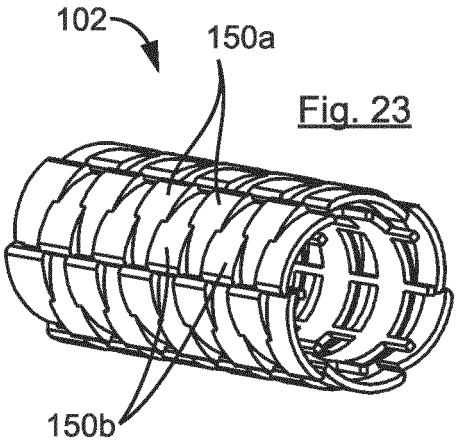

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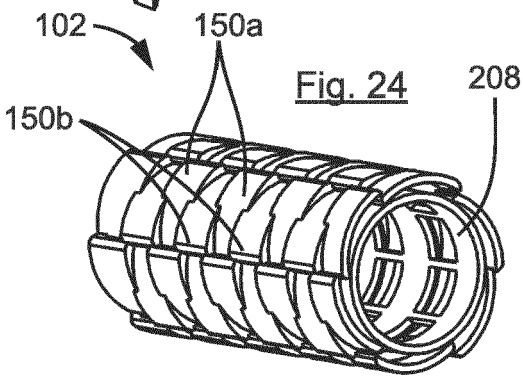

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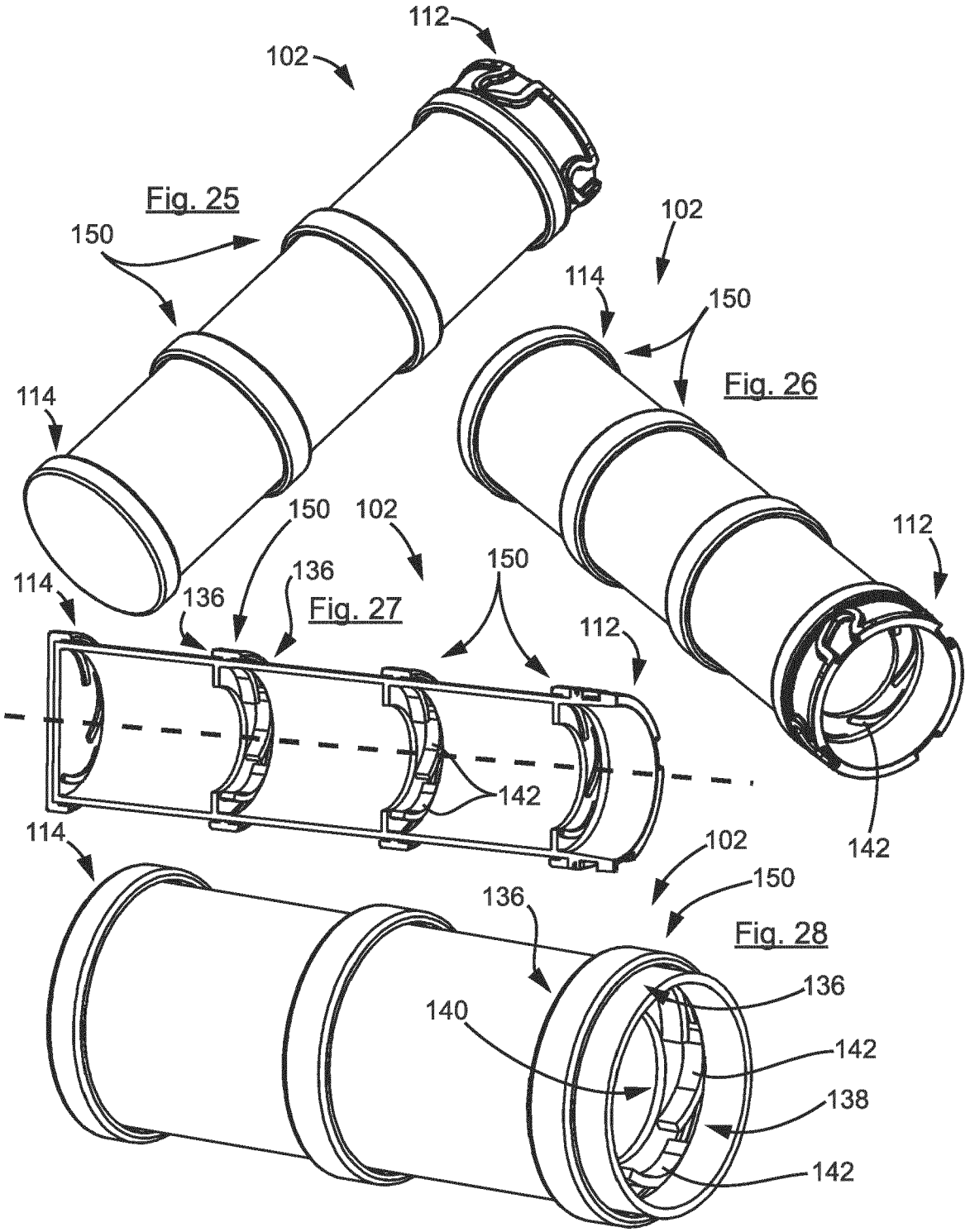

Fig. 25

Fig. 26

Fig. 27

Fig. 28

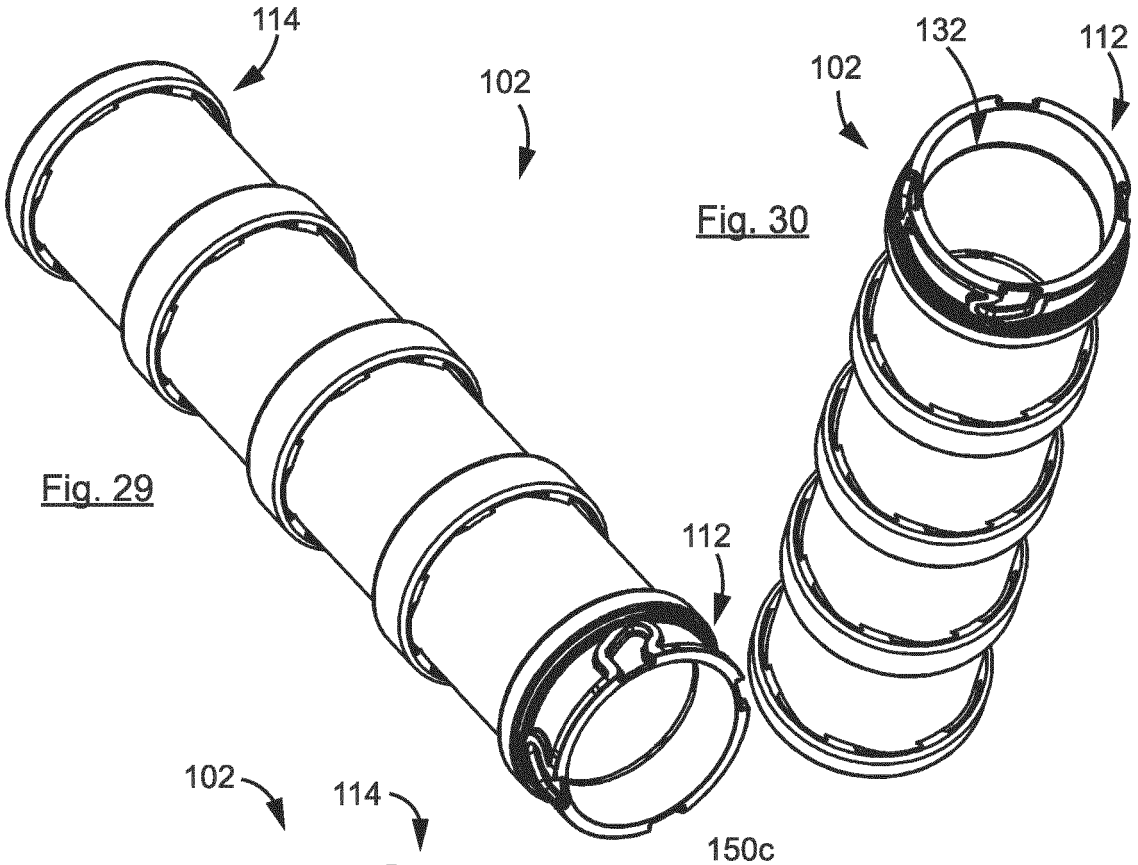

Fig. 29

Fig. 30

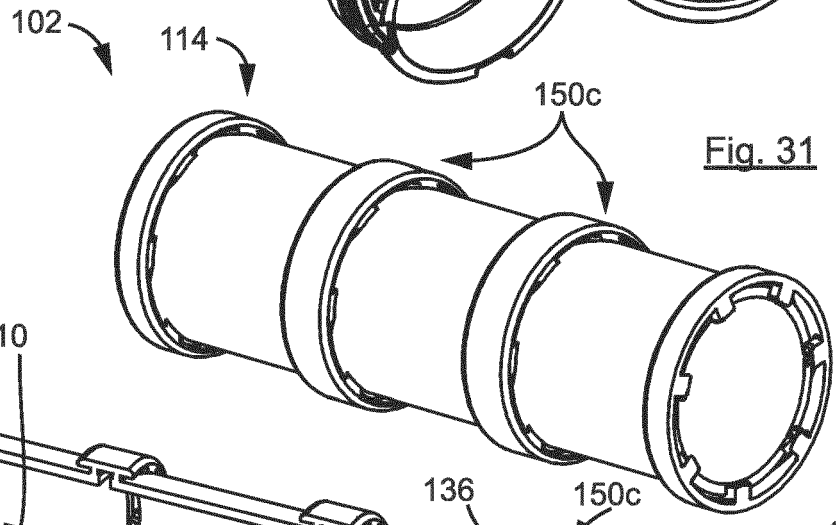

Fig. 31

Fig. 32

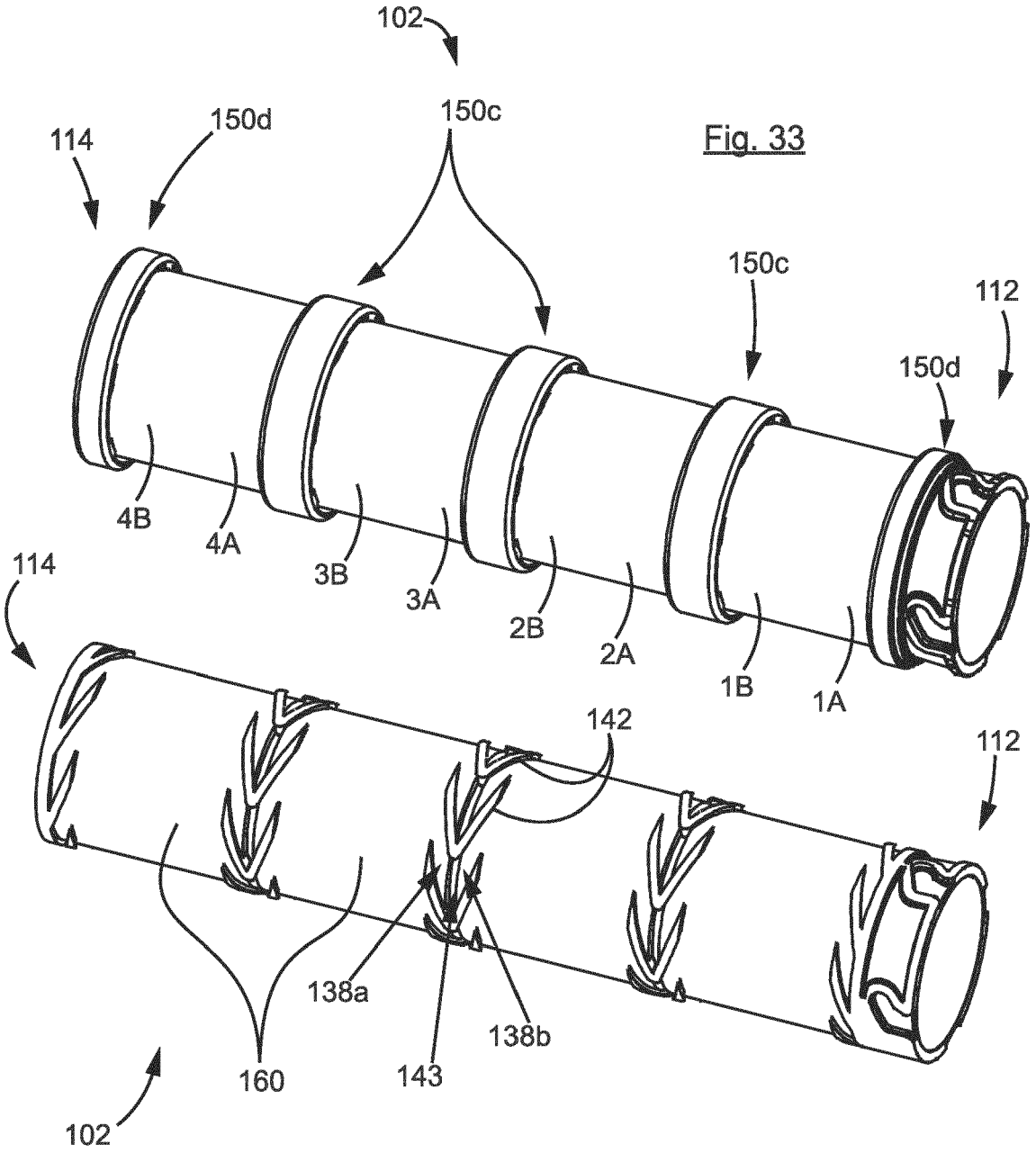
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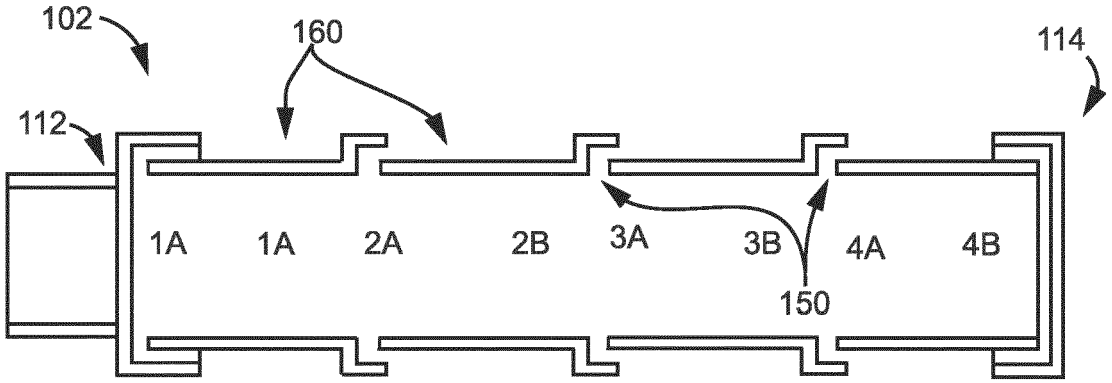
Fig. 33

Fig. 34



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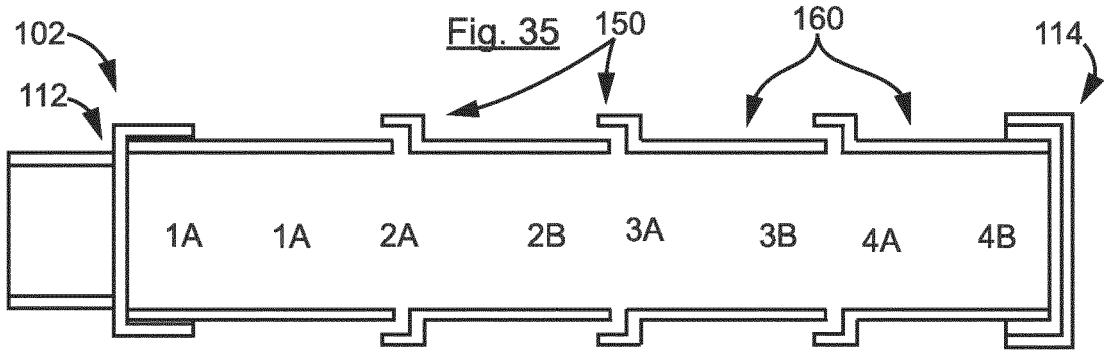

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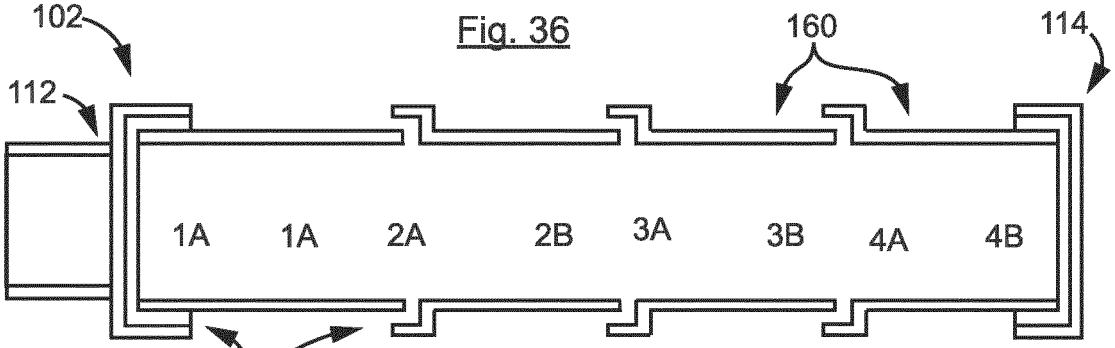

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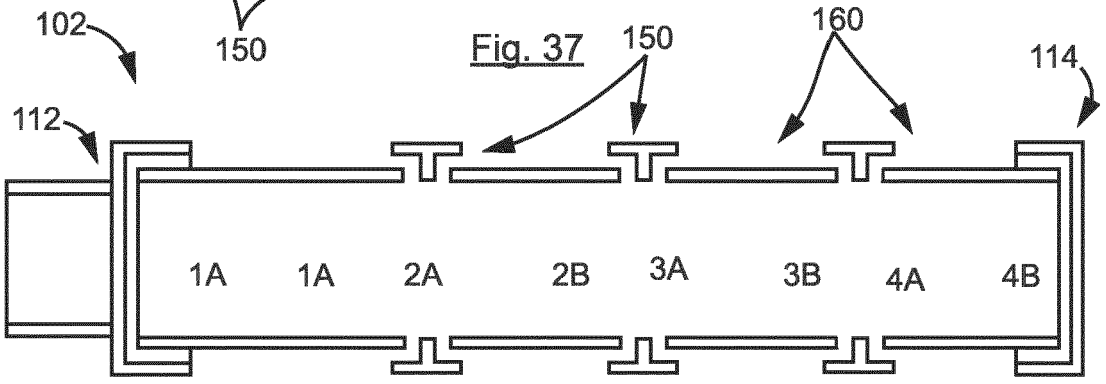

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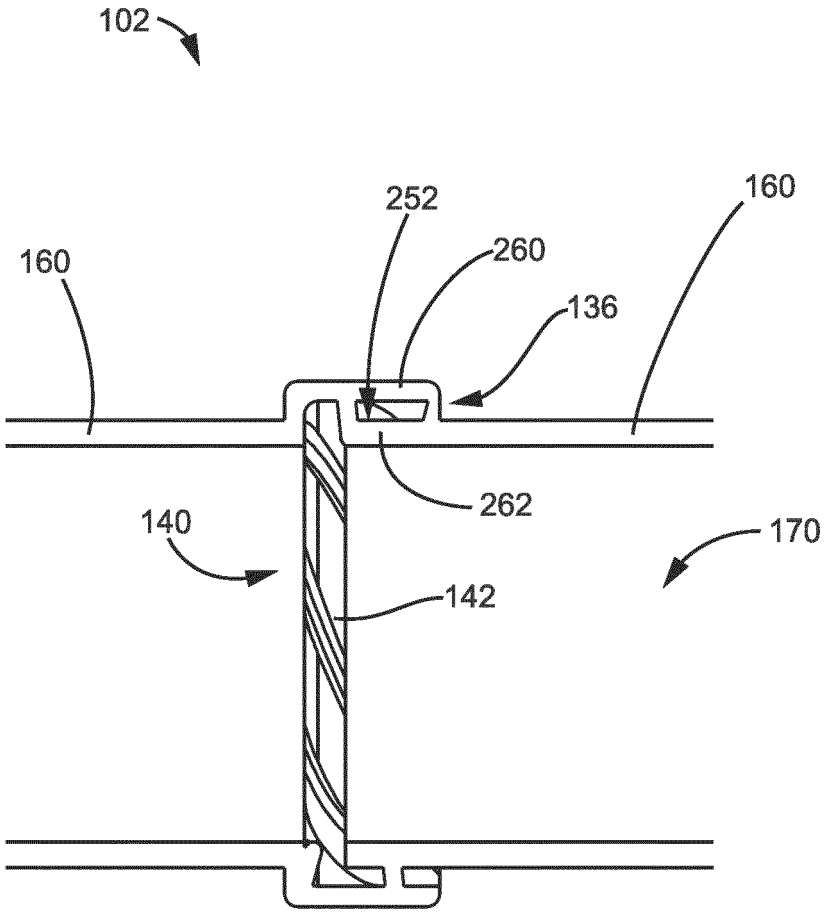

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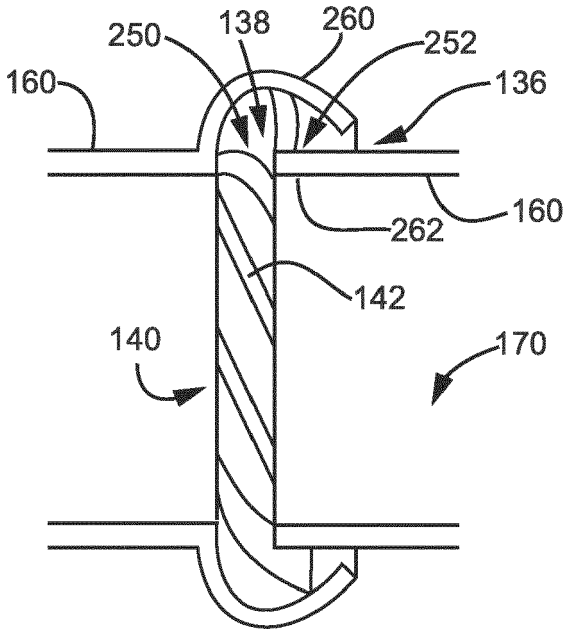
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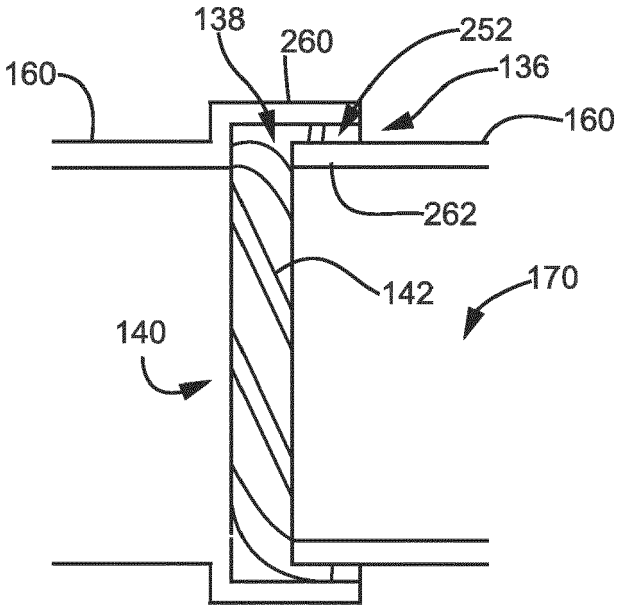
Fig. 40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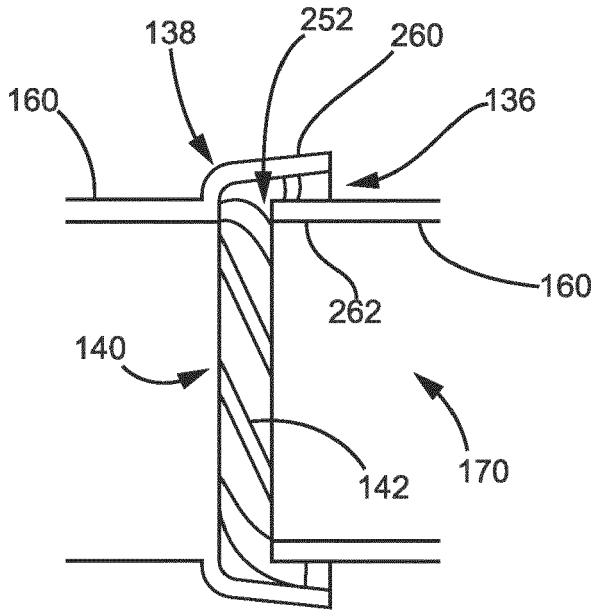
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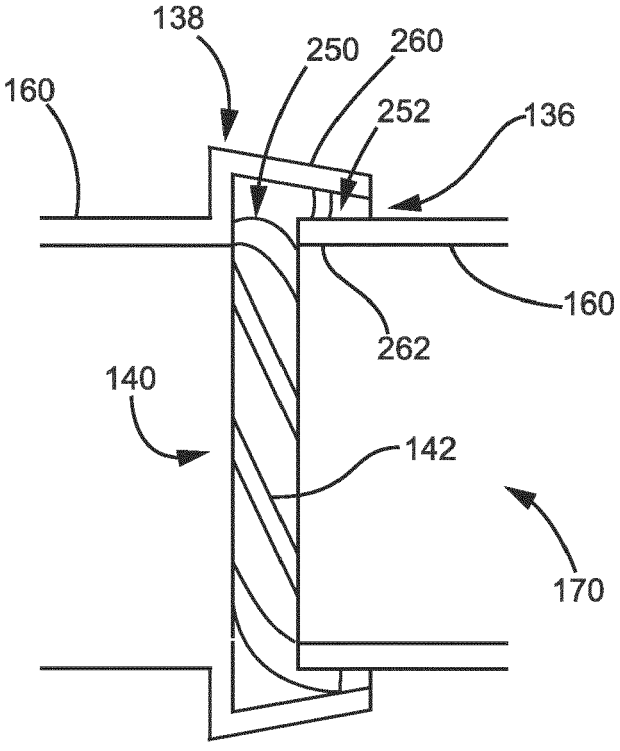
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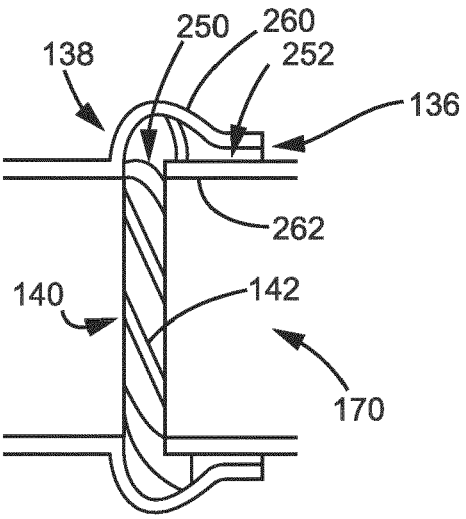
Fig. 43



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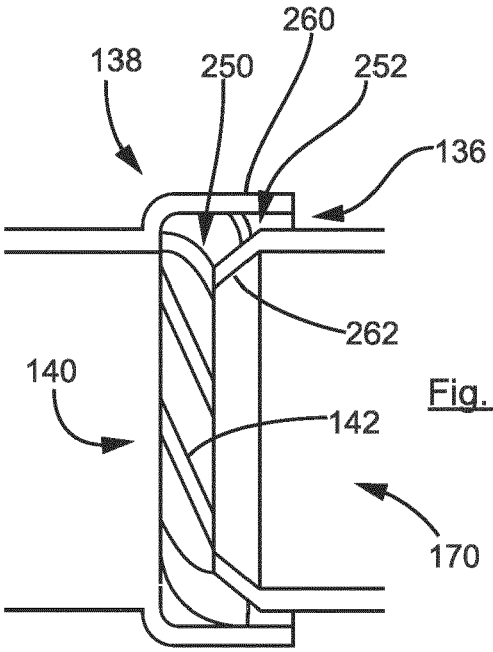

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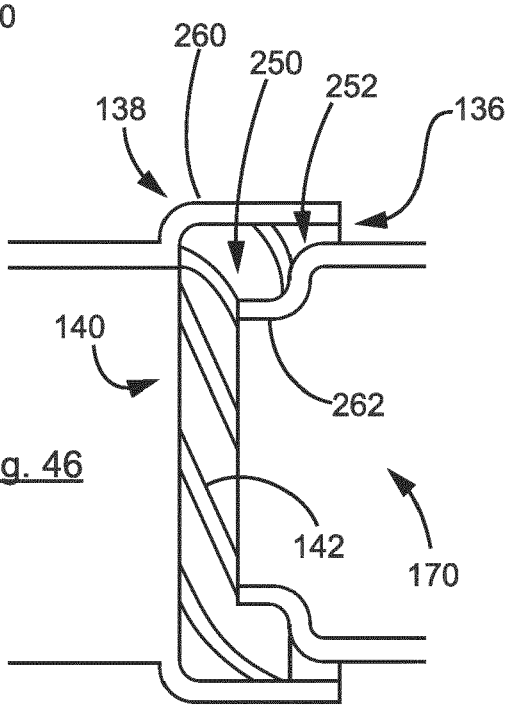

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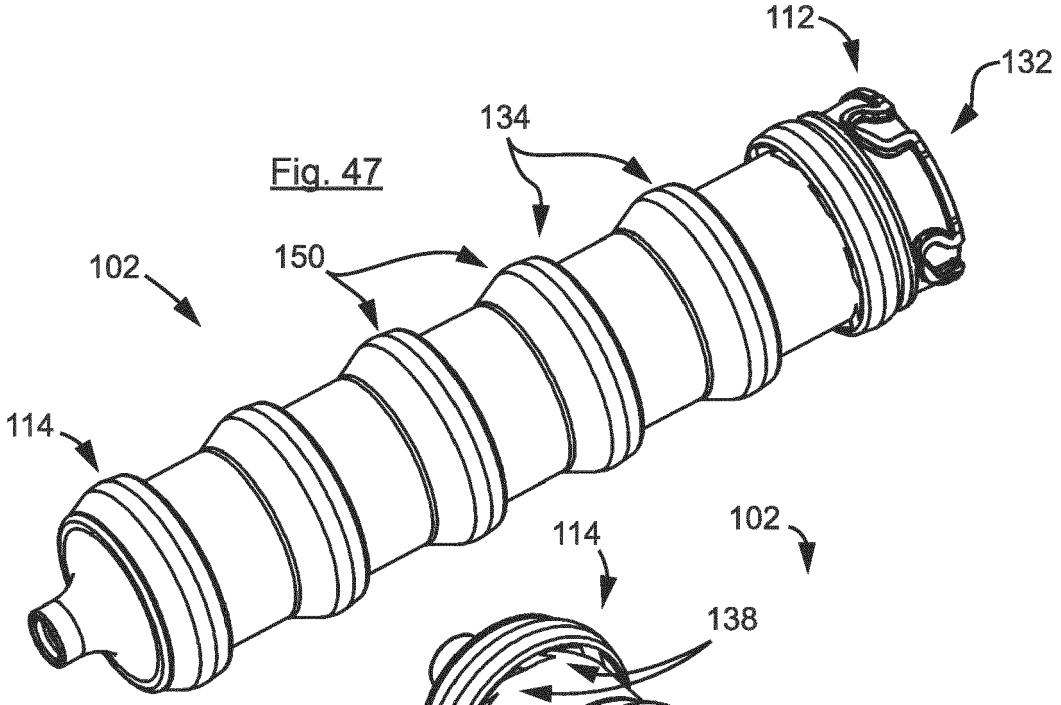
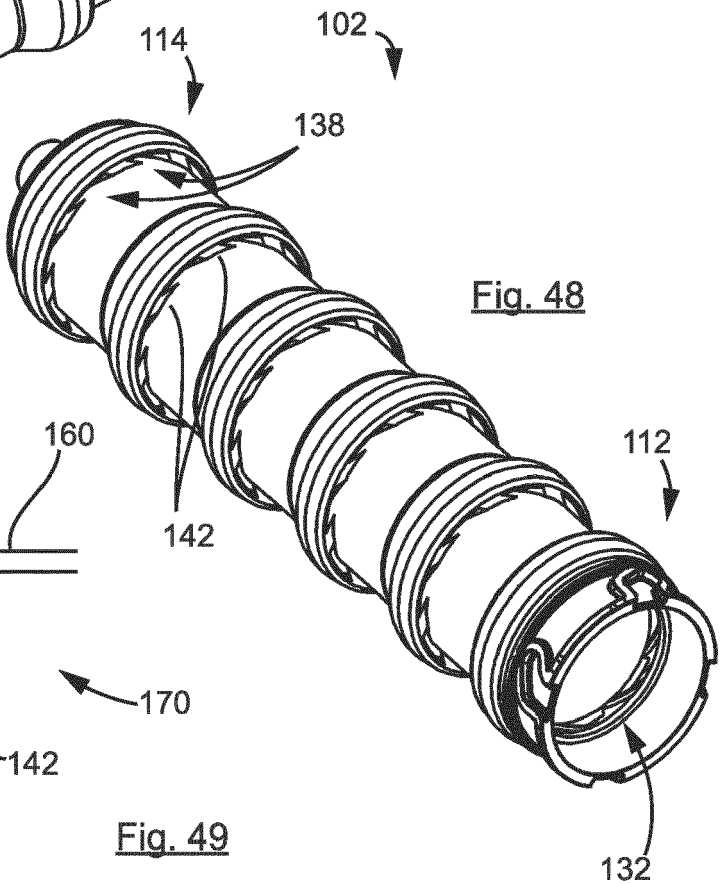


Fig. 47



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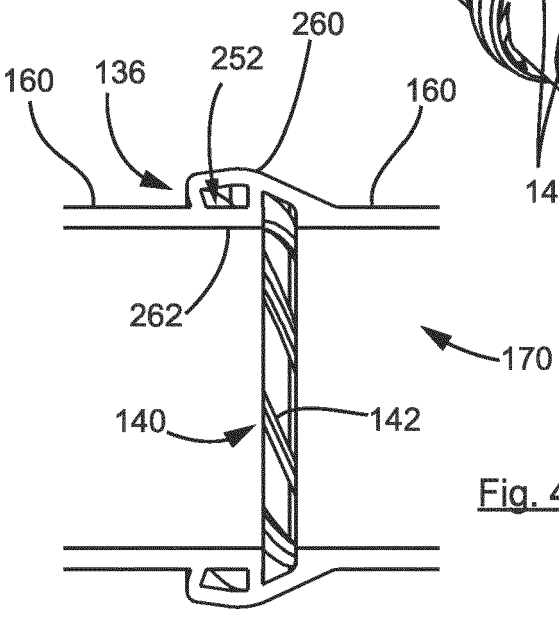

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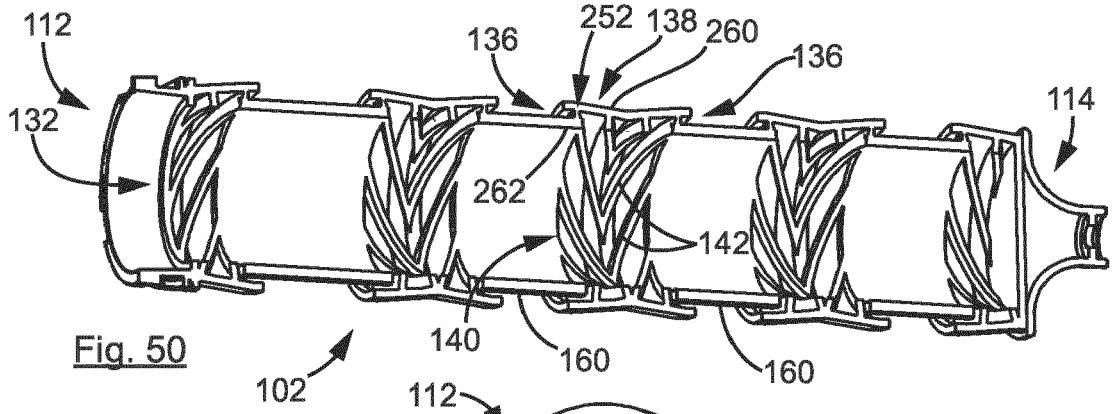

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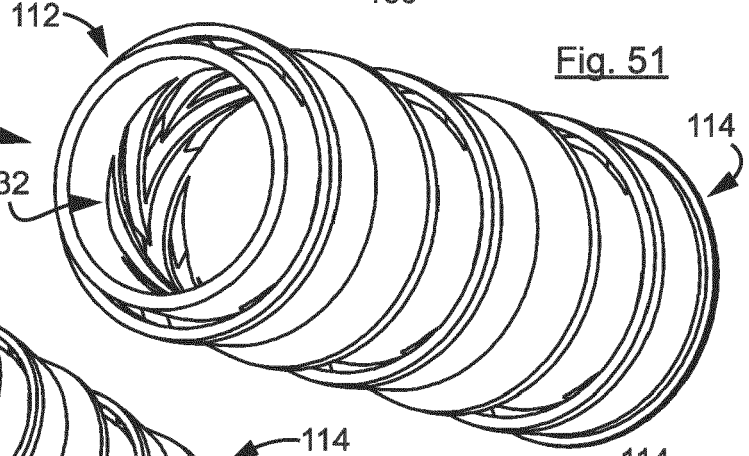

Fig. 51

Fig. 52

Fig. 53

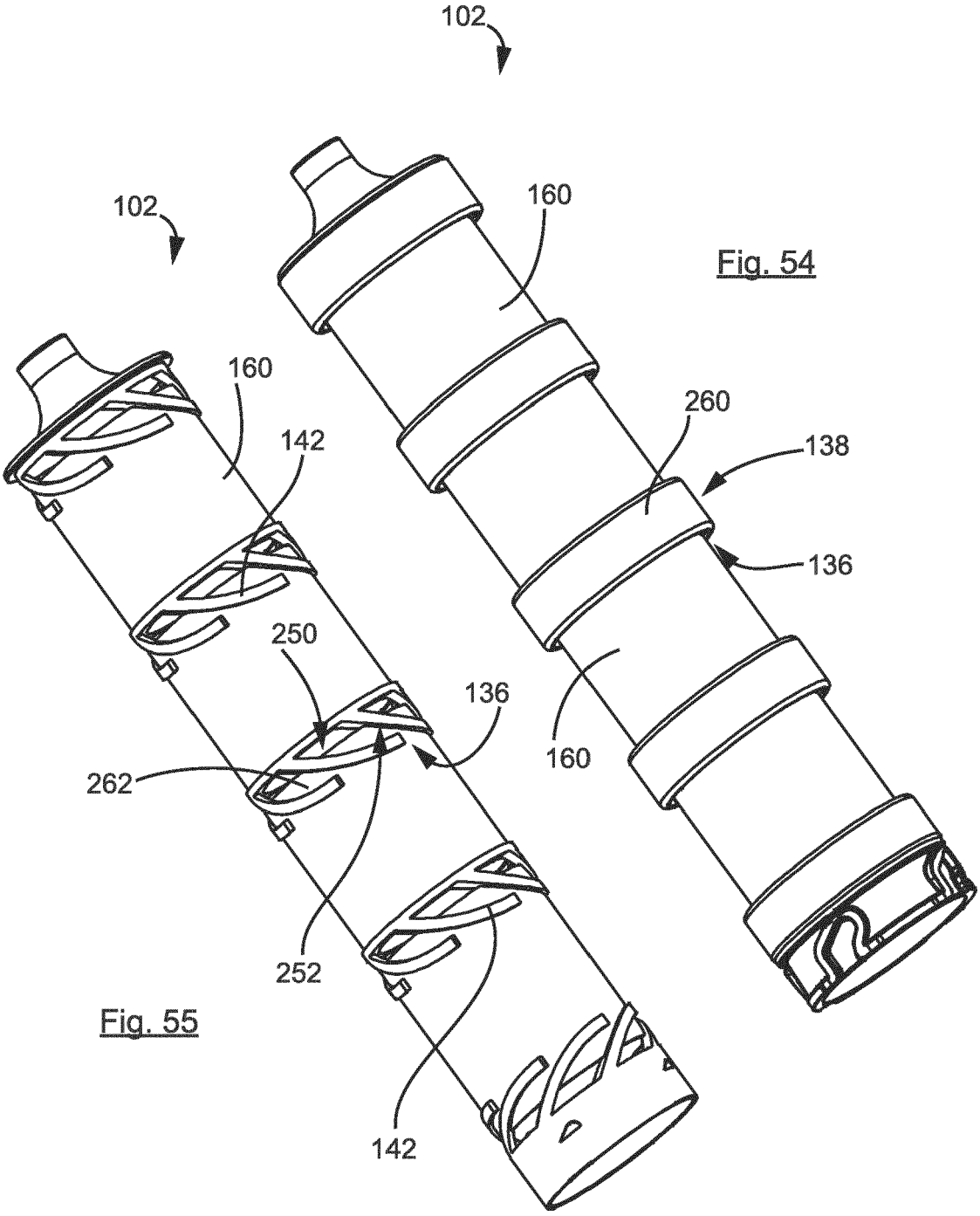

Fig. 54

Fig. 55

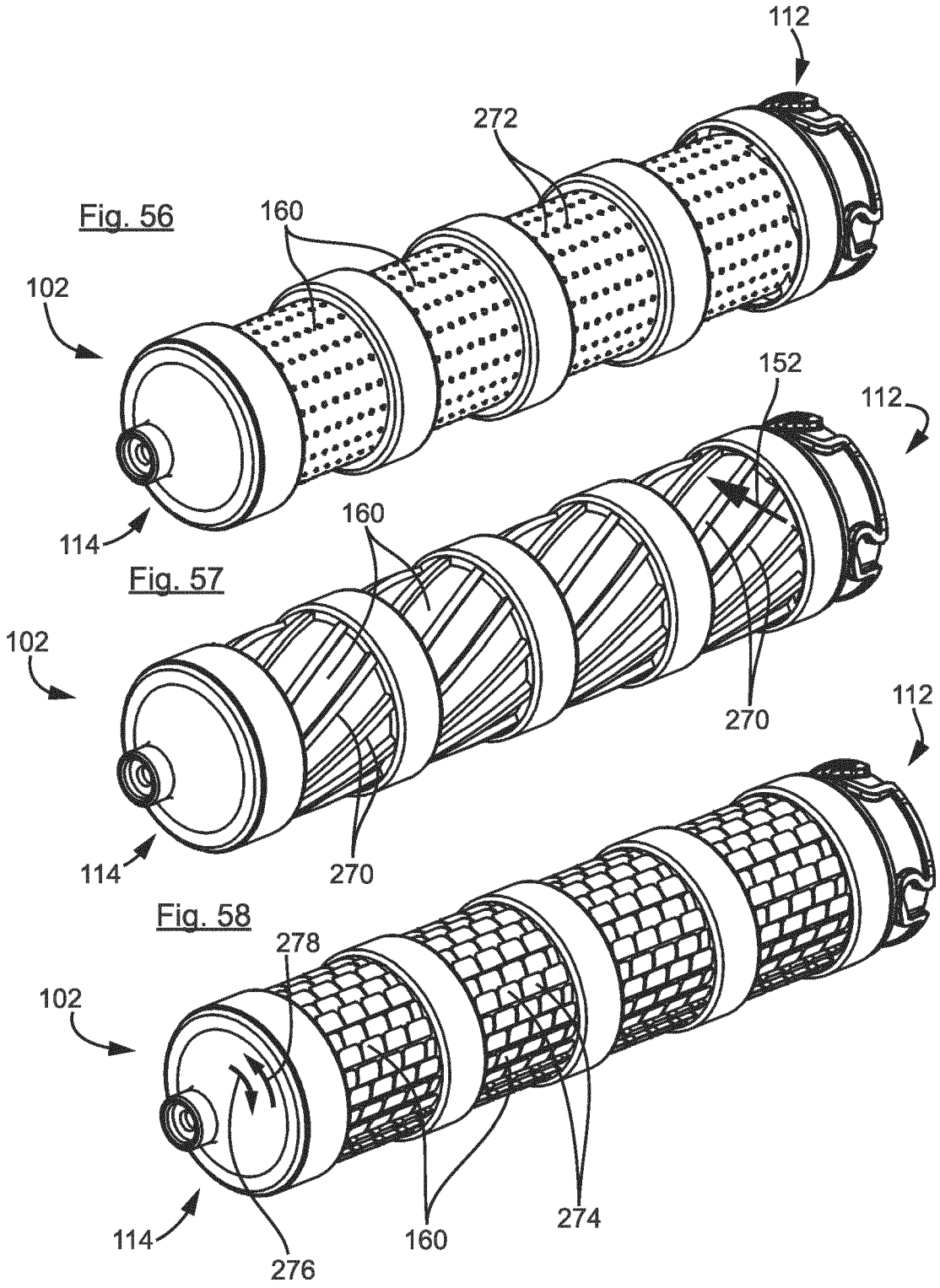

Fig. 56

Fig. 57

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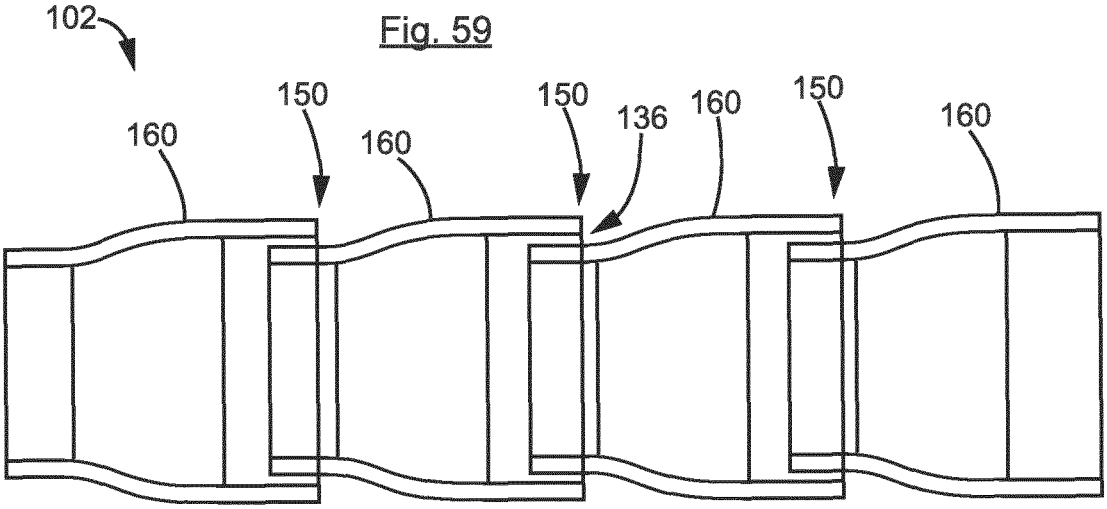
Fig. 59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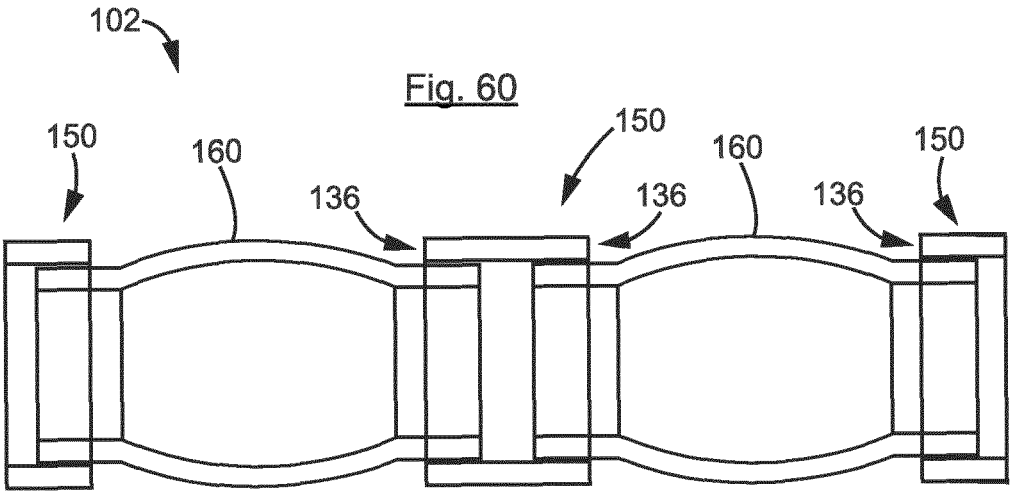
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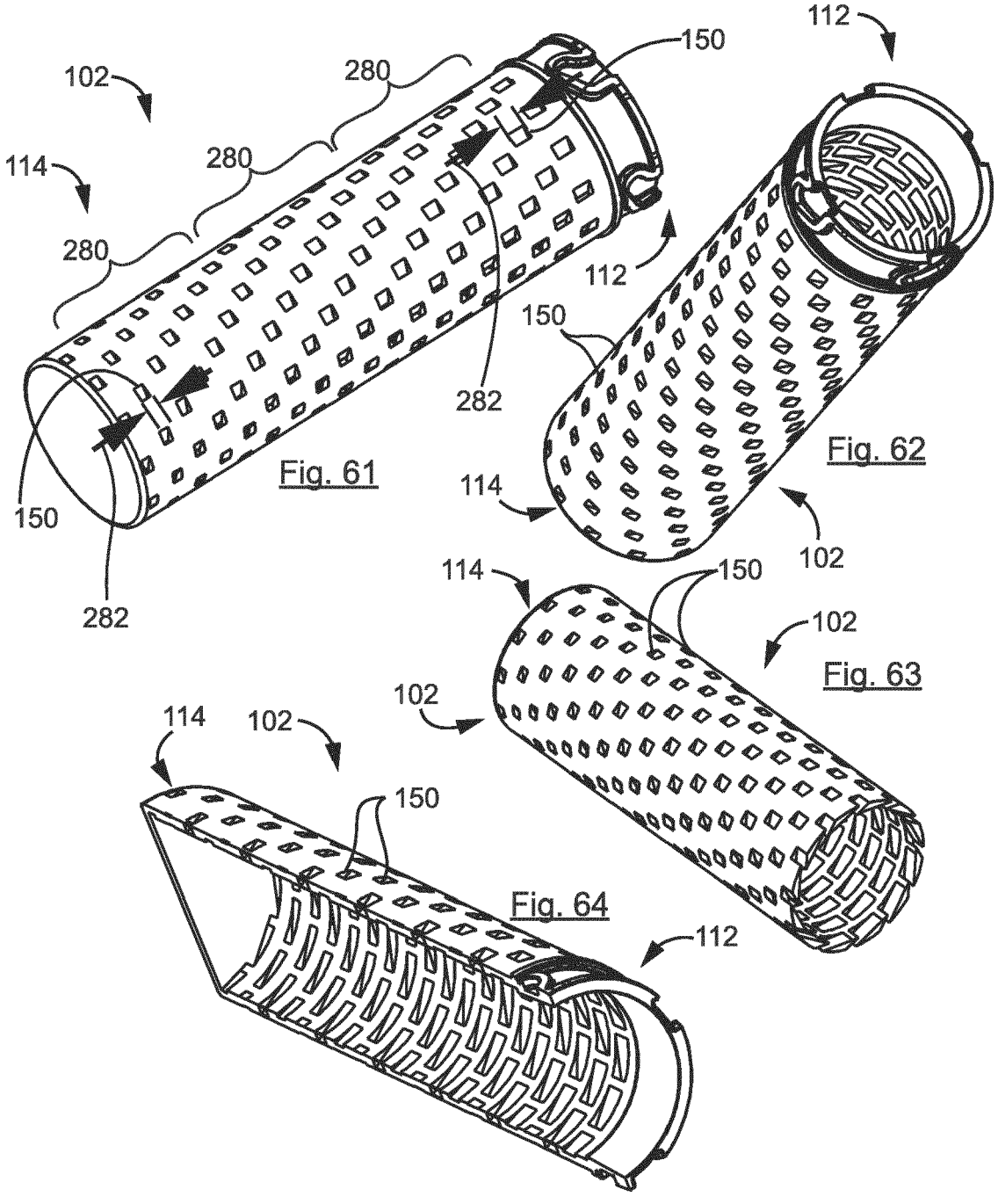
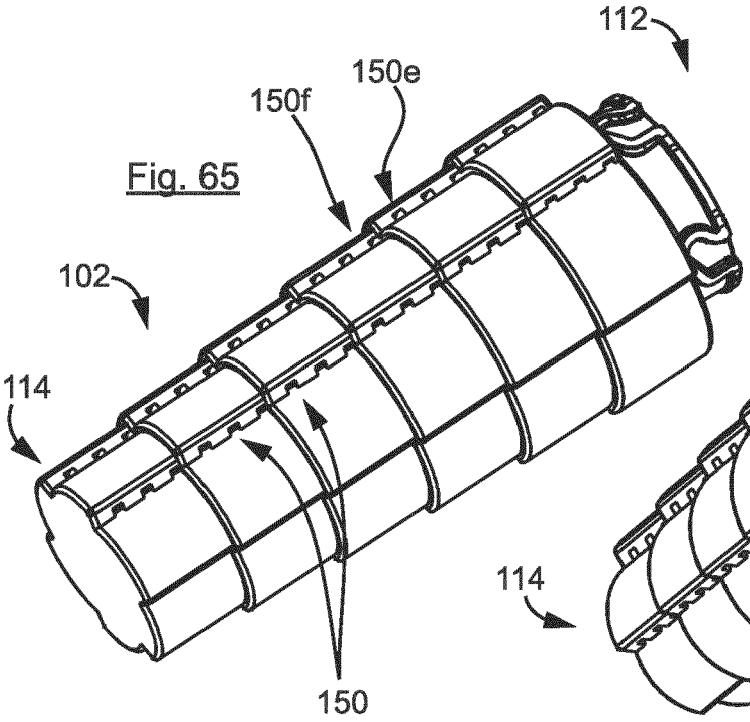


Fig. 61

Fig. 62

Fig. 63

Fig. 64



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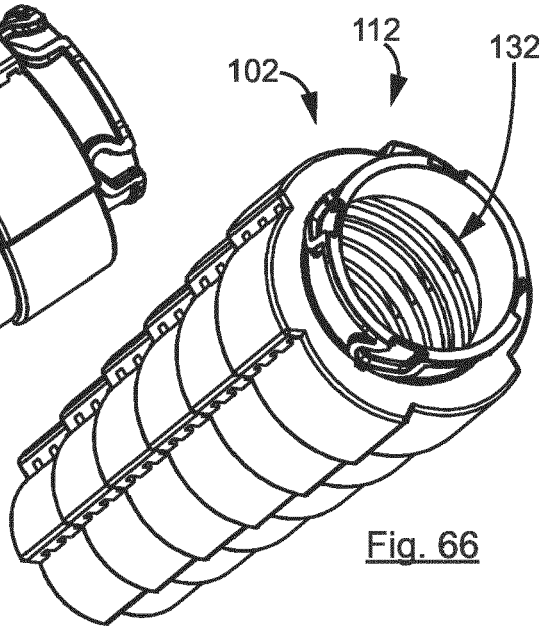

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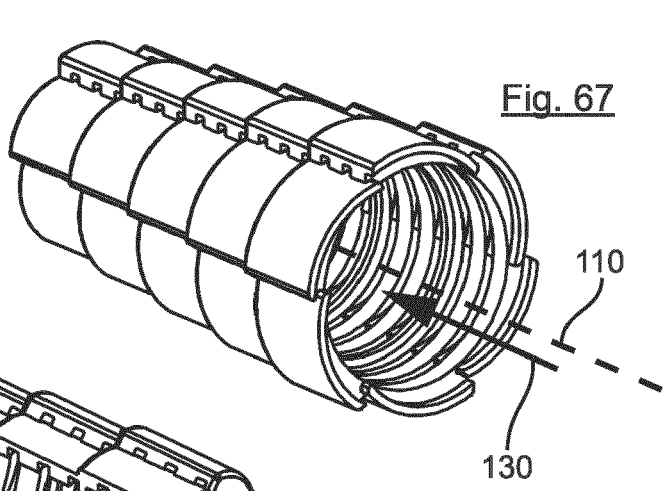

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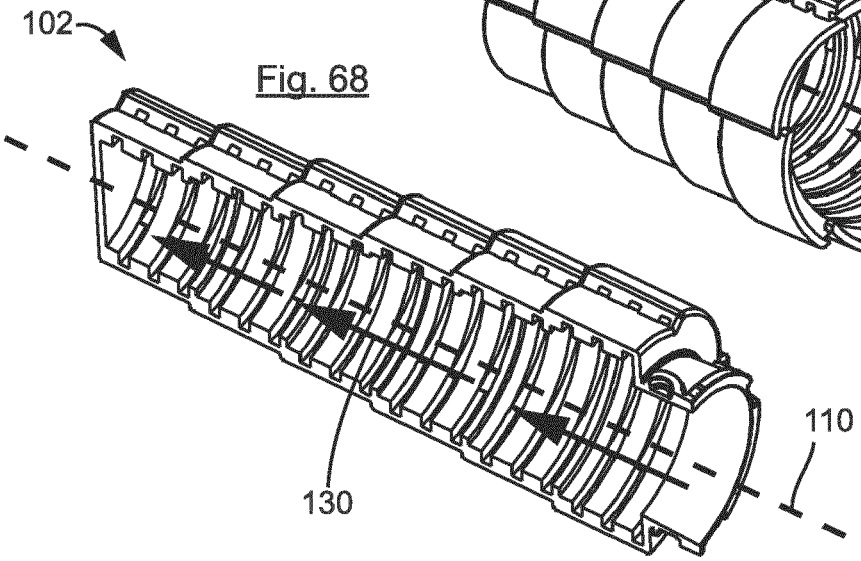

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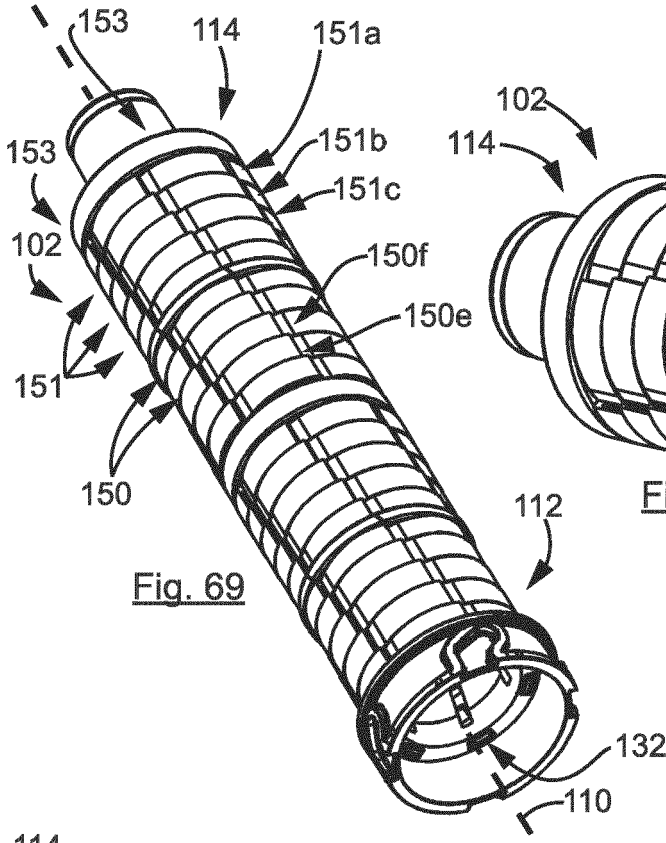

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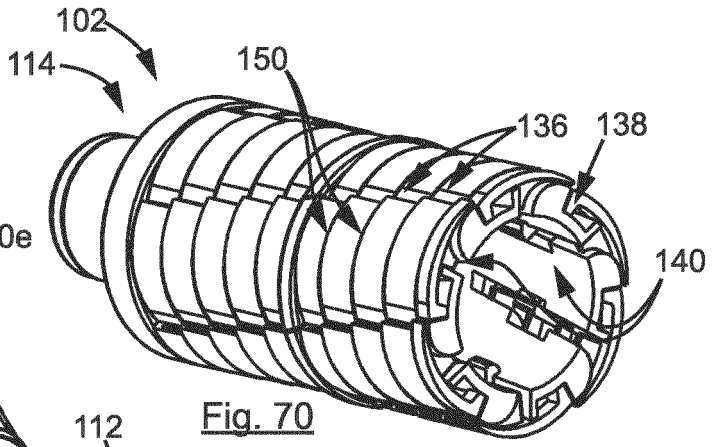

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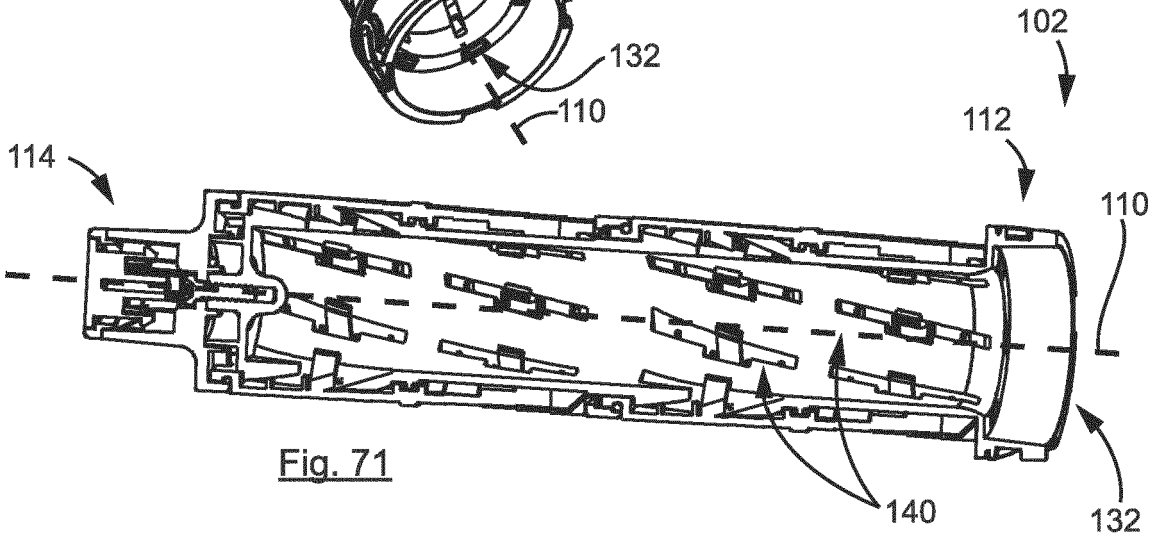

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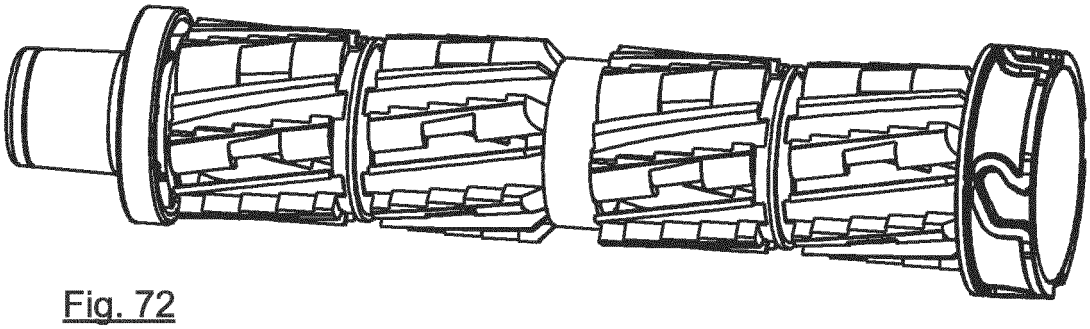

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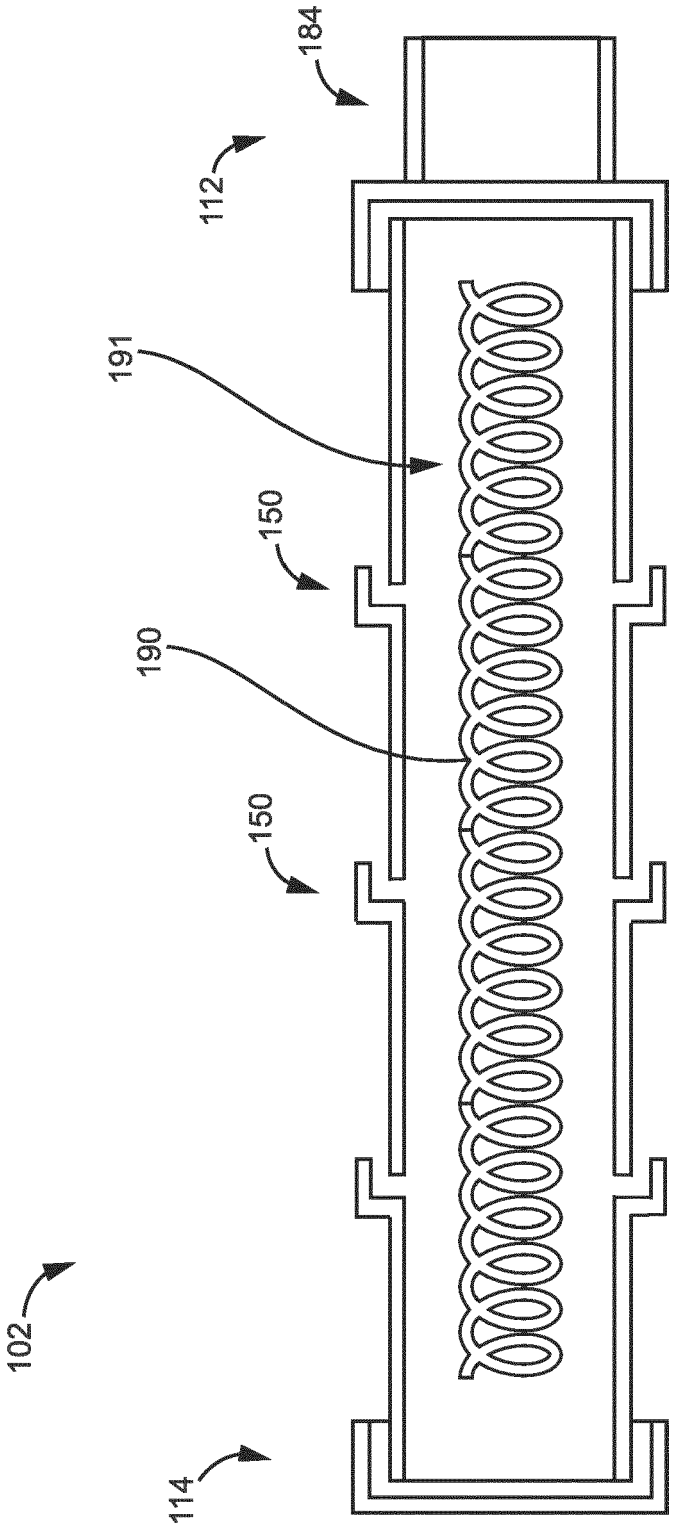

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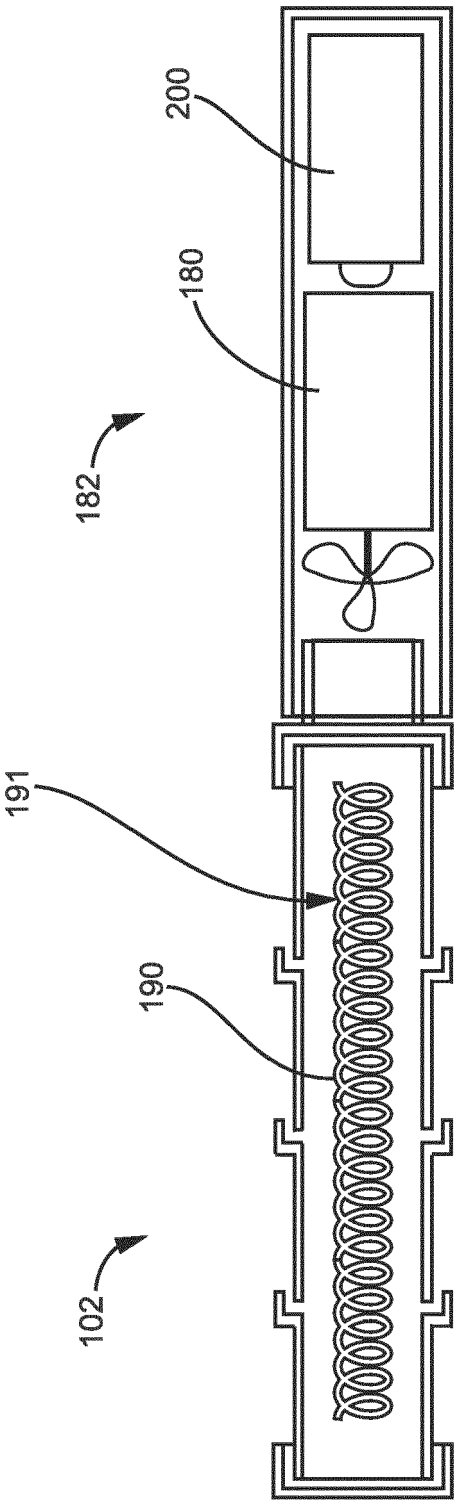

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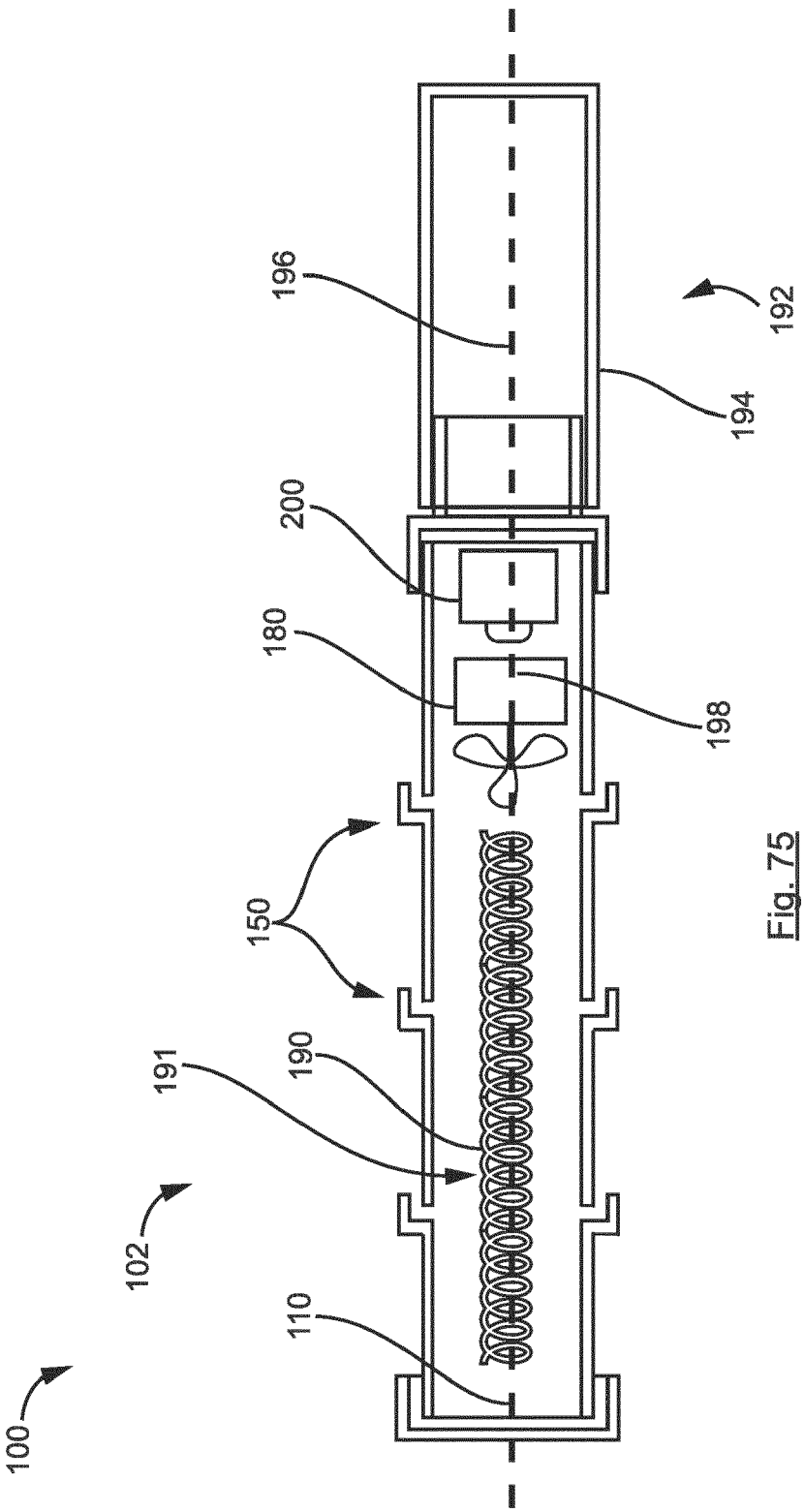

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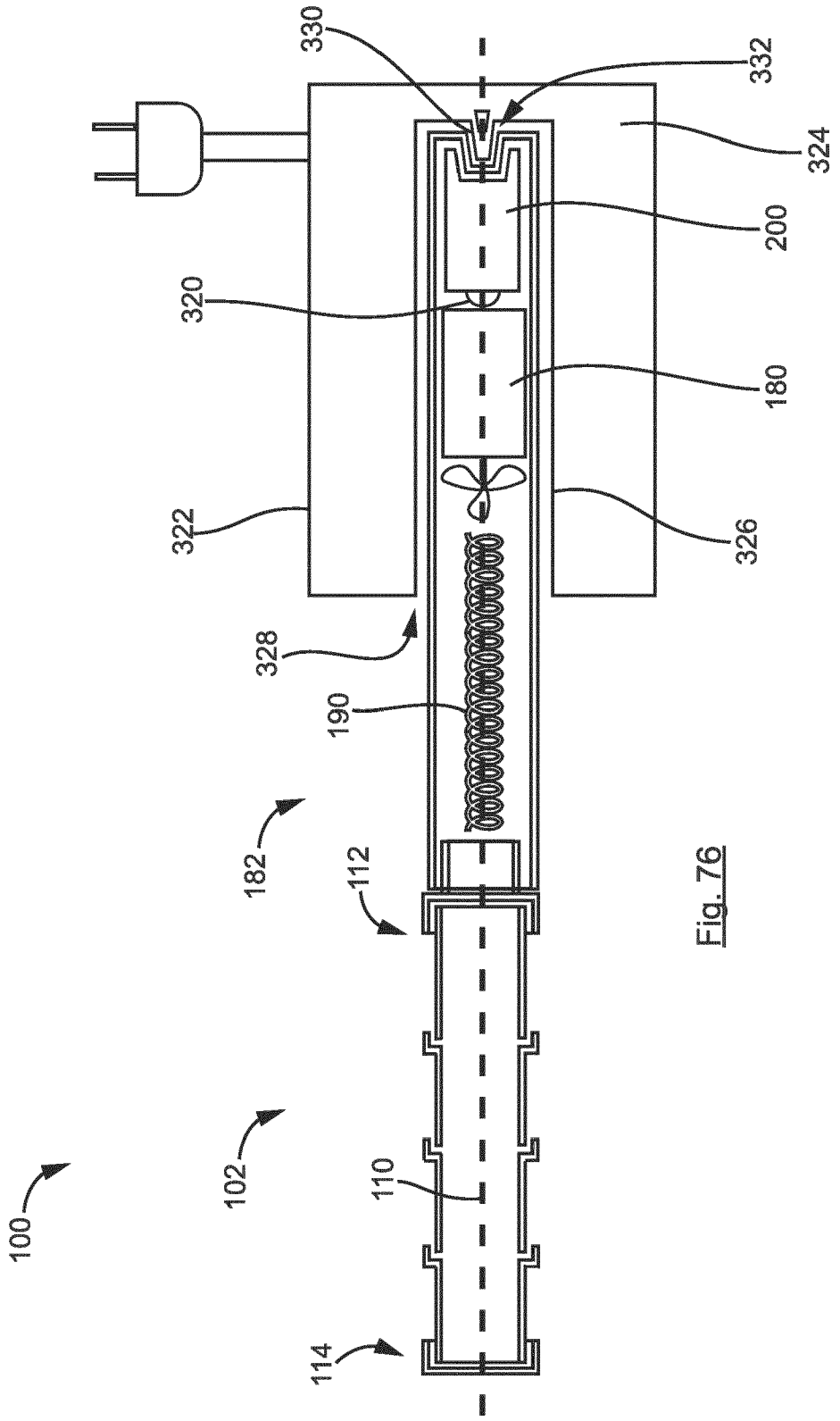

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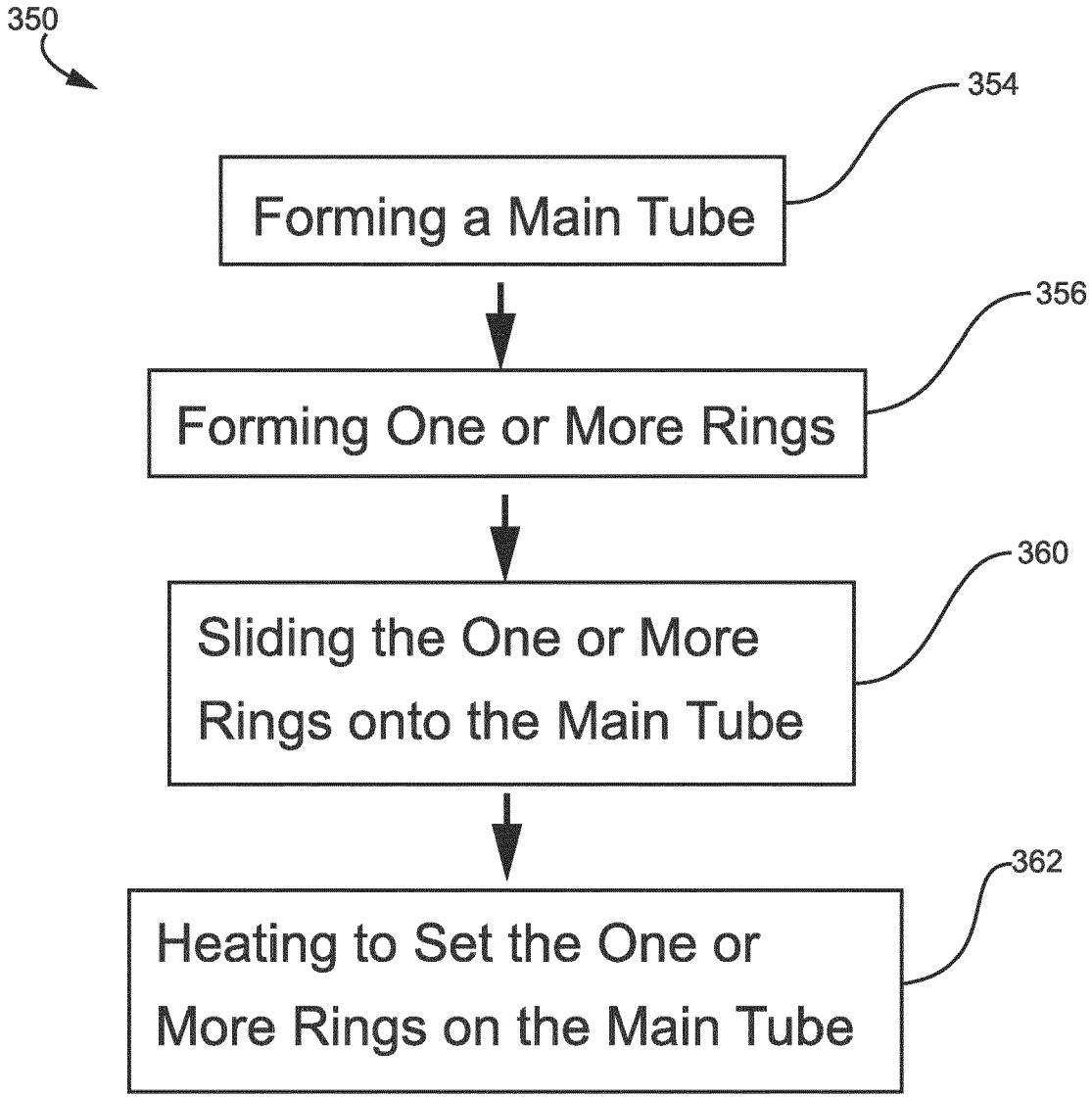
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Forming a Main Tube
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Forming One or More Rings
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Sliding the One or More Rings onto the Main Tube
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Heating to Set the One or More Rings on the Main Tube

Fig. 77

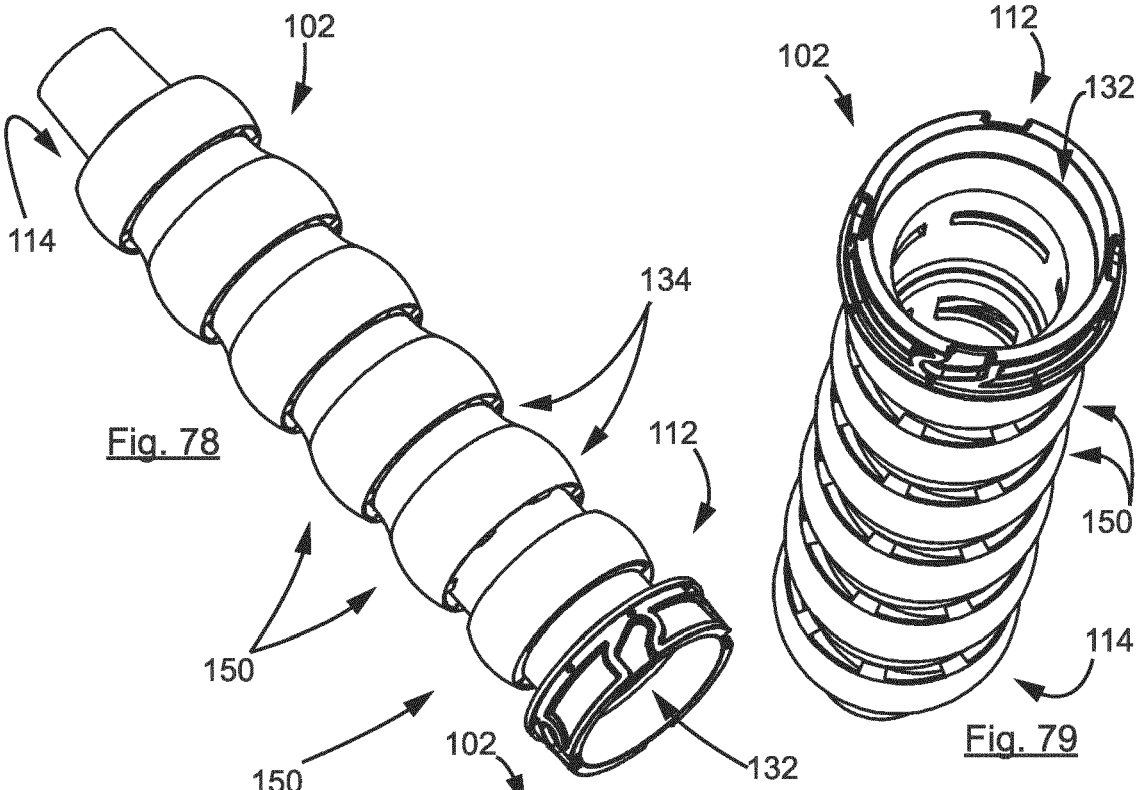


Fig. 78

Fig. 79

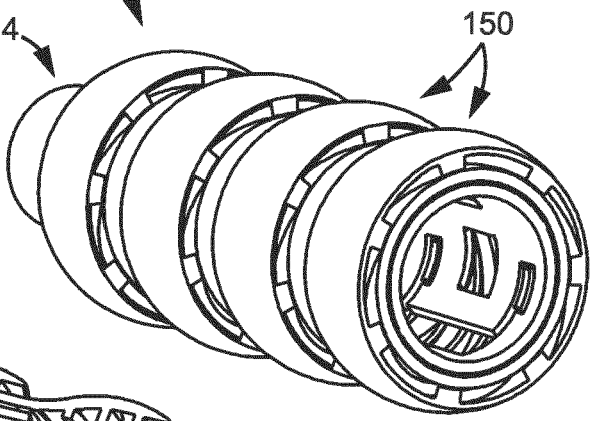
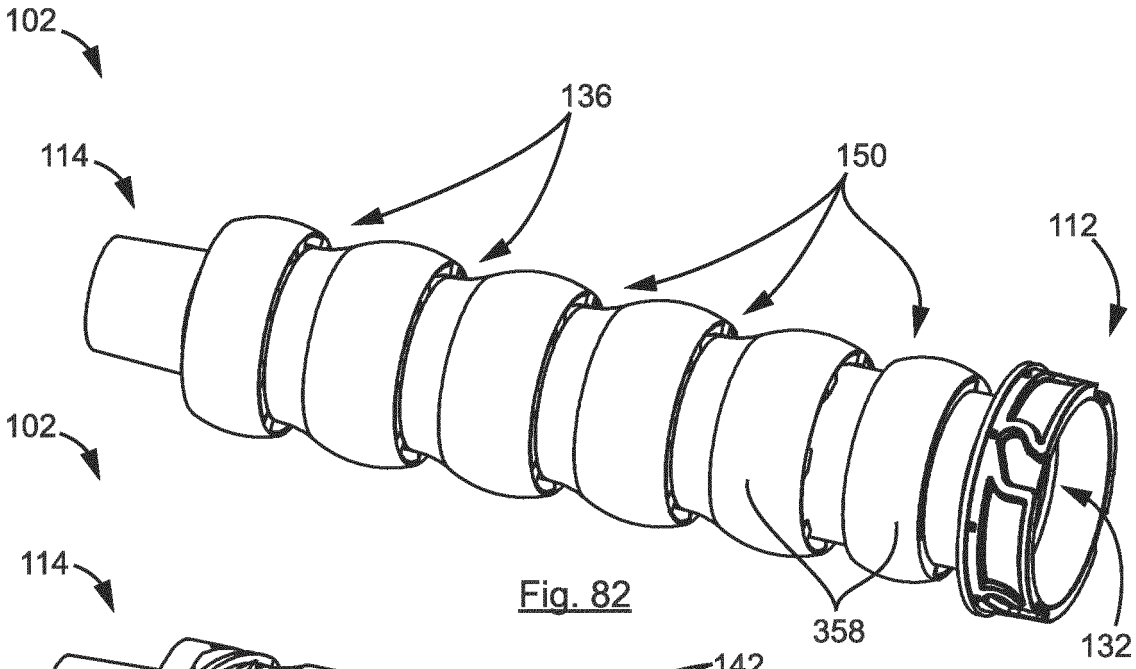


Fig. 80

Fig. 81



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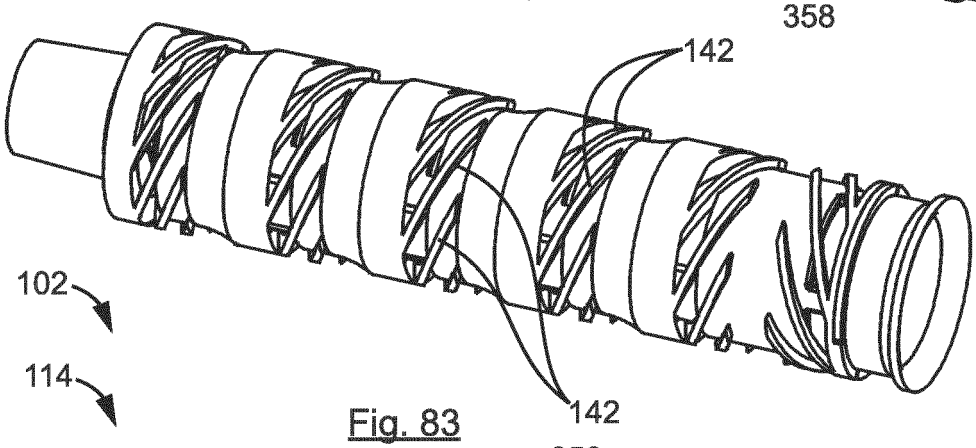

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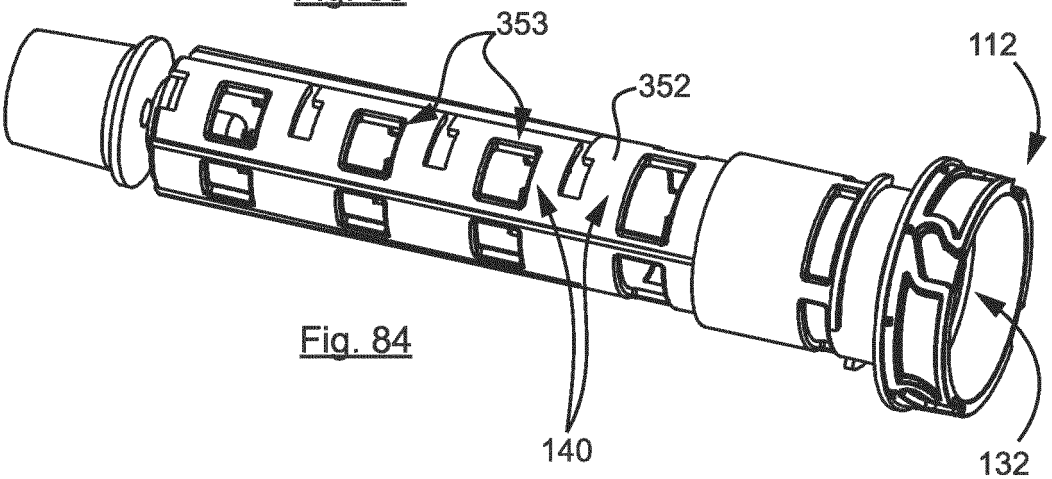

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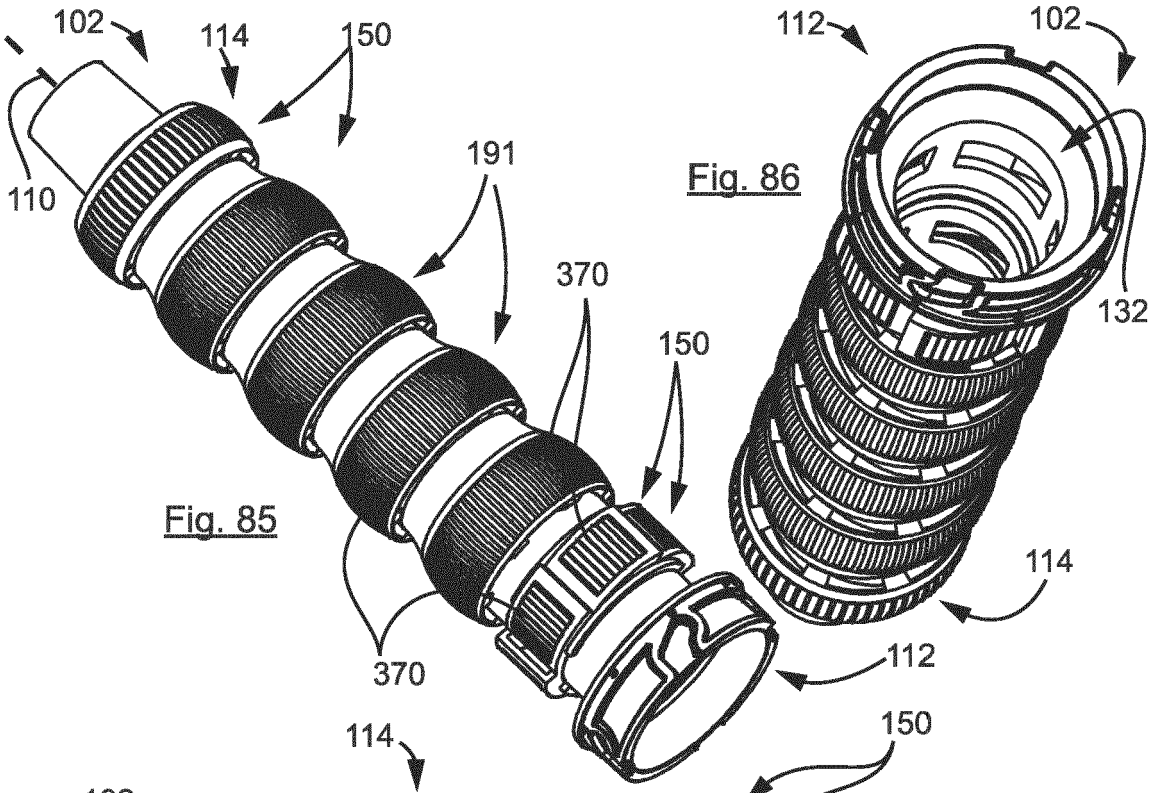
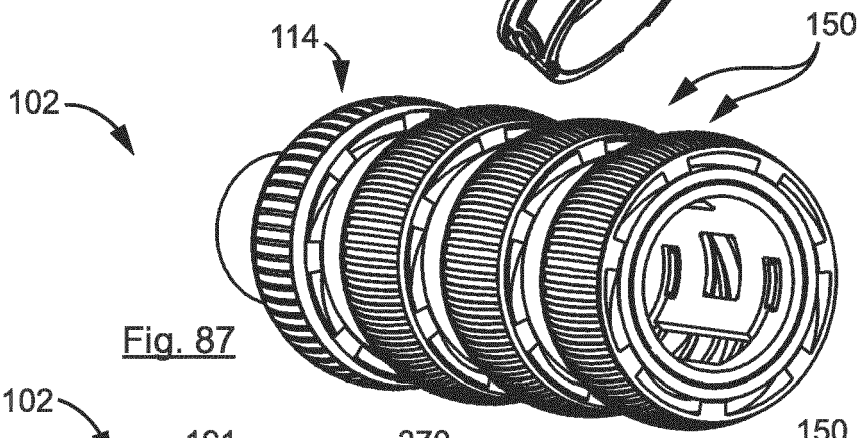


Fig. 85

Fig. 86



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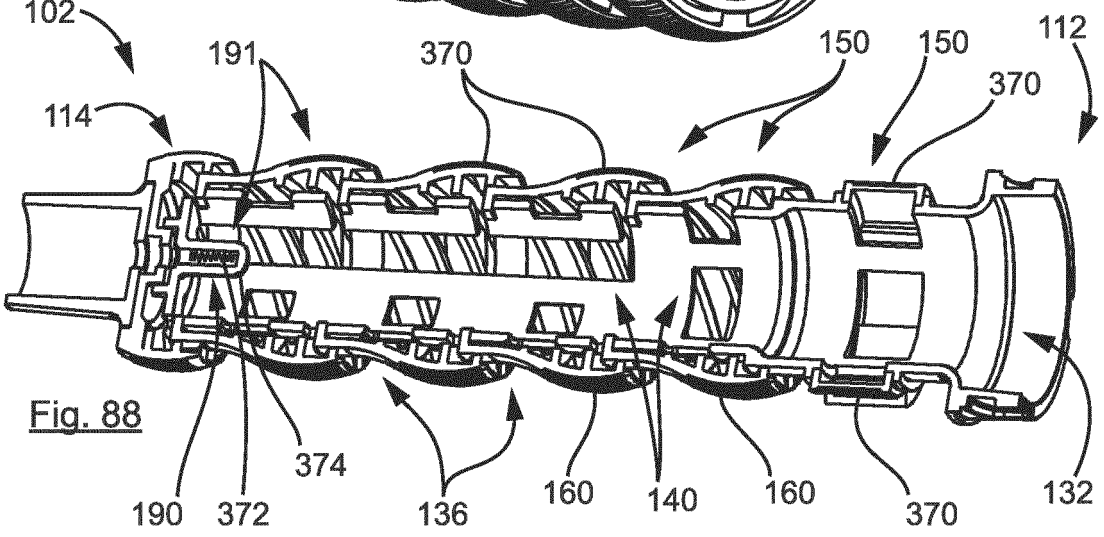

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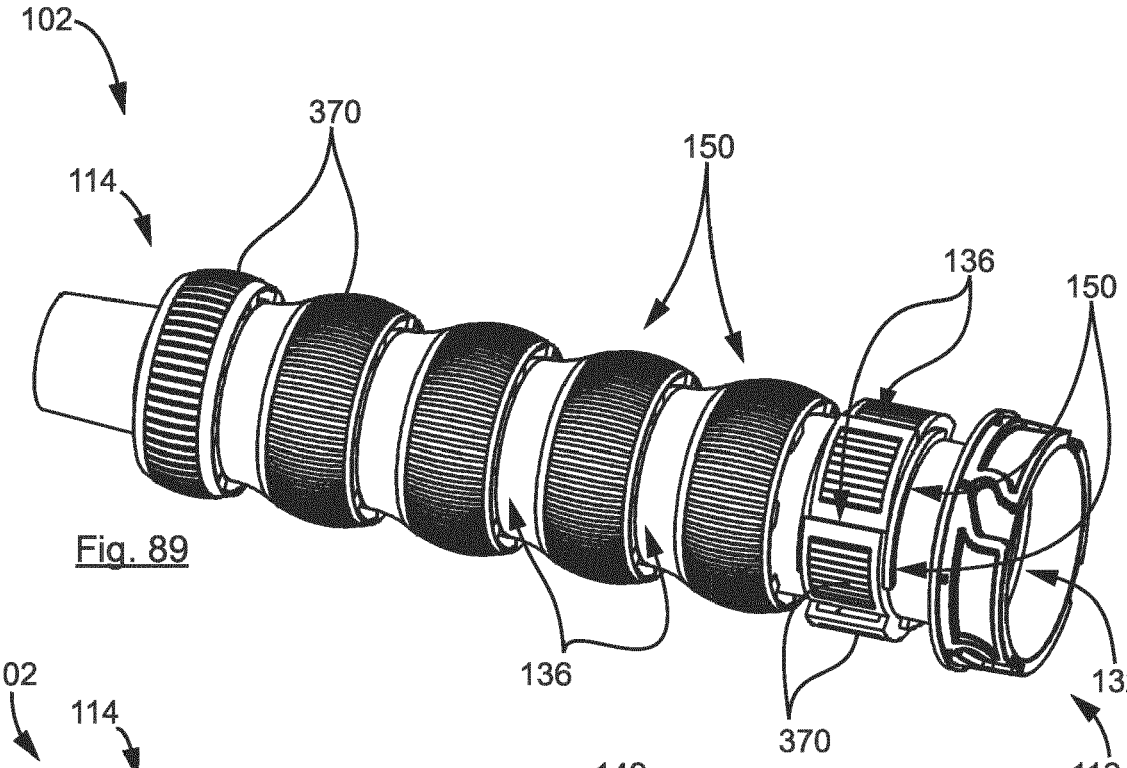

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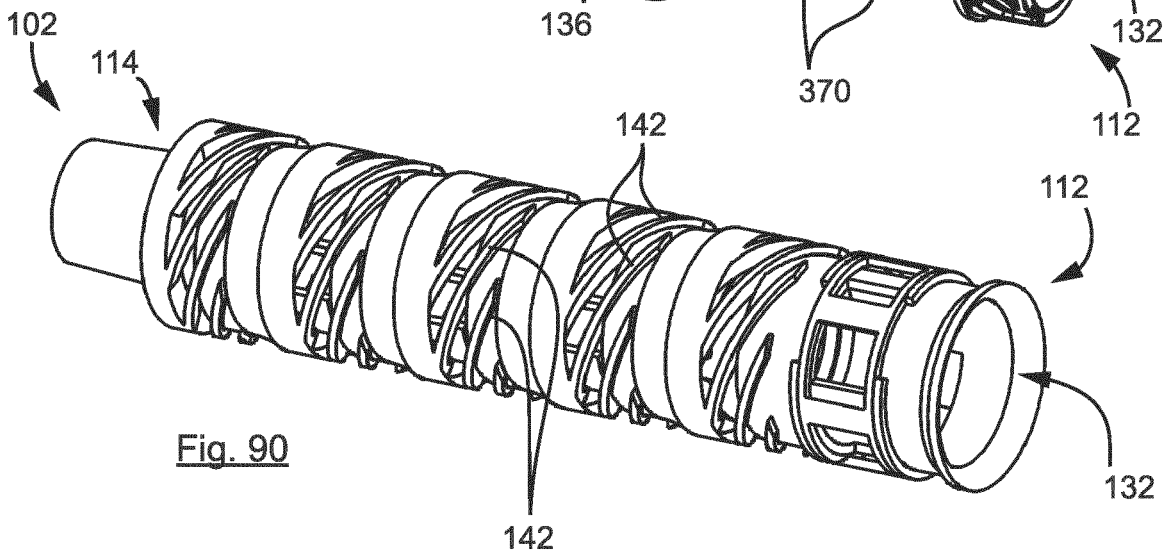

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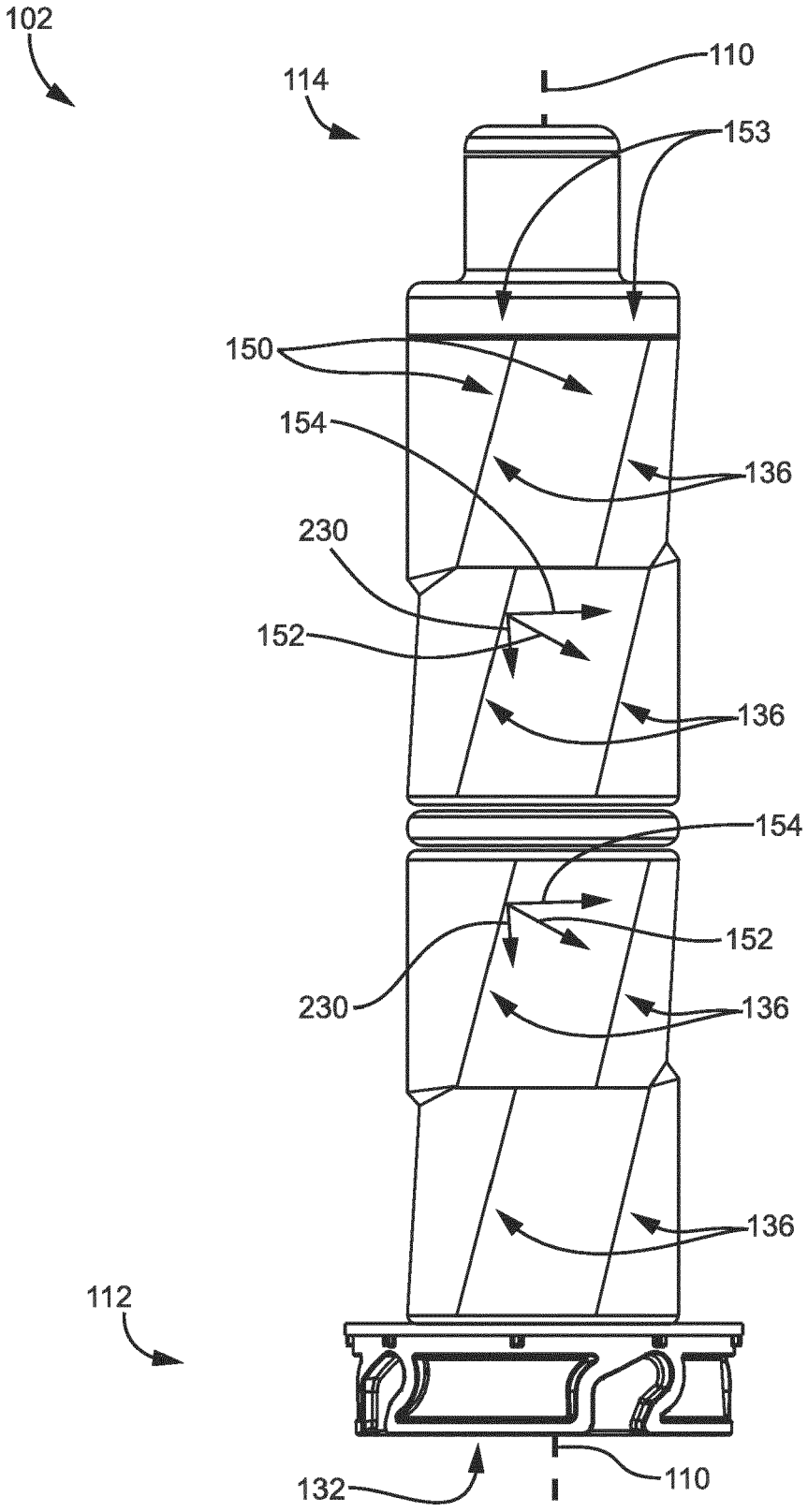
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Fig. 91

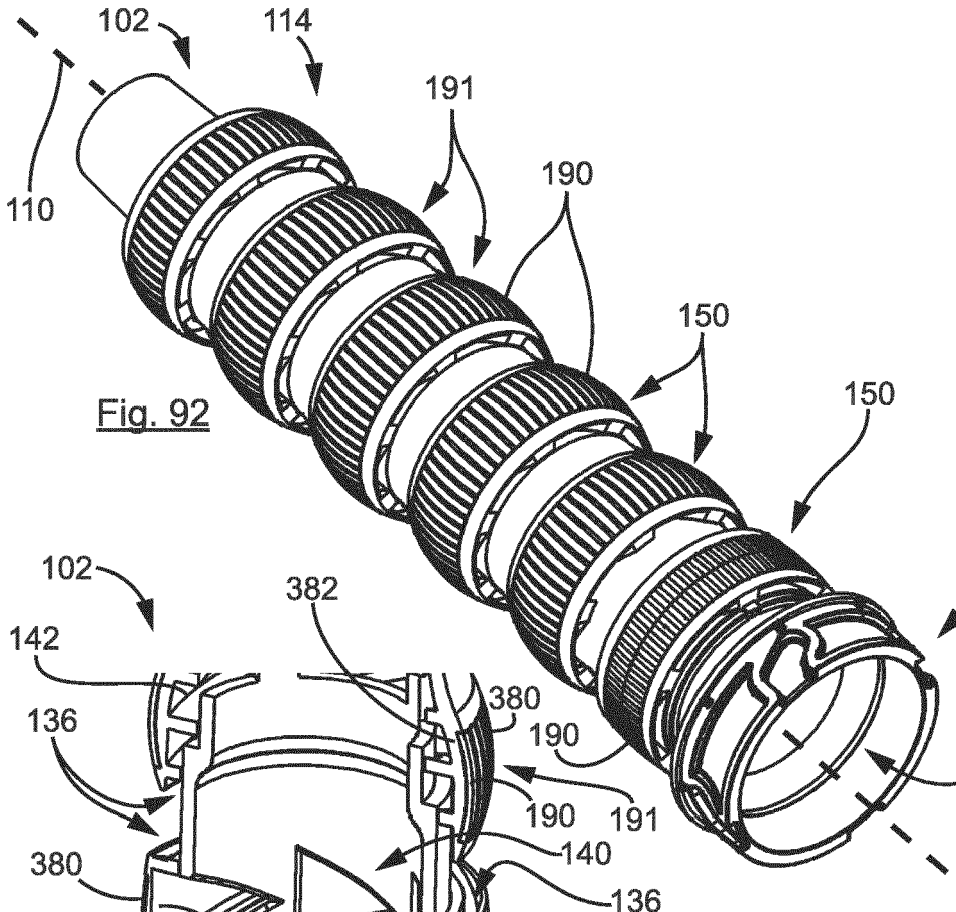
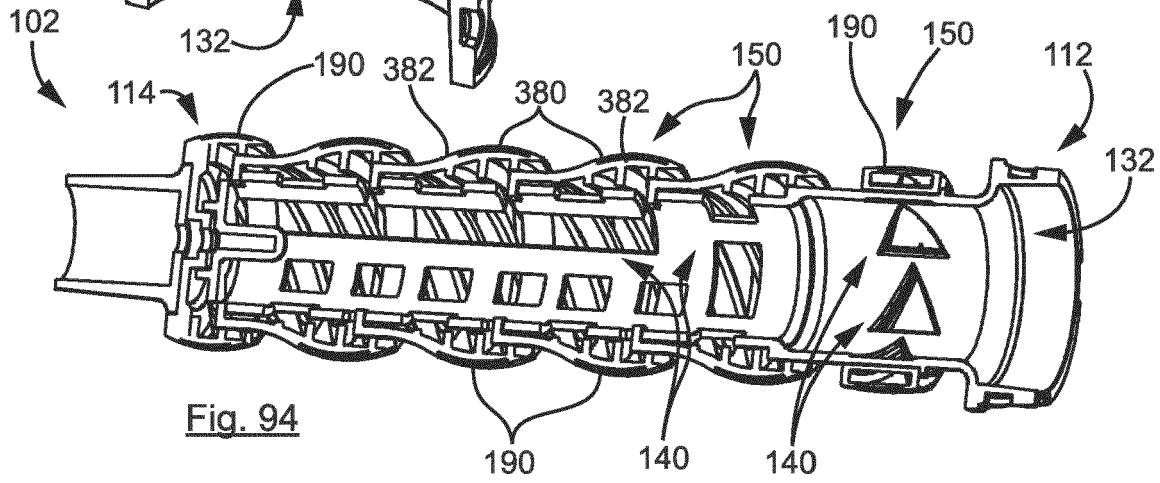


Fig. 92

Fig. 93



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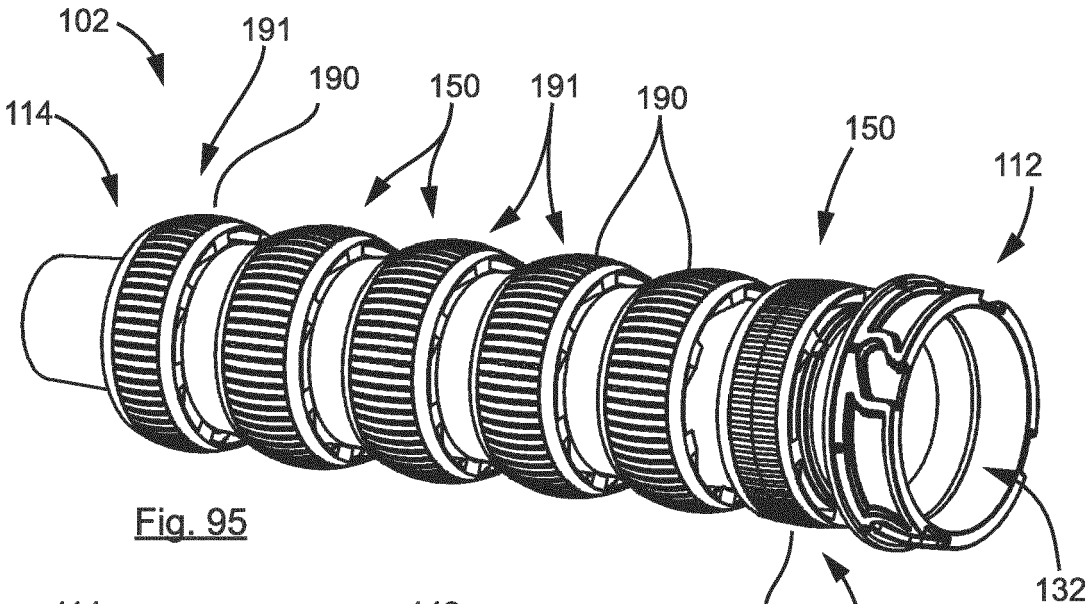
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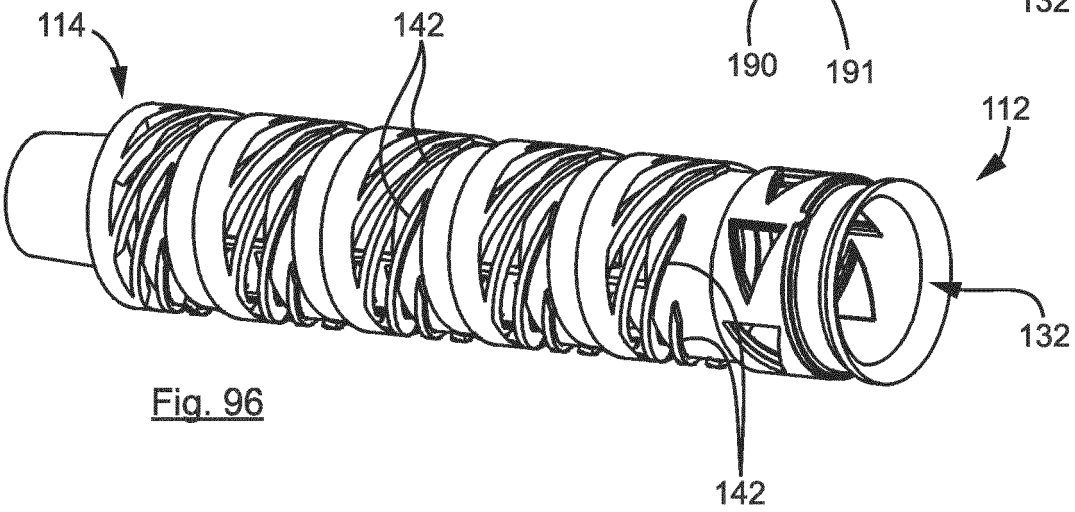
Fig. 95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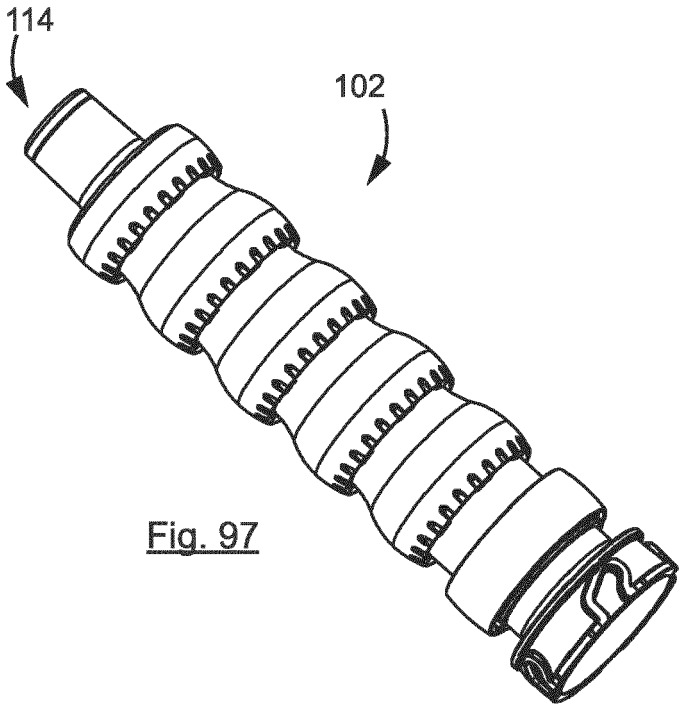
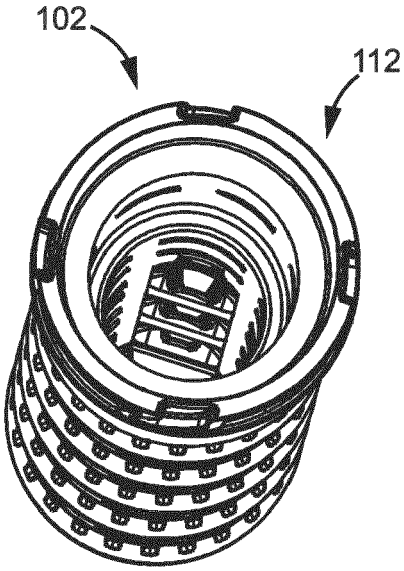


Fig. 97



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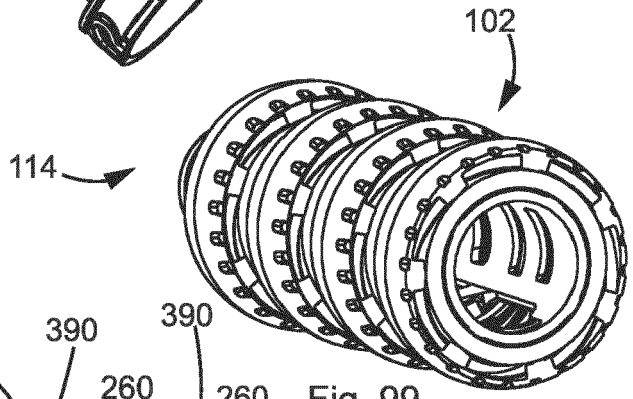

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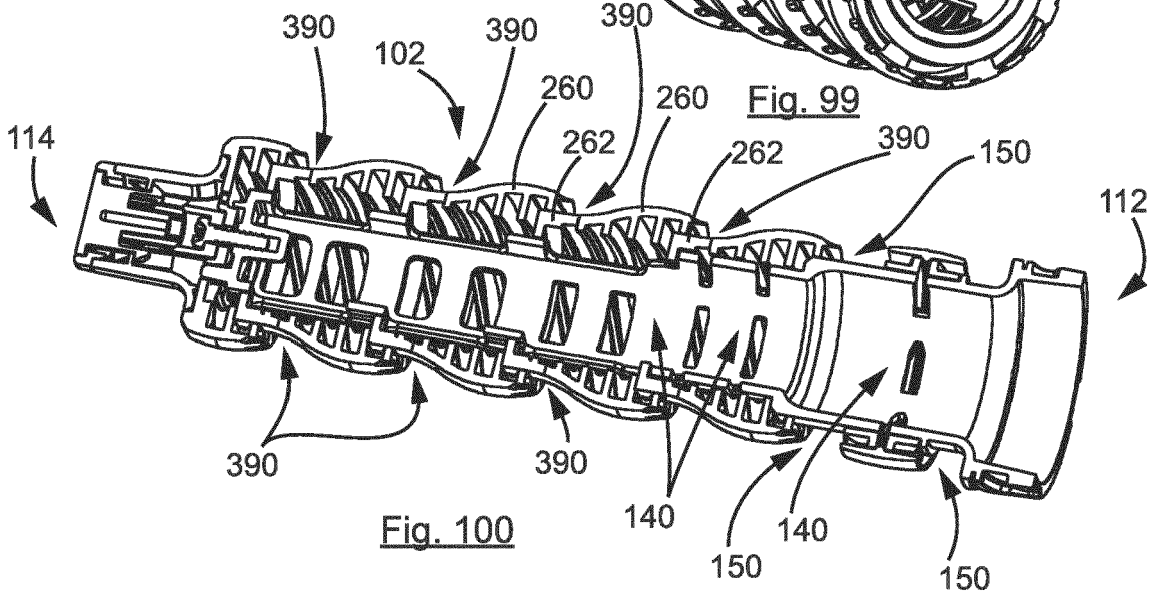

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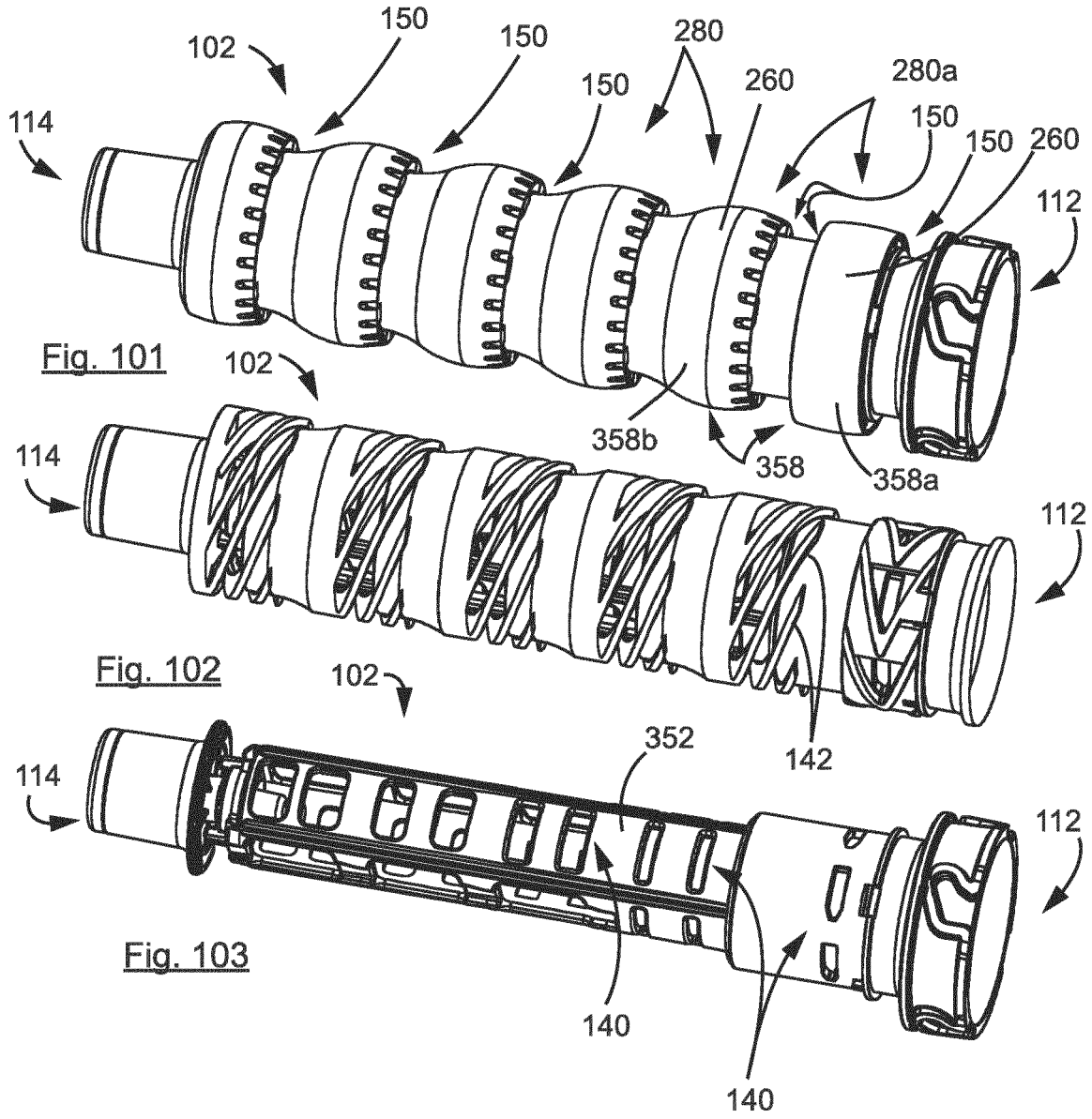


Fig. 101

Fig. 102

Fig. 103

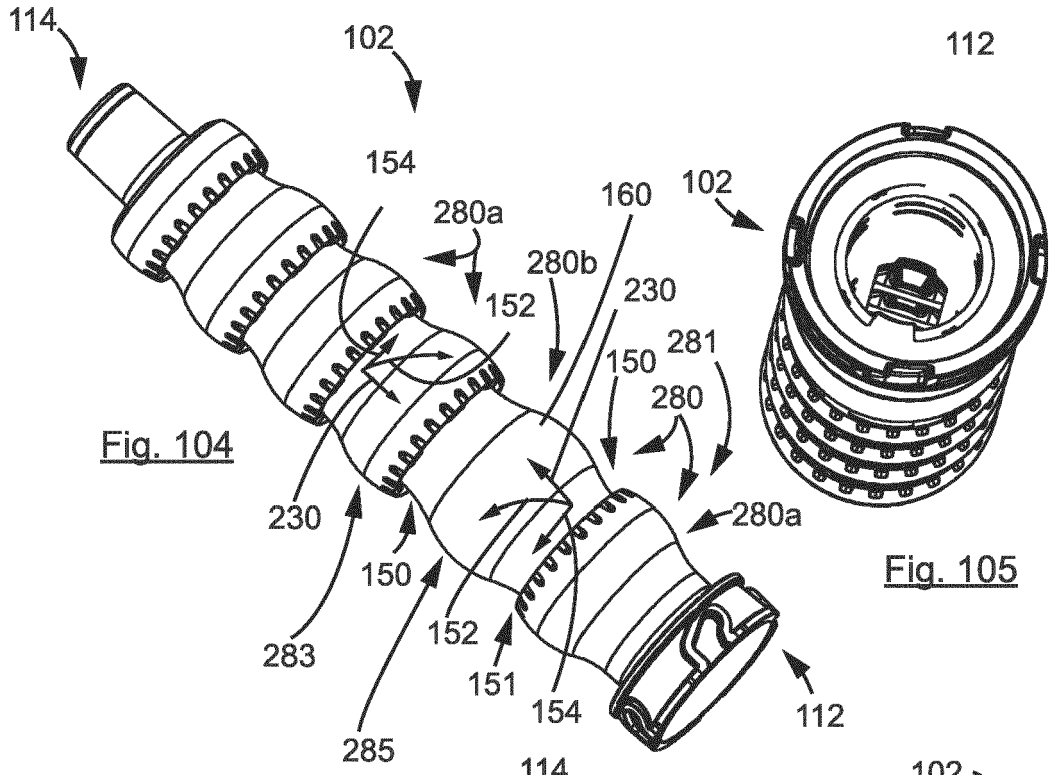
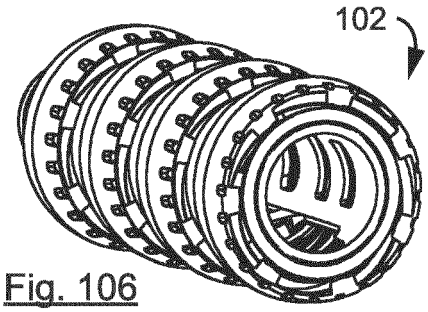


Fig. 104

Fig. 105



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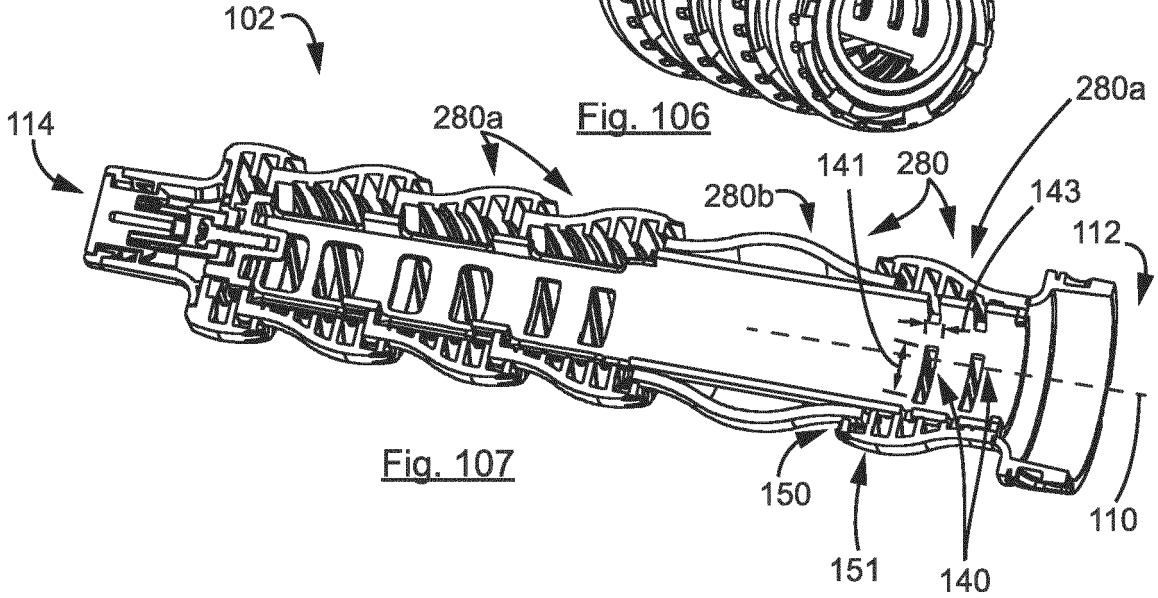


Fig. 107

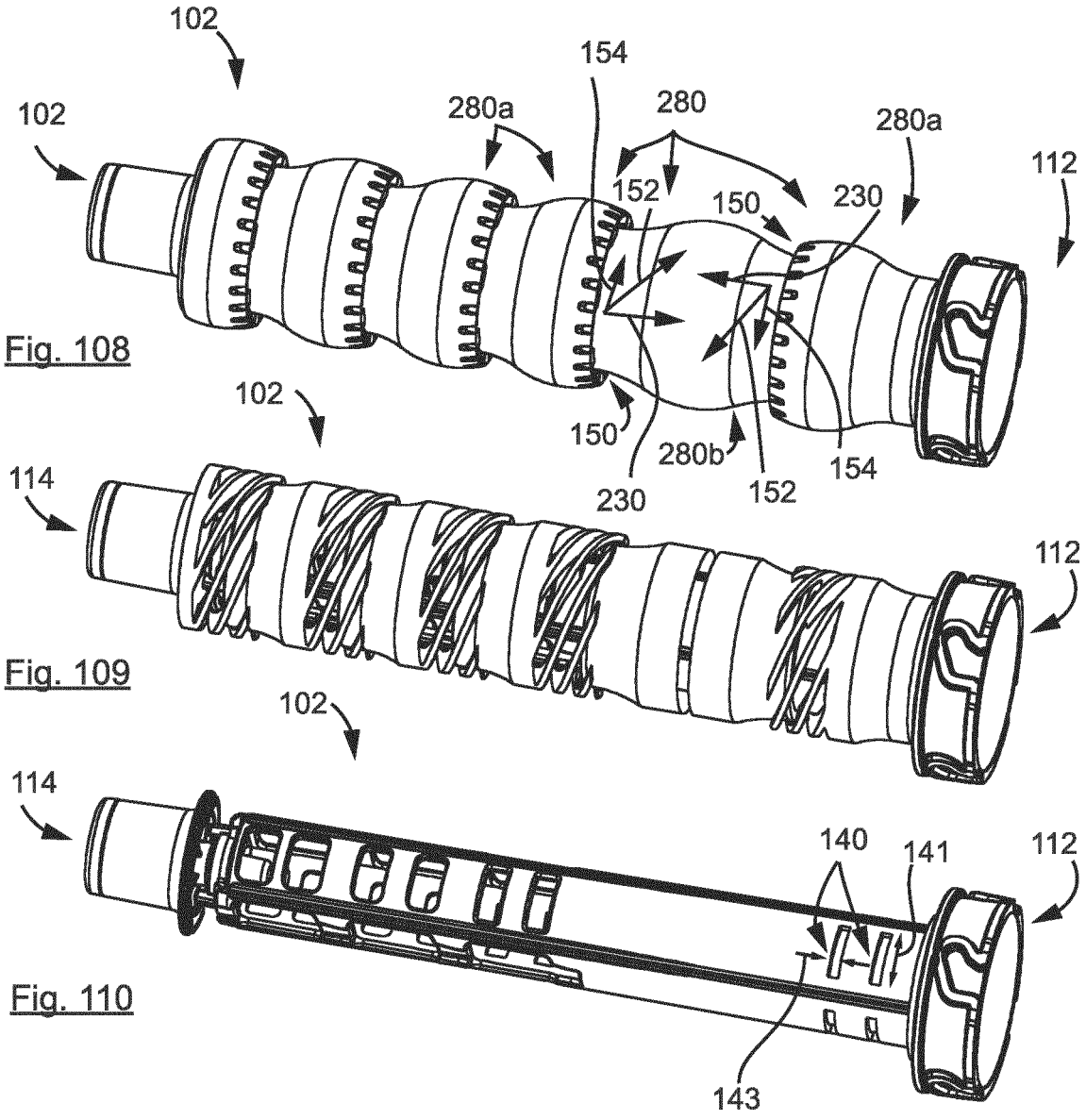
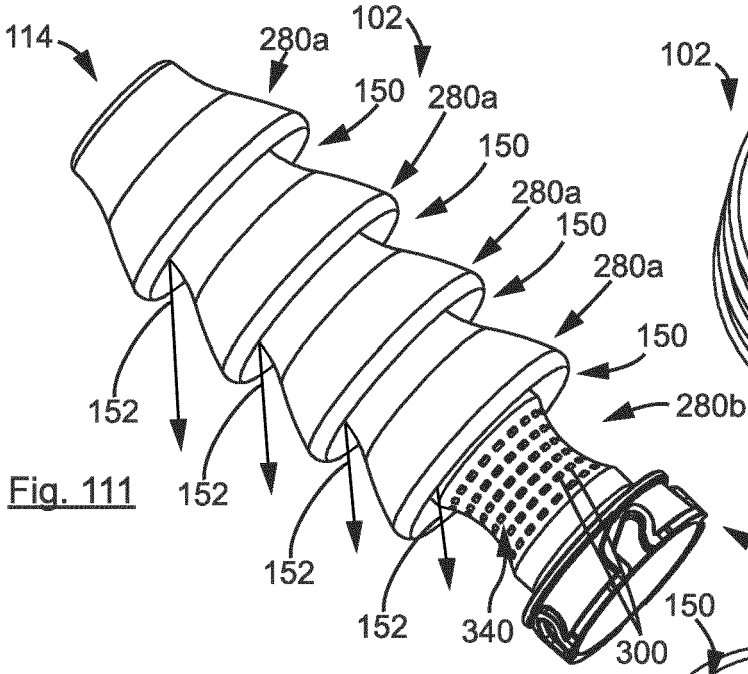


Fig. 108

Fig. 109

Fig. 110



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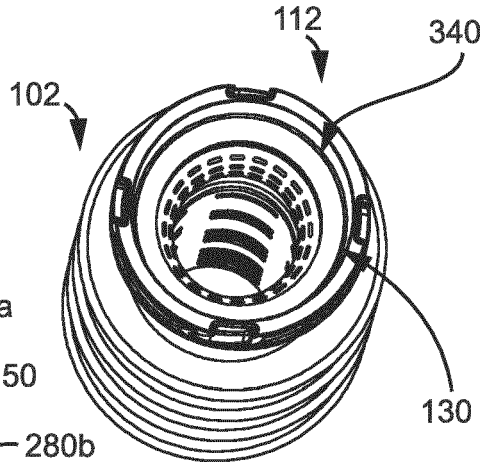

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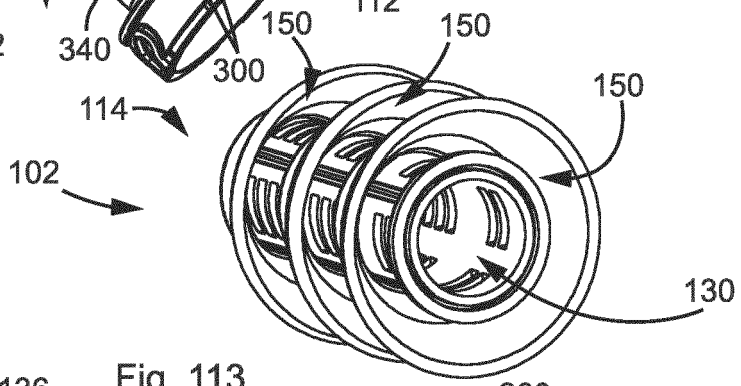

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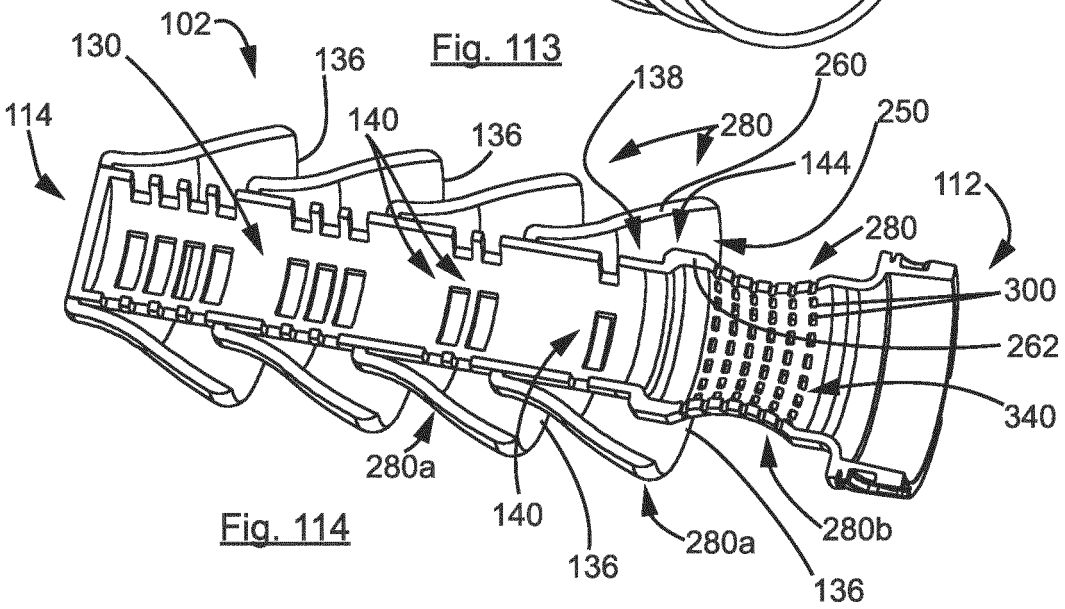

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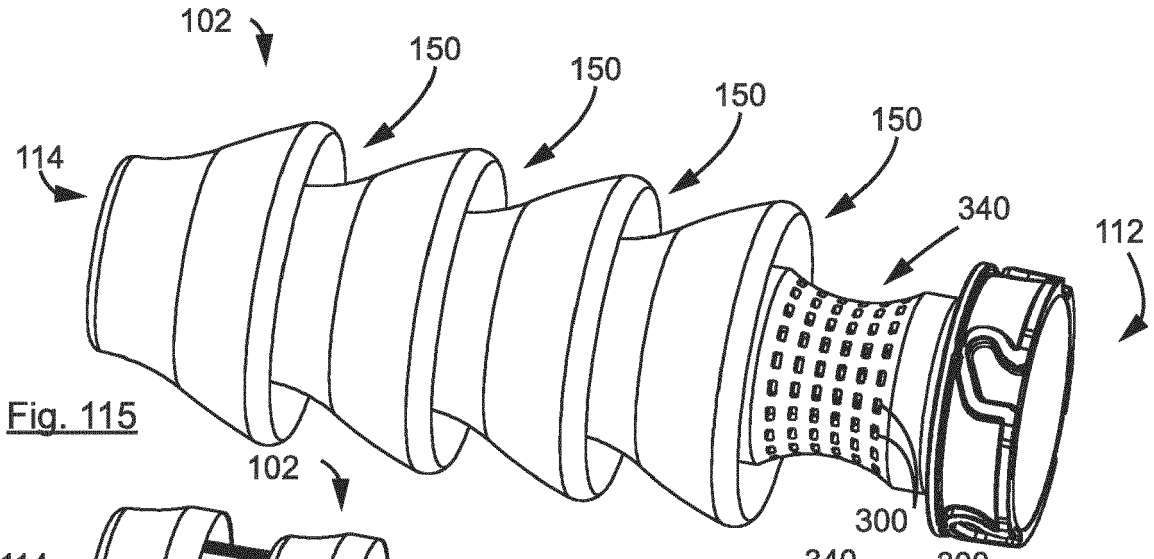

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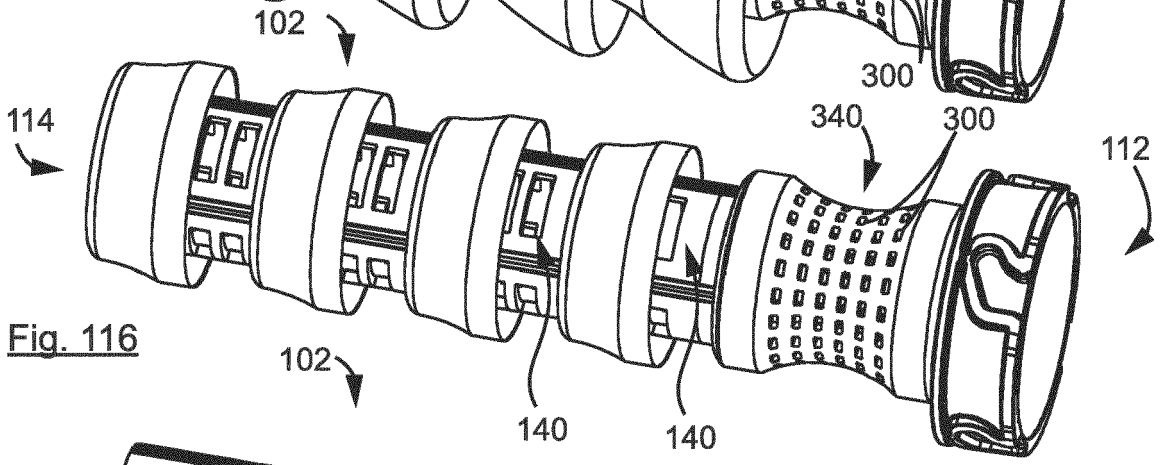

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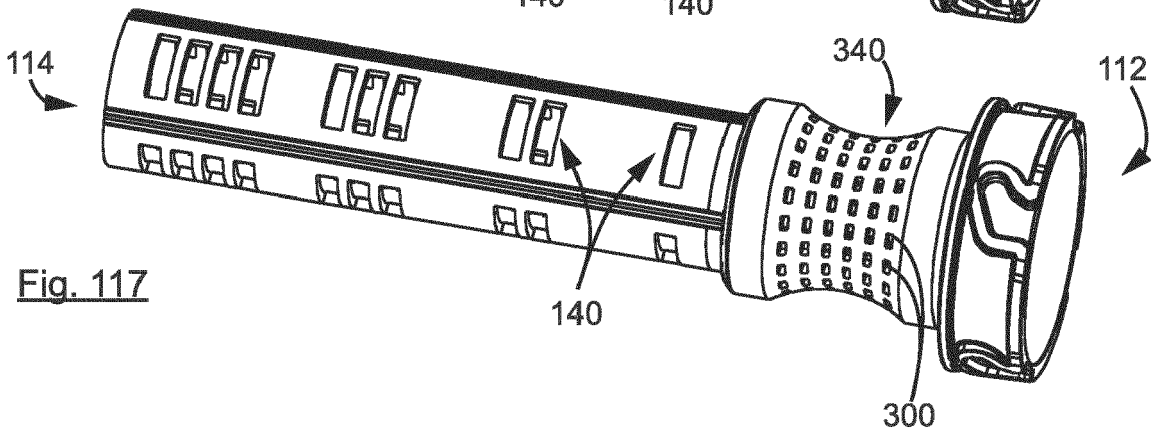

Fig. 117

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 24 18 9787

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 115 474 756 A (GUANGDONG ROMAN TECH CO LTD) 16 December 2022 (2022-12-16) * the whole document *	1,3-7, 11-15	INV. A45D1/16 A45D2/36 A45D20/12
X	CN 113 243 648 B (SHENZHEN SOOCAS TECH CO LTD) 18 April 2023 (2023-04-18) * the whole document *	1-15	
X	CN 207 721 390 U (ZHEJIANG MEISEN ELECTRICAL APPLIANCE CO LTD) 14 August 2018 (2018-08-14) * paragraphs [0022] - [0031] * * figures 1,2,5,6 *	1-15	
A	WO 2022/069881 A1 (DYSON TECHNOLOGY LTD [GB]) 7 April 2022 (2022-04-07) * page 14, line 18 - page 15, line 4 * * figure 7 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

A45D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 December 2024	Witkowska-Piela, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 24 18 9787

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17-12-2024

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