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(54) Title: CLEANING BRISTLE BRUSHES AND CLEANING SYSTEMS AND METHODS USING SAME

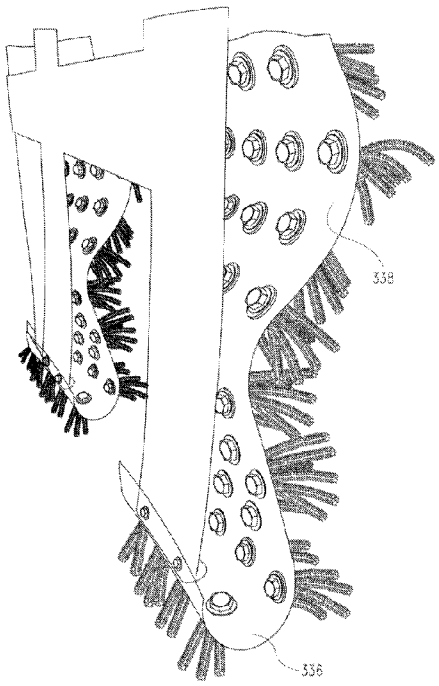

Fig. 42

(57) Abstract: Washing devices, systems and methods comprise a brushing apparatus including vertical, elongated stanchions supporting a flexible, wave-like brush carrier. An array of brushes is mounted to the front of the brush carrier. In particular embodiments the brushes include hubs which are received within apertures formed by the brush carrier. The systems may include a single, relatively-wide stanchion, or multiple stanchions. The stanchions are articulated in an up-and-down, optionally orbital, movement. Spray nozzles and lights may be included in the stanchions and/or brash carrier.

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CLEANING BRISTLE BRUSHES AND CLEANING SYSTEMS AND METHODS USING SAME

FIELD OF THE INVENTION

This invention relates to the design, manufacture and use of cleaning brushes and more particularly bristle brushes including a hub and several outwardly extending bristles. In a particular aspect, the brushes are injection molded and include bristles having projecting cleaning structures presenting multiple cleaning edges. The brushes may comprise an assembly of separate components, or may be formed as integral, one-piece units. In one aspect, the brushes are produced by folding a planar brush precursor to reposition the bristles relative to the hub. The brushes may include integral structures for facilitating attachment to a support structure. The brushes are well suited for use in cleaning a variety of surfaces, and have a particular application in the washing and cleaning of vehicles.

This invention further relates to devices, systems and methods relating to the washing of vehicles. The devices include elongated stanchions which hang vertically and contain brushes which bear against the vehicle as it is washed. In embodiments, the stanchions support wavelike brush carriers to which the brushes are mounted. In particular embodiments, the brush carriers include apertures in which the brushes are received. Ancillary components may also be included. The systems and methods include the manipulation of the stanchions to move the stanchions relative to the washing vehicle.

BACKGROUND OF THE DISCLOSURE

The art is well known relative to automatic vehicle washing. Such systems typically use rotating brushes and hang-down mitting curtains, which collectively have become the preferred industry standard equipment for automatically washing vehicles. The prior art discloses using a variety of cleaning materials for rotating brushes and hang-down mitting curtains, including polyethylene and polypropylene extruded strands, strips of synthetic felt, plastic fabric, and open and closed cell foam plastic. Even the use of cardboard and leather-board in rotating brushes has been disclosed as washing elements.

It is apparent from the prior art that a continuing objective in new developments for bristle brush arrangements has been to achieve and maintain good cleaning action from the tip speed and contact of the bristle tip ends with the surface being cleaned. For example,

orbital type movement of the bristle tips of a toothbrush has long recommended as part of dental hygiene guidance.

As shown in the art, this objective is easier to achieve with rotating brushes when they are used in cleaning flat or uniform type surfaces (e.g., street sweeping brushes) and can be rotated at relatively high speeds, e.g., 100-120 RPMs. However, it has always been difficult for automatic vehicle washing systems to use rotating bristle type brushes to properly and safely wash a vehicle. This is because vehicle shapes, sizes, and types of exterior painted surfaces and coatings represent extraordinary challenges for automatic vehicle washing equipment employing rotating brushes. It is important to achieve the proper tip speed and contact of rotating bristle brush tips. Also, the brushes must be gentle and soft, and be able to closely follow and penetrate the intricate contours of the various types of vehicles. If the rotating brushes do not operate in a precise manner, i.e., proper rotational speed and brush crush, vehicle damage can result, including: micro hazing and marring of the vehicle's exterior painted and coated surfaces; damage to antennae; and damage to mirrors. Also, the rotating cylinder housings which hold the brush strips are generally made of aluminum or stainless steel and are quite heavy once the wash media is attached. They are also costly to manufacture and maintain.

More recent prior art discloses means for rotating brushes using different bristle media consisting in part of felt, cotton and polyester woven fabric, foam, and closed cell foam. These types of materials can be rotated at much slower speeds, typically 60-100 RPMs, and can be configured to include multiple cleaning edges to help penetrate the recessed areas of vehicles. The prior art discloses very unique ways to incorporate differently configured washing media into a rotating brush, and also addresses the rotational requirements by achieving varying rotational RPM's of a brush.

Vehicle washes use single direction rotary type brushes that perform best when rotary brushes wash with the tips of the bristles. However, rotary type brushes frequently miss areas of the car's exterior surface, e.g., recessed windows, louvers, mirrors, moldings, etc., - because their inherent single direction rotation and inconsistent "crush" pressure causes overlaps that do not allow for consistent bristle tip cleaning of the stated areas.

Additionally, the prior art relating to hang-down mitting curtains is also extensive. The art relates to both the mechanical movement of mitting curtains for improved agitating type washing actions, and the material and design configurations of the curtains to provide better vehicle washing of the irregularities of vehicle surfaces. There is further but limited

prior art which discloses complex means for rotating, reciprocating and oscillating type vehicle washing brush media, vibrating brush media, and flexible brushes.

Although advancements in automatic vehicle washing equipment have been significant over the years, there still remain many problem areas that need improvement. These problem areas include vehicle damage caused by rotating brushes; overuse of water and chemicals by the rotating brushes flinging solution away from the vehicle due to the centrifugal action of the rotating brushes; excessive noise caused by the rotating brush actions and mitting curtains which cause a slapping effect against the vehicle; parts of the vehicle remaining uncleaned due to missing washing actions caused by rotating brushes rotating in only one direction and being unable to consistently clean with its bristle tips, frequently overlapping recessed parts of the vehicle's surfaces; excessive use of electrical power; complex multiple pieces of washing equipment being required; equipment wear, with replacement and repair being costly and time consuming; and original capital investment required for automatic vehicle washing equipment, buildings, and land.

This disclosure effectively addresses these problem areas with novel improvements that will be readily apparent through the reading and understanding of the following summary and description of the invention.

SUMMARY OF THE DISCLOSURE

This disclosure relates to the design, production and use of brushes comprising a hub and multiple, outwardly-extending bristles. The brushes in embodiments include several bristles which extend equiradially from a hub at an acute angle to the central axis of the hub. The bristles include a large number of nubs which extend from the shaft of the bristle. The disclosure includes brushes formed as an assembly of components, or as an integrated, optionally molded, one-piece unit. In an embodiment, the brushes are formed by molding the hub and bristles in a planar form and then folding the bristles to their final position. The brushes include structures configured for mounting to an external support. The disclosure further describes methods of making the brushes, brushing apparatus including the brushes, and systems using the brushing apparatus.

The present invention in one aspect is directed to a brush comprising a hub and a plurality of bristles attached thereto, each bristle including an elongated shaft extending from a proximal end to a distal tip, and each bristle having the proximal end attached to the hub. The bristles extend from the hub at an acute angle to the central axis of the hub, and each bristle has an array of multiple cleaning structures extending outwardly from the shaft. In embodiments, the hub and/or the bristles form an annular recess or other structure which receives a variety of support structures.

In another aspect, the brushes are formed from a molded brush precursor. The brush precursor provides a cylindrical hub and bristles in a first position in which each of the bristles extends radially, preferably equiradially, from the hub in a plane orthogonal to the central axis of the hub. The hub and bristles have a second position in which the bristles extend at an acute angle relative to the central axis of the hub. In a method of making a brush, the hub and bristles are formed integrally with the bristles extending coplanar with the hub, and the brush is formed by folding the bristles from the first position to the second position. The bristles are then locked in the second position. In one embodiment, the hub and/or bristles form an annular recess and a locking component is received within the recess. The locking component may comprise, for example, a ring-shaped locking collar, or it may include a webbing including an aperture which receives the annular recess of the brush which is inserted while in the second position.

The brushes are useful in a variety of applications. The brushes may be received within differing types of support structures adapted for particular uses. For example, the support structure may simply be a locking collar received by the annular recess. A number of

alternative support structures and applications are disclosed herein, although these are not to be taken as limiting.

In a particular application, an array of a number of the brushes is mounted to vertically-extending, flexible stanchions. These stanchions are arranged adjacent one another, and are moved vertically to function as a washing system for vehicles. In this application, an object of the invention is to provide a soft bristle brush arrangement for the washing of vehicles, particularly one that is vehicle-friendly and which eliminates the conventional rotating of the brushes for cleaning.

The stanchion-mounted bristle brush assemblies are moved against the vehicle's exterior surfaces. The stanchion movements include vibratory oscillation; up-and-down scrubbing; in-and-out scrubbing; and side-to-side scrubbing. These all constitute vehicle-friendly movements replicating much the same as a person would perform when carefully washing a vehicle with a soft cloth wash mitt or brush. The described washing movements using multiple soft flexible bristle brushes are also worker-friendly, because they do not include rotating type brushes.

Another preferred aspect of the disclosure is a bristle brush having integral attachment means that securely fastens the brush to a material such as a composited stanchion without requiring any additional hardware. In general, the brushes may comprise any common locking feature such as those using complementary shapes providing a form, press or snap fit.

A further aspect of the disclosed brushes is an injection molded, multiple bristle brush as described herein produced as a single part that does not require additional manufacturing or processing for its assembly or installation as a brush, representing a significant cost savings with injection molded bristle brush manufacturing. The brushes do not require tufting, stapling, fusing, bonding, channeling, or crimping that are common sub-assembly types of manufacturing processes associated with other forms of multi-step bristle brush manufacturing.

This disclosure also applies to devices, systems and methods for washing vehicles which do not require the previously-described brushes. The inventive washing devices comprise stanchions which include wavelike brush carriers which may be used with a variety of brushes, including but not limited to the unique brushes disclosed herein. The wavelike brush carriers support cleaning brushes and position them in a variety of positions, and at a variety of angles, to facilitate efficient and effective cleaning of vehicles. Spray nozzle, lights, and other ancillary components may also be provided.

The foregoing and other uses, features and advantages of the present invention will be apparent from the following more detailed description of the particular embodiments of the invention, as illustrated in the accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side, elevational view of a Formed Brush in accordance with an embodiment of the present invention.

FIG. 2 is a perspective view of the Formed Brush of FIG. 1.

FIG. 3 is a partial, perspective side view of the distal end portion of an embodiment of a bristle with exemplary cleaning structures useful in the brushes disclosed herein.

FIGS. 4 is a perspective, side view of the distal end portion of an alternate embodiment of a bristle showing cleaning structures comprising rounded nubs.

FIG. 5 is a perspective, side view of the distal end portion of an alternate embodiment of a bristle showing cleaning structures comprising cup-shaped cleaning nubs.

FIG. 6 is a perspective, side view of the distal end portion of an alternate embodiment of a bristle showing cleaning structures comprising needle-type nubs.

FIG. 7 is a perspective, side view of the distal end portion of an alternate embodiment of a bristle showing cleaning structures comprising wafer-type cleaning nubs.

FIG. 8 is a perspective, side view of the distal end portion of an alternate embodiment of a bristle showing cleaning structures comprising pad-type cleaning nubs.

FIG. 9 is a perspective, side view of the distal end portion of an alternate embodiment of a bristle showing cleaning structures comprising a corkscrew nub.

FIG. 10 is a plan view showing additional alternate embodiments of bristles useful in the disclosed brushes.

FIG. 11 is a perspective view of the exterior side of a brush precursor in accordance with the present invention, with the bristles in a first position relative to the hub.

FIG. 12 is a plan view of the exterior side of the brush precursor of FIG. 11.

FIG. 13 is a partial, enlarged plan view of the central portion of the exterior side of the brush precursor of FIG. 12, showing the hub and proximal ends of the bristles.

FIG. 14 is a plan view of the interior side of the brush precursor of FIG. 11.

FIG. 15 is a partial, enlarged plan view of the central portion of the interior side of the brush precursor of FIG. 14, showing the hub and proximal ends of the bristles.

FIG. 16 is a side, elevational view of the brush precursor of FIG. 11.

FIG. 17 is a side elevational view of a brush formed from the folding of the bristles of the brush precursor of FIG. 11.

FIG. 18 is a perspective view showing the interior of the Folded Brush of FIG. 17.

FIG. 19 is a top, plan view showing the exterior of the Folded Brush of FIG. 17.

FIG. 20 is a bottom, plan view showing the interior of the Folded Brush of FIG. 17.

FIG. 21 is a side, partial cross-sectional view of a Folded Brush with the bristles locked in the second position by a locking collar, which is in turn received by a separate supporting structure, such as a stanchion.

FIG. 22 is a side, elevational view of the Folded Brush, collar and support structure as shown in FIG. 21.

FIG. 23 is a side, elevational view of a Folded Brush having an annular recess received within an aperture in a support structure.

FIG. 24 is a partial, cross-sectional side view of the Folded Brush and support structure of FIG. 23.

FIG. 25 is a partial, cross-sectional, side view of a Folded Brush secured to a support structure and including a tapered opening to control the angle of extension of the bristles from the hub.

FIG. 26 is a front view of an exemplary embodiment of a linear type of stanchion with openings to receive brushes, and useful for example in a vehicle washing system.

FIG. 27 is a perspective view of the stanchion of FIG. 26 populated with brushes.

FIG. 28 is a partial, cross-sectional side view showing a stanchion containing brushes incorporating water and solution type nozzles, and LED lighting.

FIG. 29 is perspective view of a cylindrical stanchion with openings to receive brushes.

FIG. 30 is a perspective view of the cylindrical stanchion of FIG. 29 populated with brushes.

FIG. 31 is a perspective view of an exemplary embodiment of a support structure comprising a flexible washing mitt containing several brushes.

FIG. 32 is a perspective view of an injection-molded, double-ended bristle having multiple mounting positions in a support structure.

FIG. 33 is a side, elevational view of a linear stanchion showing the multiple mounting positions for the double-ended bristle of FIG. 32.

FIG. 34 is a perspective view of an exemplary embodiment of a support structure comprising a pole-extended type washing device holding a plurality of brushes.

FIG. 35 is a perspective view of an exemplary embodiment of a support structure comprising a hand-held washing brush, such as used for cleaning a vehicle.

FIG. 36 is a perspective view of an exemplary embodiment of a support structure comprising a toothbrush containing a plurality of brushes.

FIG. 37 is a perspective view of an exemplary embodiment of a support structure comprising a dishwashing type brush containing a plurality of brushes.

FIG. 38 is an exploded, perspective view showing the assembly of a sub-brush into a brush.

FIG. 39 is a side, elevational view, partially in cross section, showing the reception of a sub-brush into a brush.

FIG. 40 is front, elevational view of a center component of the vehicle washing system.

FIG. 41 is a back, elevational view of the center component of FIG. 40.

FIG. 42 is a back side, perspective view of a stanchion and brush support.

FIG. 43 is a front view of the system depicting the presence of nozzles intermixed with the brushes.

FIG. 44 is a rear, elevational view of the top end of a stanchion.

FIG. 45 is a rear, perspective view showing additional details as to the attachment of a stanchion to a crankshaft component.

FIG. 46 is a perspective view of a washing system useful in washing the front, side and/or rear surfaces of a vehicle.

FIG. 47 is a perspective view showing additional details of the washing system of FIG. 46.

DETAILED DESCRIPTION OF THE DISCLOSURE

Disclosed herein are brushes providing uniquely advantageous cleaning of surfaces. The bristles of the disclosed brushes have circumferential cleaning edges which provide high-resolution surface cleaning using less water, less chemicals, less energy, and without causing damage. The brushes comprise a number of bristles including shafts extending outwardly from a hub. A variety of cleaning structures are positioned on the shafts. The brushes are secured to support structures for moving the brushes against surfaces to be cleaned. The brushes in certain embodiments are particularly adapted for use in the cleaning of vehicles in an automated vehicle washing system.

Brushes

The present invention in one aspect comprises a brush including a hub and a plurality of bristles attached thereto. Each bristle includes an elongated shaft extending from a proximal end to a distal tip. Each bristle has the proximal end attached to the hub. The bristles extend from the hub at an acute angle to a central axis of the hub. Each bristle has an array of multiple cleaning structures extending outwardly from the shaft. The hub and/or the bristles may form a locking structure, such as an annular recess configured to be received within a complementary component, such as a locking collar or an aperture in a support structure.

Brush Components

Referring to FIGS. 1-3, there is shown an embodiment of a brush 10 of the present disclosure. Brush 10 includes a hub 12 and several bristles 14 extending from hub 12. The bristles preferably extend in a radial direction from the hub. Each bristle comprises a shaft 16 attached at a proximal end 17 to hub 12, and carrying a number of cleaning structures 18 which may have varying numbers, shapes and locations. Bristles 14 may also contain through holes 20 spaced along shaft 16.

In an embodiment, hub 12 includes a central axis 22, and shafts 16 extend parallel to or at an angle to central axis 22. In an embodiment, the bristles extend at an outward, acute angle of no more than 45°, preferably 15°-35°. The bristles may be positioned symmetrically or asymmetrically about central axis 22. Wedge-shaped gussets 24 may be provided to strengthen the positioning of the shafts. A locking structure 26, shown as an annular recess, may be provided to facilitate attachment of hub 12 to a support structure.

Bristles

In accordance with the present invention, a bristle 14 comprises a shaft 16 carrying a variety of cleaning structures 18. The term "shaft" refers to an elongated member which is generally linear in shape and may include a central axis 28 and a distal tip 30. The bristles may be straight, curved, angled or combinations thereof.

The shaft of each bristle includes a proximal end 17 secured to the hub. The shaft may extend from the hub at a range of angles, and a variety of such angles may be used for a given brush. The angles are selected based on the intended use of the brush. The angle(s) are also selected to ensure that the bristles are positioned to move effectively relative to nearby bristles. Typically, the bristle shafts will extend at an angle in the range of 0° to 45°, preferably 15° to 35°, relative to the central axis 22 of the hub.

The shaft is formed from a durable material which is suitably pliant and resilient for holding the cleaning components adjacent a surface to be cleaned. The shaft may have any cross section that provides the desired strength and flexibility. For example, the cross section may be an irregular or regular shape, and it may vary along the length of the shaft. A "regular" cross section refers to one which comprises a cross section that has the shape of a regular polygon. Preferred cross-sectional shapes include round, oval, square, pentagonal, hexagonal, octagonal, etc. In embodiments, the shaft has a number of lengthwise surfaces, for example eight in the case of an octagonal shaft, and cleaning structures may extend from each of these surfaces. The shafts may also include through holes 20, shown in FIGS. 1-2, which allow for fluid flow therethrough.

Cleaning Structures

The shafts of the bristles support a number of cleaning structures 18 extending outwardly therefrom. In embodiments, cleaning structures 18 are preferably formed integrally with the shaft, as by extrusion molding. The variety and number of such cleaning structures are selected based on the composition of the bristles and the intended use of the brush. Examples of cleaning structures are shown throughout the figures.

Nubs

One form of a cleaning structure is referred to herein as a "nub". The term "nub" refers to a relatively small diameter projection extending from the shaft with a size and position to contact a surface to be cleaned. Referring to FIG. 3, numerous nubs 32 are shown. Nubs 32 have side walls 34 extending from shaft 16 and terminating in end surfaces

36. In embodiments, the nubs extend normal to the surface of the shaft. However, nubs 32 may also extend at other angles relative to the shaft.

Nubs thereby present several surfaces for contacting and cleaning a surface, including the side wall surfaces 34 and the end surfaces 36. The junction between side walls 34 and end surfaces 36 may be smooth or rough. In one aspect, the junction between a side wall 34 and an end surface 36 is rounded, and in another aspect the junction provides a corner edge 38 which may further enhance the cleaning action of the nub.

The bristles have multiple nubs attached to each shaft. The number of nubs on a shaft may vary depending on the size of the brush, the use of the brush, and the cleaning effect desired. In embodiments, a bristle includes at least 10, at least 50, or even at least 100 nubs. The nubs may be arranged in patterns or may be irregularly positioned on the shaft. The number, shape and arrangement of the nubs may differ for different portions of a bristle. In one embodiment, the total number of individual nubs 32 per bristle 14 is approximately 120, with cleaning edges per bristle of approximately 960. In such an embodiment there are approximately 7,680 cleaning edges per brush.

Shaft Tips

Shafts 16 terminate in end portions or tips 30 which may have a variety of shapes. Shaft tips 30 thereby provide another form of a cleaning structure 18. The shaft tip may have any of a variety of shapes adapted to enhance the cleaning action of the bristle, and may include other cleaning structures as described herein. The end portion of the bristle may be pointed, rounded, or have a flat or irregular surface. Shaft tip 30 thereby provides a cleaning surface positioned to contact a surface to be cleaned.

Wiper Blades

Shaft 16 may also support one or more wiper blades 40. The term wiper blade refers to a component extending from the shaft in a position to act in the manner of a scraper of the surface to be cleaned. Along with the nubs, the wiper blades provide excellent cleaning, and help in retaining the chemical solution during the washing process. Referring to FIG. 3, wiper blade 40 comprises a wall-like structure which includes side walls 42 extending outwardly from shaft 16 and terminating in a contact surface 44. Contact surface 44 may be positioned such that the nubs extend outwardly from the shaft either more, the same, or less, than contact surfaces 44 of wiper blades 40. The positions of the contact surfaces of the wiper blades relative to end surfaces 36 of nubs 32 may vary within the same bristle.

In embodiments, the bristles include more than one wiper blade, preferably two or more wiper blades, located along the shaft. The contact surfaces of the wiper blades may be variously oriented relative to the longitudinal axis of the shaft. For example, the contact surface of a wiper blade may be parallel to or angled from longitudinal axis 28 of shaft 16. The wiper blades of a bristle may vary in number and in position along the length of the shaft. Also, the wiper blades may be located adjacent to or nested within the nubs, or may be located spaced from the nubs.

Other Cleaning Structures

The cleaning structures 18 may further comprise a wide variety of other regularly or irregularly shaped structures. Referring to FIGS. 4-9, there are shown a number of different cleaning structures located on shafts 16. FIG. 4 is a perspective view of a bristle having rounded nubs 46. FIG. 5 is a perspective view of an embodiment of a bristle structure having flexible tentacle-type, cup-shaped cleaning nubs 48. FIG. 6 is a perspective view of an embodiment of a bristle structure having flexible needle-type cleaning nubs 50. FIG. 7 is a perspective view of an embodiment of a bristle structure having flexible wafer-type cleaning nubs 52. FIG. 8 is a perspective view of an embodiment of a bristle structure having flexible, pad-type cleaning nubs 54. FIG. 9 is a perspective view of an embodiment of a bristle structure having flexible, corkscrew-type nub 56.

FIG. 10 further represents the capabilities of injection molding uniquely designed bristles. FIG. 10 is a plan view of bristles having a variety of additional types of cleaning structures. Shown in FIG. 10 is a brush 60 having eight different types of bristles with different diameters, lengths, nubs, wiper blades, etc. For example, FIG. 10 depicts bristles having such structures as a tree branch shape 62, a coarse comb 64, a forked wiper blade 66, a tapered branch 68, a dense comb 70, fine tapered fins 72, and coarse tapered fins 74, all integrally connected. The varying lengths of the individual bristles are shown by comparison to radius 76.

Brush Materials

The components of the brushes may be formed from a variety of suitable materials. In a preferred embodiment, thermoplastic media and/or thermoset media are used. These materials have a generally rubbery, soft touch and feel, are highly flexible and shock absorbing, are chemically resistant, are resistant to Ozone, have high elasticity, and can be recycled. Materials such as low-density polyethylene (LDPE), high density polyethylene (HDPE), and reinforced PVC, to name a few, also provide excellent composited brush structures. Examples of materials also include any and all polymer alloys, such as thermoplastic polyurethane (TPU), thermoplastic elastomers (TPE), and thermoplastic vulcanizate (TPV).

The parts of the brush may need some stiffness and or "extra" strength in the hub area for some designs. This may be obtained from "two shot molding", which involves sequential injection of a hard polymer followed by an over-molding of a soft polymer. This brings the mixed physical properties together in one part. This may also be done with insert molding where a previously molded part is inserted into an open mold and when the mold is closed a different polymer is shot over or around the inserted part giving the two-tone effect of different properties. This adds strength and durability to a soft exterior part by providing a hard, internal part via molding.

An example of a good quality co-polymer thermoplastic media bristle brush as described herein is formed from injected molded TPV produced by ExxonMobil Chemical Company and having the following properties:

- a specific gravity of approximately 0.930;
- an approximate density of 0.930 g/cm3;
- an approximate 35-45 shore A hardness;
- a compression set of approximately 8-10% (23°C);
- an elongation at break of approximately 350%-450% (23°C);
- a tensile strength at break of approximately 420-580 psi (23°C); and
- a tensile stress at break of approximately 420-580 psi (23°C).

The TPV has excellent wear characteristics and has many superior abrasion resistant qualities including that it is: highly flexible; naturally hydrophobic; self-cleaning; non-marking; highly resistant to chemicals; polyolefin based; and recyclable within the manufacturing process. The injection molding process has a fast injection rate with rear, middle, and front processing

temperatures of approximately 350° to 400°F; mold temperature of approximately 75°-125°F; nozzle temperature of approximately 365°-410°F; processing melt temperature of approximately 290°-420°F; screw speed of approximately 100-200 RPM's, and a screw compression ratio of approximately 2.0:1 to 2.5:1. Clamp tonnage is approximately 3.0 to 5.0 tons/in^2.

Brush Production

The brushes of the present disclosure may be formed in various manners. In one approach, the brush components are formed separately and then combined. In another approach, at least some of the brush components are formed as integral units. In a preferred embodiment, all of the brush components are formed as an integral unit. As used herein, the term "integral" refers to the components comprising a single, unitary structure, such as obtained by injection molding or 3D additive manufacturing.

The brushes in one embodiment are produced by assembling separate components, or by molding the brushes as integral components. In this respect, the brushes may be referred to as "Formed Brushes".

Folded Brushes

In embodiments, the brushes are formed from a brush precursor 80. The brush precursor includes a hub and bristles which are integrally formed in a generally planar shape, as shown in FIG. 11. The brushes are formed by folding the bristles of the brush precursor relative to the hub. Brushes produced by folding a brush precursor may be referred to herein as "Folded Brushes". The brush precursor may include any or all of the same components as the previously described brushes, and the corresponding components are identified using like numbering. Unless indicated otherwise, features of the present invention may be applied to either Formed Brushes or Folded Brushes.

In a particular aspect, the hub and bristles of the brush are injection molded to form the brush precursor. The bristles are then repositioned relative to the hub to provide the bristles at the desired angle(s) to the hub. The brush precursor initially has the bristles in a first position relative to the hub, in which, for example, the bristles are oriented relative to the central axis of the hub to facilitate injection molding of the bristles in unison with the hub. To facilitate molding, the hub may have a planar configuration and the bristles are formed in a first position extending in a coplanar fashion with the hub. That is, the attachments of the bristle shafts define a plane with the hub, and the bristles extend in the plane orthogonal to the central axis of the hub.

The bristles are then moved to a second position extending at an angle to the central axis of the hub. For example, in a preferred embodiment the bristles are folded relative to the hub to form a brush having the bristles in the second position. In the second position, the bristles may extend parallel to or at an angle to the central axis of the hub. The resulting Folded Brush may comprise any of the features associated with a Formed Brush, and vice versa. For example, a Formed Brush and a Folded Brush may both have a "squid-like" appearance with the bristles extending at an acute angle of not more than 45°, such as 15° to 35°, relative to the central axis of the hub. For this reason, the brushes of the present invention are also sometimes collectively referred to as the SQUID™ brushes.

FIG. 11 shows a perspective view of the exterior side of a brush precursor 80 as obtained from a mold. This is the side which will form the exterior of the brush when the bristles are folded together. The hub and bristles are shown in FIG. 11 in a first, unfolded position in which the bristles extend radially from the hub in a plane orthogonal to the central axis of the hub. The brush may include any number of bristles which are preferably, but not necessarily, positioned equiradially.

Hub 12 is cylindrical in shape and has a central axis 22. The center of the hub may be solid (FIG. 10), or may include a central aperture 82 (FIG. 11), which may be used, for example, to receive fluid tubing or nozzles. A plurality of bristles 14 include elongated shafts 16 which carry multiple cleaning structures and extend from a proximal end 84 to the distal tip 30. The proximal ends 84 of the bristles 14 are attached to the hub by radially-spaced connectors 86. Connectors 86 define intervening open spaces 87 which facilitate the folding of the bristles relative to the hub. The bristles are attached by radially arch-shaped webbing 88 which secures adjacent bristles, but which is flexible and further allows for folding of the bristles.

The brush precursor 80 is preferably molded as a single, integral unit. As shown in FIG. 12, the brush precursor includes molding ejection pin locations 90 and 92 on each bristle. Having a significant number of combined mold ejector pin locations 90 and 92 provides for exceptionally fast and precise production output of the planar brush precursors. The ejector pin areas are purposely positioned on the same horizontal plane as the bristle's wiper blade 40. The core of the hub has an increased molded material thickness area for added structural strength in supporting the bristles. Also visible in FIGS. 11-12 are braces 94, which strengthen the support of the bristles.

FIGS. 14-15 show plan views of the interior side of the brush precursor with the bristles in the first position. FIG. 16 is a side, elevational view of the brush precursor with the bristles in the first position. These views show wedge-shaped gussets 96. The gussets are configured to facilitate formation and support of a brush formed from the brush precursor, as hereafter described.

The bristles of the brush precursor are folded inward from the first position to the second position to form a Folded Brush 98. Referring to FIGS. 17-18, a Folded Brush 98 is shown with the hub and bristles in the second position in which the bristles extend at an acute angle relative to the central axis 22 of the hub 12. As previously noted, in a preferred embodiment the hub is integrally molded with the bristles and the hub, and the bristles are moved from the first position to the second position by folding the bristles relative to the hub. More preferably, the hub has a planar, cylindrical shape. The bristles in the first position extend coplanar with the hub, and in the second position the bristles extend at an angle to the central axis of the hub not greater than 45°, and preferably 15° to 35°.

The brushes are easily formed by hand, or by mechanical means, by simultaneously pushing upwardly and inwardly on the interior side of the hub 12 while collectively rotating down the proximal ends of the bristles. The wedge-shaped gussets 96 are thereby brought together. As shown in FIG. 20, the wedge portions 100 of gussets 96 are configured to form a solid form when the bristles are fully in the second position. The wedge portions 100 include two angled mating faces 101 (FIG. 16) which help align, support and secure the bristles in a side-by-side arrangement upon fold-forming of the brush precursor into the squid shape. The angled faces 101 of the wedge portions 100 uniformly come together, as shown at the interior center of the Folded Brush 98 in FIGS. 18 and 20.

Locking Systems

The Folded Brushes may also include a system for locking the bristles in the second position relative to the hub. Such locking systems may be as simple as the use of an adhesive, sonic welding, or other means for directly securing the bristles together, for example by connecting wedge portions of adjacent gussets 96.

Alternatively, the bristles and/or the hub may include mechanical features that are used to secure the bristles in position. In such embodiments, separate locking members may secure the bristles together in the second position. For example, a locking collar may be applied surrounding the bristles and holding them in place. In one approach, at least one of the hub and the bristles defines a structure formed complementary to the locking member. As shown in the drawings, an exemplary complementary structure 26 may comprise an annular recess 102 defined by the hub and/or bristles. Referring to FIGS. 1 and 17, the brushes 10 and 98 are shown to have a locking structure 26 comprising an annular recess. In the Formed Brush 10, the annular recess is molded in as part of the hub, and the bristles extend therefrom. In FIG. 17, the Folded Brush 98 defines an annular recess 102 composed of aligned recesses in the bristles. Thus, referring to FIG. 11, each of the foldable bristles 14 of the brush precursor 80 includes a bristle recess 104 defined between a proximal shoulder 106 and a distal shoulder 108. Upon being folded, the bristle recesses 104 are aligned and form the complete annular recess 102.

Referring to FIG. 17, there is also shown a Folded Brush having a locking member 110 received in annular recess 102. The locking member in one form is a locking collar, which may be as simple as a ring-shaped member 112 received within the annular recess. The locking collar may be applied by assembling the collar about the brush, or the folded brush precursor can be pushed through the opening of the locking member, relying on the elasticity of the collar or of the brush to insert the brush.

In another aspect, the locking mechanism can be used to dictate the angles of the bristles in the second position. For example, the bristles of the Folded Brush may be angled based on the configuration of the locking mechanism. Considering the Folded Brush of FIG. 17, the use of a larger diameter locking collar would result in a greater bristle angle relative to the central axis of the hub. In this approach, the bristles would not have to be fully folded such that the wedge-shaped gussets contact each other.

It will be appreciated that various other mechanical configurations can operate in a similar manner. For example, the brush may instead include an annular ridge received in an

annular recess of a locking mechanism. Further, other mechanical couplings providing a form fit, press fit, snap fit, or the like, can be adapted to lock the bristles in the second position.

Support Structures

The brushes may be used in a variety of ways and for a variety of purposes. For example, the Formed Brushes exemplified in FIG. 1 can be used without further modification. Similarly, a Folded Brush with the bristles locked in the second position, such as by a locking collar, are also useful in that condition. In the alternative, the brushes may be secured to a variety of support structures adapting the brushes to particular uses.

In embodiments, the locking structure is also used to secure the brush to a support structure. For example, FIG. 21 shows a brush 114 receiving a locking collar 116 within an annular recess 118. In this embodiment, the locking collar is used to lock the bristles in the second position, and also to secure the brush within a support structure 120. Also shown in FIG. 21 is an embodiment in which the locking collar includes a tapered surface 122 within an annular recess 118 which has a complementary shape. This embodiment further demonstrates the ability to control the angle of the bristles relative to the hub axis by using differing internal structures, e.g., tapers, of a locking member. FIG. 22 provides an elevational view of the brush and support structure of FIG. 21.

In other embodiments, the folded brush may be directly inserted into a support structure which also functions as the locking mechanism. FIGS. 23-24 show a brush 124 received directly into an aperture 126 of support structure 128. The brush is form-folded and then inserted into the support structure. An additional advantage of the brush design is that it is readily inserted in either direction, either by first inserting the hub or first inserting the bristles into an aperture. In FIG. 25 there is shown a brush 130 including a tapered annular recess received in a complementary shaped aperture 132 in support structure 134. This also demonstrates that a support structure, rather than a locking mechanism, can be used to control the angle of the bristles.

Vehicle Washing

By way of example, a particular utility of the Squid Brushes is in the cleaning of vehicles. Shown in FIGS. 26-27 is the mounting of a combination of brushes in a stanchion to form a brushing apparatus for use in cleaning a vehicle or other subjects. The brushes in one aspect are carried on an elongated support structure and are arranged to be useful in washing a vehicle. The support structures preferably comprise vertically-suspended, elongated stanchions. The stanchions extend from a proximal end to a distal end, and suspended at the proximal end.

A preferred aspect is a brush apparatus comprising an array of brushes supported on a composite stanchion as shown in FIG. 26. Stanchion 140 includes an array of apertures 142 configured to receive and lock in place the brushes 144. Stanchion 140 includes an attachment end 146 provided with attachment means, e.g., apertures 148 to facilitate suspension of the stanchion and brushes in a vertical position. The stanchions comprise rigid or flexible substrates onto which the brushes are secured. The Squid brushes are securely fastened within the composited stanchion through their compression fitment within the annular recesses of the brushes defined by proximal shoulders 106 and distal shoulders 108. The stanchions may operate individually or as part of an overall system. In an embodiment, the stanchions are configured for use in washing the exterior of a vehicle.

The brushing apparatus may also provide additional components to enhance the utility of the SQUID™ Brushes. As shown in FIG. 28, brushes 144 include hubs 150 received in apertures in stanchion 140. FIG. 28 depicts the spacing of the brushes to provide for overlapping coverage of a surface to be cleaned. As the brushes are compressed against a surface, the bristles will spread in various directions, and will overlap with each other. Along with the movement of the stanchion, this provides a thorough and comprehensive contact between the brushes and the surface, thereby assuring a complete cleaning of the surface.

Also shown in FIG. 28 is the provision of auxiliary equipment useful in a vehicle washing system. Spray nozzles 152 communicate with tubing 154 and extend through central apertures 82 (FIG. 11) in brushes 144. Tubing 154 is connected with a fluid source and is operable to direct a fluid to the nozzles and out from the interior of the brush. This advantageously provides an application of a soap, rinsing solution, water, etc. at a position in close proximity to the surface being cleaned. Moreover, it dispenses the fluid in the midst of the brushes. As a result, a highly efficient and effective use of such fluids is accomplished.

In addition, other devices of interest may be positioned within or extending through the central apertures 82. By way of example, LED tubing 156 positions an LED light source 158 at the end of the central aperture. Such lighting allows for better visibility of the cleaning of the vehicle, and also can provide an interesting visual effect for persons in a vehicle being cleaned.

As known in the art, the cleaning effect of the brushing apparatus can be enhanced by having the stanchions, and therefore the brushes, move relative to the vehicle during cleaning. The type of relative movement between the stanchions and the vehicle can be varied, including up-and-down, translated, rotary, oscillating, etc. Also, the stanchion may be moved relative to a stationary vehicle, or the vehicle may be moved through a stationary vehicle washing system.

Example Vehicle Washing System

The structural and material makeup of the injection molded bristle brush can be flexibly formulated with many different specifications. By way of example, it has been found that an exemplary embodiment includes approximately eight (8) bristles with an overall length of approximately 3". The bristles have even or uneven lengths, a textured shaft diameter of approximately 0.250", and a length of approximately 1". In one embodiment, each bristle has approximately six rows, each row having approximately twenty nubs, and each nub having approximately eight cleaning edges for the remaining bristle length of approximately 2" and an overall outside diameter of approximately 0.375".

The annular recess of the brushes (upon being fold-formed into a Squid shape) has a cylindrical shape having an approximate inside diameter of 1.125" and outside proximal and distal shoulder diameters of approximately 1.375. The inside height dimension of the cylindrical shoulder is approximately 0.250".

After the brush assembly has been inserted into the stanchion's approximate 1" diameter hole and approximate 0.250 thickness, the annular recess experiences an approximate .065" compression throughout the shoulder area to secure its attachment to the stanchion.

Thus, in an embodiment, an aspect of the present invention is a multiple soft bristle brush assembly that is manufactured (e.g., injection molded) in a planar form which is then subsequently formed into a geometrical shape (resembling the profile of a squid). Each bristle may include a wedge-shaped, gusseted shaft with multiple projections (nubs) having cleaning edges circumferentially around the shaft. The brushes may be received in any type

of support. In a particular embodiment, the brushes are mounted to a stanchion comprising an elongate material which may hold numerous brushes and which may be moved against a surface to be cleaned. The brushes preferably include a formed locking recess for simple insertion into the composited type stanchion. The stanchion contains multiple soft bristle brushes each having bristles with multiple cleaning type tips (nubs) throughout the profile of the bristles which provide continuous total brush cleaning regardless of how the bristles of the brush may deflect during the washing process.

Drum

FIG. 29 shows a circular drum-type composited stanchion 160 with Squid Brush receiving apertures 162. FIG. 30 shows drum stanchion 160 populated with Squid Brushes 98. The drum stanchion can be used in conventional fashion by rotating the drum stanchion with the brushes in contact with a vehicle.

Hand Washer

FIG. 31 shows a flexible fabric wash mitt 164 with a wrist cuff 166 having Squid brushes 98 attached to a very flexible composited support structure 168. The Squid structures and their attachments are very much the same as what has been previously described.

Dual Bristles

FIGS. 32-33 show injected molded single and dual bristle variations. These types of single or dual bristles have specific vehicle targeted cleaning purposes and are usually interposed with Squid bristles for targeting relatively small cleaning areas requiring a special type of vehicle washing bristle cleaning, e.g., white wall tires. The dual bristle 170 shown in FIG. 32 is formed in a longitudinal linear shape having two separate similar bristles with bristle shafts 172 and bristle nubs 174 connected in the middle by multiple rings 176 defining several annular recesses 178. The dual-bristle design allows for cleaning special vehicle exterior areas from both sides of a suspended composited support structure, e.g., the front of a moving (conveyorized) vehicle and its reverse in following the rear of the vehicle. Each separate recess 178 provides adjustment to lengthen or shorten the bristle's cleaning length as required. The use of two differently sized and shaped bristles within one molded unit, each bristle having the same or different protuberances, lengths, diameters, etc., allows for the unit to be located within a recess to provide two completely different types of bristles for two different types of required washing. FIG. 33 is a side view showing the different mounting positions for dual bristle 170 in a stanchion 180.

In embodiments, disclosed are vehicle washing devices and systems using the Squid Brushes. The devices comprise suspended linear composited stanchions which are fully populated with Squid brushes and which are generally non-rotating type. The articulating brushes achieve excellent high-resolution vehicle cleaning requiring significantly less water, chemical, and energy to operate.

The soft bristles of the Squid brushes with their circumferential cleaning edges have been shown to reach inwardly to totally clean even the toughest to reach areas of the vehicle - ledges, crevices, nooks and crannies often found with recessed windows, lights, door handles, mirrors, and grills. The washing process is extremely quiet in its operation, and almost totally eliminates the possible incidence of vehicle damage, because conventional brush rotation and required crush of the rotating brushes has been eliminated.

A vehicle washing brush apparatus and system in accordance with the present invention, provides soft bristle brushes which are self-fastening without the need for ancillary attachment parts; are light weight; are easy to assemble, install, replace, and service; and have purchase costs that are significantly reduced.

Miscellaneous Uses

FIG. 34 shows a Squid pole brush 182 having a flexible water/solution line 184 and a rigid conduit 186 connected thereto. Fluid travels under pressure through rigid conduit 186 into a reservoir and support structure 188. Spraying of washing fluids through the Squid Brushes 190 is shown at 192, and may use nozzles as described with respect to FIG. 28. FIG. 35 shows a similar hand brush 194 comprising a support structure 196 carrying brushes 198, and including a handle 200.

FIG. 36 shows a toothbrush 202 having brushes 204 mounted to a support structure 206 which is connected to a handle 208. FIG. 37 shows a dish washing brush 210 including a support structure 212 comprising a handle 214. Brush 216 is received within an aperture in the support structure. Mounting of the brushes to the support structures as shown in FIGS. 34-37 may be in the same manner as previously described and shown herein.

FIGS. 38 and 39 show an additional embodiment with a smaller brush nested within a Squid Brush. Nesting brush 218 includes bristles 220 and stem 222. The stem of the nesting brush is received within the hub aperture.

Vehicle Washing System and Method

The invention further includes vehicle washing systems and methods which may advantageously use the foregoing described brushes and related components. Provided are photographs of a system exemplifying structures and features of the system.

Referring to FIG. 40, there is shown an overall, elevational view of a center component of the system. This center component 300 is useful in cleaning the front, top and rear portions of a vehicle moved relative to the center component.

This center component 300 includes a support structure 302 including sides 304 and top support 306. These may comprise any suitable material for supporting the components of the system hereafter described. Advantageously, the center component has a low profile which leaves considerable clearance for a vehicle to be washed, while also not requiring an excessive amount of room outside of the support structure.

As shown in FIG. 40, a series of brushing units 308 are suspended from the top support 306. Each brushing unit comprises a brush support 310 carrying a number of brushes 312. The brushes may comprise units received within aperture in the brush supports as previously described. In the same manner, the brush supports and brushes may have the same or similar structures and functions as previously described.

The brush supports may have a wave-like form. This form provides for having the brushes contact a vehicle at various angles in order to effectively clean surfaces of varying shapes and positions. With the wave-like form, it is apparent that some brushes extend somewhat upwardly, others extend straight out, and yet others extend somewhat downwardly.

In use, the center component moves the brushing units as they contact the vehicle to be washed. In a preferred embodiment, the vehicle is moved relative to the center component, which is fixed to the floor. Alternatively, the center unit is moved as a vehicle is held stationary. It will be appreciated that the relative movement of the vehicle toward the brushing units will cause the brushing units to move against the vehicle front, up and onto the vehicle hood, and continuing on over the front windshield and the top of the vehicle. As the movement continues, the brushing units will move along the back of the vehicle, such as onto the back trunk hood and/or into and against the bed of a truck.

As previously mentioned, the wave-like form of the brush supports will cause the brushes to move against surfaces of the vehicle at differing angles, which can facilitate a thorough washing of all of the various surfaces of the vehicle. As will be discussed hereafter,

the movement of the brush supports, and therefore of the brushes, relative to a vehicle further contributes to the thorough washing of the vehicle. The brush supports are formed of a material having a selected degree of flexibility, which can be determined to optimize the flexing of the brush supports as they interact with the vehicle surfaces.

From the front view it is shown that an exemplary embodiment includes five brush supports, each having rows of four brushes. The brushes are sized and positioned to provide overlapping coverage of the vehicle surfaces. The brushes are also positioned along the edges of each brush support to assure overlapping coverage between brush supports. The brush supports are also positioned so that the outer brush supports align with and can ride along the outside surfaces of the vehicle hood and roof, as well as the rails of a pickup truck. The interior brush supports are positioned to cover the central surfaces of the vehicle, including to fully span the width of the bed of a pickup truck.

Also as described later in more detail, the brush supports may carry associated components. For example, spray nozzles are spaced throughout the brush supports to direct fluids against the vehicle. The placement of these nozzles is highly advantageous as it applies the liquids directly at the location intended. This is contrasted from prior art systems where the liquids may be dropped only onto the upper facing surfaces of the vehicle, or the liquids may be applied by the rotation of large brushes. The use of such brushes is further inefficient as the brushes fling the liquids in all directions such that only a small arc of the rotation directs the liquids against the vehicle.

The use of the nozzles adjacent the brushes in the present system is thereby seen to provide an efficient use of liquids employed in vehicle washing. This has ecological benefits as the total amount of such liquids can be reduced. It also is economical in that reducing the amount of liquids used means that there is less expense in reclaiming or disposing of the liquids.

The brush supports may also include lights. For example, strip LED lighting can be provided which extends, such as vertically, along the brush supports. This lighting has both a practical use and an aesthetic effect for occupants of the vehicle as it is being washed.

Referring to FIG. 41, there is shown the back side of the brushing units 308. It is shown that each brushing unit, and particularly each of the brush supports, is mounted to a stanchion 314. The stanchions are relatively rigid structures in order to ensure that the brush supports, and therefore the brushes, are firmly pressed against the surfaces of the vehicle.

The stanchions also contribute a significant amount of weight which itself provides for pressing the brushes against the vehicle.

One aspect of the stanchions is that they are secured together to provide lateral stability to the movement of the brush supports. As shown in FIG. 41, for example, outer stanchions 316 and 318 are secured to center stanchion 320 by lateral arm 322. Similarly, stanchion 324 is attached to stanchion 326 by lateral arm 328. It will further be noted that center stanchion 320 extends along the front side of lateral arm 328 and slider 330 forms a contact surface positioned against center stanchion 320 to allow the center stanchion to readily slide relative to lateral arm 328 when the stanchions are in motion. Similarly, lateral arm 322 includes sliders 332 and 334 to facilitate sliding of stanchions 324 and 326 against lateral arm 322. In one embodiment, as shown in FIG. 41, the sliders comprise material that is wrapped around and attached to the lateral arms by fasteners, although various other configurations may be employed.

The interconnection of the stanchions serves several purposes. The connections in general impart overall strength and relative rigidity of the brushing units. Also, the connection of the outer stanchions through the center stanchion allows the outer stanchions to be positioned to ride on the outside edges of the vehicle, including the rails of a pickup truck bed, without falling off to the outside. The overall weight also is applied in a manner that evens out the pressure applied to the vehicle.

FIG. 42 shows features of the bottom end of the stanchions. FIG. 42 shows that the stanchions 314 may be sized to be slightly narrower than the brush supports 310. As shown in FIG. 42, the brush supports are sized to allow positioning of the brushes along the outer edges to be close to the brushes of the adjacent brush support.

FIG. 42 shows a close-up perspective view of the bottom end of one of the stanchion-support member combinations. The brush support is curved at the bottom and includes an end portion fastened to the stanchion. The fastening is shown to be on the back side of the stanchion, although the fastening could instead be on the front side. Also, other means of securing the brush support to the stanchion could be employed.

The curved bottom portion of the brush support serves several purposes. As is apparent in the drawings, the curved bottom provides that brushes located in that area extend in varying directions ranging from horizontal, to angled downwardly, to extending straight down. This assures efficient and effective cleaning of the surfaces of a vehicle as the vehicle moves relative to the brush support. The curved bottom also provides increasing flexing of

the brush support as the brushes move across changing surfaces of the vehicle, such as in the transition from the vehicle hood to the front windshield.

In a similar manner, the brush supports in certain embodiments include two or more curved portions extending along the length of the stanchions. As shown in FIG. 42, for example, there is shown a bottom curved portion 336 and a second curved portion 338. The second curved portion functions essentially the same as the bottom curved portion. It provides brushes in different positions relative to horizontal, and provides flexibility to allow the shape of the brush supports to change according to the shape of the vehicle.

In FIG. 43 other features associated with the brush supports and stanchions are shown. FIG. 43 shows strip lighting, such as LED lighting, comprising tubes 340 containing electrically-connected lights 342. The tubes are shown as being attached to a stanchion, although other placements are possible, including on the brush supports 310. These lights allow for visualizing the operation of the brushes 312. The lights also are aesthetic and can be entertaining to occupants of the vehicle. For example, the lights can have different colors, and may even transition between color and on/off condition in a visually pleasing way.

The stanchions and/or brush supports may also carry nozzles 344 used to deliver fluids to the vehicle. As previously mentioned, this is particularly advantageous in providing a delivery of fluids closely directed to the surfaces of the vehicle. Both the lights and the nozzles may be placed in any configuration that is considered to be effective in the system.

FIG. 44 provides some detail as to the mounting of the stanchions to the center component. The stanchions are mounted to provide an oscillating motion. As some stanchions move upward, other stanchions move downward. The vertical, up-and-down movement provides a scrubbing action as it moves the brushes up and down against the vehicle surface. The stanchions also preferably impart an in-and-out motion to the brush supports, which has the effect of pushing the brushes against the vertical or inclined surfaces of the vehicle. This enhances the contact of the brushes against the vehicle, and also causes the brushes to spread out, providing an additional scrubbing action and enhancing overlap of adjoining brushes.

The motion of the stanchions can be achieved, for example, by the use of a crankshaft component 346 for the stanchion mount. This translates the rotary motion of a motor to the up-and-down and in-and-out motion of the brushes.

The crankshaft component includes a series of aligned crank arms 348 having corresponding first and second ends. The crankshaft component is mounted to rotate about

an axis which extends through the midpoints of the crank arms. A drive shaft, such as from a motor, is aligned with the axis of rotation of the crankshaft component.

Alternate stanchions are mounted on supports extending between the first ends of adjacent crank arms, such as at 350. The other stanchions are mounted on supports extending between the second ends of adjacent crankshafts. The alternating stanchions are thereby mounted on arms which extend in opposite directions from the axis. As a result, rotation of the crank shaft component causes the outer stanchions 316 and 318 and center stanchion 320 to move upward as the intermediate stanchions 324 and 326 move downward.

FIG. 44 provides additional details as to the mounting of the stanchions to the crankshaft component. Stanchion 326 carries brush support 310 and brushes 312. Stanchion 326 is formed from a strip of material that has its upper end wrapped over stanchion support 354 and fastened to itself with bolts 356. Collars 358 are attached to stanchion support 354 and maintain the position of stanchion 326.

A supporting strap 364 is shown in FIG. 45 connecting between top support 306 and stanchion 326. Strap 364 supports lines 366, such as fluid lines leading to the nozzles or lighting lines, as the stanchions oscillate relative to the center component 300. The end 368 of crankshaft component 345 opposite the motor is also shown in FIG. 45 rotatably received by end strut 370 secured to top support 306.

The present invention provides a system and related method for washing vehicles using novel and highly effective washing brushes, brush supports and stanchions, as well as systems for oscillating the stanchions as the brushes ride against the vehicle surfaces. These systems are supported by ancillary components which may comprise conventional systems known in the art. For example, known drive motors and supports may be used, including existing hydraulic fluid systems. Fluids may be delivered to the inventive system by conventional sources.

In FIG. 46 there is shown a related washing system operating with much the same structures and features as previously described, except that the system 400 articulates in order to wash surfaces including the front, side and/or rear surfaces of the vehicle. As indicated, articulating system 400 may be constructed and may operate in the same manner as described with respect to the center component 300. However, the articulating system is mounted to external support 402 so as to be pivoted or rotated about one or more vertical axes. For example, system 400 incudes a top structure 404 mounted to horizontal arm 406, which pivots relative to the external support 402 about a vertical pin 408. As shown in FIG. 46, the

top structure is also able to rotate relative to horizontal arm 406 about a second vertical pin 410. Alternative arrangements may also be used to provide the same articulation of system 400.

The articulating system includes a bank of brushing structures as previously described. The articulation is used to move the bank of brushing structures against any or all of the front, sides and rear of the vehicle as the vehicle and system 400 are moved relative to one another. For example, in a conventional approach a vehicle is moved forward into engagement with the washing system. The articulating system may first be positioned in front of the vehicle with the brushing units parallel to the front of the vehicle. Due to the articulation, the brushing units may even be moved along with the vehicle a distance to provide for prolonged brushing of the vehicle front.

As the vehicle continues to move relative to the system 400, the bank of brushing units is moved toward the outside of the vehicle, while engaging the vehicle at the front corner. Still further, the bank of brushing units continues to pivot until the brushing units extend parallel to the side of the vehicle. The bank of brushing units may be maintained in this position as the vehicle continues to move forward, thus causing the brushing units to move along the side of the vehicle towards the rear end.

As for the front end, the bank of brushing units are rotated around the rear corner of the vehicle to thoroughly wash the corner components of the vehicle. Eventually, the bank of brushing units is rotated until the brushing units extend parallel to the rear of the vehicle. Also as before, the articulation can be used to have the brushing units "follow" the vehicle, which allows the brushing of the rear of the vehicle to be maintained for a period of travel of the vehicle.

Disclosed is a suspended linear composited stanchion which is fully populated with brushes having a generally non-rotating type of car washing action. The articulating brushes achieve excellent high-resolution vehicle cleaning requiring significantly less water, chemicals, and energy to operate.

Reference Number

10	brush
12	hub
14	bristle
16	shaft
17	proximal end
18	cleaning structures
20	through holes
22	central axis of hub 12
24	gussets
26	locking structure
28	central axis of shaft 16
30	end portion / tip
32	nub
34	side wall of a nub 32
36	end surface of a nub 32
38	corner edge of nub 32
40	wiper blade
42	side wall of blade 40
44	contact surface of blade 40
46	rounded nubs
48	cup-shaped nubs
50	needle-type nubs
52	wafer type nubs
54	pad-type nubs
56	corkscrew nubs
58	
60	brush
62	tree branches
64	coarse comb
66	forked wiper blade
68	tapered branches

70 dense comb
72 fine tapered fins
74 coarse tapered fins
76 radius
80 brush precursor
82 hub central aperture
84 proximal end of 16
86 connectors
87 open spaces
88 webbing
90 ejection pin locations (inner)
92 ejection pin locations (outer)
94 braces
96 wedge-shaped gussets
98 Folded Brush
100 wedge portions
101 gusset mating faces
102 annular recess (FIG. 17)
104 bristle recess
106 proximal shoulder
108 distal shoulder
110 locking member
112 annular ring
114 brush - FIG. 21
116 locking collar - FIG. 21
118 annular recess - FIG. 21
120 support structure – FIG. 21
122 tapered surface – FIG. 21
124 brush – FIGS. 23-24
126 aperture – FIGS. 23-24
128 support structure – FIGS. 23-24
130 brush – FIG. 25
132 aperture – FIG. 25

134 support structure
140 stanchion (FIG. 26)
142 apertures (FIG. 26)
144 brushes
146 attachment end
148 attachment means
150 hubs
152 spray nozzles
154 tubing
156 LED tubing
158 LED light source
160 drum stanchion
162 apertures
164 washing mitt
166 wrist cuff
168 support structure
170 dual bristle
172 dual bristle shafts
174 bristle nubs
176 rings
178 annular recesses
180 stanchion
182 pole brush
184 water line
186 rigid conduit
188 support structure
190 brushes
192 spraying
194 hand brush
196 support structure
198 brushes
200 handle
202 toothbrush

204 brushes
206 support structure
208 handle
210 dishwashing brush
212 support structure
214 handle
216 brush
218 nesting brush
220 bristle
222 stem

300 center component
302 support structure
304 sides
306 top support
308 brushing units
310 brush support
312 brushes
314 stanchion
316 outer stanchion
318 outer stanchion
320 center stanchion
322 lateral arm
324 stanchion
326 stanchion
328 lateral arm
330 slider
332 slider
334 slider
336 bottom curved portion
338 second curved portion
340 tubes
342 lights

344 nozzles
346 crankshaft component
348 crank arms
350 between crank arms
354 stanchion support
356 bolts
358 collar
364 supporting strap
366 support lines
368 end of crankshaft component
370 end strut
400 articulating system
402 external support
404 top structure
406 horizontal arm
408 vertical pin
410 second vertical pin

Claims

1. A brushing apparatus for a vehicle washing system, the brushing apparatus comprising:

an elongated stanchion extending from a proximal end to a distal end;

a flexible, wavelike brush carrier mounted to the stanchion and having a front facing away from the stanchion; and

an array of brushes mounted to the front of the brush carrier.

2. The brush apparatus of claim 1 in which the brushes are mounted in apertures formed in the brush carrier.

3. The brush apparatus of claim 2 in which the brushes include annular recesses received in the apertures.

4. The brush apparatus of claim 1 in which the brushes include multiple fingers extending away from the brush carrier, the array of brushes being spaced to cause overlap when the brushes are pressed against a vehicle.

5. The brush apparatus of claim 1 and further including tubing extending within the array of brushes, the tubing including nozzles configured to spray a fluid against a vehicle being washed.

6. The brush apparatus of claim 5 in which the tubing is mounted on the front of the brush carrier.

7. The brush apparatus of claim 6 in which the nozzles comprise holes formed in the tubing.

8. The brush apparatus of claim 5 in which the light tubing is mounted between the brush carrier and the stanchion, and in which the nozzles are received in apertures in the brush carrier.

9. The brush apparatus of claim 1 and further including an array of LEDs positioned between the brushes.

10. The brush apparatus of claim 9 in which the LEDs are mounted between the brush carrier and the stanchion, and are visible through the brush carrier.

11. The brush apparatus of claim 10 in which the LEDs are in the form of light tubing containing the LEDs.

12. The brush apparatus of claim 11 in which the light tubing extends linearly between the proximal and distal ends of the stanchion.

13. A system for washing a vehicle comprising:

a horizontal support system; and

at least one brush apparatus according to claim 1 mounted to the support system and hanging downwardly therefrom.

14. The system of claim 13 in which the support system includes a motion assembly configured to move the at least one brush apparatus in an up and down motion.

15. The system of claim 14 in which the at least one brush apparatus is moved in an orbital motion.

16. The system of claim 13 and including at least 2 brushing apparatuses according to claim 1.

17. The system of claim 16 in which there are gaps between adjacent brush carriers.

18. The system of claim 16 in which the brushes include multiple fingers extending away from the brush carrier, the array of brushes being spaced to cause overlap with brushes on an adjacent brush carrier when the brushes are pressed against a vehicle.

19. The system of claim 16 in which alternating stanchions are secured together.

20. The system of claim 18 including five brush apparatuses positioned in a line comprising a first, a second, a third, a fourth and a fifth brush apparatus, the first, third and fifth brush apparatuses being secured together, and the second and fourth brush apparatuses being secured together.

21. The system of claim 20 in which the first, third and fifth brush apparatuses are secured together by a cross-member extending along the back side of the second and fourth brush apparatuses, and the second and fourth brush apparatuses are secured together by a second cross-member extending along the back side of the third brush apparatus.

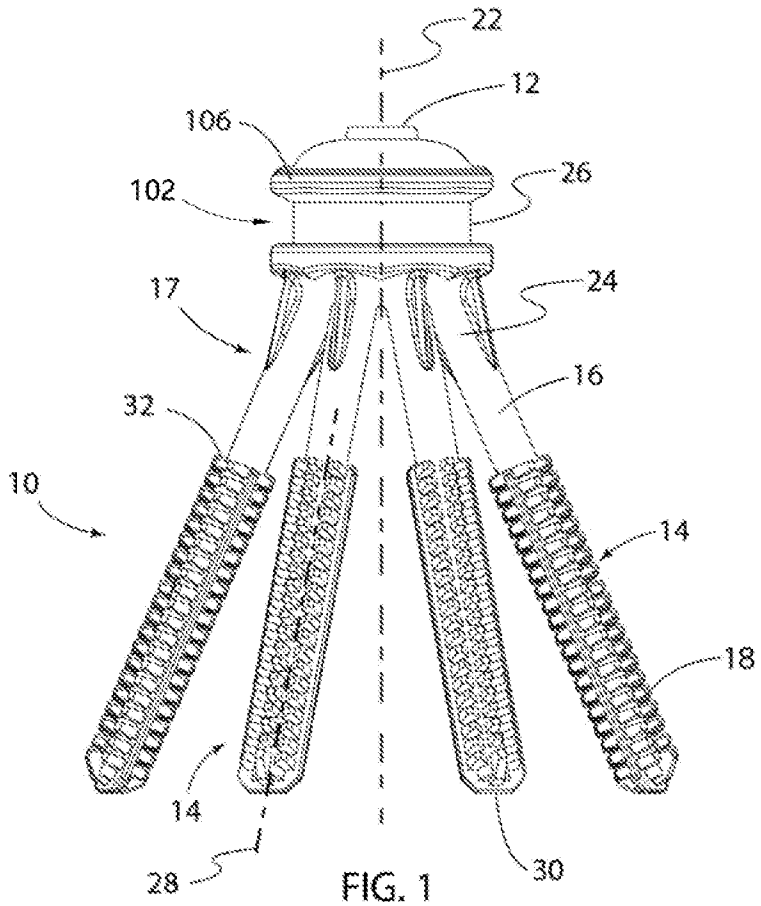

FIG. 1

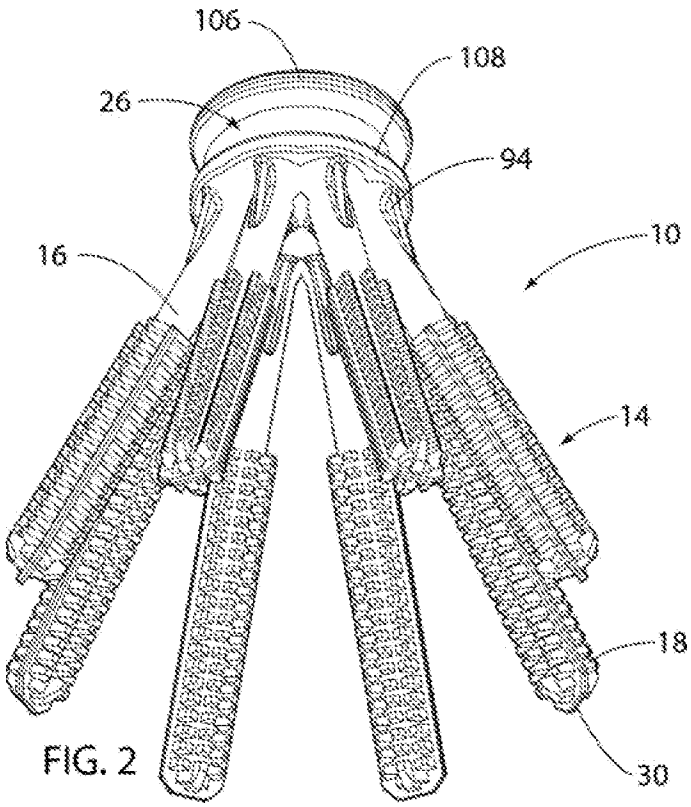

FIG. 2

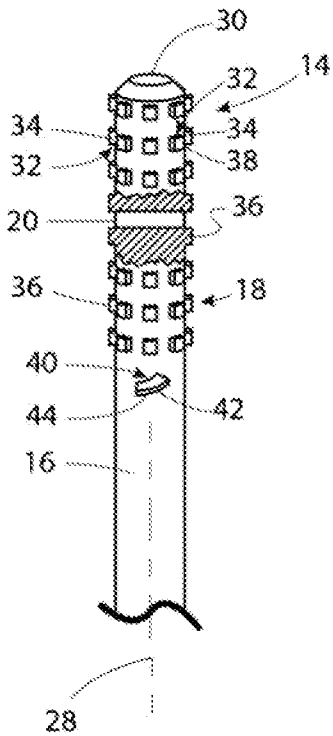

FIG. 3

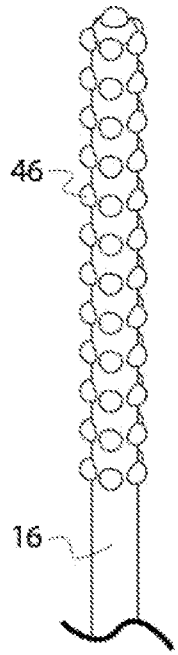

FIG. 4

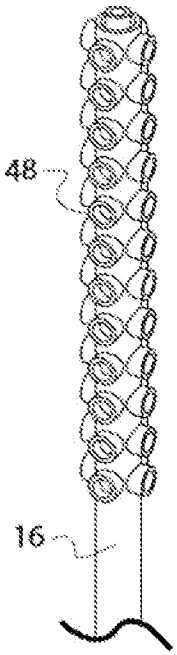

FIG. 5

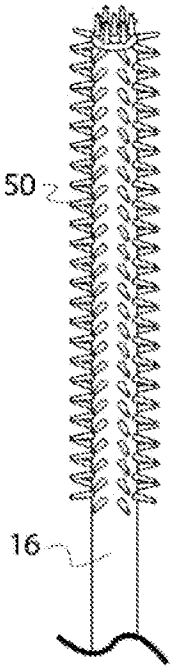

FIG. 6

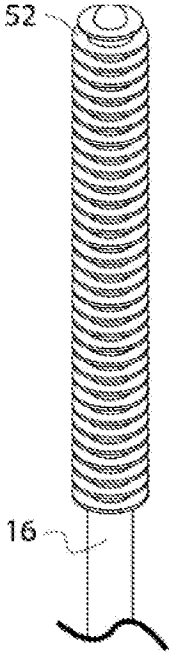

FIG. 7

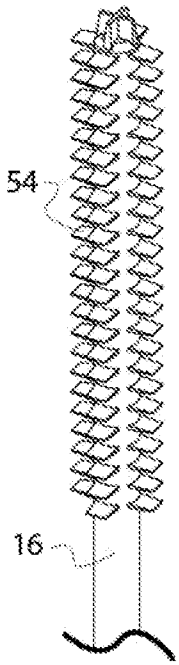

FIG. 8

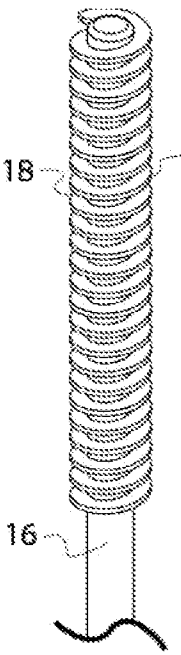

FIG. 9

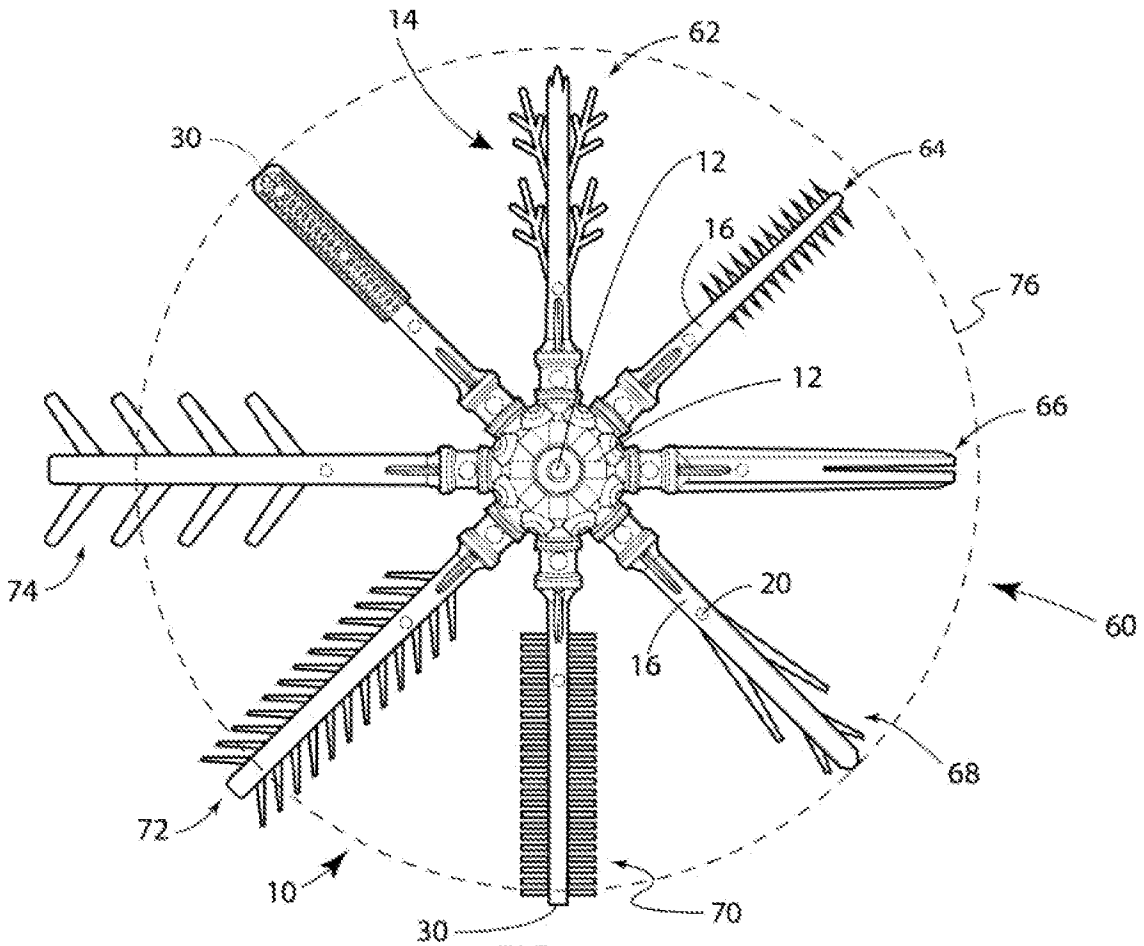

FIG. 10

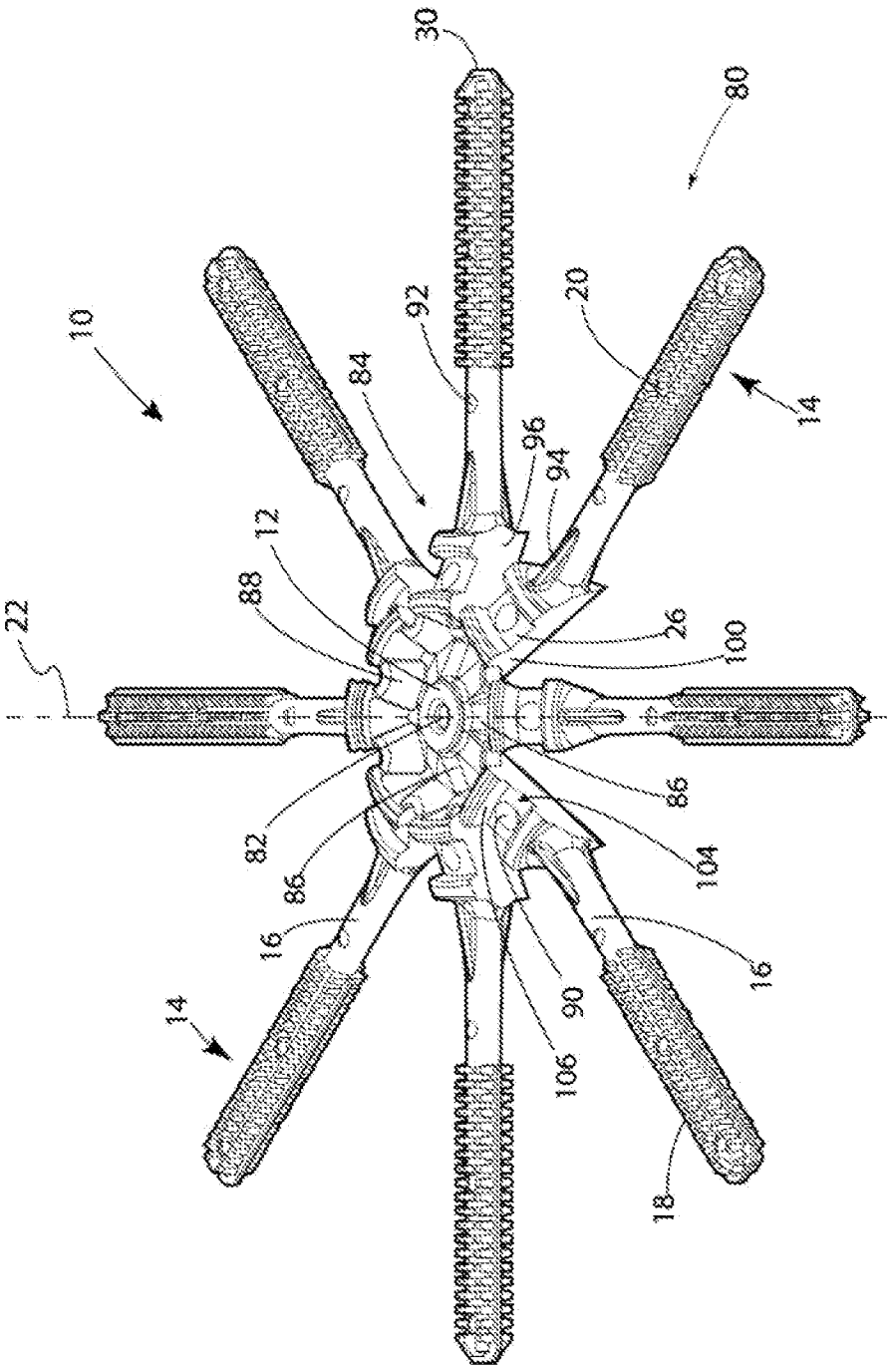
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FIG. 11

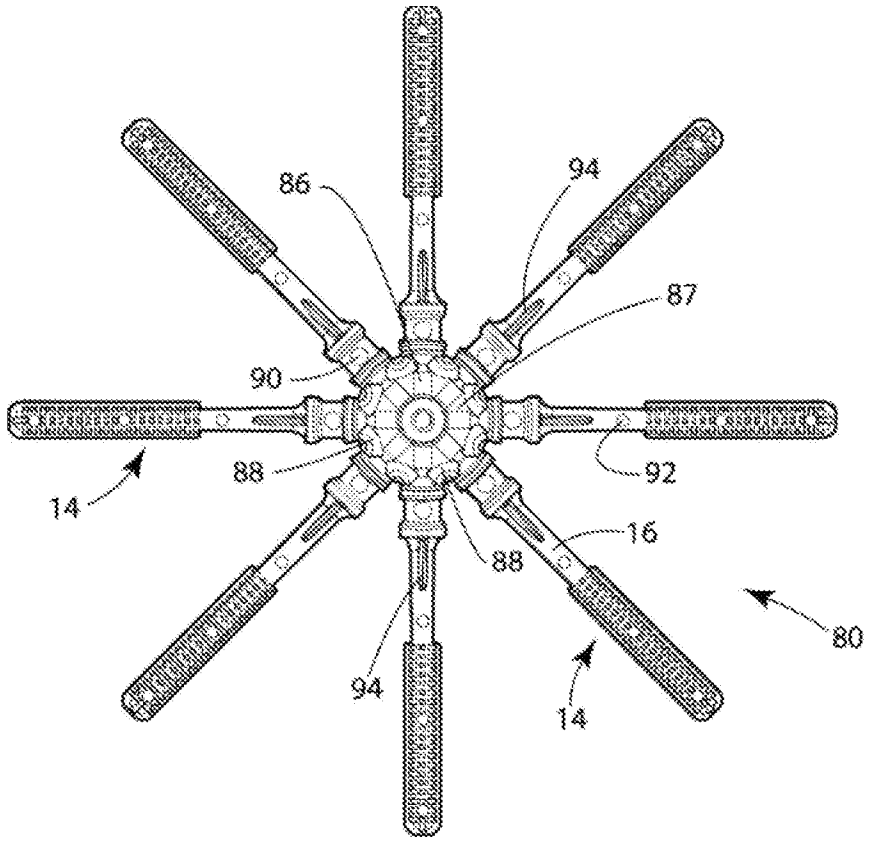

FIG. 12

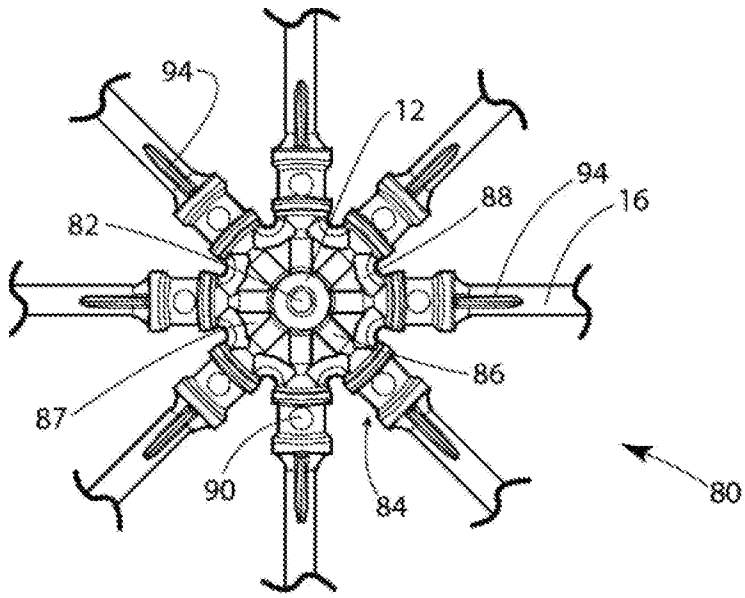

FIG. 13

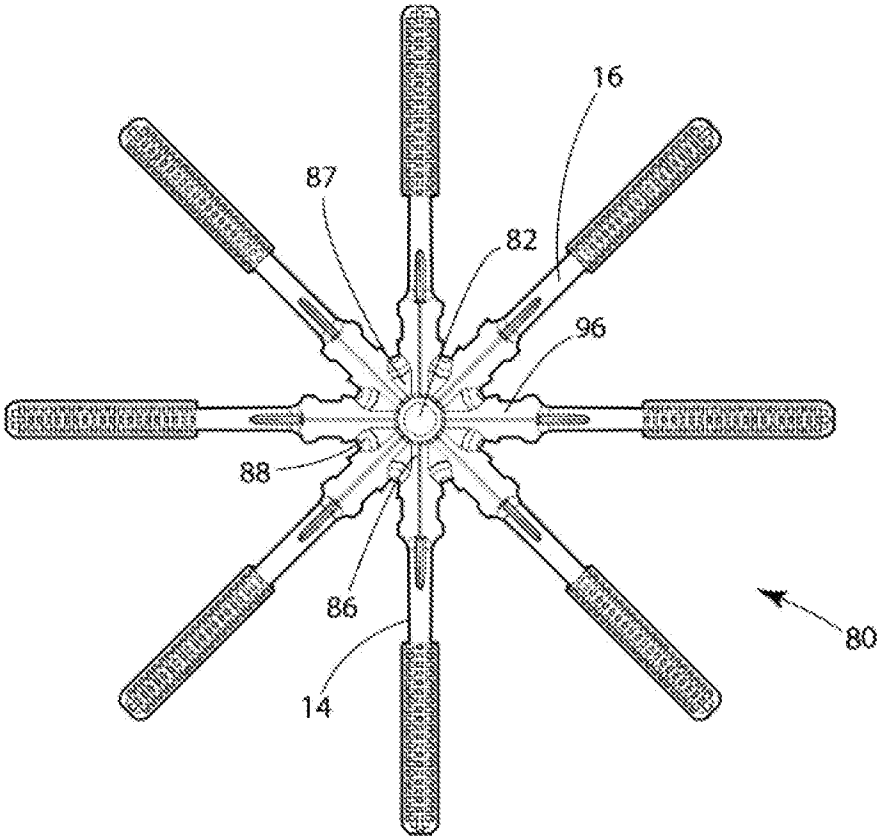

FIG. 14

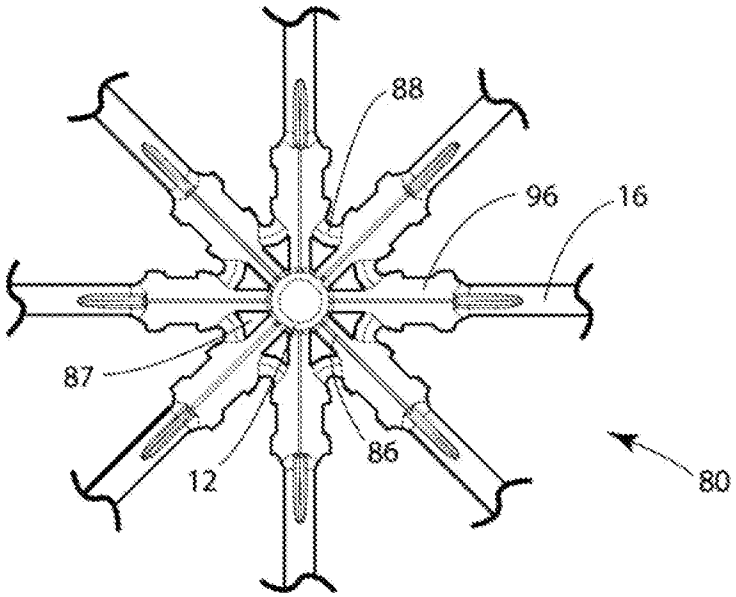

FIG. 15

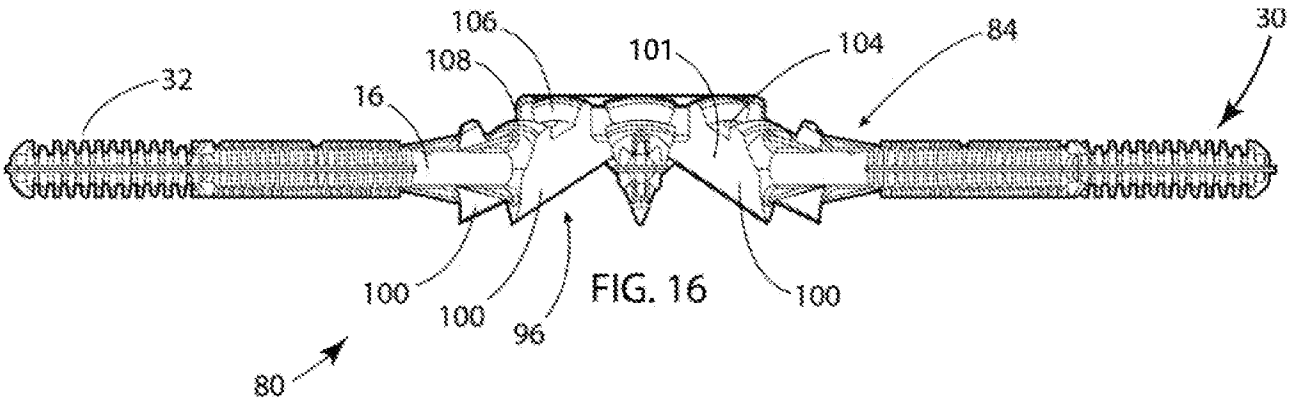

FIG. 16

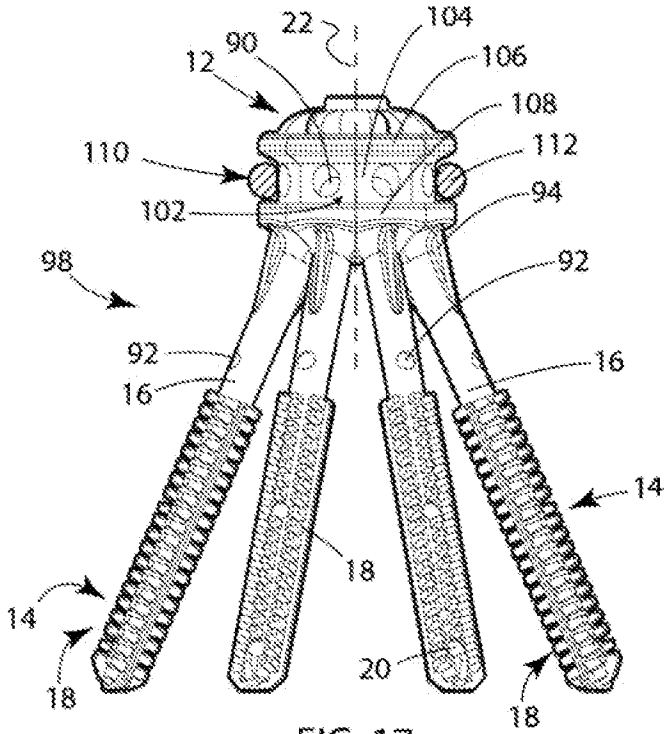

FIG. 17

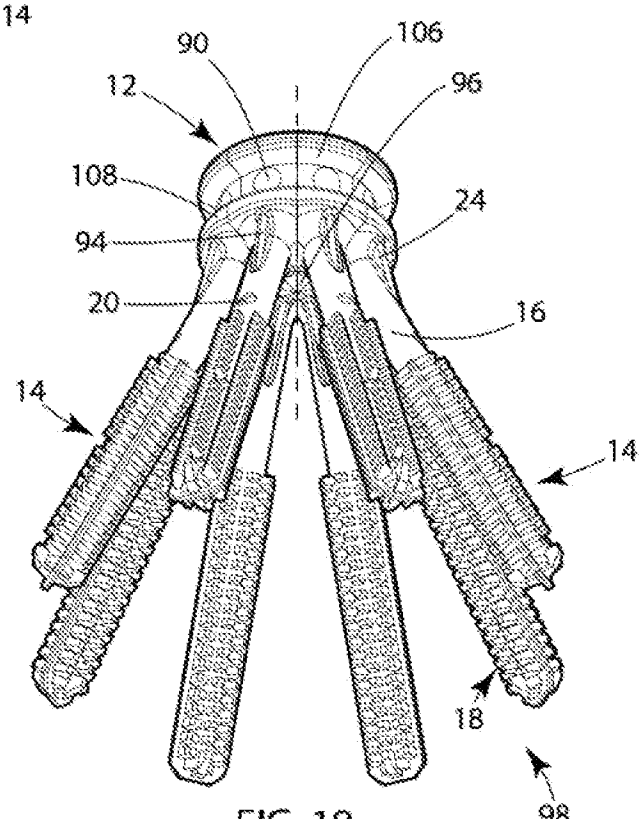

FIG. 18

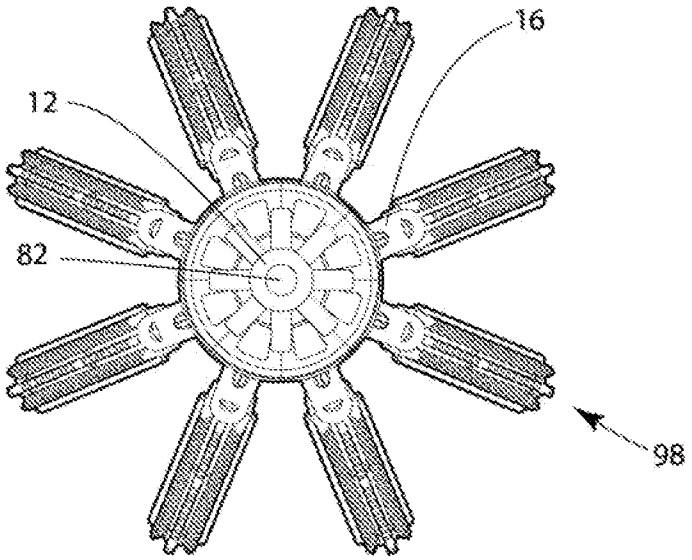

FIG. 19

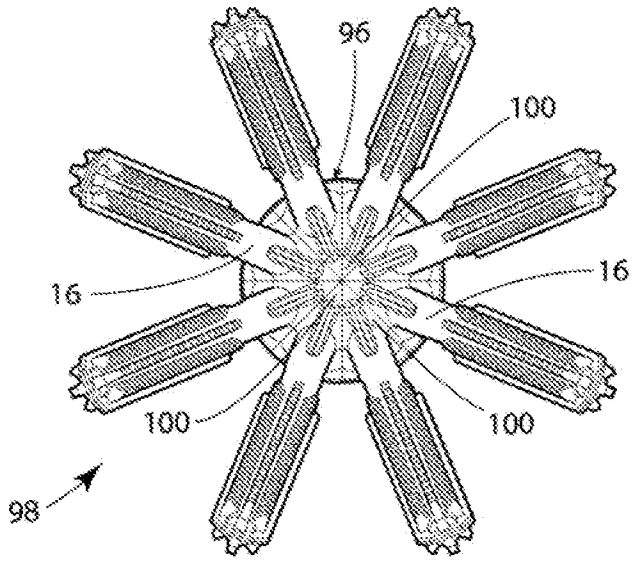

FIG. 20

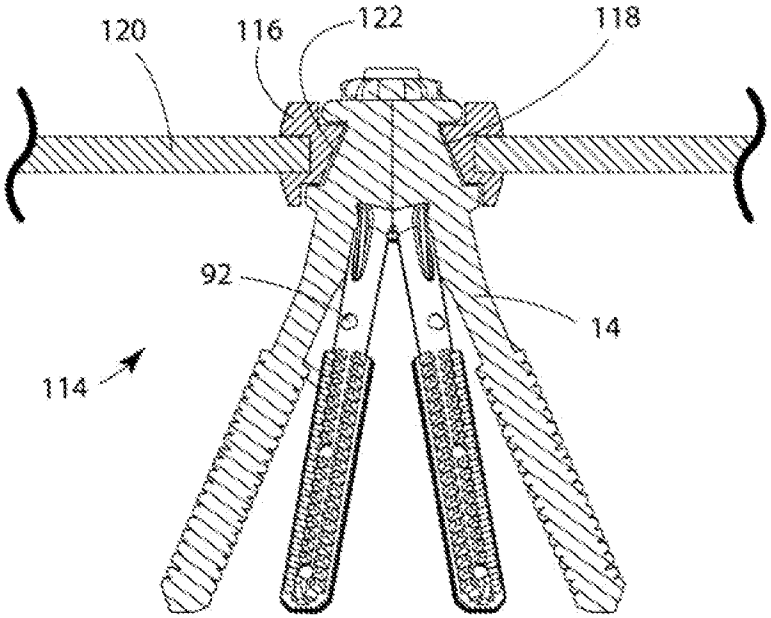

FIG. 21

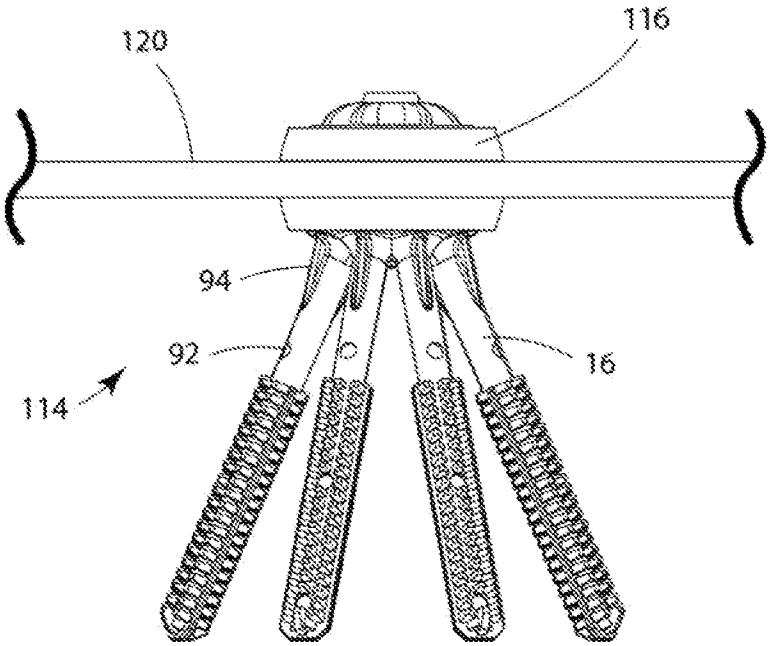

FIG. 22

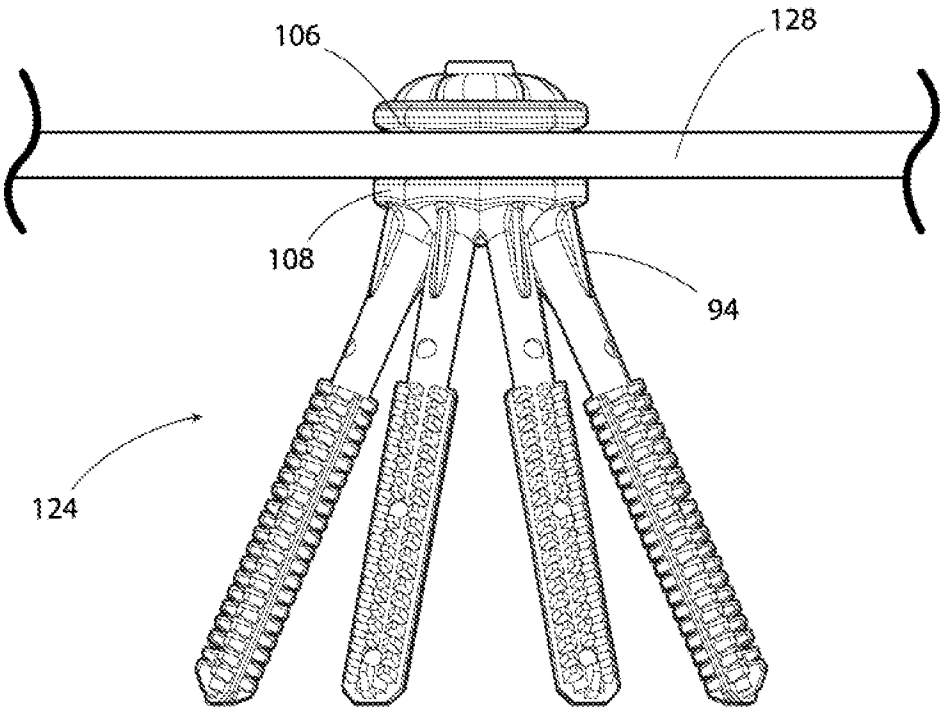

FIG. 23

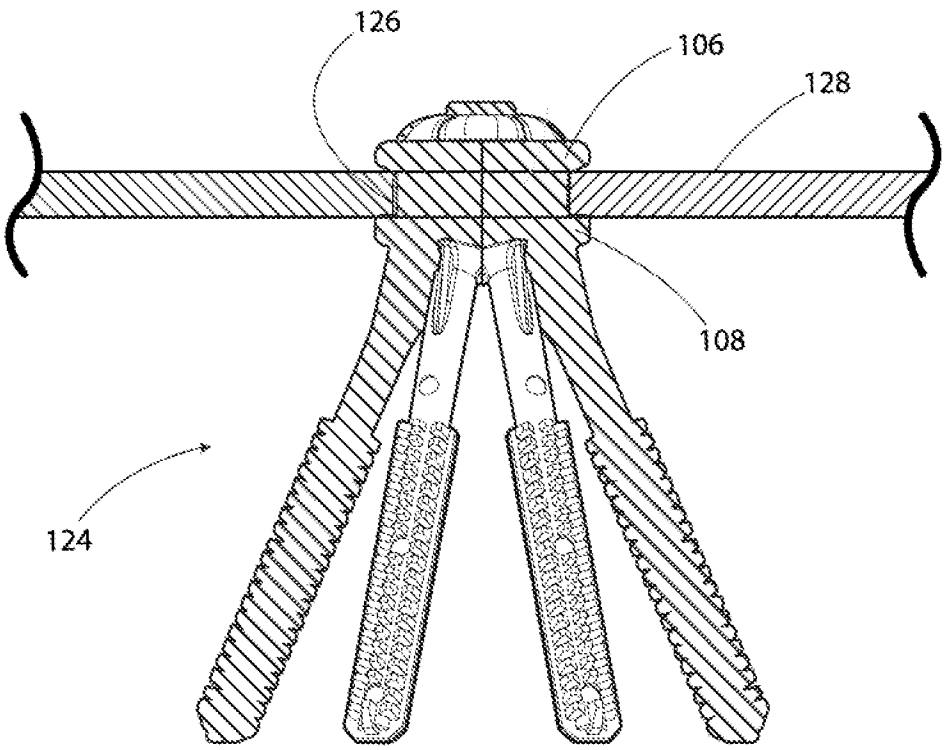

FIG. 24

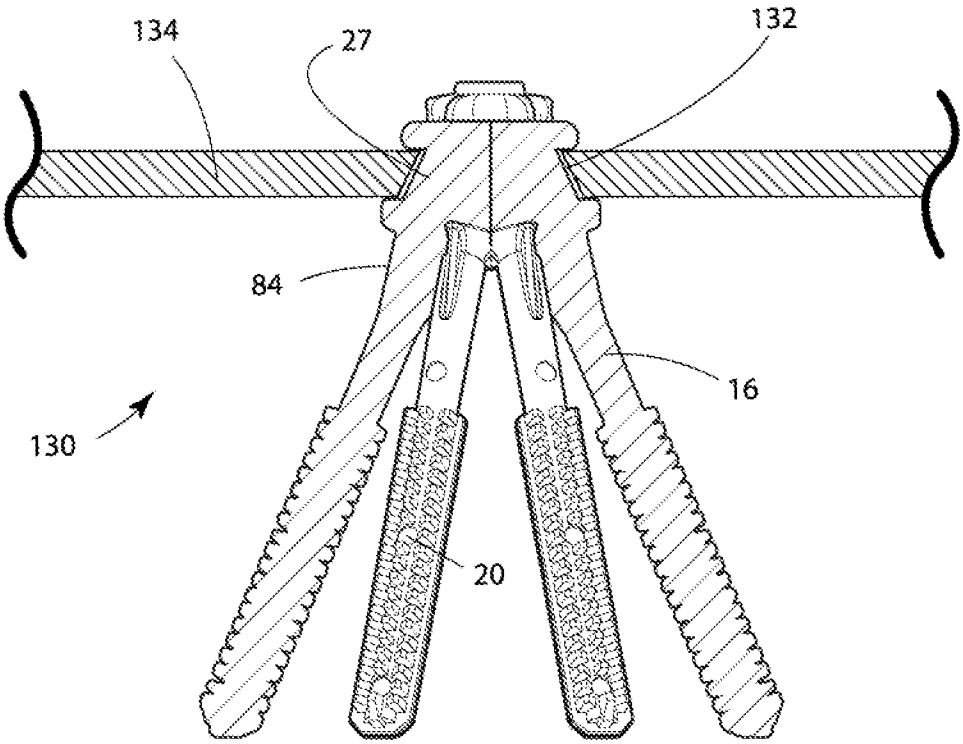

FIG. 25

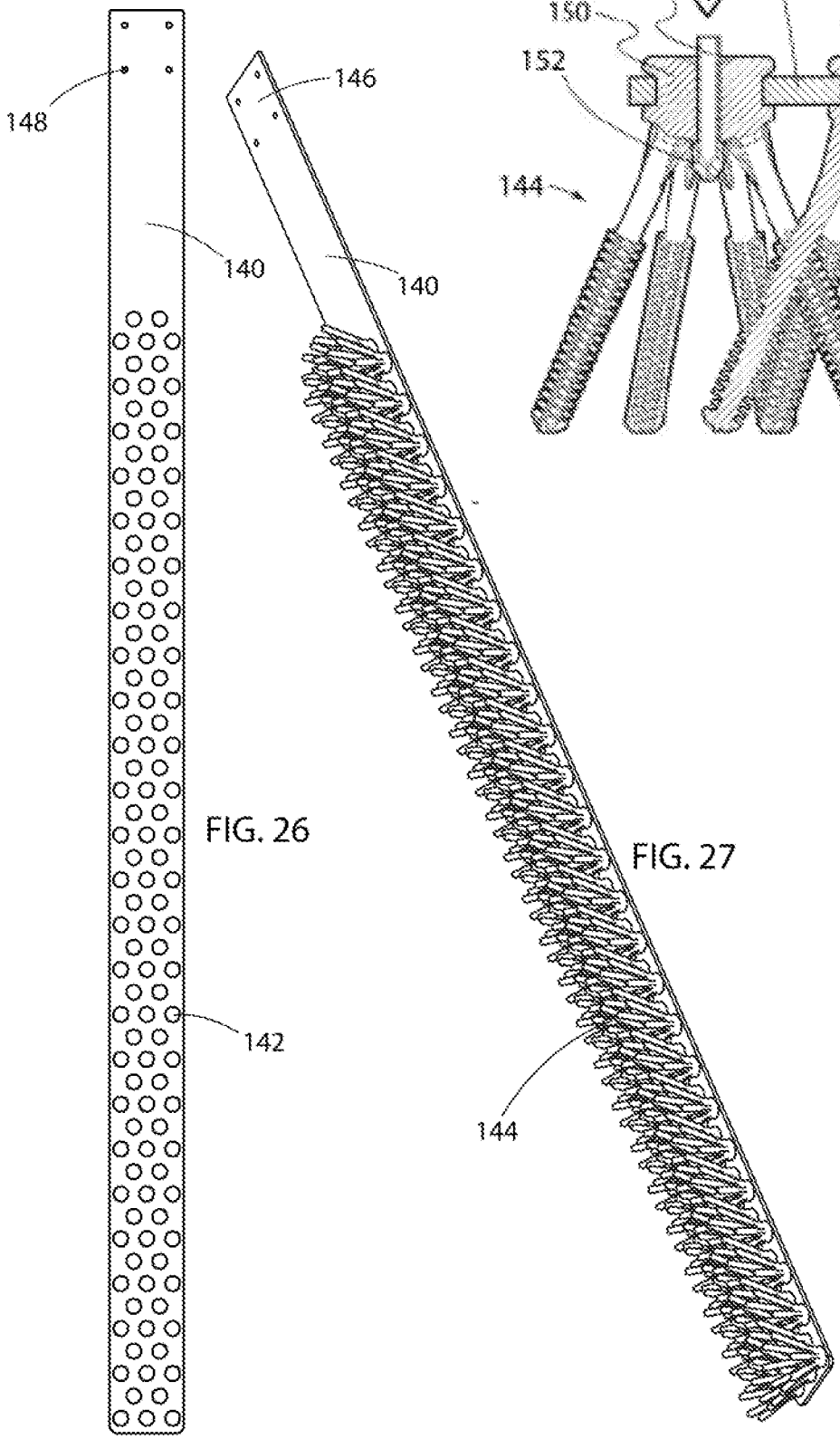

FIG. 26

FIG. 27

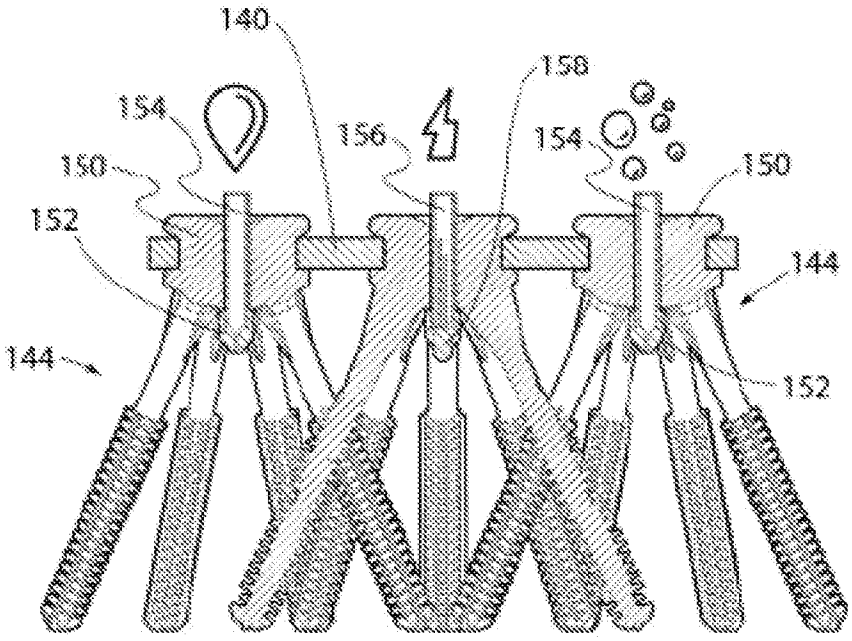

FIG. 28

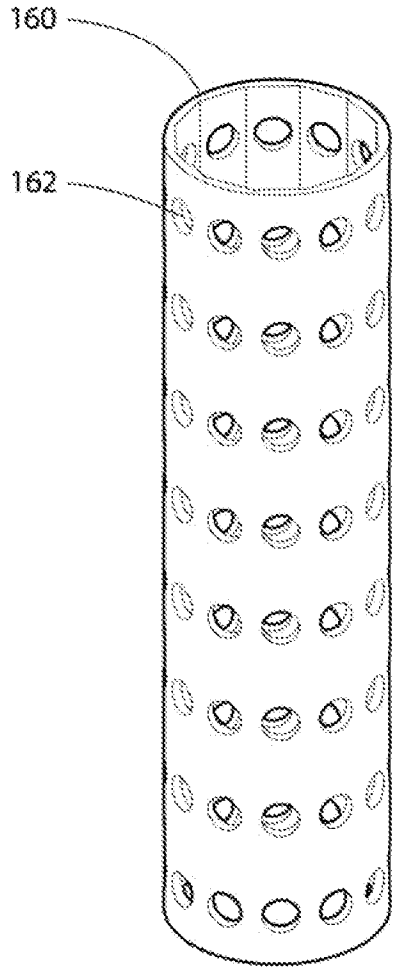

FIG. 29

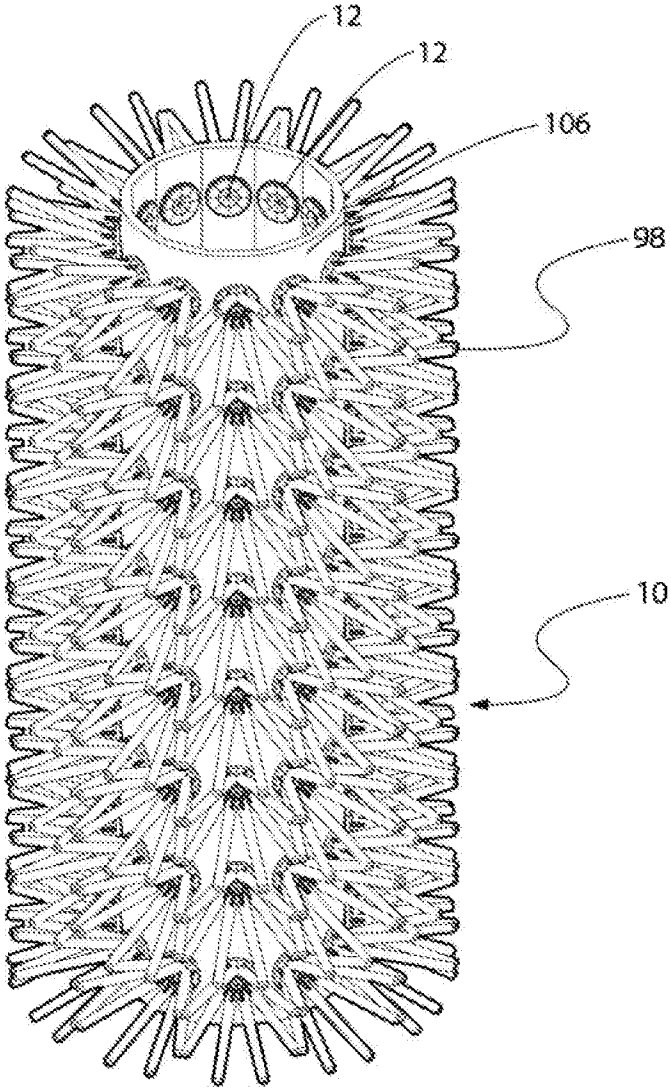

FIG. 30

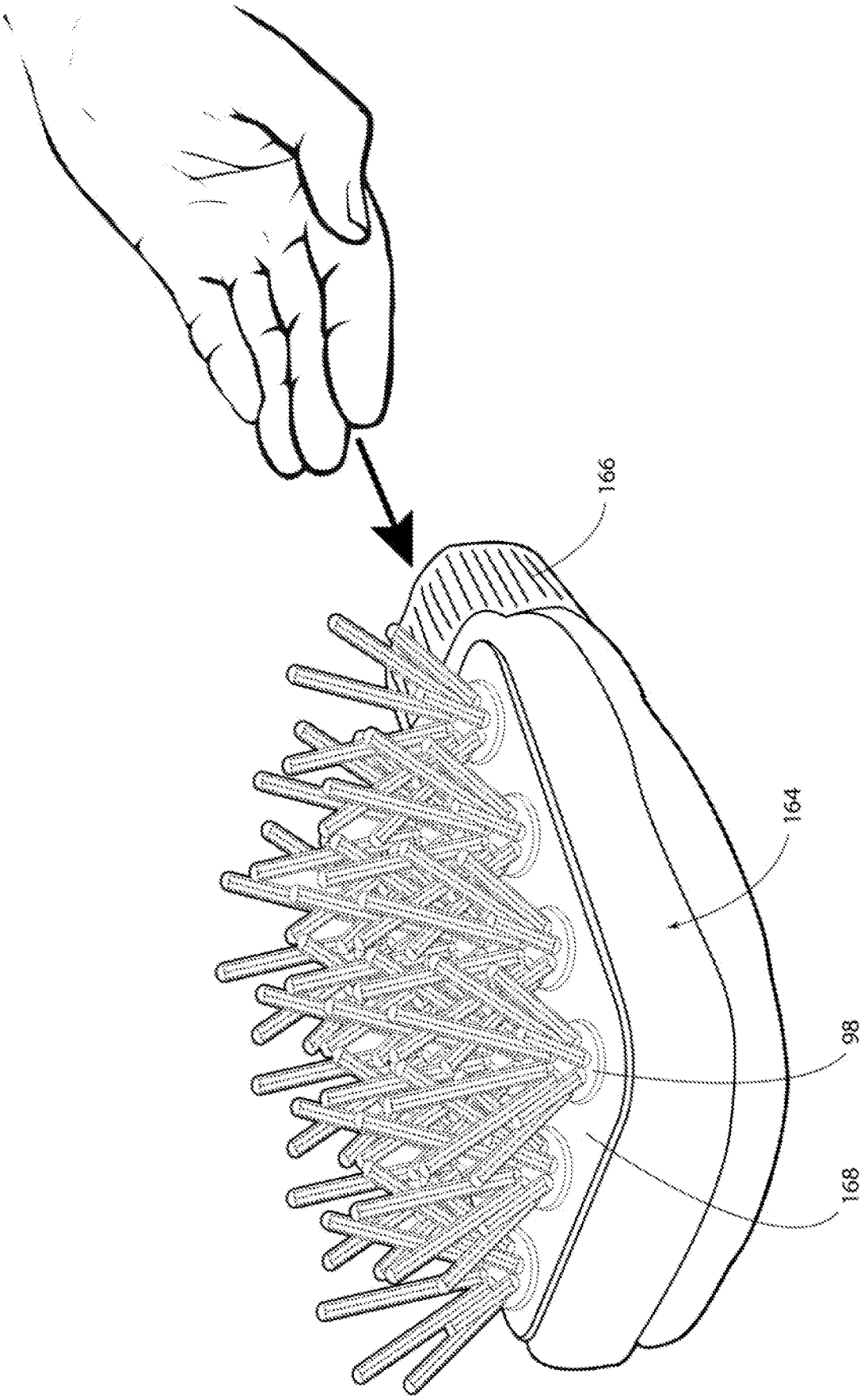

FIG. 31

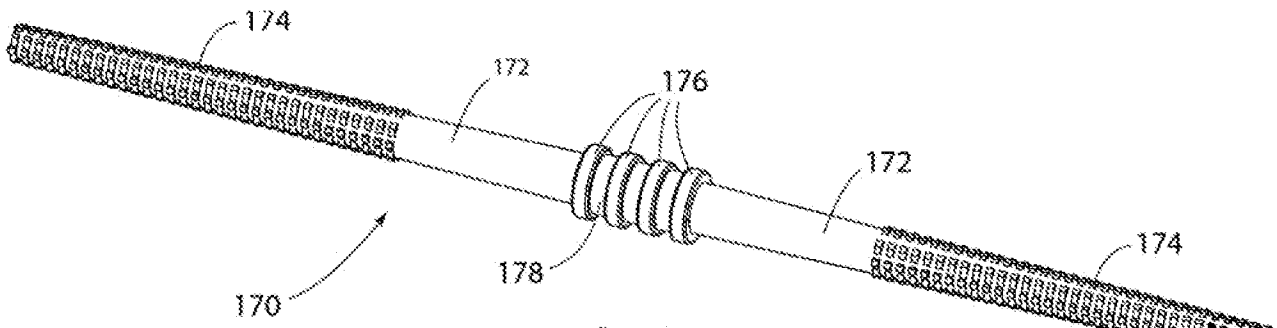

FIG. 32

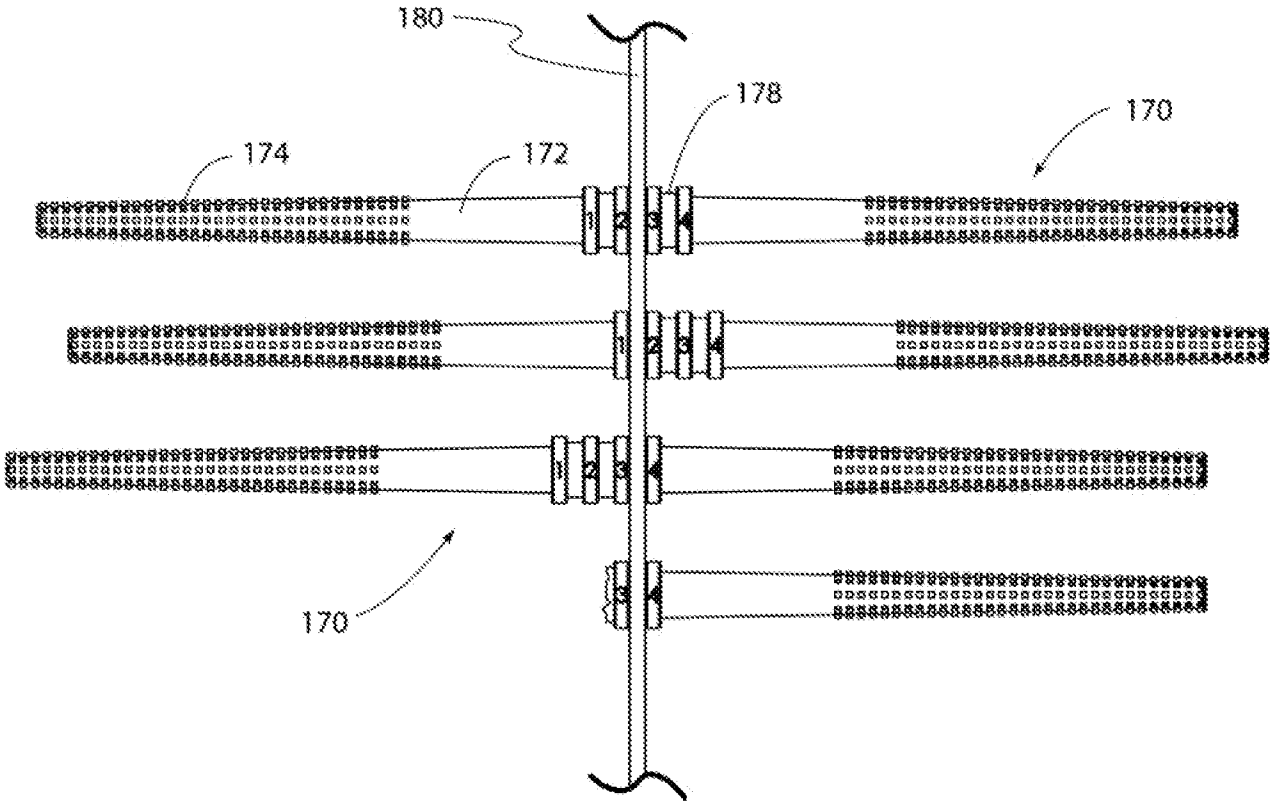

FIG. 33

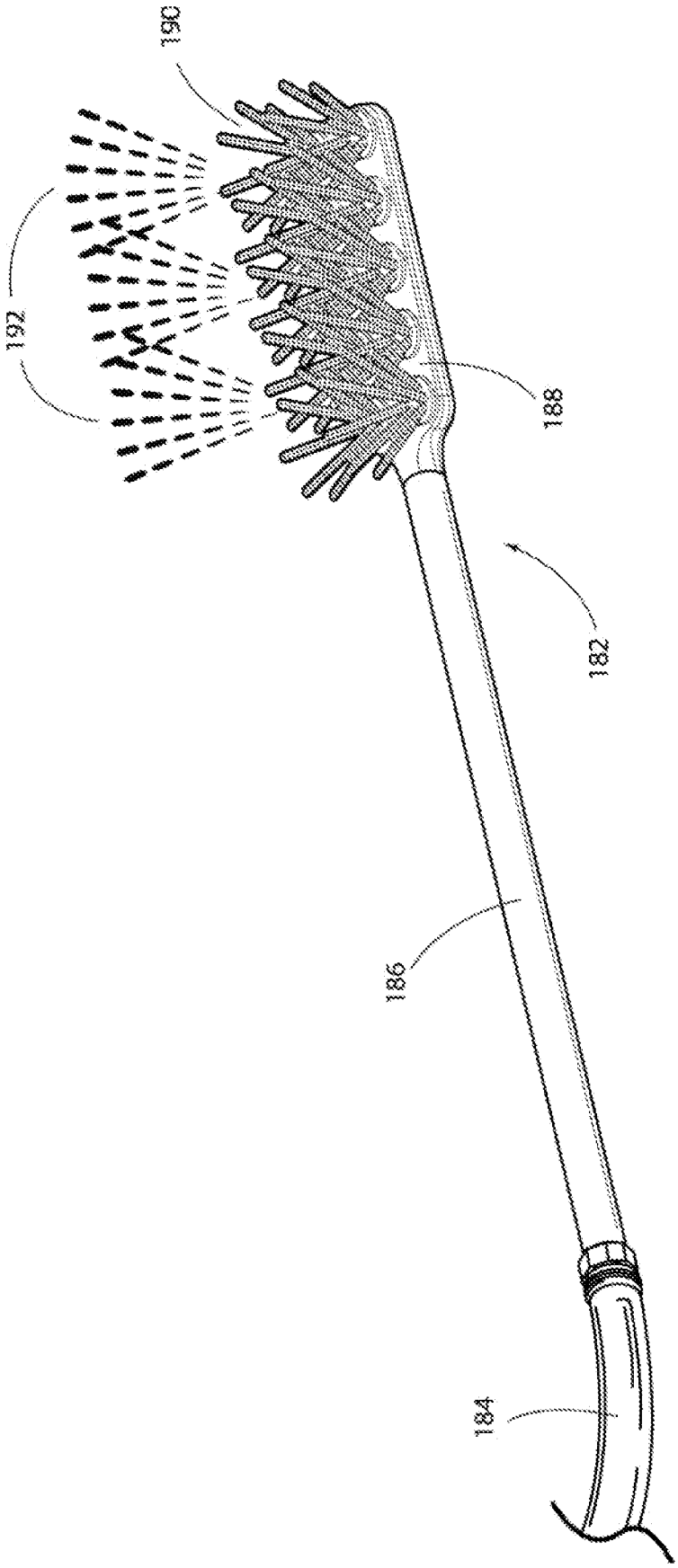

FIG. 34

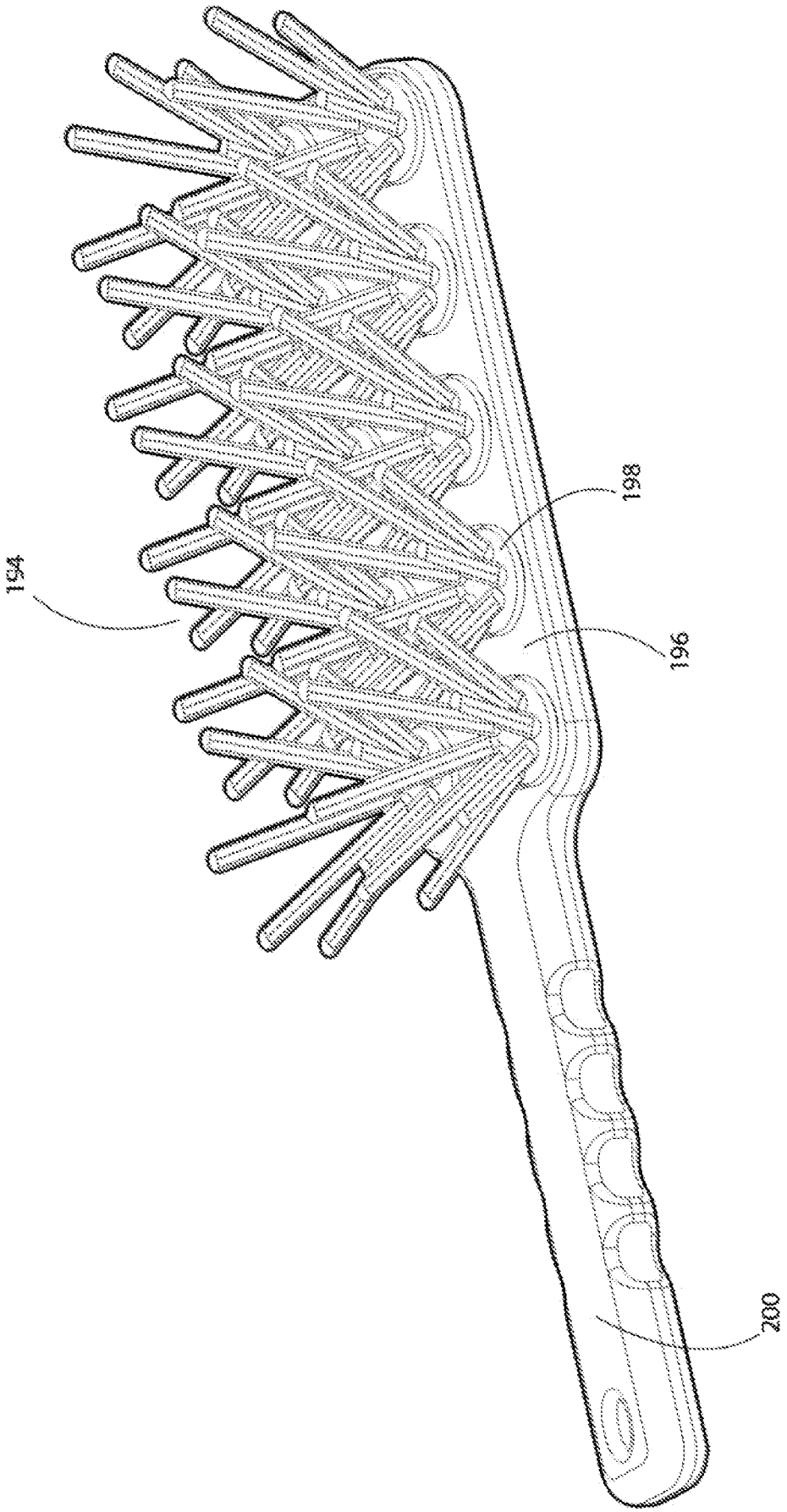

FIG. 35

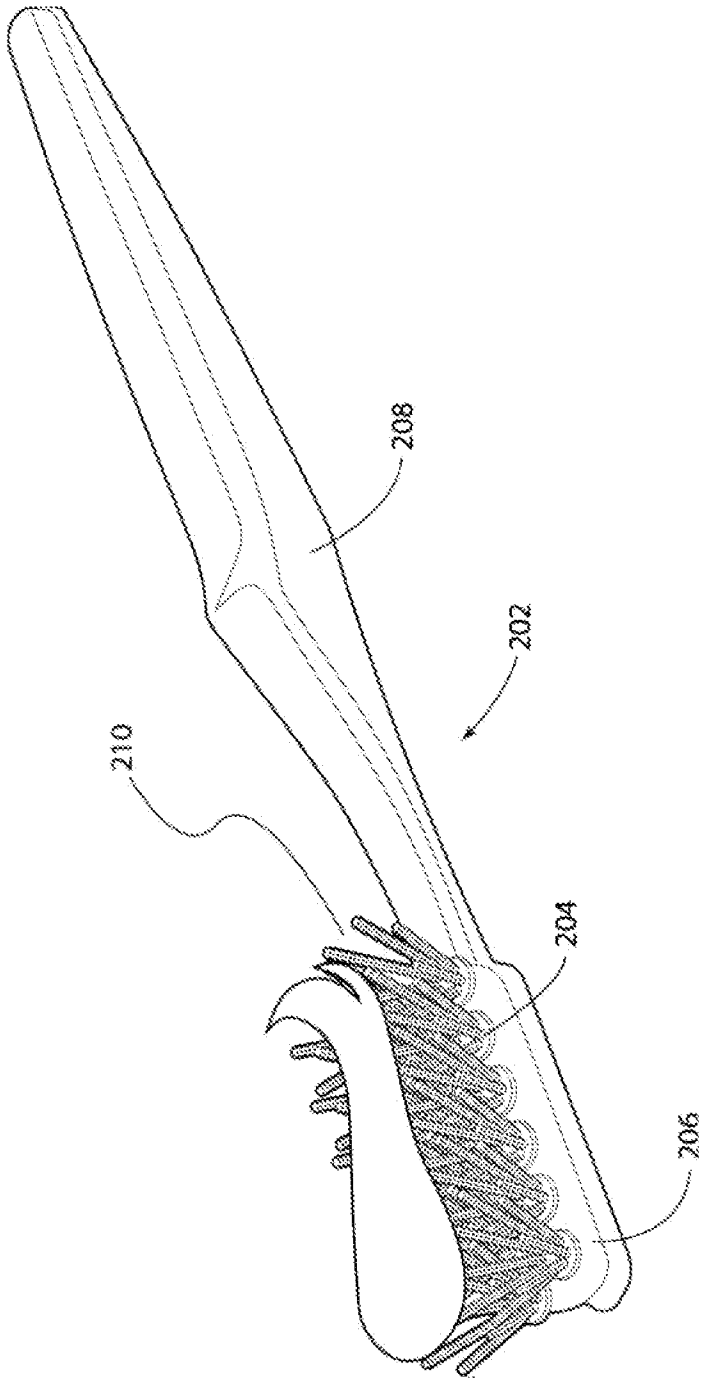

FIG.36

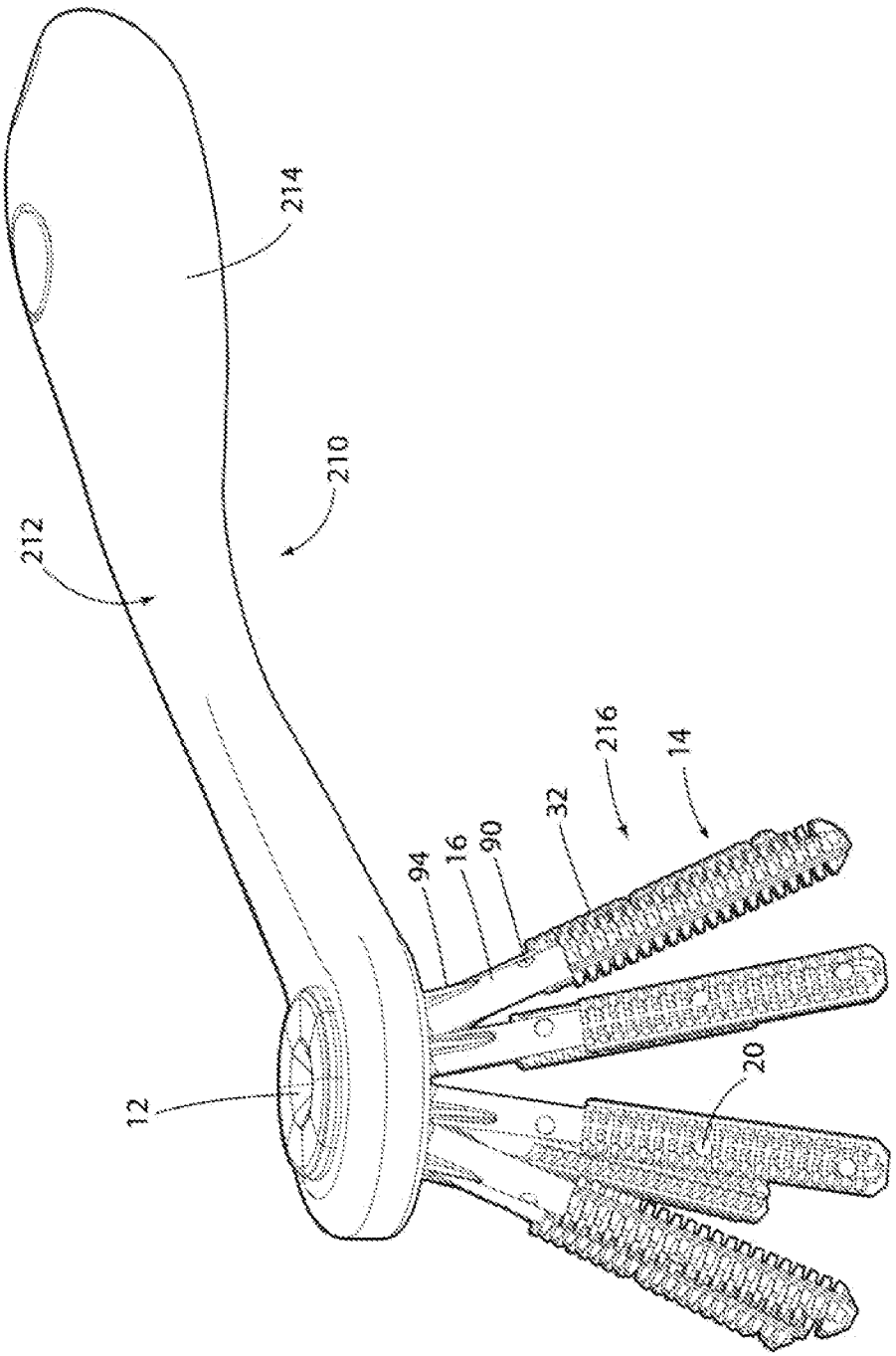

FIG. 37

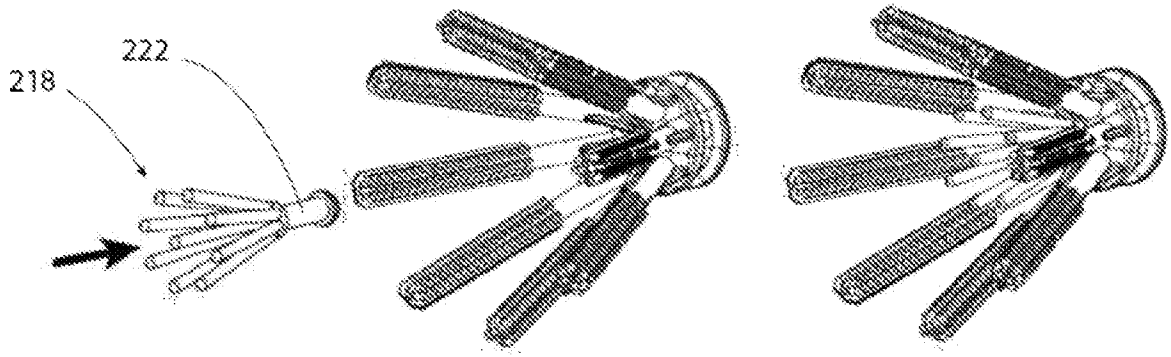

FIG. 38

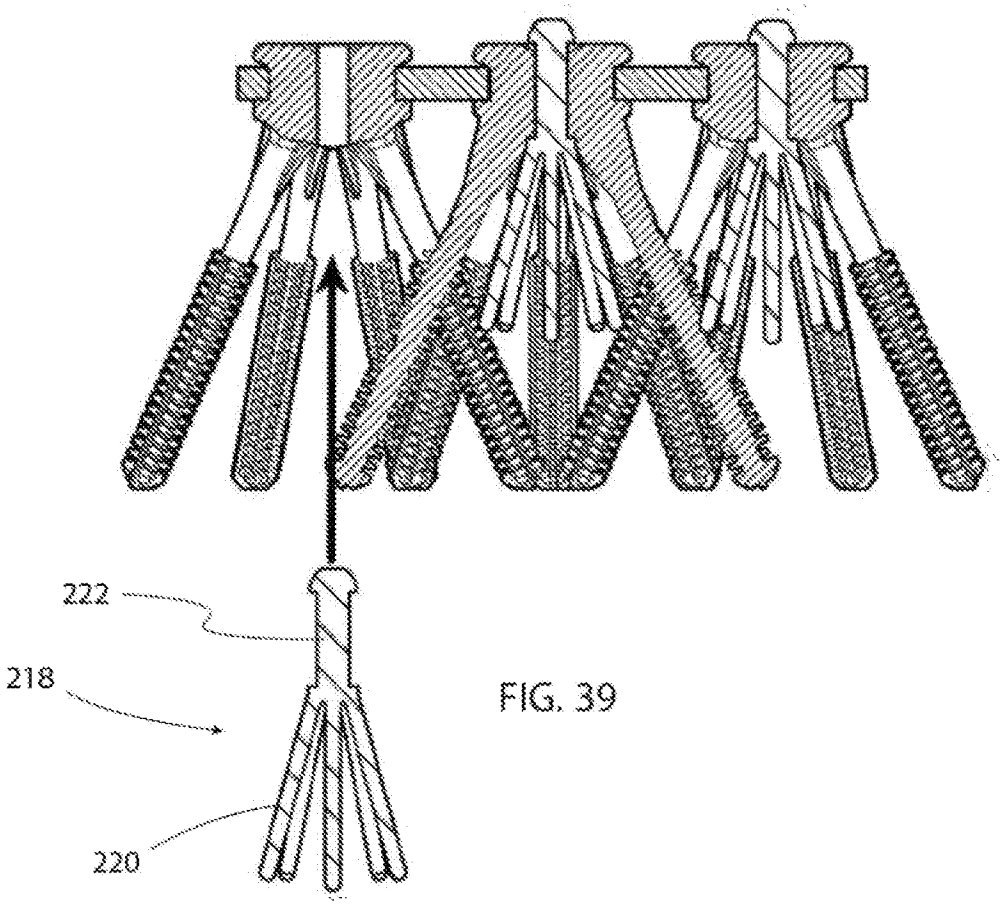

FIG. 39

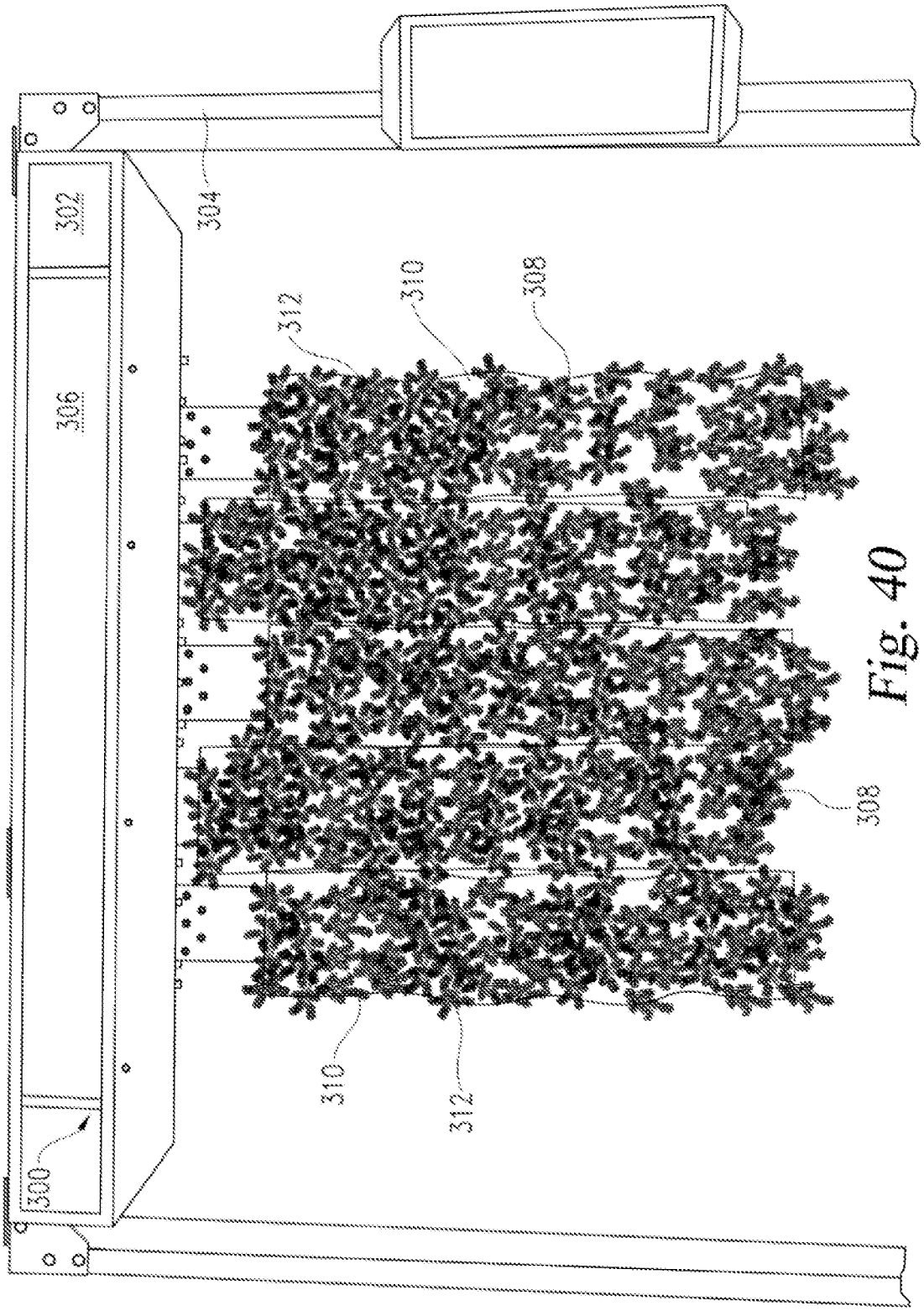

Fig. 40

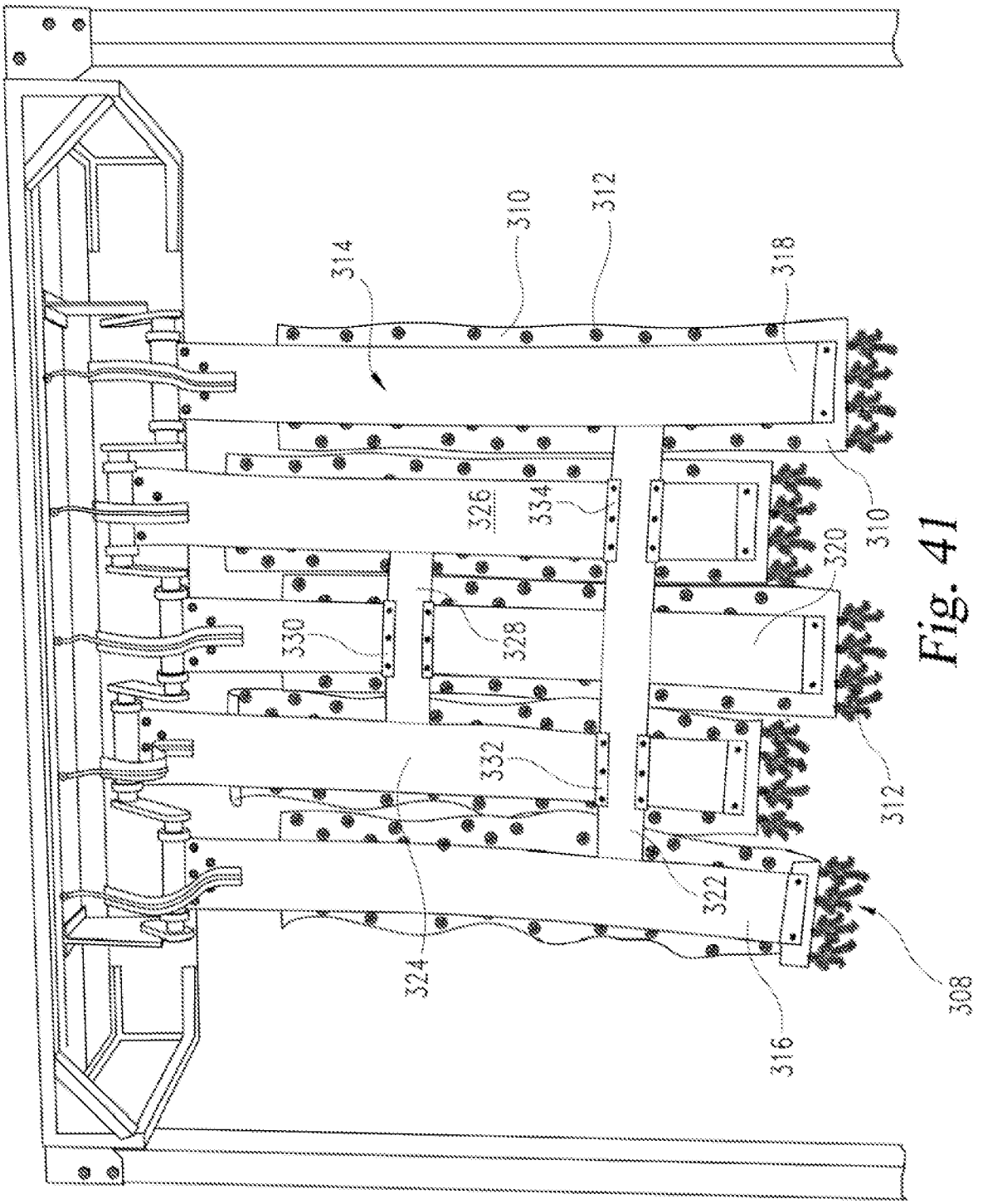

Fig. 41

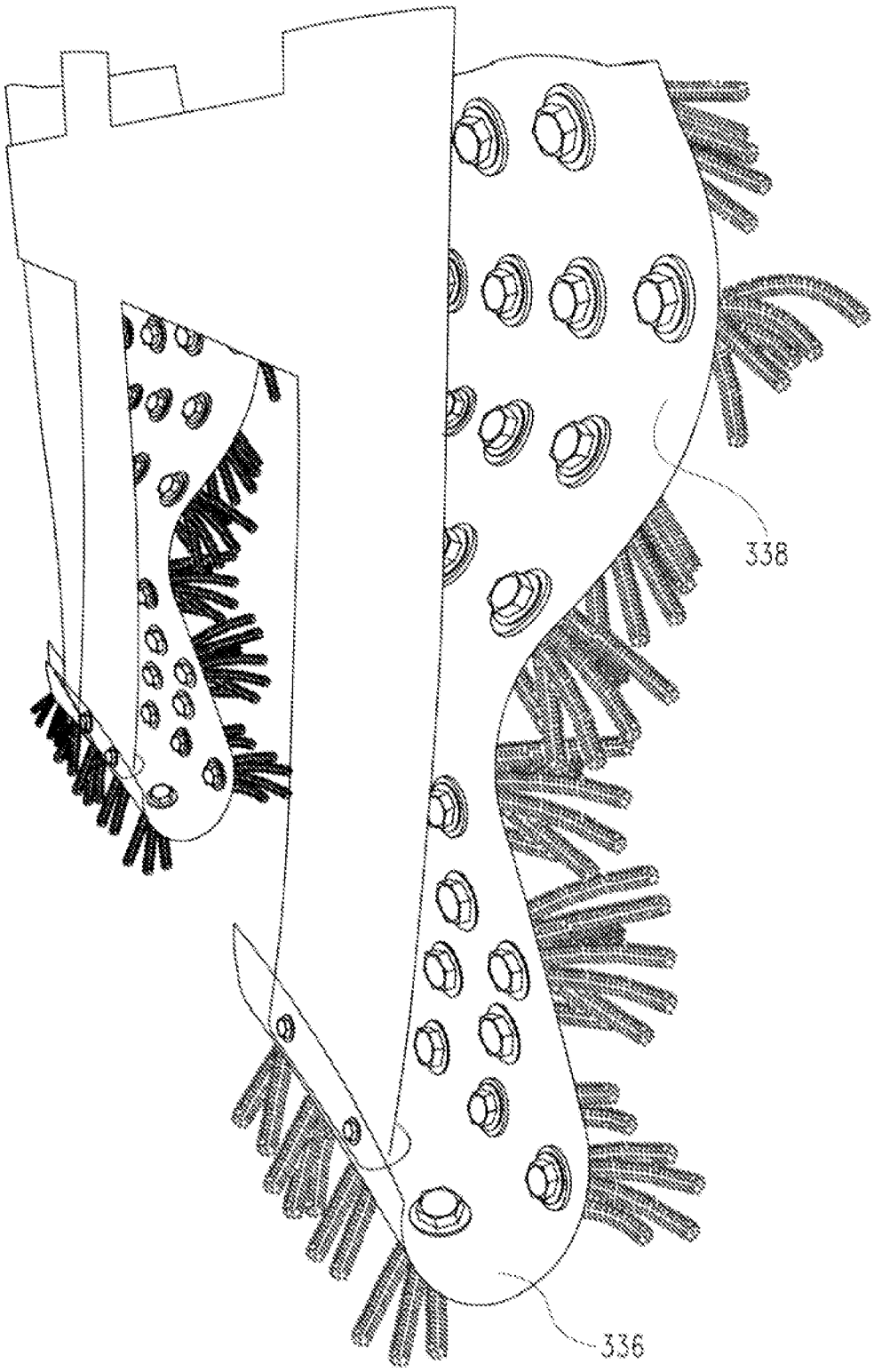

Fig. 42

Fig. 43

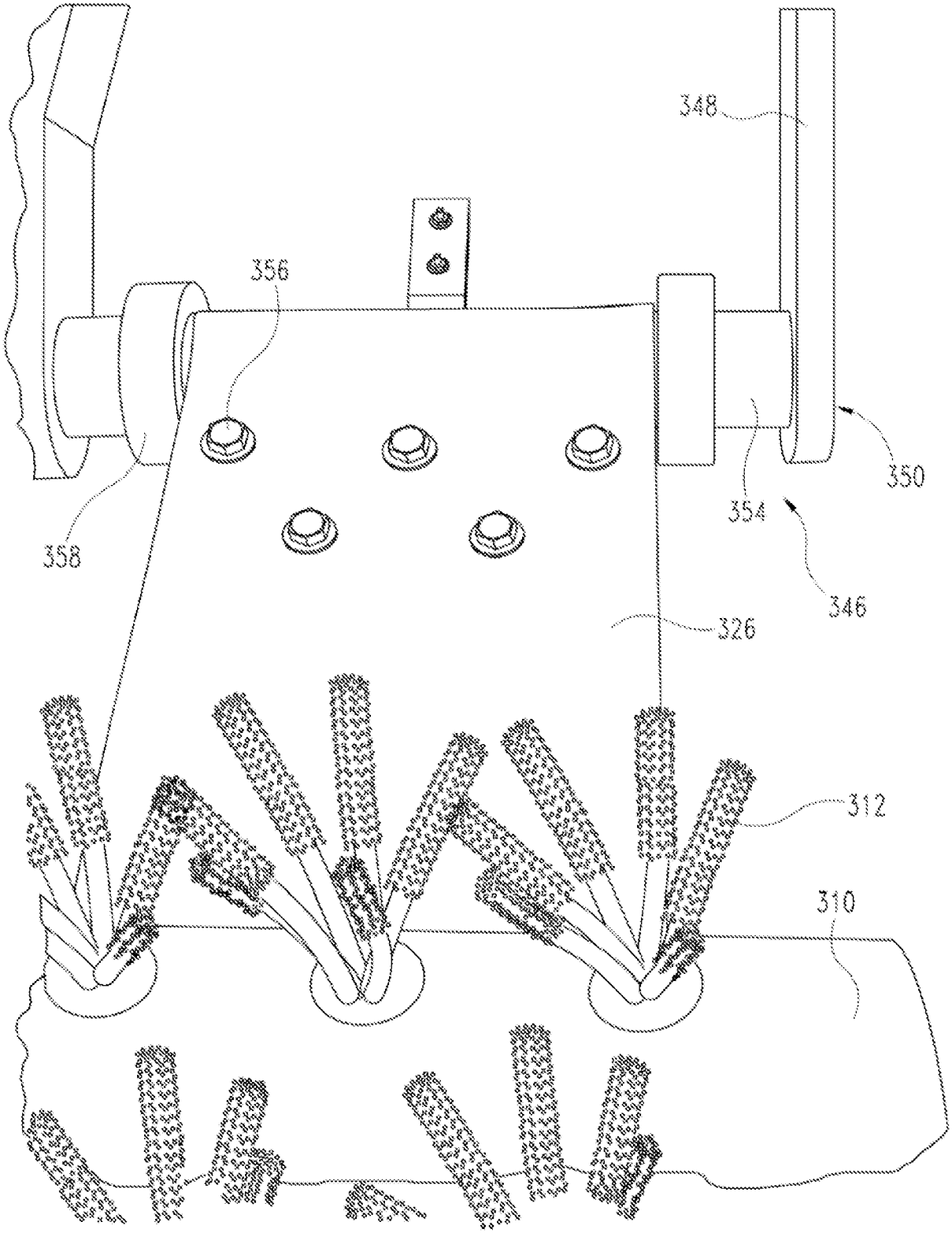

Fig. 44

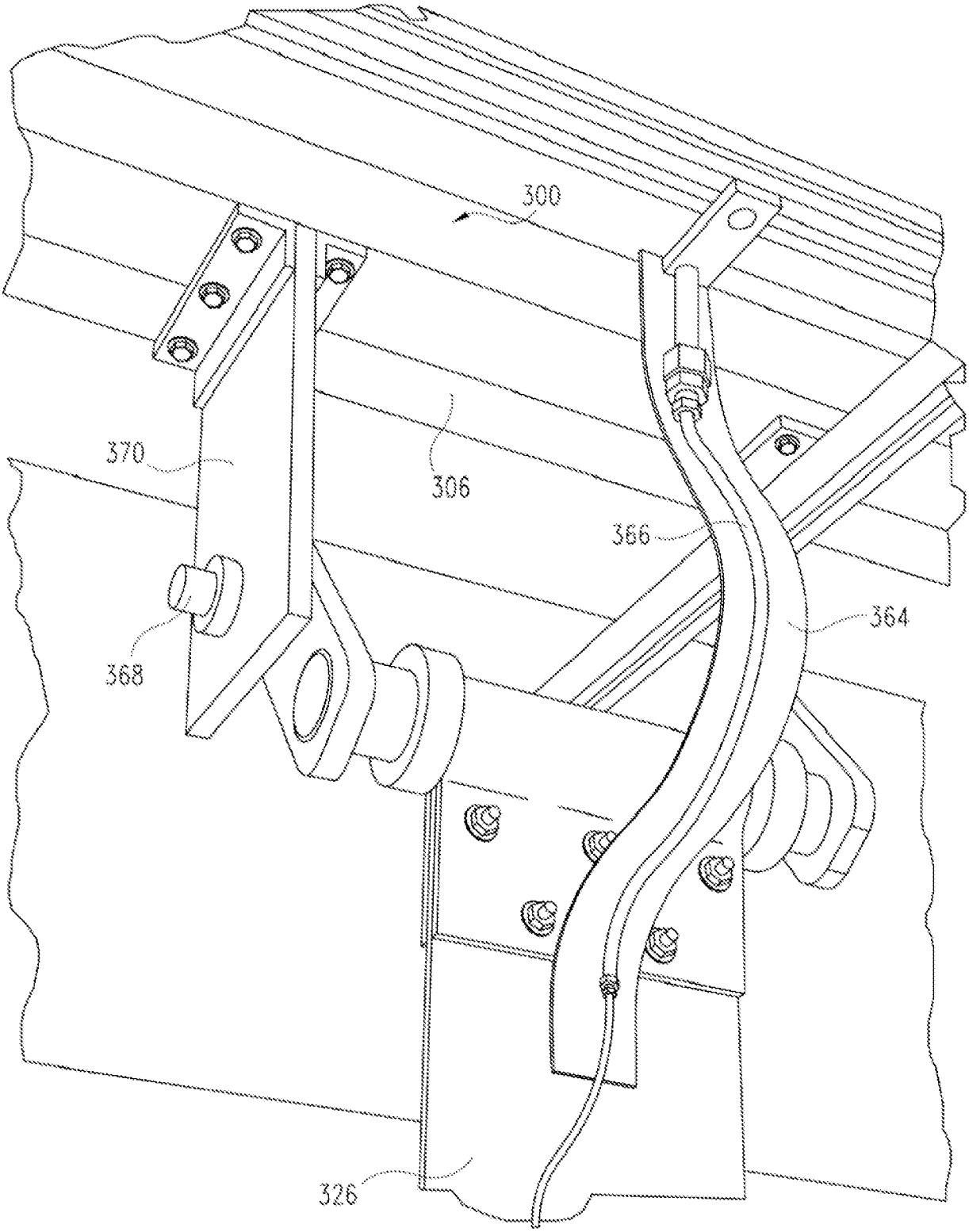

Fig. 45

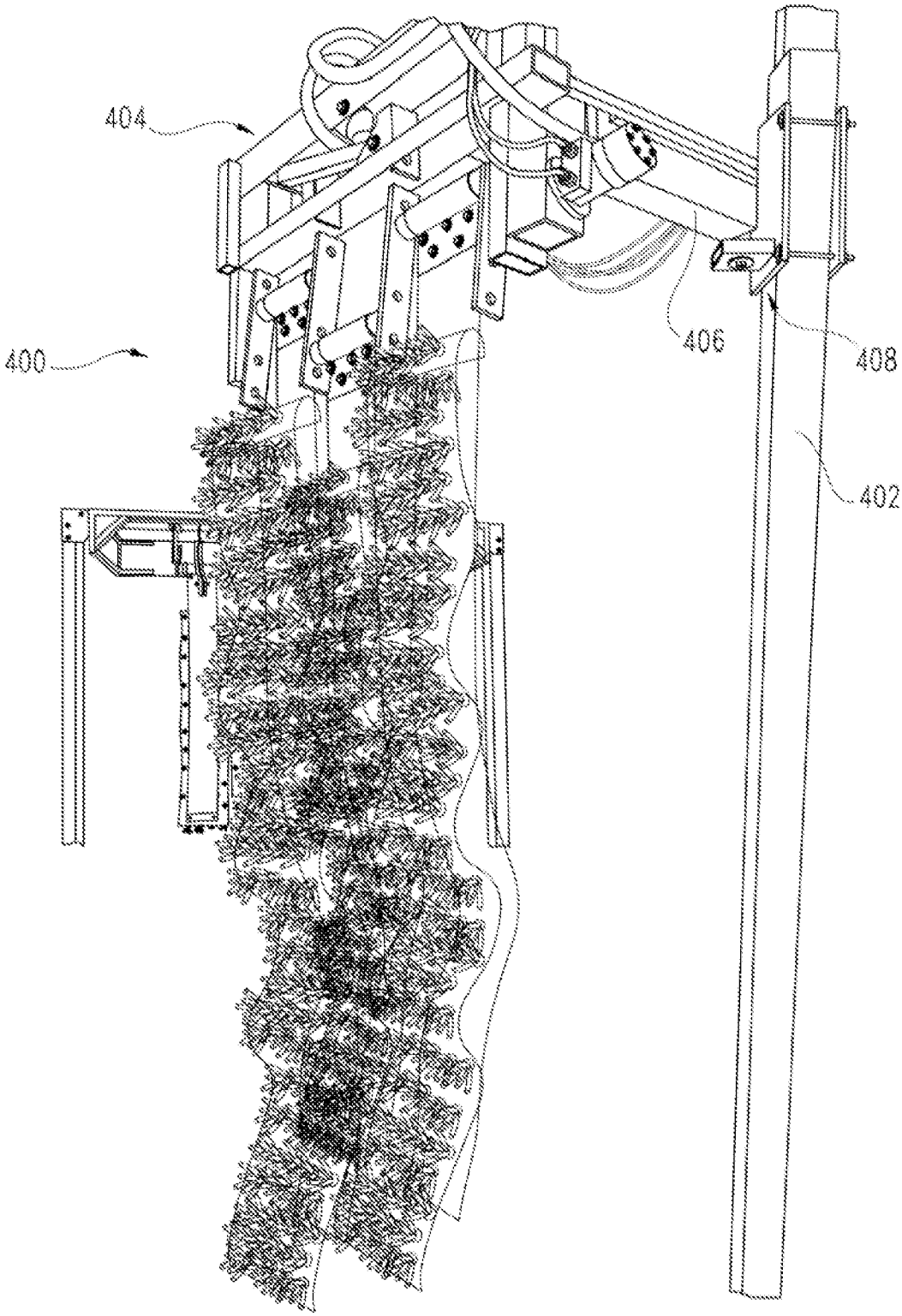

Fig. 46

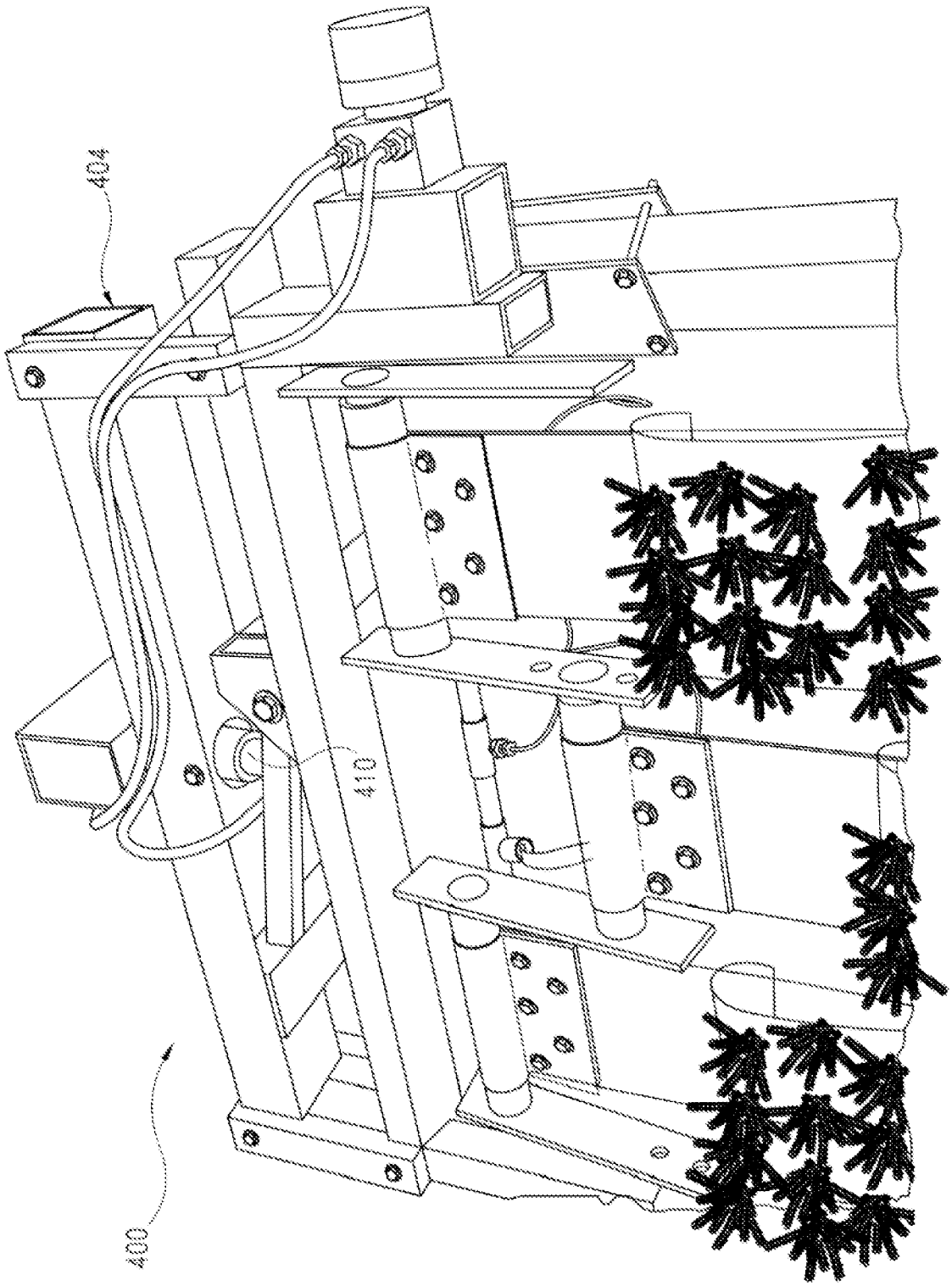

Fig. 47

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2022/034292

A. CLASSIFICATION OF SUBJECT MATTER

B60S 3/04(2006.01)i; **B08B 1/00**(2006.01)i; **B08B 3/02**(2006.01)i; **B08B 13/00**(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60S 3/04(2006.01); A46B 11/00(2006.01); A46B 9/00(2006.01); B60S 3/06(2006.01)

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

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: carwash, brush, brush carrier, stanchion, and aperture

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2021-0179034 A1 (GALLOP BRUSH, LLC) 17 June 2021 (2021-06-17) paragraphs [0001], [0002], [0033]-[0040] and figures 1-10	1-4,13-21
Y		5-12
Y	KR 10-2158951 B1 (K-1 INDUSTRY CO., LTD.) 22 September 2020 (2020-09-22) paragraph [0056]	5-8
Y	US 2014-0366290 A1 (BELANGER, MICHAEL J. et al.) 18 December 2014 (2014-12-18) paragraphs [0038], [0039] and figures 3-5, 12	9-12
A	US 2002-0065031 A1 (CHOU, YEUN-JONG et al.) 30 May 2002 (2002-05-30) paragraphs [0025]-[0074] and figures 1a-3b	1-21
A	US 10549728 B1 (IWASH TECHNOLOGY LLC) 04 February 2020 (2020-02-04) claims 1-6	1-21

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 October 2022	**21 October 2022**

Name and mailing address of the ISA/KR	Authorized officer
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International application No.
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