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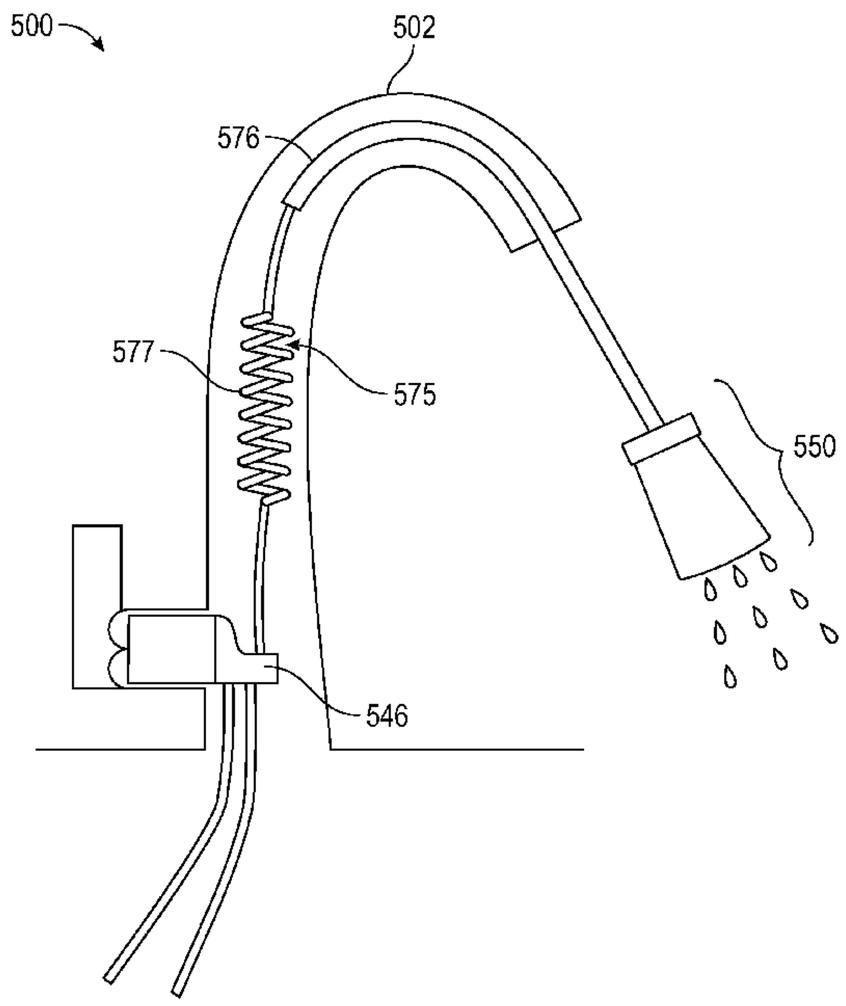

FIG. 5B

(57) **Abstract:** A pull-out faucet assembly, comprising a faucet body comprising a proximal end and a distal end; a spray head comprising a proximal end and a distal end, wherein the spray head is configured to be releasably docked at the faucet body distal end, and the spray head distal end comprises a water outlet; and an expandable hose comprising a first downstream end coupled to the spray head proximal end and an expandable hose length running through a length of the faucet body, wherein the expandable hose is configured to fluidly connect the water outlet to a mixing valve.

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Faucet Assembly

This relates to faucet assemblies and, particularly, to pull-out/pull-down spray head arrangements for faucet assemblies.

Background

By nature, conventional faucets direct water flow from a stationary water outlet to a single location at the bottom of a sink basin. Conventional faucets typically have little, if any, ability to alter the location of the water outlet or the direction of the water flow. Thus, conventional faucets are very limiting for users cleaning a sink basin and/or washing items of a particular nature (i.e., large items, heavy items, oddly-shaped items, etc.) since the water flow cannot be directed to various locations within the sink basin, the faucet body may be in the way of large items (i.e., large pots) that need to be washed, and/or a user may have to lift a heavy item to the water outlet for cleaning, instead of maneuvering the water outlet to a heavy item resting on the bottom of the sink basin, for example.

Many modern faucets, and in particular, modern kitchen faucets, are now equipped with pull-out spray heads. With a pull-out spray head, a user can pull the spray head away from the body of the faucet. When the spray head is pulled away from the faucet body, a water supply hose attached to the spray head slides through the faucet body and extends out of the faucet body. Thus, a user is able to direct water flow in any direction that the attached flexible hose can accommodate. Pull-out spray heads also enable users to move the water source to an item to be cleaned, instead of requiring the user to deliver the item to the water source. This is particularly helpful for items that may be large, heavy, or oddly-shaped, such as large and heavy pots and pans and/or large cookie sheets.

Summary

As discussed above, pull-out (or pull-down) faucet assemblies include a spray head that a user can pull away from the faucet body. When the spray head is pulled away, it remains connected to the faucet assembly by a water supply hose. The water supply hose is typically attached to the spray head at the same location at which the spray head couples to the faucet body (a location opposite the water outlet). The water supply hose travels or

slides through the faucet body as the spray head moves away from, and back towards, the faucet body. Thus, a slack length of hose (located underneath the faucet or sink) is required such that a length of the hose is able to slide out of the faucet body along with the spray head, while the opposing end of the hose remains connected to the water supply. Further, the assembly is often equipped with a weight or spring mechanism such that the hose (and spray head) retract once released. The terms “pull-out” and “pull-down” are employed interchangeably herein.

However, a conventional pull-out spray head faucet assembly having a hose with a slack length, as described above, has several limitations. For example, it can be difficult to install, cumbersome to replace and/or fix, and take up space underneath the sink. Further, pull-out spray head arrangements also pose design limitations. For example, the faucet body must be wide enough to accommodate the size of the hose and to allow it to slide back and forth within the body of the faucet. Further, pull-out faucet arrangements requiring a slack hose length are not suitable for use with some modern faucet designs, such as 3D-printed faucets.

Accordingly, provided herein are improved pull-out spray head faucet assemblies that may address one or more of the problems discussed above.

Pull-out spray head faucet assemblies according to embodiments described herein may include a water supply hose that is configured to expand under pressure and/or when manually pulled. In some embodiments, the water supply hose may include an inner tubing and an outer sheath. As with conventional pull-out spray head faucet assemblies described above, when a faucet assembly is turned "on", water is delivered from the water supply to the water outlet disposed at the end of a spray head. According to some embodiments, the water pressure generated by turning the water on can cause the water supply hose to expand. Accordingly, when the spray head is pulled away from the faucet body, the water supply hose can extend from the faucet body by expanding length-wise instead of sliding through the faucet body as described above in conventional pull-out spray head faucet assemblies. Some embodiments can also include a bellows and/or a piston mechanism.

In some embodiments, an expandable hose may comprise one or more “coiled” portions. In some embodiments, an expandable hose may substantially entirely be a coiled

hose. An expandable hose may comprise one or more coiled portions and one or more "standard" or conventional hose sections. A "coiled" portion or section may be configured to expand upon a spray head being pulled out and/or down from a faucet body.

In some embodiments, a coiled portion may be coupled to a water source and a standard hose portion and disposed in a faucet body, and a standard hose portion is coupled to a spray head. In some embodiments, a coiled portion may not be visible to a user upon pulling the spray head out or down. In other embodiments, a hose coiled portion may be coupled to a spray head, and to a water source or a standard hose portion, and may be visible upon pulling a spray head out or down.

In some embodiments, a hose coiled portion may comprise one or more of a rubber, an elastomer, a latex or neoprene. In some embodiments, an expandable hose comprising one or more coiled portions may comprise one or more compression or expansion springs which may be configured to aid in recoiling the hose and docking the spray head. In some embodiments, a spring may be disposed within a center of a coiled hose section and may be coupled to one or more parts of a standard or coiled hose section. In some embodiments, a spring may be "interwoven" with the coils. In other embodiments, a spring may be coupled to an exterior of a coiled or standard hose section.

In some embodiments, a release mechanism may not be required. In some embodiments, water pressure may assist in pulling a spray head out and/or docking a spray head.

In some embodiments, an expandable hose may comprise a single fluid channel or may be multi-channeled. Multiple hose channels may carry mixed tap water, filtered water, treated water (e.g. ozone treated water), cold water, hot water, etc.

In some embodiments, a coiled hose section may comprise a single channel. In other embodiments, a coiled hose section may comprise more than one fluid channel, for example two or three fluid channels coiled together or separately. In some embodiments, a standard hose portion may also comprise multiple channels and may be configured to couple to a multi-channeled coiled section.

In some embodiments, expandable hoses of the disclosure require no pull-down or counter weight. In some embodiments, expandable hoses of the disclosure do not require a long length (as they are expandable) and may not require any “slack” length for pull-out or pull-down action.

In some embodiments, a pull-out spray head faucet assembly may include a release mechanism configured to couple the spray head to the faucet body. For example, oftentimes a user may use the faucet without needing to utilize the pullout spray head feature. Thus, a release mechanism may be included to hold the spray head to the faucet body. Specifically, the release mechanism may be configured to hold the spray head to the faucet body when the faucet is turned on and the water travelling from the water supply to the water outlet exerts pressure on the expandable hose. In this case, instead of the expandable hose expanding length-wise and extending out from the faucet body, the expandable hose may expand predominantly in a radial direction within the faucet body. Thus, unless and until a user disengages the release mechanism coupling the spray head to the faucet body, the expandable water hose will only expand within the faucet body to the extent possible (mostly radial expansion with some length-wise expansion) and will not extend out from the faucet body. In some embodiments, the expandable hose may not expand radially or length-wise. For example, the expandable hose may not expand radially or length-wise when the spray head is coupled to the faucet body, even when the faucet is turned on.

While the present disclosure discusses pull-out spray heads with reference to faucet assemblies, it should be noted that pull-out spray heads in accordance with the present disclosure may be used not only for faucet assemblies, but may instead be used for side sprayers often used in conjunction with a conventional, stationary faucet.

In some embodiments, a pull-out faucet assembly is provided, the pull-out faucet assembly comprising: a faucet body comprising a proximal end and a distal end; a spray head comprising a proximal end and a distal end, the distal end comprising a water outlet, and the proximal end configured to be releasably dockable at the distal end of the faucet body; an expandable hose comprising a first end of the expandable hose coupled to the proximal end of the spray head and a length of the expandable hose running through a length of the faucet body, wherein the expandable hose is configured to fluidly connect the

water outlet to a mixing valve; and a release mechanism comprising a coupling means configured to hold the proximal end of the spray head to the distal end of the faucet body when the coupling means is engaged.

In some embodiments of the pull-out faucet assembly, the expandable hose comprises an inner tubing and an outer sheath.

In some embodiments of the pull-out faucet assembly, the expandable hose is configured to expand radially.

In some embodiments of the pull-out faucet assembly, the expandable hose is configured to expand length-wise.

In some embodiments of the pull-out faucet assembly, the spray head is in a docked position when the coupling means of the release mechanism is engaged and holding the proximal end of the spray head to the distal end of the faucet body.

In some embodiments of the pull-out faucet assembly, the spray head is configured to pull away from the distal end of the faucet body when the expandable hose expands and the coupling means of the release mechanism is disengaged.

In some embodiments of the pull-out faucet assembly, the spray head is configured to remain in a docked position with the coupling means of the release mechanism engaged when the faucet is in operation.

In some embodiments of the pull-out faucet assembly, an inner tubing of the expandable hose comprises one or more of rubber, latex, or polychloroprene (neoprene).

In some embodiments of the pull-out faucet assembly, an outer sheath of the expandable hose restricts the inner tubing from expanding such that the inner tubing does not achieve plastic deformation or failure.

In some embodiments of the pull-out faucet assembly, the coupling means of the release mechanism comprises a magnetic mechanism, a latching mechanism, a twisting mechanism, or a gripping mechanism.

In some embodiments of the pull-out faucet assembly, the expandable hose is configured to fluidly connect the water outlet to the mixing valve such that a slack length of hose is not required.

In some embodiments, a pull-out faucet assembly is provided, the pull-out faucet assembly comprising: a faucet body comprising a proximal end and a distal end; a spray head comprising a proximal end and a distal end, the distal end comprising a water outlet and the proximal end disposed at the distal end of the faucet body; a release mechanism comprising a coupling means configured to hold the proximal end of the spray head to the distal end of the faucet body when the coupling means is engaged; a hose comprising a first end coupled to the proximal end of the spray head and a length of the hose running through a length of the faucet body; and a piston mechanism coupled to a second end of the hose.

In some embodiments of the pull-out faucet assembly, the spray head is in a docked position when the coupling means of the release mechanism is engaged and holding the proximal end of the spray head to the distal end of the faucet body.

In some embodiments of the pull-out faucet assembly, the piston mechanism comprises a piston and a spring.

In some embodiments, a pull-out faucet assembly may comprise a bellows mechanism, wherein the mechanism comprises a bellows and a spring.

In some embodiments of the pull-out faucet assembly, the spray head is configured to pull away from the distal end of the faucet body when the piston slides in the faucet body and the coupling means of the release mechanism is disengaged.

In some embodiments of the pull-out faucet assembly, the piston is configured to slide back and forth between two positions within the faucet body, wherein the piston is in a first position when the spray head in a docked position, and the piston is in a second position when

the spray head is pulled away from the distal end of the faucet body to its fullest extent.

In some embodiments of the pull-out faucet assembly, the piston is configured to slide between the first position and the second position when pressurized by water flow, that is, when force is applied to the piston by water flow.

In some embodiments of the pull-out faucet assembly, the spray head is configured to remain in a docked position with the coupling means of the release mechanism engaged when the faucet is in operation.

In some embodiments of the pull-out faucet assembly, the spring of the piston mechanism expands when the spray head is pulled away from the distal end of the faucet body and the piston is in the second position, and the spring contracts as the spray head moves towards the distal end of the faucet body until the piston is in the first position.

In some embodiments of the pull-out faucet assembly, the coupling means of the release mechanism comprises a magnetic mechanism, a latching mechanism, a twisting mechanism, or a gripping mechanism.

Brief Description of the Drawings

The disclosure described herein is illustrated by way of example and not by way of limitation in the accompanying figures. For simplicity and clarity of illustration, features illustrated in the figures are not necessarily drawn to scale. For example, the dimensions of some features may be exaggerated relative to other features for clarity. Further, where considered appropriate, reference labels have been repeated among the figures to indicate corresponding or analogous elements.

Fig. 1A and **Fig. 1B** show a pull-out spray head faucet assembly according to some embodiments.

Fig. 2 depicts a pull-out spray head faucet assembly having a 3D-printed design according to some embodiments.

Fig. 3 shows a pull-out spray head faucet assembly comprising a piston mechanism according to some embodiments.

Fig. 4 shows a pull-out spray head faucet assembly comprising a bellows mechanism according

to an embodiment.

Fig. 5A and **Fig. 5B** show a faucet assembly comprising an expandable hose comprising a coiled section and a conventional section, according to an embodiment.

Detailed Description

Described herein are exemplary embodiments of pull-out spray heads that may provide for less cumbersome installation and repair and may also be less restrictive on faucet body design.

Pull-out spray head faucet assemblies may provide for less cumbersome installation and repair. Specifically, conventional pull-out spray head faucet assemblies require a reserve, slack length of hose to allow the spray head to be pulled away from the faucet body. Often, this reserve, slack length of hose is underneath a sink or behind the mounted faucet, for example. When the spray head is pulled away from the faucet body, the hose attached to the spray head is pulled along with it. Thus, in order for the spray head to be pulled away from the faucet body and still have a steady stream of water supply, the slack length of hose slides from its resting position (i.e., underneath the sink basin or behind the mounted faucet) and through the faucet body while remaining connected to the main water supply. A portion of the hose length located nearest to the spray head extends out of the faucet body as required by the force pulling the spray head. Thus, this reserve, slack length of hose can be cumbersome to install and repair.

However, pull-out spray heads according to embodiments disclosed herein do not require this reserve, slack length of hose. Instead, an expandable hose may be mounted within the faucet body. In some embodiments, the expandable hose may be mounted directly to the water source (or plumbing supply). Regardless of where the expandable hose is mounted, a slack length of hose is not required to allow the spray head to pull away from the faucet body, since the expandable hose is configured to expand length-wise when subjected to water pressure. Accordingly, embodiments of pull-out spray head faucet assemblies provided herein may be less cumbersome to install and easier to repair or replace, since a shorter length of hose is required, streamlining the component parts and design of the overall faucet assembly.

Additionally, pull-out spray head faucet assemblies according to embodiments provided herein may be less restrictive on some faucet designs. For example, conventional pull-out spray

head faucet assemblies described above require a slack length of hose to pass back-and- forth through the faucet body as the spray head is pulled away from and directed back towards the faucet body. Thus, the width of the faucet body must be large enough to accommodate not only the water supply hose, but also the sliding back-and-forth motion of the hose through the faucet body. Additionally, the aesthetic of some specific types of modem faucets are not designed to accommodate a hose passing through the entire length of the faucet body, such as the hose of a conventional pull-out faucet assembly. For example, 3D-printed faucet assembles include void spaces through the faucet body as part of the design, and the entire length of the faucet body is not enclosed, as it is with conventional designs. Thus, the faucet body of 3D-printed faucet designs are often unable to accommodate the hose of a conventional pull-out spray head faucet assembly. However, embodiments of pull-out spray head faucet assemblies provided herein may be less restrictive on some faucet designs and may even be able to be incorporated in some faucet designs where a conventional pull-out spray head is impractical. Specifically, by using an expandable hose, as described in detail below, there is no need for the hose to pass back-and- forth as required with a conventional pull-out spray head design. Accordingly, the width of the faucet body can not only be narrower, but it can also be partially unenclosed, as in many 3D- printed faucet designs. Instead, the expandable hose may be installed only in an upper portion of the faucet body, where the faucet body is enclosed, without interfering with the aesthetic design of the faucet.

Various embodiments of pull-out/pull-down spray head faucets are described below in detail with reference to the figures included herein.

Fig. 1A depicts a pull-out/pull-down spray head faucet assembly ("faucet assembly") **100**, according to an embodiment. Faucet assembly **100** includes faucet body **102** (shown in cross-section), having distal end **140** and proximal end **142**, spray head **150**, having proximal end **104** and distal end **106**, release mechanism **108**, and hose **110** (shown in cross-section). Spray head **150** of faucet assembly **100** is in a docked position. Spray head **150** may be in a docked position when proximal end **104** of spray head **150** is coupled to the distal end of faucet body **102**. Additionally, spray head **150** may be in a docked position with or without an engaged release mechanism.

As used herein, the terms "docked position", "docking", "docked", and variations are used to refer to a spray head coupled to a faucet body, such that the attached hose does not

extend outwardly from the faucet body.

Faucet body **102** can include a cylindrical housing configured to enclose hose **110**. A distal end of faucet body **102** may be configured to mount to a surface such as a countertop, a sink top, a wall, and/or a floor. Distal end **140** of faucet body **102** may be configured to couple to proximal end **104** of spray head **150**. In some embodiments, a release mechanism **108** may be disposed at distal end **140** of faucet body **102**. Release mechanism **108** (described in more detail below) may be configured to hold proximal end **104** of spray head **150** to distal end **140** of faucet body **102**.

Spray head **150** of faucet assembly **100** may include proximal end **104** and distal end **106**. Proximal end **104** may be configured to couple to distal end **140** of faucet body **102**, as described above. Additionally, a first end of hose **110** can be attached to proximal end **104** of spray head **150**. In some embodiments, hose **110** can be attached to a main water supply or an additional conduit, and can be configured to transport water from a water source to a water outlet. For example, water can be delivered from a water supply, through hose **110** to proximal end **104** of spray head **150**, and through spray head **150** to a water outlet located at distal end **106** of spray head **150**.

In some embodiments, release mechanism **108** may be disposed at distal end **140** of faucet body **102** or at proximal end **104** of spray head **150**. In some embodiments, release mechanism **108** may comprise one or more components disposed on distal end **140** of faucet body **102** and one or more components disposed on proximal end **104** of spray head **150**. Release mechanism **108** may be configured to hold spray head **150** to faucet body **102**, for example, when spray head **150** is in a docked position. Release mechanism **108** may incorporate various coupling means to hold spray head **150** to faucet body **102**. For example, possible coupling means that can be used to hold proximal end **104** of spray head **150** to distal end **140** of faucet body **102** include a magnetic mechanism, a latching mechanism, a twisting mechanism, a gripping mechanism, and other suitable coupling means. In some embodiments, a user may manually disengage release mechanism **108**, causing proximal end **104** of spray head **150** to decouple from distal end **140** of faucet body **102**. For example, a user may apply a strong pulling force on spray head **150** to overcome the strength of a magnet in the case of a magnetic mechanism or to overcome the frictional force in the case of a gripping mechanism. In some embodiments, a user may press a button that is configured to release the coupling means

of release mechanism **108**. For example, a user may press a button that causes a latch to release spray head **150** in the case of a latching mechanism, causes a magnet to demagnetize and release spray head **150** in the case of a magnetic mechanism, and/or causes a gripper to expand and release spray head **150** in the case of a gripping mechanism.

Hose **110** of the pull-out spray head faucet assembly **100** may include various materials and features. In some embodiments, hose **110** may be expandable. For example, when a user turns the faucet assembly "on", and water begins to flow from the water supply to the water outlet of spray head **150**, the pressure from the water flow can cause hose **110** to expand radially and/or length-wise. As shown in **Fig. 1A**, spray head **150** is in a docked position, meaning that proximal end **104** of spray head **150** is coupled to distal end **140** of faucet body **102**. Thus, when a user turns the faucet "on", and water transfers from the water supply through hose **110** to spray head **150**, pressure generated by the water flow forces hose **110** to expand. So long as release mechanism **110** is engaged and holding proximal end **104** of spray head **150** to distal end **140** of faucet body **102**, hose **110** will predominately expand in a radial direction, to the extent the width of faucet body **102** allows. **Fig. 1B** demonstrates an embodiment of an expandable hose **110** when spray head **150** is pulled out from faucet body **102** (and not in a docked position).

In some embodiments, hose **110** may comprise inner tubing **114** and an outer sheath **112**. Inner tubing **114** can include flexible, expandable material and behave much like a balloon when subjected to water pressure by water flowing through hose **110**. In some embodiments, the force required for inner tubing **114** to expand radially may be less than the force required for it to expand length-wise. Flexible, expandable material of inner tubing **114** can include rubber, latex, polychloroprene, and/or other suitable materials. Outer sheath **112** can include a flexible, strong material. For example, outer sheath **112** may be flexible to allow manipulation and movement of the hose (to form to the interior of faucet body **102** as well as enabling a user to fluidly move a pulled-out spray head in various directions). However, outer sheath **112** may also be strong and durable to prevent inner tubing **114** from over-expanding, which could lead to plastic deformation and/or failure of hose **110**.

Additionally, outer sheath **112** also provides control of expandable hose **110**. For example, as described above, the force required for inner tubing **114** to expand radially may be less than the force required for inner tubing **114** to expand length-wise. Thus, inner tubing **114**

may expand radially until it conforms to the interior of outer sheath **112**. At this point, the force required to expand outer sheath **112** radially may be greater than the force required for the inner tubing **114** to expand length-wise. Thus, inner tubing **114** may expand predominantly radially until it conforms to the interior of outer sheath **112**, at which point it will expand length-wise. This behavior is particularly useful for enabling a user who wishes to operate spray head **150** in a pulled-out configuration.

Other features provided in **Fig. 1A** include a water control assembly **116** and hot/cold water supply conduit **118**. Water control assembly **116** and hot/cold water supply conduit **118** are only provided for reference, and are not intended to limit faucet assembly **100** provided herein.

Water control assembly **116** is provided with a single handle configured to operate a mixing valve. For example, faucet assembly **100** may comprise single handle **144** configured to manipulate mixing valve **146**, controlling the ratio of hot water to cold water that flows from the water supply, to hose **110** of faucet body **102**, and through the water outlet disposed on distal end **106** of spray head **150**. In some embodiments, water control assembly **116** may include two or more handles **144** with a single mixing valve **146** serving the two or more handles. Water control assembly **116** may also include two valves, one for each of two handles. Further, **Fig. 1A** shows that water control assembly **116** located at a base of faucet body **102**, with mixing valve **146** located within faucet body **102**. In some embodiments, water control assembly **116** may instead be located proximate to faucet body **102** along with accompanying valves for controlling water flow. For example, a valve controlling the inward flow of hot/cold water may be located on an opposite side of a mounting surface from faucet body **102** (i.e., sink top, countertop, floor, wall, etc.). Such valve could also be located within a shell or housing that may be part of the pull-out spray head faucet assembly **100** or separate from faucet assembly **100**. The hot/cold water supply hosing **118** is configured to transfer water directly from the main water supply to water control assembly **116**.

Fig. 1B shows pull-out spray head faucet assembly **100** with spray head **150** extended from faucet body **102**. Faucet assembly **100** can include any and/or all of the features described above with reference to faucet assembly **100**, including faucet body **102** (shown in cross-section), having proximal end **142** and distal end **140** and spray head **150**,

having proximal end **104** and distal end **106**. However, **Fig. 1B** shows a pulled-out spray head instead of the docked spray head depicted in **Fig. 1A**. Thus, release mechanism **108** has been disengaged to allow spray head **150** to be pulled away from distal end **140** of faucet body **102**. As described above, release mechanism **108** may comprise a coupling means to hold proximal end **104** of spray head **150** to distal end **140** of faucet body **102**. For example, coupling means may be a magnetic mechanism, a latching mechanism, a twisting mechanism, a gripping mechanism, or other suitable coupling means. In **Fig. 1B**, release mechanism **108** has been disengaged by unlatching, untwisting, applying a force, demagnetizing, and/or any other operation necessary to disengage the coupling means of release mechanism **108** and enable a user to pull spray head **150** away from faucet body **102**.

Hose **110** is shown in cross-section. A portion of hose **110** proximate to proximal end **104** of spray head **150** may extend outward from distal end **140** of faucet body **102** to allow spray head **150** to be pulled away from distal end **140** of faucet body **102**. At the same time, the end of hose **110** opposite spray head **150** may remain coupled to the main water supply or an intermediate conduit attached to the main water supply (i.e., hot and cold water lines **118**).

As discussed above, when a user turns the faucet assembly **100** "on" using handle **144** of water control assembly **116**, it can cause water to transfer from the water supply to faucet assembly **100**. Further, this transfer of water generates an influx of pressure on hose **110**. Under pressure, hose **110** may expand radially and/or length-wise. Further, as described above, hose **110** may include at least two separate parts-inner tubing **114** and outer sheath **112**. Inner tubing **114** can be configured to expand much like a balloon in radial and/or length-wise directions. Outer sheath **112** may, when spray head **150** is in a docked position, collapse in size much like a concertina or bellows. For example, when outer sheath **112** is not in a completely open/expanded configuration, material of the sheath may fold over itself, creating a zig-zag formation, or rib-like protrusions running along the circular perimeter of the inner tubing, as shown. Inner tubing **114** can contract and/or collapse in size when not under pressure. Thus, when the faucet assembly is in an "off' configuration, inner tubing **114** can collapse and outer sheath **112** can contract such that spray head **150** can rest in a docked position without forming a slack length of hose **110**, as required of conventional pull-out spray head faucet assemblies . As shown in **Fig. 1B**, when

faucet assembly **100** is turned "on", water flow pressurizes hose **110**. Thus, inner tubing **114** expands radially (within outer sheath **112** and faucet body **102**) and length-wise (extending out from a distal end of faucet body **102**) and outer sheath **112** opens as required by the expanding inner tubing **114**. Thus, outer sheath **112** may open a limited amount radially within faucet body **102**; this limited radial opening by outer sheath **112** can be designed to restrict inner tubing from over-expanding radially and causing plastic deformation and/or failure to hose **110**. Outer sheath **112** can also open length-wise, much like a concertina or bellows-type mechanism. As with radial over-expansion of inner tubing **114**, outer sheath **112** may be designed such that it can open length-wise just enough to allow spray head **150** to be able to reach the desired distance, and such that inner tubing **114** cannot over-expand length-wise and cause plastic deformation and/or failure to hose **110** as well.

Fig. 2 provides another example of a pull-out spray head faucet assembly **200**. Specifically, **Fig. 2** provides an example of a pull-out spray head integrated with a modern faucet design. For example, many 3D-printed faucet designs, like the one depicted in **Fig. 2**, include illusive features such as the lattice design of proximal end **220** of faucet body **202**. Specifically, the faucet design of **Fig. 2** features proximal end **220** including numerous small waterways intertwined and converging at proximal end **223** of faucet body **202** (shown in cross-section). The small waterways of proximal end **220** are intertwined such that the faucet body is not a single, hollow, cylindrical housing like that of faucet assembly **100**. Instead, the numerous small waterways are surrounded by void space. Accordingly, it would be impractical and aesthetically unpleasing to integrate a conventional pull-out spray head with the faucet design of **Fig. 2**, since the non-expandable hose of a conventional pull-out spray head is required to pass back-and- forth through the entire length of the faucet body. Having a hose pass back-and-forth through the entire length of faucet body **202** would be impractical, since proximal end **220** of faucet body **202** is not fully enclosed (only the individual small waterways are fully enclosed).

However, using an expandable hose **210** (shown in cross-section) enables a pull-out spray head to be integrated into faucet assembly **200** without sacrificing aesthetic. As shown in **Fig. 2**, expandable hose **210** can be mounted within distal end **222** of faucet body **202**. Thus, using the expanding mechanisms described above, expandable hose **210** can

expand radially and length-wise when pressurized by water flow to allow spray head **250** to be pulled away from distal end **222** of faucet body **202**.

Just as with the previously-depicted pull-out spray head faucet assemblies, faucet assembly **200** may also include a release mechanism **208**, expandable hose **210** may include inner tubing **214** and outer sheath **212**, and spray head **250** may include a proximal end **204** (where hose **210** is attached) and distal end **206** (having a water outlet). Additionally, a water control assembly and hot/cold water supply hosing may also be included.

Fig. 3 depicts a pull-out spray head faucet assembly **300** according to some embodiments (shown in cross-section except spray head **350**). In some embodiments, faucet assembly **300** may include a conventional water hose instead of an expandable hose. Faucet assembly **300** may also include a spray head having a proximal end **304** and a distal end **306**, a faucet body, a release mechanism configured to hold proximal end **304** of spray head **350** to the faucet body, a water control assembly, and hot/cold water supply tubing.

In some embodiments, faucet assembly **300** may include piston mechanism **360** configured to allow spray head **350** to be pulled away from and directed back towards the distal end of the faucet body. For example, piston mechanism **360** may comprise a piston **328** and a spring **326**. By using piston mechanism **360** with a conventional hose, a pull-out spray head can be implemented into a faucet design without the need for a slack length of hose, as required in conventional pull-out spray head faucet designs, described above. In some embodiments, piston **328** can be coupled to hose **330**. Thus, when water flows into piston mechanism **360** from a water supply and any release mechanism is disengaged, the force of the water flow can cause piston **328** to slide upwards, which pushes hose **330** upwards, and in tum pushes spray head **350** outward and away from the faucet body. Thus, when the water flows into the piston mechanism **360**, pressure from the water flow can push the piston from an "off' (or resting) location to an "on" location while at the same time forcing some water to pass through an opening in piston **328** leading to hose **330** and out of spray head **350**.

In some embodiments, faucet assembly **300** may be used with a release mechanism engaged. As described above, a release mechanism according to embodiments described herein may be configured to hold proximal end **304** of spray head **350** to a distal end of the faucet body. In some embodiments, the release mechanism may be disposed at proximal end **304** and/or a distal end of the faucet body. The release mechanism may also be located within the faucet body, configured to hold in place piston **328** unless disengaged. In some embodiments, the force of the water flow when the faucet is "on" is less than the force required to overcome the release mechanism. Accordingly, when the release mechanism is engaged, a user may use the faucet without taking advantage of the pull-out spray head feature. Unless the release mechanism is disengaged, spray head **350** can remain coupled to the faucet body, with the release mechanism configured such that it can hold proximal end **304** of spray head **350** to the distal end of the faucet body, even when the faucet is "on" and water flow is pushing against piston **328**. Thus, when the faucet is being operated without pulling out spray head **350**, the release mechanism can remain engaged so long as the force of the water flow is less than the force required to overcome the force of the release mechanism holding spray head **350** to the faucet body.

In some embodiments, faucet assembly **300** includes a mechanism to return spray head **350** to a docked position once the faucet is turned "off," the water flow stops, and the user releases spray head **350**. For example, **Fig. 3** shows a spring **326** within the piston mechanism **360**. Spring **326** can be attached at one end to piston **328**, and at the opposing end to hose **330**. When the faucet assembly is “off”, the piston can be in an "off' position that corresponds to a resting position for spring **326**. When the faucet assembly is "on" and spray head **350** is fully extended outward from the faucet body, the piston **328** is in an "on" position and the spring is fully contracted. Piston **328** can be in any position between its "off' position and its "on" position, and spring **326** may be between a fully contracted position and a resting position, as spray head **350** extends outward from the faucet body and retracts back toward the faucet body.

As mentioned above, when spray head **350** is pulled away from the faucet body (along with hose **330**), spring **326** can contract as piston **328** is pushed by the water flow. Thus, once the water flow stops pushing on piston **328**, the force of contracted spring **326** can cause the spring to extend back to a resting position, forcing piston **328** back to its "off' location when all

forces applied to spray head **350** are released (i.e., water flow, pull from user, etc.).

Fig. 4 shows pull-out spray head faucet assembly **400** according to some embodiments (shown in cross-section except spray head **450**). In some embodiments, faucet assembly **400** can include conventional water hose **430** or an expandable hose. Additionally, faucet assembly **400** may include a spray head having proximal end **404** and distal end **406**, a faucet body, a release mechanism configured to hold proximal end **404** of spray head **450** to the faucet body, a water control assembly, and hot/cold water supply tubing.

In some embodiments, faucet assembly **400** may include a bellows mechanism **460**. For example, bellows mechanism **460** may comprise hose **430**, running the entire length of the faucet body. In some embodiments, bellows mechanism **460** may comprise bellows **434** in addition to conventional hose **430**, with bellows **434** coupled to hose **430**. Bellows mechanism **460** can also be applied to embodiments including an expandable hose, such as those depicted in **Fig. 1A**, **Fig. 1B** and **Fig. 2**.

In some embodiments, bellows mechanism **460** may expand length-wise. When spray head **450** is in a docked position, bellows mechanism **460** may be fully contracted. In this embodiment, bellows **434** is associated with compression spring **432** which may aid in retracting pray head **450** to a docked position. As depicted in **Fig. 4**, a contracted bellows mechanism **460** has rib-like protrusions extending outwardly from a center axis running the length of bellows mechanism **460**. The protrusions can extend outwardly from the center axis, creating circular ribs running the circular perimeter of the cylindrical bellows mechanism **460**. Thus, numerous circular ribs may be stacked up and down along the length of the bellows mechanism **460**. When the faucet is turned "on", water is transferred from a water supply to the faucet assembly **400**. As water enters the bellows mechanism **460**, the force of the water flow can cause the bellows mechanism **460** to expand.

When the bellows mechanism **460** expands length-wise, it can cause the hose **430** to slide through the faucet body, allowing spray head **450** to decouple and pull away from the distal end of the faucet body (so long as any release mechanism is disengaged). Conversely, if a user needs to use faucet assembly **400** without the pull-out spray head feature, a release mechanism can remain engaged during use of the faucet, keeping proximal end **406** of spray head **450** coupled to a distal end of the faucet body. In this

situation, the release mechanism can overcome any force caused by the water flow pushing on the bellows mechanism **460**, keeping the bellows mechanism **460** in a contracted position and spray head **450** coupled to the faucet body while water flows through and out of the faucet spray head.

Fig. 5A and **Fig. 5B** show faucet assembly **500** comprising expandable hose **575** comprising conventional portion **576** and coiled portion **577**, according to an embodiment. Faucet body **502** is shown in cross-section. Expandable hose **575** comprises coiled hose portion **577** coupled to mixing valve **546** and to standard conventional hose portion **576**. Standard conventional hose portion **576** is coupled to spray head **550**. In **Fig. 5A**, spray head **550** is in a docked position and hose coiled portion **577** is in a resting coiled (contracted) position. In **Fig. 5B**, spray head **550** is pulled out from faucet body **502**, and hose coiled portion **577** is in an extended (expanded) position, where it provides a counter force allowing the spray head to be re-positioned to a docked position when desired. In this embodiment, hose coiled portion **577** is not visible to an operator upon use as it remains positioned within the faucet body. In some embodiments, coiled portion **577** may be coupled to a spring to aid in re-docking spray head **550**.

The foregoing description, for the purpose of explanation, has been described with reference to specific embodiments. However, the illustrative discussions above are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the techniques and their practical applications. Others skilled in the art are thereby enabled to best utilize the techniques and various embodiments with various modifications as are suited to the particular use contemplated.

Although the disclosure and examples have been fully described with reference to the accompanying figures, it is to be noted that various changes and modifications will become apparent to those skilled in the art. Such changes and modifications are to be understood as being included within the scope of the disclosure and examples as defined by the claims.

Following are some embodiments of the disclosure.

In a first embodiment, disclosed is a pull-out faucet assembly, comprising a faucet body comprising a proximal end and a distal end; a spray head comprising a proximal end and a distal end, the distal end comprising a water outlet, and the proximal end configured to be releasably dockable at the distal end of the faucet body; an expandable hose comprising a first end coupled to the proximal end of the spray head and a length of the expandable hose running through a length of the faucet body, wherein the expandable hose is configured to fluidly connect the water outlet to a mixing valve; and optionally a release mechanism comprising a coupling means configured to hold the proximal end of the spray head to the distal end of the faucet body when the coupling means is engaged.

In a second embodiment, disclosed is a faucet assembly of the first embodiment, wherein the expandable hose comprises an inner tubing and an outer sheath.

In in third embodiment, disclosed is a faucet assembly of the first or second embodiments, wherein the expandable hose comprises one or more coiled sections.

In a fourth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the expandable hose comprises one or more coiled sections and one or more conventional hose sections.

In a fifth embodiment, disclosed is a faucet assembly according to any of the preceding embodiments, wherein the expandable hose is configured to expand radially.

In a sixth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the expandable hose is configured to expand length-wise.

In a seventh embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the spray head is in a docked position when the coupling means of the release mechanism is engaged and holding the proximal end of the spray head to the distal end of the faucet body.

In an eighth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the spray head is configured to pull away from the distal end of the

faucet body when the expandable hose expands and/or the coupling means of the release mechanism is disengaged.

In a ninth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the spray head is configured to remain in a docked position with the coupling means of the release mechanism engaged when the faucet is in operation.

In a tenth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the expandable hose comprises one or more of rubber, latex, elastomer, or polychloroprene.

In an eleventh embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the coupling means of the release mechanism comprises one or more of a magnetic mechanism, a latching mechanism, a twisting mechanism, or a gripping mechanism.

In a twelfth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the expandable hose is configured to fluidly connect the water outlet to the mixing valve such that a slack length of hose is not required and/or a counter weight is not required.

In a thirteenth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the expandable hose comprises a bellows, or comprises a bellows and a spring.

Following are another set of embodiments.

In a first embodiment, disclosed is a pull-out faucet assembly, comprising a faucet body comprising a proximal end and a distal end; a spray head comprising a proximal end and a distal end, the distal end comprising a water outlet and the proximal end disposed at the distal end of the faucet body; a release mechanism comprising a coupling means configured to hold the proximal end of the spray head to the distal end of the faucet body when the coupling means is engaged; a hose comprising a first end coupled to the proximal end of the spray head and a length of the hose running through a length of the faucet body; and a piston mechanism coupled to a second end of the hose.

In a second embodiment, disclosed is a faucet assembly of the first embodiment, wherein the spray head is in a docked position when the coupling means of the release mechanism is engaged and holding the proximal end of the spray head to the distal end of the faucet body.

In a third embodiment, disclosed is a faucet assembly of the first or second embodiments, wherein the piston mechanism comprises a piston and a spring.

In a fourth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the spray head is configured to pull away from the distal end of the faucet body when the piston slides in the faucet body and the coupling means of the release mechanism is disengaged.

In a fifth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the piston is configured to slide back and forth between two positions within the faucet body, wherein the piston is in a first position when the spray head in a docked position, and the piston is in a second position when the spray head is pulled away from the distal end of the faucet body to its fullest extent.

In a sixth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the piston is configured to slide between a first position and a second position when pressurized by water flow.

In a seventh embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the spray head is configured to remain in a docked position with the coupling means of the release mechanism engaged when the faucet is in operation.

In an eighth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein a spring of the piston mechanism expands when the spray head is pulled away from the distal end of the faucet body and the piston is in the second position, and the spring contracts as the spray head moves towards the distal end of the faucet body until the piston is in the first position.

In a ninth embodiment, disclosed is a faucet assembly of any of the preceding embodiments, wherein the coupling means of the release mechanism comprises one or more of a magnetic mechanism, a latching mechanism, a twisting mechanism, or a gripping mechanism.

The term “adjacent” may mean “near” or “close-by” or “next to”.

The term “coupled” means that an element is “attached to” or “associated with” another element. Coupled may mean directly coupled or coupled through one or more other elements. An element may be coupled to an element through two or more other elements in a sequential manner or a non-sequential manner. The term “via” in reference to “via an element” may mean “through” or “by” an element. Coupled or “associated with” may also mean elements not directly or indirectly attached, but that they “go together” in that one may function together with the other.

The term “flow communication” means for example configured for liquid or gas flow there through and may be synonymous with “fluidly coupled” or “fluid communication”. The terms “upstream” and “downstream” indicate a direction of gas or fluid flow, that is, gas or fluid will flow from upstream to downstream.

The term “electrical communication” may be synonymous with “electrically coupled” or “electrically connected” and may mean an element may send or receive electricity or electronic signals to another element, either via a wired connection or a wireless connection. The term “associated with” may mean “coupled”, i.e. “electrically coupled”.

The term “towards” in reference to a of point of attachment, may mean at exactly that location or point or, alternatively, may mean closer to that point than to another distinct point, for example “towards a center” means closer to a center than to an edge.

The term “like” means similar and not necessarily exactly like. For instance “ring-like” means generally shaped like a ring, but not necessarily perfectly circular.

The articles "a" and "an" herein refer to one or to more than one (e.g. at least one) of the grammatical object. Any ranges cited herein are inclusive. The term "about" used throughout is used to describe and account for small fluctuations. For instance, "about" may mean the

numeric value may be modified by ±0.05%, ±0.1%, ±0.2%, ±0.3%, ±0.4%, ±0.5%, ±1%, ±2%, ±3%, ±4%, ±5%, ±6%, ±7%, ±8%, ±9%, ±10% or more. All numeric values are modified by the term "about" whether or not explicitly indicated. Numeric values modified by the term "about" include the specific identified value. For example "about 5.0" includes 5.0.

The term “substantially” is similar to “about” in that the defined term may vary from for example by ±0.05%, ±0.1%, ±0.2%, ±0.3%, ±0.4%, ±0.5%, ±1%, ±2%, ±3%, ±4%, ±5%, ±6%, ±7%, ±8%, ±9%, ±10% or more of the definition; for example the term “substantially perpendicular” may mean the 90° perpendicular angle may mean “about 90°”. The term “generally” may be equivalent to “substantially”.

Features described in connection with one embodiment of the disclosure may be used in conjunction with other embodiments, even if not explicitly stated.

Embodiments of the disclosure include any and all parts and/or portions of the embodiments, claims, description and figures. Embodiments of the disclosure also include any and all combinations and/or sub-combinations of embodiments.

Claims

1. A pull-out faucet assembly, comprising

a faucet body comprising a proximal end and a distal end;

a spray head comprising a proximal end and a distal end, wherein the spray head proximal end is configured to be releasably docked at the faucet body distal end, and the spray head distal end comprises a water outlet; and

an expandable hose comprising a first downstream end coupled to the spray head proximal end and an expandable hose length running through a length of the faucet body, wherein the expandable hose is configured to fluidly connect the water outlet to a mixing valve.

2. The faucet assembly of claim **1**, wherein the expandable hose comprises an inner tubing and an outer sheath.

3. The faucet assembly of claim **1**, wherein the expandable hose comprises one or more coiled sections.

4. The faucet assembly of claim **1**, wherein the expandable hose comprises one or more coiled sections and one or more conventional hose sections.

5. The faucet assembly of claim **1**, wherein the expandable hose comprises one or more coiled sections, and wherein one or more of the coiled sections comprises a spring.

6. The faucet assembly of claim **1**, comprising a piston mechanism coupled to a second upstream end of the hose, the piston mechanism comprising a piston.

7. The faucet assembly of claim **6**, wherein the piston mechanism comprises a piston and a spring.

8. The faucet assembly of claim **7**, wherein the spring expands when the spray head is pulled away from the faucet body, and the spring contracts as the spray head retracts towards a

docked position.

9. The faucet assembly of claim **6**, wherein the piston is configured to move between a first position and a second position when force is applied to the piston by water flow.

10. The faucet assembly of claim **6**, wherein the piston is in a first position when the spray head is in a docked position, and the piston is in a second position when the spray head is pulled away from the faucet body.

11. The faucet assembly of claim **1**, comprising a bellows mechanism coupled to a second upstream end of the hose.

12. The faucet assembly of claim **1**, wherein the expandable hose is configured to expand radially.

13. The faucet assembly of claim **1**, wherein the expandable hose is configured to expand length-wise.

14. The faucet assembly of any of claims **1** to **13**, comprising a coupling means configured to hold the spray head proximal end to the faucet body distal end in a docked position when the coupling means is engaged, and wherein the spray head is configured to pull away from the distal end of the faucet body when the expandable hose expands and/or the coupling means is disengaged.

15. The faucet assembly of claim **14**, wherein the spray head is configured to remain in the docked position with the coupling means engaged when the faucet is in operation.

16. The faucet assembly of claim **14**, wherein the coupling means comprises one or more of a magnetic mechanism, a latching mechanism, a twisting mechanism, or a gripping mechanism.

17. The faucet assembly of any of claims **1** to **13,** wherein the assembly does not comprise a hose slack length.

18. The faucet assembly of any of claims **1** to **13**, wherein the assembly does not comprise a

counter weight.

19. The faucet assembly of any of claims **1** to **13**, wherein the expandable hose comprises one or more of rubber, latex, or polychloroprene.

20. The faucet assembly of any of claims **1** to **13**, wherein the expandable hose is multi-channeled.

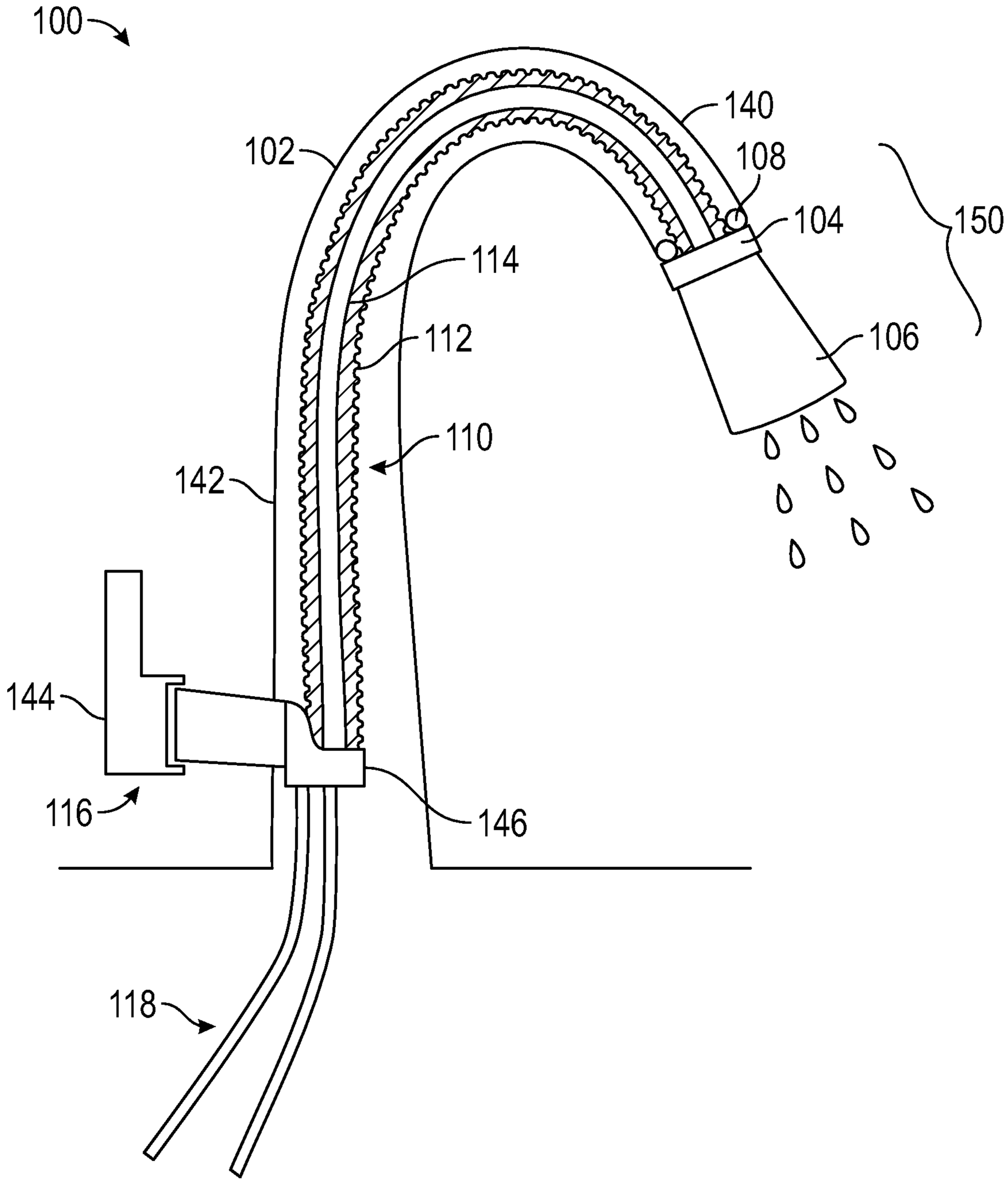

FIG. 1A

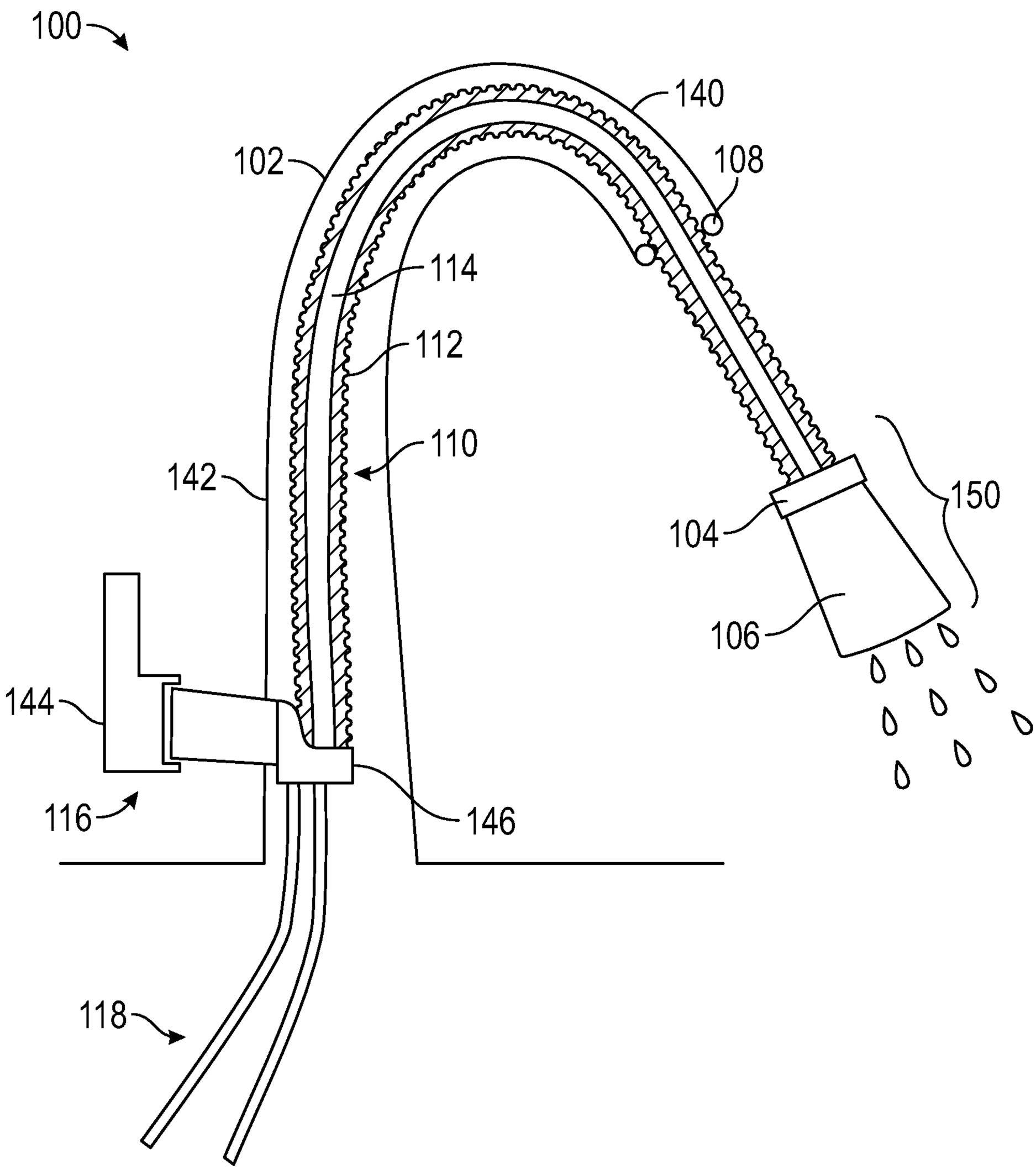

FIG. 1B

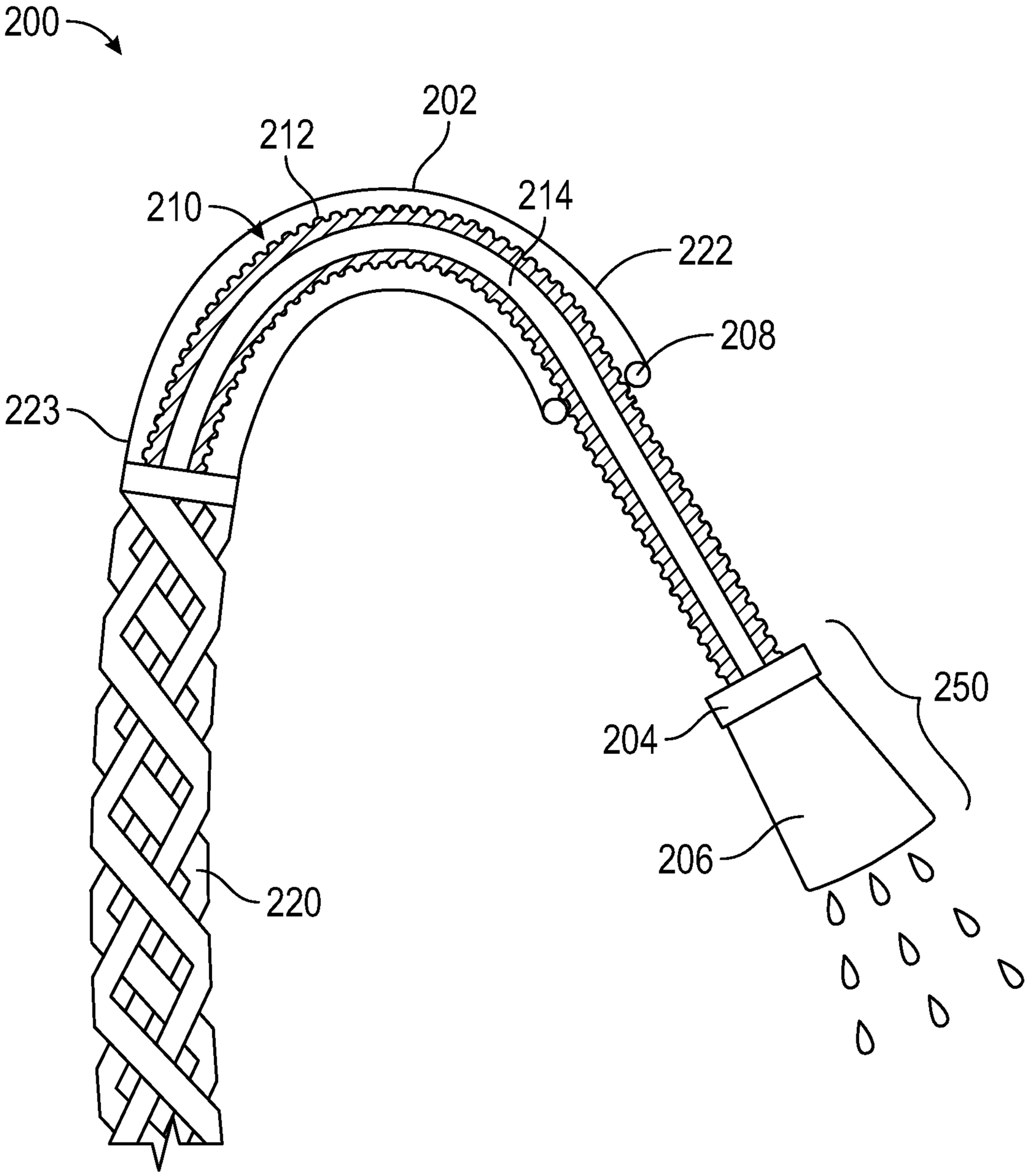

FIG. 2

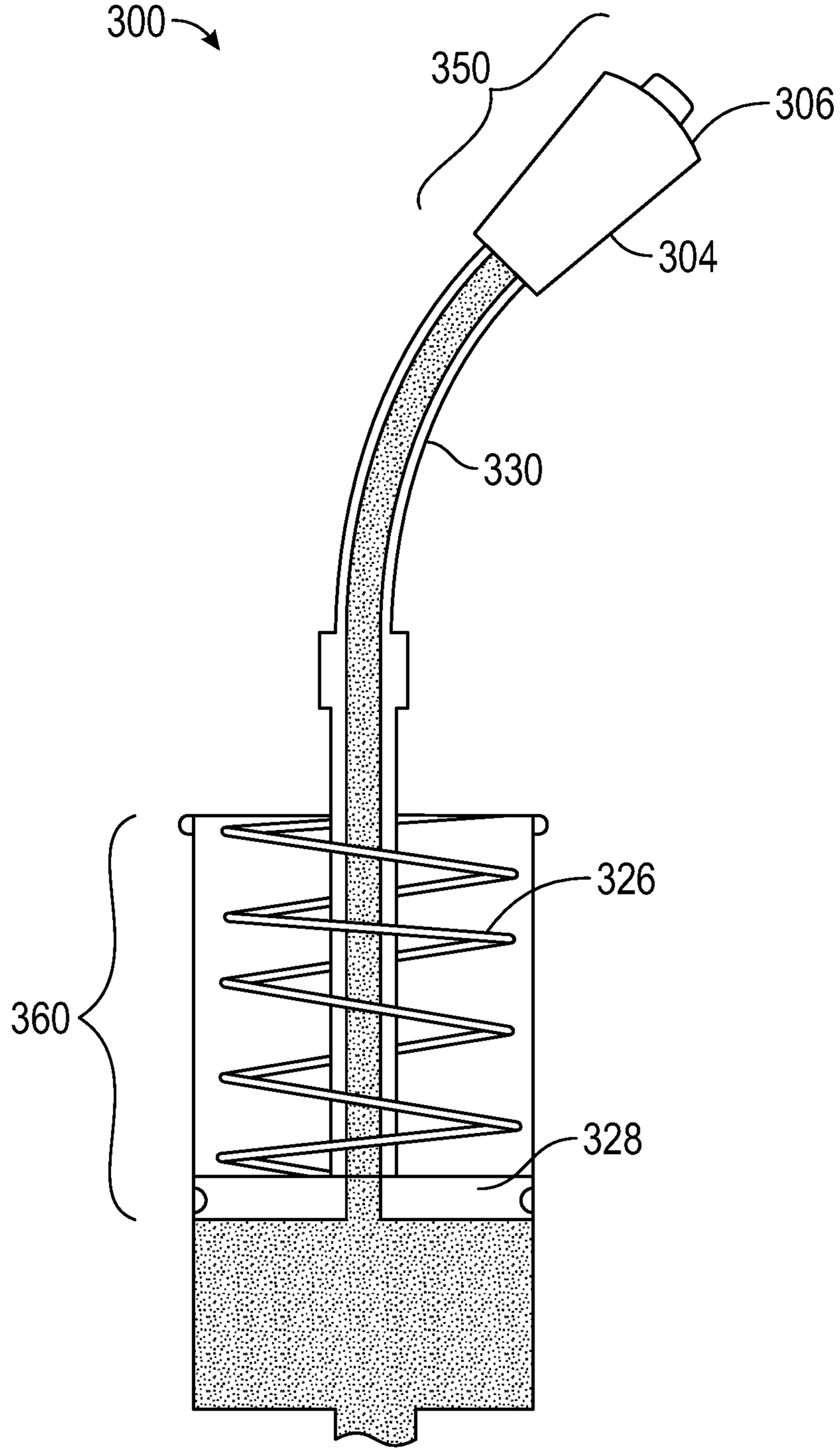

FIG. 3

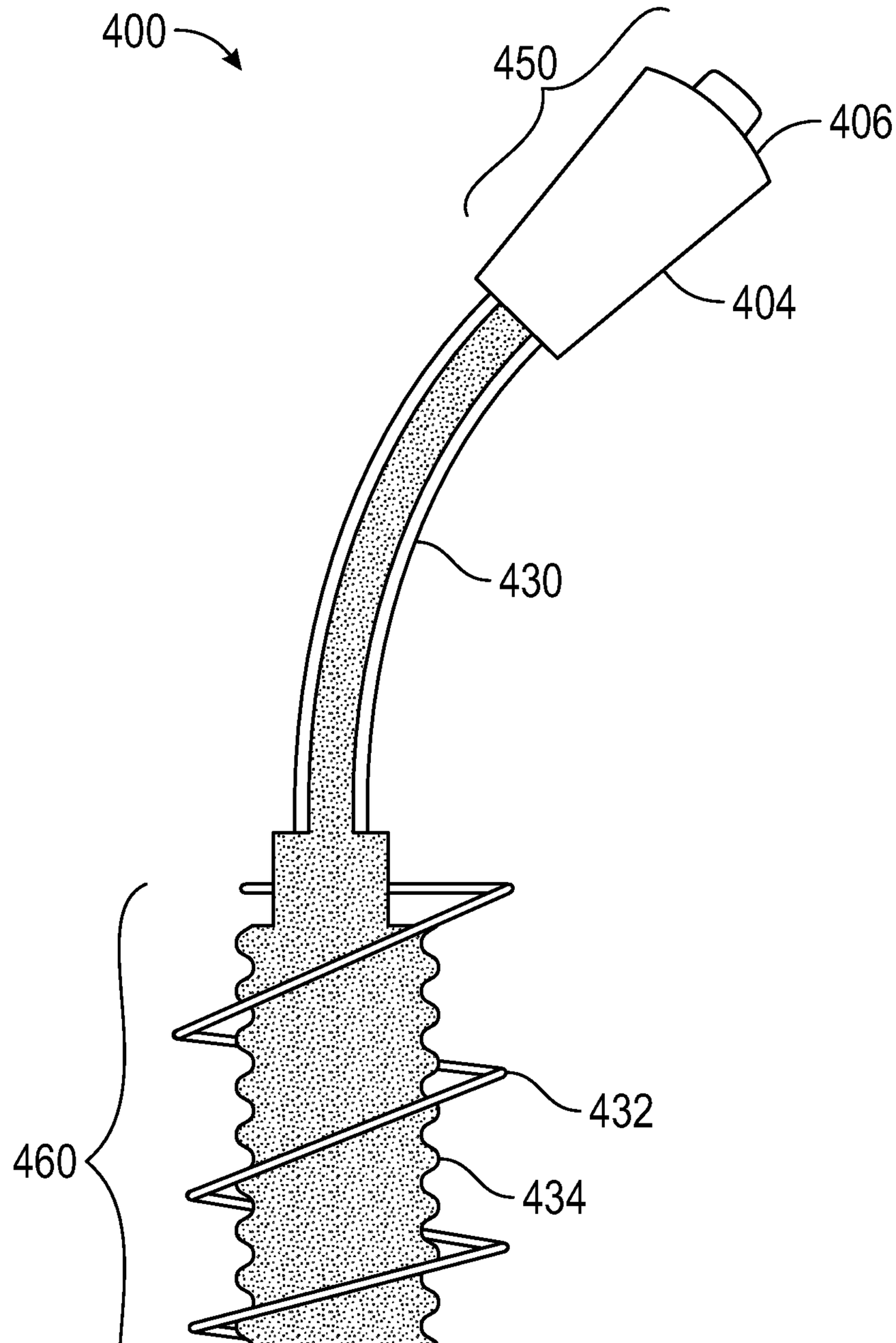

FIG. 4

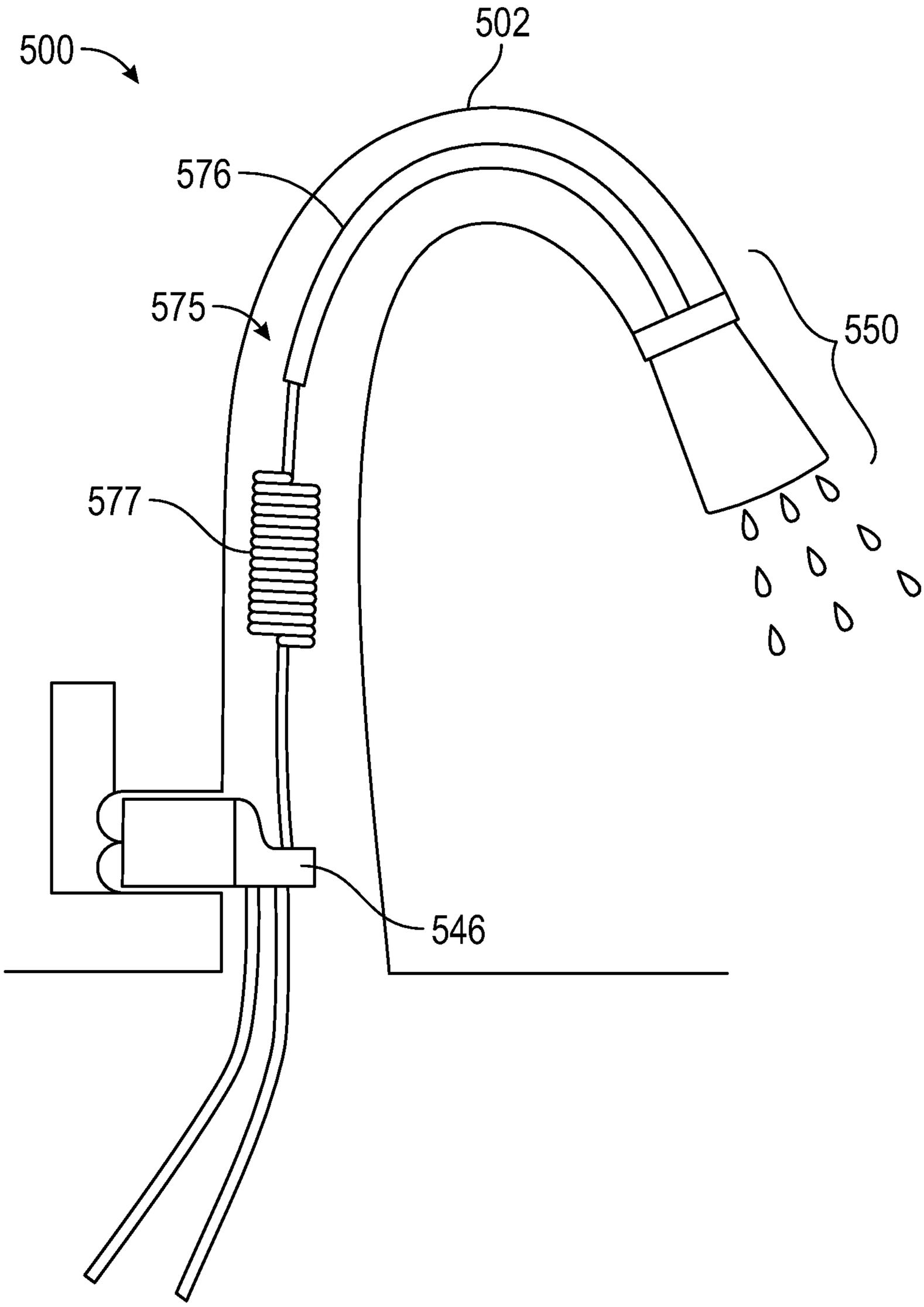

FIG. 5A

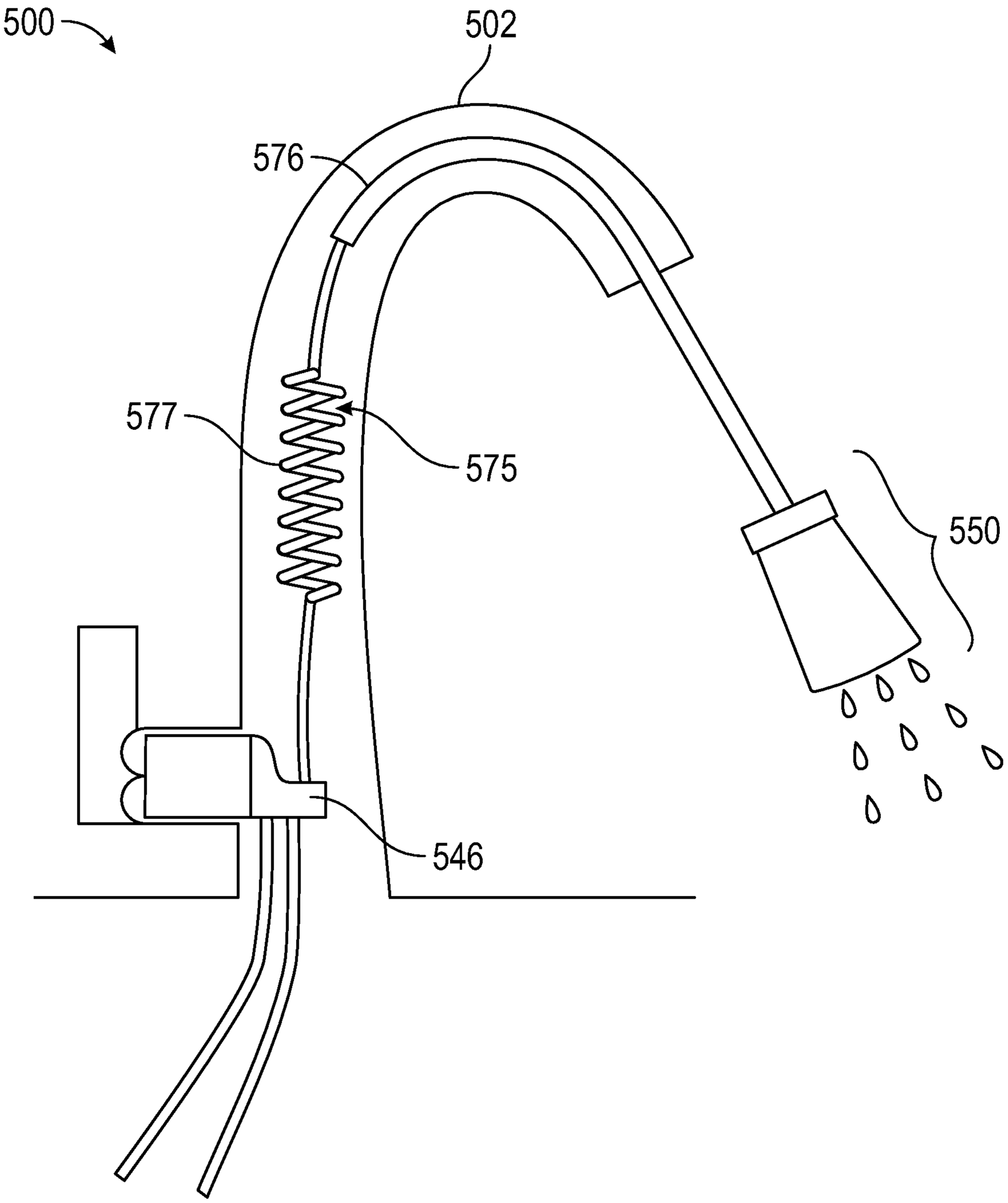

FIG. 5B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/60364

A. CLASSIFICATION OF SUBJECT MATTER
IPC - E03C 1/04 (2021.01)
CPC - E03C 1/0404, E03C 2001/0415, E03C 1/0401, E03C 1/0403, E03C 2201/30, F16L 33/01

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y -- A	US 2017/0101325 A1 (AS IP Holdco, LLC), 13 April 2017 (13.04.2017), entire document, especially Fig. 1-10; para [0031]-[0033], [0044]-[0047].	1, 2, 6, 7, 9, 18/(1, 2, 6, 7, 9), 19/(1, 2, 6, 7, 9), 20/(1, 2, 6, 7, 9) --- 3-5, 11-13, 14/(1-7, 9, 11-13), 15, 16, 17/(1-7, 9, 11-13), 18/(1-7, 9, 11-13), 19/(1-7, 9, 11-13), 20/(1-7, 9, 11-13) --- 8, 10, 14/(8, 10), 17/(8, 10), 18/(8, 10), 19/(8, 10), 20/(8, 10)
Y	US 2003/0098084 A1 (Ragner et al.), 29 May 2003 (29.05.2003), entire document, especially Fig. 1A-9B; para [0056]-[0058].	3-5, 11-13, 14/1-7, 9, 11-13), 15, 16, 17/(1-7, 9, 11-13), 18/(3-5, 11-13), 19/(3-5, 11-13) and 20/(3-5, 11-13)
Y	US 2016/0237663 A1 (As IP Holdco, LLC), 18 August 2016 (18.08.2016), entire document, especially Fig. 1-35; para [0043]-[0045], [0048], [0056].	14/1-7, 9, 11-13), 15, 16

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

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International application No.
PCT/US 20/60364

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2013/0042926 A1 (Jonte et al.), 21 February 2013 (21.02.2013), entire document.	1-20
A	US 6,093,313 A (Bovaird et al.), 25 July 2000 (25.07.2000), entire document.	1-20