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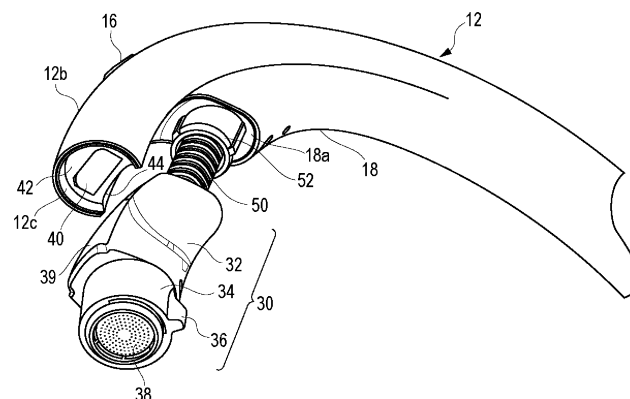
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(54) **AUTOMATIC FAUCET**

(57) An automatic water faucet includes a spout pipe 12; a spout port member 30 having a spout port 38, the spout port member 30 being housed at a leading end of the spout pipe 12 such that the spout port member 30 can be freely pulled out; and a sensor 40 provided in the

vicinity of the spout port 38 for causing water to start being discharged upon detecting an object underneath the spout port. The spout port member 30 is configured to be pulled out from a side behind the sensor 40 in an axial direction of the spout pipe.

[FIG. 5]



Description

[Technical Field]

[0001] The present invention relates to automatic water faucets that with sensors control the discharge of water.

[Background Art]

[0002] Automatic water faucets provided with a spout pipe, a sensor disposed at the leading end of the spout pipe, and a spout port member is widely used in kitchens, wash basins, and the like. When a detection object, such as a hand or tableware, placed underneath the spout port member is detected by the sensor, the automatic water faucet is controlled to discharge water through a spout port in the spout port member.

[0003] Among automatic water faucets are devices in which the spout port member can be pulled out from the main body of the spout pipe (for example, Patent Document 1).

[0004]

Patent Document 1 JP2013-108286
Patent Document 2 JP2011-122359
Patent Document 3 JP2011-94480
Patent Document 4 JP5465687
Patent Document 5 JP2011-137289

[Disclosure of Invention]

[Problems to be Solved by the Invention]

[0005] In the automatic water faucet described in Patent Document 1, the spout port member, which can be pulled out, is disposed closer to the user than is the sensor on the leading end of the spout pipe, and the spout port member is configured so as to separate from the spout pipe at a faucet end lower than the sensor. Such a configuration leads to an increase in the distance between a light emitting portion of the sensor and the spout port, which results in a problem in that the sensor is less responsive when a hand is placed underneath the spout port.

[0006] The present invention has been made in view of such an issue and is directed to providing a technique for enhancing the usability of an automatic water faucet in which a spout port member can be pulled out from the leading end of a spout pipe.

[Means To Solve the Problem]

[0007] To address the above-described issue, an aspect of the present invention provides an automatic water faucet that includes a spout pipe; a spout port member having a spout port, the spout port member being housed at a leading end of the spout pipe such that the spout

port member can be freely pulled out; and a sensor provided in the vicinity of the spout port for causing water to start being discharged upon detecting an object underneath the spout port. The spout port member is configured to be pulled out from a side that is behind the sensor in an axial direction of the spout pipe.

ADVANTAGE OF THE PRESENT INVENTION

[0008] According to the present invention, the usability of an automatic water faucet in which a spout port member can be pulled out from the leading end of a spout pipe can be enhanced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a schematic diagram of a kitchen provided with an automatic water faucet according to a first embodiment of the present invention;

Fig. 2 is an overall perspective view of an automatic water faucet;

Fig. 3 is a side view of a spout pipe;

Fig. 4 is an enlarged perspective view of the leading end of a spout pipe;

Fig. 5 is a perspective view of a state in which a spout port member is being pulled out;

Fig. 6 is a perspective view illustrating a portion of a kitchen provided with an automatic water faucet according to a second embodiment of the present invention;

Fig. 7 is a perspective view of the automatic water faucet according to the second embodiment of the present invention;

Fig. 8 is an enlarged view of the vicinity of a leading end portion of a spout pipe as viewed from below;

Fig. 9 is a sectional view of the vicinity of a leading end portion of a spout pipe;

Fig. 10 is a perspective view illustrating a portion of a kitchen provided with an automatic water faucet according to a third embodiment of the present invention;

Fig. 11 is a perspective view of the automatic water faucet according to the third embodiment of the present invention;

Fig. 12 is an enlarged view of the vicinity of a leading end portion of a spout pipe as viewed from below, illustrating a state in which a spout port member is housed in the spout pipe;

Fig. 13 illustrates an automatic water faucet as viewed from a rear side, illustrating a state in which a spout port member is being pulled out from a spout pipe along with a water supply hose;

Fig. 14 is a perspective view illustrating a guide member;

Fig. 15 is an enlarged view of the vicinity of a leading end portion of a spout pipe as viewed from below,

illustrating a state in which a spout port member is being pulled out from the spout pipe;

Fig. 16 is a schematic diagram of a kitchen provided with a water faucet according to a fourth embodiment of the present invention;

Fig. 17 is an overall perspective view of a water faucet;

Fig. 18 is a side view of a spout pipe;

Fig. 19 is an enlarged perspective view of the leading end of a spout pipe;

Fig. 20 is a perspective view of a state in which a spout port member is being pulled out;

Fig. 21 is an enlarged perspective view of the leading end of a spout pipe as viewed from a different direction;

Fig. 22 illustrates a spout port member as viewed from a back side;

Fig. 23 is a schematic diagram of a kitchen provided with an automatic water faucet according to a fifth embodiment of the present invention;

Fig. 24 is an overall perspective view of an automatic water faucet;

Fig. 25 is a side view of a spout pipe;

Fig. 26 is an enlarged perspective view of the leading end of a spout pipe;

Fig. 27 is a perspective view of a state in which a spout port member is being pulled out;

Fig. 28 is an enlarged perspective view of the leading end of a spout pipe as viewed from a different direction;

Fig. 29 is a plan view of the leading end of a spout pipe as viewed in the direction from a spout port;

Fig. 30 is a perspective view illustrating a portion of a kitchen provided with an automatic water faucet according to a sixth embodiment of the present invention;

Fig. 31 is a perspective view of the automatic water faucet according to the sixth embodiment of the present invention;

Fig. 32 is an enlarged view of the vicinity of a leading end portion of a spout pipe as viewed from below, illustrating a state in which a spout port member is housed in the spout pipe;

Fig. 33 illustrates an automatic water faucet as viewed from a rear side, illustrating a state in which a spout port member is being pulled out from a spout pipe along with a water supply hose;

Fig. 34 is a perspective view illustrating a guide member;

Fig. 35 illustrates a leading end portion of a spout pipe as viewed from below; and

Fig. 36 illustrates an automatic water faucet according to a seventh embodiment of the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0010] Hereinafter, embodiments of the present inven-

tion will be described in detail with reference to the drawings. Identical or equivalent constituent elements, members, and processes illustrated in the drawings are given identical reference characters, and duplicate descriptions thereof will be omitted as appropriate. In addition, the embodiments are not intended to limit the invention but are illustrative in nature. All of the features described in the embodiments and combinations thereof are not necessarily essential to the invention.

First Embodiment

[0011] An overview of a first embodiment will be given. An aspect of the present invention provides an automatic water faucet that includes a spout pipe; a spout port member having a spout port, the spout port member being housed at a leading end of the spout pipe such that the spout port member can be freely pulled out; and a sensor provided in the vicinity of the spout port for causing water to start being discharged upon detecting an object underneath the spout port. The spout port member is configured to be pulled out from a side that is behind the sensor in an axial direction of the spout pipe.

[0012] According to this aspect, the structure in which the spout port member is pulled out from a side that is behind the sensor in the axial direction of the spout pipe, or in other words, from the back side of the sensor makes it possible to reduce the amount by which the spout port member projects downward with respect to a light emitting portion of the sensor and to reduce the distance between the light emitting portion of the sensor and the spout port. Thus, the sensor is responsive when a hand is placed underneath the spout port, and the usability improves. In addition, a broad space can be secured underneath the spout port.

[0013] The spout pipe may have a shape that expands from an intermediate portion to the leading end thereof, and the spout port member may be able to be pulled out from the expanded portion. This configuration can achieve a structure in which the spout port member is attached to the leading end of the spout pipe without increasing the diameter of the spout pipe along the entire length thereof. In addition, irregularity on the spout pipe can be kept minimum, which thus leads to an aesthetically pleasing design and increased ease of cleaning.

[0014] The spout port member may have a shape that smoothly curves continuously from an upstream side of the spout pipe to the spout port member in a state in which the spout port member is being attached. This configuration can prevent a water supply hose connected to the spout port member from being caught inside the spout pipe when the spout port member is pulled out or housed, which thus facilitates the operation of the spout port member. In addition, the smooth spout pipe is easy to clean.

[0015] The spout pipe may have a shape that expands in the depthwise direction toward the leading end as viewed from the user, and the spout port member may be able to be pulled out from either side of the portion

that expands in the depthwise direction. This configuration makes the expanded portion less noticeable when the automatic water faucet is viewed from the side closer to the user and can give the user a generally compact and neat impression.

[0016] The configurations described above can enhance the usability of the automatic water faucet in which the spout port member can be pulled out from the leading end of the spout pipe.

[0017] Fig. 1 is a schematic diagram of a kitchen provided with an automatic water faucet 10 according to the first embodiment of the present invention. A kitchen 100 is provided with a sink 102, and a counter 104 having a step with respect to a top surface is provided behind the sink 102. The automatic water faucet 10 is installed on the left side in the counter 104, and a purified water faucet 106 is installed on the right side in the counter 104. The automatic water faucet 10 is connected to a water service pipe and supplies regular tap water, whereas the purified water faucet 106 is connected to a water purifying device installed underneath the sink 102 and supplies purified water.

[0018] Hereinafter, when the terms indicating directions, such as "upper," "underneath," "front," "back," "left," "right," "inner," "outer," "closer," and "behind," are used in the present specification, these terms indicate directions relative to the posture of the automatic water faucet 10 mounted to the kitchen or the like.

[0019] Fig. 2 is an overall perspective view of the automatic water faucet 10 illustrated in Fig. 1. The automatic water faucet 10 primarily includes a spout pipe 12, a base end portion 24, and a handle lever 22. Fig. 3 is a side view of the spout pipe 12 that is being detached from the base end portion 24.

[0020] The spout pipe 12 is formed into a so-called gooseneck shape in which an intermediate portion 12a is curved into an inverted U-shape and a leading end 12b extends obliquely downward. The spout pipe 12 is formed by a casting of a metal material serving as a raw material. Although details will be given later, a spout port member 30 having a spout port 38 and an automatic water discharge sensor 40 for controlling the water discharged through the spout port 38 are provided at the leading end 12b of the spout pipe 12. As illustrated in Fig. 3, a coupling member 26 to be coupled to the base end portion 24 is provided in the spout pipe 12 at a side toward the base end portion.

[0021] As illustrated in Fig. 1, the base end portion 24 is disposed on the upper surface of the counter 104 in the kitchen. The handle lever 22 is provided on the upper end of the base end portion 24.

[0022] A cold water pipe and a hot water pipe (not illustrated) connected to supply sources of cold water and hot water, respectively, extend inside the base end portion 24. A solenoid valve (not illustrated) is provided between the cold water pipe and hot water pipe and a water supply hose for supplying water to the spout port 38 housed in the spout pipe 12. This solenoid valve can

open or close the valve under the control of a control unit, which is not illustrated, to control the flow of water from the cold water pipe and the hot water pipe to the water supply hose.

[0023] A mixing valve (not illustrated) that mixes cold water and hot water at a predetermined ratio to produce warm water of an appropriate temperature is provided inside the base end portion 24. The handle lever 22 is a lever for operating this mixing valve, and the horizontal pivot operation thereof adjusts the mixture ratio of cold water and hot water, or in other words, adjusts the temperature of the mixed water, whereas the vertical pivot operation thereof adjusts the flow rate of the discharged warm water.

[0024] The automatic water discharge sensor 40 is provided at the leading end 12b of the spout pipe 12. The automatic water discharge sensor 40, for example, is an infrared range finding sensor having a light emitting portion and a light receiving portion. The automatic water discharge sensor 40 projects light from the light emitting portion toward a space underneath the spout port 38 of the spout port member 30, receives, with the light receiving portion, reflected light of the projected light from a detection target, such as a hand of the user or tableware, and determines whether there is a detection target within a predetermined detection area. The automatic water discharge sensor 40 outputs a signal indicating the detection result of the detection target to the control unit.

[0025] A proximity sensor 14 is provided on the front side of the spout pipe 12, or in other words, on the side that faces the user standing in the kitchen. The proximity sensor 14 is an infrared light quantity sensor having a light emitting portion and a light receiving portion. The proximity sensor 14 projects light obliquely upward, receives, with the light receiving portion, reflected light of the projected light from a detection target, such as a hand of the user, and determines whether there is a detection target within a predetermined detection area. The proximity sensor 14 outputs a signal indicating the detection result of the detection target to the control unit.

[0026] The control unit is constituted by a circuit board having a microcomputer mounted thereon. The control unit opens or closes the solenoid valve on the basis of an output signal from the automatic water discharge sensor 40 or the proximity sensor 14 and makes a switch as to whether water is supplied through the spout port 38 of the spout port member 30. The control unit may be implemented through a combination of devices such as a CPU and a memory of a computer and a circuit.

[0027] It is to be noted that water is controlled to be supplied through the spout port 38 only for the duration in which a detection target is being detected by the automatic water discharge sensor 40 within the detection area, whereas water continues to be supplied through the spout port 38 even after a detection target that has once been detected by the proximity sensor 14 within the detection area becomes no longer detected. When a detection target is detected again within the detection area,

the water supply through the spout port 38 is shut off.

[0028] An on/off switch 16 of a push button type is provided on the spout pipe 12 on the side closer to the user and underneath the proximity sensor 14 (toward the leading end 12b). While the on/off switch 16 is set to OFF, the automatic water discharge sensor 40 is inactive, and water is not supplied through the spout port 38 even if an object is present underneath the sensor 40.

[0029] As can be seen from Fig. 3, the spout pipe 12 is formed to have a constant curvature in the first embodiment. Furthermore, a hollow stretched-out portion 18 that expands toward the lower side of the spout pipe 12 is formed from a portion near the top of the intermediate portion 12a of the spout pipe 12 to the leading end 12b. The lower surface of this stretched-out portion 18 is formed to produce a continuous smooth curve extending from the side of the base end portion 24 of the spout pipe 12 and having a curvature smaller than the curvature of the spout pipe 12. A leading end 18a of the stretched-out portion 18 is located further back in the axial direction of the spout pipe (the upstream side of the spout pipe 12, the upper right side in Fig. 3) than is the leading end 12b of the spout pipe 12. Methods of forming such a spout pipe include a bulge process, zinc die casting, and resin molding.

[0030] The spout port member 30, which can be freely pulled out, is attached behind the automatic water discharge sensor 40 at the leading end 12b of the spout pipe 12 as viewed from the user. As can be seen from Fig. 3, the spout port member 30 is attached to the leading end of the stretched-out portion 18 and behind the leading end 12b of the spout pipe 12 as viewed from the user. In a state in which the spout port member 30 is being attached, the inner peripheral side of the curve of the spout port member 30 is formed to produce a continuous smooth curve with the inner peripheral sides of the base end portion 24 and the stretched-out portion 18 of the spout pipe 12.

[0031] Fig. 4 is an enlarged perspective view of the vicinity of the leading end 12b of the spout pipe 12, and Fig. 5 illustrates a state in which the spout port member 30 is being pulled out.

[0032] The spout port member 30 includes a cover portion 32, a switch operation portion 34, and the spout port 38.

[0033] As illustrated in Fig. 5, a flexible metal water supply hose 50 is connected to the spout port member 30. The other end of the water supply hose 50 is connected to the solenoid valve described above. The water supply hose 50 is housed such that the water supply hose 50 can move by a predetermined length in the direction of the pipe axis inside the spout pipe 12 and the stretched-out portion 18. Thus, when the spout port member 30 is pulled out from the spout pipe 12, the water supply hose 50 is also pulled out along therewith. The direction in which the spout port member 30 is pulled out substantially coincides with the axial direction of the spout pipe 12. When the spout port member 30 is attached to the spout

pipe 12, the water supply hose 50 moves toward the base end portion 24 inside the stretched-out portion 18 and the spout pipe 12. The water that flows inside the water supply hose 50 is discharged through the spout port 38.

[0034] The cover portion 32 connects the water supply hose 50 to the switch operation portion 34 and also constitutes a portion that the user holds when removing the spout port member 30 from the spout pipe 12. In addition, the cover portion 32 serves as an attachment that enables the spout port member 30 to be easily attached to or detached from the spout pipe 12.

[0035] An end surface 42 that is recessed toward the inside of the pipe is formed at the leading end 12b of the spout pipe 12, and the automatic water discharge sensor 40 is disposed to be flush with this end surface 42. A pipe wall 12c of the spout pipe 12 allows the surrounding of the automatic water discharge sensor 40 to be located inward, which thus can prevent a hand of the user from making contact with the sensor 40 to contaminate the light emitting surface and the light receiving surface of the sensor or prevent tableware from hitting the sensor to cause damage thereto.

[0036] At the leading end 12b of the spout pipe 12, the pipe wall 12c is partially cut out, and a concave guide portion 44, which functions as a guide when the spout port member 30 is housed, is provided at the cut-out portion. A convex portion 39, which opposes the guide portion 44 when the spout port member 30 is housed, is formed on the upper surface (the front surface as viewed from the user) of the cover portion 32 of the spout port member 30.

[0037] A cylindrical hose guide portion 52 having a hole into which the water supply hose 50 is inserted is provided at the leading end 18a of the stretched-out portion 18. Although not illustrated, a recess portion that receives the hose guide portion 52 is formed at the trailing end of the spout port member 30 that faces the stretched-out portion 18.

[0038] When the spout port member 30 is housed, the water supply hose 50 is pushed into the hole in the hose guide portion 52, and thus the trailing end of the spout port member 30 is guided to the hose guide portion 52. As the spout port member 30 continues to be pushed thereinto, the convex portion 39 formed on the upper surface of the spout port member 30 is guided by the guide portion 44 of the spout pipe 12, and the spout port member 30 fits with the hose guide portion 52. Thus, the spout port member 30 is held by the spout pipe 12. When the spout port member 30 is pulled out, the spout port member 30 is pulled obliquely downward, and thus the convex portion 39 is guided by the guide portion and pulled out therefrom.

[0039] As described above, the lower surfaces of the stretched-out portion 18 and the spout pipe 12 are smoothly continuous with each other, and a corner or a large change in the curvature is not present inside the pipe. This configuration can prevent the water supply hose 50 connected to the spout port member 30 from

being caught inside the spout pipe 12 and the stretched-out portion 18 when the spout port member 30 is pulled out or housed, which thus facilitates the operation of the spout port member 30. In addition, the absence of any bent portion makes it easier to clean the outer surfaces of the spout pipe 12 and the stretched-out portion 18.

[0040] The leading end 18a of the stretched-out portion 18, with which the trailing end of the spout port member 30 in a housed state makes contact, is located further back in the axial direction of the spout pipe (the upstream side of the spout pipe 12) than is the leading end 12b of the spout pipe 12. Thus, in a state in which the spout port member 30 is housed, the spout port 38 of the spout port member 30 is located relatively close to the automatic water discharge sensor 40. In this manner, the structure in which the spout port member 30 is pulled out from a side that is behind the automatic water discharge sensor 40 in the axial direction of the spout pipe, or in other words, from the back side of the sensor 40 makes it possible to reduce the amount by which the spout port member projects downward with respect to the light emitting portion of the sensor 40 and to reduce the distance between the light emitting portion of the sensor and the spout port. Thus, the sensor becomes responsive when a hand is placed underneath the spout port.

[0041] The switch operation portion 34 of the spout port member 30 is a member for switching the water flowing from the water supply hose 50 to shower water discharge or straight water discharge. The switch operation portion 34 has a shape that is smoothly continuous with the lower side of the outer periphery of the cover portion 32 and forms a cylindrical shape as a whole. The switch operation portion 34 is configured to rotate by a predetermined angle (for example, 90 degrees) about the center axis relative to the cover portion 32. A tab portion 36 for the user to hook his/her finger thereon is formed on the cylindrical surface of the switch operation portion 34. The user can switch between the shower water discharge and the straight water discharge by rotating the position of the tab portion 36 by a predetermined angle.

[0042] As described thus far, according to the first embodiment, the structure in which the spout port member is pulled out from a side that is behind the automatic water discharge sensor in the axial direction of the spout pipe, or in other words, from the back side of the sensor makes it possible to reduce the amount by which the spout port member projects downward with respect to the light emitting portion of the sensor and to reduce the distance between the light emitting portion of the sensor and the spout port. Thus, the sensor is responsive when a hand is placed underneath the spout port, and the usability improves. In addition, the reduction in the amount by which the spout port member projects downward makes it possible to secure a broad space underneath the spout port.

[0043] In addition, the spout pipe has the stretched-out portion that expands in the depthwise direction from the intermediate portion to the leading end as viewed from

the user, and the spout port member can be pulled out from this stretched-out portion. This configuration can achieve a structure in which the spout port member is housed at the leading end of the spout pipe without increasing the diameter of the spout pipe along the entire length thereof. In addition, irregularity on the spout pipe can be kept minimum, which thus leads to an aesthetically pleasing design and increased ease of cleaning. Furthermore, by providing the stretched-out portion toward the back side in the axial direction of the spout pipe, the stretched-out portion becomes less noticeable when the automatic water faucet is seen from the front side as viewed from the user, which can give the user a generally compact and neat impression.

[0044] In the first embodiment described above, the spout port member is provided behind the automatic water discharge sensor (toward the counter) as viewed from the user. Alternatively, the stretched-out portion may be formed on the front side of the spout pipe (toward the sink), and the spout port member may be provided to the front of the automatic water discharge sensor. In this case as well, an advantageous effect similar to that of the first embodiment can be expected as long as the boundary between the spout port member and the stretched-out portion is located behind the light emitting portion of the automatic water discharge sensor (toward the base end portion) in the axial direction of the spout pipe and the spout port member is pulled out therefrom.

[0045] In place of the shape in which only the leading end side of the spout pipe expands in the depthwise direction as viewed from the user as in the stretched-out portion described in the first embodiment, a shape in which the spout pipe expands in the depthwise direction throughout its length may be employed, or a shape in which the spout pipe expands in the lateral direction throughout its length may be employed.

[0046] The automatic water faucet according to the first embodiment can be used in facilities installed in buildings, ships, and the like and may be used in washing basins, hand washers, bathrooms, and so on, aside from kitchens. In addition, the counter has been illustrated as a base member to which the base end portion of the automatic water faucet is fixed. Alternatively, the base member may be a wall member or the like that defines the inside and the outside of a facility such as a bathroom.

[0047] In addition, the shape of the spout pipe is not limited to the gooseneck shape, and the spout pipe may be formed into a different shape.

50 Second Embodiment

[0048] Conventionally, there is known an automatic water faucet that includes a spout port member and a sensor provided at a leading end portion of a spout pipe and that discharges water through the spout port member upon detecting a detection target such as a hand with the sensor (see, for example, patent document 2).

[0049] In such a conventional automatic water faucet

as described above, when water is poured over the spout pipe, the water may run down the outer surface of the spout pipe to reach the leading end of the spout pipe, and water droplets may adhere to the sensor window of the sensor. When water droplets adhere to the sensor window, the sensor window is stained with the water droplets, which may result in a false detection.

[0050] A second embodiment provides an automatic water faucet that can suppress adherence of water droplets onto a sensor window of a sensor.

[0051] An overview of the second embodiment will be given. An automatic water faucet according to an aspect of the present invention includes a spout portion; a sensor that detects the presence of a detection target; a spout port member that discharges water upon a detection target being detected by the sensor; and a holding member that holds the sensor inside the spout portion. The holding member includes a planar portion having a sensor window of the sensor and a rising portion formed to rise from a periphery of the planar portion.

[0052] According to this aspect, the rising portion formed at the periphery of the planar portion makes water less likely to flow onto the planar portion from the leading end of the spout portion, and thus adherence of water droplets onto the sensor window of the sensor can be suppressed. As a result, the sensor window can be prevented from being stained, and a false detection can thus be suppressed.

[0053] The spout portion may be a spout pipe. The sensor may be held at a leading end portion of the spout pipe. When the sensor is located at the leading end portion of the spout pipe, water droplets are more likely to adhere to the sensor window, and thus the rising portion is particularly effective.

[0054] The planar portion may be disposed at a position more inward than the leading end of the spout portion, and the rising portion may be formed to rise along an inner wall of the spout portion. In this case, as the planar portion is located more inward than the leading end of the spout portion, water is even less likely to flow onto the planar portion from the leading end of the spout portion, and thus adherence of water droplets onto the sensor window of the sensor can be further suppressed. In addition, as the rising portion rises along the inner wall of the spout portion, the inner wall of the spout portion is covered by the rising portion, and thus the appearance can be improved.

[0055] A leading end of the rising portion may project more than the leading end of the spout portion. In this case, water is even less likely to flow onto the planar portion from the leading end of the spout portion, and thus adherence of water droplets onto the sensor window of the sensor can be further suppressed.

[0056] The rising portion may be connected to the planar portion via a continuous curved surface. In this case, even if water flows onto the planar portion from the leading end of the spout portion, the water is easily drained from the planar portion. In addition, the portion that joins

the planar portion and the rising portion is less likely to be stained, which thus improves the ease of cleaning.

[0057] The configurations described above makes it possible to suppress adherence of water droplets onto the sensor window of the sensor in the automatic water faucet.

[0058] Fig. 6 is a perspective view illustrating a portion of a kitchen 1100 provided with an automatic water faucet 1010 according to the second embodiment of the present invention. A sink 1102 that is recessed in a concave shape is provided in the kitchen 1100. The automatic water faucet 1010 according to the second embodiment, a purified water faucet 1106 for supplying purified water, and a storage portion 1108 for storing various items such as a dishwashing detergent and a sponge are provided in a counter 1104 behind the sink 1102. When the terms indicating directions, such as "upper," "underneath," "front," "back," "left," "right," "inner," and "outer" are used in the present specification, these terms indicate directions relative to the posture of the automatic water faucet 1010 mounted to the kitchen or the like.

[0059] Fig. 7 is a perspective view of the automatic water faucet 1010 according to the second embodiment of the present invention. As illustrated in Fig. 7, the automatic water faucet 1010 includes a water faucet main body 1012 erected on the counter and a spout pipe 1014, which serves as a spout portion, that extends from the upper end surface of the water faucet main body 1012. A spout port member 1020 having a spout port 1018 is provided at a leading end side of the spout pipe 1014 in the direction of the pipe axis.

[0060] The water faucet main body 1012 includes a mixing valve (not illustrated) provided therein and a lever handle 1016 for operating the mixing valve. The mixing valve mixes cold water and hot water at a predetermined ratio to produce warm water of an appropriate temperature. The horizontal pivot operation of the lever handle 1016 adjusts the mixture ratio of cold water and hot water, or in other words, adjusts the temperature of the mixed water, and the vertical pivot operation thereof adjusts the flow rate of the discharged warm water.

[0061] The spout pipe 1014 is constituted by a spout pipe main body 1014a formed into a so-called gooseneck shape having an inverted U-shape and a stretched-out portion 1014b that stretches out toward the back side (the side opposite to the user) from the intermediate portion to the leading end portion of the spout pipe main body 1014a. The spout pipe main body 1014a and the stretched-out portion 1014b are formed integrally by a casting of a metal material serving as a raw material. The spout pipe main body 1014a has a shape that extends downward toward a leading end 1014e from the portion of a maximum height, and the opening in the leading end 1014e faces downward.

[0062] A flexible water supply hose (not illustrated) is disposed inside the spout pipe 1014. One end of the water supply hose is connected to the spout port member 1020. The spout port member 1020 can be pulled out

from the spout pipe 1014 along with the water supply hose. In a state in which the spout port member 1020 is housed in the spout pipe 1014, the spout port 1018 of the spout port member 1020 faces downward.

[0063] The other end of the water supply hose is connected to a solenoid valve (not illustrated). This solenoid valve is provided underneath the counter and controls the discharge and shutoff of the water through the spout port 1018. The solenoid valve is controlled by a control unit (not illustrated) constituted by a circuit board having a microcomputer mounted thereon. This control unit may be implemented through a combination of devices such as a CPU and a memory of a computer and a circuit.

[0064] A proximity sensor 1022, which serves as a first human body detection sensor, is provided on the front surface (the side toward the user) of the spout pipe 1014. The proximity sensor 1022 may be an infrared sensor having a light emitting portion and a light receiving portion, for example. The proximity sensor 1022 receives, with the light receiving portion, reflected light of the light projected by the light emitting portion from a detection target and thus determines whether a detection target such as a hand of a person is present within a predetermined detection area. The proximity sensor 1022 is provided such that a sensor window 1022a faces obliquely upward.

[0065] The proximity sensor 1022 detects the hand upon the user placing his/her hand over the sensor window. When a body part is detected by the proximity sensor 1022, the control unit opens the solenoid valve, and water is discharged through the spout port 1018 of the spout port member 1020. Once a body part is detected by the proximity sensor 1022, the water continues to be discharged even after the body part becomes no longer detected. Thereafter, when the proximity sensor 1022 detects a body part again as the user places his/her hand over the proximity sensor 1022 again, the control unit closes the solenoid valve, and the water stops being discharged through the spout port 1018 of the spout port member 1020. The presence of such a proximity sensor 1022 makes it possible to control the discharge and shutoff of the water without operating the lever handle 1016, and thus the lever handle 1016 is prevented from being stained even when the hands are not clean, for example.

[0066] Fig. 8 is an enlarged view of the vicinity of the leading end portion of the spout pipe 1014 as viewed from below. As illustrated in Fig. 8, the spout port member 1020 is provided at the leading end portion of the spout pipe 1014 on the side away from the user, and an automatic sensor 1024, which serves as a second human body detection sensor, is provided on the side closer to the user. The automatic sensor 1024 is provided inside a leading end portion 1014c of the spout pipe main body 1014a. The spout port member 1020 is provided at a leading end portion 1014d of the stretched-out portion 1014b such that the spout port member 1020 can be pulled out along with the water supply hose. As illustrated in Fig. 8, the leading end portion 1014d of the stretched-

out portion 1014b does not extend to the leading end portion 1014c of the spout pipe main body 1014a and has a shape in which the leading end portion of the spout pipe 1014 is partially cut out. The sectional shape of the leading end portion 1014c of the spout pipe main body 1014a along a plane perpendicular to the direction of the pipe axis is a circular arc shape with a central angle of approximately 270 degrees. The spout port member 1020 is formed such that a portion thereof follows along the cut-out portion of the spout pipe 1014 in a state in which the spout port member 1020 is being housed in the spout pipe 1014.

[0067] The automatic sensor 1024 may be an infrared sensor having a light emitting portion and a light receiving portion, for example. The automatic sensor 1024 receives, with the light receiving portion, reflected light of the light projected by the light emitting portion from a detection target and thus determines whether a detection target such as a hand of a person is present within a predetermined detection area. The automatic sensor 1024 is provided such that a sensor window 1024a faces downward.

[0068] The automatic sensor 1024 detects the hand upon the user placing his/her hand underneath the spout port 1018. When a body part is detected by the automatic sensor 1024, the control unit opens the solenoid valve, and water is discharged automatically through the spout port 1018 of the spout port member 1020. Thereafter, when the user pulls back the hand out of the detection area of the automatic sensor 1024, the automatic sensor 1024 no longer detects a body part. Thus, the control unit closes the solenoid valve, and the water stops being discharged through the spout port 1018 of the spout port member 1020. The presence of such an automatic sensor 1024 makes it possible to discharge water only for the duration in which a detection target is being detected by the automatic sensor 1024, and thus water consumption can be reduced.

[0069] A switch 1026 for switching between ON and OFF of the automatic sensor 1024 is provided on the front surface (the side toward the user) of the spout pipe 1014. The automatic water discharge and water shutoff as described above is carried out only when the automatic sensor 1024 is ON.

[0070] Fig. 9 is a sectional view of the vicinity of the leading end portion of the spout pipe 1014. Fig. 9 illustrates a state in which the spout port member is being pulled out from the spout pipe 1014 and in which a water supply hose 1028 extends from the spout pipe 1014.

[0071] As illustrated in Fig. 9, the automatic sensor 1024 is held inside the leading end portion 1014c of the spout pipe main body 1014a by a holding member 1030. The holding member 1030 is made of resin and is formed integrally with a guide portion 1032 of the water supply hose 1028 provided inside the stretched-out portion 1014b. The guide portion 1032 also serves the function of holding the spout port member 1020.

[0072] The holding member 1030 includes a planar

portion 1030a provided to cover the opening in the leading end portion 1014c of the spout pipe main body 1014a. An opening 1030b for exposing the sensor window 1024a of the automatic sensor 1024 to the outside of the spout pipe 1014 is formed in the planar portion 1030a. In a state in which the automatic sensor 1024 is held by the holding member 1030, the sensor window 1024a of the automatic sensor 1024 may be flush with the planar portion 1030a of the holding member 1030. The light emitting surface of the light emitting portion and the light receiving surface of the light receiving portion are located on the sensor window 1024a of the automatic sensor 1024.

[0073] In the second embodiment, the planar portion 1030a is disposed at a position more inward than the leading end 1014e of the spout pipe main body 1014a in the direction of the pipe axis, or in other words, more toward the inside of the spout pipe main body 1014a than the leading end 1014e thereof in the direction of the pipe axis.

[0074] Furthermore, in the second embodiment, the holding member 1030 includes a rising portion 1030c formed to rise outward from the periphery of the planar portion 1030a in the direction of the pipe axis. As illustrated in Fig. 9, a leading end 1030d of the rising portion 1030c projects more outward than the leading end 1014e of the spout pipe main body 1014a in the direction of the pipe axis. The rising portion 1030c is formed to rise along an inner wall 1014f of the spout pipe main body 1014a. The sectional shape of the rising portion 1030c along a plane perpendicular to the direction of the pipe axis is a circular arc shape with a central angle of approximately 270 degrees, similarly to the leading end portion 1014c of the spout pipe main body 1014a. In addition, the rising portion 1030c is connected to the planar portion 1030a via a continuous curved surface 1030e.

[0075] An advantageous effect of the automatic water faucet 1010 configured as described above will be described. When the automatic water faucet 1010 is in use, water can be poured over the outer surface of the spout pipe 1014. This water poured over the outer surface of the spout pipe 1014 runs down the outer surface of the spout pipe 1014 due to the gravitational force and reaches the leading end 1014e of the spout pipe main body 1014a. When this water flows into the spout pipe 1014 and adheres to the sensor window 1024a of the automatic sensor 1024, the sensor window may be stained, which may result in a false detection.

[0076] In the automatic water faucet 1010 according to the second embodiment, the rising portion 1030c formed at the periphery of the planar portion 1030a makes the water less likely to flow onto the planar portion 1030a from the leading end 1014e of the spout pipe main body 1014a, and thus adherence of water droplets onto the sensor window 1024a of the automatic sensor 1024 is suppressed. As a result, the sensor window can be prevented from being stained, and a false detection can thus be suppressed.

[0077] In addition, in the automatic water faucet 1010

according to the second embodiment, the leading end 1030d of the rising portion 1030c projects more outward than the leading end 1014e of the spout pipe main body 1014a in the direction of the pipe axis. This configuration makes the water even less likely to flow onto the planar portion 1030a from the leading end 1014e of the spout pipe main body 1014a, and thus adherence of water droplets onto the sensor window 1024a of the automatic sensor 1024 is further suppressed.

[0078] In addition, in the automatic water faucet 1010 according to the second embodiment, the planar portion 1030a is disposed at a position more inward than the leading end 1014e of the spout pipe main body 1014a in the direction of the pipe axis. Such a configuration makes the water even less likely to flow onto the planar portion 1030a from the leading end 1014e of the spout pipe main body 1014a, and thus adherence of water droplet onto the sensor window 1024a of the automatic sensor 1024 is further suppressed.

[0079] Here, in a case in which the rising portion 1030c as in the second embodiment is not formed and the planar portion 1030a is simply disposed at a position more inward than the leading end 1014e of the spout pipe main body 1014a in the direction of the pipe axis, the inner wall 1014f of the spout pipe main body 1014a is exposed. When the inner wall 1014f is exposed in this manner, the appearance can be degraded. The degradation of the appearance may possibly be suppressed by subjecting the inner wall 1014f to surface treatment, but the manufacturing cost may increase in this case. In addition, dirt is more likely to sneak into the corner between the planar portion 1030a and the inner wall 1014f of the spout pipe main body 1014a, which may lead to reduced ease of cleaning.

[0080] In the automatic water faucet 1010 according to the second embodiment, the rising portion 1030c is formed to rise along the inner wall 1014f of the spout pipe main body 1014a, and thus the inner wall 1014f of the spout pipe main body 1014a is covered by the rising portion 1030c. Therefore, the inner wall 1014f of the spout pipe main body 1014a is not exposed, and thus the appearance can be improved even without subjecting the inner wall 1014f to any special surface treatment. Since the inner wall 1014f does not need to be subjected to any special surface treatment, an increase in the manufacturing cost can be suppressed. In addition, since the corner between the planar portion 1030a and the inner wall 1014f of the spout pipe main body 1014a is covered by the rising portion 1030c, dirt does not sneak thereinto, which leads to the ease of cleaning.

[0081] Furthermore, in the automatic water faucet 1010 according to the second embodiment, since the rising portion 1030c is connected to the planar portion 1030a via the continuous curved surface 1030e, even if water flows onto the planar portion 1030a from the leading end 1014e of the spout pipe main body 1014a, the water is drained easily from the planar portion 1030a. In addition, the portion that joins the planar portion 1030a

and the rising portion 1030c is less likely to be stained, which thus can improve the ease of cleaning.

[0082] In the second embodiment described above, the planar portion 1030a is disposed at a position more inward than the leading end 1014e of the spout pipe main body 1014a in the direction of the pipe axis. However, the position of the planar portion 1030a is not limited thereto, and the planar portion 1030a may, for example, be flush with the leading end 1014e of the spout pipe main body 1014a or may project from the leading end 1014e.

[0083] The shape of the spout portion is not limited to that of the spout pipe having a gooseneck shape as described above, and the spout portion may be formed into any well-known shape, as in a linear spout pipe or a box-shaped spout pipe. In addition, the spout portion need not be a member constituted by a single piece and may be constituted by a combination of a plurality of members.

[0084] The automatic water faucet according to the second embodiment described above may be used in facilities installed in buildings, ships, and the like and may be used in washing basins, hand washers, bathrooms, and so on, aside from kitchens. In addition, an automatic water faucet provided with a proximity sensor has been illustrated in the second embodiment described above, but the proximity sensor is not an essential constituent element.

Third Embodiment

[0085] Conventionally, a water faucet provided with a spout port member that can be pulled out from a spout pipe along with a water supply hose is known (see, for example, patent document 3). According to such a water faucet, water can be supplied throughout a sink, which makes it easier to clean the sink.

[0086] In such a water faucet in which a spout port member can be pulled out from a spout pipe as described above, it is desirable that the spout port member can be housed into the spout pipe with ease.

[0087] A third embodiment provides a technique by which ease of housing a spout port member into a spout portion can be increased in a water faucet provided with a spout port member that can be pulled out from a spout portion along with a water supply hose.

[0088] An overview of the third embodiment will be given. A water faucet according to an aspect of the present invention includes a spout portion; a water supply hose disposed inside the spout portion; and a spout port member connected to the water supply hose, the spout port member being provided such that the spout port member can be pulled out from the spout portion along with the water supply hose. When the spout port member is housed into the spout portion, a portion of a side surface of the spout port member can abut against a portion of a side surface of the spout portion. One of an abutment portion of the spout port member and an abutment portion of the spout portion is formed into a convex shape, and

the other one of the abutment portions is formed into a concave shape corresponding to the convex shape.

[0089] According to this aspect, when the spout port member that has been pulled out is housed into the spout portion, the abutment portion of the spout port member and the abutment portion of the spout portion move along the corresponding concave and convex shapes, and thus the spout port member is guided to a predetermined posture suitable for housing. This configuration facilitates the operation of housing the spout port member into the spout portion.

[0090] The convex shape or the concave shape formed at the abutment portion of the spout port member may extend along a lengthwise direction of the water supply hose, and the convex shape or the concave shape formed at the abutment portion of the spout portion may extend along an axial direction of the spout portion. In this case, the ease of guiding the spout port member improves, which further facilitates the operation of housing the spout port member into the spout portion.

[0091] In a state in which the spout port member is housed in the spout portion, the spout port member may be located behind the spout portion relative to the user. In this case, the spout port member is hidden behind the spout portion, and thus the spout port member is less visible, which can improve the appearance of the water faucet.

[0092] The configurations described above can enhance the ease of housing the spout port member into the spout portion in the water faucet provided with the spout port member that can be pulled out from the spout portion along with the water supply hose.

[0093] Fig. 10 is a perspective view illustrating a portion of a kitchen 2100 provided with an automatic water faucet 2010 according to the third embodiment of the present invention. A sink 2102 that is recessed in a concave shape is provided in the kitchen 2100. The automatic water faucet 2010 according to the third embodiment, a purified water faucet 2106 for supplying purified water, and a storage portion 2108 for storing various items such as a dishwashing detergent and a sponge are provided in a counter 2104 behind the sink 2102. When the terms indicating directions, such as "upper," "underneath," "front," "back," "left," "right," "inner," and "outer" are used in the present specification, these terms indicate directions relative to the posture of the automatic water faucet 2010 mounted to the kitchen or the like.

[0094] Fig. 11 is a perspective view of the automatic water faucet 2010 according to the third embodiment of the present invention. As illustrated in Fig. 11, the automatic water faucet 2010 includes a water faucet main body 2012 erected on the counter and a spout pipe 2014, which serves as a spout portion, that extends from the upper end surface of the water faucet main body 2012. A spout port member 2020 having a spout port 2018 is provided at a leading end side of the spout pipe 2014 in the direction of the pipe axis.

[0095] The water faucet main body 2012 includes a

mixing valve (not illustrated) provided thereinside and a lever handle 2016 for operating the mixing valve. The mixing valve mixes cold water and hot water at a predetermined ratio to produce warm water of an appropriate temperature. The horizontal pivot operation of the lever handle 2016 adjusts the mixture ratio of cold water and hot water, or in other words, adjusts the temperature of the mixed water, and the vertical pivot operation thereof adjusts the flow rate of the discharged warm water.

[0096] The spout pipe 2014 includes a spout pipe main body 2014a formed into a so-called gooseneck shape having an inverted U-shape and a stretched-out portion 2014b that stretches out toward the back side (the side opposite to the user) from the intermediate portion to the leading end portion of the spout pipe main body 2014a. The spout pipe main body 2014a and the stretched-out portion 2014b are formed integrally by a casting of a metal material serving as a raw material. The spout pipe main body 2014a has a shape that extends downward toward a leading end 2014e from the portion of a maximum height, and the opening in the leading end 2014e faces downward.

[0097] A flexible water supply hose (not illustrated) is disposed inside the spout pipe 2014. One end of the water supply hose is connected to the spout port member 2020. The spout port member 2020 can be pulled out from the spout pipe 2014 along with the water supply hose. In a state in which the spout port member 2020 is housed in the spout pipe 2014, the spout port 2018 of the spout port member 2020 faces downward.

[0098] The other end of the water supply hose is connected to a solenoid valve (not illustrated). This solenoid valve is provided underneath the counter and controls the discharge and shutoff of the water through the spout port 2018. The solenoid valve is controlled by a control unit (not illustrated) constituted by a circuit board having a microcomputer mounted thereon. This control unit may be implemented through a combination of devices such as a CPU and a memory of a computer and a circuit.

[0099] A proximity sensor 2022, which serves as a first human body detection sensor, is provided on the front surface (the side toward the user) of the spout pipe 2014. The proximity sensor 2022 may be an infrared sensor having a light emitting portion and a light receiving portion, for example. The proximity sensor 2022 receives, with the light receiving portion, reflected light of the light projected by the light emitting portion from a detection target and thus determines whether a detection target such as a hand of a person is present within a predetermined detection area. The proximity sensor 2022 is provided such that a sensor window 2022a faces obliquely upward.

[0100] The proximity sensor 2022 detects the hand upon the user placing his/her hand over the sensor window. When a body part is detected by the proximity sensor 2022, the control unit opens the solenoid valve, and water is discharged through the spout port 2018 of the spout port member 2020. Once a body part is detected by the

proximity sensor 2022, the water continues to be discharged even after the body part becomes no longer detected. Thereafter, when the proximity sensor 2022 detects a body part again as the user places his/her hand over the proximity sensor 2022 again, the control unit closes the solenoid valve, and the water stops being discharged through the spout port 2018 of the spout port member 2020. The presence of such a proximity sensor 2022 makes it possible to control the discharge and shut-off of the water without operating the lever handle 2016, and thus the lever handle 2016 is prevented from being stained even when the hands are not clean, for example.

[0101] Fig. 12 is an enlarged view of the vicinity of a leading end portion of the spout pipe 2014 as viewed from below, illustrating a state in which the spout port member 2020 is housed in the spout pipe 2014. In addition, Fig. 13 illustrates the automatic water faucet 2010 as viewed from the back side, illustrating a state in which the spout port member 2020 is being pulled out from the spout pipe 2014 along with a water supply hose 2028.

[0102] The spout port member 2020 is provided at the leading end portion of the spout pipe 2014 on the side away from the user, and an automatic sensor 2024, which serves as a second human body detection sensor, is provided on the side closer to the user. The automatic sensor 2024 is provided inside a leading end portion 2014c of the spout pipe main body 2014a. The spout port member 2020 is provided at a leading end portion 2014d of the stretched-out portion 2014b such that the spout port member 2020 can be pulled out along with the water supply hose 2028. The leading end portion 2014d of the stretched-out portion 2014b does not extend to the leading end portion 2014c of the spout pipe main body 2014a and has a shape in which the leading end portion of the spout pipe 2014 is partially cut out. The sectional shape of the leading end portion 2014c of the spout pipe main body 2014a along a plane perpendicular to the direction of the pipe axis is a circular arc shape with a central angle of approximately 270 degrees.

[0103] The automatic sensor 2024 may be an infrared sensor having a light emitting portion and a light receiving portion, for example. The automatic sensor 2024 receives, with the light receiving portion, reflected light of the light projected by the light emitting portion from a detection target and thus determines whether a detection target such as a hand of a person is present within a predetermined detection area. The automatic sensor 2024 is provided such that a sensor window 2024a faces downward.

[0104] The automatic sensor 2024 detects the hand upon the user placing his/her hand underneath the spout port 2018. When a body part is detected by the automatic sensor 2024, the control unit opens the solenoid valve, and water is discharged automatically through the spout port 2018 of the spout port member 2020. Thereafter, when the user pulls back the hand out of the detection area of the automatic sensor 2024, the automatic sensor 2024 no longer detects a body part. Thus, the control unit

closes the solenoid valve, and the water stops being discharged through the spout port 2018 of the spout port member 2020. The presence of such an automatic sensor 2024 makes it possible to discharge water only for the duration in which a detection target is being detected by the automatic sensor 2024, and thus water consumption can be reduced.

[0105] A switch 2026 for switching between ON and OFF of the automatic sensor 2024 is provided on the front surface (the side toward the user) of the spout pipe 2014. The automatic water discharge and water shutoff as described above is carried out only when the automatic sensor 2024 is ON.

[0106] The spout port member 2020 includes a water guiding member (not illustrated) for guiding water from the water supply hose 2028 to the spout port 2018, a cover member 2040 made of resin for covering the leading end portion of the water supply hose 2028 and the water guiding member from the outside, and a switch operation member 2042 that switches the water discharged through the spout port 2018 from the straight water discharge to the shower water discharge or vice versa.

[0107] A guide member 2044 is provided inside the spout pipe main body 2014a and the stretched-out portion 2014b. Fig. 14 is a perspective view illustrating the guide member 2044. The guide member 2044 is an integrally molded member made of resin and includes a hose guide portion 2044a for guiding the water supply hose 2028, a sensor holding portion 2044b for holding the automatic sensor 2024, a wire guide portion 2044c for guiding a wire connecting the automatic sensor 2024 to the control unit, and a spout port member guide portion 2044d for guiding the spout port member 2020. As illustrated in Fig. 13, in a state in which the guide member 2044 is mounted inside the spout pipe main body 2014a and the stretched-out portion 2014b, the hose guide portion 2044a projects from the leading end portion 2014d of the stretched-out portion 2014b. In addition, the spout port member guide portion 2044d covers the opening of the cut-out portion of the spout pipe main body 2014a and constitutes a portion of the spout pipe 2014 together with the spout pipe main body 2014a and the stretched-out portion 2014b.

[0108] The cover member 2040 has a recess portion 2040a formed therein to fit with the hose guide portion 2044a. When the spout port member 2020 is housed into the spout pipe 2014, this recess portion 2040a fits with the hose guide portion 2044a, and thus the spout port member 2020 is held by the spout pipe 2014.

[0109] In a state in which the spout port member 2020 is housed in the spout pipe 2014, a guided portion 2040b, which is a portion of a side surface of the spout port member 2020, opposes the spout port member guide portion 2044d, which is a portion of a side surface of the spout pipe 2014. Here, the side surface of the spout port member 2020 is an outer peripheral surface that extends along substantially the lengthwise direction of the water supply

hose 2028 (that is, the direction in which the spout port member 2020 is pulled out). In addition, the side surface of the spout pipe 2014 is an outer peripheral surface that extends along the direction of the pipe axis. When the spout port member 2020 is housed in the spout pipe 2014, the spout port member 2020 is located behind a leading end portion 2014c of the spout pipe main body 2014a with respect to the user. In other words, in a state in which the spout port member 2020 is housed in the spout pipe 2014, the guided portion 2040b of the cover member 2040 of the spout port member 2020 is located on a side toward the user.

[0110] Fig. 15 is an enlarged view of the vicinity of the leading end portion of the spout pipe 2014 as viewed from below, illustrating a state in which the spout port member 2020 is being pulled out from the spout pipe 2014. As illustrated in Fig. 15, the guided portion 2040b of the spout port member 2020 is formed into a convex shape. The convex shape of the guided portion 2040b extends along the lengthwise direction of the water supply hose 2028. Meanwhile, the spout port member guide portion 2044d of the spout pipe 2014 is formed into a concave shape corresponding to the convex shape of the guided portion 2040b of the spout port member 2020. The concave shape of the spout port member guide portion 2044d extends along the direction of the pipe axis of the spout pipe main body 2014a.

[0111] As illustrated in Fig. 15, a projection portion 2044e is formed on the hose guide portion 2044a of the spout pipe 2014. Meanwhile, a groove portion (not illustrated) that engages with the projection portion 2044e is formed in the recess portion 2040a of the spout port member 2020. The spout port member 2020 is not held by the spout pipe 2014 unless the spout port member 2020 is in a predetermined posture in which the projection portion 2044e engages with the groove portion (that is, a posture in which the guided portion 2040b of the spout port member 2020 faces toward the user).

[0112] In the automatic water faucet 2010 formed as described above, when the spout port member 2020 that has been pulled out is housed into the spout pipe 2014, the guided portion 2040b of the spout port member 2020 and the spout port member guide portion 2044d of the spout pipe 2014 abut against each other and move along the corresponding concave and convex shapes, and thus the spout port member 2020 is guided to a predetermined posture suitable for housing. This configuration facilitates the operation of fitting the hose guide portion 2044a of the spout pipe 2014 to the recess portion 2040a of the spout port member 2020, and thus the ease of housing the spout port member 2020 into the spout pipe 2014 can be enhanced. In addition, the guided portion 2040b of the spout port member 2020 and the spout port member guide portion 2044d of the spout pipe 2014 are curved along the shape of the spout pipe in the direction of the pipe axis, and thus moving the spout port member along the shape of the spout pipe naturally brings the spout port member to the predetermined posture suitable for

housing.

[0113] In particular, in the third embodiment, in a state in which the spout port member 2020 is housed in the spout pipe 2014, the spout port member 2020 is located behind the leading end portion 2014c of the spout pipe main body 2014a with respect to the user. If the guided portion 2040b of the spout port member 2020 and the spout port member guide portion 2044d of the spout pipe 2014 are not formed into the corresponding concave and convex shapes, the posture of the spout port member 2020 becomes less visible as the spout port member 2020 is hidden behind the spout pipe main body 2014a, and thus it may become difficult to house the spout port member 2020 into the spout pipe 2014. In this respect, in the automatic water faucet 2010 according to the third embodiment, the spout port member 2020 is guided to the predetermined posture suitable for housing due to the concave and convex shapes of the guided portion 2040b and the spout port member guide portion 2044d, and thus even in a case in which it is difficult to visually observe the accurate posture of the spout port member 2020, the spout port member 2020 can be housed into the spout pipe 2014 with ease.

[0114] In addition, in the third embodiment, the guided portion 2040b of the spout port member 2020 extends along the lengthwise direction of the water supply hose 2028, and the spout port member guide portion 2044d of the spout pipe 2014 extends along the direction of the pipe axis of the spout pipe main body 2014a. In this case, the guided portion 2040b can be slid along the spout port member guide portion 2044d, and thus the ease of guiding the spout port member 2020 can be improved, and in turn the ease of housing the spout port member 2020 into the spout pipe 2014 can be further enhanced.

[0115] In addition, in the third embodiment, in a state in which the spout port member 2020 is housed in the spout pipe 2014, the guided portion 2040b of the spout port member 2020 and the spout port member guide portion 2044d of the spout pipe 2014 have the concave and convex shapes that correspond to and follow along each other, and thus rattling in the housed state can be prevented, and a gap between the spout port member 2020 and the spout pipe 2014 is less noticeable when seen from the side.

[0116] Furthermore, according to the third embodiment, the spout pipe main body 2014a can be disposed on the side closer to the user, and the spout port member 2020 can be disposed on the side away from the user without sacrificing the ease of housing, and thus the degree of freedom in the design of the automatic water faucet can be improved. For example, the automatic sensor 2024 can be disposed on the front side of the spout port member 2020 with respect to the user, as in the automatic water faucet 2010 according to the third embodiment. Disposing the automatic sensor 2024 on the side toward the user is advantageous in that the detection sensitivity of a detection target can be increased. Furthermore, when the spout pipe main body 2014a is dis-

posed on the side closer to the user and the spout port member 2020 is disposed on the side away from the user as in the third embodiment, the spout port member 2020 is hidden behind the spout pipe main body 2014a when the automatic water faucet 2010 is viewed from the front, which makes the spout port member 2020 less visible, and the appearance of the automatic water faucet 2010 can advantageously be improved.

[0117] In the third embodiment described above, the guided portion 2040b, which is the abutment portion of the spout port member 2020, has a convex shape, and the spout port member guide portion 2044d, which is the abutment portion of the spout pipe 2014, has a concave shape, but these shapes may be reversed. In other words, the spout port member guide portion 2044d, which is the abutment portion of the spout pipe 2014, may have a convex shape, and the guided portion 2040b, which is the abutment portion of the spout port member 2020, may have a concave shape. In this case as well, the ease of housing the spout port member 2020 into the spout pipe 2014 can be enhanced.

[0118] In the third embodiment described above, an automatic water faucet has been illustrated as the water faucet, but the type of the water faucet is not limited to an automatic water faucet, and any type of water faucet in which the spout port member 2020 can be pulled out from the spout pipe 2014 along with the water supply hose 2028 may be employed.

[0119] In the third embodiment described above, the automatic sensor 2024 is provided inside the leading end portion 2014c of the spout pipe main body 2014a, but another member may be provided therein. For example, a member that discharges foam soap may be provided inside the leading end portion 2014c of the spout pipe main body 2014a.

[0120] The shape of the spout portion is not limited to that of the spout pipe having a gooseneck shape as described above, and the spout portion may be formed into any well-known shape, as in a linear spout pipe or a box-shaped spout pipe.

[0121] The water faucet according to the third embodiment described above may be used in facilities installed in buildings, ships, and the like and may be used in washing basins, hand washers, bathrooms, and so on, aside from kitchens.

Fourth Embodiment

[0122] Conventionally, a water faucet provided with a spout port member that can be pulled out from a spout portion along with a water supply hose is known (see, for example, patent document 3). According to such a water faucet, water can be supplied throughout a sink, which makes it easier to clean the sink.

[0123] When the user is to pull out the spout port member from the water faucet, water or suds are often on the user's hands. Therefore, the user may have difficulty in grasping and pulling out the spout port member.

[0124] A fourth embodiment provides a technique that makes it easier to grasp a spout port member in a water faucet in which the spout port member can be pulled out from the leading end of a spout portion.

[0125] An overview of the fourth embodiment will be given. An aspect of the present invention provides a water faucet that includes a spout portion; and a spout port member having a spout port, the spout port member being housed at a leading end of the spout portion such that the spout port member can be freely pulled out. The spout port member includes a finger hooking portion on which a grasping unit is hooked in a pulling direction thereof when the spout port member is to be grasped. The grasping unit may, for example, be fingers of a user.

[0126] According to this aspect, the grasping unit is naturally guided to the finger hooking portion when the user is to pull out the spout port member. In addition, even when water or suds are on the hands and the hands are slippery, the spout port member is easy to grasp, which facilitates the operation of pulling the spout port member.

[0127] The finger hooking portion may have a shape in which a portion between a large diameter portion, which is a leading end side of the spout port member, and a small diameter portion, which is an inward side in the pulling direction, is tapered or recessed. This configuration makes the grasping unit fit well on the tapered or recessed portion and enables the grasping unit to be naturally hooked on the finger hooking portion.

[0128] The spout port member may be located behind the spout portion as viewed from the user in the housed state. With this configuration, although the spout port member is less visible when the spout port member in the housed state is behind the spout portion as viewed from the user, the presence of the finger hooking portion does not hinder the pulling operation even if the spout port member is not easily visible.

[0129] The spout portion includes a stretched-out portion that expands from the spout pipe from an intermediate portion to the leading end of the spout pipe, and a curved line that defines a boundary between the spout portion and the stretched-out portion and a curved line that defines a step of the finger hooking portion may be smoothly continuous with each other. With this configuration, as the grasping unit touches the boundary between the spout portion and the stretched-out portion, the grasping unit can be naturally guided to the finger hooking portion.

[0130] The configurations described above makes it easier to grasp the spout port member becomes in the water faucet in which the spout port member can be pulled out from the leading end of the spout portion.

[0131] Fig. 16 is a schematic diagram of a kitchen provided with a water faucet 3010 according to the fourth embodiment of the present invention. A kitchen 3100 is provided with a sink 3102, and a counter 3104 having a step with respect to a top surface is provided on a back side of the sink 3102. The water faucet 3010 is installed

on the left side in the counter 3104, and a purified water faucet 3106 is installed on the right side in the counter 3104. The water faucet 3010 is connected to a water service pipe and supplies regular tap water, whereas the purified water faucet 3106 is connected to a water purifying device installed underneath the sink 3102 and supplies purified water.

[0132] Hereinafter, when the terms indicating directions, such as "upper," "underneath," "front," "back," "left," "right," "inner," "outer," "closer," and "behind," are used in the present specification, these terms indicate directions relative to the posture of the water faucet 3010 mounted to the kitchen or the like.

[0133] Fig. 17 is an overall perspective view of the water faucet 3010 illustrated in Fig. 16. The water faucet 3010 primarily includes a base end portion 3024, a handle lever 3022, and a spout pipe 3012, which serves as a spout portion, that extends from the upper end surface of the base end portion 3024. Fig. 18 is a side view of the spout pipe 3012 that is being detached from the base end portion 3024.

[0134] The spout pipe 3012 is formed into a so-called gooseneck shape in which an intermediate portion 3012a is curved into an inverted U-shape and a leading end 3012b extends obliquely downward. The spout pipe 3012 is formed by a casting of a metal material serving as a raw material. Although details will be given later, a spout port member 3030 having a spout port 3038 and an automatic water discharge sensor 3040 for controlling the water discharged through the spout port 3038 are provided at the leading end 3012b of the spout pipe 3012. As illustrated in Fig. 18, a coupling member 3026 to be coupled to the base end portion 3024 is provided in the spout pipe 3012 at a side toward the base end portion.

[0135] As illustrated in Fig. 16, the base end portion 3024 is disposed on the upper surface of the counter 3104 in the kitchen. The handle lever 3022 is provided on the upper end of the base end portion 3024.

[0136] A cold water pipe and a hot water pipe (not illustrated) connected to supply sources of cold water and hot water, respectively, extend inside the base end portion 3024. A solenoid valve (not illustrated) is provided between the cold water pipe and hot water pipe and a water supply hose for supplying water to the spout port 3038 housed in the spout pipe 3012. This solenoid valve can open or close the valve under the control of a control unit, which is not illustrated, to control the flow of water from the cold water pipe and the hot water pipe to the water supply hose.

[0137] A mixing valve (not illustrated) that mixes cold water and hot water at a predetermined ratio to produce warm water of an appropriate temperature is provided inside the base end portion 3024. The handle lever 3022 is a lever for operating this mixing valve, and the horizontal pivot operation thereof adjusts the mixture ratio of cold water and hot water, or in other words, adjusts the temperature of the mixed water, whereas the vertical pivot operation thereof adjusts the flow rate of the dis-

charged warm water.

[0138] The automatic water discharge sensor 3040 is provided at the leading end 3012b of the spout pipe 3012. The automatic water discharge sensor 3040, for example, is an infrared range finding sensor having a light emitting portion and a light receiving portion. The automatic water discharge sensor 3040 projects light from the light emitting portion toward a space underneath the spout port 3038 of the spout port member 3030, receives, with the light receiving portion, reflected light of the projected light from a detection target, such as a hand of the user or tableware, and determines whether there is a detection target within a predetermined detection area. The automatic water discharge sensor 3040 outputs a signal indicating the detection result of the detection target to the control unit.

[0139] A proximity sensor 3014 is provided on the front side of the spout pipe 3012, or in other words, on the side that faces the user standing in the kitchen. The proximity sensor 3014 is an infrared light quantity sensor having a light emitting portion and a light receiving portion. The proximity sensor 3014 projects light obliquely upward, receives, with the light receiving portion, reflected light of the projected light from a detection target, such as a hand of the user, and determines whether there is a detection target within a predetermined detection area. The proximity sensor 3014 outputs a signal indicating the detection result of the detection target to the control unit.

[0140] The control unit is constituted by a circuit board having a microcomputer mounted thereon. The control unit opens or closes the solenoid valve on the basis of an output signal from the automatic water discharge sensor 3040 or the proximity sensor 3014 and makes a switch as to whether water is supplied through the spout port 3038 of the spout port member 3030. The control unit may be implemented through a combination of devices such as a CPU and a memory of a computer and a circuit.

[0141] It is to be noted that water is controlled to be supplied through the spout port 3038 only for the duration in which a detection target is being detected by the automatic water discharge sensor 3040 within the detection area, whereas water continues to be supplied through the spout port 3038 even after a detection target that has once been detected by the proximity sensor 3014 within the detection area becomes no longer detected. When a detection target is detected again within the detection area, the water supply through the spout port 38 is shut off.

[0142] An on/off switch 3016 of a push button type is provided on the spout pipe 3012 on the side closer to the user and underneath the proximity sensor 3014 (toward the leading end 3012b of the spout pipe 3012). While the on/off switch 3016 is set to OFF, the automatic water discharge sensor 3040 is inactive, and water is not supplied through the spout port 3038 even if an object is present underneath the sensor 3040.

[0143] As can be seen from Fig. 18, the spout pipe

3012 is formed to have a constant curvature in the fourth embodiment. Furthermore, a hollow stretched-out portion 3018 that expands toward the lower side of the spout pipe 3012 is formed from a portion near the top of the intermediate portion 3012a of the spout pipe 3012 to the leading end 3012b of the spout pipe. The lower surface of this stretched-out portion 3018 is formed to produce a continuous smooth curve extending from the side of the base end portion 3024 of the spout pipe 3012 and having a curvature smaller than the curvature of the spout pipe 3012. A leading end 3018a of the stretched-out portion 3018 is located on the further back in the axial direction of the spout pipe (the upstream side of the spout pipe 3012, the upper right side in Fig. 18) than is the leading end 3012b of the spout pipe 3012. Methods of forming such a spout pipe include a bulge process, zinc die casting, and resin molding.

[0144] The spout port member 3030, which can be freely pulled out, is attached behind the automatic water discharge sensor 3040 in the spout pipe 3012 as viewed from the user. As can be seen from Fig. 18, the spout port member 3030 is attached to the leading end of the stretched-out portion 3018 and behind the leading end 3012b of the spout pipe 3012 as viewed from the user. In a state in which the spout port member 3030 is being attached, the inner peripheral side of the curve of the spout port member 3030 is formed to produce a continuous smooth curve with the inner peripheral sides of the base end portion 3024 and the stretched-out portion 3018 of the spout pipe 3012.

[0145] Fig. 19 is an enlarged perspective view of the vicinity of the leading end 3012b of the spout pipe 3012, and Fig. 20 illustrates a state in which the spout port member 3030 is being pulled out.

[0146] The spout port member 3030 includes a cover portion 3032, a switch operation portion 3034, and the spout port 3038.

[0147] As illustrated in Fig. 20, a flexible metal water supply hose 3050 is connected to the spout port member 3030. The other end of the water supply hose 3050 is connected to the solenoid valve described above. The water supply hose 3050 is housed such that the water supply hose 3050 can move by a predetermined length in the direction of the pipe axis inside the spout pipe 3012 and the stretched-out portion 3018. Thus, when the spout port member 3030 is pulled out from the spout pipe 3012, the water supply hose 3050 is also pulled out along therewith. The direction in which the spout port member 3030 is pulled out substantially coincides with the axial direction of the spout pipe 3012. When the spout port member 3030 is attached to the spout pipe 3012, the water supply hose 3050 moves toward the base end portion 3024 inside the stretched-out portion 3018 and the spout pipe 3012. The water that flows inside the water supply hose 3050 is discharged through the spout port 3038.

[0148] The cover portion 3032 connects the water supply hose 3050 to the switch operation portion 3034 and also constitutes a portion that the user holds when re-

moving the spout port member 3030 from the spout pipe 3012. In addition, the cover portion 3032 serves as an attachment that enables the spout port member 3030 to be easily attached to or detached from the spout pipe 3012.

[0149] An end surface 3042 that is recessed toward the inside of the pipe is formed at the leading end 3012b of the spout pipe 3012, and the automatic water discharge sensor 3040 is disposed to be flush with this end surface 3042. A pipe wall 3012c of the spout pipe 3012 allows the surrounding of the automatic water discharge sensor 3040 to be located inward, which thus can prevent a hand of the user from making contact with the sensor 3040 to contaminate the light emitting surface and the light receiving surface of the sensor or prevent tableware from hitting the sensor to cause damage thereto.

[0150] At the leading end 3012b of the spout pipe 3012, the pipe wall 3012c is partially cut out, and a concave guide portion 3044, which functions as a guide when the spout port member 3030 is housed, is provided at the cut-out portion. A convex portion 3039, which opposes the guide portion 3044 when the spout port member 3030 is housed, is formed on the upper surface (the front surface as viewed from the user) of the cover portion 3032 of the spout port member 3030.

[0151] A cylindrical hose guide portion 3052 having a hole into which the water supply hose 3050 is inserted is provided at the leading end 3018a of the stretched-out portion 3018. Although not illustrated, a recess portion that receives the hose guide portion 3052 is formed at the trailing end of the spout port member 3030 that faces the stretched-out portion 3018.

[0152] When the spout port member 3030 is housed, the water supply hose 3050 is pushed into the hole in the hose guide portion 3052, and thus the trailing end of the spout port member 3030 is guided to the hose guide portion 3052. As the spout port member 3030 continues to be pushed thereinto, the convex portion 3039 formed on the upper surface of the spout port member 3030 is guided by the guide portion 3044 of the spout pipe 3012, and the spout port member 3030 fits the hose guide portion 3052. Thus, the spout port member 3030 is held by the spout pipe 3012. When the spout port member 3030 is pulled out, the spout port member 3030 is pulled obliquely downward, and thus the convex portion 3039 is guided by the guide portion and pulled out therefrom.

[0153] As described above, the lower surfaces of the stretched-out portion 3018 and the spout pipe 3012 are smoothly continuous with each other, and a corner or a large change in the curvature is not present inside the pipe. This configuration can prevent the water supply hose 3050 connected to the spout port member 3030 from being caught inside the spout pipe 3012 and the stretched-out portion 3018 when the spout port member 3030 is pulled out or housed, which thus facilitates the operation of the spout port member 3030. In addition, the absence of any bent portion makes it easier to clean the outer surfaces of the spout pipe 3012 and the stretched-

out portion 3018.

[0154] The leading end 3018a of the stretched-out portion 3018, with which the trailing end of the spout port member 3030 in a housed state makes contact, is located further back in the axial direction of the spout pipe (the upstream side of the spout pipe 3012) than is the leading end 3012b of the spout pipe 3012. Thus, in a state in which the spout port member 3030 is housed, the spout port 3038 of the spout port member 3030 is located relatively close to the automatic water discharge sensor 3040. In this manner, the structure in which the spout port member 3030 is pulled out from a side that is behind the automatic water discharge sensor 3040 in the axial direction of the spout pipe in the direction of the pipe axis, or in other words, from the back side of the sensor 3040 makes it possible to reduce the amount by which the spout port member projects downward with respect to the light emitting portion of the sensor 3040 and to reduce the distance between the light emitting portion of the sensor and the spout port. Thus, the sensor becomes responsive when a hand is placed underneath the spout port, and the usability improves. In addition, the reduction in the amount by which the spout port member projects downward makes it possible to secure a broad space underneath the spout port.

[0155] The switch operation portion 3034 of the spout port member 3030 is member for switching the water flowing from the water supply hose 3050 to the shower water discharge or the straight water discharge. The switch operation portion 3034 has a shape that is smoothly continuous with the lower side of the outer periphery of the cover portion 3032 and forms a cylindrical shape as a whole. The switch operation portion 3034 is configured to rotate by a predetermined angle (for example, 90 degrees) about the center axis relative to the cover portion 3032. A tab portion 3036 for the user to hook his/her finger thereon is formed on the cylindrical surface of the switch operation portion 3034. The user can switch between the shower water discharge and the straight water discharge by rotating the position of the tab portion 3036 by a predetermined angle.

[0156] Fig. 21 is an enlarged perspective view of the leading end of the spout pipe as viewed from a direction different from that of Fig. 19. Fig. 22 illustrates the back side (rear side) of the spout port member as viewed from the user.

[0157] A finger hooking portion 3032a for making it easier for the user to grasp the spout port member 3030 is provided on the cover portion 3032 of the spout port member 3030. This finger hooking portion 3032a may be a smooth step that increases in width in the lateral direction (the widthwise direction of the sink) in Fig. 22, for example. To be more specific, the finger hooking portion 3032a has a shape in which a portion between a large diameter portion, which is the leading end side of the spout port member 3030, and a small diameter portion, which is the inward side in the pulling direction, is tapered or recessed. The finger hooking portion 3032a is formed

on the lower side of the cover portion 3032 of the spout port member 3030 so that the fingers are naturally hooked thereon in the pulling direction when the user is to pull out the spout port member 3030. In addition, it is preferable that the finger hooking portion 3032a be formed into a semicircular, smoothly curved surface facing downward so that the fingertips fit well thereon. The presence of such a finger hooking portion 3032a makes it easier to grasp the spout port member even when water or suds are on the hands of the user and the hands are slippery, which facilitates the operation of pulling out the spout port member 3030.

[0158] As described above, the spout port member 3030 is located behind the spout pipe 3012 as viewed from the user in the housed state. In the case of such a configuration, the spout port member is less visible from the user standing in front of the water faucet. However, as the finger hooking portion 3032a is provided in the lateral direction (the widthwise direction of the sink) of the spout port member 3030, the fingers are hooked on the finger hooking portion 3032a as the user moves his/her fingers along the pulling direction, and thus the pulling operation is not hindered even if the spout port member 3030 is not easily visible. In addition, it is easy to grasp the spout port member 3030 from the rear side of the spout pipe.

[0159] As illustrated in Fig. 21, as the stretched-out portion 3018 expands in the depthwise direction from the spout pipe 3012, a curved line 3060 that defines the boundary between the spout pipe 3012 and the stretched-out portion 3018 is present on the side surface of the spout pipe 3012. In addition, when the finger hooking portion 3032a is formed into a step, a curved line 3062 that defines the step from the side surface of the cover portion 3032 is present. When the water faucet 3010 is observed from the side, the curved line 3060 and the curved line 3062 may be configured to be smoothly continuous with each other. With this configuration, the fingertips can be naturally guided to the finger hooking portion 3032a as the user moves his/her fingers downward after placing the fingers at the boundary portion between the spout pipe 3012 and the stretched-out portion 3018 when the user is to pull out the spout port member 3030. Thus, it becomes easier to pull out the spout port member 3030, for example, in a dark room or to operate the switch operation portion 3034 located underneath the finger hooking portion 3032a.

[0160] As described thus far, according to the fourth embodiment, as the finger hooking portion is provided in the direction in which the spout port member is pulled out, the user can naturally guide his/her fingers to the finger hooking portion when trying to pull out the spout port member. In addition, even when water or suds are on the hands and the hands are slippery, the spout port member is easier to grasp, which facilitates the pulling operation.

[0161] In addition, the spout pipe has the stretched-out portion that expands in the depthwise direction from the

intermediate portion to the leading end as viewed from the user, and the spout port member can be pulled out from this stretched-out portion. This configuration can achieve a structure in which the spout port member is housed at the leading end of the spout pipe without increasing the diameter of the spout pipe along the entire length thereof. In addition, irregularity on the spout pipe can be kept minimum, which thus leads to an aesthetically pleasing design and increased ease of cleaning. Furthermore, by providing the stretched-out portion toward the back side in the axial direction of the spout pipe, the stretched-out portion is less noticeable when the water faucet is seen from the front side as viewed from the user, which can give the user a generally compact and neat impression.

[0162] In the fourth embodiment, the spout port member is provided behind the automatic water discharge sensor (toward the counter) as viewed from the user. Alternatively, the stretched-out portion may be formed on the front side of the spout pipe (toward the sink), and the spout port member may be provided to the front of the automatic water discharge sensor.

[0163] In place of the shape in which only the leading end side of the spout pipe expands in the depthwise direction as viewed from the user as in the stretched-out portion described in the fourth embodiment, a shape in which the spout pipe expands in the depthwise direction throughout its length may be employed. In addition, without expanding the spout pipe, the spout port member may be pulled out from the leading end of the spout pipe.

[0164] The finger hooking portion may have a different shape such as a step-like shape or a shape including a groove or a projection for preventing slipping.

[0165] The water faucet according to the fourth embodiment can be used in facilities installed in buildings, ships, and the like and may be used in washing basins, hand washers, bathrooms, and so on, aside from kitchens. In addition, the counter has been illustrated as a base member to which the base end portion of the water faucet is fixed. Alternatively, the base member may be a wall member or the like that defines the inside and the outside of a facility such as a bathroom.

[0166] In addition, the shape of the spout portion is not limited to the spout pipe having a gooseneck shape, and the spout portion may be formed into any other shape such as a linear spout pipe or a box-shaped spout pipe.

Fifth Embodiment

[0167] An automatic water faucet provided with a spout pipe, a sensor disposed at the leading end of the spout pipe, and a spout port member is widely used in kitchens, washing basins, and the like. When an object to be detected, such as a hand or tableware, placed underneath the spout port member is detected by the sensor, the automatic water faucet is controlled to discharge water through a spout port in the spout port member (for example, patent document 1).

[0168] Among automatic water faucets, there is one provided with a switch operation portion that can switch the water discharged through the spout port between the straight water discharge and the shower water discharge (for example, patent document 4). The switch operation portion is provided with a tab portion that projects outward to make it easier for a user to hook his/her fingers thereon.

[0169] When the switch operation portion such as the one described in patent document 4 is provided in an automatic water faucet having a sensor for automatic water discharge, if the position of the sensor is not appropriate, the tab portion may be erroneously detected by the sensor.

[0170] A fifth embodiment provides a technique for preventing a false detection of a sensor in an automatic water faucet in which the sensor for starting water discharge is located closer to the user than is the spout port as viewed from the user.

[0171] An overview of the fifth embodiment will be given.

An aspect of the present invention provides an automatic water faucet that includes a spout portion; a sensor that detects the presence of a detection target; a spout port that discharges water upon the detection target being detected by the sensor; and a switch operation portion that can switch a water discharge state from the spout port. The sensor is located closer to a user than is the spout port as viewed from the user. The switch operation portion includes a convex portion that is moved to a switching position of a corresponding water discharge state, and the switch operation portion is located behind the spout port no matter at which position the convex portion is located.

[0172] According to this aspect, as the convex portion is disposed behind the spout port, even with the configuration in which the sensor is located to the front of the spout port as viewed from the user, the convex portion is not erroneously detected by the sensor. Therefore, the positions of the sensor and of the spout portion can be brought closer to each other, and the spout portion can be made compact. It is to be noted that "behind the spout port" may be behind the center of the spout port.

[0173] The switching positions may be arranged symmetrically with respect to the center axis. This configuration makes it easier to visually recognize at which switching position the convex portion is located when the spout portion is observed from the front.

[0174] A pictogram that indicates a corresponding water discharge state may be provided at a position corresponding to the switching position in front of the spout portion. With this configuration, the user can find the current water discharge state with ease by looking at the switching position of the convex portion along with the pictogram.

[0175] The upper portion of the convex portion may have a smooth tapered shape. With this configuration, the user can naturally guide his/her fingers to the convex portion when the user grasps the spout port member.

[0176] The configurations described above makes it possible to prevent a false detection of the in the automatic water faucet in which the sensor for starting water discharge is located closer to the user than is the spout port as viewed from the user.

[0177] Fig. 23 is a schematic diagram of a kitchen provided with an automatic water faucet 4010 according to the fifth embodiment of the present invention. A kitchen 4100 is provided with a sink 4102, and a counter 4104 having a step with respect to a top surface is provided on a back side of the sink 4102. The automatic water faucet 4010 is installed on the left side in the counter 4104, and a purified water faucet 4106 is installed on the right side in the counter 4104. The automatic water faucet 4010 is connected to a water service pipe and supplies regular tap water, whereas the purified water faucet 4106 is connected to a water purifying device installed underneath the sink 4102 and supplies purified water.

[0178] Hereinafter, when the terms indicating directions, such as "upper," "underneath," "front," "back," "left," "right," "inner," "outer," "closer," and "behind," are used in the present specification, these terms indicate directions relative to the posture of the automatic water faucet 4010 mounted to the kitchen or the like.

[0179] Fig. 24 is an overall perspective view of the automatic water faucet 4010 illustrated in Fig. 23. The automatic water faucet 4010 primarily includes a base end portion 4024, a handle lever 4022, and a spout pipe 4012, which serves as a spout portion, that extends from the upper end surface of the base end portion 4024. Fig. 25 is a side view of the spout pipe 4012 that is being detached from the base end portion 4024.

[0180] The spout pipe 4012 is formed into a so-called gooseneck shape in which an intermediate portion 4012a is curved into an inverted U-shape and a leading end 4012b extends obliquely downward. The spout pipe 4012 is formed by a casting of a metal material serving as a raw material. Although details will be given later, a spout port member 4030 having a spout port 4038 and an automatic water discharge sensor 4040 for controlling the water discharged through the spout port 4038 are provided at the leading end 4012b of the spout pipe 4012. As illustrated in Fig. 25, a coupling member 4026 to be coupled to the base end portion 4024 is provided in the spout pipe 4012 at a side toward the base end portion.

[0181] As illustrated in Fig. 23, the base end portion 4024 is disposed on the upper surface of the counter 4104 in the kitchen. The handle lever 4022 is provided on the upper end of the base end portion 4024.

[0182] A cold water pipe and a hot water pipe (not illustrated) connected to supply sources of cold water and hot water, respectively, extend inside the base end portion 4024. A solenoid valve (not illustrated) is provided between the cold water pipe and hot water pipe and a water supply hose for supplying water to the spout port 4038 housed in the spout pipe 4012. This solenoid valve can open or close the valve under the control of a control unit, which is not illustrated, to control the flow of water

from the cold water pipe and the hot water pipe to the water supply hose.

[0183] A mixing valve (not illustrated) that mixes cold water and hot water at a predetermined ratio to produce warm water of an appropriate temperature is provided inside the base end portion 4024. The handle lever 4022 is a lever for operating this mixing valve, and the horizontal pivot operation thereof adjusts the mixture ratio of cold water and hot water, or in other words, adjusts the temperature of the mixed water, whereas the vertical pivot operation thereof adjusts the flow rate of the discharged warm water.

[0184] The automatic water discharge sensor 4040 is provided at the leading end 4012b of the spout pipe 4012. The automatic water discharge sensor 4040, for example, is an infrared range finding sensor having a light emitting portion and a light receiving portion. The automatic water discharge sensor 4040 projects light from the light emitting portion toward a space underneath the spout port 4038 of the spout port member 4030, receives, with the light receiving portion, reflected light of the projected light from a detection target, such as a hand of the user or tableware, and determines whether there is a detection target within a predetermined detection area. The automatic water discharge sensor 4040 outputs a signal indicating the detection result of the detection target to the control unit.

[0185] A proximity sensor 4014 is provided on the front side of the spout pipe 4012, or in other words, on the side that faces the user standing in the kitchen. The proximity sensor 4014 is an infrared light quantity sensor having a light emitting portion and a light receiving portion. The proximity sensor 4014 projects light obliquely upward, receives, with the light receiving portion, reflected light of the projected light from a detection target, such as a hand of the user, and determines whether there is a detection target within a predetermined detection area. The proximity sensor 4014 outputs a signal indicating the detection result of the detection target to the control unit.

[0186] The control unit is constituted by a circuit board having a microcomputer mounted thereon. The control unit opens or closes the solenoid valve on the basis of an output signal from the automatic water discharge sensor 4040 or the proximity sensor 4014 and makes a switch as to whether water is supplied through the spout port 4038 of the spout port member 4030. The control unit may be implemented through a combination of devices such as a CPU and a memory of a computer and a circuit.

[0187] It is to be noted that water is controlled to be supplied through the spout port 4038 only for the duration in which a detection target is being detected by the automatic water discharge sensor 4040 within the detection area, whereas water continues to be supplied through the spout port 4038 even after a detection target that has once been detected by the proximity sensor 4014 within the detection area becomes no longer detected. When a detection target is detected again within the detection

area, the water supply through the spout port 4038 is shut off.

[0188] An on/off switch 4016 of a push button type is provided on the spout pipe 4012 on the side closer to the user and underneath the proximity sensor 4014 (toward the leading end 4012b of the spout pipe 4012). While the on/off switch 4016 is set to OFF, the automatic water discharge sensor 4040 is inactive, and water is not supplied through the spout port 4038 even if an object is present underneath the sensor 4040.

[0189] As can be seen from Fig. 25, the spout pipe 4012 is formed to have a constant curvature in the fifth embodiment. Furthermore, a hollow stretched-out portion 4018 that expands toward the lower side of the spout pipe 4012 is formed from a portion near the top of the intermediate portion 4012a of the spout pipe 4012 to the leading end 4012b of the spout pipe. The lower surface of this stretched-out portion 4018 is formed to produce a continuous smooth curve extending from the side of the base end portion 4024 of the spout pipe 4012 and having a curvature smaller than the curvature of the spout pipe 4012. A leading end 4018a of the stretched-out portion 4018 is located on the further back in the axial direction of the spout pipe (the upstream side of the spout pipe 4012, the upper right side in Fig. 25) than is the leading end 4012b of the spout pipe 4012. Methods of forming such a spout pipe include a bulge process, zinc die casting, and resin molding.

[0190] The spout port member 4030, which can be freely pulled out, is attached behind the automatic water discharge sensor 4040 in the spout pipe 4012 as viewed from the user. As can be seen from Fig. 25, the spout port member 4030 is attached to the leading end of the stretched-out portion 4018 and behind the leading end 4012b of the spout pipe 4012 as viewed from the user. In a state in which the spout port member 4030 is being attached, the inner peripheral side of the curve of the spout port member 4030 is formed to produce a continuous smooth curve with the inner peripheral sides of the base end portion 4024 and the stretched-out portion 4018 of the spout pipe 4012.

[0191] Fig. 26 is an enlarged perspective view of the vicinity of the leading end 4012b of the spout pipe 4012, and Fig. 27 illustrates a state in which the spout port member 4030 is being pulled out.

[0192] The spout port member 4030 includes a cover portion 4032, a switch operation portion 4034, and the spout port 4038.

[0193] As illustrated in Fig. 27, a flexible metal water supply hose 4050 is connected to the spout port member 4030. The other end of the water supply hose 4050 is connected to the solenoid valve described above. The water supply hose 4050 is housed such that the water supply hose 4050 can move by a predetermined length in the direction of the pipe axis inside the spout pipe 4012 and the stretched-out portion 4018. Thus, when the spout port member 4030 is pulled out from the spout pipe 4012, the water supply hose 4050 is also pulled out along there-

with. The direction in which the spout port member 4030 is pulled out substantially coincides with the axial direction of the spout pipe 4012. When the spout port member 4030 is attached to the spout pipe 4012, the water supply hose 4050 moves toward the base end portion 4024 inside the stretched-out portion 4018 and the spout pipe 4012. The water that flows inside the water supply hose 4050 is discharged through the spout port 4038.

[0194] The cover portion 4032 connects the water supply hose 4050 to the switch operation portion 4034 and also constitutes a portion that the user holds when removing the spout port member 4030 from the spout pipe 4012. In addition, the cover portion 4032 serves as an attachment that enables the spout port member 4030 to be easily attached to or detached from the spout pipe 4012.

[0195] An end surface 4042 that is recessed toward the inside of the pipe is formed at the leading end 4012b of the spout pipe 4012, and the automatic water discharge sensor 4040 is disposed to be flush with this end surface 4042. A pipe wall 4012c of the spout pipe 4012 allows the surrounding of the automatic water discharge sensor 4040 to be located inward, which thus can prevent a hand of the user from making contact with the sensor 4040 to contaminate the light emitting surface and the light receiving surface of the sensor or prevent tableware from hitting the sensor to cause damage thereto.

[0196] At the leading end 4012b of the spout pipe 4012, the pipe wall 4012c is partially cut out, and a concave guide portion 4044, which functions as a guide when the spout port member 4030 is housed, is provided at the cut-out portion. A convex portion 4039, which opposes the guide portion 4044 when the spout port member 4030 is housed, is formed on the upper surface (the front surface as viewed from the user) of the cover portion 4032 of the spout port member 4030.

[0197] A cylindrical hose guide portion 4052 having a hole into which the water supply hose 4050 is inserted is provided at the leading end 4018a of the stretched-out portion 4018. Although not illustrated, a recess portion that receives the hose guide portion 4052 is formed at the trailing end of the spout port member 4030 that faces the stretched-out portion 4018.

[0198] When the spout port member 4030 is housed, the water supply hose 4050 is pushed into the hole in the hose guide portion 4052, and thus the trailing end of the spout port member 4030 is guided to the hose guide portion 4052. As the spout port member 4030 continues to be pushed therinto, the convex portion 4039 formed on the upper surface of the spout port member 4030 is guided by the guide portion 4044 of the spout pipe 4012, and the spout port member 4030 fits the hose guide portion 4052. Thus, the spout port member 4030 is held by the spout pipe 4012. When the spout port member 4030 is pulled out, the spout port member 4030 is pulled obliquely downward, and thus the convex portion 4039 is guided by the guide portion and pulled out therefrom.

[0199] As described above, the lower surfaces of the

stretched-out portion 4018 and the spout pipe 4012 are smoothly continuous with each other, and a corner or a large change in the curvature is not present inside the pipe. This configuration can prevent the water supply hose 4050 connected to the spout port member 4030 from being caught inside the spout pipe 4012 and the stretched-out portion 4018 when the spout port member 4030 is pulled out or housed, which thus facilitates the operation of the spout port member 4030. In addition, the absence of any bent portion makes it easier to clean the outer surfaces of the spout pipe 4012 and the stretched-out portion 4018.

[0200] The leading end 4018a of the stretched-out portion 4018, with which the trailing end of the spout port member 4030 in a housed state makes contact, is located further back in the axial direction of the spout pipe (the upstream side of the spout pipe 4012) than is the leading end 4012b of the spout pipe 4012. Thus, in a state in which the spout port member 4030 is housed, the spout port 4038 of the spout port member 4030 is located relatively close to the automatic water discharge sensor 4040. In this manner, the structure in which the spout port member 4030 is pulled out from a side that is behind the automatic water discharge sensor 4040 in the axial direction of the spout pipe in the direction of the pipe axis, or in other words, from the back side of the sensor 4040 makes it possible to reduce the amount by which the spout port member projects downward with respect to the light emitting portion of the sensor 4040 and to reduce the distance between the light emitting portion of the sensor and the spout port. Thus, the sensor becomes responsive when a hand is placed underneath the spout port, and the usability improves. In addition, the reduction in the amount by which the spout port member projects downward makes it possible to secure a broad space underneath the spout port.

[0201] Configuring the spout port member 4030 to be capable of being pulled out from the stretched-out portion 4018 can achieve a structure in which the spout port member is housed at the leading end of the spout pipe without increasing the diameter of the spout pipe 4012 along the entire length thereof. In addition, irregularity on the spout pipe can be kept minimum, which thus leads to an aesthetically pleasing design and increased ease of cleaning. Furthermore, by providing the stretched-out portion 4018 behind the spout pipe 4012, the stretched-out portion is less noticeable when the automatic water faucet 4010 is viewed from the front side, which can give the user a generally compact and neat impression.

[0202] The switch operation portion 4034 of the spout port member 4030 is a member for switching the water flowing from the water supply hose 4050 to the shower water discharge or the straight water discharge. The switch operation portion 4034 has a shape that is smoothly continuous with the lower side of the outer periphery of the cover portion 4032 and forms a cylindrical shape as a whole. The switch operation portion 4034 is configured to rotate by a predetermined angle (for example, 90

degrees) about the center axis relative to the cover portion 4032. A convex portion 4036 for the user to hook his/her fingers thereon is formed on the cylindrical surface of the switch operation portion 4034. The user can switch between the shower water discharge and the straight water discharge by rotating the position of the convex portion 4036 by a predetermined angle.

[0203] Fig. 28 is an enlarged perspective view of the leading end of the spout pipe as viewed from a direction different from that of Fig. 26.

[0204] A finger hooking portion 4032a for making it easier for the user to grasp the spout port member 4030 is provided on the cover portion 4032 of the spout port member 4030. This finger hooking portion 4032a may be a smooth step that increases in width in the lateral direction (the widthwise direction of the sink) in Fig. 29, for example. To be more specific, the finger hooking portion 4032a has a shape in which a portion between a large diameter portion, which is the leading end side of the spout port member 4030, and a small diameter portion, which is an inward side in the pulling direction, is tapered or recessed. The finger hooking portion 4032a is formed on the lower side of the cover portion 4032 of the spout port member 4030 so that the fingers are naturally hooked thereon in the pulling direction when the user is to pull out the spout port member 4030. In addition, it is preferable that the finger hooking portion 4032a be formed into a semicircular, smoothly curved surface facing downward so that the fingertips fit well thereon. The presence of such a finger hooking portion 4032a makes it easier to grasp the spout port member even when water or suds are on the hands of the user and the hands are slippery, which facilitates the operation of pulling out the spout port member 4030.

[0205] Fig. 29 is a plan view of the leading end 4012b of the spout pipe 4012 as viewed from the direction from the spout port 4038 (from below). The convex portion 4036 of the switch operation portion 4034 is movable between a shower water discharge position A and a straight water discharge position B. When the convex portion 4036 is at the shower water discharge position A, shower water is discharged through the spout port 4038. When the convex portion 4036 is at the straight water discharge position B, straight water is discharged through the spout port 4038.

[0206] Pictograms 4060a and 4060b are marked, respectively, on the left side surface and the right side surface of the leading end 4012b of the spout pipe as viewed from the user by using, for example, a laser. Fig. 29 illustrates only the shapes of the pictograms 4060a and 4060b, but in reality such a marking is provided at the position indicated by the pictogram 4060b in Fig. 28. The pictogram 4060a is marked on the side opposite to the pictogram 4060b in the radial direction.

[0207] The pictogram 4060a indicates the shower water discharge, and the pictogram 4060b indicates the straight water discharge. The positions at which the pictograms 4060a and 4060b are marked on the surface of

the leading end 4012b correspond, respectively, to the shower water discharge position A and the straight water discharge position B of the convex portion 4036 of the switch operation portion 4034. The user can find the current water discharge state with ease by looking at the switching position of the convex portion 4036 along with the pictogram.

[0208] As illustrated in Fig. 29, the convex portion 4036 is located behind the spout port 4038 (the lower side in Fig. 29) no matter at which of the shower water discharge position A and the straight water discharge position B the convex portion 4036 is located. With such a configuration, even in a configuration in which the automatic water discharge sensor 4040 is closer to the user than is the spout port 4038 as viewed from the user, the convex portion 4036 is not erroneously detected by the automatic water discharge sensor 4040. Thus, the positions of the automatic water discharge sensor 4040 and of the spout port 4038 can be brought closer to each other, and the leading end of the spout pipe can be made compact.

[0209] It is preferable that the shower water discharge position A and the straight water discharge position B be arranged symmetrically about the center axis and that the central angle D be approximately 90 degrees. With this configuration, even when the automatic water faucet 4010 is observed from the front side as viewed from the user (the upper side in Fig. 29), it becomes easier to visually recognize at which of the shower water discharge position A and the straight water discharge position B the convex portion 4036 is located.

[0210] As illustrated in Fig. 28, the upper portion of the convex portion 4036 may have a smooth tapered shape. With this configuration, the user can naturally guide the fingers to the convex portion when the user tries to grasp the convex portion with the fingers.

[0211] The automatic water faucet according to the fifth embodiment can be used in facilities installed in buildings, ships, and the like and may be used in washing basins, hand washers, bathrooms, and so on, aside from kitchens. In addition, the counter has been illustrated as a base member to which the base end portion of the automatic water faucet is fixed. Alternatively, the base member may be a wall member or the like that defines the inside and the outside of a facility such as a bathroom.

[0212] In addition, the shape of the spout portion is not limited to the spout pipe having a gooseneck shape, and the spout portion may be formed into any other shape such as a linear spout pipe or a box-shaped spout pipe. In addition, the present invention can also be applied to an automatic water faucet that is not provided with a pull-out type spout port member.

[0213] In the fifth embodiment, the switch operation portion can switch between the shower water discharge and the straight water discharge, but in addition thereto, or in place thereof, the switch operation portion may be able to make a switch to another water discharge state.

Sixth Embodiment

[0214] Conventionally, a water faucet in which members such as a sensor for automatic water discharge and a spout port member are housed inside a spout pipe is known (see, for example, patent document 5).

[0215] In such a water faucet as described above, it is desirable that the housed members be housed stably inside the spout pipe.

[0216] A sixth embodiment provides a water faucet in which a housed member can be housed stably inside a spout pipe.

[0217] An overview of the sixth embodiment will be given. A water faucet according to an aspect of the present invention includes a spout pipe of which a leading end portion is partially cut out; and a housed member to be housed inside the spout pipe. A holding unit for holding the housed member inside the spout pipe is formed at the leading end portion of the spout pipe.

[0218] According to this aspect, even when the leading end portion of the spout pipe is partially cut out, the housed member can be housed stably without falling through a cut-out portion.

[0219] The sectional shape of the leading end portion of the spout pipe along a plane perpendicular to the direction of the pipe axis may be a circular arc shape with a central angle exceeding 180 degrees. In this case, the housed member is embraced by circumferential direction end portions of the leading end portion of the spout pipe, and thus the housed member can be housed stably inside the spout pipe.

[0220] The housed member may include a sensor that detects the presence of a detection target. A spout port member that discharges water upon a detection target being detected by the sensor may be disposed at the cut-out portion of the spout pipe.

[0221] The configurations described above can provide the water faucet in which the housed member can be housed stably inside the spout pipe.

[0222] Fig. 30 is a perspective view illustrating a portion of a kitchen 5100 provided with an automatic water faucet 5010 according to the sixth embodiment of the present invention. A sink 5102 that is recessed in a concave shape is provided in the kitchen 5100. The automatic water faucet 5010 according to the sixth embodiment, a purified water faucet 5106 for supplying purified water, and a storage portion 5108 for storing various items such as a dishwashing detergent and a sponge are provided in a counter 5104 behind the sink 5102. When the terms indicating directions, such as "upper," "underneath," "front," "back," "left," "right," "inner," and "outer" are used in the present specification, these terms indicate directions relative to the posture of the automatic water faucet 5010 mounted to the kitchen or the like.

[0223] Fig. 31 is a perspective view of the automatic water faucet 5010 according to the sixth embodiment of the present invention. As illustrated in Fig. 31, the automatic water faucet 5010 includes a water faucet main

body 5012 erected on the counter and a spout pipe 5014 that extends from the upper end surface of the water faucet main body 5012. A spout port member 5020 having a spout port 5018 is provided at a leading end side of the spout pipe 5014 in the direction of the pipe axis.

[0224] The water faucet main body 5012 includes a mixing valve (not illustrated) provided therein and a lever handle 5016 for operating the mixing valve. The mixing valve mixes cold water and hot water at a predetermined ratio to produce warm water of an appropriate temperature. The horizontal pivot operation of the lever handle 5016 adjusts the mixture ratio of cold water and hot water, or in other words, adjusts the temperature of the mixed water, and the vertical pivot operation thereof adjusts the flow rate of the discharged warm water.

[0225] The spout pipe 5014 includes a spout pipe main body 5014a formed into a so-called gooseneck shape having an inverted U-shape and a stretched-out portion 5014b that stretches out toward the back side (the side opposite to the user) from the intermediate portion to the leading end portion of the spout pipe main body 5014a. The spout pipe main body 5014a and the stretched-out portion 5014b are formed integrally by a casting of a metal material serving as a raw material. The spout pipe main body 5014a has a shape that extends downward toward a leading end 5014e from the portion of a maximum height, and the opening in the leading end 5014e faces downward.

[0226] A flexible water supply hose (not illustrated) is disposed inside the spout pipe 5014. One end of the water supply hose is connected to the spout port member 5020. The spout port member 5020 can be pulled out from the spout pipe 5014 along with the water supply hose. In a state in which the spout port member 5020 is housed in the spout pipe 5014, the spout port 5018 of the spout port member 5020 faces downward.

[0227] The other end of the water supply hose is connected to a solenoid valve (not illustrated). This solenoid valve is provided underneath the counter and controls the discharge and shutoff of the water through the spout port 5018. The solenoid valve is controlled by a control unit (not illustrated) constituted by a circuit board having a microcomputer mounted thereon. This control unit may be implemented through a combination of devices such as a CPU and a memory of a computer and a circuit.

[0228] A proximity sensor 5022, which serves as a first human body detection sensor, is provided on the front surface (the side toward the user) of the spout pipe 5014. The proximity sensor 5022 may be an infrared sensor having a light emitting portion and a light receiving portion, for example. The proximity sensor 5022 receives, with the light receiving portion, reflected light of the light projected by the light emitting portion from a detection target and thus determines whether a detection target such as a hand of a person is present within a predetermined detection area. The proximity sensor 5022 is provided such that a sensor window 5022a faces obliquely upward.

[0229] The proximity sensor 5022 detects the hand upon the user placing his/her hand over the sensor window. When a body part is detected by the proximity sensor 5022, the control unit opens the solenoid valve, and water is discharged through the spout port 5018 of the spout port member 5020. Once a body part is detected by the proximity sensor 5022, the water continues to be discharged even after the body part becomes no longer detected. Thereafter, when the proximity sensor 5022 detects a body part again as the user places his/her hand over the proximity sensor 5022 again, the control unit closes the solenoid valve, and the water stops being discharged through the spout port 5018 of the spout port member 5020. The presence of such a proximity sensor 5022 makes it possible to control the discharge and shut-off of the water without operating the lever handle 5016, and thus the lever handle 5016 is prevented from being stained even when the hands are not clean, for example.

[0230] Fig. 32 is an enlarged view of the vicinity of a leading end portion of the spout pipe 5014 as viewed from below, illustrating a state in which the spout port member 5020 is housed in the spout pipe 5014. In addition, Fig. 33 illustrates the automatic water faucet 5010 as viewed from the back side, illustrating a state in which the spout port member 5020 is being pulled out from the spout pipe 5014 along with a water supply hose 5028.

[0231] The spout port member 5020 is provided at the leading end portion of the spout pipe 5014 on the side away from the user, and an automatic sensor 5024, which serves as a second human body detection sensor, is provided on the side closer to the user. The automatic sensor 5024 is provided inside a leading end portion 5014c of the spout pipe main body 5014a. The spout port member 5020 is provided at a leading end portion 5014d of the stretched-out portion 5014b such that the spout port member 5020 can be pulled out along with the water supply hose 5028. The leading end portion 5014d of the stretched-out portion 5014b does not extend to the leading end portion 5014c of the spout pipe main body 5014a. Therefore, the spout pipe 5014 has a shape in which the leading end portion is partially cut out along the direction of the pipe axis. The spout port member 5020 is disposed at the cut-out portion of the leading end portion 5014c of the spout pipe 5014 in a state in which the spout port member 5020 is housed in the spout pipe 5014.

[0232] The automatic sensor 5024 may be an infrared sensor having a light emitting portion and a light receiving portion, for example. The automatic sensor 5024 receives, with the light receiving portion, reflected light of the light projected by the light emitting portion from a detection target and thus determines whether a detection target such as a hand of a person is present within a predetermined detection area. The automatic sensor 5024 is provided such that a sensor window 5024a faces downward.

[0233] The automatic sensor 5024 detects the hand upon the user placing his/her hand underneath the spout port 5018. When a body part is detected by the automatic

sensor 5024, the control unit opens the solenoid valve, and water is discharged automatically through the spout port 5018 of the spout port member 5020. Thereafter, when the user pulls back the hand out of the detection area of the automatic sensor 5024, the automatic sensor 5024 no longer detects a body part. Thus, the control unit closes the solenoid valve, and the water stops being discharged through the spout port 5018 of the spout port member 5020. The presence of such an automatic sensor 5024 makes it possible to discharge water only for the duration in which a detection target is being detected by the automatic sensor 5024, and thus water consumption can be reduced.

[0234] A switch 5026 for switching between ON and OFF of the automatic sensor 5024 is provided on the front surface (the side toward the user) of the spout pipe 5014. The automatic water discharge and water shutoff as described above is carried out only when the automatic sensor 5024 is ON.

[0235] The spout port member 5020 includes a water guiding member (not illustrated) for guiding water from the water supply hose 5028 to the spout port 5018, a cover member 5040 made of resin for covering the leading end portion of the water supply hose 5028 and the water guiding member from the outside, and a switch operation member 5042 that switches the water discharged through the spout port 5018 from the straight water discharge to the shower water discharge or vice versa.

[0236] A guide member 5044 is housed inside the spout pipe main body 5014a and the stretched-out portion 5014b. Fig. 34 is a perspective view illustrating the guide member 5044. The guide member 5044 is an integrally molded member made of resin and includes a hose guide portion 5044a for guiding the water supply hose 5028, a sensor holding portion 5044b for holding the automatic sensor 5024, a wire guide portion 5044c for guiding a wire connecting the automatic sensor 5024 to the control unit, and a spout port member guide portion 5044d for guiding the spout port member 5020. As illustrated in Fig. 33, in a state in which the guide member 5044 is mounted inside the spout pipe main body 5014a and the stretched-out portion 5014b, the hose guide portion 5044a projects from the leading end portion 5014d of the stretched-out portion 5014b. In addition, the spout port member guide portion 5044d covers the opening at the cut-out portion of the spout pipe main body 5014a.

[0237] The cover member 5040 has a recess portion 5040a formed therein to fit with the hose guide portion 5044a. When the spout port member 5020 is housed into the spout pipe 5014, this recess portion 5040a fits with the hose guide portion 5044a, and thus the spout port member 5020 is held by the spout pipe 5014.

[0238] Fig. 35 illustrates the leading end portion 5014c of the spout pipe 5014 as viewed from below. Fig. 35 illustrates a state in which the spout port member is being pulled out from the spout pipe 5014. The guide member 5044 that includes the automatic sensor 5024 is housed

inside the leading end portion 5014c of the spout pipe 5014. As described above, the leading end portion of the spout pipe 5014 is partially cut out. Therefore, in the automatic water faucet 5010 according to the sixth embodiment, the sectional shape of the leading end portion 5014c of the spout pipe 5014 along a plane perpendicular to the direction of the pipe axis has a circular arc shape having a central angle θ of approximately 270 degrees. In other words, the leading end portion 5014c of the spout pipe 5014 has a substantially 3/4th cylinder shape. When the leading end portion 5014c of the spout pipe 5014 is formed into such a shape, the guide member 5044 is embraced by the circumferential direction end portions 5060 and 5061 of the leading end portion 5014c, and thus the guide member 5044 is housed stably inside the spout pipe 5014 without falling through the cut-out portion of the spout pipe 5014. The circumferential direction end portions 5060 and 5061 of the leading end portion 5014c function as a holding unit for holding the guide member 5044 inside the spout pipe 5014.

[0239] It suffices that the sectional shape of the leading end portion 5014c of the spout pipe 5014 along a plane perpendicular to the direction of the pipe axis be a circular arc shape with a central angle θ exceeding 180 degrees. When the central angle θ is no greater than 180 degrees, the guide member 5044 cannot be embraced by the circumferential direction end portions 5060 and 5061 of the leading end portion 5014c, and thus the guide member 5044 may fall through the cut-out portion of the spout pipe 5014.

[0240] The sectional shape of the leading end portion 5014c of the spout pipe 5014 along a plane perpendicular to the direction of the pipe axis is not particularly limited to a circular arc shape, and any desired shape, such as a quadrangular shape, may be employed as long as a holding unit that holds the guide member 5044 inside the spout pipe 5014 is formed.

Seventh Embodiment

[0241] A seventh embodiment also provides a water faucet in which a housed member can be housed stably inside a spout pipe.

[0242] An overview of the seventh embodiment will be given. A water faucet according to an aspect of the present invention includes a spout pipe; and a housed member to be housed inside the spout pipe. A holding unit for holding the housed member in a part of a space within the spout pipe is formed inside the spout pipe. According to this aspect as well, the housed member can be housed stably inside the spout pipe.

[0243] Fig. 36 illustrates an automatic water faucet 5070 according to the seventh embodiment of the present invention. In the automatic water faucet 5070 illustrated in Fig. 36, constituent elements that are identical or corresponding to those of the automatic water faucet 5010 according to the sixth embodiment described above are given identical reference characters, and du-

plicate descriptions thereof will be omitted as appropriate. Fig. 36 illustrates a state in which the spout port member is being pulled out from the spout pipe 5014.

[0244] In the automatic water faucet 5070 illustrated in Fig. 36 as well, the spout pipe 5014 is constituted by the spout pipe main body 5014a formed into a so-called gooseneck shape having an inverted U-shape and the stretched-out portion 5014b that stretches out toward the back side from the intermediate portion to the leading end portion of the spout pipe main body 5014a. In the automatic water faucet 5070, the leading end portion 5014d of the stretched-out portion 5014b extends to the leading end portion 5014c of the spout pipe main body 5014a. In other words, in the automatic water faucet 5070, the spout pipe 5014 is not cut out.

[0245] As illustrated in Fig. 36, in the automatic water faucet 5070 according to the seventh embodiment, a partition wall 5072 that defines an inner space of the spout pipe 5014 into a first space in which the automatic sensor 5024 is housed and a second space in which the water supply hose 5028 is housed is formed inside the spout pipe 5014. This partition wall 5072 holds the sensor holding portion 5044b that includes the automatic sensor 5024 in the first space inside the spout pipe 5014. The presence of the partition wall 5072 inside the spout pipe 5014 makes it possible to house the automatic sensor 5024 and the water supply hose 5028 stably in separate spaces inside the spout pipe 5014.

[0246] In the seventh embodiment illustrated in Fig. 36, the partition wall 5072 is provided inside the spout pipe 5014 to completely define the inner space of the spout pipe 5014 into the first space and the second space. However, the partition wall 5072 does not have to be provided as long as the sensor holding portion 5044b can be held in the first space. The sectional shape of the first space along a plane perpendicular to the direction of the pipe axis in Fig. 36 is a circular arc shape with a central angle θ exceeding 180 degrees, and thus the sensor holding portion 5044b is held stably in the first space even without the partition wall 5072. Therefore, even in a case in which the partition wall 5072 is removed from the automatic water faucet 5070 illustrated in Fig. 36, the automatic sensor 5024 and the water supply hose 5028 can be housed stably in separate spaces inside the spout pipe 5014.

[0247] The sectional shape of the leading end portion 5014c of the spout pipe main body 5014a along a plane perpendicular to the direction of the pipe axis is not particularly limited to a circular arc shape, and any desired shape, such as a quadrangular shape, may be employed as long as a holding unit that holds the housed member such as the sensor holding portion 5044b inside the spout pipe 5014 is formed.

[0248] In the sixth and seventh embodiments described above, an automatic water faucet has been illustrated as the water faucet, but the type of the water faucet is not limited to an automatic water faucet and may be an ordinary water faucet that discharges water upon a

lever handle or the like being operated manually.

[0249] In the sixth and seventh embodiments described above, the automatic sensor 5024 is provided at the leading end portion 5014c of the spout pipe main body 5014a, but a different member may instead be provided therein. For example, a member that discharges foam soap may be provided inside the leading end portion 5014c of the spout pipe main body 5014a.

[0250] The shape of the spout pipe 5014 is not limited to a gooseneck shape as described above, and the spout pipe may be formed into any well-known shape such as a linear spout pipe.

[0251] The water faucets according to the sixth and seventh embodiments described above may be used in facilities installed in buildings, ships, and the like and may be used in washing basins, hand washers, bathrooms, and so on, aside from kitchens.

[0252] Thus far, the present invention has been described on the basis of embodiments, but the embodiments merely illustrate the principle and the applications of the present invention. In addition, a number of modifications or arrangement changes can be made to the embodiments within the scope that does not depart from the spirit of the present invention set forth in the claims.

INDUSTRIAL APPLICABILITY

[0253] The present invention can be used in an automatic water faucet that controls the discharge of water with a sensor.

Claims

1. An automatic water faucet, comprising:
 - a spout portion;
 - a spout port member having a spout port, the spout port member being housed at a leading end of the spout portion such that the spout port member can be freely pulled out; and
 - a sensor provided in the vicinity of the spout port for detecting an object below the spout port to cause water discharge to start; wherein the spout port member is configured to be pulled out from an end of the spout portion that is axially depthward of the sensor.
2. The automatic water faucet according to claim 1, wherein
 - the spout portion has a shape that is expanded in a section from an intermediate portion, to the leading end, of the spout portion, and
 - the spout port member can be pulled out from the expanded section.
3. The automatic water faucet according to claim 1 or 2, wherein the spout port member has a shape that

in a state in which the spout port member has been housed smoothly curves continuously from an upstream side of the spout portion to the spout port member.

4. The automatic water faucet according to any one of claims 1 to 3, wherein the spout portion has a shape in which a portion thereof expands in a depthwise direction toward the leading end as viewed from a user and is configured such that the spout port member can be pulled out from either side of the portion that expands in the depthwise direction.
5. The automatic water faucet according to any one of claims 1 to 4, further comprising:
 - a holding member that holds the sensor inside the spout portion, wherein the holding member includes
 - a planar portion having a sensor window of the sensor, and
 - a rising portion formed to rise from a periphery of the planar portion.
6. The automatic water faucet according to any one of claims 1 to 5, wherein:
 - the spout portion is a spout pipe; and
 - the sensor is held at a leading end portion of the spout pipe.
7. The automatic water faucet according to claim 5 or 6, wherein:
 - the planar portion is disposed at a position that is more inward than is the leading end of the spout portion; and
 - the rising portion is formed to rise along an inner wall of the spout portion.
8. The automatic water faucet according to any one of claims 5 to 7, wherein a leading end of the rising portion projects more than the leading end of the spout portion.
9. The automatic water faucet according to any one of claims 5 to 8, wherein the rising portion is connected to the planar portion via a continuous curved surface.
10. The automatic water faucet according to any one of claims 1 to 9, further comprising:
 - a water supply hose disposed inside the spout portion; wherein
 - the spout port member is connected to the water supply hose and is provided to be capable of being pulled out from the spout portion along with the water supply hose;

a portion of a side surface of the spout port member can abut against a portion of a side surface of the spout portion when the spout port member is housed into the spout portion; and one of an abutment portion of the spout port member and an abutment portion of the spout portion is formed into a convex shape, and the other one of the abutment portions is formed into a concave shape corresponding to the convex shape.

11. The automatic water faucet according to claim 10, wherein:

the either convex shape or concave shape formed at the abutment portion of the spout port member extends along a lengthwise direction of the water supply hose; and the either convex shape or concave shape formed at the abutment portion of the spout portion extends along the axial direction of the spout portion.

12. The automatic water faucet according to any one of claims 1 to 11, wherein in a state in which the spout port member is housed in the spout portion, the spout port member is located behind the spout portion relative to the user.

13. The automatic water faucet according to any one of claims 1 to 12, wherein the spout port member includes a finger hooking portion that latches a grasping unit in a pulling direction thereof when the spout port member is grasped.

14. The automatic water faucet according to claim 13, wherein the finger hooking portion is formed into a tapered shape or a concave shape at a portion between a large diameter portion, which is a leading end side of the spout port member, and a small diameter portion, which is an inward side in the pulling direction.

15. The automatic water faucet according to claim 13 or 14, wherein the spout port member is located behind, as viewed from the user, the spout portion in a housed state.

16. The automatic water faucet according to any one of claims 13 to 15, wherein:

the spout portion includes a stretched-out portion that expands from the spout pipe from the intermediate portion to the leading end of the spout pipe; and a curved line that defines a boundary between the spout portion and the stretched-out portion and a curved line that defines a step of the finger

hooking portion are smoothly continuous with each other.

17. The automatic water faucet according to any one of claims 1 to 4, further comprising:

a switch operation portion that can switch states of water discharge from the spout port; wherein the sensor is located before the spout port as viewed from the user, and the switch operation portion includes a convex portion that shifts into a switched positions for the respective water discharge states, and is located depthward in the spout port no matter which position the convex portion is in the switch operation portion includes a convex portion that shifts into switching position of a corresponding water discharge state, and is located behind the spout port no matter at which position the convex portion is located.

18. The automatic water faucet according to claim 17, wherein the switching positions are arranged symmetrically with respect to a center axis.

19. The automatic water faucet according to claim 17 or 18, wherein a pictogram that indicates a corresponding water discharge state is provided at a position corresponding to the switching position on the front of the spout portion.

20. The automatic water faucet according to any one of claims 17 to 19, wherein an upper portion of the convex portion has a smooth tapered shape.

21. The automatic water faucet according to any one of claims 1 to 4, wherein:

the spout portion is a spout pipe of which a leading end portion is partially cut out; and a holding unit that holds a housed member inside the spout pipe is provided at the leading end portion of the spout pipe.

22. The automatic water faucet according to claim 21, wherein a sectional shape of the leading end portion of the spout pipe along a plane perpendicular to the pipe axially is a circular arc shape with a central angle exceeding 180 degrees.

23. The automatic water faucet according to claim 21 or 22, wherein:

the housed member includes a sensor that detects the presence of a detection target; the spout port member is disposed at a cut-out portion of the spout pipe; and water is discharged through the spout port upon

the detection target being detected by the sensor.

- 24.** The automatic water faucet according to any one of claims 1 to 4, wherein:

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the spout portion is a spout pipe, and
a holding unit that holds a housed member in at
least a part of a space inside the spout pipe is
formed inside the spout pipe.

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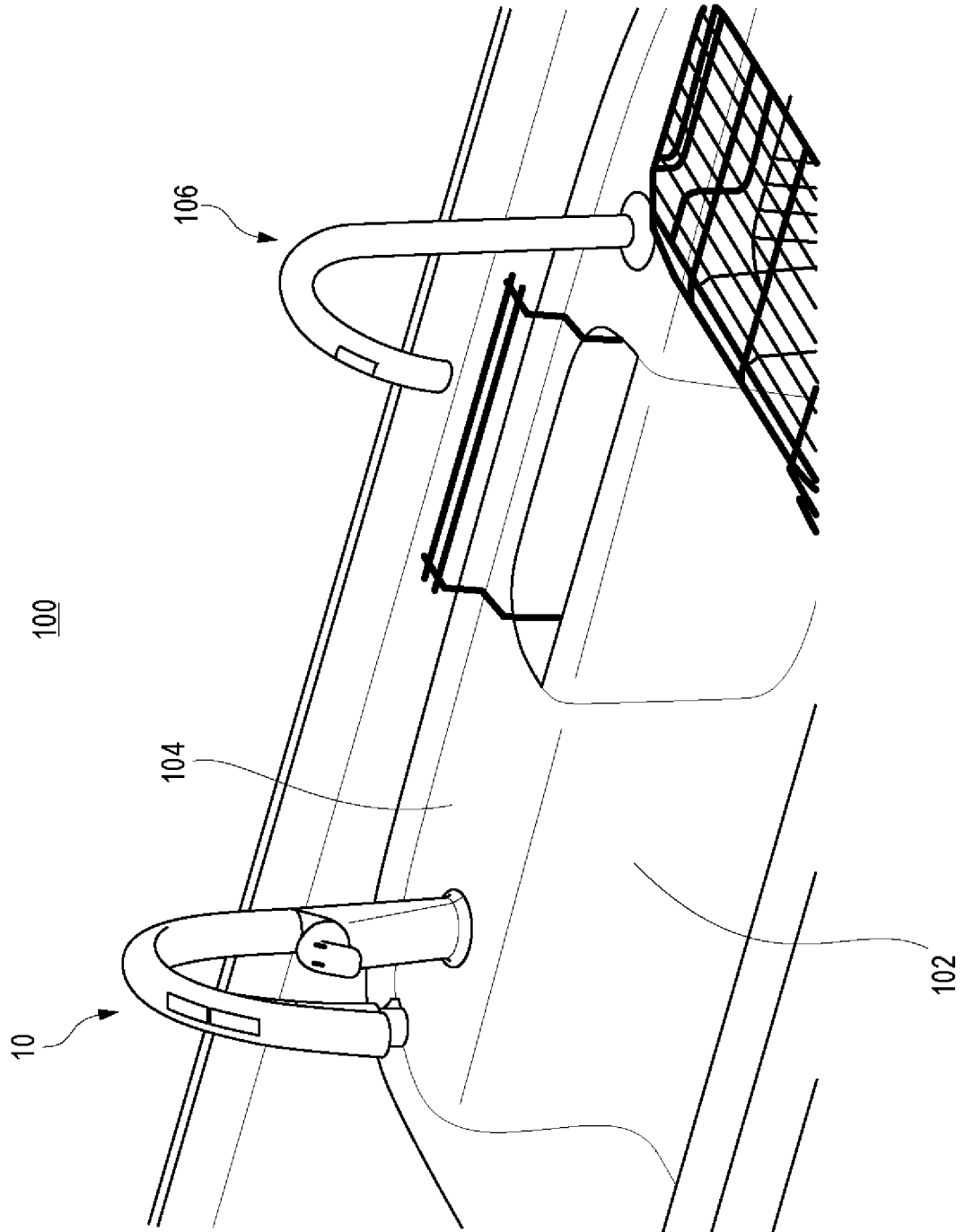
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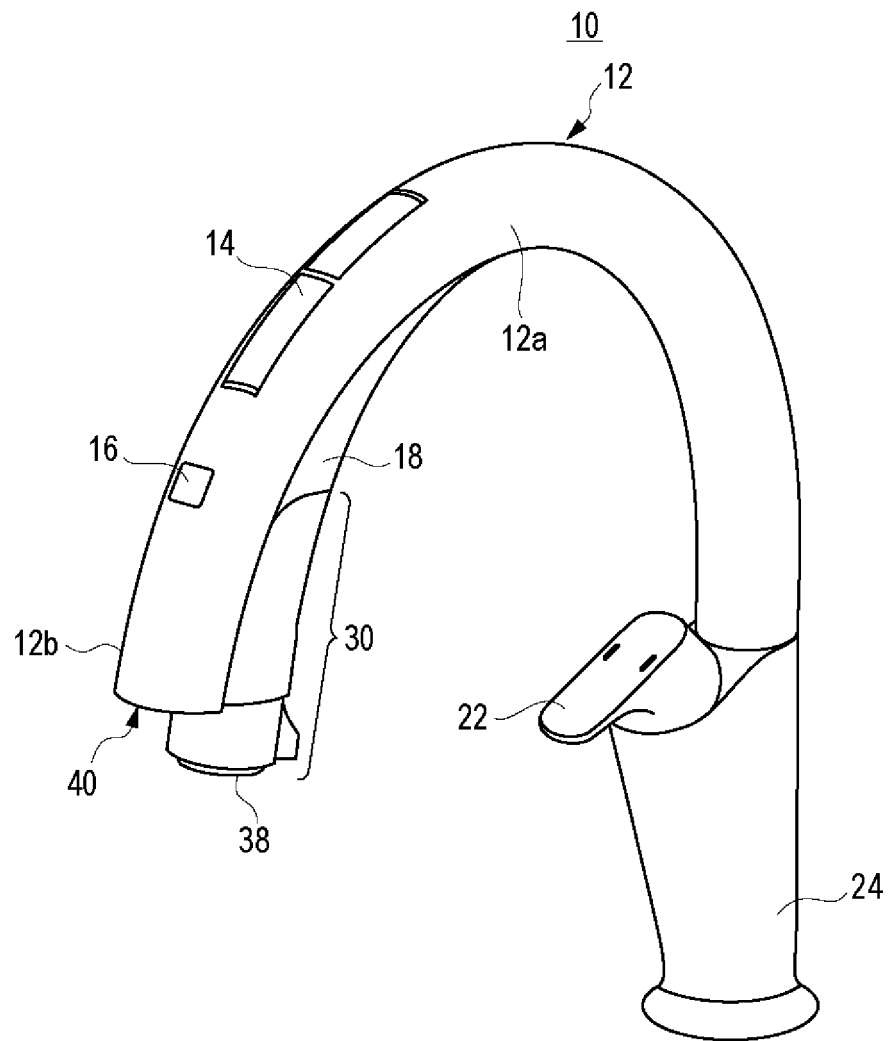
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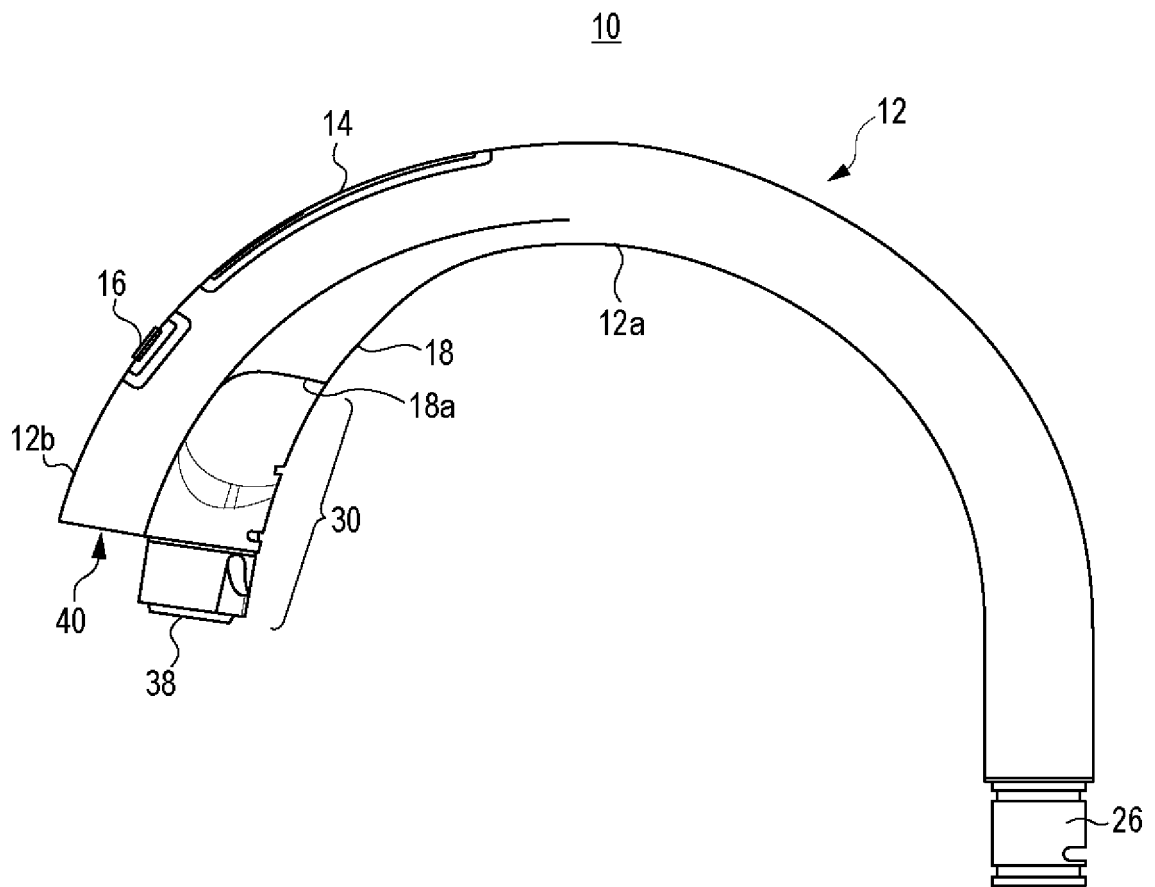
[FIG. 1]



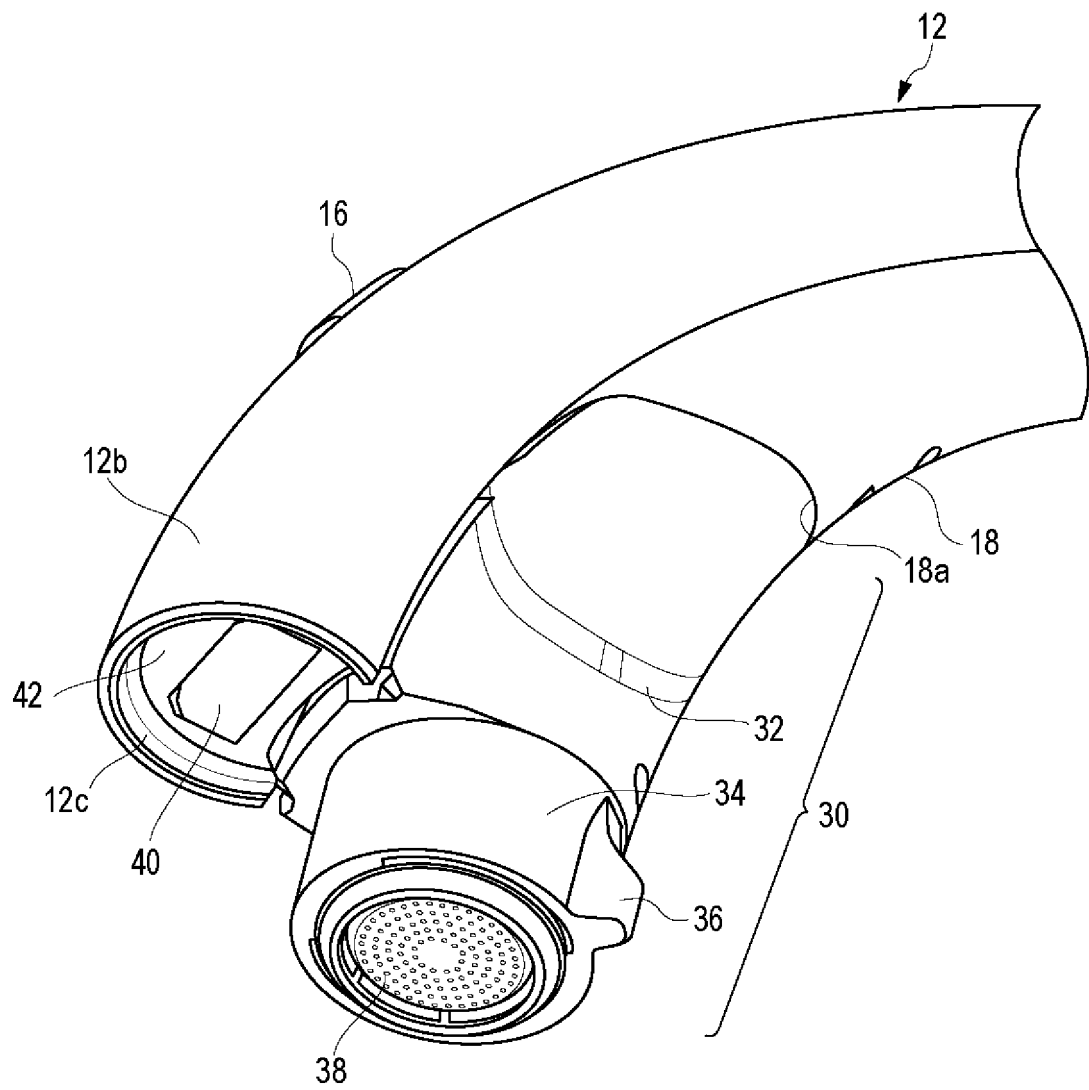
[FIG. 2]



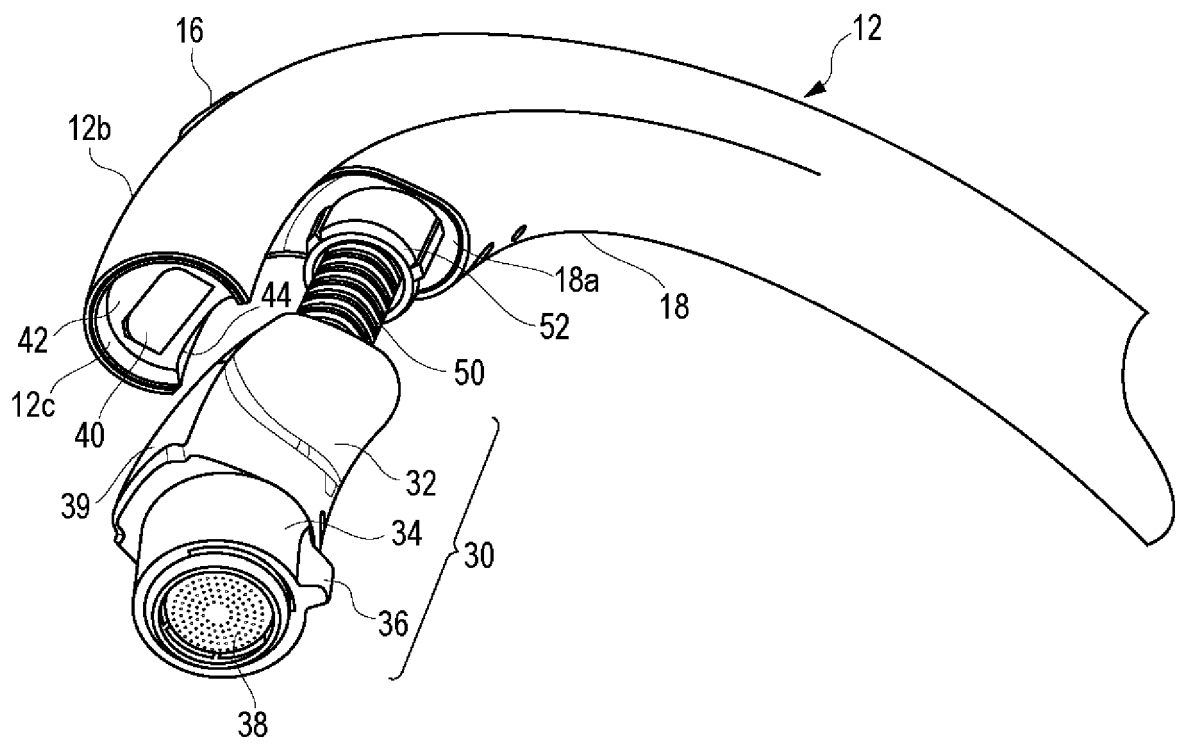
[FIG. 3]



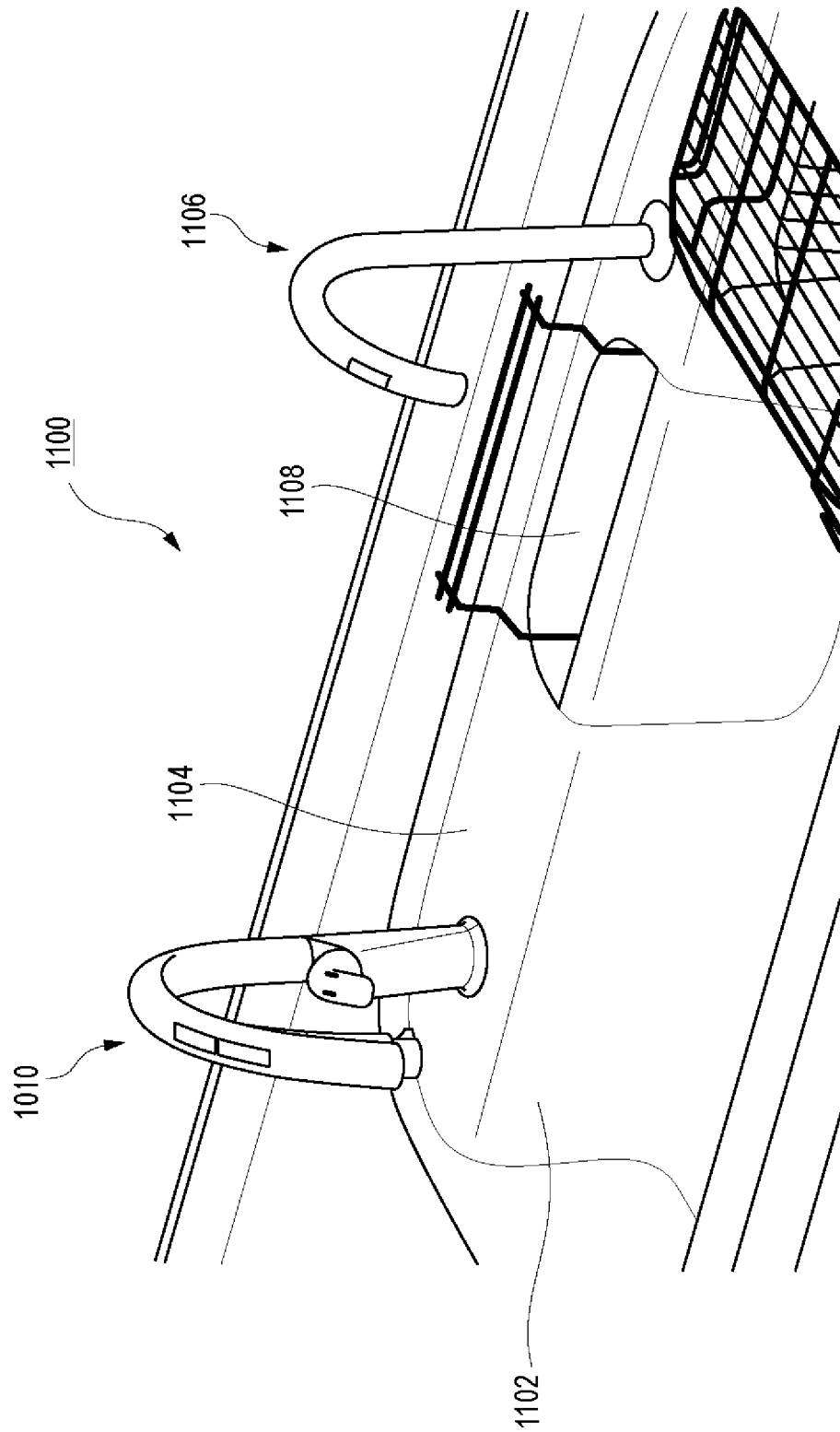
[FIG. 4]



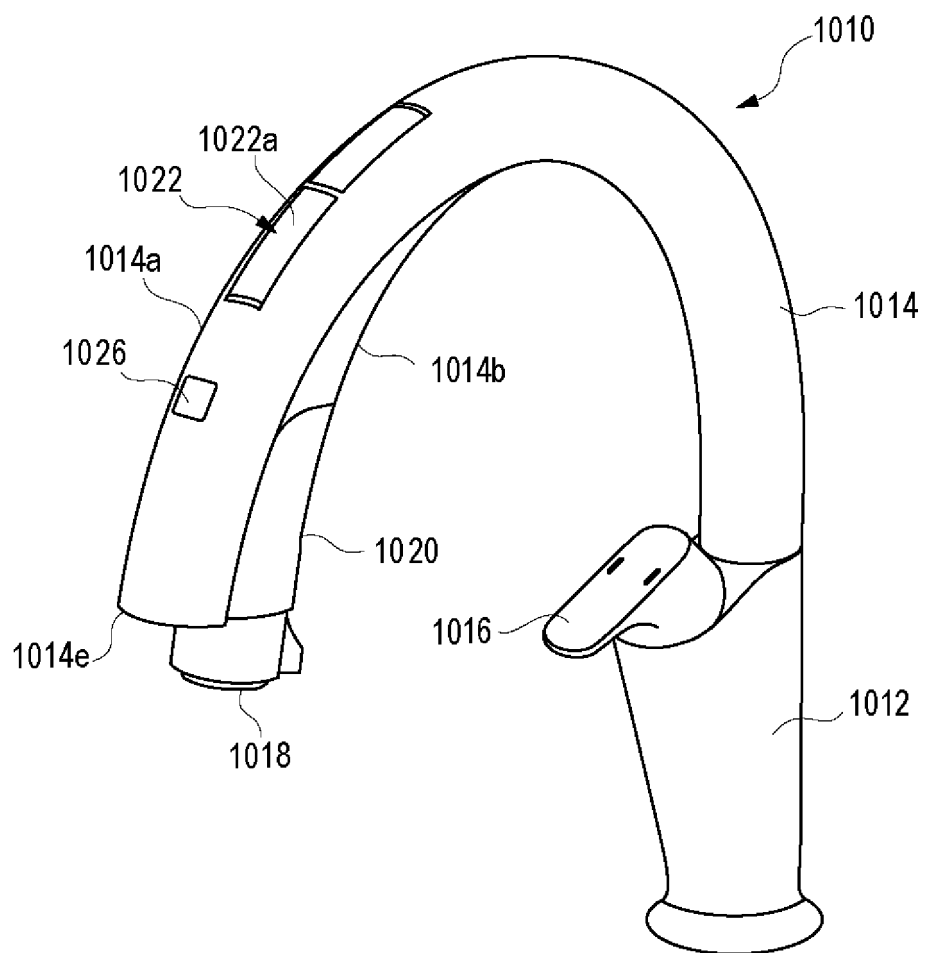
[FIG. 5]



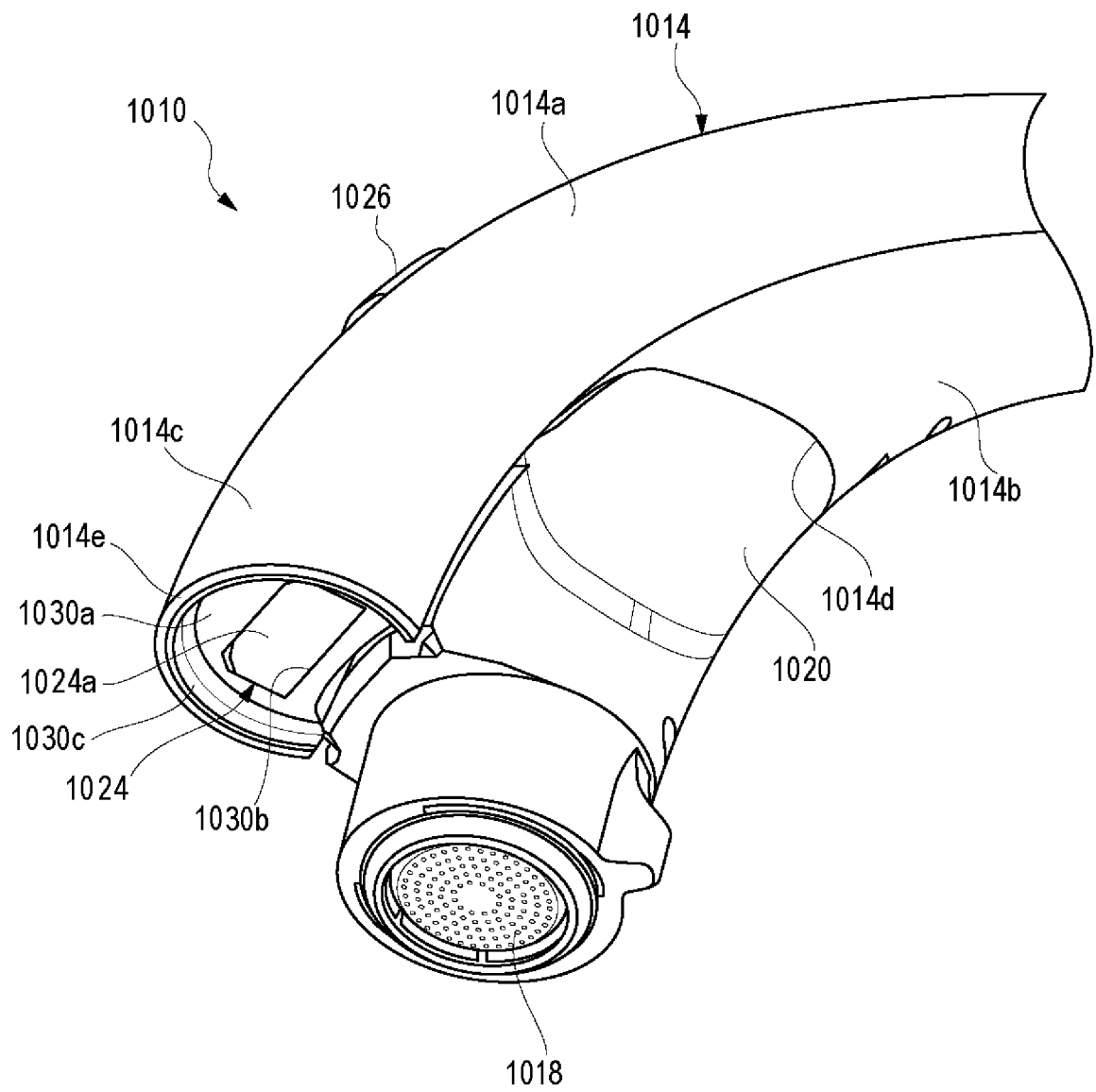
[FIG. 6]



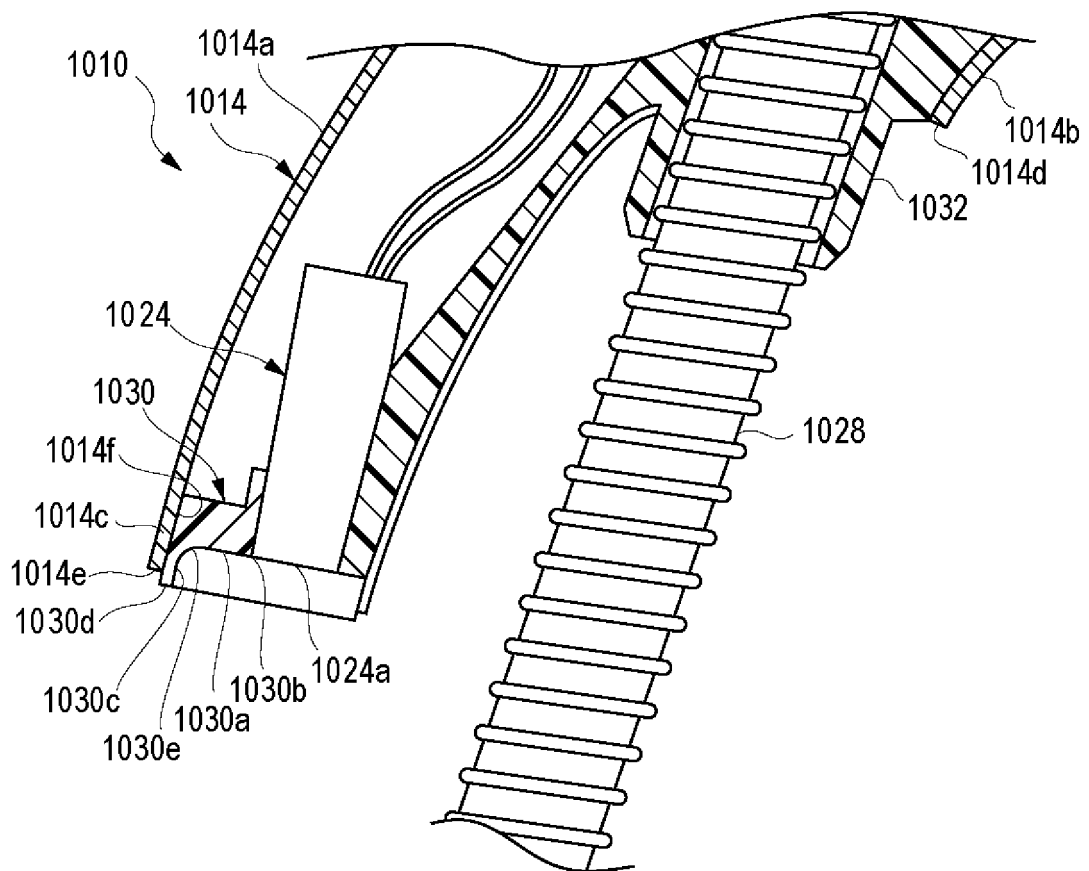
[FIG. 7]



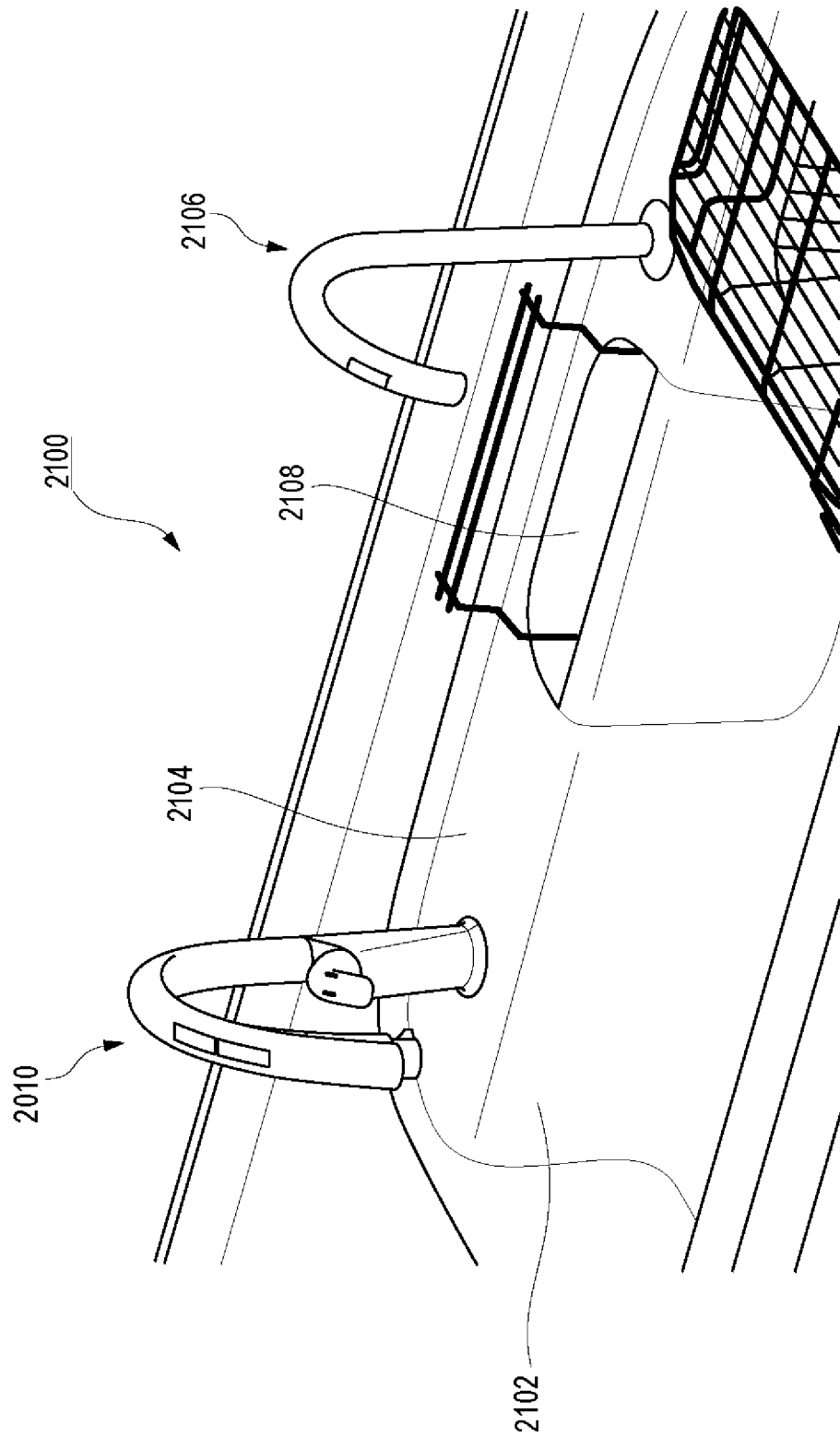
[FIG. 8]



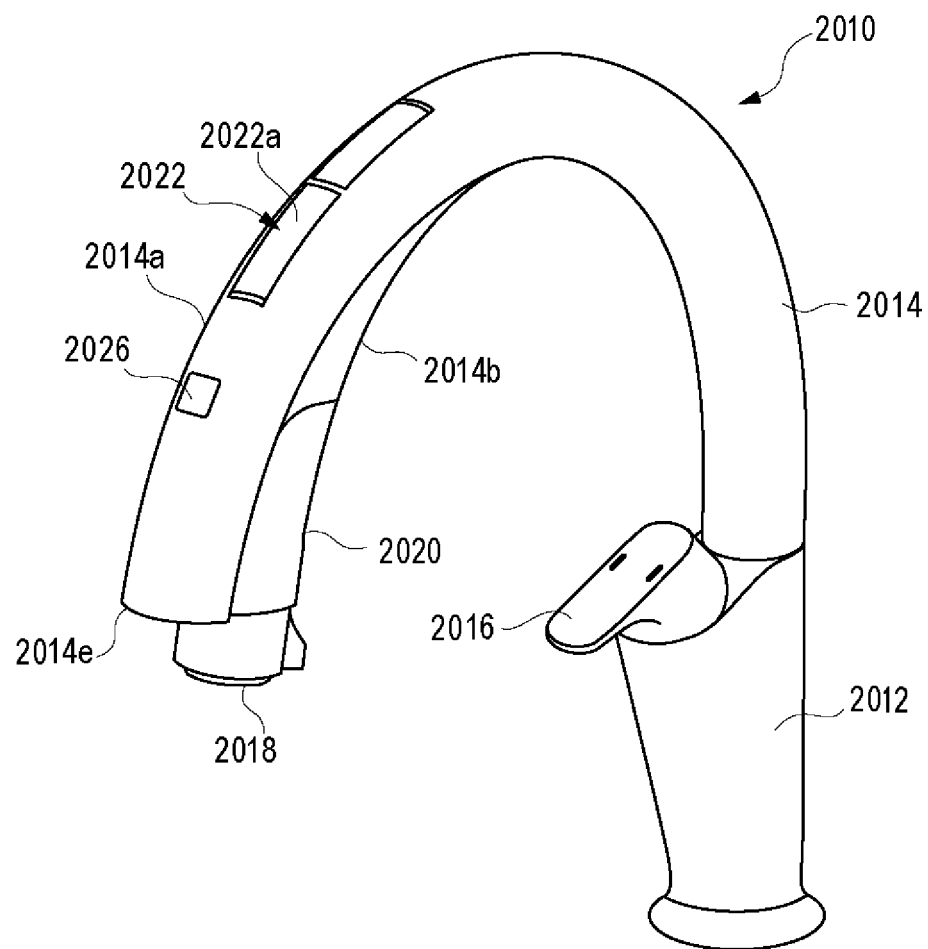
[FIG. 9]



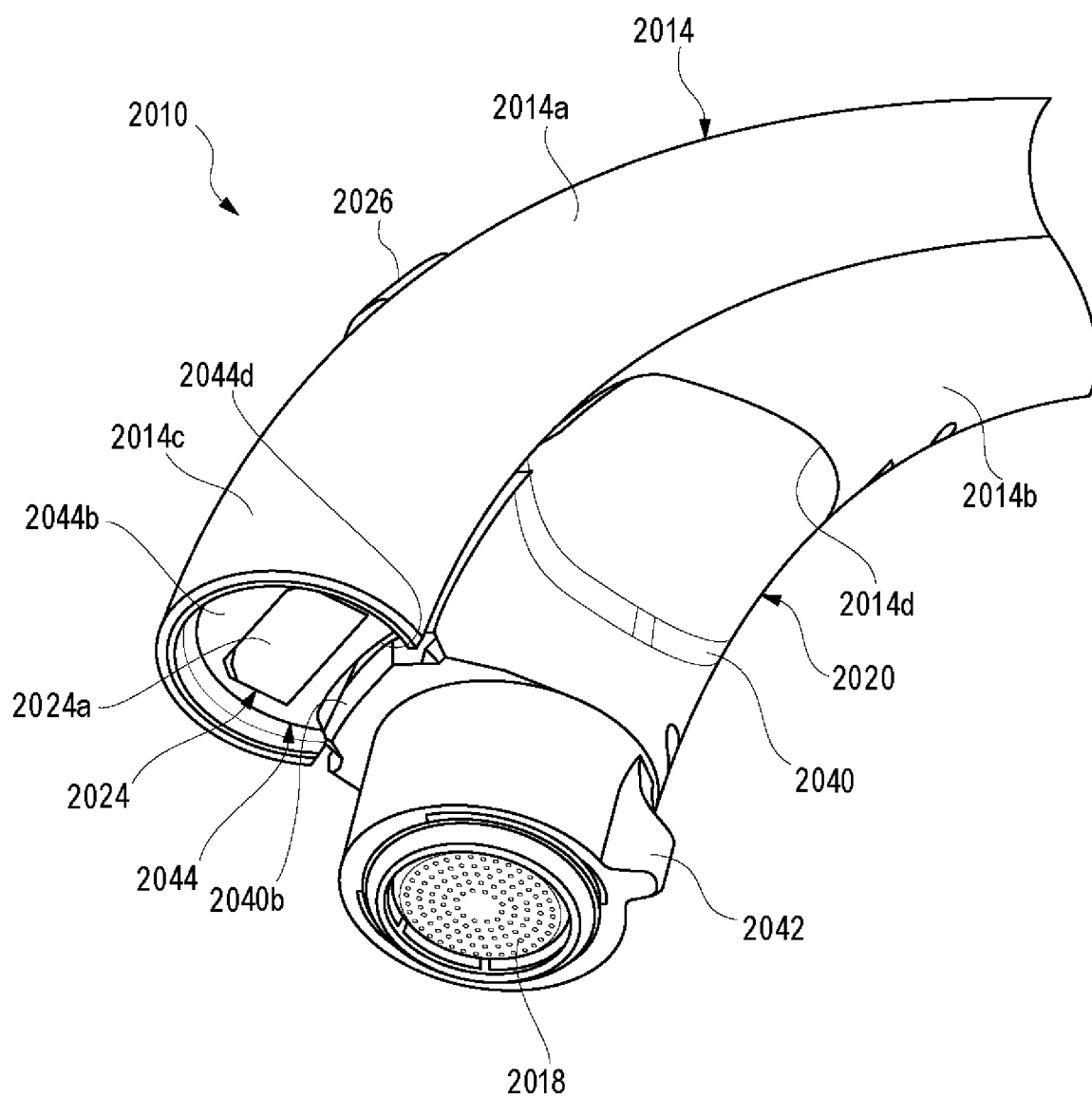
[FIG. 10]



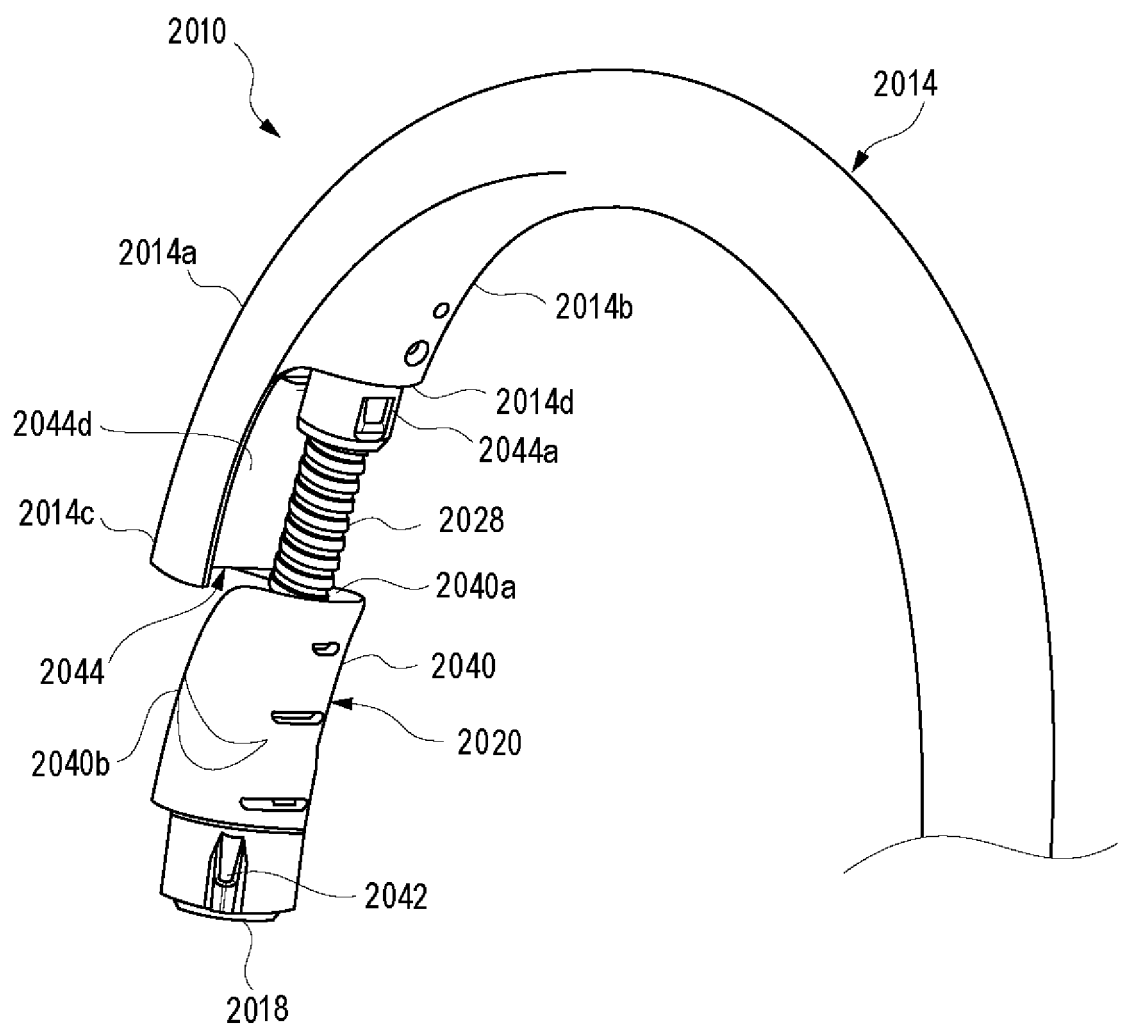
[FIG. 11]



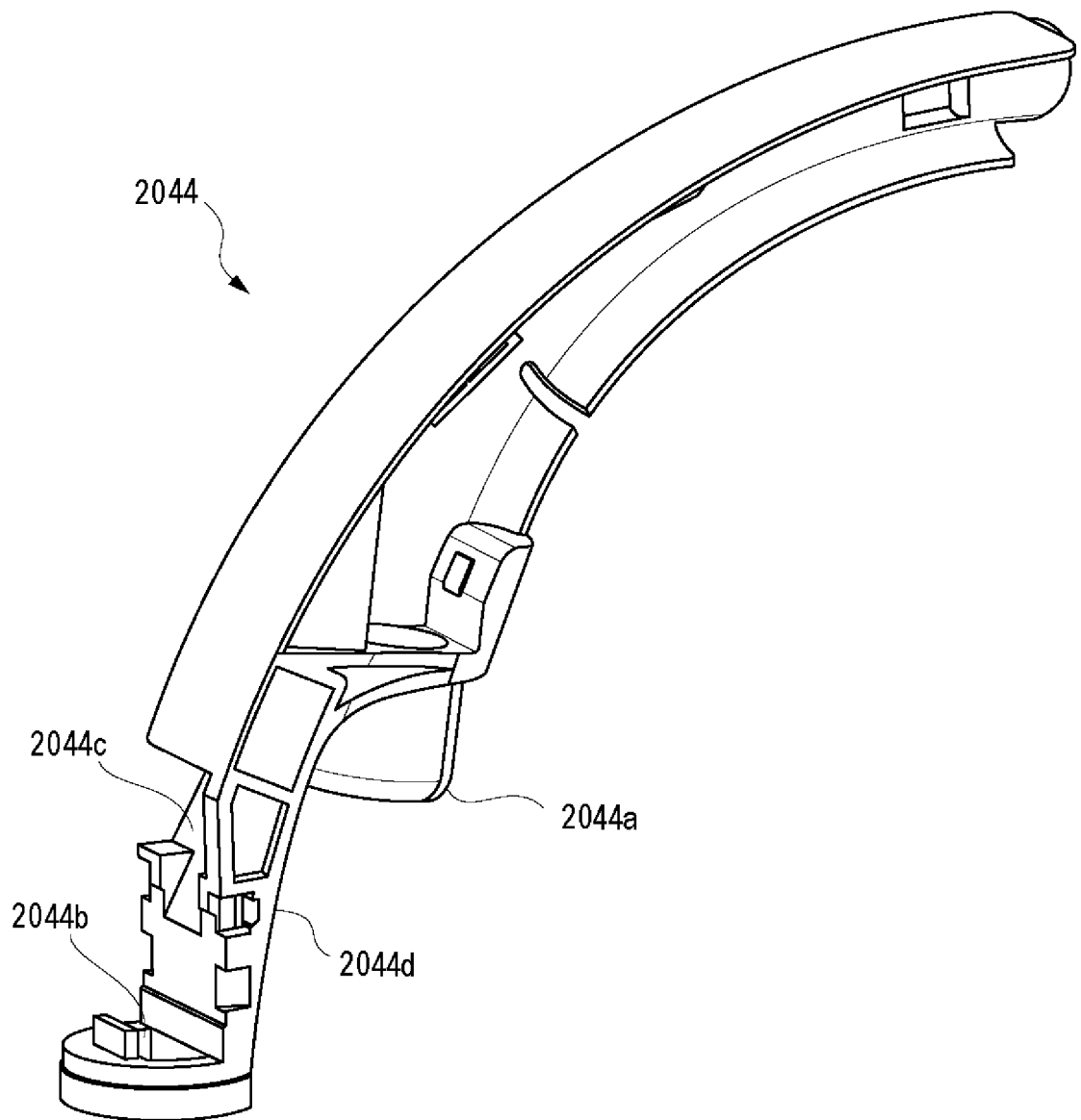
[FIG. 12]



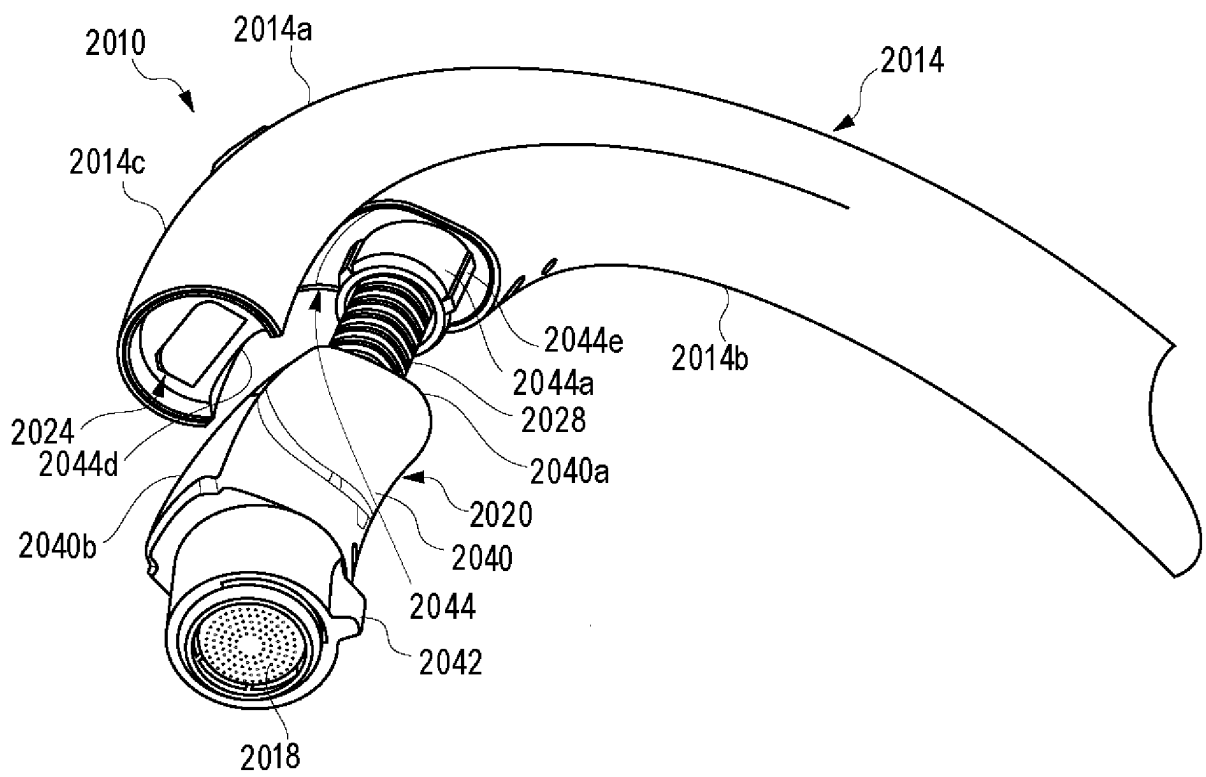
[FIG. 13]



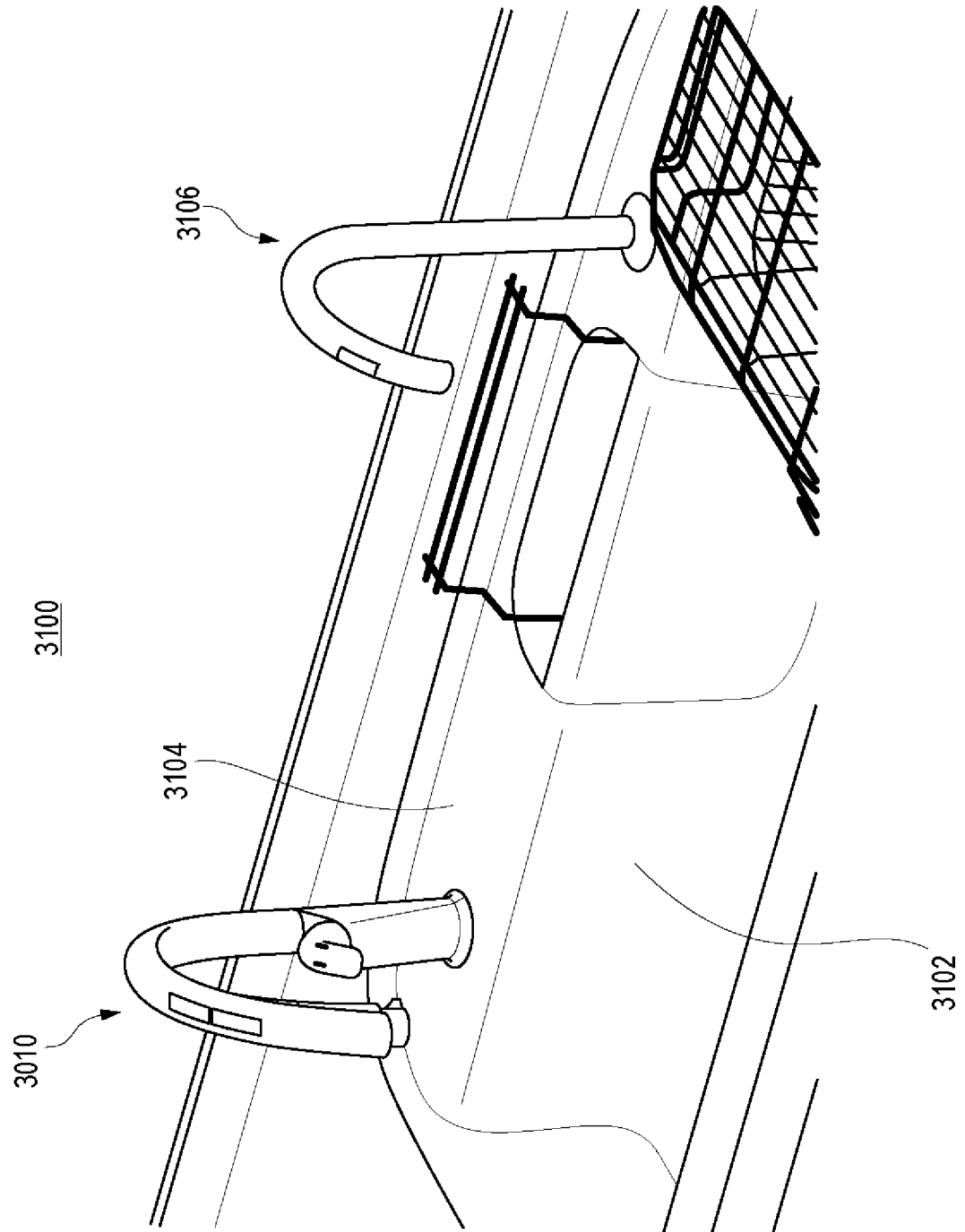
[FIG. 14]



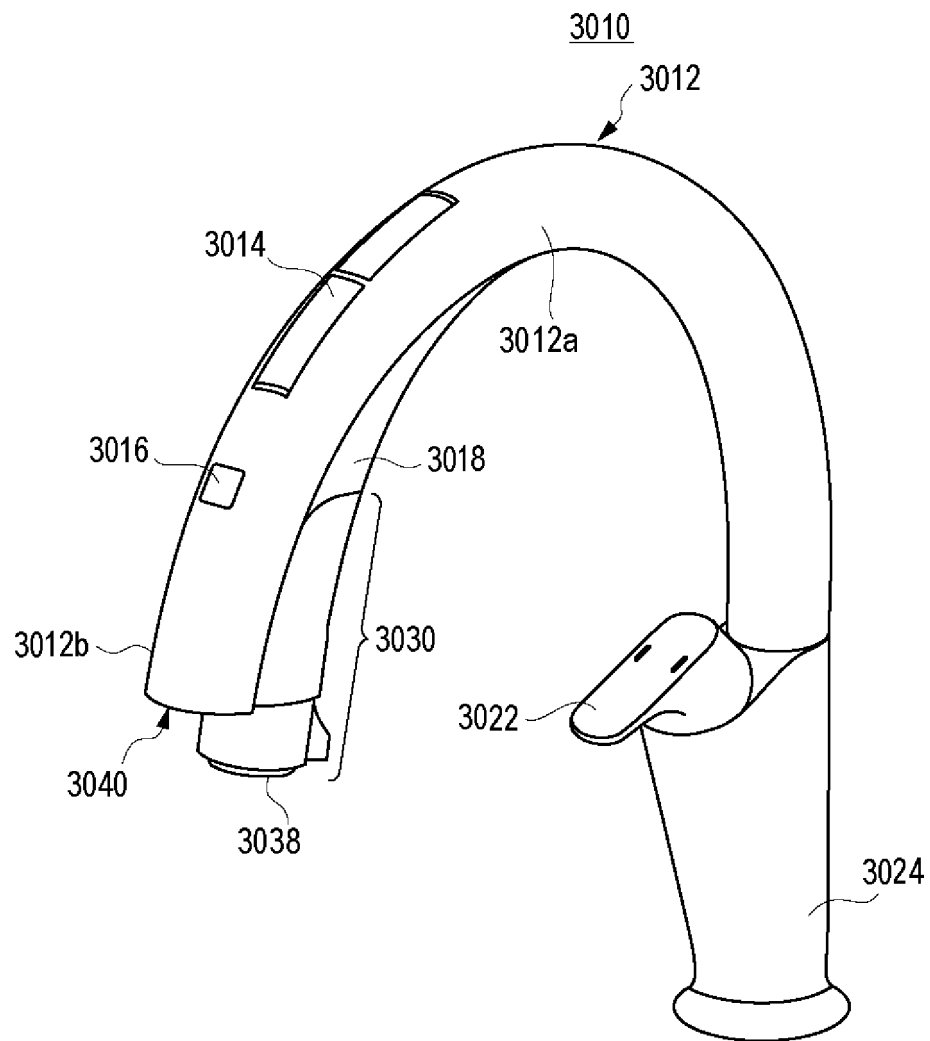
[FIG. 15]



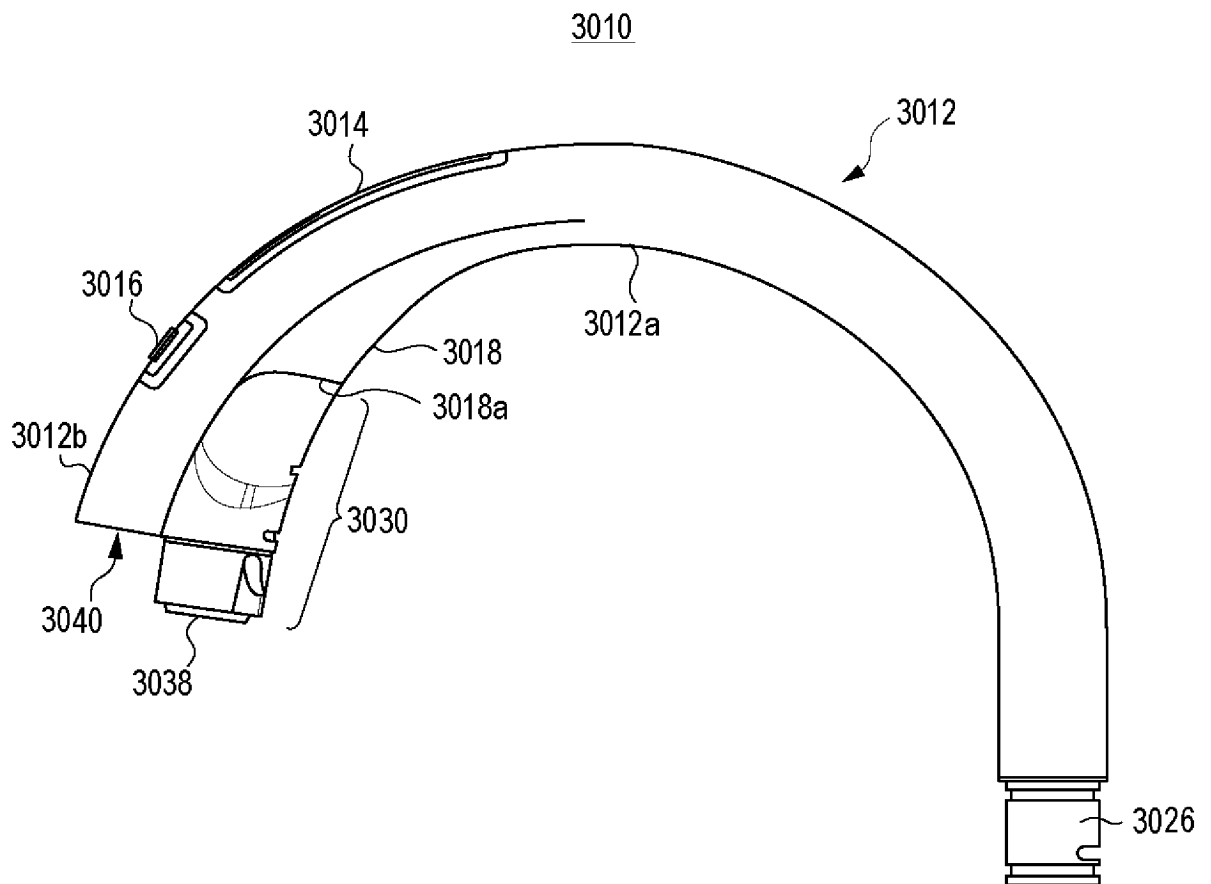
[FIG. 16]



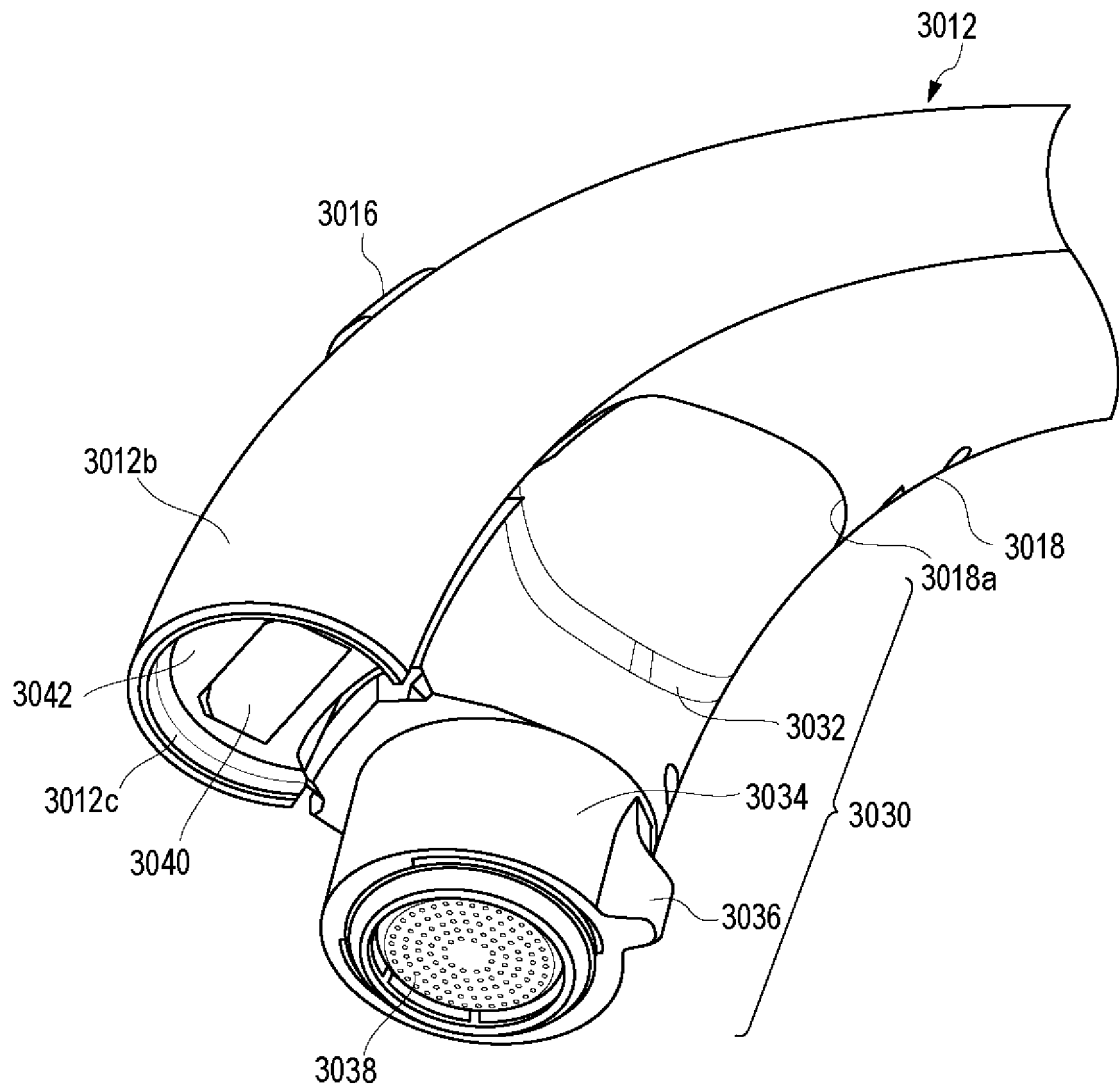
[FIG. 17]



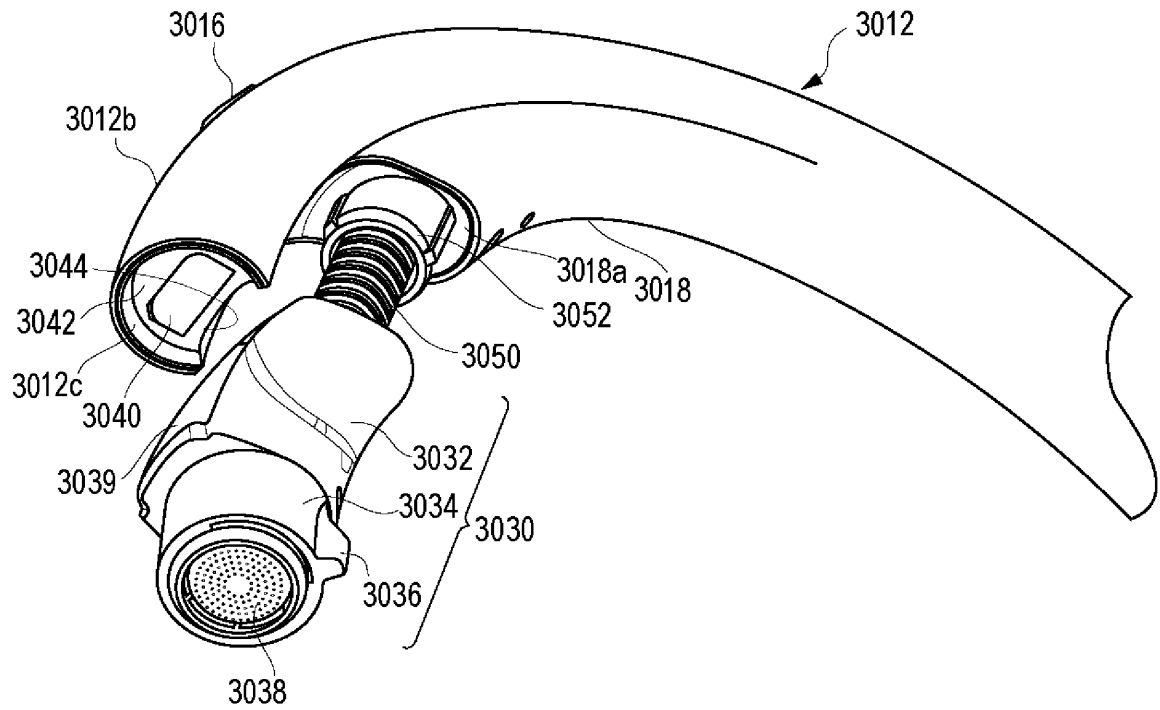
[FIG. 18]



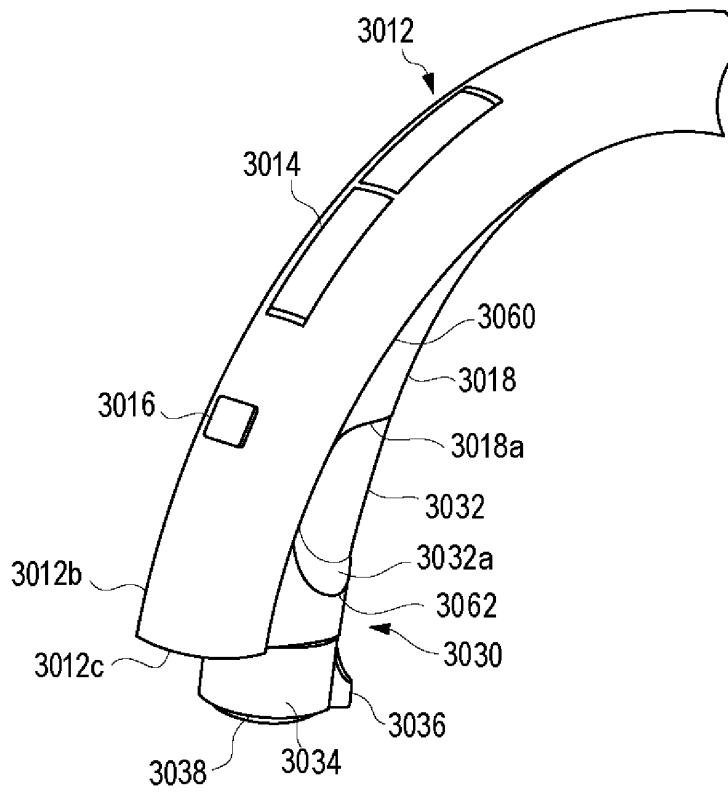
[FIG. 19]



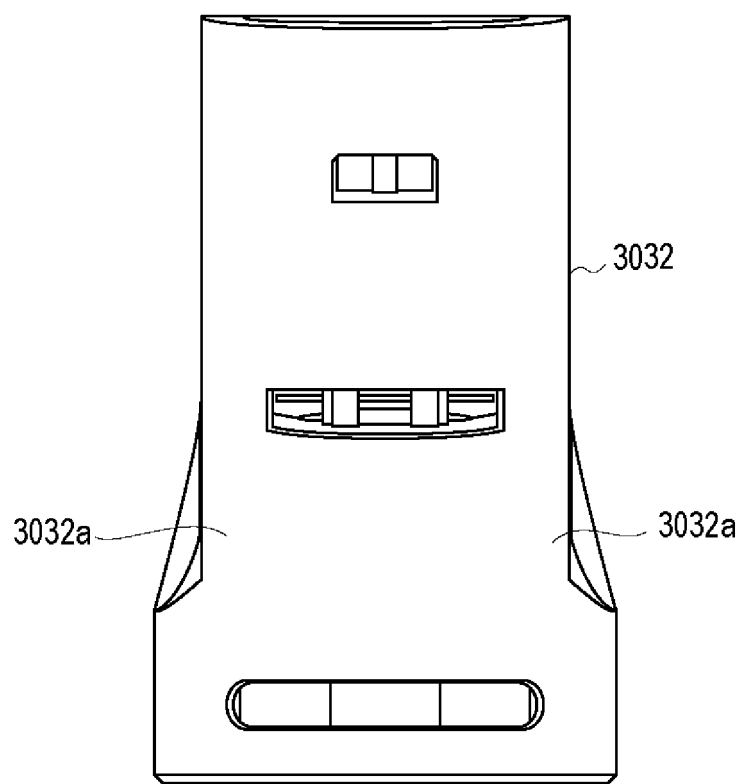
[FIG. 20]



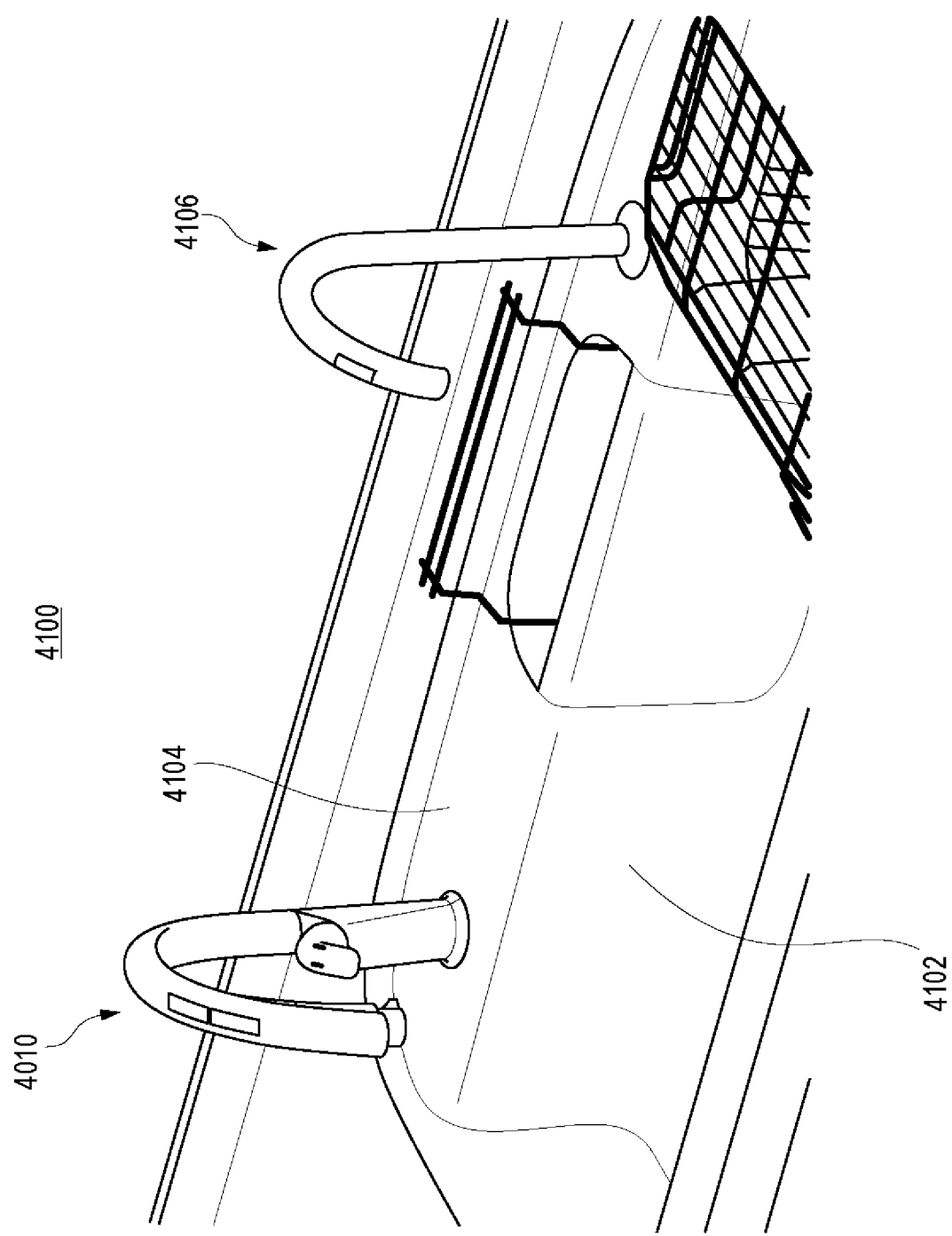
[FIG. 21]



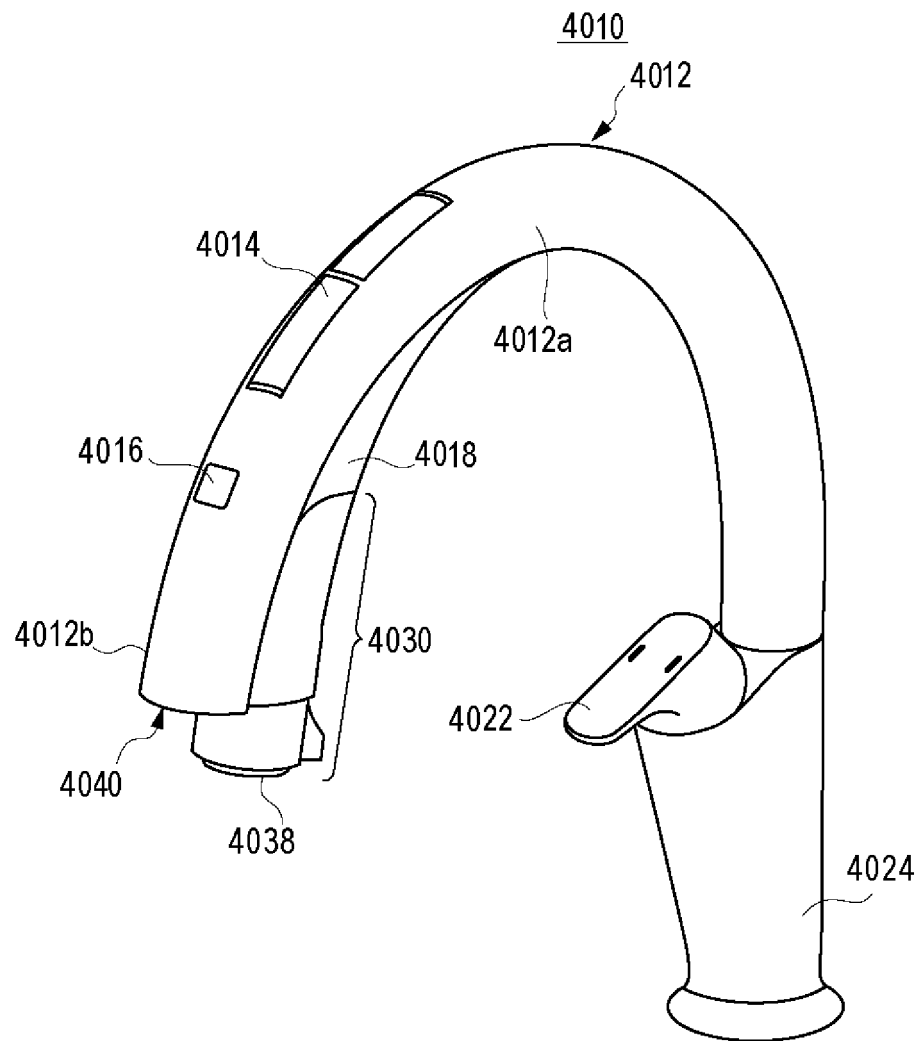
[FIG. 22]



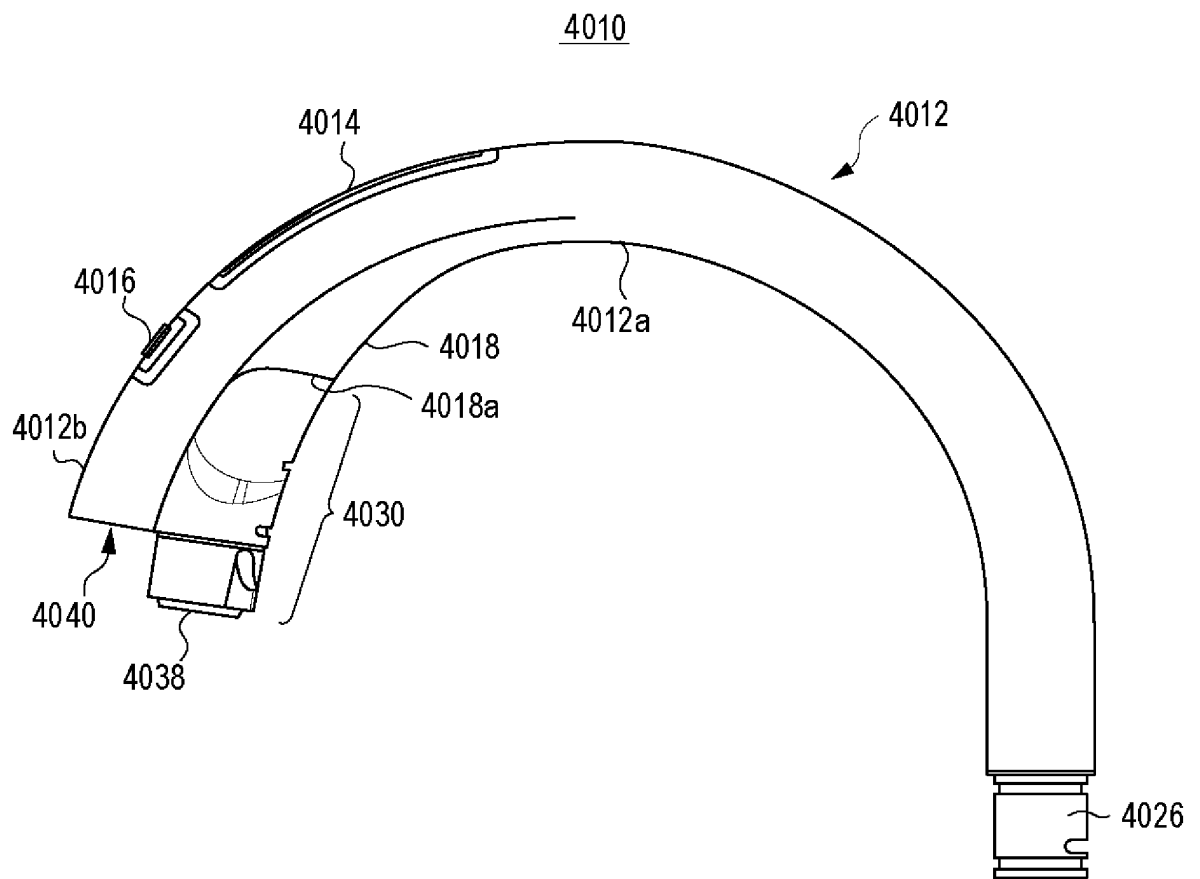
[FIG. 23]



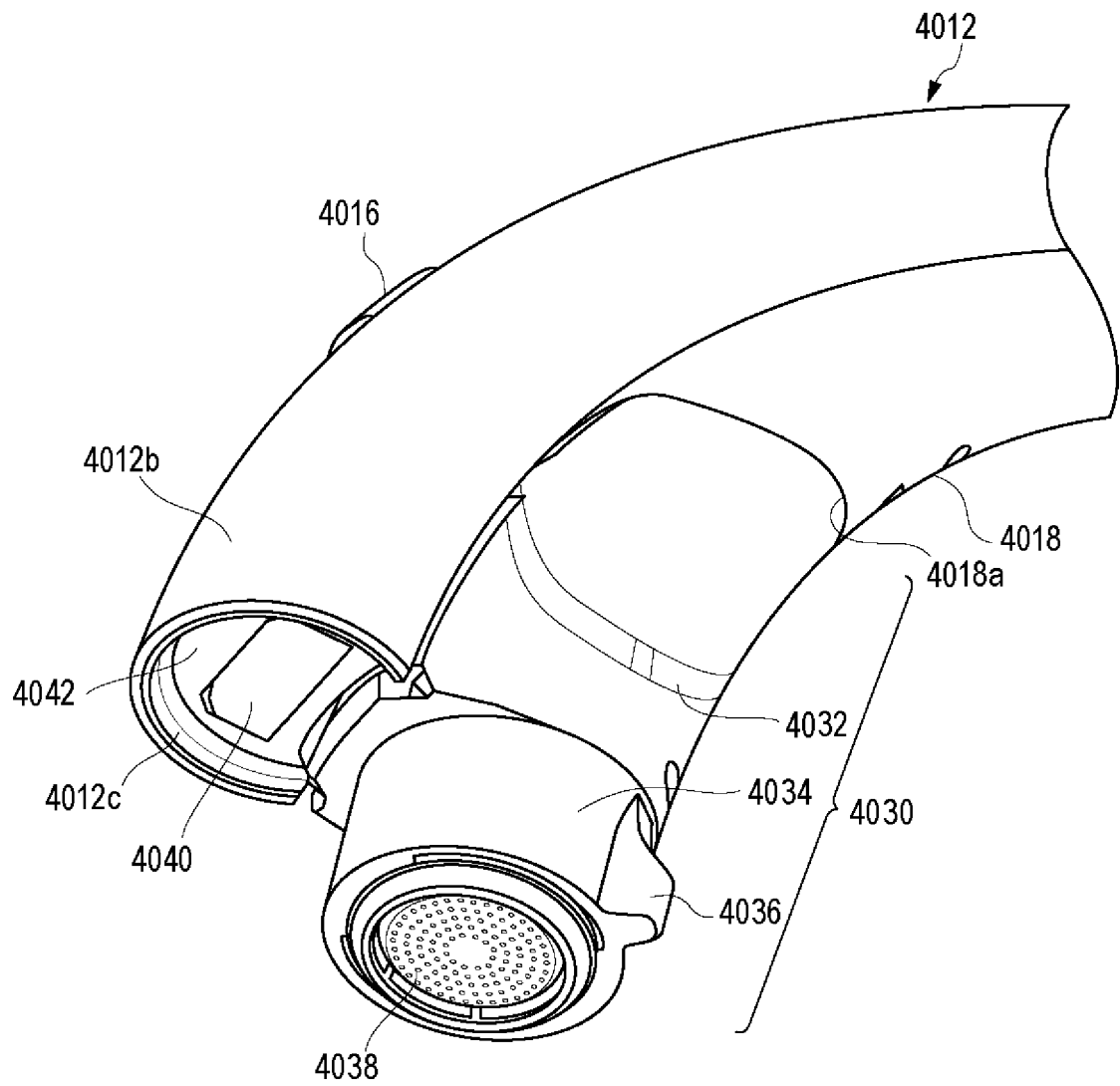
[FIG. 24]



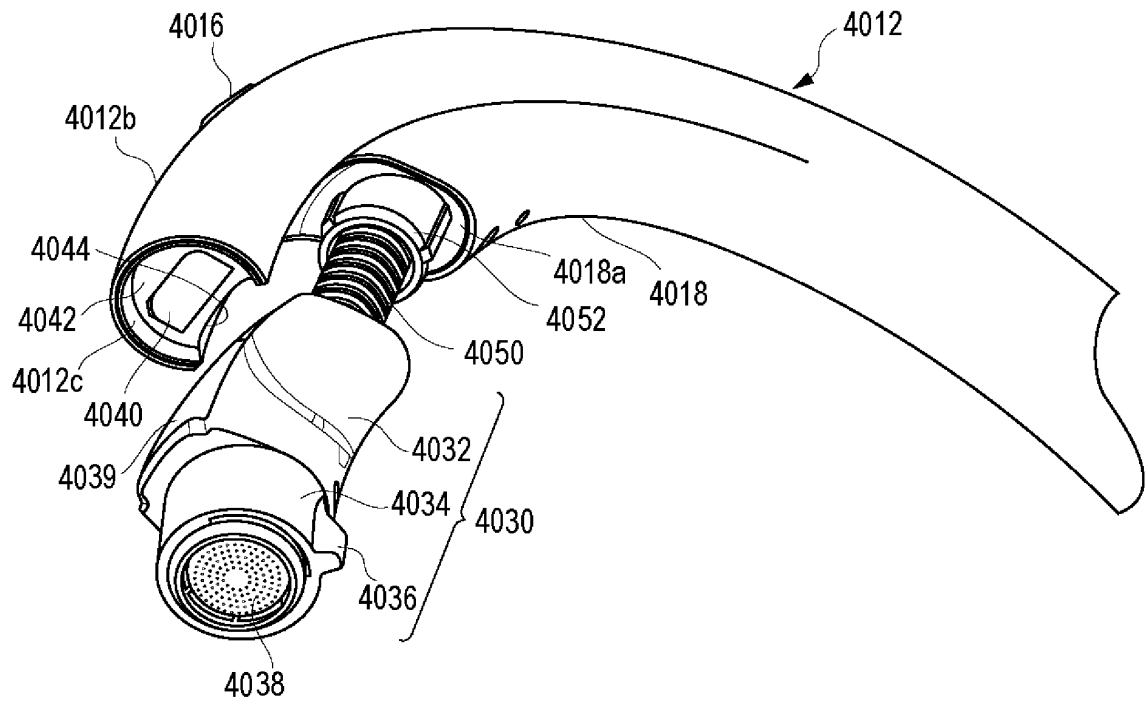
[FIG. 25]



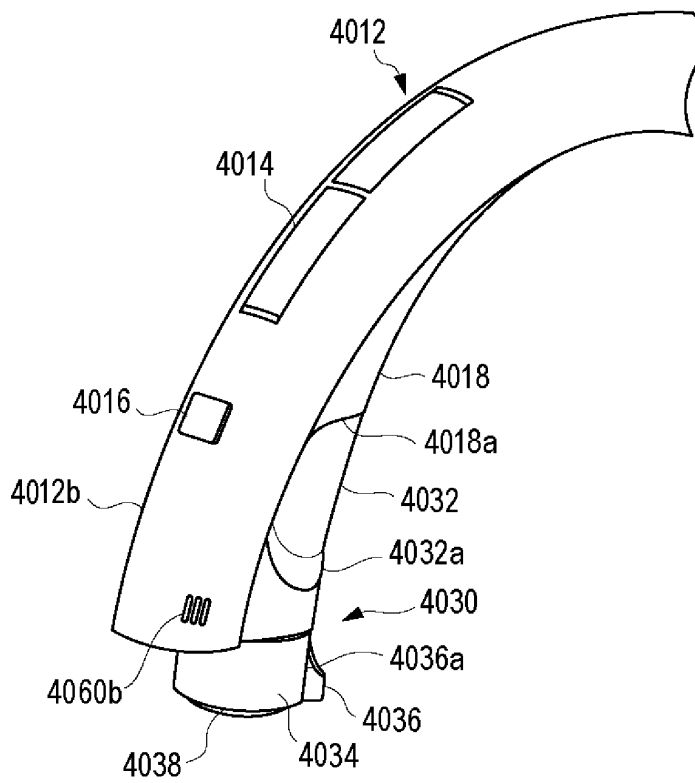
[FIG. 26]



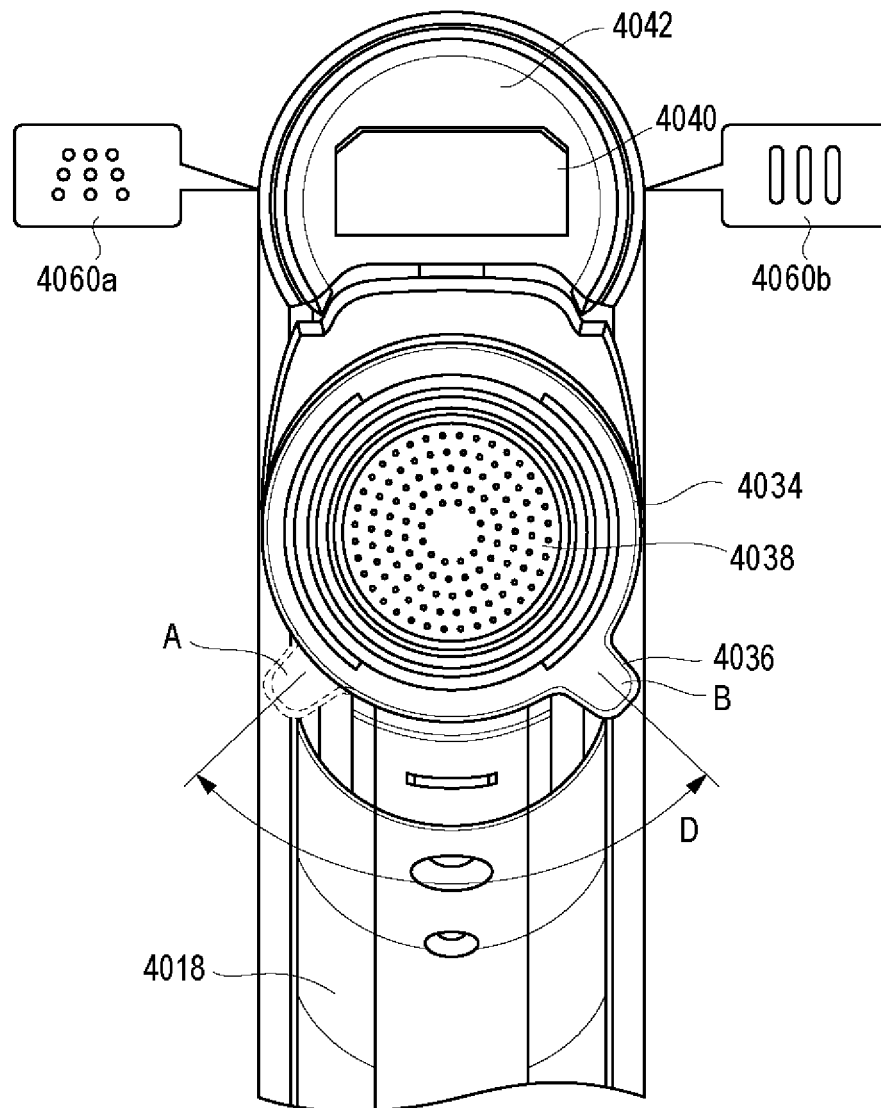
[FIG. 27]



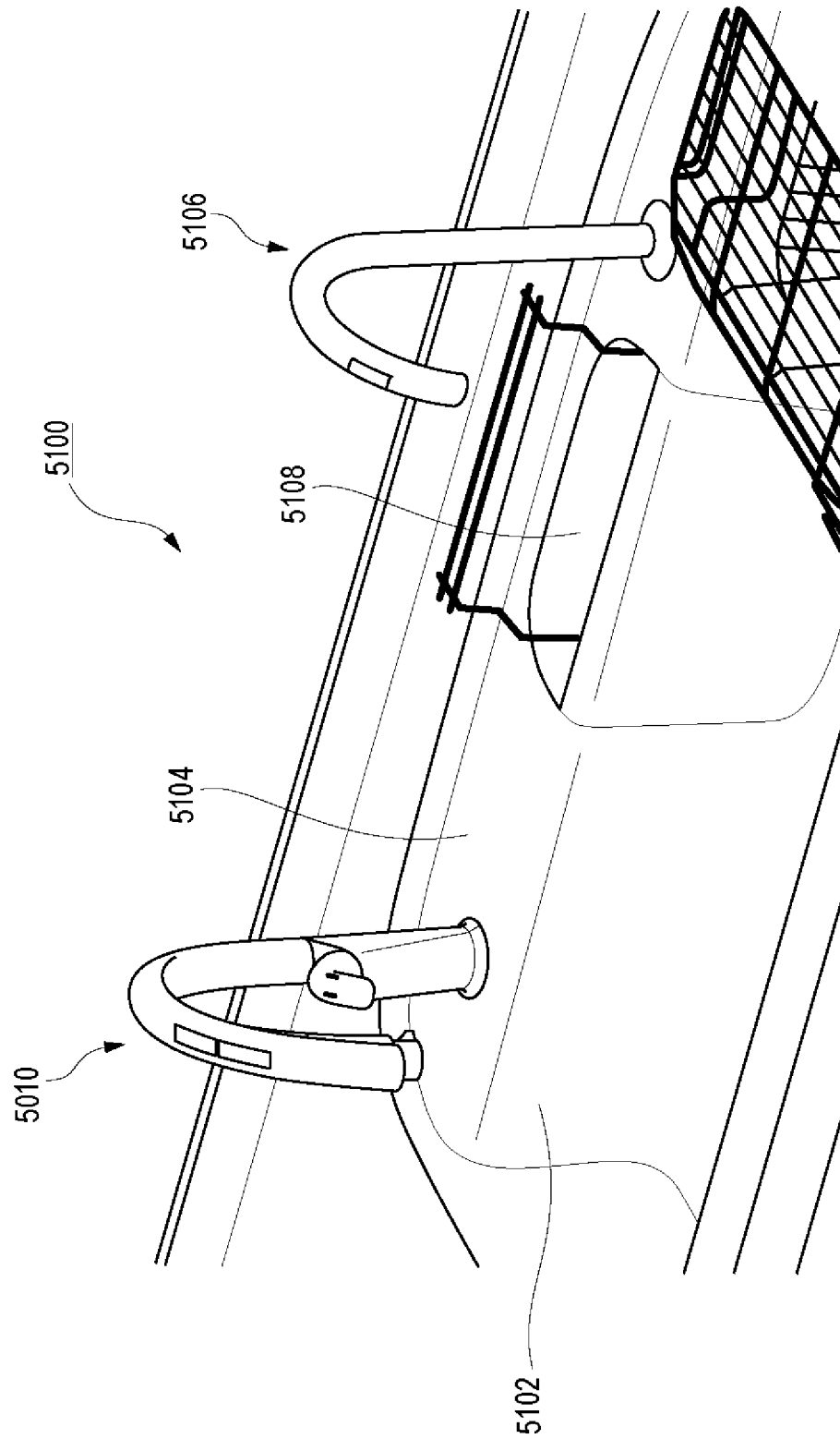
[FIG. 28]



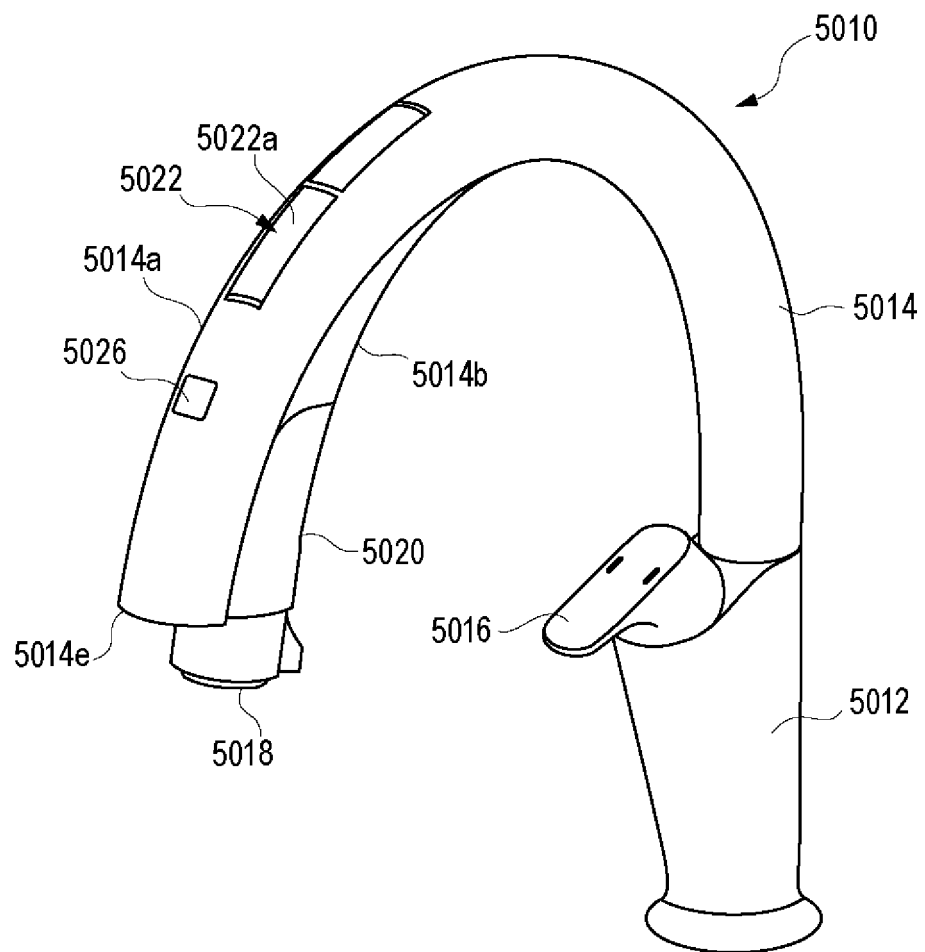
[FIG. 29]



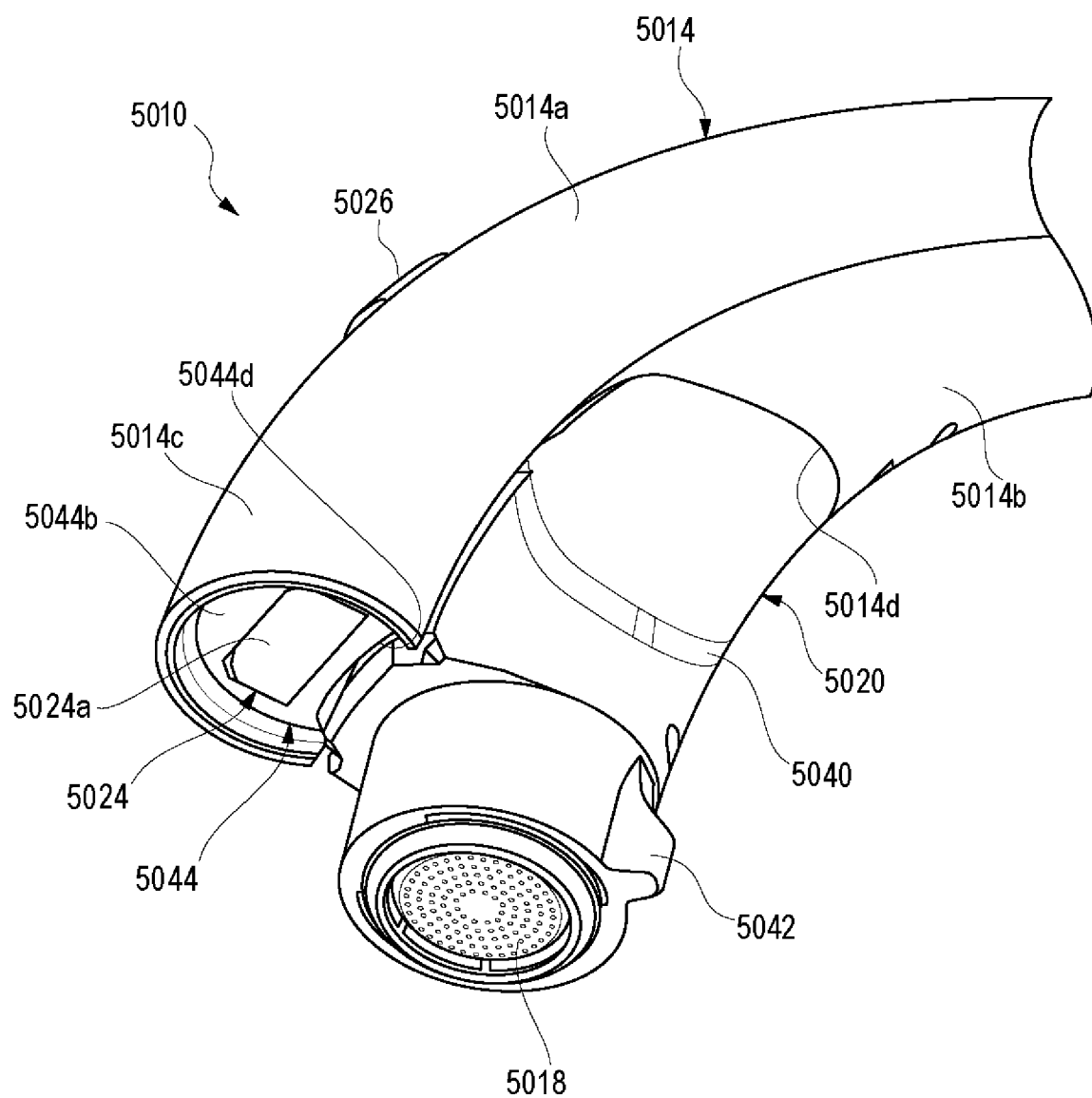
[FIG. 30]



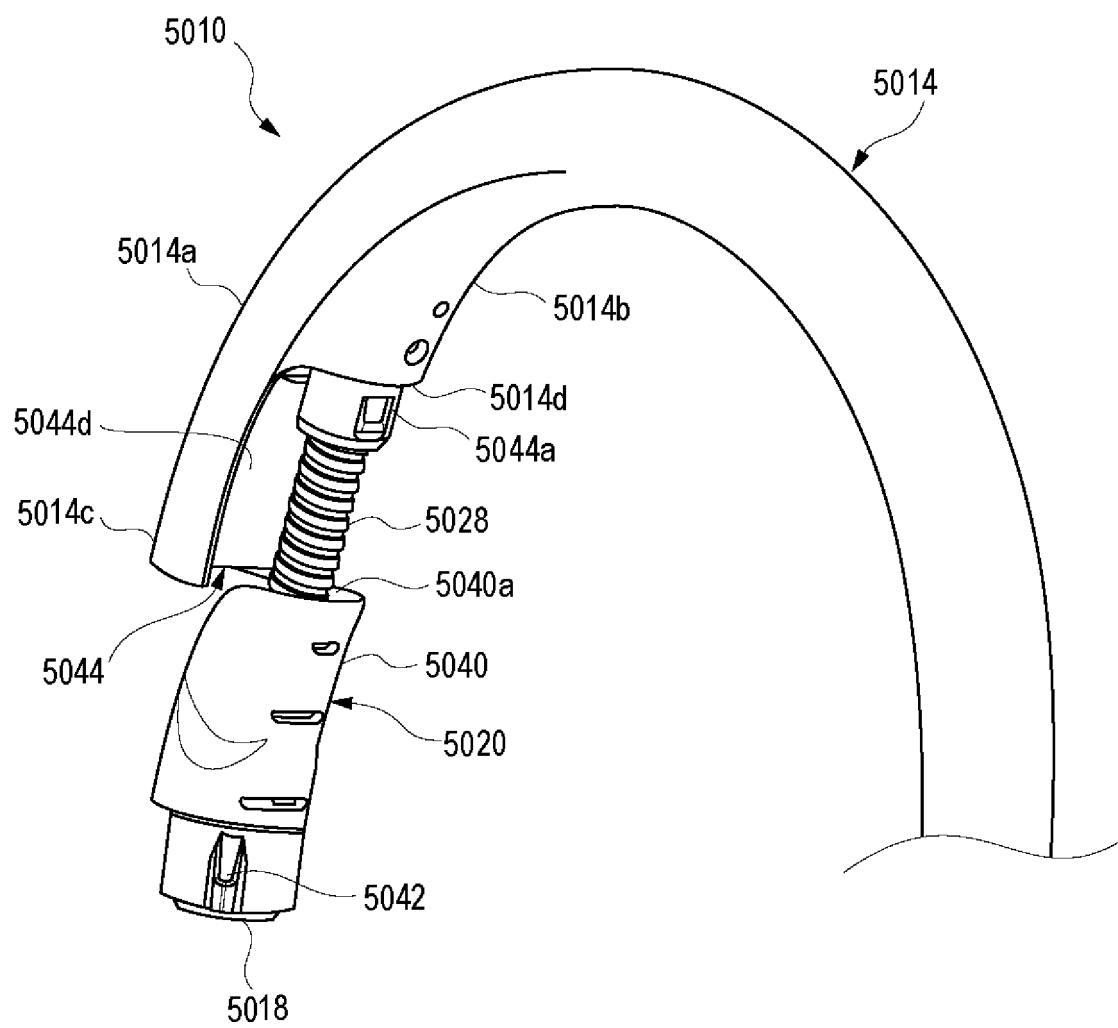
[FIG. 31]



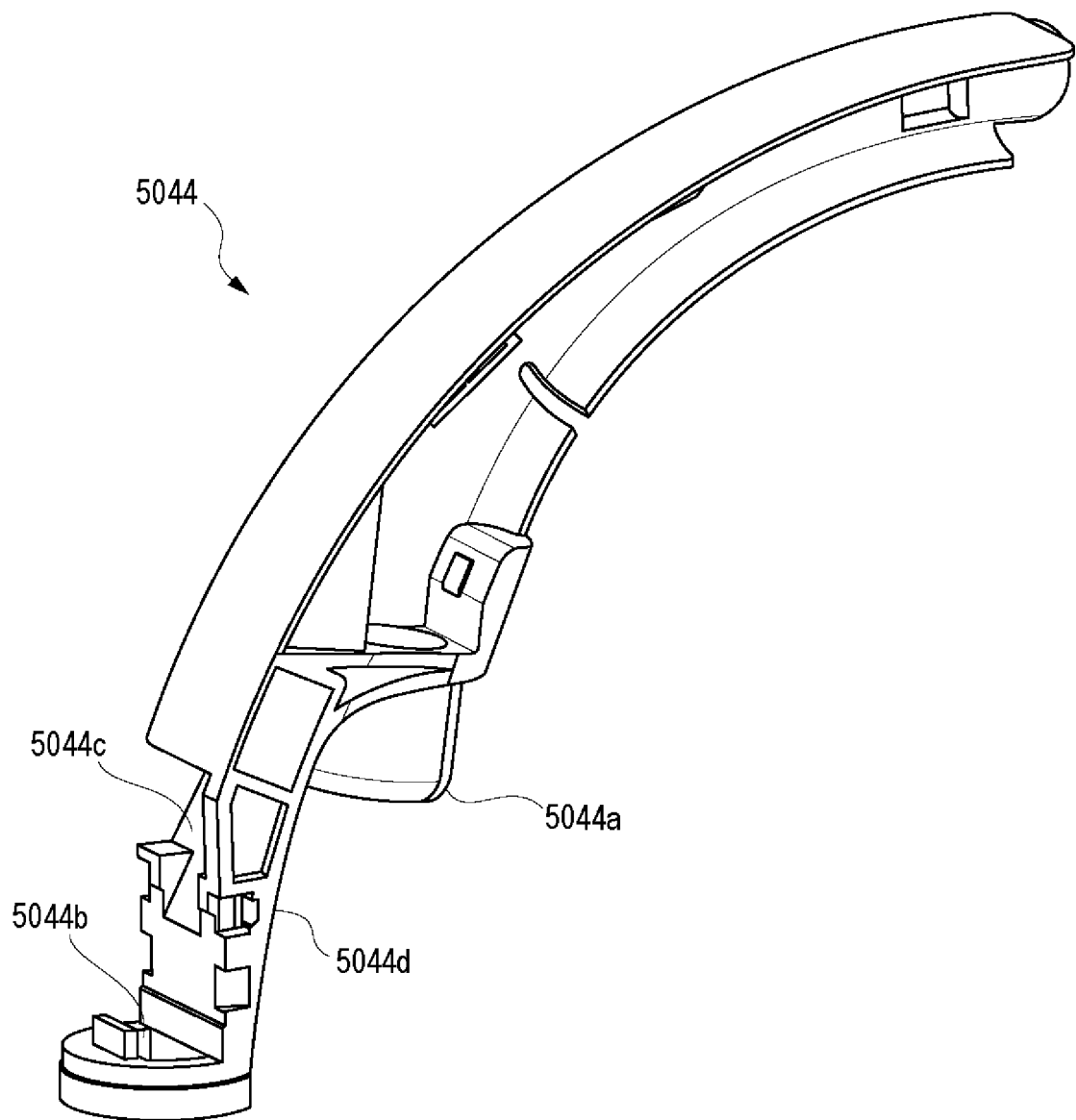
[FIG. 32]



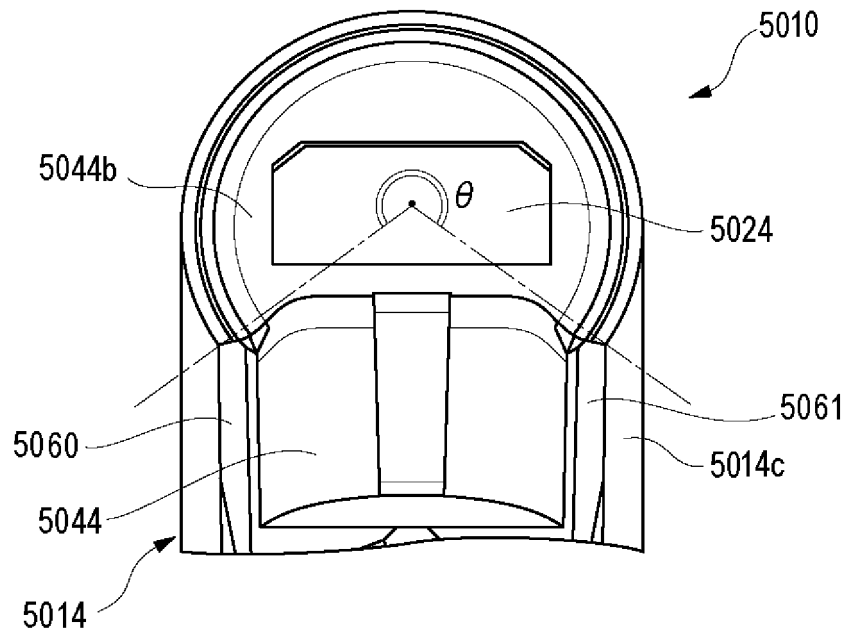
[FIG. 33]



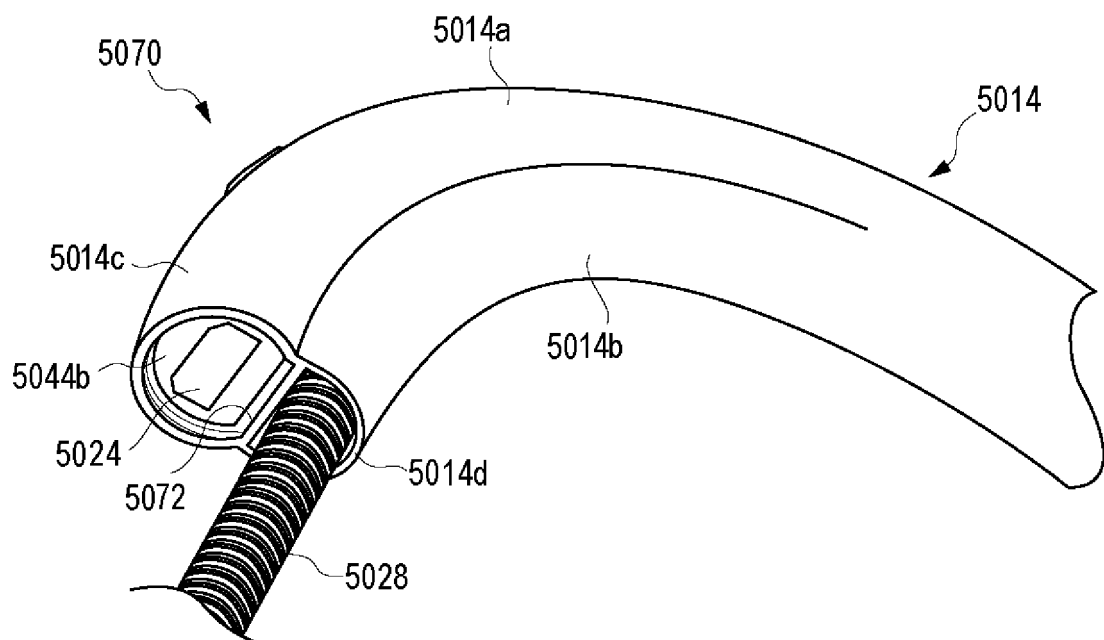
[FIG. 34]



[FIG. 35]



[FIG. 36]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/079271

A. CLASSIFICATION OF SUBJECT MATTER

E03C1/05(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)

E03C1/05

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015

Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-278123 A (Toto Ltd.), 07 October 2004 (07.10.2004), entire text; all drawings (Family: none)	1-24
A	JP 2009-133103 A (Inax Corp.), 18 June 2009 (18.06.2009), paragraphs [0022], [0025]; fig. 1, 5, 7 (Family: none)	5-9, 21-24
A	JP 9-41439 A (Friedrich Grohe AG.), 10 February 1997 (10.02.1997), paragraph [0015]; fig. 3 & US 5758690 A & EP 756038 A1 & DE 19527232 A1	1-24

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

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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

09 December 2015 (09.12.15)

Date of mailing of the international search report

26 January 2016 (26.01.16)

 Name and mailing address of the ISA/
 Japan Patent Office
 3-4-3, Kasumigaseki, Chiyoda-ku,
 Tokyo 100-8915, Japan

Authorized officer

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/079271

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 3-286050 A (Rinnai Corp.), 17 December 1991 (17.12.1991), page 3, upper left column, lines 4 to 16; fig. 2 (Family: none)	17-20

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2013108286 A [0004]
- JP 2011122359 A [0004]
- JP 2011094480 A [0004]
- JP 5465687 B [0004]
- JP 2011137289 A [0004]