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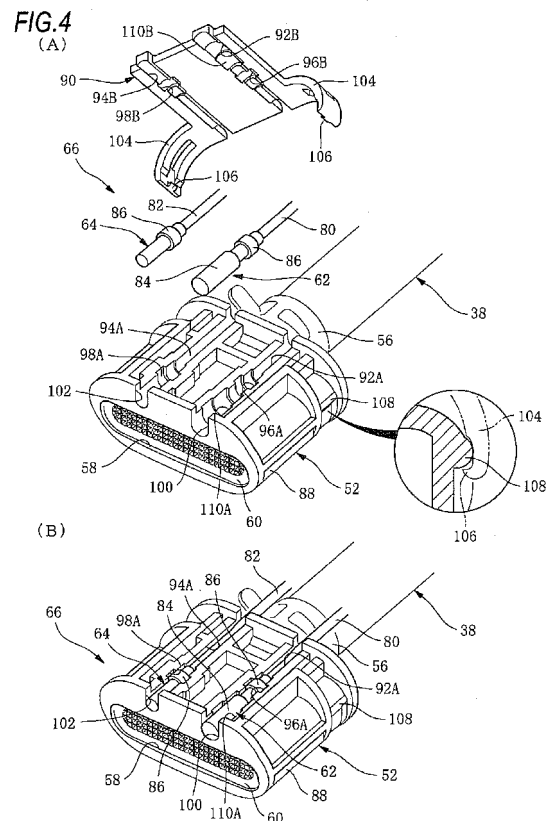
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(54) **AUTOMATIC FAUCET**

(57) An object of the present invention is to provide an automatic faucet wherein the respective tip section of an optical fiber on a light projection side and an optical fiber on a light receiving side constituting a light projection section and a light receiving section can be easily fixed and separated, workability during assembling of the tip sections of the optical fibers and workability during maintenance can be good rendered, the tip section of a water spout pipe can be made compact.

A cylindrical water spout member 52 is provided inside the tip section of the water spout pipe, the optical fiber 80 on the light projection side and the optical fiber 82 on the light receiving side are passed inside the water spout pipe up to the tip section of the water spout pipe, and the tips of the optical fibers 80 and 82 configure a light projection section 62 and a light receiving section 64. Moreover, fitting convex section 86 are provided on the outer surfaces of the tip sections of the optical fibers 80 and 82, and the fitting concave sections 96A and 98A are provided on the outer surface of the water spout member 52. The tip sections of the optical fibers 80 and 82 are fixed in a positioned state based on the concave-convex fitting.



Description

Technical Field

[0001] The present invention relates to an automatic faucet which automatically discharges water from a water spout based on the detection of a detection target using an optical sensor, and specifically, to a fixing structure of a tip section of an optical fiber.

Background Art

[0002] Now, an automatic faucet in a public toilet, a lavatory or the like has been widely used which has an optical sensor (hereinafter, simply referred to as a sensor) that projects light from a light projection section provided in a tip section of a water spout pipe and then receives the reflected light from a detection target such as the hand of a user or the like by a light receiving section provided in the water spout pipe to detect the detection target, and thus automatically discharges water based on the detection using the sensor.

Generally, the sensor determines that there is a detection target when a light receiving amount is greater than the set threshold value.

In such an automatic faucet, previously, in many cases, the light projection section and the light receiving section have been provided in the tip section of the water spout pipe.

[0003] Meanwhile, in the automatic faucet of the related art, a light emitting element such as an LED emitting the light as the light projection section and the light receiving element such as a photodiode and a phototransistor as the light receiving section have been placed in the tip section of the water spout pipe, and a sensor circuit, which includes a light emitting drive circuit for emitting the light using the light emitting element and a photoelectric conversion circuit for converting the light received by the light receiving element into an electric signal to perform the signal processing has been provided in the tip section of the water spout pipe in the state of being connected to the light emitting element and the light receiving element.

[0004] For example, Patent Literature 1 and Patent Literature 2 disclose an automatic faucet which is formed by providing the light emitting element, the light receiving element, and the sensor including the sensor circuit in the tip section of the water spout pipe.

However, as disclosed in Patent Literature 1 and Patent Literature 2, in the case of the automatic faucet provided with the light emitting element, the light receiving element, and the sensor including the sensor circuit in the tip section of the water spout pipe, the shape of the tip section of the water spout pipe has been inevitably increased in size, and there has been a problem in that the size of the overall water spout pipe is increased along with this and the design is degraded.

[0005] In the related art, an automatic faucet has been

known in which a sensor main body including the light emitting element and the light receiving element is placed outside the water spout pipe, an optical fiber on the light projection side to guide the light from the light emitting element of the sensor main body and an optical fiber on the light receiving side to guide the reflected light from the detection target to the light receiving element are passed inside an inner part of the water spout pipe up to the tip section of the water spout pipe, so that the light projection section is formed in the tip of the optical fiber on the light projection side and the light receiving section is formed in the tip of the optical fiber on the light receiving side, respectively.

[0006] For example, Patent Literature 3 and Patent Literature 4 disclose this type of automatic faucet using optical fiber.

In this manner, in a case where the sensor main body is placed outside the water spout pipe, the optical fibers are passed inside the water spout pipe up to the tip section of the water spout pipe, and the light projection section and the light receiving section are configured in the tips of the optical fibers, it is possible to reduce the size of the water spout pipe compared to a case of providing the sensor main body in the tip section of the water spout pipe.

[0007] However, in a case of configuring the light projection section and the light receiving section in the tips of the optical fibers passed into the water spout pipe, a fixing structure of the tip section of each of the optical fiber on the light projection side and the optical fiber on the light receiving side becomes a problem.

Depending on the fixing structure, the assembling work of the tip section of the optical fiber to the water spout pipe, and a work when removing the tip section of the optical fiber from the water spout pipe to perform the maintenance work become difficult, and the tip section of the water spout pipe is increased in size depending on the situation.

However, Patent Literature 3 and Patent Literature 4 do not specifically disclose the fixing structure of the tip section of the optical fiber.

References

Patent Literature

[0008]

[Patent Literature 1] JP-A-2009-133103

[Patent Literature 2] JP-A-2002-70096

[Patent Literature 3] JP-UM-A-3-125862

[Patent Literature 4] JP-A-5-311709

Summary of Invention

Technical Problem

[0009] The present invention has been made based

on such background, and an object thereof is to provide an automatic faucet which is able to easily fix and separate each tip section of the optical fiber on the light projection side and the optical fiber on the light receiving side for configuring the light projection section and the light receiving section, which is able to have satisfactory workability when assembling the tip section of the optical fiber and workability during maintenance, and which is able to maintain the tip section of the water spout pipe in a small size.

Solution to Problem

Advantageous Effects of Invention

[0010] According to a first aspect of the present invention, an automatic faucet, in which a cylindrical water spout member forming a water spout as a tip of a water path in a water spout pipe is provided inside the tip section of the water spout pipe, an optical fiber on a light projection side for guiding light from a light emitting element and an optical fiber on a light receiving side for guiding a reflected light from a detection target to a light receiving element are passed inside the water spout pipe up to the tip section of the water spout pipe, the tip of the optical fiber on the light projection side configures a light projection section, and the tip of the optical fiber on the light receiving side configures a light receiving section, and in which water is discharged from the water spout based on the detection of the detection target using an optical sensor, wherein a fitting convex section is provided in one of an outer surface of the tip section of each of the optical fiber on the light projection side and the optical fiber on the light receiving side and a fiber holding section of the outer surface of the water spout member, and a fitting concave section corresponding to that is provided in the other thereof, and wherein the tip sections of the optical fibers are fixed in a positioned state based on the concave-convex fitting of the fitting convex section and the fitting concave section.

[0011] According to a second aspect of the present invention, in the first aspect, a cover is further provided to cover a fixing section of the tip sections of the optical fibers to the outer surface of the water spout member.

[0012] According to a third aspect of the present invention, an automatic faucet, in which a cylindrical water spout member forming a water spout as a tip of a water path in a water spout pipe is provided inside the tip section of the water spout pipe, an optical fiber on a light projection side for guiding light from a light emitting element and an optical fiber on a light receiving side for guiding a reflected light from a detection target to a light receiving element are passed inside the water spout pipe up to the tip section of the water spout pipe, the tip of the optical fiber on the light projection side configures a light projection section, and the tip of the optical fiber on the light receiving side configures a light receiving section, and in which water is discharged from the water spout based

on the detection of the detection target using an optical sensor, wherein a fitting convex section is provided in one of an outer surface of the tip section of each of the optical fiber on the light projection side and the optical fiber on the light receiving side and a fiber holding section of the cover fixed to the water spout member in a state of covering the outer surface of the water spout member, a fitting concave section corresponding to that is provided on the other thereof, and wherein the tip sections of the optical fibers are fixed in a positioned state based on a concave-convex fitting of the fitting convex section and the fitting concave section.

[0013] According to a fourth aspect of the present invention, an automatic faucet, in which a cylindrical water spout member forming a water spout as a tip of a water path in a water spout pipe is provided inside the tip section of the water spout pipe, an optical fiber on a light projection side for guiding light from a light emitting element and an optical fiber on a light receiving side for guiding a reflected light from a detection target to a light receiving element are passed inside the water spout pipe up to the tip section of the water spout pipe, the tip of the optical fiber on the light projection side configures a light projection section, and the tip of the optical fiber on the light receiving side configures a light receiving section, respectively, and in which water is discharged from the water spout based on the detection of the detection target using an optical sensor, wherein a groove as a fiber holding section holding the tip sections of the optical fibers is provided on both of the outer surface of the water spout member and the inner surface of the cover that covers the outer surface in a state of facing each other, and the tip section of the optical fiber is fitted into the grooves, and wherein a fitting convex section is provided in one of the outer surface of the tip sections of the optical fibers and the inner surfaces of the grooves, a fitting concave section is provided in the other thereof, and wherein the tip sections of the optical fibers are fixed in a positioned state based on a concave-convex fitting of the fitting convex section and the fitting concave section.

[0014] According to a fifth aspect of the present invention, in any one of the first to fourth aspects of the present invention, the tip sections of the optical fibers are placed and fixed in a straight line shape so as to be parallel to a pipe axis of the water spout pipe.

[0015] According to a sixth aspect of the present invention, an automatic faucet comprises, a water spout member that is provided inside a tip section of a water spout pipe and forms a water spout; a light projection section having a first optical fiber that guides light from a light emitting element; and a light receiving section having a second optical fiber that guides a reflected light from a detection target to a light receiving element, the automatic faucet discharging water from the water spout based on the detection of the detection target using an optical sensor, wherein the first optical fiber has a first fitting convex section, and the second optical fiber has a second fitting convex section, and wherein the water

spout member has a first fitting concave section fitted to the first fitting convex section and a second fitting concave section fitted to the second fitting convex section.

[0016] According to a seventh aspect of the present invention, in the sixth aspect of the present invention, a cover is further provided to cover the water spout member, the cover having a third fitting concave section which is fitted to the first fitting convex section of the first optical fiber provided in the water spout member, and a fourth fitting concave section which is fitted to the second fitting convex section of the second optical fiber provided in the water spout member.

[0017] According to an eighth aspect of the present invention, an automatic faucet comprising: a water spout member that is provided inside a tip section of a water spout pipe and forms a water spout; a light projection section having a first optical fiber that guides light from a light emitting element; a light receiving section having a second optical fiber that guides a reflected light from a detection target to a light receiving element; and a cover that covers the water spout member, the automatic faucet discharging water from the water spout based on the detection of the detection target using an optical sensor, wherein the first optical fiber has a first fitting convex section and the second optical fiber has a second fitting convex section, and wherein the cover has a first fitting concave section fitted to the first fitting convex section and a second fitting concave section fitted to the second fitting convex section.

[0018] According to a ninth aspect of the present invention, a water spout unit of an automatic faucet comprising: a water spout member that is provided inside a tip section of a water spout pipe and forms a water spout; a light projection section having a first optical fiber that guides light from a light emitting element; a light receiving section having a second optical fiber that guides a reflected light from a detection target to a light receiving element; and a cover that covers the water spout member, wherein the first optical fiber has a first fitting convex section, and the second optical fiber has a second fitting convex section, wherein the water spout member has a first fitting concave section fitted to the first fitting convex section and a second fitting concave section fitted to the second fitting convex section, and wherein the first optical fiber and the second optical fiber are fixed by the water spout member and the cover.

Effects of the Invention

[0019] As mentioned above, according to the first aspect of the present invention, a fitting convex section is provided in one of the outer surface of the tip section of each of the optical fiber on the light projection side and the optical fiber on the light receiving side and a fiber holding section of the outer surface of the cylindrical water spout member forming the water spout of the tip of the water path in the water spout pipe, a fitting concave section corresponding to that is provided on the other

thereof, and the tip sections of the optical fibers are fixed in a positioned state based on the concave-convex fitting of the fitting convex section and the fitting concave section. According to the present invention, it is easily possible to fix each tip section of the optical fiber on the light projection side and the optical fiber on the light receiving side to the tip section of the water spout pipe via the water spout member by the concave-convex fitting and also the release of the fixing is easy, and thus it is possible to perform the work with good workability when assembling the tip section of the optical fibers to the water spout pipe, and also the fixing release thereof is easy, so that it is also possible to perform the work with good workability when detaching and maintaining the top section of the optical fibers from the water spout pipe.

[0020] In the present invention, it is possible to directly fix the tip section of each of the optical fiber on the light projection side and the optical fiber on the light receiving side to the water spout member, so that it is possible to reduce the size of the tip section of the water spout pipe compared to case that the tip section of the optical fiber on the light projection side including the light projection section and the tip section of the optical fiber on the light receiving side including the light receiving section is assembled in advance as a unit and it is fixed in the state of the unit to the tip section of the water spout pipe.

[0021] In the present invention, it is possible to further include the cover that covers the fixing section of the tip sections of the optical fibers to the outer surface of the water spout member (the second aspect of the present invention).

In this way, the tip sections of the optical fibers can be interposed between the water spout member and the cover, and the tip sections of the optical fibers can be fixed more good to the water spout member.

[0022] In the present invention, a fitting convex section is provided in one of the outer surface of the tip section of each of the optical fiber on the light projection side and the optical fiber on the light receiving side and a fiber holding section of the cover fixed to the water spout member in a state of covering the outer surface of the water spout member, a fitting concave section corresponding to that is provided on the other thereof, and the tip sections of the optical fibers are fixed in a positioned state based on the concave-convex fitting of the fitting convex section and the fitting concave section (the third aspect of the invention).

In this case, it is also possible to perform the work with good workability when assembling the respective tip sections of the optical fibers to the tip section of the water spout pipe and maintaining, and the tip section of the water spout pipe can be reduced in size.

In this case, the fiber holding section may be provided at an inner surface of the cover.

In this way, the tip sections of the optical fibers can be interposed between the cover and the water spout member, and the tip sections of the optical fibers can be fixed more good.

[0023] In this case, the fiber holding section may be a groove and the tip sections of the respective optical fibers can be fixed to the groove in the fitted state.

In this way, the tip sections of the respective optical fibers can be more easily fixed to the water spout member, and thus can be fixed to the tip section of the water spout pipe. In addition, binding force to the respective tip section can be increased and the fixing strength can be increased.

[0024] Furthermore, since the tip sections of the respective optical fibers are fitted into the inner section of the groove, so that the light projection section and the light receiving section can be protected in the groove, and thus the tip sections of the respective optical fibers can be fixed into the water spout member or the cover in the housed state, so that the tip section of the water spout pipe can be more effectively reduced in size.

In this case, the groove can be provided, with respect to the water spout member or the cover, in a shape extending from the end of the water spout pipe base end side up to the end of the tip side.

[0025] According to the fourth aspect of the present invention, a groove a fiber holding section are provided on both of the outer surface of the water spout member and the inner surface of the cover in a state of facing each other, the tip sections of the optical fibers are fitted into the grooves, a fitting convex section is provided in one of the outer surface of the tip sections of the optical fibers and the inner surfaces of the grooves, a fitting concave section is provided in the other thereof and are fitted by the concave-concave fitting, and the tip sections of the optical fibers are fixed in a positioned state. Thus, according to the claim 5, the tip sections of the respective optical fibers can be effectively bound to the inner portions of the grooves, and it is possible to further increase the positioning function and the fixing function to the tip sections of the respective optical fibers.

Furthermore, it is possible to cover the tip sections of the respective optical fibers including the light receiving section by the water spout member and the cover, and thus the protective function of the respective tip section can be increased.

[0026] The tip sections of the respective optical fibers can be placed and fixed in the straight line shape to be parallel to a pipe axis of the water spout pipe (the fifth aspect of the present invention).

In this way, the thickness of the water spout member and the cover can be reduced compared to a case of obliquely fixing of the tip sections of the optical fibers, and thus the tip section of the water spout pipe can be reduced in size.

Brief Description of Drawings

[0027]

FIG. 1 is an overall view of an automatic faucet in an embodiment of the present invention.

FIG. 2 is a longitudinal cross-sectional view of a water spout pipe in the embodiment.

FIG. 3 is a cross-sectional view of a major part of a tip section of the water spout pipe in the embodiment. FIG. 4 is a view of a water spout unit in the embodiment.

FIG. 5 is a view of the water spout unit in the embodiment in a state before being assembled to the water spout pipe.

FIG. 6 is a view of another embodiment of the present invention

Description of Embodiments

[0028] Next, embodiments of the present invention will be described based on the drawings.

In FIG. 1, reference numeral 10 is an automatic faucet of the present embodiment, and reference numeral 12 is a water spout pipe in the automatic faucet 10. Herein, the water spout pipe 12 is made of metal.

The water spout pipe 12 is installed in the form of standing from a counter (an attachment base) 14, an upper section has a goose neck shape that is inverted U-shaped, and a tip face thereof extends forward and obliquely downward with respect to the user.

As shown in Figs. 1 and 2, the water spout pipe 12 is formed with a substantially elliptical opening 16 corresponding to the cross-sectional shape of the water spout pipe 12 at the tip thereof.

[0029] As shown in FIG. 2, the water spout pipe 12 integrally has a seating section 18 and an inserting pipe 20 extended downward from the seating section 18 at the base end side thereof.

The inserting pipe 20 is inserted into an attachment hole 22 of the counter 14 and is projected up to the underside of the counter 14, and a fixing nut 26 is screwed into a male screw section 24 provided on the outer circumferential surface thereof.

The water spout pipe 12 is attached to the counter 14 by seating the seating section 18 on the upper surface of the counter 14, in a state of interposing the counter 14 from both sides of the upper and lower sides via packing 28 and 30 by the seating section 18 and the fixing nut 26.

[0030] In FIG. 1, reference numeral 32 is a main body functioning section placed under the counter 14, reference numeral 34 is a functioning section box of the main body functioning section 32, and an electromagnetic valve 36 is accommodated therein.

The electromagnetic valve 36 is a valve which opens and closes a water supply path supplying water from a water supply source pipe to a water spout 58 (FIG. 2) described later, and a lower end of a water supply tube 38 is connected to the electromagnetic valve 36 via a joint 40.

[0031] The water supply tube 38 is a member that forms a part of the water supply path, is extended upward from the functioning section box 34, and enters into the water spout pipe 12 through an opening 42 of the base end (a lower end) of the water spout pipe 12, as shown in FIG. 2.

The water supply pipe 38 further extends the inner sec-

tion of the water spout pipe 12 up to the tip section thereof. Additionally, in this example, since the water supply tube 38 is a tube which has flexibility, here it is formed from polyurethane resin.

Incidentally, in FIG. 1, reference numeral 44 indicates a stopcock.

[0032] In the inner section of the functioning section box 34, a control section 46 including a microcomputer as a main component, and a sensor main body 48 configuring a main component of an optical sensor (hereinafter, easily referred to as a sensor) are accommodated. The control section 46 operates and controls the electromagnetic valve 36, opens the electromagnetic valve 36 based on the detection of the detection target using the sensor, and closes the electromagnetic valve 36 when the sensor does not detect the detection target.

[0033] The sensor main body 48 has a light emitting element such as an LED that emits light (herein, infrared light), a light receiving element such as a phototransistor, and a sensor circuit which includes a light emitting driving circuit that performs the light emitting using the light emitting element, and a photoelectric conversion circuit that converts the light received by the light receiving element into the electric signal and processes the signal.

An optical fiber 80 (see FIG. 4) on the light projection side is projected from the light emitting element of the sensor main body 48, and an optical fiber 82 on the light receiving side is extended from the light receiving element.

[0034] The optical fiber 80 on the light projection side and the optical fiber 82 on the light receiving side are bundled into one.

In FIG. 1, reference numeral 50 indicates a fiber optical cord that is bundled into one.

The optical fiber 80 on the light projection side and the optical fiber 82 on the light receiving side extended from the sensor main body 48 enter into the water spout pipe 12 through the opening 42 of the base end of the water spout pipe 12. And, they are extended up to the tip end section thereof in the water spout pipe 12.

[0035] As shown in FIG. 3, a water spout member 52 is housed in the inner section of the tip section of the water spout pipe 12.

In the present example, the water spout member 52 is made of resin (herein, POM resin (polyacetal resin)), and thus has a substantially elliptical cylindrical shape corresponding to the shape of the tip section of the water spout pipe 12 as a whole.

[0036] The water spout member 52 integrally includes an elliptical insertion section 54 in the right end side of the drawings. The insertion section 54 is pressed into the water supply tube 38, and then the insertion section 54 is connected and fixed to the water supply tube 38 by a band-shaped tightening member 56 that tightens the water supply tube 38 from the outer circumferential surface.

[0037] As shown in Figs. 4 and 5, the opening of the tip of the water spout member 52 configures the water spout 58 as the tip of the water path in the spout pipe 12,

and a discharging end member 60, which causes the water flow to pass therethrough and controls the discharging pattern of the water discharge from the water spout 58, is placed in the water spout 58.

Specifically, the discharging end member 60 has a cylindrical shape in which a cross-sectional shape is a flattened elliptical shape, the discharging end member 60 is inserted to be the state of being fitted into the water spout member 52 forming the cylindrical shape and is held in the water spout member 52 in a position which is slightly inside of the water spout 58.

[0038] The discharging end member 60 in the present embodiment rectifies and discharges the flow of water sent through the water supply tube 38. That is, the discharging pattern of the water discharge is set to the rectifying water discharge a bundle.

However, it is possible to discharge water sent through the water supply tube 38 as foam flow mixed with air bubbles or as a shower flow. Otherwise, the water discharge can be discharged by other various patterns.

[0039] In the present embodiment, the discharging end member 60 and the water spout member 52 are commonly fixed to the water spout pipe 12 in the fixing hole 68, by the fixing member 67 shown in FIG. 3.

[0040] The fixing member 67 is a member of a circular push button type, and integrally has a circular outer circumferential wall member 70, a first fitting convex section 71 standing from the center section thereof, and a second fitting convex section 72 of a small diameter projected upward from the upper end of the first fitting convex section 71. The fixing member 67 is attached to the water spout pipe 12 in the state of fitting the second fitting convex section 72 to a fitting hole 74 of the discharging end member 60, fitting the first fitting convex section 71 to a penetrated fitting hole 76 of the water spout member 52, and fitting the outer circumferential wall section 70 to the circular fixing hole 68 of the water spout pipe 12, and thus the fixing member 67 is fixed in the state of positioning the discharging end member 60 and the water spout member 52 in the water spout pipe 12.

Additionally, as shown in FIG. 3(B), the fixing member 67 has a pair of left and right claws 78 when viewed from front and thus is stopped to the water spout pipe 12 by engaging the claws 78 with the edge section of the fixing hole 68.

[0041] In FIG. 4, reference numeral 62 is a light projection section, and reference numeral 64 is a light receiving section. The light projection section 62 and the light receiving section 64 are constituted by the optical fiber 80 on the light projection side and the optical fiber 82 on the light receiving side, respectively.

Furthermore, the light projection section 62 is equipped with a lens 84 for giving directionality to the projected light.

[0042] In the present embodiment, the sensor is configured by the sensor main body 48 shown in FIG. 1, and the light projection section 62 and the light receiving section 64 configured by the tip section of the extended op-

tical fibers 80 and 82. When the sensor detects a detection target, normally, a hand inserted by a user, the electromagnetic valve 36 is opened under the control using the control section 46, and water is automatically discharged from the water spout 58 of FIG. 3.

Meanwhile, when the user retracts their hand and is away from the detection area by the sensor, the sensor does not detect the hand, the electromagnetic valve 36 is closed under the control of the control section 46, and the water discharge from the water spout 58 is stopped.

[0043] The respective tip section of the optical fiber 80 on the light projection side and the optical fiber 82 on the light receiving side shown in FIG. 4 are integrally provided with an annular fitting convex section 86 for fixing the tip sections of the respective optical fibers 80 and 82 to the water spout member 52 in the positioned state.

On the outer surface of one water spout member 52, specifically, on the upper surface of FIG. 4, a deep holding groove 92A as a fiber holding section of the optical fiber 80 on the light projection side and a deep holding groove 94A as a fiber holding section of the optical fiber 82 on the light receiving side are provided in a shape extended in the axial direction of the respective optical fibers 80 and 82 so as to be parallel to the pipe axis of the water spout pipe 12. Most of the respective lower sides of the optical fibers 80 and 82 in the drawing are fitted into the holding grooves 92A and 94A.

[0044] Herein, the respective holding grooves 92A and 94A are extended in a straight line shape from the end of the right end in the drawing of the water spout member 52, that is, the base end side of the water spout pipe 12 to the left end in the drawing, that is, the end of the tip side of the water spout pipe 12.

Moreover, the front end of the left side of the holding groove 92A in the drawing is a light projection window 100 with a U-like notch shape, and the front end of the left side of the holding groove 94A in the drawing is a light receiving window 102 with a U-like notch shape. Moreover, the light projection section 62 and the light receiving section 64 are fitted downward into the light projection window 100 and the light receiving window 102 in the drawing so that the tips thereof are aligned.

[0045] The holding grooves 92A and 94A are provided with the fitting concave section 96A and 98A corresponding to the fitting convex sections 86 of the optical fibers 80 and 82, respectively. The tip sections of the optical fibers 80 and 82 fitted into the respective holding grooves 92A and 94A are axially positioned and fixed by the concave-convex fitting between the fitting convex section 86 and the fitting concave section 96A and 98A in the holding grooves 92A and 94A.

[0046] That is, the respective tip section of the optical fibers 80 and 82 are positioned and fixed in the left-light direction in the drawing perpendicular to the axes of the respective optical fibers 80 and 82 and the axial direction, by restriction using the holding grooves 92A and 94A and the concave-convex fitting between the fitting convex section 86 and the fitting concave sections 96A and 98A.

[0047] In FIG. 4, reference numeral 90 is a cover that covers the outer surface of the water spout member 52, specifically, the upper surface thereof, and the cover 90 is also made of the same resin material as the water spout member 52.

The cover 90 is integrally formed with a pair of curved elastic arms 104, and the cover 90 is assembled to the water spout member 52, by elastically engaging the claws 106 of the tips of the pair of elastic arms 104 with the corresponding engaging protrusion 108 of the water spout member 52.

[0048] In the present embodiment, on the inner surface of the cover 92, a shallow holding groove 92B for the optical fiber 80 on the light projection side as the fiber holding section, and a shallow holding groove 94B for the optical fiber 82 on the light receiving side are provided in the state of vertically facing the holding grooves 92A and 94A corresponding to the water spout member 52. The holding grooves 92B and 94B are also formed with fitting concave section 96B and 98B, respectively, corresponding to the fitting convex section 86 of the optical fiber 80.

However, the fitting concave section 96B and 98B of the cover 90 side have shallow depths compared to the fitting concave section 96A and 98A of the water spout member 52 side.

[0049] According to the combination of the inner sides of the holding groove 92A of the water spout member 52 side and the holding groove 92B of the cover 90 side, continuous groove spaces with a circular cross-sectional shape as a whole is formed corresponding to the cross-sectional shape of the optical fiber 80, as shown in FIG. 3(B).

Similarly, According to the combination of the inner sides of the holding groove 94A of the water spout member 52 side and the holding groove 94B of the cover 90 side, groove spaces with a circular cross-section as a whole is formed corresponding to the cross-sectional shape of the optical fiber 82.

[0050] That is, in the present embodiment, both of the outer surface of the water spout member 52 and the inner surface of the cover 90 are formed with the holding grooves as the fiber holding section, they cooperate with each other to hold the tip sections of the optical fibers 80 and 82 in the positioned state.

Further, the respective tip sections of the optical fiber 80 on the light projection side and the optical fiber 82 on the light receiving side, in which most of the lower side thereof is fitted to the deep holding grooves 92A and 94A of the water spout member 52 and a remaining upper part (a small part) is fitted to the holding grooves 92B and 94B of the cover 90, are interposed between the water spout member 52 and the cover 90 in the holding grooves 92A, 92B, 94A and 94B and are also restricted in a up-down direction in FIG. 3(B). The respective tip section of the respective fibers 80 and 82 are fixed in the positioned state in either direction.

Therefore, the light projections section 62 and the light

receiving section 64 are correctly positioned in a set position, and thus the detection target is precisely detected by the light projection and the light reception.

Incidentally, the holding groove may be provided only on the water spout member 52 side, and the respective tip section of the optical fibers 80 and 82 may be held in the positioned state only on the water spout member 52 side.

[0051] Additionally, each of the holding groove 92A of the water spout member 52 side and the holding groove 92B of the cover 90 side is provided with concave section 110A and 110B for accommodating the lens 84 of the light projections section 62, respectively.

Further, as shown in FIG. 3(B), the water spout member 52 is assembled inside of the tip section of the water spout pipe 12 in the fitting state together with the cover 90, and the water spout member 52 is fixed in the pipe axis direction of the water spout pipe 12 and in a direction perpendicular to the pipe axis in the fitted state, by the fixing member 67 mentioned above.

[0052] Additionally, in the present embodiment, it is possible to consider that reference numeral 52 is a main body of the water spout member, the water spout member is vertically divided into the main body and the cover 90, and the tip sections of the optical fibers 80 and 82 are interposed therebetween and are embedded into the water spout member.

[0053] According to the present embodiment as mentioned above, the respective tip sections of the optical fiber 80 on the light projection side and the optical fiber 82 on the light receiving side can be easily fixed to the tip section of the water spout pipe 12 via the water spout member 52 and also the release of the fixing thereof is easy, and thus it is possible to perform the work with good workability when assembling the tip sections of the optical fibers 80 and 82 to the water spout pipe 12, and also the fixing release thereof is easy, so that it is also possible to perform the work with good workability when detaching and maintaining the tip sections of the optical fibers 80 and 82 from the water spout pipe 12.

[0054] Additionally, in the present embodiment, the respective tip section of the optical fiber 80 on the light projection side and the optical fiber 82 on the light receiving side are independently and directly fixed to the water spout member 52, respectively, so that it is possible to reduce the size of the tip section of the water spout pipe 12 compared to case that the tip section of the optical fiber 80 on the light projection side including the light projection section 62 and the tip section of the optical fiber 82 on the light receiving side including the light receiving section 64 are assembled in advance to configure a unit and it is fixed in the state of the unit to the tip section of the water spout pipe 12.

[0055] Additionally, in the present embodiment, since the tip sections of the optical fibers 80 and 82 are fixed so as to be interposed between the water spout member 52 and the cover 90, the tip sections of the optical fibers 80 and 82 can be firmly fixed.

[0056] Additionally, the tip sections of the respective

optical fibers 80 and 82 can be protected in the inner section of the holding grooves 92A, 92B, 94A and 94B, and the tip sections of the respective optical fibers 80 and 82 can be fixed in the state of being housed in the inner section of the water spout member 52 and the cover 90, and thus the tip section of the water spout pipe 12 can be effectively miniaturized.

[0057] The tip sections of the respective optical fibers 80 and 82 are placed and fixed to be parallel to the pipe axis of the water spout pipe 12, so that, as compared to a case of obliquely fixing the tip sections of the optical fibers 80 and 82, the thickness of the water spout member 52 and the cover 90 can be thin, and the tip section of the water spout pipe 12 can be miniaturized.

[0058] The present embodiment has been described in detail, and but this shows only an example.

For example, in the present invention, as shown in FIG. 6, it is also possible that the holding groove on the side of the water spout member 52 is not provided, deep holding grooves 92B and 94B are provided only on the inner surface of the cover 90 fixed to the water spout member 52, and thus the respective tip section of the optical fiber 80 on the light projection side and the optical fiber 82 on the light receiving side are fitted thereto and is held only by the cover 90 side.

Additionally, it is also possible that the holding groove is provided on the outer surface of the cover 90, and the fiber holding section is provided by a shape other than the groove.

[0059] Furthermore, in the embodiment mentioned above, the fitting convex section is provided on the side of the tip section of the optical fiber, the fitting concave section is provided on the side of the cover of the water spout member, and they are fitted to each other by the concave-convex fitting. However, on the contrary, it is also possible that the fitting concave section may be provided on the side of the tip section of the optical, and the fitting convex section is provided on the sides of the water spout member and the cover, and they are fitted to each other in the concave-convex fitting.

In addition, another aspect of the present invention can be configured by aspects added with various modifications in the scope without departing from the gist thereof.

[0060] The present invention has been described in detail or with reference to specific embodiments, but it will be appreciated by those skilled in the art that various modifications and alterations can be added without departing from the gist and the scope of the present invention.

This application claims priority to and the benefit of Japanese Patent Application No. 2009-281030 filed on December 10, 2009, the contents of which are incorporated herein by reference.

Reference Signs List

[0061]

10: automatic faucet
 12: water spout pipe
 52: water spout member
 58: water spout
 62: light projection section
 64: light receiving section
 80, 82: optical fiber
 86: fitting convex section
 90: cover
 92A, 92B, 94A, 94B: holding groove
 96A, 96B, 98A, 98B: fitting concave section

Claims

1. An automatic faucet, in which a cylindrical water spout member forming a water spout as a tip of a water path in a water spout pipe is provided inside the tip section of the water spout pipe, an optical fiber on a light projection side for guiding light from a light emitting element and an optical fiber on a light receiving side for guiding a reflected light from a detection target to a light receiving element are passed inside the water spout pipe up to the tip section of the water spout pipe, the tip of the optical fiber on the light projection side configures a light projection section, and the tip of the optical fiber on the light receiving side configures a light receiving section, and in which water is discharged from the water spout based on the detection of the detection target using an optical sensor, wherein a fitting convex section is provided in one of an outer surface of the tip section of each of the optical fiber on the light projection side and the optical fiber on the light receiving side and a fiber holding section of the outer surface of the water spout member, and a fitting concave section corresponding to that is provided in the other thereof, and wherein the tip sections of the optical fibers are fixed in a positioned state based on the concave-convex fitting of the fitting convex section and the fitting concave section.
2. The automatic faucet according to claim 1, further comprising a cover that covers a fixing section of the tip sections of the optical fibers to the outer surface of the water spout member.
3. An automatic faucet, in which a cylindrical water spout member forming a water spout as a tip of a water path in a water spout pipe is provided inside the tip section of the water spout pipe, an optical fiber on a light projection side for guiding light from a light emitting element and an optical fiber on a light receiving side for guiding a reflected light from a detection target to a light receiving element are passed inside the water spout pipe up to the tip section of

the water spout pipe, the tip of the optical fiber on the light projection side configures a light projection section, and the tip of the optical fiber on the light receiving side configures a light receiving section, and in which water is discharged from the water spout based on the detection of the detection target using an optical sensor, wherein a fitting convex section is provided in one of an outer surface of the tip section of each of the optical fiber on the light projection side and the optical fiber on the light receiving side and a fiber holding section of the cover fixed to the water spout member in a state of covering the outer surface of the water spout member, a fitting concave section corresponding to that is provided on the other thereof, and wherein the tip sections of the optical fibers are fixed in a positioned state based on a concave-convex fitting of the fitting convex section and the fitting concave section.

4. An automatic faucet, in which a cylindrical water spout member forming a water spout as a tip of a water path in a water spout pipe is provided inside the tip section of the water spout pipe, an optical fiber on a light projection side for guiding light from a light emitting element and an optical fiber on a light receiving side for guiding a reflected light from a detection target to a light receiving element are passed inside the water spout pipe up to the tip section of the water spout pipe, the tip of the optical fiber on the light projection side configures a light projection section, and the tip of the optical fiber on the light receiving side configures a light receiving section, respectively, and in which water is discharged from the water spout based on the detection of the detection target using an optical sensor, wherein a groove as a fiber holding section holding the tip sections of the optical fibers is provided on both of the outer surface of the water spout member and the inner surface of the cover that covers the outer surface in a state of facing each other, and the tip section of the optical fiber is fitted into the grooves, and wherein a fitting convex section is provided in one of the outer surface of the tip sections of the optical fibers and the inner surfaces of the grooves, a fitting concave section is provided in the other thereof, and wherein the tip sections of the optical fibers are fixed in a positioned state based on a concave-convex fitting of the fitting convex section and the fitting concave section.
5. The automatic faucet according to any one of claims 1 to 4, wherein the tip sections of the optical fibers are placed and fixed in a straight line shape to be parallel to a pipe axis of the water spout pipe.

6. An automatic faucet comprising:

a water spout member that is provided inside a tip section of a water spout pipe and forms a water spout; 5
 a light projection section having a first optical fiber that guides light from a light emitting element; and
 a light receiving section having a second optical fiber that guides a reflected light from a detection target to a light receiving element, the automatic faucet discharging water from the water spout based on the detection of the detection target using an optical sensor, 10
 wherein the first optical fiber has a first fitting convex section, and the second optical fiber has a second fitting convex section, and
 wherein the water spout member has a first fitting concave section fitted to the first fitting convex section and a second fitting concave section 20
 fitted to the second fitting convex section.

7. The automatic faucet according to claim 6, further comprising:

a cover that covers the water spout member, the cover having a third fitting concave section which is fitted to the first fitting convex section of the first optical fiber provided in the water spout member, and a fourth fitting concave section which is fitted to the second fitting convex section of the second optical fiber provided in the water spout member. 25 30

8. An automatic faucet comprising:

a water spout member that is provided inside a tip section of a water spout pipe and forms a water spout; 35
 a light projection section having a first optical fiber that guides light from a light emitting element; 40
 a light receiving section having a second optical fiber that guides a reflected light from a detection target to a light receiving element; and 45
 a cover that covers the water spout member, the automatic faucet discharging water from the water spout based on the detection of the detection target using an optical sensor, 50
 wherein the first optical fiber has a first fitting convex section and the second optical fiber has a second fitting convex section, and
 wherein the cover has a first fitting concave section fitted to the first fitting convex section and a second fitting concave section fitted to the second fitting convex section. 55

9. A water spout unit of an automatic faucet comprising:

a water spout member that is provided inside a tip section of a water spout pipe and forms a water spout;
 a light projection section having a first optical fiber that guides light from a light emitting element;
 a light receiving section having a second optical fiber that guides a reflected light from a detection target to a light receiving element; and
 a cover that covers the water spout member, wherein the first optical fiber has a first fitting convex section, and the second optical fiber has a second fitting convex section, wherein the water spout member has a first fitting concave section fitted to the first fitting convex section and a second fitting concave section fitted to the second fitting convex section, and wherein the first optical fiber and the second optical fiber are fixed by the water spout member and the cover.

FIG. 1

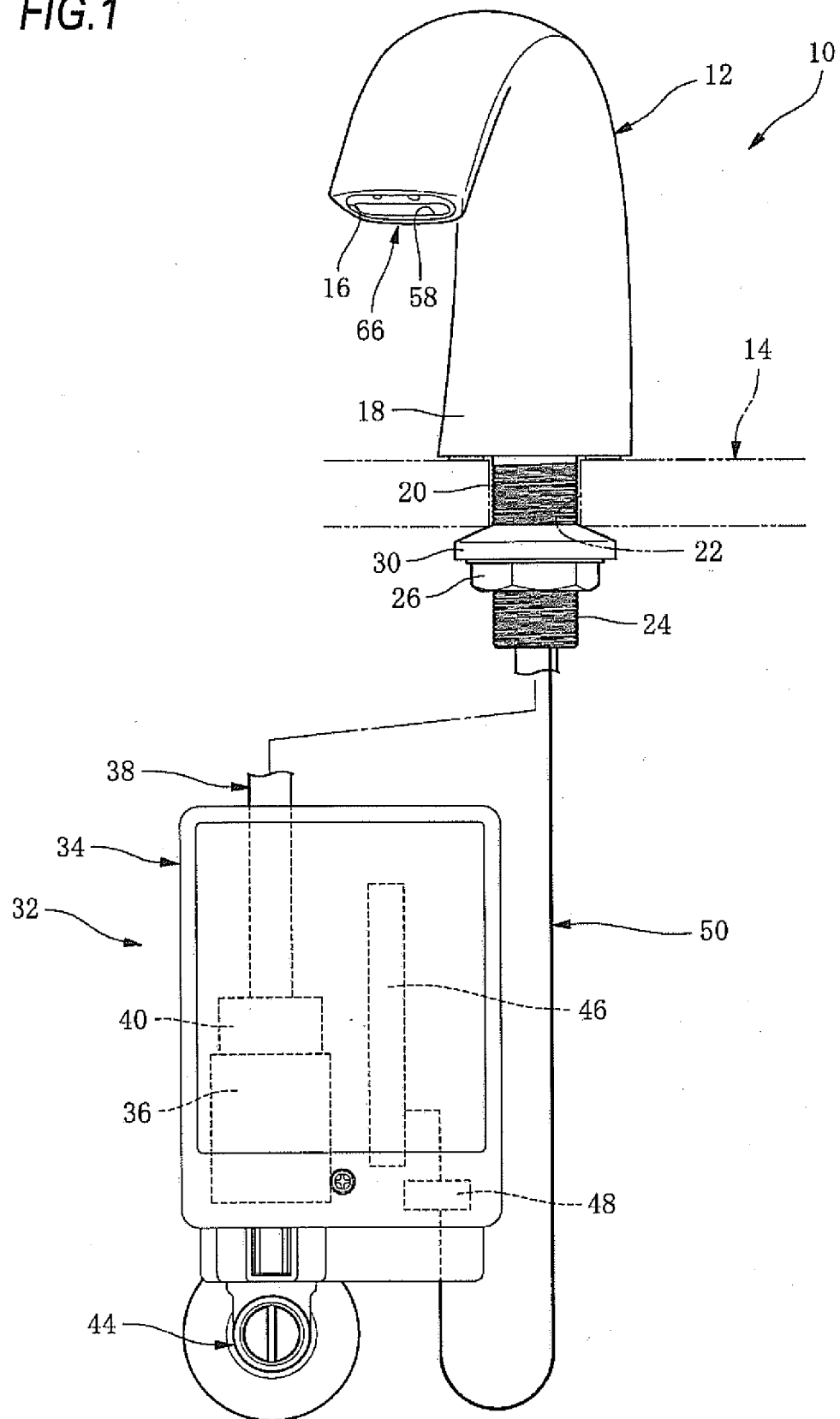


FIG.2

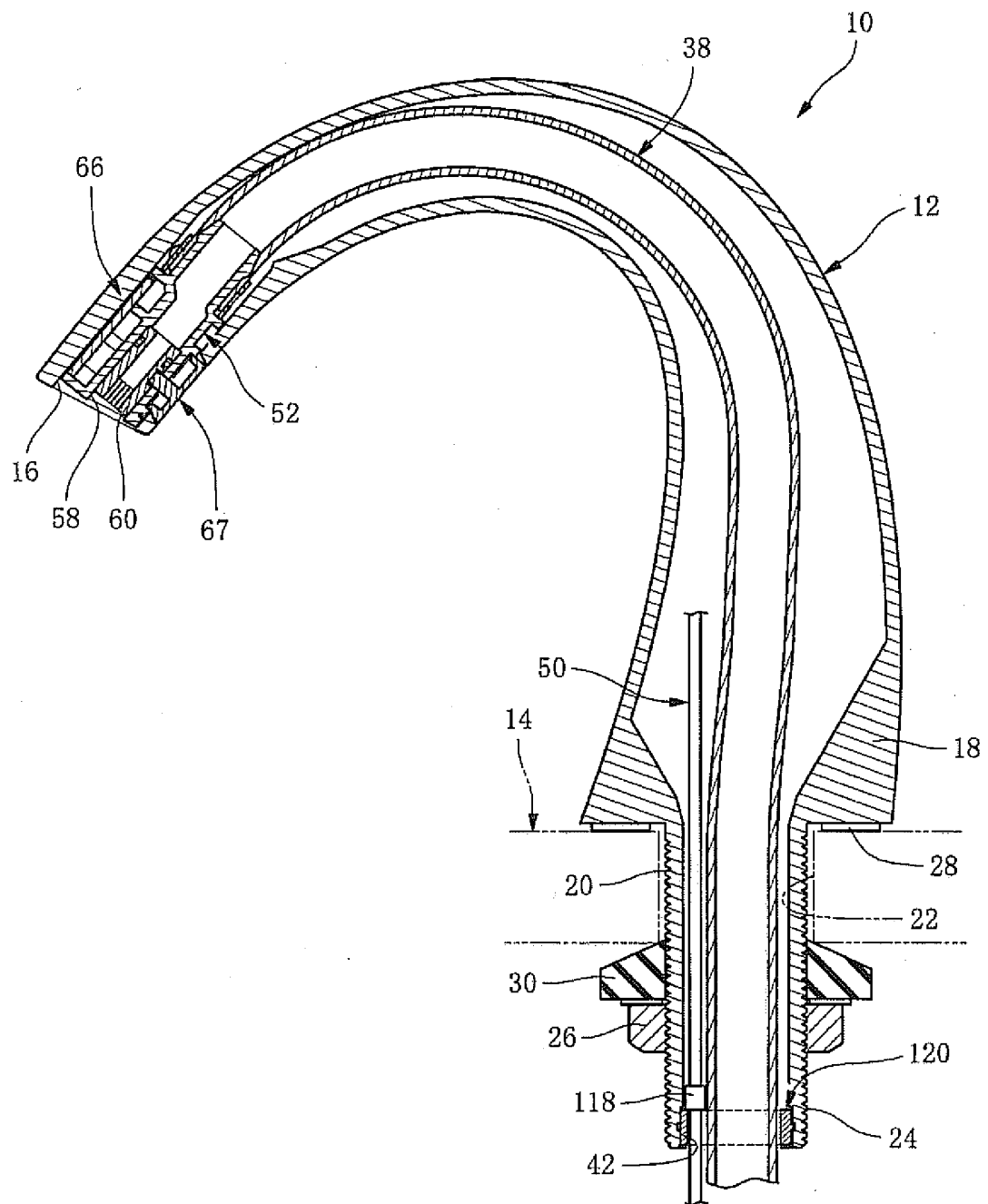
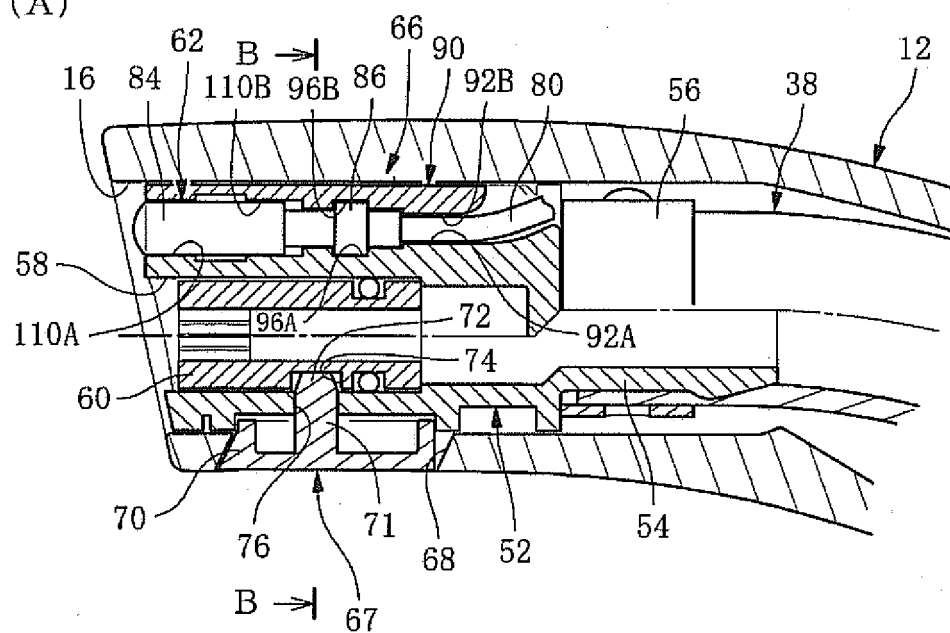


FIG.3

(A)



(B)

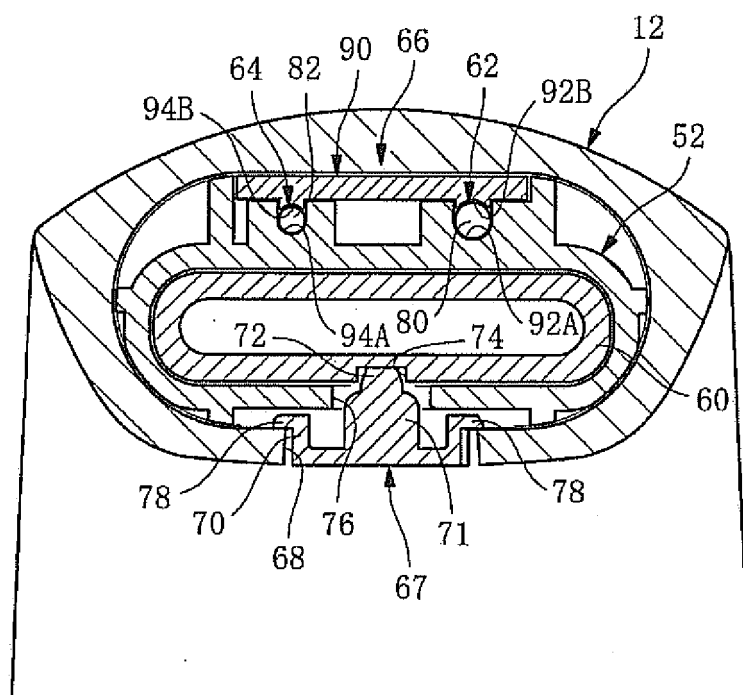
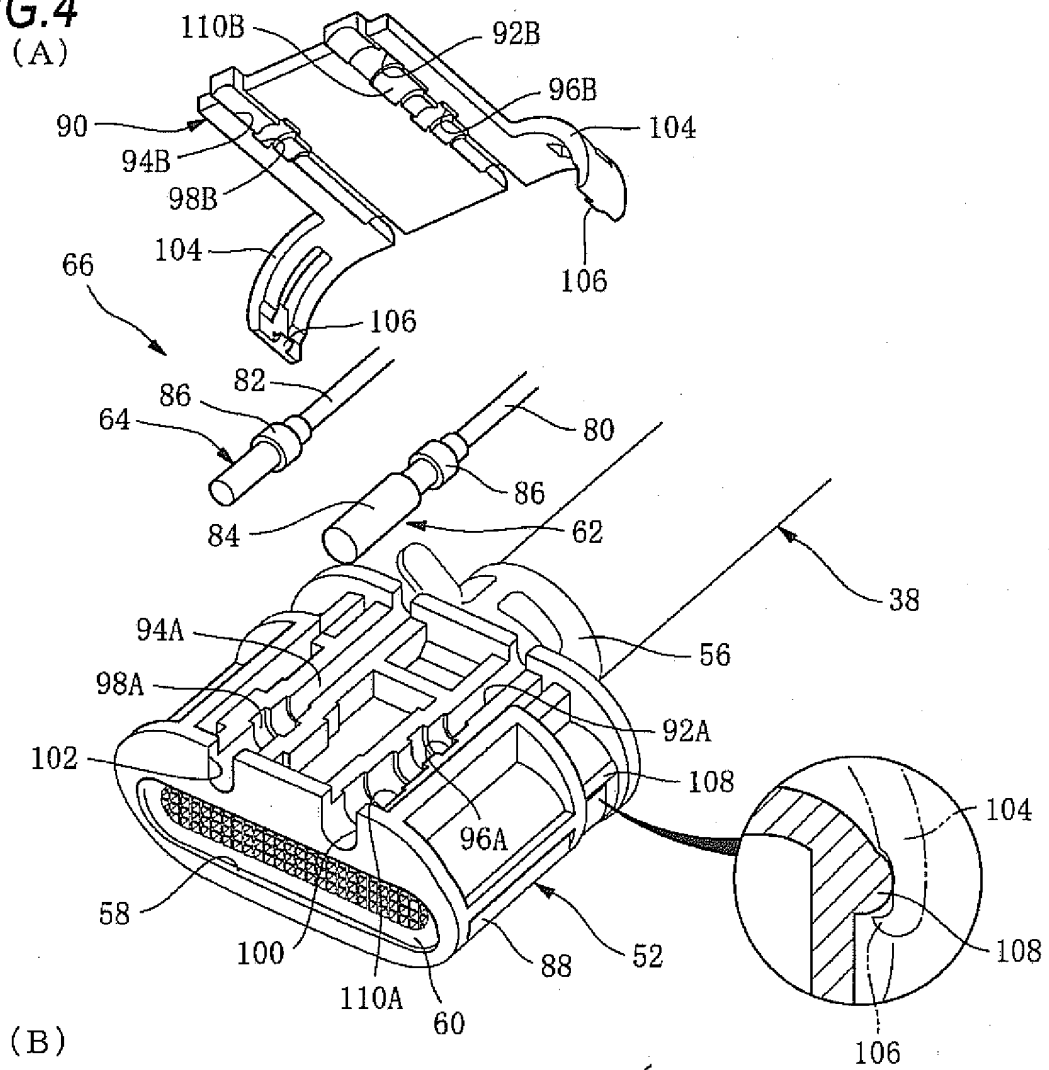


FIG.4
(A)



(B)

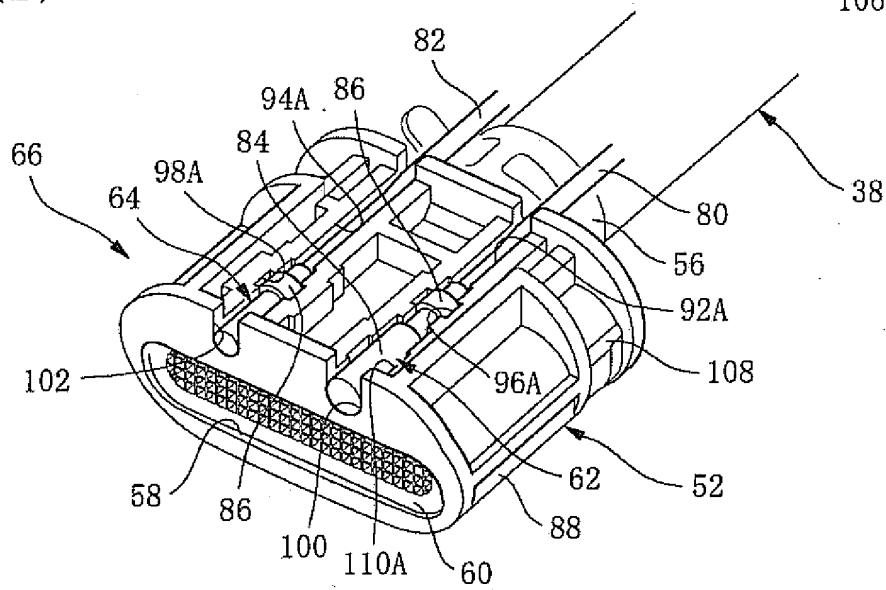


FIG.5

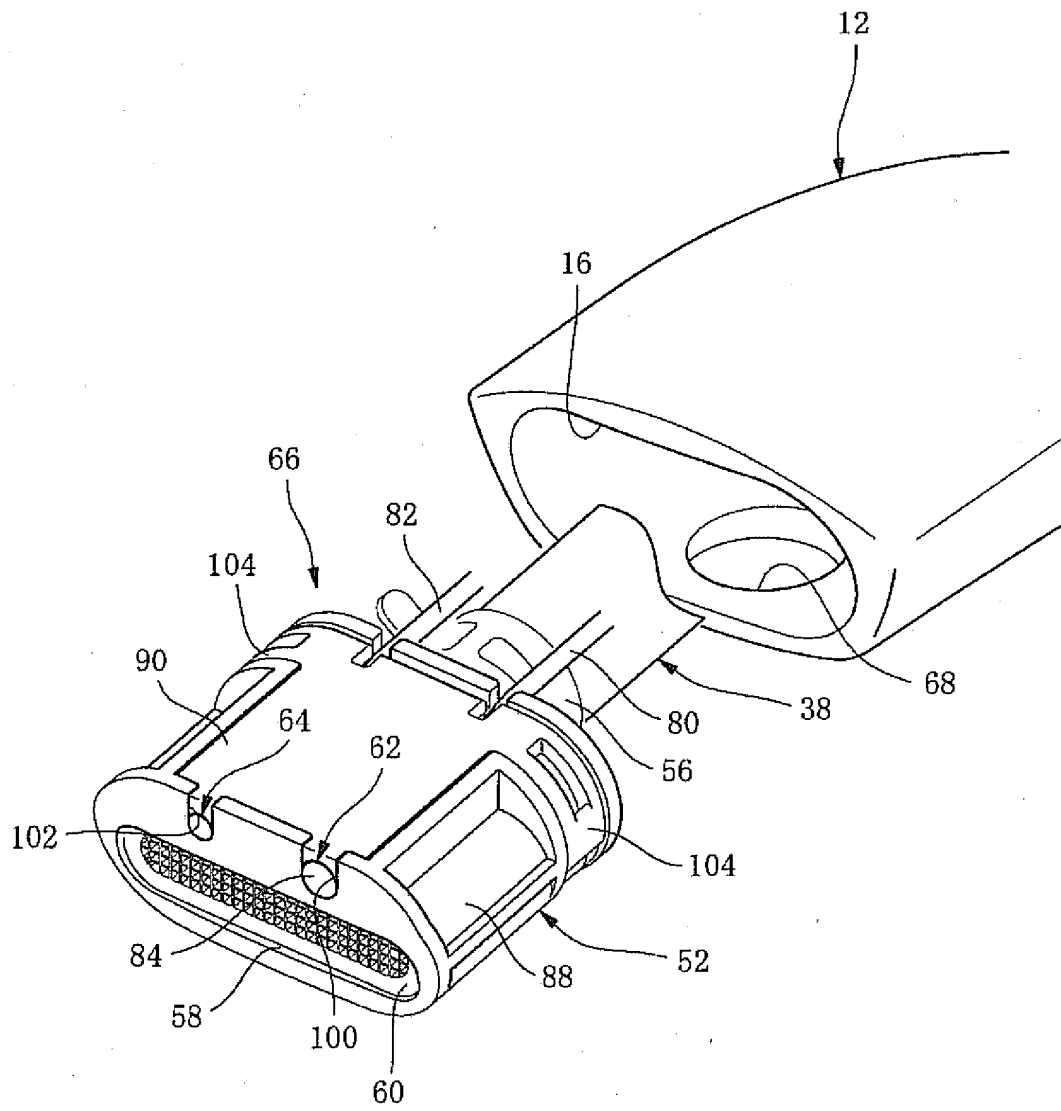
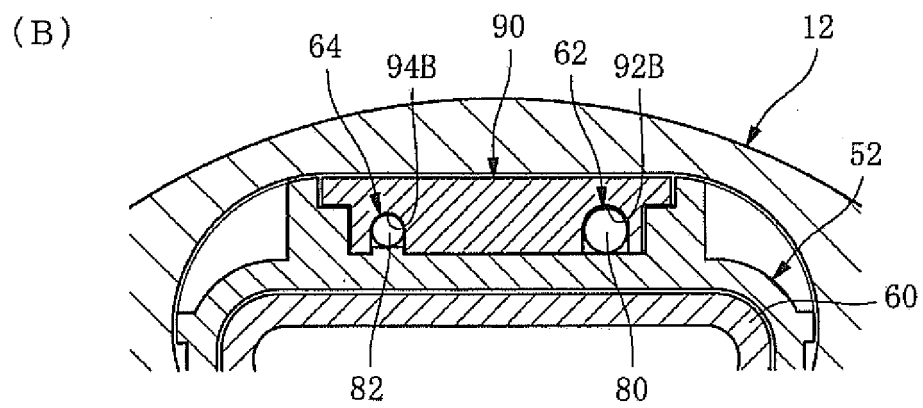
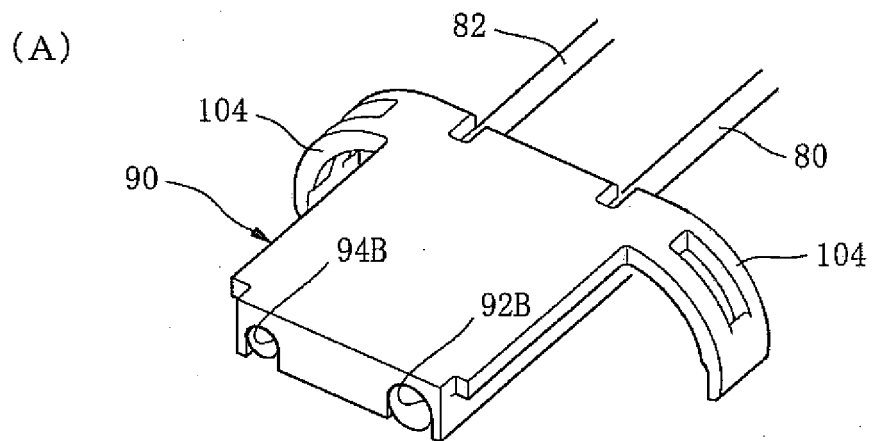


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/072276

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	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

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.
P, X A	JP 2009-299431 A (Denso Corp.), 24 December 2009 (24.12.2009), paragraphs [0021], [0075] to [0084]; fig. 7, 10 (Family: none)	3, 8 1, 2, 4-7, 9
A	JP 2009-281009 A (Inax Corp.), 03 December 2009 (03.12.2009), paragraphs [0024] to [0045]; fig. 1, 2 (Family: none)	1-9
A	JP 2002-270889 A (Inax Corp.), 20 September 2002 (20.09.2002), entire text; all drawings (Family: none)	1-9

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

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Date of the actual completion of the international search
28 December, 2010 (28.12.10)Date of mailing of the international search report
11 January, 2011 (11.01.11)Name and mailing address of the ISA/
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- JP 2002070096 A [0008]
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