US 20250264190A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2025/0264190 A1**

KANEKO et al. (43) **Pub. Date: Aug. 21, 2025**

(54) **GAS SUPPLY DEVICE**

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(21) Appl. No.: **19/020,015**

(22) Filed: **Jan. 14, 2025**

(30) **Foreign Application Priority Data**

Feb. 21, 2024 (JP) 2024-024803

Publication Classification

(51) **Int. Cl.**

F17C 7/00 (2006.01)

F17C 13/08 (2006.01)

(52) **U.S. Cl.**

CPC ***F17C 7/00*** (2013.01); ***F17C 13/084*** (2013.01); *F17C 2205/0388* (2013.01); *F17C 2221/012* (2013.01); *F17C 2223/0123* (2013.01)

(57) **ABSTRACT**

A gas supply device disclosed herein includes a connector attached to and detached from a main stop valve of a gas cartridge, an actuator, and a gas discharger. The actuator moves the connector closer to the main stop valve of the attached gas cartridge. The gas discharger blows gas to the tip of the connector before it is connected to the main stop valve. The gas supply device disclosed in the present specification blows gas to the tip of the connector prior to connecting the connector to the main stop valve to remove dust and the like adhering to the connector. Therefore, it is possible to suppress dust and the like entering the gas supply device.

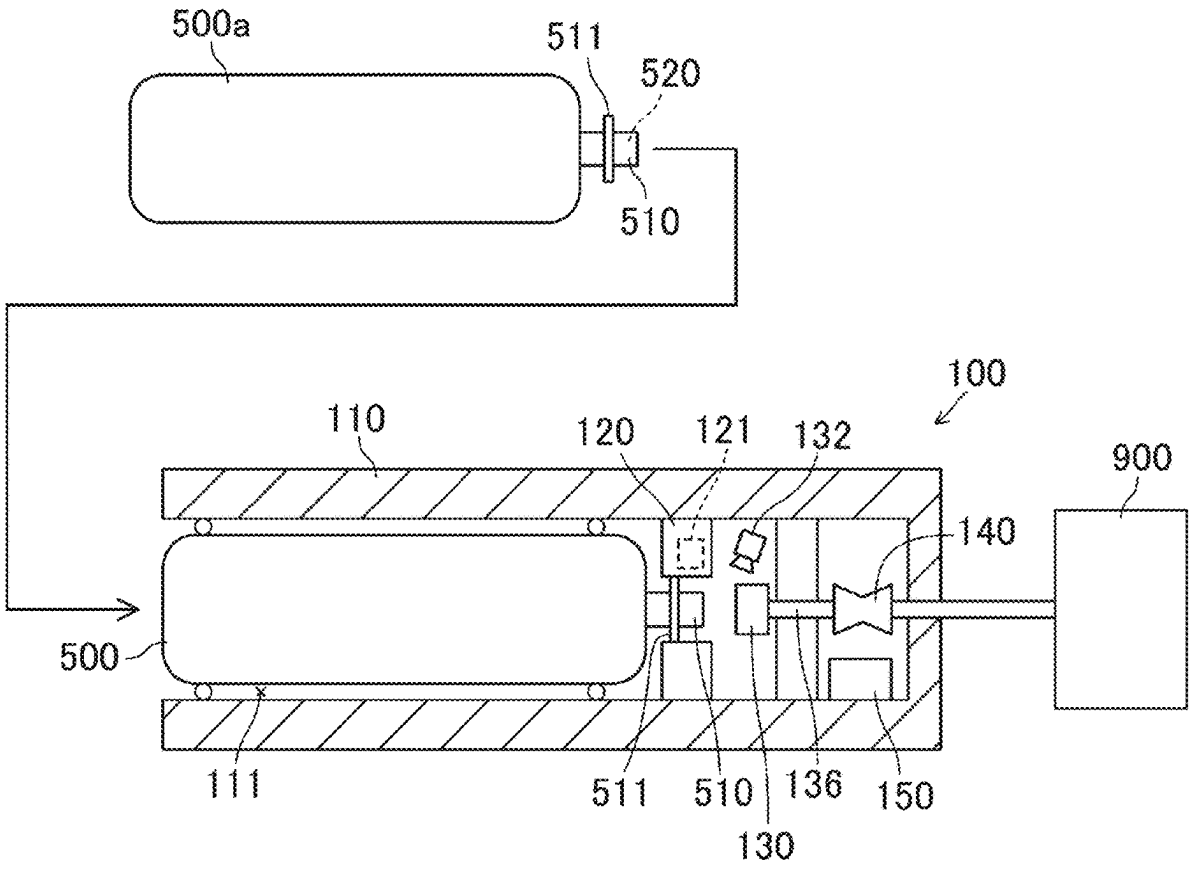


FIG. 1

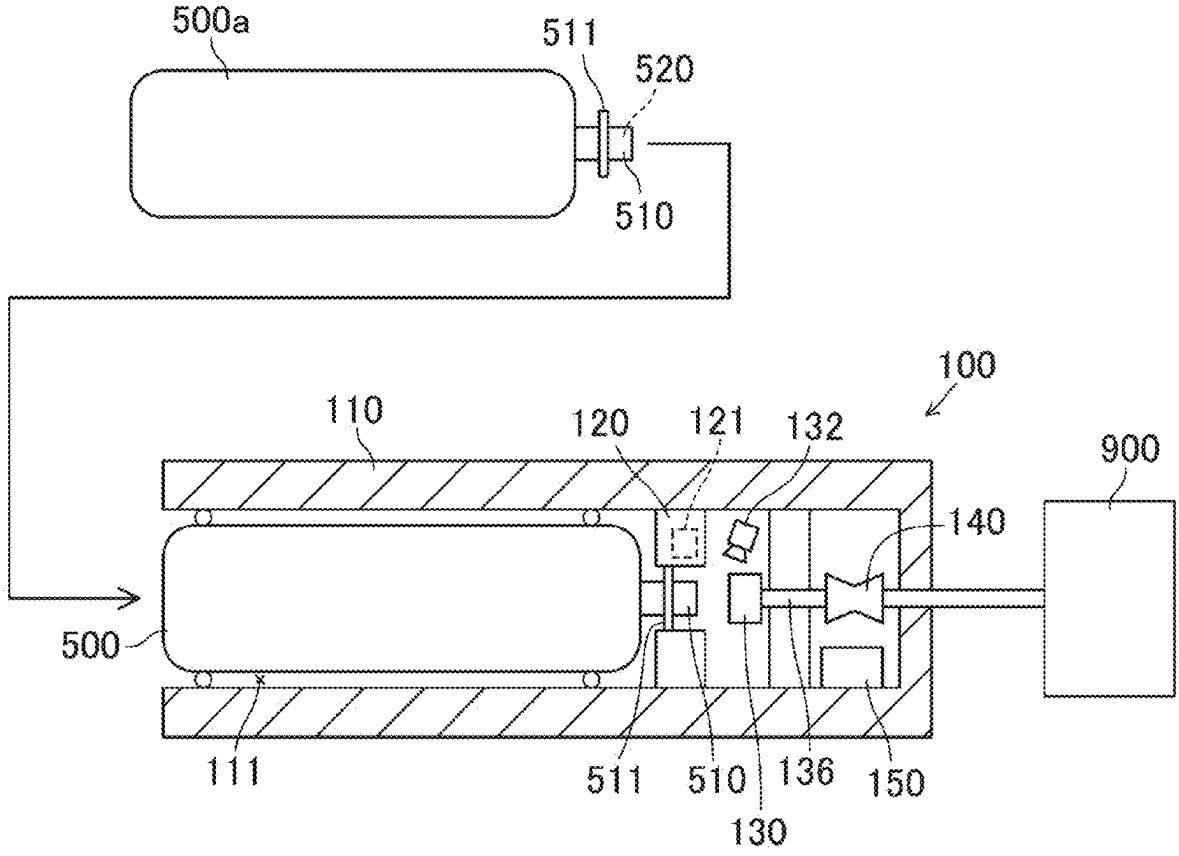

500a
511
520
510
100
110
120
121
132
900
140
500
111
511
510
136
150
130

FIG. 2A

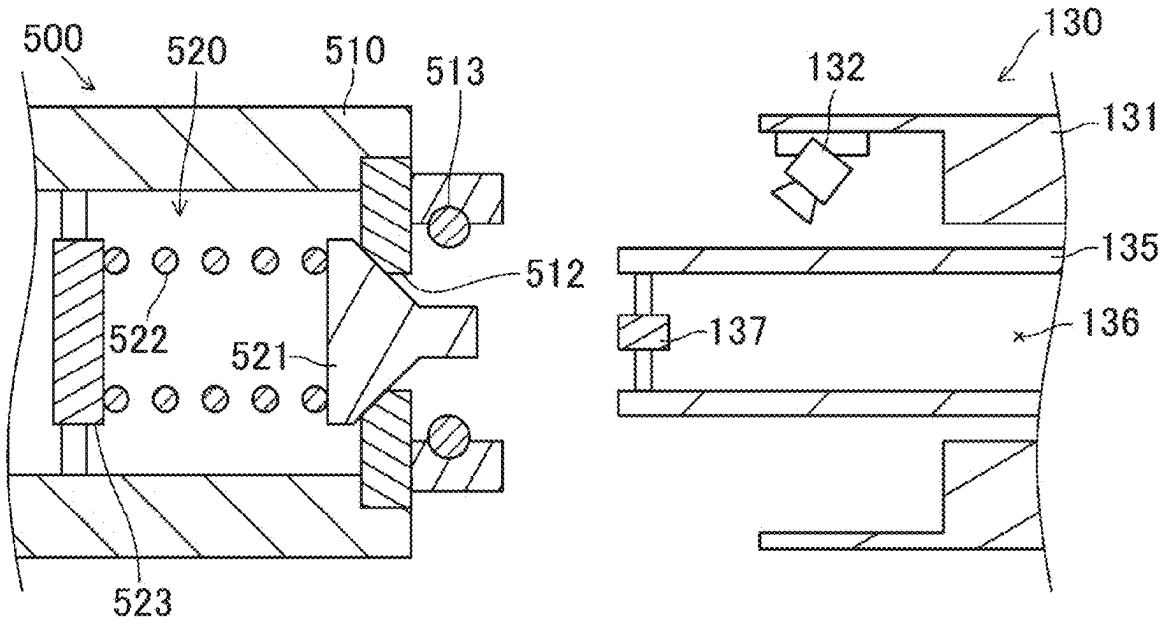

500
520
510
513
512
522
521
523
130
132
131
135
137
136

FIG. 2B

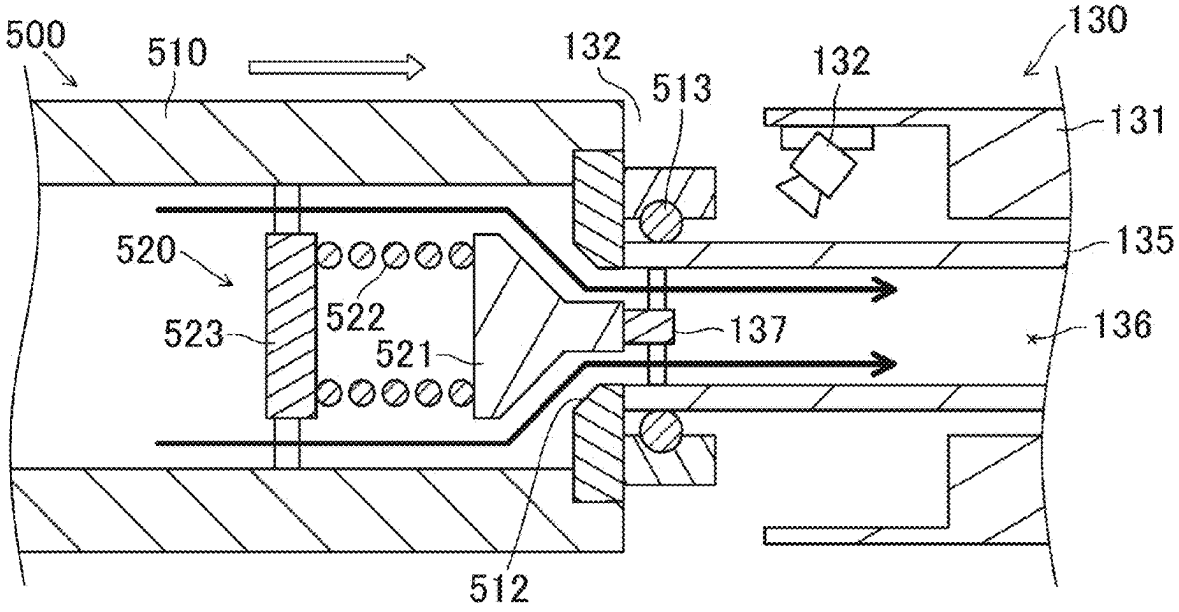

500
510
132
513
132
130
131
135
520
522
523
521
137
136
512

FIG. 3A

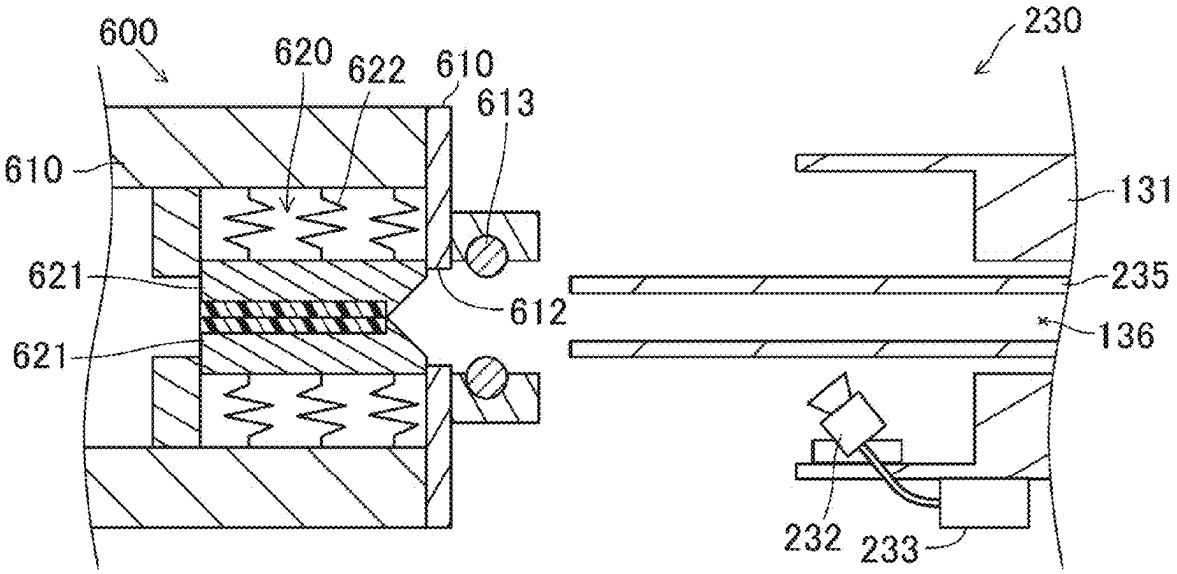
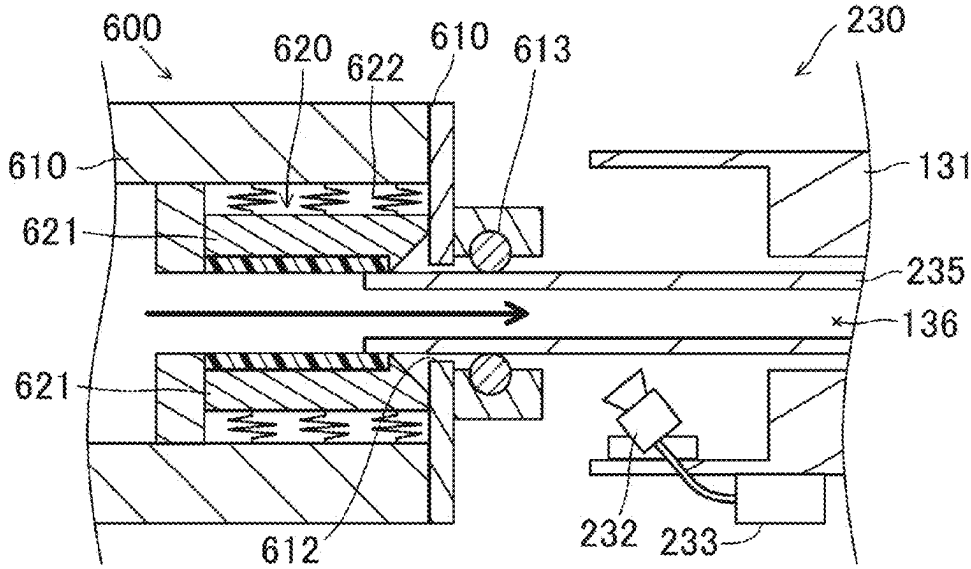

600
620
622
610
613
230
610
131
621
235
612
136
621
232
233

FIG. 3B


600
620
622
610
613
230
610
131
621
235
136
621
612
232
233

GAS SUPPLY DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Japanese Patent Application No. 2024-024803 filed on Feb. 21, 2024, incorporated herein by reference in its entirety.

BACKGROUND

1. Technical Field

[0002] The technology disclosed in the present specification relates to a gas supply device that enables a gas cartridge to be attached to and detached from the gas supply device, the gas cartridge storing a fuel gas, and the gas supply device supplying the fuel gas in the gas cartridge to a gas utilization device.

2. Description of Related Art

[0003] There is proposed a technique in which a fuel gas is stored in a gas cartridge and the gas cartridge is mounted to a gas utilization device (Japanese Unexamined Patent Application Publication No. 2023-56952 (JP 2023-56952 A), for example). Examples of the gas utilization device include a fuel cell. JP 2023-56952 A discloses a gas cartridge that is attachable to and detachable from the gas utilization device. A main stop valve of the gas cartridge is connected to a connector on the gas utilization device side through operation to mount the cartridge to the gas utilization device.

SUMMARY

[0004] If dust or the like adheres to the connector when connecting the connector to the main stop valve of the gas cartridge, the dust or the like may be mixed into the gas utilization device together with the fuel gas. The present specification provides a technique of suppressing dust or the like being mixed in when connecting a connector to a main stop valve.

[0005] An aspect of the present specification provides a gas supply device including a connector attached to and detached from a main stop valve of a gas cartridge, an actuator, and a gas discharger.

The actuator relatively moves the connector closer to the main stop valve of the gas cartridge mounted to the gas supply device.

The gas discharger blows the gas to a tip of the connector before being connected to the main stop valve.

In the gas supply device disclosed in the present specification, the gas is blown to the tip of the connector before connecting the connector to the main stop valve to remove dust or the like adhering to the connector. Therefore, it is possible to suppress dust or the like being mixed into the gas supply device.

[0006] Details of the technique disclosed in the present specification and further improvements will be described in the "DETAILED DESCRIPTION OF EMBODIMENTS" below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Features, advantages, and technical and industrial significance of exemplary embodiments of the disclosure will be described below with reference to the accompanying drawings, in which like signs denote like elements, and wherein:

[0008] FIG. **1** is a cross-sectional view of a gas supply device **100**;

[0009] FIG. **2**A is a cross-sectional view of a connector-periphery;

[0010] FIG. **2**B is another cross-sectional view of the connector-periphery;

[0011] FIG. **3**A is a cross-sectional view of the periphery of a modified connector; and

[0012] FIG. **3**B is another cross-sectional view of the periphery of the connector of a modification.

DETAILED DESCRIPTION OF EMBODIMENTS

[0013] A gas supply device **100** according to an embodiment will be described with reference to the drawings. FIG. **1** is a cross-sectional view of a gas supply device **100**. The gas supply device **100** is a device that supplies hydrogen gas (fuel gas) stored in the gas cartridge **500** to the fuel cell **900**. The fuel cell **900** corresponds to an example of a gas utilization device.

[0014] The gas cartridge **500** is detachable from the gas supply device **100**. The reference numeral **500***a* in FIG. **1** indicates a gas cartridge prior to being installed in the gas supply device **100**. The gas cartridge **500***a* is inserted into the cartridge accommodating space **111** of the housing **110** of the gas supply device **100** by the user. The base **510** of the gas cartridge **500** is provided with a flange **511**. The user inserts the gas cartridge **500** into the cartridge accommodating space **111** and rotates the gas cartridge **500**. The cartridge accommodating space **111** is provided with a cartridge holder **120**. When the gas cartridge **500** rotates in the cartridge accommodating space **111**, the flange **511** is locked to the cartridge holder **120**. A detailed description of the mechanism for locking the flange **511** (i.e., the gas cartridge **500**) is omitted.

[0015] A connector **130** is disposed in the cartridge accommodating space **111**. Further, the base **510** of the gas cartridge **500** is provided with a main stop valve **520**. One end of the gas flow path **136** is connected to the connector **130**, and the other end of the gas flow path **136** is connected to the fuel cell **900**. An auxiliary valve **140** is attached to the gas flow path **136**. When the connector **130** is connected to the main stop valve **520** and the main stop valve **520** and the auxiliary valve **140** are opened, the hydrogen gas in the gas cartridge **500** is supplied to the fuel cell **900** through the gas flow path **136**.

[0016] When the gas cartridge **500** is secured to the cartridge holder **120**, the base **510** faces the connector **130**. The cartridge holder **120** is provided with an actuator **121**, and when the actuator **121** is operated, the base **510** (the gas cartridge **500**) is drawn toward the connector **130**. The connector **130** is provided with a push rod, which will be described later, and when the base **510** approaches the connector **130**, the push rod pushes open the main stop valve **520**. The structure of the connector **130** will be described later.

[0017] The actuator **121** includes, for example, a ball screw and a stepping motor. When the stepper motor rotates

the ball screw, the jig holding the flange **511** moves toward the connector **130**. That is, the gas cartridge **500** approaches the connector **130**. Since a known structure may be adopted for the actuator **121**, a specific structure of the actuator **121** will not be described. The actuator **121** may move the connector **130** toward the base **510**. The actuator **121** may be any mechanism that moves one of the gas cartridge **500** and the connector **130** toward the other. The gas supply device **100** is provided with a controller **150**, and the controller **150** controls the actuator **121** and the auxiliary valve **140**.

[0018] A cross-sectional view of the periphery of the connector **130** is shown in FIGS. **2**A and **2**B. In FIGS. **2**A and **2**B, the cartridge holder **120** and the actuator **121** are not shown.

[0019] First, the structure of the gas cartridge **500** will be described. The gas cartridge **500** includes a main stop valve **520** in the base **510**. The main stop valve **520** blocks an opening **512** provided in the base **510**. When the main stop valve **520** is opened, the hydrogen gas (fuel gas) in the gas cartridge **500** is jetted out through the opening **512**.

[0020] The main stop valve **520** includes a valve body **521** and a spring **522**. The valve body **521** blocks the opening **512** from the inside of the gas cartridge **500**. The spring **522** presses the valve body **521** against the edge of the opening **512** from the inside of the gas cartridge **500**. The rear end of the spring **522** abuts against a stopper **523** provided inside the gas cartridge **500**. When the spring **522** presses the valve body **521** against the edge of the opening **512**, the opening **512** is closed. When the valve body **521** is pushed into the gas cartridge **500** from the outside of the gas cartridge **500**, the main stop valve **520** opens and the hydrogen gas is ejected.

[0021] The connector **130** of the gas supply device **100** includes a push rod **135** and a blower **132** secured to the connector base **131**. The inside of the push rod **135** serves as a gas flow path **136**. Further, a push piece **137** is provided at the tip of the push rod **135**. The push piece **137** pushes the valve body **521**. The push piece **137** is fixed to the tip of the push rod **135**, but does not block the gas flow path **136** of the push rod **135**, when the main stop valve **520** is opened hydrogen gas passes through the side of the push piece **137** to the gas flow path **136**.

[0022] The blower **132** discharges air. The discharge port of the blower **132** faces the distal end of the push rod **135**. FIG. **2**A shows the gas cartridge **500** prior to the base **510** contacting the connector **130**. When the gas cartridge **500** is fixed to the cartridge holder **120** and the connector **130** faces the base **510**, the controller **150** activates the blower **132**. The blower **132** vigorously blows air to the tip of the connector **130** (the tip of the push rod **135**). At this time, the main stop valve **520** is still closed.

[0023] The controller **150** then stops the blower **132**, actuates the actuator **121**, and brings the base **510** closer to the connector **130**. As described above, when the main stop valve **520** of the base **510** approaches the connector **130**, the push piece **137** at the tip of the push rod **135** pushes the valve body **521** into the gas cartridge **500**. The valve body **521** is separated from the opening **512**, and the main stop valve **520** is opened. When the main stop valve **520** is opened, the hydrogen gas flows through the side of the push piece **137** to the gas flow path **136**. In FIG. **2**B, the main stop valve **520** is opened, and the hydrogen gas inside the gas cartridge **500** flows into the gas flow path **136**. The thick arrow line in FIG. **2**B indicates the flow of hydrogen-gas. As described above, the gas flow path **136** is connected to the fuel cell **900**, and when the auxiliary valve **140** of FIG. **1** is opened, the hydrogen gas is supplied to the fuel cell **900**.

[0024] The gap between the outer periphery of the push rod **135** approaching the main stop valve **520** and the base **510** is sealed by a gasket **513**.

[0025] In the gas supply device **100** of the embodiment, before the push rod **135** opens the main stop valve **520**, the blower **132** blows air to the tip of the connector **130** (the outer surface of the tip of the push rod **135**). The dust or the like adhering to the outer surface of the distal end of the push rod **135** is removed. When the hydrogen gas is supplied to the fuel cell **900** through the gas flow path **136**, dust and the like are prevented from entering. The blower **132** is an example of a gas discharger that discharges air to the tip of the push rod **135**.

Modification

[0026] A modification of the main stop valve and the connector will be described. FIGS. **3**A and **3**B show cross-sectional views of the periphery of a modified main stop valve **620** and a modified connector **230**. The gas supply device of the modified example includes a gas discharger **232**. The gas discharger **232** sprays the nitrogen gas in the nitrogen tank **233** onto the tip of the connector **230** (the tip of the push rod **235**). Nitrogen gas is a typical inert gas that does not significantly affect the operation of the fuel cell **900** when mixed into **25** the fuel cell **900**.

[0027] The main stop valve **620** has two valve bodies **621**. The two valve bodies **621** are located inside the opening **612** of the gas cartridge **600**. The two valve bodies **621** are pressed against each other by a spring **622** and block the opening **612** of the base **610** (FIG. **3**A).

[0028] FIG. **3**A shows the gas cartridge **600** prior to the base **610** contacting the connector **230**. In FIGS. **3**A and **3**B, the flanges of the base **610** and the cartridge holder and the actuator of the gas supply device are illustrated. When the gas cartridge **600** is fixed to the cartridge holder and the connector **230** faces the base **610**, the controller of the gas supply device activates the gas discharger **232**. The gas discharger **232** blows nitrogen gas to the tip of the connector **230** (the tip of the push rod **235**). At this time, the main stop valve **620** is still closed.

[0029] The controller deactivates the gas discharger **232** and actuates the actuator to bring the base **610** closer to the connector **230**. As the distal end of the base **610** approaches the connector **230**, the distal end of the push rod **235** pushes open the two valve bodies **621** of the main stop valve **620**, and the main stop valve **620** opens (FIG. **3**B). The hydrogen gas in the gas cartridge **600** passes through the opening **612** and flows into the gas flow path **136** inside the push rod **235**. The gas flow path **136** is connected to the fuel cell **900**, and when the auxiliary valve **140** of FIG. **1** is opened, hydrogen gas is supplied to the fuel cell **900**. The thick arrow line in FIG. **3**B represents the flow of hydrogen-gas. The gap between the outer periphery of the push rod **235** approaching the main stop valve **620** and the base **610** is sealed by a gasket **613**.

[0030] The gas supply device having the connector **230** of the modified example also has the same advantages as the gas supply device **100** of the first embodiment.

[0031] Some features of the gas supply device described in the examples are listed below. The gas supply device includes a gas discharger that blows gas to a tip of the

connector (a tip of the push rod). The gas supply device of the first embodiment includes a blower **132** that blows air to the tip of the connector. The blower **132** is an example of a gas discharger. The controller of the gas supply device operates the blower **132** prior to connecting the connector to the main stop valve of the gas cartridge. The gas discharged by the blower **132** removes dust and the like from the connector tip (push rod tip). Dust or the like is prevented from being mixed into the fuel cell **900**. The controller stops the blower and controls the actuator such that the connector **130** (**230**) moves further towards the main stop valve **520** (**620**). When the connector **130** (**230**) is connected to the main stop valve **520** (**620**) and the main stop valve **520** (**620**) is opened, hydrogen gas is supplied to the fuel cell **900** through the connector.

[0032] The main stop valve includes a valve body that closes an opening of the gas cartridge from the inside of the gas cartridge, and a spring that presses the valve body against the opening. The connector includes a push rod that pushes open the valve body from the outside of the gas cartridge. When the connector abuts against the main stop valve and the connector further moves toward the main stop valve, the tip of the push rod pushes open the valve body, and the main stop valve opens. The gas discharger sprays gas on the outside of the push rod. The gas may be air or an inert gas such as nitrogen.

[0033] A gasket **513** (**613**) is disposed around the opening of the base. Just before the push rod pushes open the main stop valve, the push rod is inserted into the gasket. The gasket seals between the outer periphery of the push rod and the base.

[0034] The fuel cell **900** is an example of a gas utilization device. The gas-utilizing device may be a device other than a fuel cell. The gas supply device of the embodiment may be incorporated in a gas utilization device.

[0035] Although specific examples of the disclosure have been described in detail above, the examples are merely examples and do not limit the scope of claims. The technique described in the claims includes various modifications and variations of the specific examples exemplified above. The technical elements described in the present specification or in the drawings exhibit technical usefulness alone or in various combinations, and are not limited to the combinations described in the claims at the time of filing the application. In addition, the technique exemplified in the present specification or drawings can achieve a plurality of purposes at the same time, and achieving one of the purposes itself has technical usefulness.

What is claimed is:

1. A gas supply device that enables a gas cartridge to be mounted to the gas supply device, the gas cartridge storing a fuel gas and including a main stop valve that seals the fuel gas, and the gas supply device supplying the fuel gas in the gas cartridge to a gas utilization device and comprising:

a connector attached to and detached from the main stop valve;

an actuator that relatively moves the connector closer to the main stop valve of the gas cartridge mounted to the gas supply device; and

a gas discharger that blows the gas to a tip of the connector before being connected to the main stop valve.

* * * * *