

PRE-FILLED CONTAINER AND METHOD FOR PREVENTING AIR BUBBLE CONTAMINATION

TECHNICAL FIELD

5 **[0001]** The present invention relates to a pre-filled container and a method for preventing air bubble contamination.

BACKGROUND

10 **[0002]** Patent Literature (PTL) 1 describes an injection cylinder for a dispenser and a paste-like adhesive. The injection cylinder for a dispenser described in PTL 1 includes a cylinder for containing silver paste being a paste-like adhesive, a nozzle cap detachably attached to a nozzle portion formed in the cylinder, a head cap detachably attached to the cylinder, and a piston movably disposed inside the cylinder, for pressure feeding the silver
15 paste. The nozzle cap has a blocking portion that blocks a passage for ejecting the paste-like adhesive contained in the nozzle portion of the cylinder. It is described that, as a securing method between a nozzle cap attachment portion of the cylinder and the nozzle cap, a screw type is preferable.

20 **[0003]** PTL 1 further describes a problem in which, in a case in which air or gas accumulated in a cavity in the passage of the nozzle portion formed in the cylinder remains in the the passage as is, the air or gas causes blanking when the silver paste is used, thereby impairing uniformity and application workability of the silver paste. Therefore, a problem is described in which, after the inside of the cylinder is filled with the silver paste, the cavity in the
25 passage of the nozzle portion must be filled with the silver paste. In addition, another problem is pointed out that, after the passage of the nozzle portion is filled with the silver paste, air or gas is mixed into the silver paste inside the cylinder through a small gap between the nozzle portion and the nozzle cap, and causes blanking when the silver paste is used, which impairs the
30 uniformity and the application workability of the silver paste. Therefore, in the injection cylinder for a dispenser described in PTL 1, the nozzle cap is provided with a needle-like protruding portion, which serves as the blocking portion to block the passage for ejecting the silver paste contained in the nozzle portion of the cylinder.

35

CITATION LIST

Patent Literature

[0004] PTL 1: JP 2003-175353 A

SUMMARY

5 **[0005]** As described in PTL 1, in a syringe (pre-filled container) filled with silver paste or the like, it is important to prevent air from entering a nozzle portion (to prevent air bubbles from entering). Therefore, it is desired to provide a pre-filled container in which a nozzle portion is filled with paste. In addition, it is desired to provide a method of preventing air bubbles from
10 entering the nozzle portion.

[0006] In order to use a syringe in which air has entered a nozzle portion, when the syringe is defoamed using a defoamer using centrifugal force or the like to defoam the syringe, a dispersion state of silver paste or the like may become non-uniform (e.g., unevenness of silver particles).

15 **[0007]** In a case in which a nozzle cap is provided with a needle-like protruding portion that serves as a blocking portion to block a passage for ejecting silver paste contained in a nozzle portion of a cylinder, as in the injection cylinder for a dispenser described in PTL 1, air could be mixed into the nozzle portion when the nozzle cap is removed from the nozzle portion.
20 Therefore, it is desired to provide a pre-filled container that can prevent air bubbles from entering a nozzle portion during use. In addition, it is desired to provide a method to prevent air bubbles from entering the nozzle portion during use.

[0008] It would be helpful to provide a pre-filled container that is filled up to
25 a nozzle portion with paste and that can prevent air bubbles from entering the nozzle portion during use, and a method for preventing air bubbles from entering the nozzle portion.

[0009] A pre-filled container according to the present disclosure includes:
a cylindrical body portion;
30 a cylindrical nozzle portion provided at a tip end portion of the body portion, the nozzle portion being thinner than the body portion;
a bottomed cylindrical cap externally fitted onto a tip of the nozzle portion, the cap being detachably attached to the nozzle portion; and
paste to be discharged from the nozzle portion, wherein
35 a tip end portion of the nozzle portion and a bottom surface of a cylinder of the cap are separated from each other, and cap interior space is

formed between the tip end portion of the nozzle portion and the bottom surface of the cylinder of the cap, and

the paste is filled into a cylinder of the body portion, a cylinder of the nozzle portion, and the cap interior space.

5 **[0010]** Further, in the pre-filled container according to the present disclosure, a tip end surface of the cylinder of the nozzle portion and the cap are preferably separated from each other, and the paste is preferably filled into space between the tip end surface and the cap, in the cap interior space.

10 **[0011]** Further, in the pre-filled container according to the present disclosure, the tip end portion of the nozzle portion and the bottom surface of the cylinder of the cap are preferably separated from each other by a distance equal to or more than an internal diameter of the nozzle portion.

15 **[0012]** Further, in the pre-filled container according to the present disclosure, the paste preferably has a viscosity of 5 to 90 Pa·s and a thixotropy of 1.0 to 11.5.

[0013] Further, in the pre-filled container according to the present disclosure, the cap is preferably transparent, and the paste filled into the cap interior space is preferably visible from outside the cap.

20 **[0014]** A method for preventing air bubble contamination according to the present disclosure is a method for preventing air bubble contamination in a pre-filled container including:

a cylindrical body portion;

a cylindrical nozzle portion provided at a tip end portion of the body portion, the nozzle portion being thinner than the body portion;

25 a bottomed cylindrical cap externally fitted onto a tip of the nozzle portion, the cap being detachably attached to the nozzle portion; and

paste to be discharged from the nozzle portion.

The method includes:

30 forming cap interior space between a tip end portion of the nozzle portion and a bottom surface of a cylinder of the cap, by separating the tip end portion of the nozzle portion and the bottom surface of the cylinder of the cap from each other; and

filling the paste into a cylinder of the body portion, a cylinder of the nozzle portion, and the cap interior space to prevent air bubble contamination.

35 **[0015]** It is possible to provide the pre-filled container that is filled up to the nozzle portion with the paste and that can prevent air bubbles from entering

the nozzle portion during use, and the method for preventing air bubbles from entering the nozzle portion.

BRIEF DESCRIPTION OF THE DRAWINGS

5 **[0016]** In the accompanying drawings:

FIG. 1 illustrates the structure of a syringe used as a container for a pre-filled container;

FIG. 2 illustrates the configuration of a filling apparatus that fills the container with paste;

FIG. 3 is a partly enlarged view that explains the structure of a tip end portion of the syringe;

FIG. 4 is an explanatory view illustrating a state of inserting a filling nozzle into the syringe;

FIG. 5 is a functional block diagram of the filling apparatus;

15 FIG. 6 is an explanatory view of a method for filling the container;

FIG. 7 is a time chart in a method for filling the container;

FIG. 8 is an explanatory view illustrating a filled state of the pre-filled container;

FIG. 9 is an explanatory view illustrating a state of a nozzle portion of
20 the pre-filled container from which a cap is removed;

FIG. 10 is a diagram illustrating the structure of the pre-filled container in which an opening at a rear end portion is sealed; and

FIG. 11 is another time chart in the method for filling the container.

25 DETAILED DESCRIPTION

[0017] Based on the drawings, a pre-filled container and a method for preventing air bubble contamination according to an embodiment of the present disclosure will be described.

[0018] (Description of Outline)

FIG. 1 illustrates a syringe 1 to be used as a container for a pre-filled container according to the present embodiment. FIG. 2 illustrates an example of a filling apparatus M for the container.

[0019] As illustrated in FIG. 1, the syringe 1 is a container that can be filled with paste P and discharge the filled paste P. The specific shape of the syringe 1 illustrated in FIG. 1 is merely an example to explain the present embodiment.

[0020] The syringe 1 has a cylindrical body portion 10 into which the paste P is filled, a cylindrical nozzle portion 11 that is provided at a tip end portion of the body portion 10 and thinner than the body portion 11, and a bottomed cylindrical cap 2 externally fitted onto a tip of the nozzle portion 11.

5 **[0021]** The syringe 1 can discharge the paste P from a tip end opening of the nozzle portion 11 in an open state in which the cap 2 is removed from the nozzle portion 11.

[0022] The syringe 1 can be fitted with a plunger 18 that is inserted into a cylinder of the body portion 10. In the case of discharging the paste P, the cap
10 2 is removed, and then the paste P filled into the cylinder of the body portion 10 is pushed out and discharged from the nozzle portion 11 by pushing the plunger 18 into the inside of the cylinder of the body portion 10.

[0023] The paste P is filled into the body portion 10 after the nozzle portion 11 is sealed with the cap 2 so that there is no gap between the nozzle portion
15 11 and the cap 2, as described below.

[0024] In the following description, in the syringe 1, the side of the nozzle portion 11 is defined as a tip end side, and the opposite side is defined as a rear end side when viewed from the body portion 10.

[0025] FIG. 2 illustrates a filling apparatus M. The filling apparatus M is an
20 apparatus for filling the syringe 1 with the paste P. FIG. 2 illustrates a state in which the syringe 1 is mounted on the filling apparatus M. FIG. 2 illustrates a case in which a clip portion 10b, which is the rear end side of the body portion 10, is disposed on a top side in a vertical direction, and the nozzle portion 11, which is the tip end side of the body portion 10, is disposed on a bottom side
25 in the vertical direction. The filling apparatus M can fill the paste P into the body portion 10 of the syringe 1, the nozzle portion 11 of the body portion 10, and the cap 2.

[0026] The filling apparatus M includes a filling nozzle 6 that discharges the paste P and fills interior space S (see FIG. 1) of the body portion 10 and the
30 nozzle portion 11 of the syringe 1 with the paste P, and a control unit 9 that controls the discharge of the paste P from the filling nozzle 6.

[0027] In the present embodiment, by way of example, a case is described in which the filling apparatus M further includes a tank 3 that stores the paste P to be supplied to the syringe 1, a fluid volume regulation unit 4 that regulates
35 the volume of the paste P to be supplied from the tank 3 to the filling nozzle 6, an elevator 5 that moves up and down the filling nozzle 6, a holder 7 that

holds the syringe 1, and a support body 8 including a pillar and the like to support the elevator 5 and the holder 7.

5 **[0028]** In the following description, in the case of explaining the top and bottom of the filling apparatus M, an upward direction in the vertical direction is defined as the top, and a downward direction as the bottom. In the case of FIG. 2, the tip end side of the syringe 1 corresponds to the bottom side of the filling apparatus M, and the rear end side of the syringe 1 corresponds to the top side of the filling apparatus M.

10 **[0029]** The control unit 9 starts discharging the paste P from the filling nozzle 6, while the filling nozzle 6 is inserted into the inside of the cylinder of the nozzle portion 11 of the syringe 1, to fill the interior space S (see FIG. 1) of the body portion 10 and the nozzle portion 11 of the syringe 1 with the paste P.

[0030] (Detailed Description)

15 As illustrated in FIG. 1, the body portion 10 is a container made of resin such as polyolefin. The body portion 10 has the interior space S into which the paste P can be filled.

20 **[0031]** The body portion 10 has a cylindrical straight body portion 10a, the nozzle portion 11 formed at a tip end portion of the straight body portion 10a, a sleeve 12 that is formed at the tip end portion of the straight body portion 10a into the shape of a cylinder externally fitted onto the nozzle portion 11 and has a thread portion 13 formed on a wall of the cylinder, and the clip portion 10b formed at a rear end portion of the straight body portion 10a. The straight body portion 10a, the nozzle portion 11, the sleeve 12, and the clip portion 10b are integrally formed by injection molding or the like. The body portion 10 is preferably transparent, because the state of the paste P can be thereby visible from outside and whether a filling state of the paste P is appropriate can be grasped from outside. In the present embodiment, a case in which the body portion 10 is transparent is described. In the following description, space inside the cylinder of the straight body portion 10a, out of the interior space S, is referred to as space S1 (see FIG. 3).

30 **[0032]** The straight body portion 10a has, as an example, an outer diameter of between 10 mm and 20 mm inclusive. Also, a length in a direction along an axial center Y is between 60 mm and 120 mm inclusive. A wall thickness is between 0.5 mm and 2 mm inclusive. Note that, these outer diameter, length, and wall thickness are examples of the shape and size of the straight body portion 10a, and the present embodiment is not limited to such shape and size.

[0033] The clip portion 10b is formed in the shape of a rib extending outwardly in a radial direction of the body portion 10 at the rear end portion of the straight body portion 10a. The clip portion 10b is formed for the purpose of improving the ease of use of the syringe 1 (it can be used for grasping and supporting the syringe 1 during use), and can be omitted from the syringe 1.

[0034] The nozzle portion 11 is a cylindrical member that discharges the paste P filled into the body portion 10. The nozzle portion 11 has a slightly narrowed shape from the rear end side toward the tip end side. The outer diameter of the nozzle portion 11 is smaller than the outer diameter of the straight body portion 10a. The inside of the cylinder of the nozzle portion 11 is connected to the inside of the cylinder of the straight body portion 10a. Space inside the cylinder of the nozzle portion 11, out of the interior space S, is hereinafter referred to as space S2 (see FIG. 3).

[0035] As illustrated in FIG. 3, the nozzle portion 11 in the present embodiment is formed so as to extend along the axial center Y from a tip of a tapered portion 10c, which is formed at the tip end side of the straight body portion 10a. The nozzle portion 11 has a shape in which the outer diameter becomes slightly smaller from the rear end side to the tip end side and the tip end side is narrowed. An axial center X of the nozzle portion 11 is arranged along the axial center Y of the straight body portion 10a. In the present embodiment, as an example, the axial center X and the axial center Y overlap with each other and are coaxial.

[0036] The nozzle portion 11 has an outer diameter of between 3 mm and 6 mm inclusive, as an example. An internal diameter is between 2 mm and 4 mm inclusive. A length in a direction along the axial center X is between 8 mm and 15 mm inclusive. A wall thickness is between 0.5 mm and 2 mm inclusive. Note that, these outer diameter and the like are examples of the shape and size of the nozzle portion 11, and the present embodiment is not limited to such shape and size. In the present embodiment, a case in which the internal diameter of the nozzle portion 11 is 2.4 mm will be illustrated, by way of example.

[0037] As illustrated in FIG. 3, the sleeve 12 is a fixing seat for retaining the cap 2. The sleeve 12 is formed in a cylindrical shape, and is provided at the tip end portion of the straight body portion 10a in a positional relationship in which the nozzle portion 11 is fitted into the cylinder. The sleeve 12 is formed

so as to be coaxially centered with the axial center X of the nozzle portion 11. In the present embodiment, a case in which the outer diameter of the sleeve 12 is smaller than that of the straight body portion 10a is illustrated, but the outer diameter of the sleeve 12 may be formed larger than that of the straight body portion 10a. As an example, a thread portion 13 is formed on an inner peripheral surface of the cylinder of the sleeve 12 as a two-row thread (female thread in the present embodiment).

[0038] The cap 2 is a bottomed cylindrical lid member made of resin such as polyolefin. The cap 2 is transparent in the present embodiment. The cap 2 is preferably transparent, because the state of the paste P can be visually grasped from outside, but the cap 2 is not limited to being transparent.

[0039] The cap 2 has a bottomed cylindrical cap portion 20 that seals a tip end portion 11a of the nozzle portion 11, and an engagement portion 21 that serves as a knob for attaching and detaching the cap 2 and engages with an attachment and detachment device or the like for the cap 2. The inside of the cylinder of the cap portion 20 may have such a shape that an internal diameter becomes slightly smaller from the rear end side to the tip end side and the tip end side is narrowed, or conversely, that the internal diameter expands from the rear end side to the tip end side. An inner peripheral surface of the cylinder of the cap portion 20 is formed along an outer peripheral surface of the nozzle portion 11.

[0040] As an example, a cap-side thread portion 23 that can be screwed with the thread portion 13 of the sleeve 12 is formed on an outer peripheral surface of the cap portion 20. The cap-side thread portion 23 is a two-row screw (male screw in the present embodiment). In the present embodiment, the cap 2 is screwed with the sleeve 12 and can be secured to the body portion 10 by the screwed connection to the sleeve 12. The cap 2 is externally fitted onto the tip of the nozzle portion 11 in such a screwed connection or the like to seal the tip end opening of the nozzle portion 11.

[0041] In a sealed state in which the cap 2 is externally fitted onto the tip of the nozzle portion 11, the nozzle portion 11 is fitted into the cylinder of the cap portion 20. At this time, at least a part of the inner peripheral surface of the cylinder of the cap portion 20 contacts the outer peripheral surface of the nozzle portion 11 to seal the tip end portion 11a of the nozzle portion 11.

[0042] In the sealed state in which the cap 2 is externally fitted onto the tip of the nozzle portion 11, the tip end portion 11a of the nozzle portion 11 and a

bottom surface 20a in the cylinder of the cap portion 20 are separated from each other. In the present embodiment, the tip end portion 11a of the nozzle portion 11 and the bottom surface 20a of the cylinder are separated by a distance h that is equal to or more than an internal diameter d of the tip end portion 11a of the nozzle portion 11. In the present embodiment, the distance h between the tip end portion 11a and the bottom surface 20a of the cylinder is defined as a maximum distance between the tip end portion 11a and the bottom surface 20a of the cylinder in a direction along the axial center X. The distance h is preferably a distance equal to or more than the internal diameter d of the nozzle portion 11, as described below. The distance h is usually sufficient when the distance is three times or less than the internal diameter d. In the present embodiment, the distance h is 3.0 mm and the internal diameter d is 1.5 mm. In addition, a tip end surface of the nozzle portion 11 (in FIG. 3, a surface of the tip end portion 11a on the tip end side, an end surface of the cylinder of the nozzle portion 11 on the tip end side) of the nozzle portion 11 and an inner surface of the cap portion 20 of the cap 2 are separated from each other. Then, cap interior space S3 is formed between the tip end portion 11a and the bottom surface 20a of the cylinder.

[0043] One example of the paste P illustrated in FIG. 1 is a thermally conductive electrically conductive adhesive in which silver particles, as an electrically conductive filler, are dispersed in a solvent, a base resin, or the like. Such a silver paste is used, for example, as a bonding material (die bonding material) for bonding a semiconductor device to a lead frame, substrate, or the like. The paste P, as the thermally conductive electrically conductive adhesive, includes, as an example, a base resin such as an epoxy resin or an acrylic resin, a curing agent for the base resin, a thermoplastic resin, an organic solvent, and the like in addition to the silver particles. One example of an average particle diameter of the silver particles (average of the diameters of the particles equivalent to circles calculated from the area of each particle determined by image analysis of an electron microscope) is between 10 nm to 50 μm . The particle size distribution of the silver particles may have a so-called single peak or two or more peaks. For example, the particle size distribution of the silver particles may have peaks in a region of less than submicron (300 nm) and in a region of more than 1 μm . The shape of the silver particles is not limited to a particular shape, but may be spherical, rugby ball-shaped, needle-shaped, flake-shaped, or any other indefinite shape.

The silver paste may also contain metal oxide particles other than silver particles, such as zinc oxide, tin oxide, indium oxide, and a composite oxide of tin and bismuth. The paste P may be, for example, a particle dispersion element of the above-described silver particles having a viscosity of the order of 5 to 90 Pas and a thixotropy of the order of 1.0 to 11.5.

[0044] As the viscosity of the paste P, a value measured by an RVT type viscometer, an HVT type viscometer, or an E type viscometer can be adopted. In the present embodiment, in a case in which the viscosity of the paste P is 50 Pas or more, it is preferable to adopt a value measured by the HVT type viscometer or the E-type viscometer, and a viscosity measured at 25°C with a rotor speed of 10 rpm can be adopted. For the thixotropy, a value of viscosity measured at 25°C with a rotor speed of 10 rpm divided by a viscosity measured at 25°C with a rotor speed of 50 rpm can be adopted. In a case in which the viscosity of the paste P is 5 Pas or more and less than 50 Pas, it is preferable to adopt a value measured by the E-type viscometer, and a viscosity measured at 25°C with a rotor speed of 5 rpm can be adopted. For the thixotropy, a value of viscosity measured at 25°C with a rotor speed of 0.5 rpm divided by a viscosity measured at 25°C with a rotor speed of 5 rpm can be adopted.

[0045] In the syringe 1, as illustrated in FIG. 2, the tip end opening of the nozzle portion 11 is sealed by screwing the cap 2 onto the sleeve 12, the paste P is filled into the body portion 10 and the cap 2 by the filling apparatus M. In the present embodiment, as described below, the paste P is filled into the space S1 and the space S2 of the syringe 1 illustrated in FIG. 3, and the cap interior space S3.

[0046] In the present embodiment, after filling the syringe 1 with the paste P, as illustrated in FIG. 1, the plunger 18 and a sealing lid 19 are inserted in this order from an opening at the rear end portion to seal the opening on the rear end side. As a result, the syringe 1 becomes a paste-filled container and is used as a supply container (so-called cartridge) for the paste P in an applicator for the paste P, an adhesive device, or the like. A filling state of the syringe 1 with the paste P will be described later.

[0047] As illustrated in FIG. 2, the filling apparatus M includes the control unit 9 as a central control mechanism, the holder 7 that holds the syringe 1 to which the paste P is supplied, the elevator 5 having a cylinder 50 that can ascend and descend in the direction along the axial center Y of the straight

body portion 10a of the body portion 10, a position detector 59 that detects the elevation position of the cylinder 50, the filling nozzle 6 that is moved up and down by the cylinder 50 and supplies the paste P to the syringe 1 for filling, the tank 3 that stores the paste P to be supplied to the filling nozzle 6, the fluid volume regulation unit 4 that supplies the paste P from the tank 3 to the filling nozzle 6 and regulates the volume of the paste P to be supplied, a pressure detector 49 that detects the pressure of the paste P supplied from the fluid volume regulation unit 4, and the support body 8 that supports these parts.

10 **[0048]** In the filling apparatus M, the elevator 5 and the tank 3, the fluid volume regulation unit 4, and the filling nozzle 6 are arranged in this order from the top side to the bottom side.

[0049] The control unit 9 is a functional unit that controls the operation of the filling apparatus M and serves as a central control mechanism of the filling apparatus M. The control unit 9 receives information regarding an operation status and a detection status from each part of the filling apparatus M and each sensor, and transmits operation commands to each part to control the operation thereof. Details of the control unit 9 will be described later.

15 **[0050]** The holder 7 is a jig that holds the syringe 1 to which the paste P is supplied. The holder 7 is formed in the shape of a cylinder, for example, and holds the syringe 1 by inserting the body portion 10 of the syringe 1 into the inside of the cylinder. In the present embodiment, the holder 7 holds the syringe 1 so that the axial center Y of the straight body portion 10a of the body portion 10 is along the vertical direction.

20 **[0051]** The elevator 5 is an elevating mechanism to move the filling nozzle 6 up and down. The elevator 5 includes, as an example, a drive mechanism such as an air cylinder, an electric actuator, and a motor such as a servo motor. In the present embodiment, the elevator 5 includes the cylinder 50 that is driven by the drive mechanism to be capable of ascending and descending in the direction along the axial center Y of the straight body portion 10a of the body portion 10 (the same as the vertical direction in the present embodiment). The cylinder 50 is, for example, a slide mechanism or the like that is driven by the above-described drive mechanism capable of regulating and controlling the elevation position and realizing elevation operation by sliding operation. In the present embodiment, a case in which the cylinder 50 is driven to move up and down by an air cylinder will be illustrated by way of example. In the

present embodiment, as described below, the elevator 5 moves the filling nozzle 6 up and down via the tank 3 secured to the cylinder 50 and the fluid volume regulation unit 4 secured to the tank 3.

5 **[0052]** The position detector 59 is a measuring device such as a position sensor that detects the elevation position of the filling nozzle 6 by the elevator 5. The position detector 59 may have any principle of detecting the position, such as an optical type or a pressure type. In the present embodiment, the position detector 59 includes an optical position sensor, detects the elevation position (travel distance) of the cylinder 50, and transmits position
10 information based on the detection result to the control unit 9. The control unit 9 calculates the elevation position of the filling nozzle 6 based on the position information transmitted by the position detector 59, and controls the elevation position of the filling nozzle 6 by the elevator 5. The control unit 9 can also calculate an elevation speed of the filling nozzle 6 based on the
15 position information, and control the elevation speed of the filling nozzle 6 by the elevator 5.

[0053] The filling nozzle 6 is a nozzle device for discharging the paste P and filling the syringe 1 with the paste P. The filling nozzle 6 is connected to a downstream side of the fluid volume regulation unit 4. The filling nozzle 6 is
20 detachably secured to the fluid volume regulation unit 4, for example, in a state of being suspended from the fluid volume regulation unit 4. In the present embodiment, the filling nozzle 6 has a nozzle base 60 that is connected to the fluid volume regulation unit 4 and is suspended from and secured to the fluid volume regulation unit 4, and a nozzle-shaped needle 61
25 connected to a lower end side of the nozzle base 60.

[0054] The nozzle base 60 is a cylindrical member through which the paste P can flow inside. The nozzle base 60 supplies the paste P supplied from the fluid volume regulation unit 4 to the needle 61. By way of example, the nozzle base 60 is in a straight cylindrical shape.

30 **[0055]** As illustrated in FIG. 4, the needle 61 discharges the paste P supplied from the nozzle base 60 in the straight body portion 10a of the body portion 10, the nozzle portion 11 of the body portion 10, and the cap 2, to fill the inside of these parts with the paste P. By way of example, the needle 61 is in a straight cylindrical shape. The outer diameter of the cylinder of the needle 61
35 is thinner than the outer diameter of the nozzle base 60. Also, the outer diameter of the cylinder of the needle 61 is thinner than the internal diameter

of the cap portion 20 of the cap 2. The needle 61 is secured to the nozzle base 60, as an example.

[0056] As filling nozzle 6, combinations of the nozzle base 60 and needles 61 of various sizes and shapes may be prepared in advance. An appropriate filling
5 nozzle 6 may be selectable according to the size and shape of the syringe 1.

[0057] The filling nozzle 6 is moved up and down by the elevator 5, and the needle 61 is inserted from the rear end side of the body portion 10 into the inside of the cylinder of the body portion 10. As illustrated in FIG. 4, the filling nozzle 6 is moved up and down by the elevator 5 to allow a tip end
10 portion 62 of the needle 61 to protrude beyond the tip end portion 11a of the nozzle portion 11 further to the tip end side so as to be inserted into the cylinder of the cap portion 20. In other words, the tip end portion 62 can be advanced or retracted in a range from the opening on the rear end side of the body portion 10 to the inside of the cylinder of the cap portion 20.

[0058] In the present embodiment, the needle 61 can be arbitrarily attached to and detached from the filling nozzle 6, and exchanged for any of needles with various lengths and thicknesses (inner or outer diameters) according to the nozzle portion 11. That is, the needle 61 can be arbitrarily exchanged according to the dimensions and shape of the syringe 1.

[0059] The needle 61 has an outer diameter of, for example, between 1.5 mm and 2.5 mm inclusive. An internal diameter is between 1.0 mm and 2.0 mm inclusive. Also, a wall thickness is between 0.15 mm and 0.40 mm inclusive. These outer diameter and the like are examples of the shape and size of the needle 61, and the present embodiment is not limited to such shape and size.
20 The length of the needle 61 in a direction along the axial direction of the cylinder is longer than the length of the nozzle portion 11 in the direction along the axial center X, and is, for example, from 130% to 250% of the length of the nozzle portion 11 along the axial center X. In the present embodiment, a case in which the needle 61 has an internal diameter of 1.5 mm
25 will be described as an example.

[0060] As illustrated in FIG. 2, the tank 3 is a reservoir for storing the paste P to be supplied to the syringe 1 by the filling nozzle 6. The supply of the paste P from the tank 3 to the filling nozzle 6 can be performed by pressure feeding using, for example, the pressure of compressed air supplied from a compressor
30 A or the like. The compressed air supplied from the compressor A is regulated in terms of pressure and flow rate by a regulator 41 and a controller 42, which

will be described later, and then is supplied to the tank 3. The tank 3 supplies the paste P to the filling nozzle 6 via the fluid volume regulation unit 4. In the present embodiment, the tank 3 is secured to the cylinder 50 and is moved up and down using fluid pressure by the elevator 5.

5 **[0061]** The fluid volume regulation unit 4 is a supply regulation mechanism that regulates the volume of the paste P to be supplied from the tank 3 to the filling nozzle 6. The fluid volume regulation unit 4 has a valve 40 such as an opening regulation valve that can switch between permitting and prohibiting the supply of the paste P to be supplied from the tank 3 to the filling nozzle 6,
10 and can regulate the volume of the paste P to be supplied from the tank 3 to the filling nozzle 6. The fluid volume regulation unit 4 of the present embodiment further has the regulator 41 that reduces the pressure of the compressed air to be supplied from the compressor A, and the controller 42 that regulates the flow rate or pressure of the compressed air to be supplied
15 from the compressor A to the tank 3.

[0062] The valve 40 regulates the supply of the paste P to the filling nozzle 6 by regulating the feeding pressure of the paste P to be supplied from the tank 3 to the filling nozzle 6. In the present embodiment, the valve 40 regulates the supply of the paste P to the filling nozzle 6 by reducing the feeding pressure
20 of the paste P to be pressure fed from the tank 3. As the valve 40, for example, a diaphragm valve or a needle valve capable of regulating an opening degree can be used.

[0063] The fluid volume regulation unit 4 is secured to a lower part of the tank 3. The filling nozzle 6 is secured to a lower part of the fluid volume regulation unit 4. The tank 3, the fluid volume regulation unit 4, and the
25 filling nozzle 6 are integrally moved up and down by ascent and descent of the cylinder 50 of the elevator 5.

[0064] The pressure detector 49 is a pressure detection device such as a pressure sensor that detects the pressure of the paste P flowing from the fluid
30 volume regulation unit 4 to the filling nozzle 6. The pressure detector 49 can adopt any principle for detecting the pressure, such as a piezoelectric type or a diaphragm type. In the present embodiment, the pressure detector 49, which includes a piezoelectric pressure sensor, detects the pressure (feeding pressure) of the paste P at a downstream side of the valve 40 (upstream side of
35 the filling nozzle 6), and transmits pressure information based on the detection result to the control unit 9. The control unit 9 controls the fluid

volume regulation unit 4 based on the pressure information transmitted by the pressure detector 49, to control the feeding pressure of the paste P, thereby controlling a discharge rate of the paste P to be discharged from the filling nozzle 6. In the present embodiment, the discharge rate of the paste P to be discharged from the filling nozzle 6 is determined according to the lengths and internal diameters of the cylinders of the nozzle base 60 and the needle 61, in addition to the feeding pressure. Therefore, in the present embodiment, the control unit 9 regulates the discharge rate of the paste P from the filling nozzle 6 by taking into account, in addition to the pressure information, information on the lengths and the internal diameters of the cylinders of the nozzle base 60 and the needle 61.

[0065] The control unit 9 is realized in hardware or software by a CPU or a program (software) that causes the CPU to perform control of the filling apparatus M (control to perform a filling method described below). In the present embodiment, as illustrated in FIG. 5, the control unit 9 is realized by control software stored in a computer C such as a personal computer or a PLC and a memory 90 thereof. The control unit 9 is communicably connected to the fluid volume regulation unit 4, the elevator 5, the pressure detector 49, the position detector 59, and the like via a communication path N, which includes a port, a bus, a wired or wireless network (including an Internet line), and the like. As the memory 90, a memory device or a memory medium available in the computer C, including a flash memory such as a so-called USB memory, a hard disk, an SSD, an optical disk such as a CDROM, or the like, can be generally used.

[0066] (Description of Filling Method)

Filling of the syringe 1 with the paste P is performed by the execution of each of the following steps performed by the filling apparatus M.

[0067] First, as illustrated in FIG. 6, the control unit 9 executes, by the elevator 5, an insertion step in which the filling nozzle 6 is inserted into the inside of the cylinder of the nozzle portion 11 through the inside of the cylinder of the body portion 10 (the inside of the cylinder of the straight body portion 10a). In the present embodiment, the filling nozzle 6 is inserted into the inside of the cylinder of the nozzle portion 11 until the tip end portion 62 of the needle 61 of the filling nozzle 6 protrudes from the opening at the tip end portion 11a of the nozzle portion 11 (point A in FIG. 6). The tip end portion 62 preferably protrudes from the opening at the tip end portion 11a of

the nozzle portion 11 by 16.7% or more and 90% or less of the distance h. In addition, the tip end portion 62 preferably protrudes from the opening at the tip end portion 11a of the nozzle portion 11 by a distance of 33.4% or more of the internal diameter d of the nozzle portion 11. In the present embodiment,
5 the tip end portion 62 protrudes from the opening at the tip end portion 11a of the nozzle portion 11 by 2.5 mm. The needle 61 is preferably inserted into the nozzle portion 11 with its longitudinal direction along the axial center X of the nozzle portion 11. The needle 61 is further preferably inserted into the nozzle portion 11 with its longitudinal direction overlapping with the axial
10 center X of the nozzle portion 11.

[0068] After completing the above-described insertion step, the control unit 9 executes a filling step in which the control unit 9 controls the fluid volume regulation unit 4 to start supplying the paste P and discharging the paste P from the filling nozzle 6 to fill the space S1, the space S2, and the cap interior
15 space S3 with the paste P.

[0069] The filling step is started by starting discharging the paste P from the needle 61 while the filling nozzle 6 is inserted into the inside of the cylinder of the nozzle portion 11. In the filling step of the present embodiment, while
20 the tip end portion 62 of the filling nozzle 6 protrudes from the opening at the tip end portion 11a of the nozzle portion 11, the discharge of the paste P from the filling nozzle 6 is started. The interior space S and the cap interior space S3 can be thereby filled with the paste P.

[0070] In the filling step, the control unit 9 controls the elevator 5 to pull the filling nozzle 6 out of the body portion 10, while controlling the fluid volume regulation unit 4 to discharge the paste P from the filling nozzle 6. Thereby,
25 the interior space S can be filled with the paste P. The control unit 9 controls the fluid volume regulation unit 4 to stop supplying the paste P to the filling nozzle 6 and to stop discharging the paste P from the filling nozzle 6, at the time of pulling the tip end portion 62 of the filling nozzle 6 to a predetermined
30 position (point C in FIG. 6) in the straight body portion 10a of the body portion 10 (see FIG. 6).

[0071] In the filling step, the control unit 9 executes an initial filling step, a first filling step, and a second filling step. FIG. 7 illustrates a time chart of the operation performed by the filling apparatus M. In FIG. 7, the horizontal axis
35 represents process time. The following description will be made with reference to FIGS. 2 to 7.

[0072] A graph at an upper part of FIG. 7 illustrates variation in the feeding pressure of the paste P regulated by the fluid volume regulation unit 4 with time.

5 **[0073]** A graph at a lower part of FIG. 7 illustrates variation in the position of the tip end portion 62 of the filling nozzle 6 advanced and retreated by the elevator 5 with time. The position of the tip end portion 62 in FIG. 7 is indicated by the distance between the tip end surface of the tip end portion 11a of the nozzle portion 11 and a tip end surface of the tip end portion 62. The position of the tip end portion 62 is set to zero in a case in which the tip end surface of the tip end portion 11a and the tip end surface of the tip end portion 62 overlap in the vertical direction, a positive value in a case in which the tip end surface of the tip end portion 62 is on the top side in the vertical direction relative to the tip end surface of the tip end portion 11a, and a negative value in a case in which the tip end surface of the tip end portion 62 is on the bottom side in the vertical direction relative to the tip end surface of the tip end portion 11a. In other words, in FIG. 7, a point A is at a distance indicated by a negative value, which means that the needle 61 is located in the nozzle portion 11 and the tip end surface of the tip end portion 62 is on the bottom side in the vertical direction relative to the tip end surface of the tip end portion 11a.

20 **[0074]** In the initial filling step, while the control unit 9 keeps the tip end portion 62 of the filling nozzle 6 at the point A (while the control unit 9 stops the filling nozzle 6 from being pulled out), the control unit 9 controls the fluid volume regulation unit 4 to set the feeding pressure of the paste P to a pressure p_1 (an example of a first discharge speed) to start discharging the paste P from the filling nozzle 6 (a time t_0 in FIG. 7). The control unit 9 starts executing the first filling step, at the point in time (a time t_1 in FIG. 7) when at least the cap interior space S3 is filled with the paste P and, out of the interior space S, a range of a distance of 20% or more from the tip end side of the nozzle portion 11 along the axial direction is filled with the paste P. An example of time (time between the time t_0 and the time t_1 in FIG. 7) during which the paste P is discharged from the filling nozzle 6, while the filling nozzle 6 is stopped from being pulled out, is between 0.2 seconds and 0.5 seconds inclusive. In the present embodiment, a case in which the time is 0.3 seconds is described by way of example.

35 **[0075]** In the present embodiment, since the paste P is discharged with the tip

end portion 62 protruding from the opening at the tip end portion 11a of the nozzle portion 11 by 16.7% or more of the distance h and with the tip end portion 62 protruding from the opening at the tip end portion 11a of the nozzle portion 11 by 33.4% or more of the internal diameter d of the nozzle portion 11, it is possible to fill the paste P while minimizing contamination of air bubbles in the interior space S and the cap interior space $S3$.

[0076] In addition, in the present embodiment, since the control unit 9 starts executing the first filling step, at the point in time when at least the cap interior space $S3$ is filled with the paste P and, out of the interior space S , the range of the distance of 20% or more from the tip end side of the nozzle portion 11 along the axial direction is filled with the paste P , the tip end portion 62 can be made buried in the paste P , as described below.

[0077] Thus, at the point in time when the cap interior space $S3$ is filled with the paste P , the tip end portion 62 is buried in the paste P . This prevents (including the concept of preventing, the same applies hereinafter) air bubbles from entering the filled paste P in the steps of filling the paste P thereafter. Note that, the point A (see FIG. 6) is selected from within a region between the tip end portion 11a of the nozzle portion 11 and the bottom surface 20a in the cylinder of the cap portion 20 in the vertical direction. The pressure $p1$ is set to, for example, 200 kPa or more and 500 kPa or less. An appropriate value of the pressure $p1$ and a range thereof depend on the shape of the flow path in the filling nozzle 6 (e.g., the internal diameter and length of the needle 61), and therefore may be changed as necessary. In the present embodiment, a case where the pressure $p1$ is set to 350 kPa will be described by way of example.

[0078] In the first filling step, the control unit 9 causes the paste P to be discharged from the filling nozzle 6 at the pressure $p1$, while controlling the elevator 5 to pull out the tip end portion 62 of the filling nozzle 6 at a first pulling speed from the point A to a point B (see FIG. 6). As illustrated in FIG. 7, the pulling speed of the filling nozzle 6 is indicated by the slope of a line L representing variation in the position of the tip end portion 62 of the filling nozzle 6. The first pulling speed corresponds to the slope of the line L from the time $t1$ to a time $t2$. The point B is selected from within a region inside the cylinder of the nozzle portion 11 in the vertical direction. In the present embodiment, the distance from the point A to the point B is 5 mm.

[0079] The first pulling speed is set to a speed at which the tip end portion 62 remains buried in the paste P in relationship to the viscosity and surface

tension of the paste P. As illustrated in FIG. 6, by keeping the tip end portion 62 buried in the paste P, it is possible to prevent air bubbles from entering the filled paste P. The first pulling speed is preferably set to the same speed as a speed at which the liquid level of the paste P rises in the nozzle portion 11 during filling. One example of the first pulling speed is between 8 mm/s and 20 mm/s inclusive. In the present embodiment, a case in which the first pulling speed is 15 mm/s will be illustrated by way of example.

[0080] In the second filling step, as illustrated in FIG. 7, the control unit 9 causes the paste P to be discharged from the filling nozzle 6 at the pressure p1 (an example of a case in which a second discharge speed is the same as the first discharge speed), while controlling the elevator 5 to pull out the tip end portion 62 of the filling nozzle 6 from the point B to a point C (see FIG. 6) at a second pulling speed slower than the first pulling speed. The second pulling speed corresponds to the slope of the line L from the time t2 to a time t3. The control unit 9 ends filling (ends the filling step) when the tip end portion 62 reaches the point C (time t3). As illustrated in FIGS. 6 and 8, the filled syringe 1 becomes a pre-filled container in which the space S1, the space S2, and the cap interior space S3 are filled with the paste P.

[0081] The second pulling speed is set, for example, to a speed of 50% or more and 90% or less of the first pulling speed. One example of the second pulling speed is between 5 mm/s and 15 mm/s inclusive. In the present embodiment, a case in which the second pulling speed is 15 mm/s is illustrated by way of example. The second pulling speed is set to a speed at which the tip end portion 62 remains buried in the paste P in relation to the viscosity and surface tension of the paste P. By keeping the tip end portion 62 buried in the paste P, air bubbles can be prevented from entering the filled paste P. The second pulling speed may be arbitrary as long as the tip end portion 62 remains buried in the paste P until the filling step is completed. For example, the second pulling speed is preferably set to the same speed as a speed at which the liquid level of the paste P rises in the straight body portion 10a during filling, because the tip end portion 62 can reliably remain buried in the paste P until the filling step is completed.

[0082] In the present embodiment, after the filling step is completed, for example, the pulling speed of the filling nozzle 6 is temporarily slowed down to a speed slower than the second pulling speed, and the tip end portion 62 is slowly pulled out of the filled paste P. This prevents dripping of the paste P

from the tip end portion 62 and prevents air bubbles from entering the filled paste P. Thereafter, the pulling speed can be accelerated to completely pull the filling nozzle 6 out of the body portion 10. The acceleration while pulling out facilitates shortening process time.

5 **[0083]** Appropriate ranges of the first pulling speed and the second pulling speed depend on the size and shape of the syringe 1 (e.g., the internal diameters of the body portion 10 and the nozzle portion 11), so the first pulling speed and the second pulling speed are not limited to the examples of the above-described specific speeds, and may be set as appropriate according
10 to the size and shape of the syringe 1.

[0084] With reference to FIG. 8, the filled syringe 1 as a pre-filled container will be described in detail. As described above, the syringe 1 has the space S1, the space S2, and the cap interior space S3 filled with the paste P. In the filled syringe 1, in the cap interior space S3, the space between the tip end surface
15 of the cylinder of the tip end portion 11a and the cap 2, that is, a boundary portion 20b that is space in the vicinity of the boundary between the tip end portion 11a of the nozzle portion 11 and the inner peripheral surface of the cap portion 20 (a portion at which the tip end portion 11a of the nozzle portion 11 contacts the cap portion 20, or a middle position between the tip end portion
20 11a of the nozzle portion 11 and the cap portion 20) is also filled with the paste P. The vicinity with respect to definition of the boundary portion 20b refers to a distance within the thickness of the cylinder of the tip end portion 11a.

[0085] In the syringe 1, the space S2 and the cap interior space S3 are filled
25 with the paste P, so that air bubbles are prevented from entering the nozzle portion 11 during use of the syringe 1 (for example, when the syringe 1 with the cap 2 removed is mounted on an application device that uses the paste P in the syringe 1 and the nozzle portion 11 is connected to the application device). As a result, when the paste P in the syringe 1 is used, it is possible to prevent
30 a problem of blanking, which impairs the uniformity and the application workability of the silver paste. In addition, this eliminates the need for performing an operation in which a certain amount of the paste P in the nozzle portion 11 is pushed out and discarded to remove air bubbles mixed into the nozzle portion 11, thus allowing to use the paste P without waste. Therefore,
35 in a case in which the paste P is an expensive one such as silver paste, an economic advantage becomes extremely large.

[0086] In the syringe 1, especially by filling the cap interior space S3 with the paste P, it is possible to prevent air bubbles from entering the nozzle portion 11 when the cap 2 is removed. As illustrated in FIG. 9, in the syringe 1, when the cap 2 is removed, a part P1 of the paste P filled into the cap interior space S3 remains in a state of protruding to a tip end side from the tip end portion 11a of the nozzle portion 11 (a state of adhering to and remaining at the tip end portion 11a), due to filling the cap interior space S3 with the paste P. Therefore, it is possible to prevent air (air bubbles) from entering the cylinder of the nozzle portion 11 when the cap 2 is removed.

[0087] In order to increase the effect of preventing air (air bubbles) from entering the cylinder of the nozzle portion 11 when the cap 2 is removed, as illustrated in FIG. 3, the tip end portion 11a of the nozzle portion 11 and the bottom surface 20a of the cylinder are preferably separated from each other by the distance h that is equal to or more than the internal diameter d of the tip end portion 11a of the nozzle portion 11. This allows the cap interior space S3 to be sufficiently large to secure the volume of the paste P to be filled into the cap interior space S3, and therefore ensures, when the cap 2 is removed, the formation of the part P1 (see FIG. 9) of the paste P that remains in a state of protruding to the tip end side from the tip end portion 11a of the nozzle portion 11. In addition, due to the separation by the distance h that is equal to or more than the internal diameter d of the tip end portion 11a of the nozzle portion 11, when the cap 2 is removed, it is possible to promote the formation of the the part P1 of the paste P that remains in a state of protruding to the tip end side from the tip end portion 11a of the nozzle portion 11. These can prevent air (air bubbles) from entering the cylinder of the nozzle portion 11 when the cap 2 is removed.

[0088] In the filled syringe 1, the boundary portion 20b between the tip end portion 11a of the nozzle portion 11 and the inner peripheral surface of the cap portion 20, in the cap interior space S3, is also filled with the paste P, thus further ensuring that air (air bubbles) is prevented from entering the cylinder of the nozzle portion 11 when the cap 2 is removed. This is because, when the cap 2 is removed, the paste P in the boundary portion 20b moves to the inside of the nozzle portion 11, thus making it difficult for air (air bubbles) to enter the cylinder of the nozzle portion 11. The paste P in the boundary portion 20b also promotes the formation of the part P1 of the paste P that remains in a state of protruding to the tip end side from the tip end portion 11a of the

nozzle portion 11. These prevent air (air bubbles) from entering the cylinder of the nozzle portion 11 when the cap 2 is removed.

5 **[0089]** In particular, since the paste P has the predetermined viscosity and thixotropy, when the cap 2 is removed, as illustrated in FIG. 9, the paste P in the nozzle portion 11 (in the interior space S) does not flow out (drip), and the formation of the part P1 of the paste P that remains in a state of protruding to the tip end side from the tip end portion 11a of the nozzle portion 11 is promoted, along with the above-described movement of the paste P in the boundary portion 20b. This function also prevents air (air bubbles) from entering the cylinder of the nozzle portion 11 when the cap 2 is removed.

10 **[0090]** The filled syringe 1 is preferably shipped, as illustrated in FIG. 10, with the plunger 18 and sealing lid 19 inserted in this order from the opening at the rear end portion and the opening on the rear end side sealed. Then, the filled syringe 1 is used as a supply container for the paste P in the applicator for the paste P, the adhesive device, or the like.

15 **[0091]** The filled syringe 1 prevents air bubble contamination, and does not require any defoaming treatment (e.g., defoaming treatment using centrifugal force) in the applicator for the paste P, the adhesive device, or the like. Therefore, there is a merit of improving work efficiency at the time of use. In addition, the generation of unevenness in a dispersion state due to defoaming and the resulting performance deterioration can be avoided. Particularly, in the paste P that is highly blended, for example, the paste P that is blended so that the particle size distribution of the silver particles has two or more peaks, the unevenness in the dispersion state due to defoaming operation is likely to occur, but this is a great merit in that performance degradation due to such unevenness in the dispersion state can be prevented.

20 **[0092]** As described above, it is possible to provide a pre-filled container that can prevent air bubbles from entering the nozzle portion during use.

25 **[0093]** [Other Embodiments]

30 (1) In the above embodiment, a case in which the paste P is discharged from the filling nozzle 6 at the pressure p1 in the second filling step is described. However, as illustrated in FIG. 11, in the second filling step, the paste P may be discharged from the filling nozzle 6 at a pressure p2 higher than the pressure p1 (an example in which the second discharge speed is higher than the first discharge speed). This allows to reduce process time required for filling the syringe 1. As an example, the pressure p2 is set to

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between 300 kPa and 500 kPa inclusive. An appropriate value of the pressure p_2 and a range thereof depend on the shape of the flow path in the filling nozzle 6 (e.g., the internal diameter and length of the needle 61), and therefore may be changed as necessary.

5 **[0094]** (2) In the above embodiment, by way of example, a case in which the axial center X of the nozzle portion 11 is arranged along the axial center Y of the straight body portion 10a, more specifically, a case in which the axial center X overlaps with the axial center Y is described. However, the axial center X may not overlap with the axial center Y, but may only be along the
10 axial center Y. Even when the axial center X does not overlap with the axial center Y, the needle 61 can be inserted into the nozzle portion 11 while a longitudinal direction of the needle 61 is aligned with the axial center X of the nozzle portion 11 (for example, overlapped with the axial center X).

15 **[0095]** (3) In the above embodiment, by way of example, a case in which the axial center X of the nozzle portion 11 is arranged along the axial center Y of the straight body portion 10a is described. However, the axial center X may not be along the axial center Y. In this case, for example, the needle 61 may be made flexible by forming the needle 61 of a flexible material, and the needle 61 may be inserted into the nozzle portion 11 along an inner wall of the nozzle
20 portion 11 (e.g., while sliding on an inner wall surface of the nozzle portion 11) to perform filling.

25 **[0096]** (4) In the above embodiment, a case in which the control unit 9 controls the fluid volume regulation unit 4 to stop supplying the paste P to stop discharging the paste P from the filling nozzle 6, at the time of pulling out the tip end portion 62 of the filling nozzle 6 to a predetermined position (point C in FIG. 6) in the straight body portion 10a of the body portion 10 is described. However, the timing of stopping the discharge of the paste P is not limited to the timing when the tip end portion 62 is pulled out to the point C. For example, a weight detection sensor to detect the weight of the syringe 1 is
30 provided in the holder 7, and the discharge of the paste P may be stopped when the weight of the syringe 1 filled with the paste P reaches a predetermined weight.

35 **[0097]** (5) In the above embodiment, by way of example, a case in which the fluid volume regulation unit 4 has the valve 40 such as the opening regulation valve that can regulate the volume of the paste P to be supplied from the tank 3 to the filling nozzle 6 and that can prohibit the feeding of the paste P to the

filling nozzle 6, and the valve 40 regulates the supply of the paste P to the filling nozzle 6 by regulating the feeding pressure of the paste P to be supplied from the tank 3 to the filling nozzle 6 is described. However, the regulation of the feeding pressure of the paste P is not limited to the above aspect.

5 [0098] (6) In the above embodiment, a case in which the filling nozzle 6 is inserted into the inside of the cylinder of the nozzle portion 11 until the tip end portion 62 of the needle 61 of the filling nozzle 6 protrudes from the opening at the tip end portion 11a of the nozzle portion 11, and the discharge of the paste P from the filling nozzle 6 is started while the tip end portion 62 of the filling nozzle 6 protrudes from the opening at the tip end portion 11a of the nozzle portion 11 is described. However, the position at which the discharge of the paste P is started is not limited to the above aspect. For example, the tip end portion 62 of the needle 61 of the filling nozzle 6 is inserted into the inside of the cylinder of the nozzle portion 11 (e.g., the tip end surface of the tip end portion 62 is at the same position as the tip end surface of the tip end portion 11a in the direction along the axial center X), and the discharge of the paste P from the filling nozzle 6 may be started while the tip end portion 62 of the filling nozzle 6 is located inside the cylinder of the nozzle portion 11. By filling the interior space S and the cap interior space S3 with the paste P from the filling nozzle 6, it is possible to prevent air (air bubbles) from entering the cylinder of the nozzle portion 11 when the cap 2 is removed.

[0099] For example, the fluid volume regulation unit 4 may control only the supply and stop of the paste P at the valve 40, and regulate the feeding pressure of the paste P by the controller 42 that regulates the flow rate or pressure of the compressed air supplied to the tank 3 based on the pressure information detected by the pressure detector 49. A method and aspect of regulating the feeding pressure of the paste P by the fluid volume regulation unit 4 are not limited to the above embodiment.

30 [0100] (7) In the above embodiment, as one example of the paste P, a case in which the paste P is the thermally conductive electrically conductive adhesive in which the particles of silver, as the electrically conductive filler, are dispersed in the solvent, the base resin, or the like is described by way of example. However, the paste P is not limited to the case of dispersing the electrically conductive filler. Also, the electrically conductive filler is not

limited to the particles of silver. In addition to the particles of silver, particles of metal such as platinum, ruthenium, rhodium, palladium, osmium, iridium, gold, or copper, or particles of a thermoplastic resin such as acrylic, polyethylene, polypropylene, polystyrene, or polyester may be dispersed as a
5 filler of the paste P.

[0101] The configuration disclosed in each the above embodiments (including the other embodiments, the same hereinafter) can be applied in combination with the configurations disclosed in the other embodiments as long as no contradiction occurs. The embodiments disclosed herein are just examples,
10 and the embodiments of the present invention are not limited thereto, and may be modified as appropriate within the scope of not departing from the purpose of the present invention.

INDUSTRIAL APPLICABILITY

[0102] The present invention can be applied to pre-filled containers and
15 methods for preventing air bubble contamination.

CLAIMS

1. A pre-filled container comprising:
a cylindrical body portion;
5 a cylindrical nozzle portion provided at a tip end portion of the body portion, the nozzle portion being thinner than the body portion;
a bottomed cylindrical cap externally fitted onto a tip of the nozzle portion, the cap being detachably attached to the nozzle portion; and
paste to be discharged from the nozzle portion, wherein
10 a tip end portion of the nozzle portion and a bottom surface of a cylinder of the cap are separated from each other, and cap interior space is formed between the tip end portion of the nozzle portion and the bottom surface of the cylinder of the cap, and
the paste is filled into the cylindrical body portion, the cylindrical
15 nozzle portion, and the cap interior space.
2. The pre-filled container according to claim 1, wherein a tip end surface of the cylindrical nozzle portion and the cap are separated from each other, and the paste is filled into space between the tip end surface and
20 the cap, in the cap interior space.
3. The pre-filled container according to claim 1 or 2, wherein the tip end portion of the nozzle portion and the bottom surface of the cylinder of the cap are separated from each other by a distance equal to or more than an
25 internal diameter of the nozzle portion.
4. The pre-filled container according to any one of claims 1 to 3, wherein the paste has a viscosity of 5 to 90 Pa·s and a thixotropy of 1.0 to 11.5.
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5. The pre-filled container according to any one of claims 1 to 4, wherein the cap is transparent, and the paste filled into the cap interior space is visible from outside the cap.
- 35 6. A method for preventing air bubble contamination in a pre-filled container including:

a cylindrical body portion;

a cylindrical nozzle portion provided at a tip end portion of the body portion, the nozzle portion being thinner than the body portion;

5 a bottomed cylindrical cap externally fitted onto a tip of the nozzle portion, the cap being detachably attached to the nozzle portion; and

paste to be discharged from the nozzle portion,

the method comprising:

10 forming cap interior space between a tip end portion of the nozzle portion and a bottom surface of a cylinder of the cap, by separating the tip end portion of the nozzle portion and the bottom surface of the cylinder of the cap from each other; and

filling the paste into the cylindrical body portion, the cylindrical nozzle portion, and the cap interior space to prevent air bubble contamination.