United States Patent Application Publication	20250256342
Kind Code	A1
Publication Date	August 14, 2025
Inventor(s)	ICHIKAWA; Hirokazu et al.

METHOD OF PROCESSING SUBSTRATE USING JET SOLDERING APPARATUS

Abstract

A jet soldering apparatus includes a first housing; a first supply port provided on the first housing and configured to provide first molten solder; a second housing; and a second supply port provided on the second housing and configured to provide second molten solder. The jet soldering apparatus is configured to mix the first molten solder and the second molten solder so as to obtain mixed molten solder. The jet soldering apparatus is configured to provide the mixed molten solder such that the mixed molten solder is not separated from a substrate conveyed by a conveyance unit between the first supply port and the second supply port.

Inventors: **ICHIKAWA; Hirokazu (Tokyo, JP), TOMITSUKA; Kenichi (Tokyo, JP)**

Applicant: **SENJU METAL INDUSTRY CO., LTD.** (Tokyo, JP)

Family ID: **83360852**

Appl. No.: **19/191151**

Filed: **April 28, 2025**

Foreign Application Priority Data

JP	2021-082656	May. 14, 2021

Related U.S. Application Data

parent US division 18036024 20230509 PENDING WO division PCT/JP2022/019615 20220509 child US 19191151

Publication Classification

Int. Cl.: **B23K1/08** (20060101); **B23K3/06** (20060101)

U.S. Cl.:

CPC **B23K1/085** (20130101); **B23K3/0653** (20130101);

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a divisional of U.S. application Ser. No. 18/036,024 filed on May 9, 2023, claiming the benefit of priority of Japanese Patent Application No. 2021-082656, filed May 14, 2021. The entire disclosures of the above-identified applications, including the specifications, drawings, and claims are incorporated herein by reference in their entirety.

TECHNICAL FIELD
[0002] The present invention relates to a method of processing substrate using jet soldering apparatus that supplies molten solder to a substrate.
BACKGROUND ART
[0003] Conventionally, a jet soldering apparatus for supplying molten solder to a substrate has been known. For example, JP 2011-222785 A discloses use of an upstream jet nozzle used in a primary soldering process in which molten solder is coarsely jetted and soldered, and a downstream jet nozzle used in a secondary soldering process (for finishing) in which molten solder is finely jetted and soldered.
SUMMARY OF INVENTION
Problem to Be Solved by Invention
[0004] In the case of using molten solder composed of two types of flows as in JP 2011-222785 A, it is advantageous that the solder can be cleanly attached to the substrate, but there is a tendency that an oxide of the solder is easily generated as compared with the case of using molten solder composed of one type of flow.
[0005] The present invention provides a jet soldering apparatus capable of cleanly attaching solder to a substrate and suppressing generation of an oxide of the solder.
Means for Solving Problem
[0006] A jet soldering apparatus according to the present invention may comprise: [0007] a first housing; [0008] a first supply port provided on the first housing and configured to provide molten solder; [0009] a second housing; and [0010] a second supply port provided on the second housing and configured to provide the molten solder, [0011] wherein the molten solder supplied from the first supply port and the molten solder supplied from the second supply port may be mixed, the mixed molten solder may not be separated from a substrate conveyed by a conveyance unit between the first supply port and the second supply port.
[0012] In the jet soldering apparatus according to the present invention, [0013] an upper surface of the mixed molten solder may not be positioned below a lower end of a conveyance rail that conveys the substrate in an entire length region along a substrate conveyance direction between the first supply port and the second supply port.
[0014] The jet soldering apparatus according to the present invention may comprise: [0015] a first drive unit giving a driving force to the molten solder provided from the first supply port; and [0016] a second drive unit giving a driving force to the molten solder provided from the second supply port.
[0017] In the jet soldering apparatus according to the present invention, [0018] a width of an installation region of the second supply port along a substrate conveyance direction may be smaller than a width of an installation region of the first supply port along the substrate conveyance direction.

[0019] In this case, the width of the installation region of the second supply port along the substrate conveyance direction may be ⅓ or less of the width of the installation region of the first supply port along the substrate conveyance direction.
[0020] In the jet soldering apparatus according to the present invention, [0021] an amount of the molten solder supplied from the first supply port may be 0.8 times or more and 1.2 times or less of an amount of the molten solder supplied from the second supply port.
[0022] In the jet soldering apparatus according to the present invention, [0023] a distance between the first supply port and the second supply port along the substrate conveyance direction may be smaller than a width of an installation region of the first supply port along the substrate conveyance direction.
[0024] The distance between the first supply port and the second supply port along the substrate conveyance direction may be smaller than a width of an installation region of the second supply port along the substrate conveyance direction.
[0025] In the jet soldering apparatus according to the present invention, [0026] a place where the molten solder falls may not be provided between the first supply port and the second supply port along the substrate conveyance direction.
Effect of Present Invention
[0027] In the present invention, when an aspect where when the molten solder supplied from the first supply port and the molten solder supplied from the second supply port are mixed, and the mixed molten solder is not separated from a substrate conveyed by a conveyance unit between the first supply port and the second supply port is adopted, solder can be cleanly attached to a substrate and generation of an oxide of the solder can be suppressed.

Description

BRIEF DESCRIPTION OF FIGURES
[0028] FIG. **1** is a schematic diagram illustrating a soldering apparatus according to a present embodiment.
[0029] FIG. **2** is an upper plan view of a jet soldering apparatus according to the present embodiment.
[0030] FIG. **3** is a side cross-sectional view illustrating one aspect of the jet soldering apparatus according to the present embodiment.
[0031] FIG. **4** is a schematic diagram illustrating an aspect in which a width of a second supply port is narrow in the jet soldering apparatus according to the present embodiment.
[0032] FIG. **5** is a schematic diagram illustrating an aspect in which the width of the second supply port is wide in the jet soldering apparatus according to the present embodiment.
[0033] FIG. **6** is a schematic diagram illustrating an aspect using one pump in the present embodiment.
[0034] FIG. **7** is an upper plan view illustrating an aspect in which two slit-shaped second openings are provided in the present embodiment.
[0035] FIG. **8** is a side cross-sectional view illustrating an aspect in which a distance between a first supply port and the second supply port is smaller than a width of an installation region of the second supply port along a substrate conveyance direction in the present embodiment.
EMBODIMENT OF THE INVENTION
Embodiment
<<Configuration>>
[0036] A soldering apparatus illustrated in FIG. **1** is an apparatus that performs soldering processing on a substrate **200** on which electronic components such as semiconductor elements, resistors, and capacitors are mounted on a circuit. Typically, the electronic components and the like

are positioned on a lower side of the substrate **200**. The soldering apparatus has a main body **1** and a conveyance unit **5** that conveys the substrate **200**. The main body **1** has a carry-in port **2** through which the substrate **200** is carried in and a carry-out port **3** through which the substrate **200** is carried out. The substrate **200** may be conveyed at a predetermined angle, for example, an inclination of about 3 to 6 degrees when viewed from the side (see FIG. **3**).

[0037] In this case, a downstream side is positioned at a higher position than an upstream side in a substrate conveyance direction A. However, the present invention is not limited thereto, and the substrate **200** may be horizontally conveyed, for example. The conveyance unit **5** may have a conveyance driver (not illustrated) that applies a driving force, and a conveyance rail **6** that guides the substrate **200**.

[0038] As illustrated in FIG. **1**, the main body **1** may be provided with a fluxer **10** for applying flux to the substrate **200**, a preheater unit **15** for preheating the substrate **200** coated with flux, a jet soldering apparatus **100** for jetting molten solder into contact with the substrate **200**, and a cooler **20** for cooling the soldered substrate **200**. The substrate **200** conveyed along the conveyance rail **6** of the conveyance unit **5** sequentially passes through the fluxer **10**, the preheater unit **15**, the jet soldering apparatus **100**, and the cooler **20**. The jet soldering apparatus **100** may have a control unit **50** that gives a command to each component to control, and a storage unit **60** that stores various pieces of information. Note that in FIG. **1**, the soldering apparatus is illustrated in an upper plan view except for the control unit **50**, the storage unit **60**, and an operation unit **70**.

[0039] The fluxer **10** is used to apply flux to the conveyed substrate **200**. The flux may include a solvent, an activator, and the like. The fluxer **10** may be provided with a plurality of coating apparatuses. The type of flux may be selectively used according to the type of solder and the type of the substrate **200**.

[0040] The preheater unit **15** heats the substrate **200** to uniformly raise the substrate **200** to a predetermined temperature. When the substrate **200** is heated in this manner, the solder is easily attached to a predetermined part of the substrate **200**. For example, a far-infrared panel heater is used as the preheater unit **15**. The far-infrared panel heater can rapidly heat the substrate **200** to a set temperature. Furthermore. The substrate **200** may be heated by blowing gas (hot air) heated by the heater onto the substrate **200** by a fan. Furthermore, as the preheater unit **15**, a halogen heater or the like may be used.

[0041] The cooler **20** has a cooling fan (not illustrated), and cools the substrate **200** soldered by the jet soldering apparatus **100**. The control of the cooling fan may be only ON and OFF, but the wind speed may be adjusted. Furthermore, as the cooler **20**, a chiller or the like may be used to cool the substrate **200** to a predetermined temperature.

[0042] The control unit **50** illustrated in FIG. **1** is communicably connected to the conveyance unit **5** including the conveyance rail **6**, the fluxer **10**, the preheater unit **15**, the jet soldering apparatus **100**, the cooler **20**, the operation unit **70**, and the storage unit **60**. The communicable connections include both wired and wireless connections. The operation unit **70** may have a liquid crystal display panel, a numeric keypad, or the like, and is typically a personal computer, a smartphone, a tablet, or the like. When an operator operates the operation unit **70**, the control unit **50** may control a conveyance speed by the conveyance unit **5**, a timing of conveying the substrate **200**, a temperature of the flux at the fluxer **10**, an application amount of the flux, a temperature of the preheater unit **15**, a temperature of molten solder S of the jet soldering apparatus **100**, a jet amount, a jet speed, ON and OFF of the cooling fan of the cooler **20**, and the like. The storage unit **60** may store information input by the operation unit **70**, an instruction of the control unit **50**, an operating time of the jet soldering apparatus **100**, and the like.

[0043] Next, the jet soldering apparatus **100** of the present embodiment will be described.

[0044] As illustrated in FIG. **3**, the jet soldering apparatus **100** has a storage tank **110** that stores the molten solder S, a first pump **141** that is a first drive unit, a first supply port **125** that receives a driving force from the first pump **141** and jets the molten solder S, a second pump **146** that is a second drive unit, and a second supply port **135** that receives a driving force from the second pump **146** and jets the molten solder S. The molten solder S jetted from the first supply port **125** and the second supply port **135** is jetted upward from below. The molten solder S having received the driving force from the first pump **141** is pressure-fed in a duct and jetted toward the substrate **200** to attach the solder to a predetermined part of the substrate **200**. Similarly, the molten solder S having received the driving force from the second pump **146** is pressure-fed in a duct and jetted toward the substrate **200** to attach the solder to a predetermined part of the substrate **200**. The molten solder S is heated to a temperature of, for example, about 180° C. to 250° C. by a heater (not illustrated). The molten solder supplied from the first supply port **125** and the second supply port **135** may be circulated and used. In this case, it may be circulated through a filter (not illustrated). Each of the first pump **141** and the second pump **146** is typically constituted of one pump, but each of the first pump **141** and the second pump **146** may be constituted of a plurality of pumps.

[0045] The first supply port **125** of the jet soldering apparatus **100** illustrated in FIGS. **2** and **3** has a plurality of first openings **126**, and the first openings **126** constitute a primary jet nozzle. The plurality of first openings **126** are used to vigorously supply a large amount of molten solder S to the substrate **200**. A second opening **136** of the second supply port **135** is a secondary jet nozzle, and is used to supply the molten solder S to the substrate **200** with weaker force than the first supply port **125**. The jet solder supplied from the first supply port **125** is a dynamic supply for vigorously colliding the molten solder S against the substrate **200**, and is a supply for spreading the molten solder S to every corner of the substrate **200**. On the other hand, the jet solder supplied from the second supply port **135** is a static supply, and is a supply for cleanly attaching the solder to an electrode or the like of the substrate **200** by passing the jet solder through the molten solder S having a gentle flow.

[0046] As illustrated in FIG. **3**, a first supply unit **120** has a first housing **121** and the first supply port **125** provided on an upper surface of the first housing **121** and having one or the plurality of first openings **126** for supplying the molten solder S. The first opening **126** may be provided so as to protrude upward from the upper surface of the first housing **121**. A second supply unit **130** has a second housing **131** and the second supply port **135** provided on an upper surface of the second housing **131** and having one or a plurality of the second openings **136** for supplying the molten solder S. The first housing **121** and the second housing **131** may be provided apart from each other (see FIG. **3**), but they may be provided integrally (see FIGS. **4** and **5**). In a case where the first housing **121** and the second housing **131** are integrated, a part of the wall surface may be shared. In the present embodiment, the first supply port **125** having the plurality of circular first openings **126** and the second supply port **135** having one slit-shaped second opening **136** will be described as an example. However, the present invention is not limited to such an aspect, and for example, a plurality of the slit-shaped second openings **136** may be provided. In this case, the plurality of slit-shaped second openings **136** may be provided in an aspect of extending in parallel (see FIG. **7**).

[0047] A temperature of the molten solder S is generally about 50° C. higher than a melting temperature of the solder. In recent years, there has been an increasing need to lower a working temperature in order to reduce damage to components and reduce mechanical power consumption. Furthermore, since the market price of Sn and Ag has increased, it has been studied that a solder that does not use Sn or Ag is used, and typically, it has been studied that Sn-58Bi (melting point of 139° C.) is used instead of Sn-3Ag-0.5Cu (melting point of 217° C.). Sn-58Bi is a low-temperature eutectic solder. Note that, when Sn-58Bi is used, soldering can be performed at a temperature of 200° C. or lower. On the other hand, since Sn-58Bi has a property of being hard and brittle, it is a material difficult to handle.

[0048] While the molten solder S is supplied, the molten solder S supplied from the first supply port **125** and the molten solder S supplied from the second supply port **135** are mixed. The molten solder mixed in this manner may not be separated from the substrate **200** conveyed by the conveyance unit **5** between the first supply port **125** and the second supply port **135** (see FIGS. **4** and **5**). The substrate **200** is supported and conveyed by the conveyance rail **6**, but an upper surface of the mixed molten solder S may not be positioned below a lower end of the conveyance rail **6** that conveys the substrate **200** when viewed from a side in an entire length region along the substrate conveyance direction A between the first supply port **125** and the second supply port **135**. In the present embodiment, "between the first supply port **125** and the second supply port **135**" means between a downstream end in the substrate conveyance direction A of the first supply port **125** and an upstream end in the substrate conveyance direction A of the second supply port **135** (see "G" in FIGS. **2** and **3**). Note that in FIGS. **4** and **5**, the components other than the first pump **141** and the second pump **146** are illustrated as cross-sectional views when viewed from the side.

[0049] In the conventional aspect, a place where the molten solder S is not in contact with the substrate **200** is provided between the molten solder S supplied from the first supply port **125** and the molten solder S supplied from the second supply port **135**, and the molten solder S is jetted clearly in two stages. However, in the present embodiment, the molten solder S supplied from the first supply port **125** and the molten solder S supplied from the second supply port **135** are integrated and jetted to a position higher than a conveyance position of the substrate **200**.

[0050] A width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A may be smaller than a width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A. In a case where the plurality of first openings **126** are provided as in the present embodiment, a region between both ends of the plurality of first openings **126** is the width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A. The same applies to the second supply port **135**, and in a case where the plurality of second openings **136** are provided, a region between both ends of the plurality of second openings **136** is the width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A (see FIG. **7**). In the present embodiment, the "width of the installation region along the substrate conveyance direction A" coincides with the "width measured along an extending direction of the conveyance rail **6**".

[0051] The width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A may be narrower than the width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A. As an example, the width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A may be 1/20 or more and ⅓ or less of the width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A (see FIG. **2**). More specifically, the width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A may be 1/15 or more and ⅕ or less of the width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A.

[0052] A total amount of the molten solder S per unit time supplied from the first openings **126** which are a primary jet nozzle may be about the same as a total amount of the molten solder S per unit time supplied from the second opening **136** which is a secondary jet nozzle, or may be 0.8 times or more and 1.2 times or less. The total amount of molten solder S per unit time supplied from the first openings **126** and the total amount of molten solder S per unit time supplied from the second opening **136** which is the secondary jet nozzle may be changed according to the type of the substrate **200**. When identification information of the substrate **200** is input from the operation unit **70**, a supply amount of the corresponding molten solder S may be read from the storage unit **60** by the control unit **50**, and the molten solder S may be supplied from the first openings **126** and the second opening **136** by being adjusted to the read supply amount. The operation unit **70** may be capable of reading code information such as a bar code, and the control unit **50** may automatically adjust the supply amount of the molten solder S to the substrate **200** by reading the code information of the substrate **200**.

[0053] The molten solder S supplied from the first openings **126** which are the primary jet nozzle may be jetted to a position higher than a surface of the molten solder S supplied from the second opening **136** which is the secondary jet nozzle. A height of the molten solder S to be jetted is, for example, about 10 mm from a tip of each of the first openings **126**. The molten solder S supplied from the second supply port **135** is pushed up by the molten solder S supplied from the first supply port **125**. However, since the molten solder S is the same type of liquid, the molten solder S supplied from the first openings **126** and the molten solder S supplied from the second supply port **135** are mixed.

[0054] On a downstream side of the second supply port **135** in the substrate conveyance direction A, a downstream adjusting part **182** extending in a horizontal direction or descending downward toward the downstream side may be provided (see FIG. **3**). A height of the downstream adjusting part **182** may be appropriately changed. An upstream adjusting part **181** extending in the horizontal direction or rising upward toward the downstream side may be provided on an upstream side of the first supply port **125** in the substrate conveyance direction A. The upstream adjusting part **181** and the downstream adjusting part **182** may be linearly inclined, or may be inclined so as to draw an arc in a longitudinal cross section (see FIG. **4**). A height adjustment of the upstream adjusting part **181** and the downstream adjusting part **182** may be manually performed, or may be automatically performed in response to a command from the control unit **50**. The command from the control unit **50** may be issued on the basis of the identification information of the substrate **200**. Adjusting the heights of the upstream adjusting part **181** and the downstream adjusting part **182** as described above is also advantageous in that the amount of the molten solder S supplied to the substrate **200** can be adjusted.

[0055] A height position of the conveyance rail **6** may also be adjustable (see FIG. **3**). In a case where such an aspect is adopted, adjusting the height position of the conveyance rail **6** in addition to or instead of controlling the driving force of the first pump **141** and the second pump **146** is also advantageous in that it is possible to realize a configuration in which the substrate **200** continues to be in contact with the molten solder S between the first supply port **125** and the second supply port **135**. The height position of the conveyance rail **6** may be manually performed, or may be automatically performed in response to a command from the control unit **50**. The command from the control unit **50** may be issued on the basis of the identification information of the substrate **200**.

[0056] A distance G between the first supply port **125** and the second supply port **135** along the extending direction of the conveyance rail **6** (along the substrate conveyance direction A) may be smaller than the width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A.

[0057] The distance G between the first supply port **125** and the second supply port **135** along the extending direction of the conveyance rail **6** extends may be smaller than the width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A (distance along the extending direction of the conveyance rail **6**). In the present embodiment, as an example, it is assumed that the width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A is smaller than the width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A (see FIGS. **3** and **4**). Therefore, in a case where this aspect is adopted, the distance between the first supply port **125** and the second supply port **135** can be considerably close (see FIG. **8**).

[0058] Next, an example of a substrate processing method will be described mainly with reference to FIG. **1**.

[0059] When an operator places the substrate **200** on the conveyance rail **6**, the conveyance unit **5** conveys the substrate **200**, and the substrate **200** is conveyed into the main body **1** from the carry-in port **2**. When the substrate **200** reaches the fluxer **10**, the fluxer **10** applies flux to a predetermined part of the substrate **200**.

[0060] The conveyance unit **5** conveys the substrate **200** coated with the flux by the fluxer **10** to the preheater unit **15**. The preheater unit **15** heats the substrate **200** to a predetermined temperature.

[0061] Next, the conveyance unit **5** conveys the substrate **200** heated to the predetermined temperature by the preheater unit **15** to the jet soldering apparatus **100**. The jet soldering apparatus **100** solders a predetermined part of the substrate **200**. While the jet soldering apparatus **100** is supplying the molten solder S, the molten solder S supplied from the first supply port **125** and the molten solder S supplied from the second supply port **135** are mixed, and the molten solder S is supplied to above the conveyance rail **6**. The molten solder S is configured not to be separated from the substrate **200** conveyed by the conveyance unit **5** between the first supply port **125** and the second supply port **135**. Note that in a state where the substrate **200** does not exist, the molten solder S supplied from the first supply port **125** pushes up the molten solder S supplied from the second supply port **135**, and a plurality of convex shapes corresponding to the first openings **126** are formed by the molten solder S.
[0062] Next, the conveyance unit **5** conveys the soldered substrate **200** to the cooler **20**. For example, a cooling fan of the cooler **20** cools the soldered substrate **200** for a predetermined time. After the substrate **200** is cooled, when the conveyance unit **5** discharges the substrate **200** from the carry-out port **3**, the soldering processing to the substrate **200** is completed.
<<Effects>>
[0063] Next, effects of the present embodiment having the above-described configuration, which have not yet been described, will be mainly described. Even if it is not described in the “Configuration”, any configuration described in “Effects” can be adopted in the present invention.
[0064] According to the inventors, by adopting an aspect in which the molten solder S supplied from the first supply port **125** and the molten solder S supplied from the second supply port **135** are mixed, and the mixed molten solder S is not separated from the substrate **200** conveyed by the conveyance unit **5** between the first supply port **125** and the second supply port **135** (see FIGS. **4** and **5**), it has been confirmed that the molten solder S can be prevented from being oxidized (the generation of oxidized waste). By suppressing the oxidation of the molten solder S in this manner, the amount of solder that cannot be used is suppressed, so that the material cost can be reduced.
[0065] As in the related art, when molten solder S supplied from the first supply port and molten solder S supplied from the second supply port fall toward molten solder S stored separately, the molten solder S comes into contact with a large amount of oxygen at that time. Therefore, it is presumed that the generation of oxides increases.
[0066] Note that, since the specific gravity of the oxidized waste (dross) is light, the oxidized waste floats on an upper surface of the molten solder S. However, by adopting the present embodiment, the generation of such oxidized waste can be suppressed. In particular, in the case of using Sn-58Bi, the generation of the oxidized waste was considerably increased as compared with the case of using SAC305. Therefore, the aspect of the present embodiment is particularly advantageous when Sn-58Bi is used. In a case where the oxidized waste floats and accumulates on the molten solder S, it is necessary to stop the apparatus and remove the oxidized waste. However, in the case where the above aspect is adopted, the number of such operations can be reduced, and therefore the operation time of the machine can be secured, and the yield can be increased.
[0067] Furthermore, according to the above aspect, since the solder is supplied by mixing both the molten solder S supplied from the first supply port **125** and the molten solder S supplied from the second supply port **135**, it is advantageous in that the total amount of the jetted molten solder S can be reduced as compared with the conventional aspect. By reducing the total amount of the molten solder S jetted in this way, the generation of the oxide described above can be suppressed. Furthermore, it is also advantageous in that the molten solder S can be supplied with a stable wave.
[0068] As illustrated in FIG. **3** and the like, in the case where the width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A is smaller than the width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A, the amount of molten solder S supplied from the second supply port **135** can be made smaller than the amount of molten solder S supplied from the first supply port **125**. As a result, a plurality of

waves (convex shapes) of the molten solder S supplied from the first supply port **125** can be prevented from being crushed by the molten solder S supplied from the second supply port **135**, and both dynamic supply of the molten solder S from the first supply port **125** and static supply of the molten solder S from the second supply port **135** can be provided in a balanced manner. Note that, as illustrated in FIG. **5**, in a case where the width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A is large, it is necessary to adjust the amount of the molten solder S to be supplied so as not to be excessively large, and at the same time, adjust the substrate **200** so as to keep in contact with the molten solder S between the second supply port **135** and the first supply port **125**, which makes it difficult to adjust. From this viewpoint, it is advantageous to adopt an aspect in which the width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A is smaller than the width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A.
[0069] In order to realize such balanced supply, it is beneficial that the width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A is ⅓ or less of the width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A, and more specifically, it is beneficial that the width Z**2** is ⅕ or less. Note that, in order to make the amount of the molten solder S supplied from the second supply port **135** larger than or equal to a certain amount, the width Z**2** of the installation region of the second supply port **135** along the substrate conveyance direction A may be 1/20 or more of the width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A, and more specifically, may be 1/15 or more.
[0070] In the conventional aspect, the amount of the molten solder S supplied from the second supply port **135** is considerably large, and the amount of the molten solder S supplied from the second supply port **135** is nearly 1.5 to 2 times the amount of the molten solder S supplied from the first supply port **125**. However, by adopting this aspect, the amount of the molten solder S supplied from the second supply port **135** can be considerably reduced. As described above, in order to prevent the plurality of waves (convex shapes) of the molten solder S supplied from the first supply port **125** from being crushed by the molten solder S supplied from the second supply port **135**, the amount of the molten solder S supplied from the first supply port **125** and the amount of the molten solder S supplied from the second supply port **135** may be almost equal to each other. As an example, the amount of the molten solder S supplied from the first supply port **125** may be 0.8 times or more and 1.2 times or less the amount of the molten solder S supplied from the second supply port **135**.
[0071] An aspect may be adopted in which no opening or gap through which the molten solder S falls downward is provided between the first supply port **125** and the second supply port **135** on the upper surfaces of the first housing **121** and the second housing **131** along the substrate conveyance direction A. In a case where an opening or a gap through which the molten solder S falls downward is provided, a surface area where the molten solder S comes into contact with oxygen increases, and an oxide is generated. On the other hand, in the case of adopting an aspect in which a place where the molten solder S falls, such as an opening or a gap, is not provided between the first supply port **125** and the second supply port **135** along the substrate conveyance direction A as in the present aspect, the molten solder S does not fall between the first supply port **125** and the second supply port **135** along the substrate conveyance direction A, so that generation of an oxide of the molten solder S can be prevented.
[0072] As illustrated in FIGS. **2** to **4**, when adopting the aspect in which the distance G between the first supply port **125** and the second supply port **135** along the substrate conveyance direction A is smaller than the width Z**1** of the installation region of the first supply port **125** along the substrate conveyance direction A, the distance between the first supply port **125** and the second supply port **135** can be shortened. Therefore, it is advantageous in that it is possible to realize an aspect in which the molten solder S is not separated from the substrate **200** conveyed by the conveyance unit

5 between the first supply port **125** and the second supply port **135** while reducing the amount of the molten solder S supplied from the second supply port **135**.

[0073] In the aspect in which the width Z**2** of the installation region along the substrate conveyance direction A of the second supply port **135** is smaller than the width Z**1** of the installation region along the substrate conveyance direction A of the first supply port **125**, when adopting an aspect in which the distance G between the first supply port **125** and the second supply port **135** is smaller than the width Z**2** of the installation region along the substrate conveyance direction A of the second supply port **135** (see FIG. **8**), the distance between the first supply port **125** and the second supply port **135** can be further shortened. Therefore, it is advantageous in that it is possible to realize an aspect in which the molten solder S is not separated from the substrate **200** conveyed by the conveyance unit **5** between the first supply port **125** and the second supply port **135** while further reducing the amount of the molten solder S supplied from the second supply port **135**.

Modified Example

[0074] The amount of the molten solder S supplied from the first supply port **125** and the amount of the molten solder S supplied from the second supply port **135** may be adjustable. As an example, as illustrated in FIG. **6**, one pump **140** may be provided, and the amount of molten solder S flowing into a first passage **161** connected to the first supply port **125** and the amount of molten solder S flowing into a second passage **162** connected to the second supply port **135** may be adjustable. The amount of the molten solder S flowing into the first passage **161** may be adjusted by a first adjustment valve **166**, and the amount of the molten solder S flowing into the second passage **162** may be adjusted by a second adjustment valve **167**. The amount of the molten solder S flowing into the first passage **161** and the amount of the molten solder S flowing into the second passage **162** may be adjusted by a relative ratio between an opening degree of the first adjustment valve **166** and an opening degree of the second adjustment valve **167**. In a case where this aspect is adopted, the amount of the molten solder S supplied from the first supply port **125** and the amount of the molten solder S supplied from the second supply port **135** can be adjusted while using only one pump **140**. The opening degrees of the first adjustment valve **166** and the second adjustment valve **167** may be automatically adjusted in response to a command from the control unit **50** based on the information read from the storage unit **60** on the basis of the identification information of the substrate input by the operation unit **70** or read by the operation unit **70**.

[0075] However, since it is difficult to adjust the amount of the molten solder S using only one pump **140** to a certain extent, in the general jet soldering apparatus **100** in which many types of substrates **200** have to be treated in one day, it is advantageous that the amount of the molten solder S supplied from the first supply port **125** and the second supply port **135** can be adjusted using two or more pumps as described above.

[0076] As another aspect, sizes of the inlets of the first passage **161** and the second passage **162** may be appropriately adjusted while using only one pump **140**. In this case, by manually or automatically adjusting the sizes of the inlets of the first passage **161** and the second passage **162**, the amount of the molten solder S supplied from the first supply port **125** and the amount of the molten solder S supplied from the second supply port **135** can be adjusted.

[0077] Note that a plurality of the pumps **140** may also be provided in the modified example. Also in this case, the amount of the molten solder S supplied from the first supply port **125** and the amount of the molten solder S supplied from the second supply port **135** may be adjustable by adjusting the opening degrees of the first adjustment valve **166** and the second adjustment valve **167** and the sizes of the inlets of the first passage **161** and the second passage **162**.

[0078] The above description of each embodiment and the disclosure of the drawings are merely examples for describing the invention defined in the claims, and the invention defined in the claims is not limited by the above description of each embodiment and the disclosure of the drawings. In addition, the description of the claims at the time of filing is only an example, and the description of the claims can be changed as appropriate based on the description of the description, drawings,

and the like.
REFERENCE SIGNS LIST
[0079] **5** conveyance unit [0080] **100** jet soldering apparatus [0081] **121** first housing [0082] **125** first supply port [0083] **131** second housing [0084] **135** second supply port [0085] **141** first pump (first drive unit) [0086] **146** second pump (second drive unit) [0087] **200** substrate [0088] A substrate conveyance direction [0089] G distance between first supply port and second supply port [0090] S molten solder [0091] Z**1** width of installation region of first supply port along substrate conveyance direction [0092] Z**2** width of installation region of second supply port along substrate conveyance direction

Claims

1. A method of processing a substrate using a jet soldering apparatus having: a first housing; a first supply port provided on the first housing and configured to provide first molten solder, the first supply port having a plurality of openings arranged in a plurality of rows along a substrate conveyance direction; a second housing; a second supply port provided on the second housing and configured to provide second molten solder, the second supply port being a slit-shaped opening; a conveyance unit configured to convey the substrate, the conveyance unit including a conveyance rail; and a drive unit, wherein a distance between the first supply port and the second supply port along the substrate conveyance direction is smaller than a width, along the substrate conveyance direction, between: (i) the furthest upstream point of the furthest upstream opening of the plurality of openings of the first supply port; and (ii) the furthest downstream point of the furthest downstream opening of the plurality of openings of the first supply port; and the distance between the first supply port and the second supply port along the substrate conveyance direction is smaller than a width of the second supply port along the substrate conveyance direction, the method comprising: a step of providing the first molten solder from the first supply port; and a step of providing the second molten solder from the second supply port, wherein the first molten solder and the second molten solder are mixed so as to obtain mixed molten solder, wherein the mixed molten solder does not fall back into a solder supply between the first supply port and the second supply port along the substrate conveyance direction, wherein an upper surface of the mixed molten solder is not positioned below a lower end of the conveyance rail in an entire length region along the substrate conveyance direction between the first supply port and the second supply port such that the mixed molten solder is not separated from the substrate conveyed along the conveyance rail by the conveyance unit in an entire area between the first supply port and the second supply port, and wherein an amount of the first molten solder is 0.8 times or more and 1.2 times or less of an amount of the second molten solder.
2. The method according to claim 1, wherein a driving force to the first molten solder is given by a first drive unit; and wherein a driving force to the second molten solder is given by a second drive unit.
3. The method according to claim 1, wherein the width of the second supply port along the substrate conveyance direction is ⅓ or less of the width, along the substrate conveyance direction, between: (i) the furthest upstream point of the furthest upstream opening of the plurality of openings of the first supply port; and (ii) the furthest downstream point of the furthest downstream opening of the plurality of openings of the first supply port.
4. The method according to claim 1, further comprising: a step of adjusting the amount of the first molten solder using an upstream adjusting part which is adjacent to the first supply port, the upstream adjusting part being arcuate or oblique with respect to the first housing; or a step of adjusting the amount of the second molten solder using a downstream adjusting part which is adjacent to the second supply port, the downstream adjusting part being arcuate or oblique with respect to the second housing.

5. A method of processing a substrate using a jet soldering apparatus having: a first housing; a first supply port provided on the first housing and configured to provide a first molten solder; a second housing; and a second supply port provided on the second housing and configured to provide a second molten solder, the method comprising: a step of providing the first molten solder from the first supply port; and a step of providing the second molten solder from the second supply port, wherein the first molten solder supplied from the first supply port and the second molten solder supplied from the second supply port are mixed, and the mixed molten solder is not separated from a substrate conveyed by a conveyance unit between the first supply port and the second supply port.