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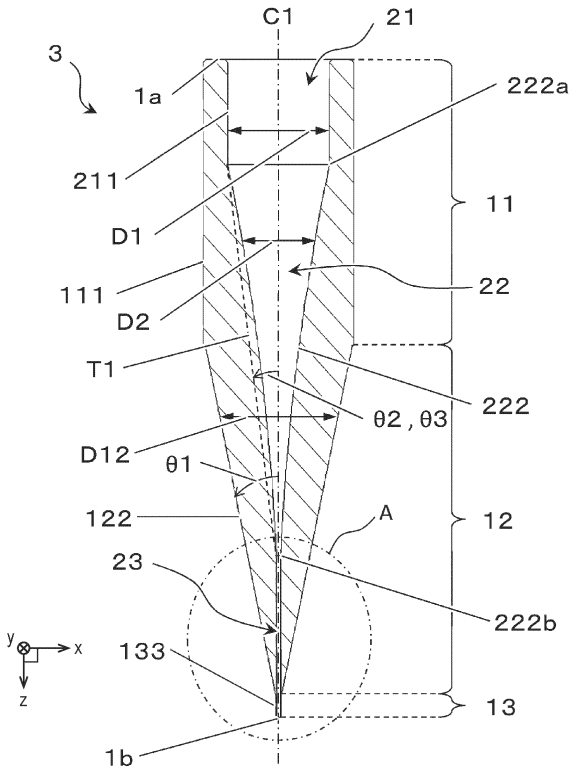
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(54) NOZZLE AND NOZZLE UNIT

(57) A nozzle includes a base part containing a ceramic as a main constituent and a through hole. The base part includes a first part, a second part, and a third part. The first part includes a first outer wall surface in a cylindrical shape. The second part includes a second outer wall surface in a conical shape. The second outer wall surface is connected to the first outer wall surface and has a first outer diameter reducing as separating from a first end surface. The third part includes a third outer wall surface in a cylindrical shape connected to the second outer wall surface. The through-hole includes a first hole part, a second hole part, and a third hole part. The first hole part has a first hole diameter and is positioned at the first part. The second hole part has a second hole diameter and is positioned from the first part to the second part. The third hole part has a third hole diameter and is positioned from the second part to the third part. the second hole diameter reduces as separating from the first part. The third hole diameter is constant.

FIG. 3



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a nozzle and a nozzle unit.

BACKGROUND OF INVENTION

[0002] In recent years, an electronic device includes numerous electronic components mounted thereon. An electronic component has been reduced or miniaturized in size, and an amount of an adhesive to be applied to a mount board is extremely small. Accurate application of an adhesive or the like to a narrow range is required.

[0003] A know invention includes, as a nozzle for application of an adhesive used for adhesion of an electronic component as described above to a mount board or the like, the invention described in Patent Literature 1 (see Patent Literature 1). The invention described in Patent Literature 1 describes a nozzle including a cylindrical part (12 in Patent Literature 1) in a cylindrical shape and a tapered part (13 in Patent Literature 1) in a tapered shape, and made of a ceramic material (for example, see FIG. 2 etc. of Patent Literature 1).

CITATION LIST

PATENT LITERATURE

[0004] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2019-58886

SUMMARY

[0005] In an embodiment of the present disclosure, (1) a nozzle includes a base part and a through hole. The base part includes a first end surface and a second end surface positioned at an opposite side to the first end surface, and contains a ceramic as a main constituent. The through-hole penetrates from the first end surface to the second end surface and includes a center axis extending in a first direction. The base part further includes a first part, a second part, and a third part. The first part includes the first end surface and a first outer wall surface in a cylindrical shape. The first outer wall surface is connected to the first end surface, and at least a portion of the first outer wall surface is press-fitted into a fix member. The second part includes a second outer wall surface in a conical shape. The second outer wall surface is connected to the first outer wall surface and has a first outer diameter reducing as separating from the first end surface in the first direction. The third part includes the second end surface and a third outer wall surface in a cylindrical shape. The third outer wall surface is connected to the second outer wall surface and the second end surface and has a second outer diameter equal to or less than the first outer diameter. The through-hole further includes a first hole part, a second hole part, and a third hole part. The first hole part has a first hole diameter and is positioned at the first part. The second hole part has a second hole diameter and is positioned from the first part to the second part. The third hole part has a third hole diameter and is positioned from the second part to the third part. The second hole diameter reduces as separating from the first part in the first direction. The third hole diameter is constant in the first direction.

[0006] (2) In the nozzle in (1), the first hole diameter is constant in the first direction.

[0007] (3) In the nozzle in (1) or (2), the first hole part includes a first inner wall surface connected to the first end surface. The second hole part includes a second inner wall surface connected to the first inner wall surface. The third hole part includes a third inner wall surface connected to the second inner wall surface. The second inner wall surface includes a first end part connected to the first inner wall surface and a second end part connected to the third inner wall surface. In sectional view passing through the center axis and in parallel to the first direction, when a straight line coupling the first end part to the second end part is a first virtual line, an inclination $\theta 1$ of the second outer wall surface with respect to the center axis is equal to or more than an inclination $\theta 2$ of the first virtual line with respect to the center axis.

[0008] (4) In the nozzle in (3), surface roughness Ra1 of the second inner wall surface is larger than surface roughness Ra2 of the third inner wall surface.

[0009] (5) In the nozzle in (1) to (4), the base part contains zirconia as a main constituent.

[0010] (6) In the nozzle in (3) to (5), in sectional view passing through the center axis and in parallel to the first direction, the second inner wall surface has an arc shape.

[0011] (7) In the nozzle in (3) to (6), in sectional view passing through the center axis and in parallel to the first direction, an inclination $\theta 3$ of the second inner wall surface with respect to the center axis is from 10 to 20°.

[0012] (8) In the nozzle in (3) to (7), in sectional view passing through the center axis and in parallel to the first direction, the second outer wall surface and the third outer wall surface are connected to one another with a first connection part in an arc shape interposed therebetween.

[0013] (9) In the nozzle in (1) to (8), when a dimension of the third part in the first direction is L1, the third hole diameter is D3, and the second outer diameter is D13, $L1 \leq 378 \times [D13^3 - (D3^4/D13)]$ is satisfied.

[0014] (10) In the nozzle in (1) to (9), the base part further includes a fourth part connected to the second end surface. The fourth part includes a fourth outer wall surface in a cylindrical shape having a third outer diameter smaller than the second outer diameter. The third hole part further extends from the third part to the fourth part.

[0015] (11) In the nozzle in (10), in sectional view passing through the center axis and in parallel to the first direction, the third outer wall surface and the fourth outer

wall surface are connected to one another with a second connection part in an arc shape interposed therebetween.

[0016] (12) In the nozzle in (10) or (11), a dimension of the fourth part in the first direction is equal to or less than half a combined dimension of the fourth part and the third part in the first direction.

[0017] (13) In the nozzle in (10) to (12), when a dimension of the fourth part in the first direction is L2, the third hole diameter is D3, and the third outer diameter is D14, $L2 \leq 378 \times [D14^3 - (D3^4/D14)]$ is satisfied.

[0018] (14) In the nozzle in (13), when a combined dimension of the fourth part and the third part in the first direction is L12, and the second outer diameter is D13, $L12 \leq 378 \times [D13^3 - (D3^4/D13)]$ is satisfied.

[0019] (15) In an embodiment of the present disclosure, a nozzle unit includes the nozzle in (1) to (14) and a fix member. The fix member includes a first opening part. At least a portion of the first part of the nozzle is press-fitted into the first opening part.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

FIG. 1 is a perspective view of a nozzle according to an embodiment of the present disclosure.

FIG. 2 is a plan view of a nozzle according to an embodiment of the present disclosure.

FIG. 3 is a sectional view of the nozzle taken along line I-I in FIG. 1.

FIG. 4 is an enlarged view of a part A of interest illustrated in FIG. 3.

FIG. 5 is an enlarged view of a part B of interest illustrated in FIG. 4.

FIG. 6 is a certain exploded sectional view of a nozzle and a nozzle unit according to an embodiment of the present disclosure.

FIG. 7 is a perspective view of a nozzle according to another embodiment of the present disclosure.

FIG. 8 is a sectional view of the nozzle taken along line II-II in FIG. 7.

FIG. 9 is an enlarged view of a part C of interest illustrated in FIG. 8.

DESCRIPTION OF EMBODIMENTS

<Nozzle Configuration>

[0021] Hereinafter, several exemplary embodiments of the present disclosure are described with reference to the drawings. Note that any direction may be defined as an upper direction or a lower direction regarding a nozzle. However, for convenience, an orthogonal coordinate system xyz is defined, and a negative side in a z-direction is assumed as the lower direction. Below, a first direction indicates, for example, the z-direction in the drawings. In the present disclosure, plan view is a concept including planar transparent view.

[0022] In an embodiment of the present disclosure, a nozzle 3 is described with reference to FIGs. 1 to 5. The nozzle 3 includes a base part 1 and a through-hole 2. The nozzle 3 contains a ceramic as a main constituent.

[0023] As illustrated in FIGs. 1 and 2, the base part 1 includes a first end surface 1a and a second end surface 1b positioned at an opposite side to the first end surface 1a. As a material for the base part 1, for example, a ceramic material, such as an aluminum oxide-based sintered body, a mullite-based sintered body, a silicon carbide-based sintered body, an aluminum nitride-based sintered body, or a silicon nitride-based sintered body, or a glass-ceramic material can be used. A size of the base part 1 in the z-direction is, for example, from 5 mm to 50 mm. A ceramic material and a glass-ceramic material are easily processible as compared with a typical metal material, and thus the nozzle 3 is easily manufacturable.

[0024] The base part 1 further includes a first part 11, a second part 12, and a third part 13. The first part 11 includes the first end surface 1a and a first outer wall surface 111. The first outer wall surface 11 is a cylindrical surface connected to the first end surface 1a, and at least a portion of the first outer wall surface 11 is press-fitted into a fix member 4. A size of the first part 11 in the z-direction is, for example, from 0.5 mm to 10 mm.

[0025] The second part 12 includes a second outer wall surface 122. The second outer wall surface 122 is a conical surface connected to the first outer wall surface 111 and having a first outer diameter D12 reducing as separating from the first end surface 1a in the z-direction (first direction). A size of the second part 12 in the z-direction is, for example, from 1 mm to 45 mm. A size of the first outer diameter D12 is, for example, from 0.1 mm to 5 mm. As illustrated in FIGs. 2 and 3, in an embodiment, the first outer diameter D12 reduces at a constant rate as separating from the first end surface 1a in the z-direction (first direction).

[0026] The third part 13 includes the second end surface 1b and a third outer wall surface 133. The third outer wall surface 133 is a cylindrical surface connected to the second outer wall surface 122 and the second end surface 1b and having a second outer diameter D13 equal to or less than the first outer diameter D12. A size of the third part 13 in the z-direction is, for example, from 0.1 mm to 3 mm. A size of the second outer diameter D13 is, for example, from 0.01 mm to 2 mm.

[0027] The through-hole 2 penetrates from the first end surface 1a to the second end surface 1b and includes a center axis C1 extending in the z-direction (first direction). The through-hole 2 may be formed by, for example, injection molding of a ceramic material or the like, or by application of punching processing to a ceramic material that has been formed in an external shape of the nozzle 3. In a case in which the nozzle 3 is used to apply fluid such as an adhesive, the fluid flows through the through-hole 2 in the positive direction of the z-axis. Pressurizing the fluid from the first end surface 1a side

causes the fluid to pass through a first hole part 21, a second hole part 22, and a third hole part 23 in this order, and thus the fluid can be ejected from the second end surface 1b side. Here, examples of the fluid include a conductive adhesive, such as an epoxy adhesive, an acrylic adhesive, and silver paste, and solder cream. Note that in the present disclosure fluid is a concept including an object in paste form.

[0028] The through-hole 2 further includes the first hole part 21, the second hole part 22, and the third hole part 23. The first hole part 21 has a first hole diameter D1 and is positioned at the first part 11. A size of the first hole diameter D1 is, for example, from 0.5 mm to 4 mm.

[0029] The second hole part 22 has a second hole diameter D2 and is positioned from the first part 11 to the second part 12. The second hole diameter D2 reduces as separating from the first part 11 in the z-direction. A size of the second hole diameter D2 is, for example, from 0.5 mm to 4 mm.

[0030] The third hole part 23 has a third hole diameter D3 and is positioned from the second part 12 to the third part 13. The third hole diameter D3 is constant in the z-direction. Therefore, as compared with a case in which the third hole part 23 has a tapered shape (the third hole diameter changes), straightness of fluid passing through the third hole part 23 can improve. A size of the third hole diameter D3 is, for example, from 0.005 mm to 3 mm. In other words, a length of the third hole part in the z-direction is longer than the length of the third part 13 in the z-direction. Here, being constant may include a manufacturing error.

[0031] As the length of the third hole part 23 increases, flow channel resistance to fluid in the third hole part 23 can be higher. An increase in flow channel resistance causes fluid to require pressure to be ejected. Therefore, adjustment of the length of the third hole part 23 can adjust the flow channel resistance, thus reducing a possibility that fluid unintendedly drops from the second end surface 1b of the nozzle 3. Further, adjustment of pressure on fluid enables precise application of fluid such as an adhesive to a desired position by using the nozzle 3. Here, in a case in which viscosity of fluid is, for example, from a hundred thousand cP to five hundred thousand cP, the above-described effect is more effectively achievable.

[0032] The third hole part 23 of the nozzle 3 is positioned from the second part 12 to the third part 13. Therefore, the nozzle 3 including the third part 13 having the second outer diameter D13 reduced in size as well as a long length in the z-direction is easily manufacturable. For example, in a case of manufacture in a manufacture method described later or the like, the length of the third part 13 in the z-direction is easily adjustable by cutting and abrading of the second outer wall surface 122.

[0033] The third part 13 of the nozzle 3 has a long length in the z-direction. Therefore, in application of an adhesive to an electronic component and a mount board by using the nozzle 3, fluid such as an adhesive that flows in the positive direction of the z-axis of the through-hole 2 is precisely applicable to a desired position.

[0034] As illustrated in FIG. 3, the first hole diameter D1 may be constant in the z-direction. With such a configuration, a length by which the nozzle 3 press-fitted into the fix member 4 described later protrudes in the z-direction (see FIG. 6) is adjustable through cutting and abrading of the first end surface a1 in such a manner that a second opening part diameter D42 of a second opening part 42 and the first hole diameter D1 match one another. Accordingly, various types of nozzles 3 are easily manufacturable in accordance with user needs.

[0035] Note that, unlikely to an embodiment illustrated in FIG. 3, the first hole part 21 and the second hole part 22 may be continue to and flush with one another. In this case, in sectional view passing through the center axis C1 and in parallel to the z-direction (for example, in the xz plane or the yz plane), when a second inner wall surface 222 described later forms a straight line with an inclination with respect to the center axis C1, this inclination may be the same as an inclination of a first inner wall surface 211 with respect to the center axis C1.

[0036] As illustrated in FIG. 3, the first hole part 21 includes the first inner wall surface 211 connected to the first end surface 1a. The second hole part 22 includes the second inner wall surface 222 connected to the first inner wall surface 211. The third hole part 23 includes a third inner wall surface 233 connected to the second inner wall surface 222. The second inner wall surface 222 includes a first end part 222a connected to the first inner wall surface 211 and a second end part 222b connected to the third inner wall surface 233. In sectional view passing through the center axis C1 and in parallel to the z-direction (for example, in the xy plane), assuming that a straight line coupling the first end part 222a to the second end part 222b is a first virtual line T1, an inclination $\theta 1$ of the second outer wall surface 122 with respect to the center axis C1 may be equal to or more than an inclination $\theta 2$ of the first virtual line T1 with respect to the center axis C1. That is, a thickness of at least a portion of the second part 12 of the nozzle 3 (a distance between the second inner wall surface 222 and the second outer wall surface 122) is not necessarily constant. With the configuration as described above, the nozzle 3 can have less possibility of getting damaged when the second part 12 (second outer wall surface 122) is gripped to press-fit the nozzle 3 into a first opening part 41 of the fix member 4 described later.

[0037] Surface roughness Ra1 of the second inner wall surface 222 may be larger than surface roughness Ra2 of the third inner wall surface 233. In a case in which the surface roughness Ra1 of the second inner wall surface 222 is the same as the surface roughness Ra2 of the third inner wall surface 233, since the third hole diameter D3 is equal to or less than the second hole diameter D2, flow channel resistance to fluid is larger in the third hole part 23 than in the second hole part 22. Therefore, the surface roughness Ra1 of the second inner wall surface 222

being larger than the surface roughness Ra2 of the third inner wall surface 233 can make the flow channel resistance of fluid in the third hole part 23 be closer to the flow channel resistance in the second hole part 22. Thereby, upon application of pressure on fluid, an ejection timing of fluid can be less likely to deviate from expectation. Accordingly, application diameter of fluid ejected from the second end surface 1b can be less likely to vary. Such a configuration can reduce a possibility that fluid flowing the through-hole 2 unintendedly drops from the second end surface 1b of the nozzle 3.

[0038] The base part 1 may contain zirconia as a main constituent. Here, a "main constituent" in the present disclosure may be any constituent with at least a highest content rate, and indicates, for example, a constituent with a content rate of 90% or more. Zirconia has higher strength than aluminum oxide or the like. Therefore, as illustrated in FIG. 5, the third part 13 can have a longer length in the z-direction with the second outer diameter D13 reduced in size. In addition, the third part 13 of the nozzle 3 can have a smaller thickness (a distance between the third inner wall surface 233 and the third outer wall surface 133). Since zirconia excels in wear resistance and chemical resistance as compared with aluminum oxide or the like, the nozzle 3 can have less possibility of getting worn or damaged.

[0039] As illustrated in FIG. 3, in sectional view passing through the center axis C1 and in parallel to the z-direction, the second inner wall surface 222 may have an arc shape. In an embodiment, the second inner wall surface 222 has an arc shape protruding to the center axis C1 side. Such a configuration can reduce flow channel resistance to fluid passing through the second hole part 22. Therefore, upon application of pressure on fluid, an ejection timing of fluid can be less likely to deviate from expectation. Accordingly, application diameter of fluid ejected from the second end surface 1b can be less likely to vary.

[0040] As illustrated in FIG. 3, in sectional view passing through the center axis C1 and in parallel to the z-direction, an inclination $\theta 3$ of the second inner wall surface 222 with respect to the center axis C1 may be from 10 to 20°. Such a configuration can facilitate, in manufacture of the nozzle 3 in the manufacture method described later, removal of a formed body of the nozzle 3 formed thorough injection molding, from a formation mold.

[0041] As illustrated in FIG. 4, in sectional view passing through the center axis C1 and in parallel to the z-direction, the second outer wall surface 122 and the third outer wall surface 133 may be connected to one another with a first connection part 123 in an arc shape interposed therebetween. With such a configuration, stress concentrates at the first connection part 123, and the nozzle 3 can have less possibility of getting damaged.

[0042] As illustrated in FIGs. 4 and 5, assuming that a dimension of the third part 13 in the z-direction is L1 [mm], the second outer diameter is D13 [mm], and the third hole diameter is D3 [mm], the following formula (1) may be satisfied. This configuration can further reduce a possibility of the third part 13 bending from the second part 12.

[0043] Note that in this case a thickness of the third part 13 (that is, D13 - D3) may be 0.04 [mm] or more. This configuration can reduce, in processing or manufacture of the nozzle 3, a possibility of the third part 13 getting damaged.

$$L1 \leq 378 \times [D13^3 - (D3^4/D13)] \quad \ldots (1)$$

(Other Embodiments)

[0044] In other embodiments of the present disclosure, the nozzle 3 is described with reference to FIGs. 7 to 9. Note that, among configurations of the other embodiments, only a configuration different from the configuration in the above-described embodiment is described below, and description of the rest of the configurations will be omitted with reference signs as those in the above-described embodiment denoted thereto.

[0045] In an embodiment, the base part 1 may further include a fourth part 14 connected to the second end surface 1b. The fourth part 14 may include a fourth outer wall surface 144 in a cylindrical shape having a third outer diameter D14 smaller than the second outer diameter D13. The third hole part 23 further extends from the third part 13 to the fourth part 14. That is, the fourth part 14 with the smaller outer diameter may be connected to a tip of the third part 13. With this configuration, even in a case in which a tip end of the nozzle 3 has a reduced diameter (third outer diameter D14) as well as an increased length, a tip-end portion of the nozzle 3 (here, indicating a portion combining the third part 13 and the fourth part 14) can have less possibility of getting damaged. Such a nozzle 3 enables application of fluid to a narrower range.

[0046] In an embodiment, as illustrated in FIG. 9, the third hole diameter D3 of the third hole part 23 in the fourth part 14 may be the same as or different from the third hole diameter D3 of the third hole part 23 in the third part.

[0047] As illustrated in FIG. 9, in sectional view passing through the center axis C1 and in parallel to the z-direction (for example, in the xz plane or the yz plane), the third outer wall surface 133 and the fourth outer wall surface 144 may be connected to one another with a second connection part 134 in an arc shape interposed therebetween. This configuration can reduce a sharp change in the dimension from the second outer diameter D13 to the third outer diameter D14, and thus the fourth part 14 can have improved strength. Further, even when an object hits the fourth part 14 from outside, the fourth part 14 can have less possibility of bending from the third part 13. In addition, when fluid is flowed into the nozzle 3, the third part 13 and the fourth part 14 can have less possibility of getting damaged by fluid pressure. In the configuration described above, the second connection part 134 may match the second end surface 1b.

[0048] More specifically, assuming that a dimension of

the fourth part 14 in the z-direction is L2 [mm], the third hole diameter D3 is D3 [mm], and the third outer diameter D14 is D14 [mm], the following formula (2) may be satisfied. Note that in this case a thickness of the fourth part 14 (that is, D14 - D3) may be 0.04 [mm] or more.

$$L2 \leq 378 \times [D14^3 - (D3^4/D14)] \ldots (2)$$

[0049] Assuming that a combined dimension of the fourth part 14 and the third part 13 in the z-direction is L12 [mm], and the second outer diameter D13 is D13 [mm], the following formula (3) may be satisfied. Note that in this case a thickness of the third part 13 (that is, D13 - D3) may be 0.04 [mm] or more.

$$L12 \leq 378 \times [D13^3 - (D3^4/D13)] \ldots (3)$$

<Nozzle Manufacture Method>

[0050] Here, an example of a method for manufacturing the nozzle 3 is described. In the example described, a ceramic containing zirconia as a main constituent (a zirconia-based ceramic) is used as a constituent material for the nozzle 3. Note that the present disclosure is not limited to the following embodiment.

(1) First, a formation material to form a formed body is prepared. The formed body is an original form of the nozzle 3. Specifically, the formation material is prepared by sufficient mixing and grinding of mixed powder of zirconium oxide powder and yttrium oxide powder by a ball mill or the like, and then adding of a binder to the grinded object to be mixed. The mixed powder may be mixture of zirconium oxide powder of 85 to 99 mass% and yttrium oxide powder of 1 to 15 mass%, particularly, mixture of zirconium oxide powder of 90 to 98 mass% and yttrium oxide powder of 2 to 10 mass%. In the zirconium oxide powder, purity of zirconium oxide can be 95% or more, particularly, 98% or more.

(2) Next, the prepared formation material is used to obtain the formed body including the through hole 2. Specifically, the formation material is filled in a cavity of a formation mold to perform injection molding, and thus the formed body is obtained. The formation mold with the cavity includes a structure for forming the through-hole 2. Note that a method for obtaining the formed body is not limited to the injection molding described above, but a method, for example, press forming, slipcasting, cold isostatic press forming, or extrusion forming may be adopted.

(3) Next, the obtained formed body is fired to obtain a sintered body. Specifically, the obtained formed body is put in a debinder furnace at 500 to 600°C for 2 to 10 hours to perform debinding, and then the debinded formed body is fired in oxygen atmosphere at 1300 to 1500°C for 0.5 to 3 hours, and thus the sintered body is obtained.

(4) Next, an inner circumferential surface of the through-hole 2 of the obtained sintered body is applied with abrading processing or the like to form the third inner wall surface 233. Specifically, an abrading material is pressed against the through-hole 2 while the nozzle 3 is rotated with the center axis C1 serving as a rotational axis, and thus the third inner wall surface 233 is formed. The same as and/or similarly to the third inner wall surface 233, the first inner wall surface 211 and the second inner wall surface 222 may also be applied with abrading processing or the like. At this time, grinding oil can be used to perform abrading while suppressing an increase in surface roughness.

(5) Next, cutting and abrading processing or the like is applied to an external shape of the obtained sintered body to form the first outer wall surface 111, the second outer wall surface 122, and the third outer wall surface 133. In this manner, the nozzle 3 is manufacturable.

<Nozzle Unit Configuration>

[0051] As illustrated in FIG. 6, a nozzle unit 5 includes the nozzle 3 and the fix member 4. The fix member 4 includes the first opening part 41. In the first opening part 41, at least a portion of the first part 11 of the nozzle 3 is press-fitted.

[0052] Examples of a material for the fix member 4 include a metal material. The first opening part 41 may have a first opening part diameter D41. The fix member 4 may include the second opening part 42 connected to the first opening part 41. The second opening part 42 has the second opening part diameter D42. In this case, the second opening part diameter D42 may be equal to or less than the first opening part diameter D41. With this configuration, the second opening part 42 serves as a guide to fix the nozzle 3 press-fitted into the first opening part 41 to a desired position. The second opening part diameter D42 may be the same as the first hole diameter D1 of the nozzle 3.

[0053] In a case in which the nozzle unit 5 is used to apply fluid such as a conductive adhesive to an application target object, the fluid is pressurized inside a pressure device (not illustrated) to which the fix member 4 is attached, and this pressure pushes out the fluid into the through-hole 2 of the nozzle 3 through the second opening part 42. The fluid is ejected from the second end surface 1b of the nozzle 3 through the through-hole 2, thus being applied to the application target object.

[0054] With such a configuration, a nozzle with a portion from which fluid is ejected and having an elongated shape is easily manufacturable.

[0055] Such a configuration can further provide a nozzle, for example, capable of applying fluid also to a narrow range, such as between electronic components.

[0056] Note that various combinations of feature parts

in an embodiment is not limited to the examples of the embodiments described above. The respective embodiments can be combined together.

INDUSTRIAL APPLICABILITY

[0057] The present disclosure is applicable to a nozzle and a nozzle unit.

REFERENCE SIGNS

[0058]

1 base part
1a first end surface
1b second end surface
11 first part
111 first outer wall surface
12 second part
122 second outer wall surface
123 first connection part
13 third part
133 third outer wall surface
134 second connection part
14 fourth part
144 fourth outer wall surface
2 through-hole
21 first hole part
211 first inner wall surface
22 second hole part
222 second inner wall surface
222a first end part
222b second end part
23 third hole part
233 third inner wall surface
C1 center axis
T1 first virtual line
D1 first hole diameter
D2 second hole diameter
D3 third hole diameter
D12 first outer diameter
D13 second outer diameter
D14 third outer diameter
D41 first opening part diameter
D42 second opening part diameter
L1 third part dimension in first direction
L2 fourth part dimension in first direction
L12 fourth part and third part combined dimension in first direction
θ1 first virtual line inclination
θ2 second outer wall surface inclination
θ3 second inner wall surface inclination
3 nozzle
4 fix member
41 first opening part
42 second opening part
5 nozzle unit

Claims

1. A nozzle comprising:

a base part comprising a first end surface and a second end surface positioned at an opposite side to the first end surface, and containing a ceramic as a main constituent; and
a through-hole penetrating from the first end surface to the second end surface and comprising a center axis extending in a first direction, wherein
the base part further comprises:

a first part comprising the first end surface and a first outer wall surface in a cylindrical shape, wherein the first outer wall surface is connected to the first end surface, and at least a portion of the first outer wall surface is configured to be press-fitted into a fix member;
a second part comprising a second outer wall surface in a conical shape, wherein the second outer wall surface is connected to the first outer wall surface and has a first outer diameter reducing as separating from the first end surface in the first direction; and
a third part comprising the second end surface and a third outer wall surface in a cylindrical shape, wherein the third outer wall surface is connected to the second outer wall surface and the second end surface and has a second outer diameter equal to or less than the first outer diameter,

the through-hole comprises:

a first hole part having a first hole diameter and positioned at the first part;
a second hole part having a second hole diameter and positioned from the first part to the second part; and
a third hole part having a third hole diameter and positioned from the second part to the third part,

the second hole diameter reduces as separating from the first part in the first direction, and
the third hole diameter is constant in the first direction.

2. The nozzle according to claim 1, wherein the first hole diameter is constant in the first direction.

3. The nozzle according to claim 1 or 2, wherein the first hole part comprises a first inner wall surface connected to the first end surface,

the second hole part comprises a second inner wall surface connected to the first inner wall surface,
the third hole part comprises a third inner wall surface connected to the second inner wall surface,
the second inner wall surface comprises a first end part connected to the first inner wall surface and a second end part connected to the third inner wall surface, and
in sectional view passing through the center axis and in parallel to the first direction, when a straight line coupling the first end part to the second end part is a first virtual line, an inclination $\theta 1$ of the first virtual line with respect to the center axis is equal to or less than an inclination $\theta 2$ of the second outer wall surface with respect to the center axis.

4. The nozzle according to claim 3, wherein surface roughness Ra1 of the second inner wall surface is larger than surface roughness Ra2 of the third inner wall surface.

5. The nozzle according to any one of claims 1 to 4, wherein the base part contains zirconia as a main constituent.

6. The nozzle according to claim 3 or 4, wherein, in sectional view passing through the center axis and in parallel to the first direction, the second inner wall surface has an arc shape.

7. The nozzle according to any one of claims 3, 4, and 6, wherein, in sectional view passing through the center axis and in parallel to the first direction, an inclination $\theta 3$ of the second inner wall surface with respect to the center axis is from 10 to 20°.

8. The nozzle according to any one of claims 1 to 7, wherein, in sectional view passing through the center axis and in parallel to the first direction, the second outer wall surface and the third outer wall surface are connected to one another with a first connection part in an arc shape interposed therebetween.

9. The nozzle according to any one of claims 1 to 8, wherein when a dimension of the third part in the first direction is L1,

the third hole diameter is D3, and
the second outer diameter is D13,
$L1 \leq 378 \times [D14^3 - (D3^4/D14)]$ is satisfied.

10. The nozzle according to any one of claims 1 to 9, wherein the base part further comprises a fourth part connected to the second end surface,
the fourth part comprises a fourth outer wall surface in a cylindrical shape having a third outer diameter smaller than the second outer diameter, and
the third hole part further extends from the third part to the fourth part.

11. The nozzle according to claim 10, wherein, in sectional view passing through the center axis and in parallel to the first direction, the third outer wall surface and the fourth outer wall surface are connected to one another with a second connection part in an arc shape interposed therebetween.

12. The nozzle according to claim 10 or 11, wherein a dimension of the fourth part in the first direction is equal to or less than half a combined dimension of the fourth part and the third part in the first direction.

13. The nozzle according to any one of claims 10 to 12, wherein when a dimension of the fourth part in the first direction is L2,

the third hole diameter is D3, and
the third outer diameter is D14,
$L2 \leq 378 \times [D14^3 - (D3^4/D14)]$ is satisfied.

14. The nozzle according to any one of claims 10 to 13, wherein when a combined dimension of the fourth part and the third part in the first direction is L12, and

the second outer diameter is D13,
$L12 \leq 378 \times [D13^3 - (D3^4/D13)]$ is satisfied.

15. A nozzle unit comprising:

the nozzle according to any one of claims 1 to 14; and
a fix member comprising a first opening part into which the first part is configured to be press-fitted.

FIG. 1

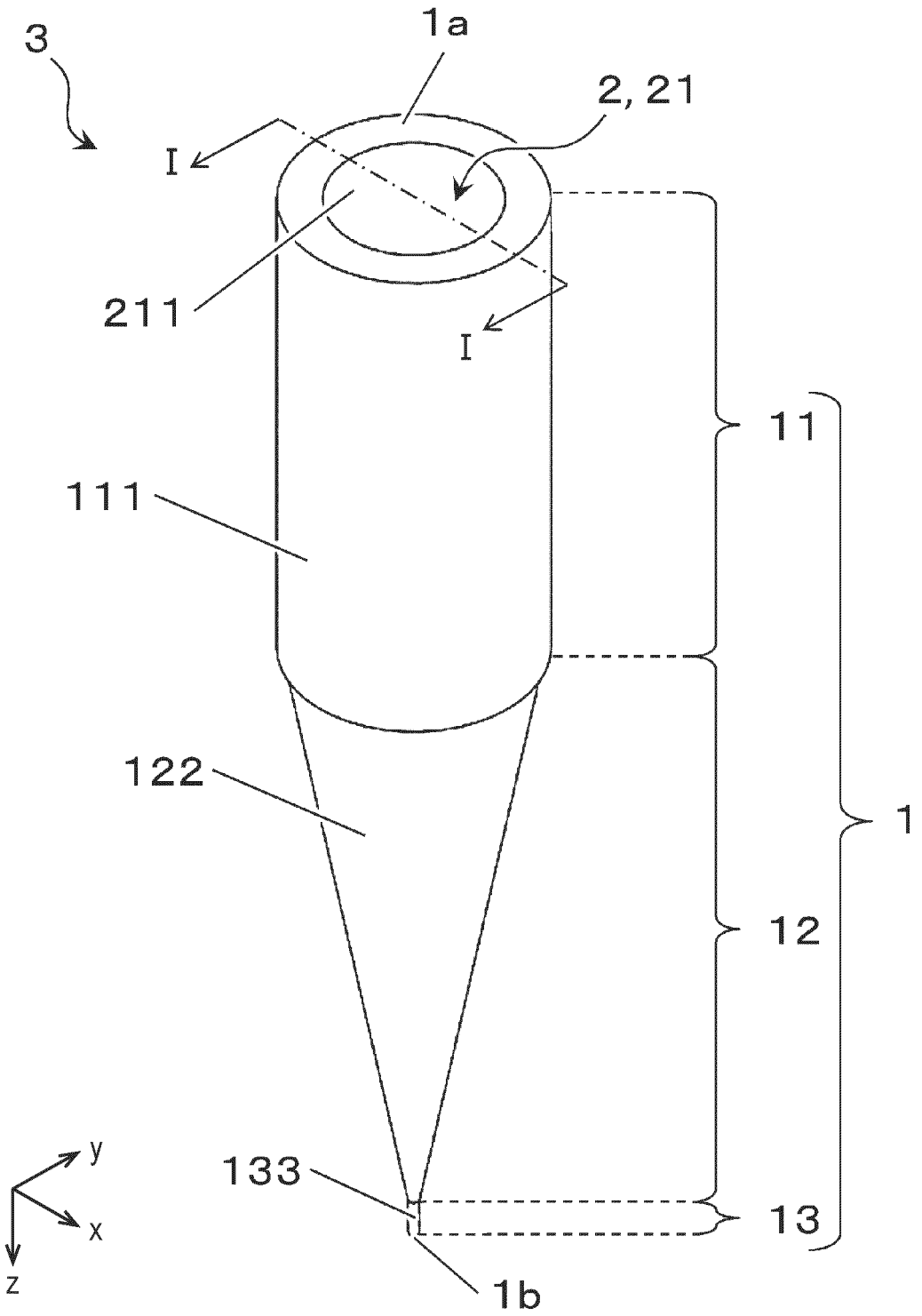


FIG. 2

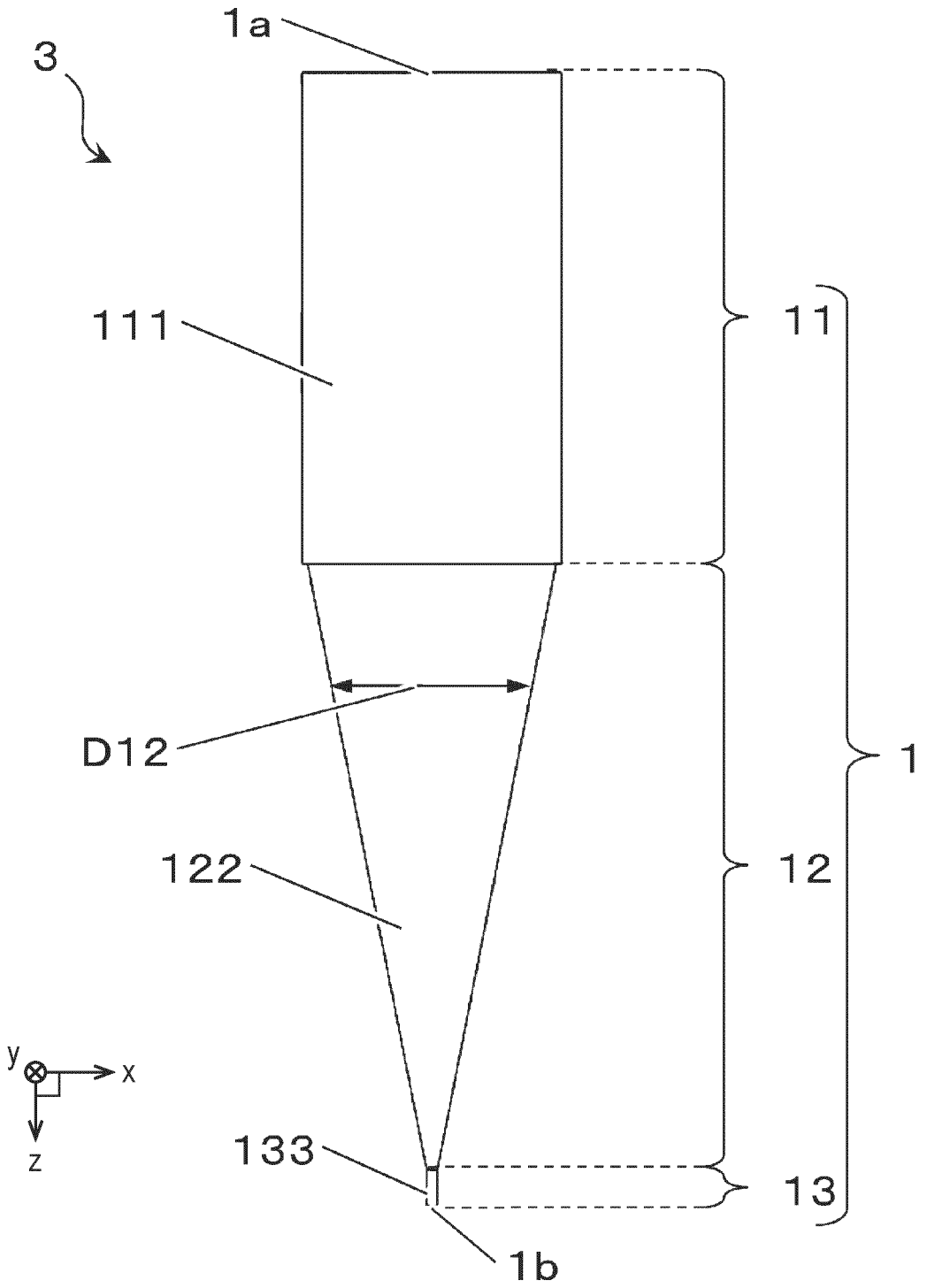


FIG. 3

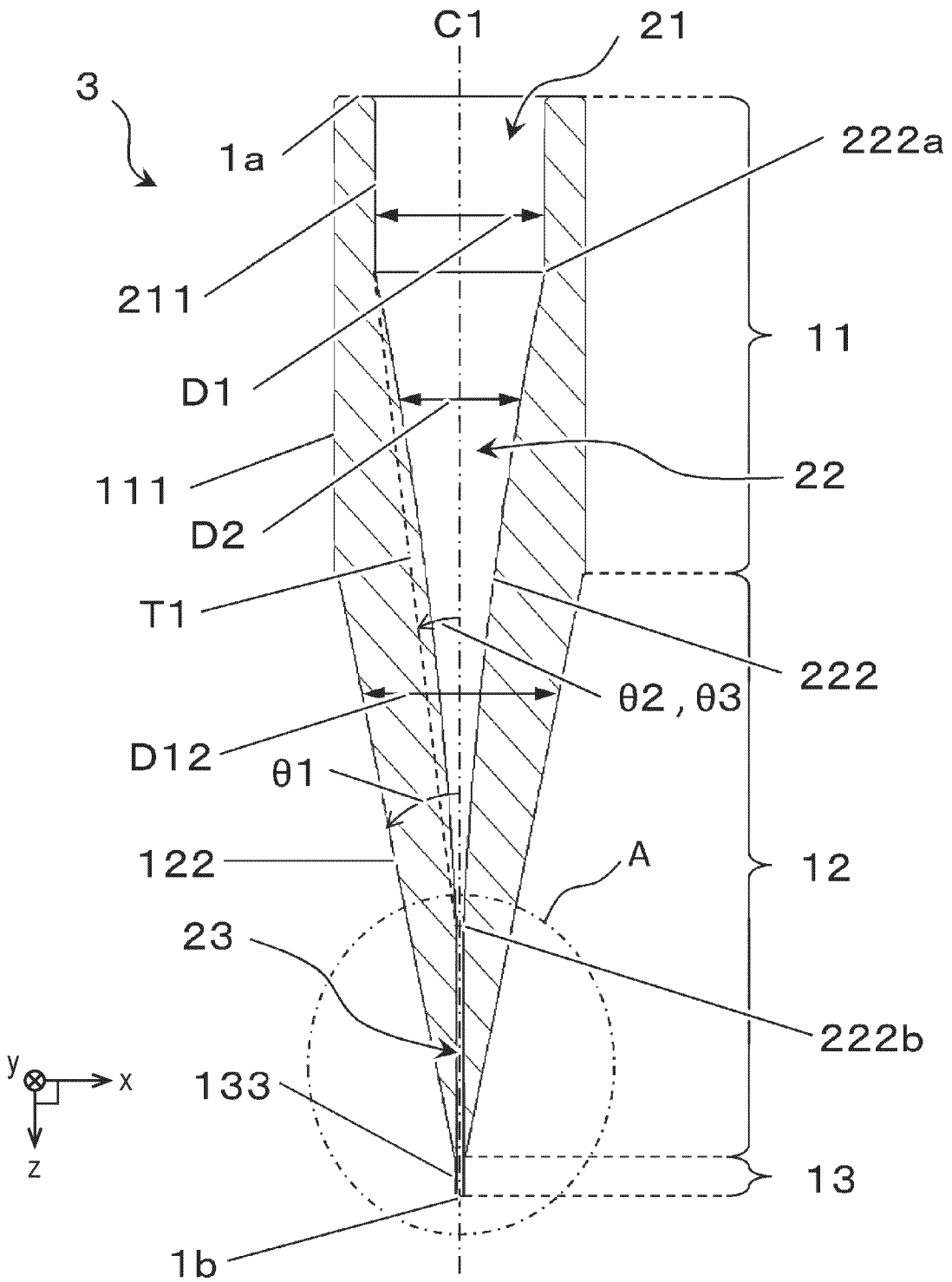

C1
21
3
1a
222a
211
11
D1
22
111
D2
T1
222
θ2, θ3
D12
θ1
122
A
12
23
222b
y
x
z
133
13
1b

FIG. 4

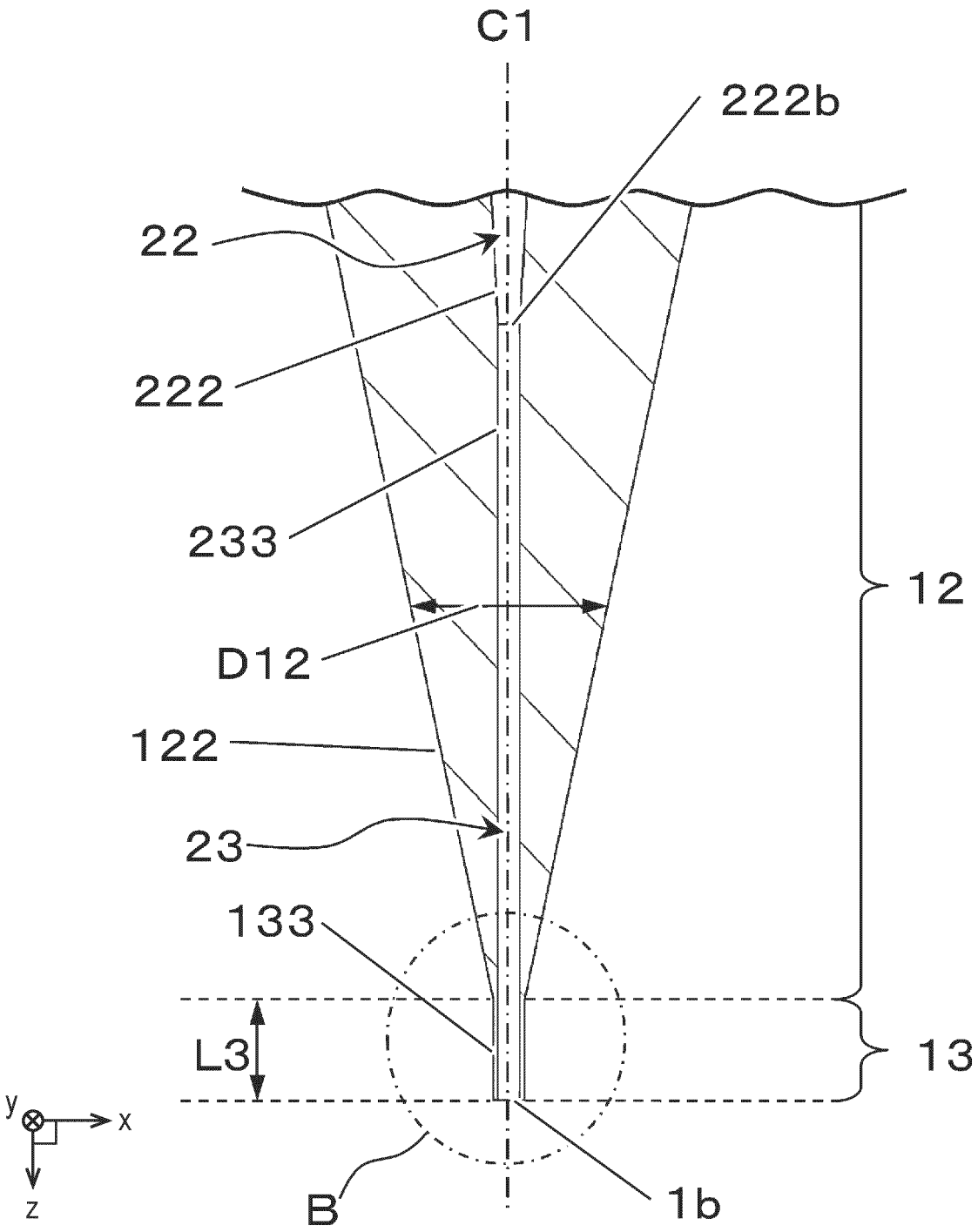


FIG. 5

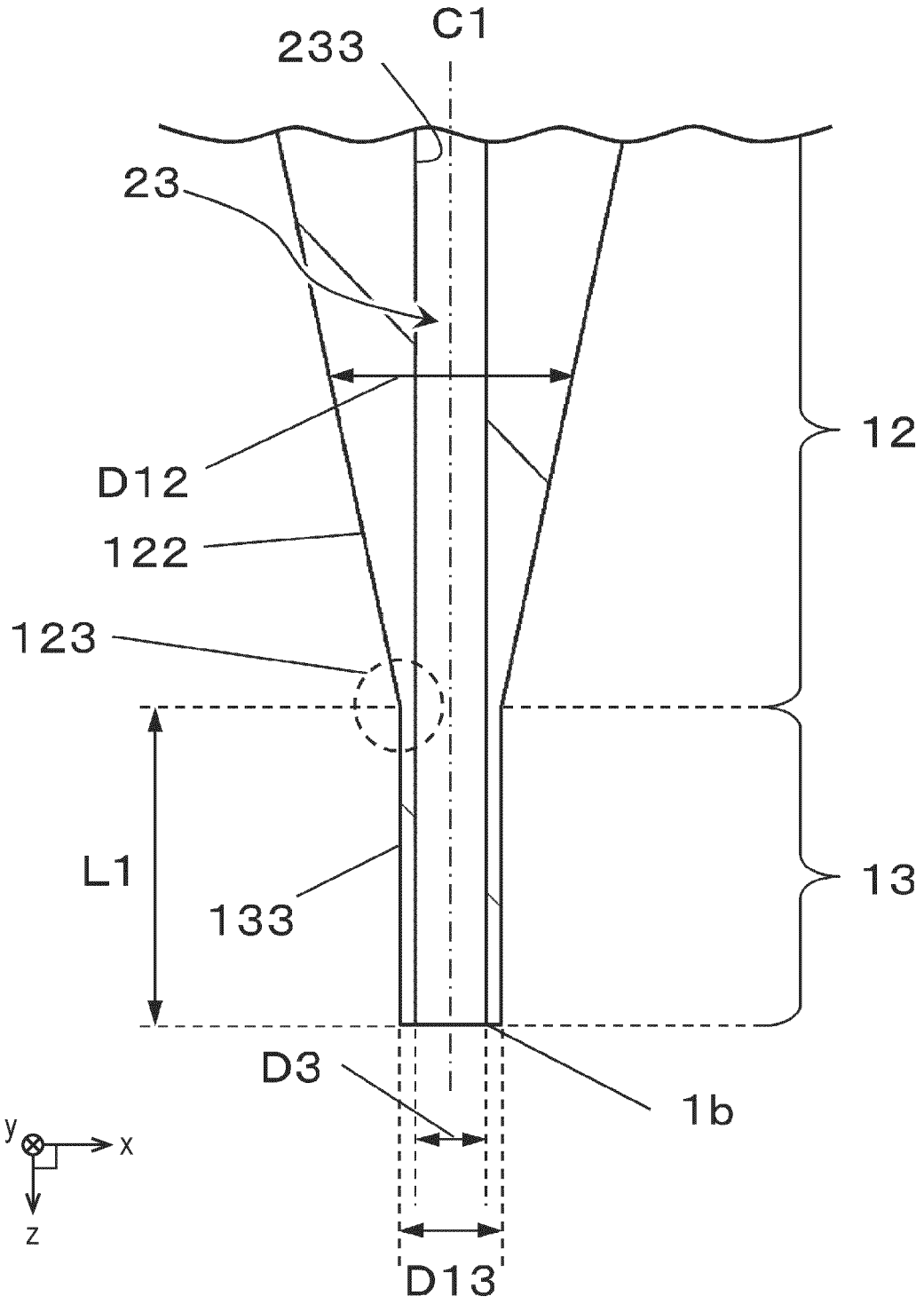


FIG. 6

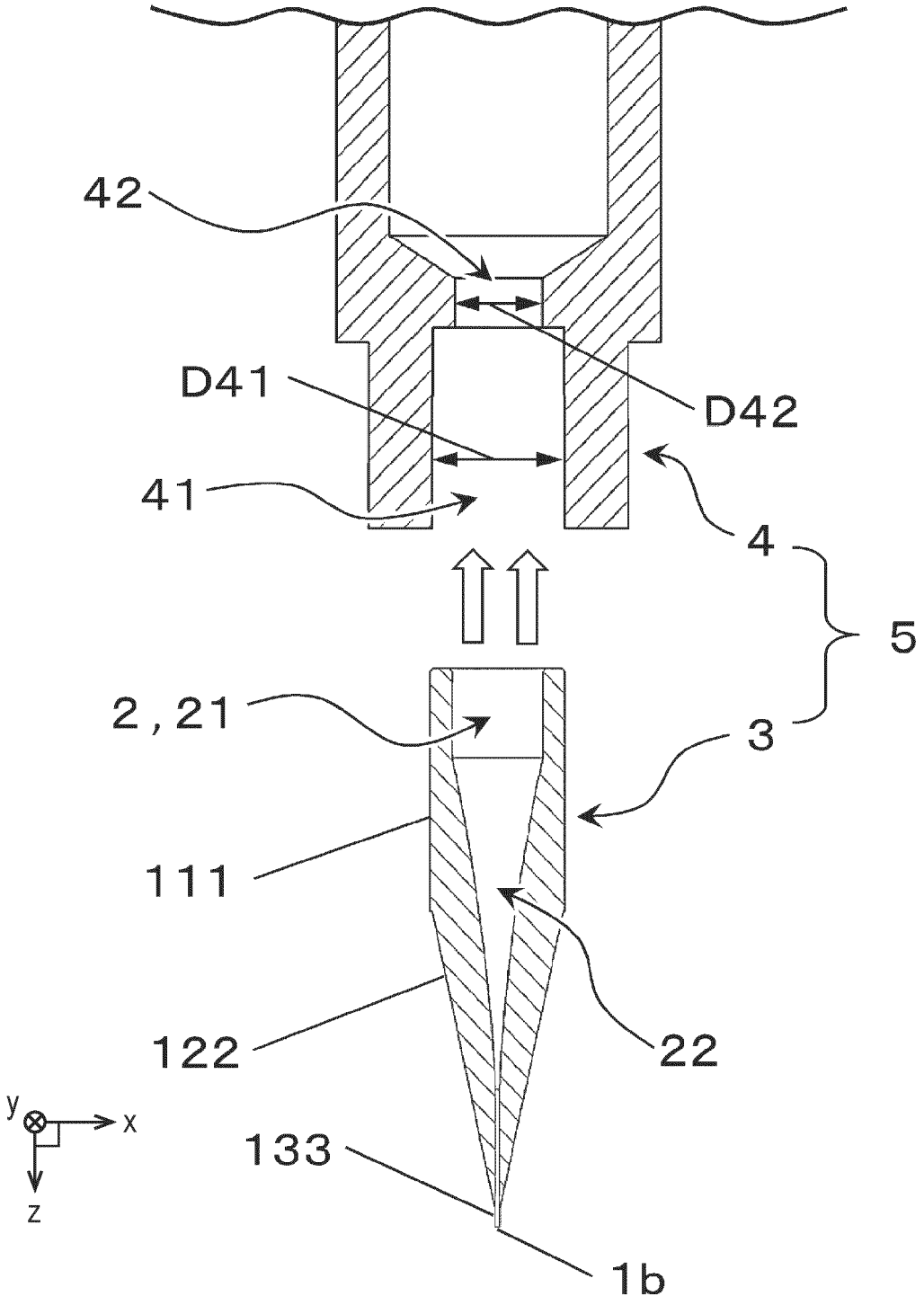


FIG. 7

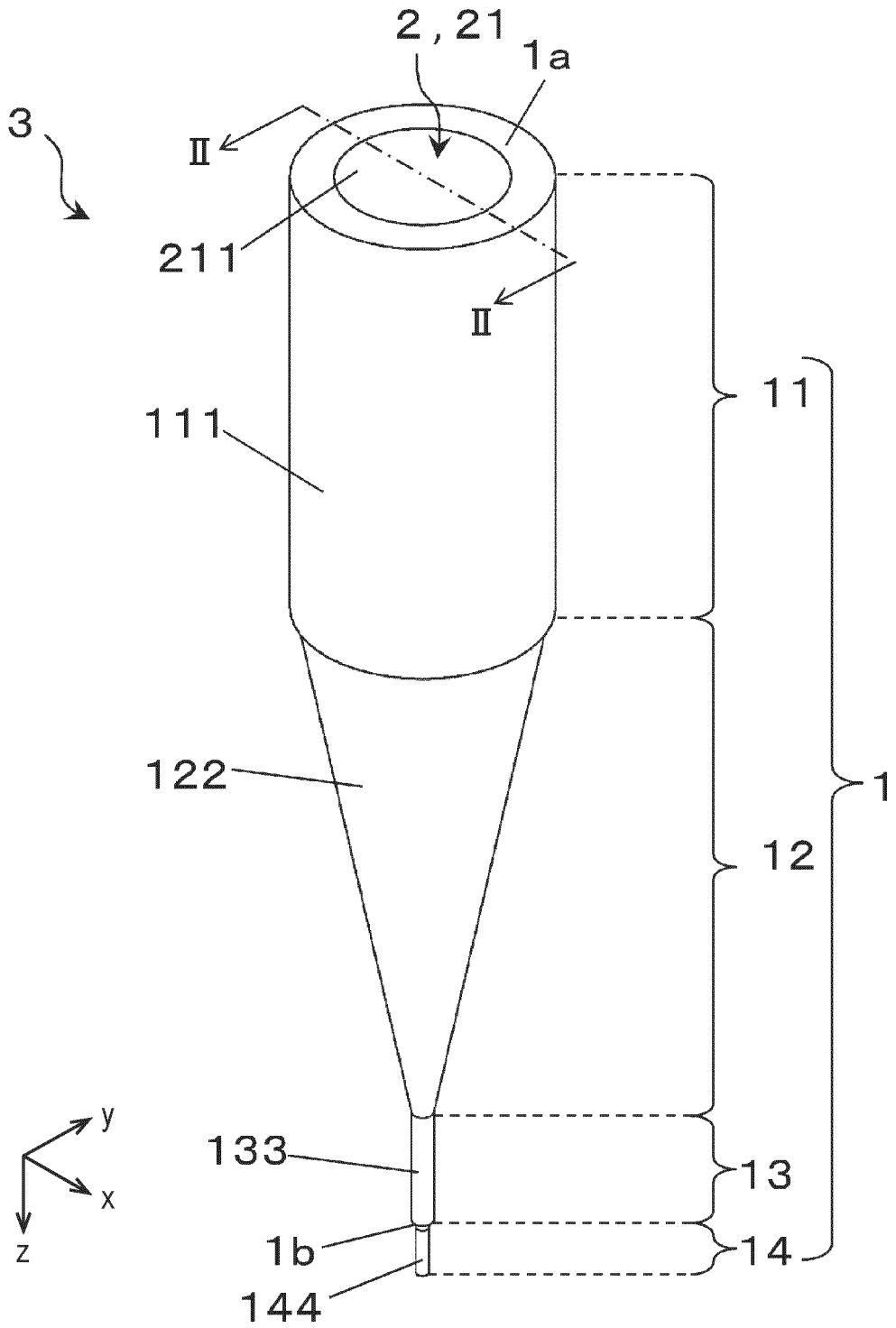


FIG. 8

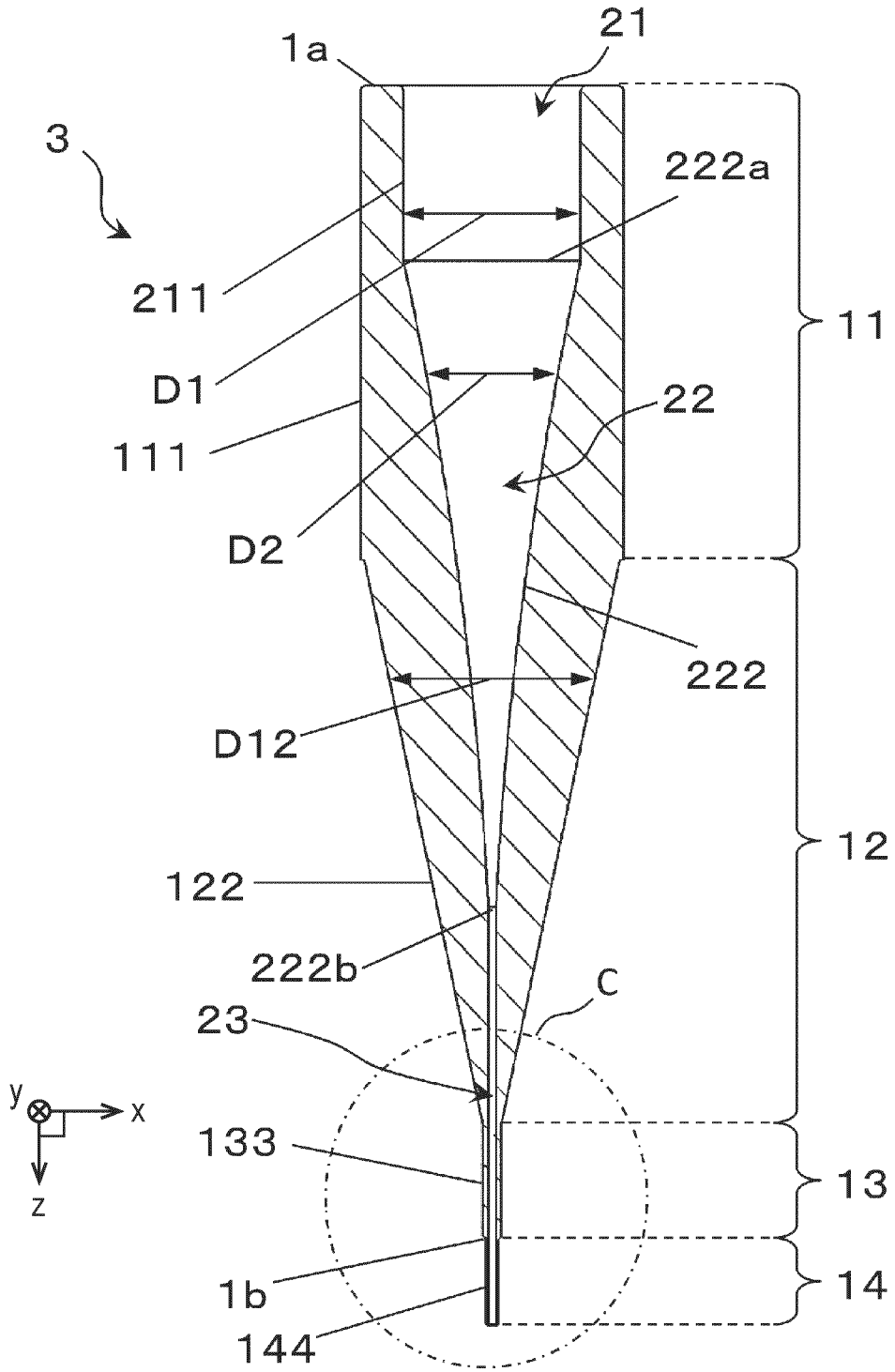
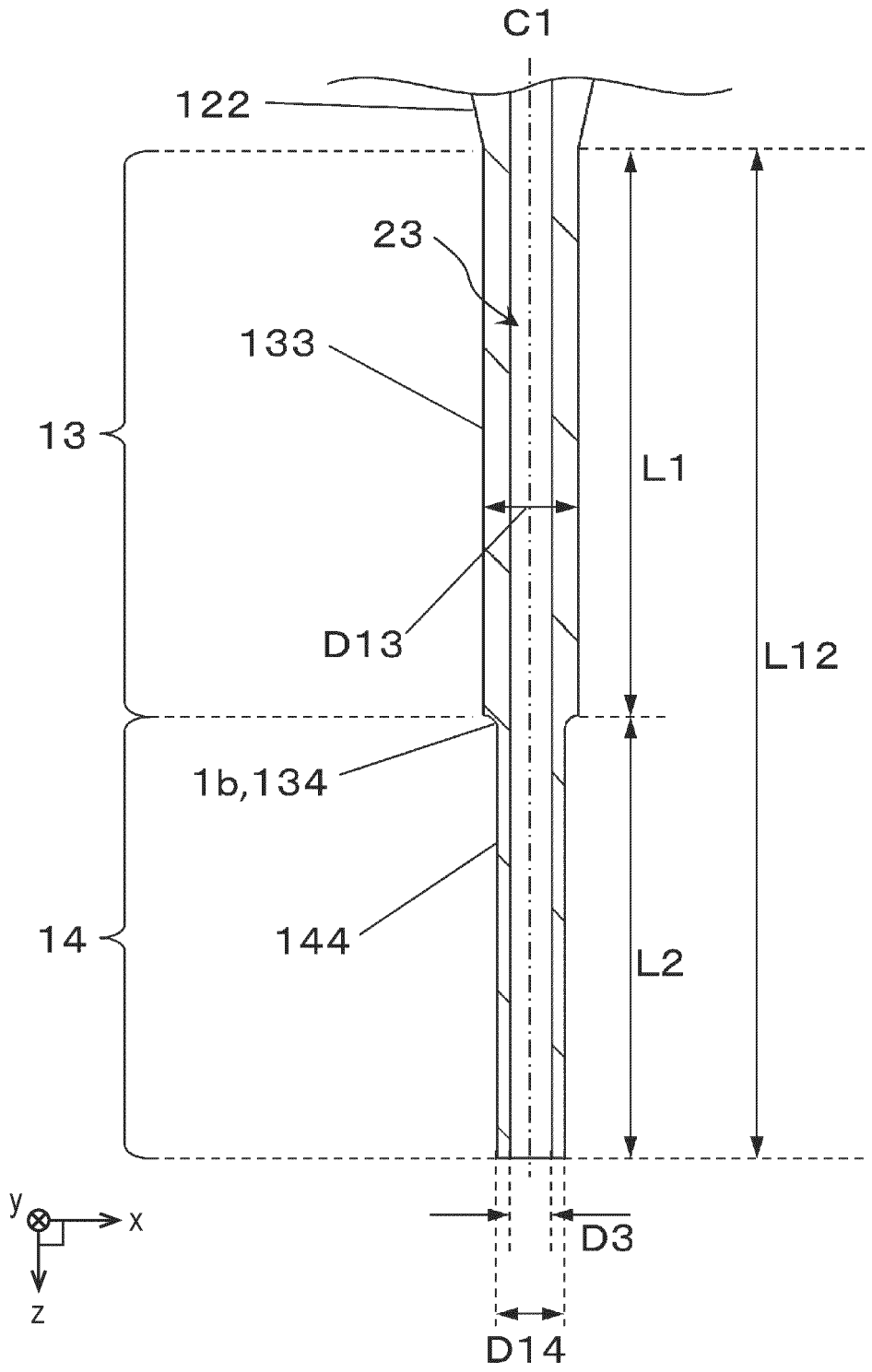

1a
21
3
222a
211
11
D1
22
111
D2
222
D12
12
122
222b
C
23
y
x
z
133
13
14
1b
144

FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/022790

A. CLASSIFICATION OF SUBJECT MATTER

B05B 1/02(2006.01)i; ***B05C 5/00***(2006.01)i
FI: B05B1/02; B05C5/00 101

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B05B1/00-3/18; B05C5/00-5/04; B05D1/00-7/26; H05K3/10-3/26,3/38

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-340318 A (KYOCERA CORP) 02 December 2003 (2003-12-02) claims 1-2, paragraphs [0017]-[0032], fig. 1	1-3, 5-6, 8, 15
Y	JP 2007-268532 A (MUSASHI ENG CO LTD) 18 October 2007 (2007-10-18) claims 1, 5, paragraphs [0001], [0025]-[0026], fig. 1-6	1-3, 5-6, 8, 15
A	JP 2003-181326 A (KYOCERA CORP) 02 July 2003 (2003-07-02) entire text	1-15
A	JP 5-200328 A (RIKEN CORP) 10 August 1993 (1993-08-10) entire text	1-15
A	JP 2000-262944 A (MATSUSHITA ELECTRIC IND CO LTD) 26 September 2000 (2000-09-26) entire text	1-15
A	JP 2008-272710 A (ULVAC CORP) 13 November 2008 (2008-11-13) whole document	1-15

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 September 2023	**19 September 2023**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/022790

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 209829298 U (DONGGUAN XITAO PRECISION CERAMICS CO., LTD.) 24 December 2019 (2019-12-24) whole document	1-15

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/022790

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2003-340318 A	02 December 2003	(Family: none)	
JP 2007-268532 A	18 October 2007	(Family: none)	
JP 2003-181326 A	02 July 2003	(Family: none)	
JP 5-200328 A	10 August 1993	(Family: none)	
JP 2000-262944 A	26 September 2000	(Family: none)	
JP 2008-272710 A	13 November 2008	(Family: none)	
CN 209829298 U	24 December 2019	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

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Patent documents cited in the description

- JP 2019058886 A **[0004]**