(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 711 088 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
15.01.2020 Bulletin 2020/03

(21) Application number: **12786423.9**

(22) Date of filing: **27.04.2012**

(51) Int Cl.:
B05C 5/02 *(2006.01)* ***B05B 1/14*** *(2006.01)*
B05D 1/26 *(2006.01)*

(86) International application number:
PCT/JP2012/061335

(87) International publication number:
WO 2012/157434 (22.11.2012 Gazette 2012/47)

(54) **FILM-COATING NOZZLE, COATING DEVICE AND COATING METHOD**

FILMBESCHICHTUNGSDÜSE, BESCHICHTUNGSVORRICHTUNG UND BESCHICHTUNGSVERFAHREN

BUSE DE PELLICULAGE, DISPOSITIF DE REVÊTEMENT ET PROCÉDÉ DE REVÊTEMENT

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **16.05.2011 JP 2011109047**

(43) Date of publication of application:
26.03.2014 Bulletin 2014/13

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Description

Technical Field

[0001] The present invention relates to a nozzle, a coating device, and a coating method for coating a liquid material in the form of a film, having a uniform thickness, on a surface of a coating target over a wide region.

Background Art

[0002] In a device for coating a liquid material in the form of a film, having a uniform thickness, on a surface of a coating target over a wide region, such as for coating, e.g., a resist liquid in manufacturing of electric and electronic products, or for coating, e.g., a phosphor paste in manufacturing of display devices, there are generally used, for the purpose of efficiently coating the liquid material, a slit nozzle including a single elongate gap formed therein, and a comb-shaped nozzle including a plurality of tubules arranged on a straight line at narrow intervals. Those nozzles are advantageous in finishing the coating with a smaller number of times of nozzle movements. On the other hand, those nozzles have drawbacks that pressure in the nozzle is not held uniform and an amount of the coated material varies due to, e.g., the difference in distances from an inflow opening to individual outflow openings of the nozzle or the presence of flow resistance at each outflow opening. Various techniques have been proposed up to date with intent to eliminate the variation in the amount of the coated material and to realize the coating in a uniform thickness.

[0003] For instance, Patent Document 1 relates to an extrusion type nozzle used to coat a coating liquid on a surface of one or more coating targets traveling in a belt-like discrete or continuous form. More specifically, Patent Document 1 discloses an extrusion type nozzle including two stages of manifolds for spreading a coating liquid in a direction of width, and two stages of slits for rectifying the coating liquid, wherein one of the two stages of slits, which is disposed on the inflow side of the coating liquid is formed of a replaceable member, and the member is replaced with an optimum member for each coating operation depending on, e.g., viscosity of the coating liquid, thereby realizing uniform coating.

[0004] Patent Document 2 relates to a device for forming a protective film on a painting surface in an external appearance of a vehicular body, and it discloses such a technique that, in the case of forming a smooth protective film by jetting out a water soluble paint to a target surface from a nozzle device, which includes many fine holes arranged on a line, at a short distance under comparatively low pressure, while utilizing a flattening property of the paint on the target surface, tip openings of the fine holes include portions communicating with each other to form a paint jetted out from the nozzle device into a thin film, thereby coating a smooth protective film.

[0005] However, when many nozzles are arranged on a line as disclosed in Patent Document 2, there occurs, due to not only difference in length of branched flow channels from one inflow opening to individual ejection ports, but also a greater increase of a pressure loss in the longer branched flow channel undergoing larger flow resistance, a problem of variation in amounts of the liquid material ejected from the nozzles, i.e., a phenomenon that the amount of the ejected liquid material increases in a central portion where the branched flow channels have shorter lengths, and that the ejection amount gradually decreases toward opposite ends.

[0006] To cope with the above-mentioned problem, the applicant has proposed a fluid ejection channel structure including multiple stages of branching portions to branch flow channels in a region from one inflow opening to a plurality of ejection ports, wherein a horizontal width of a compartment defining the branching portion in an upper stage is set to be greater than a distance between inlets of adjacent branching portions in a lower stage, adjacent compartments in upper and lower stages are communicated with each other through a tubular channel arranged at a center of the branching portion on the lower stage side, and the tubular channel is formed in length shorter than lengths of the branching portions in the upper and lower stages, thus making total lengths of individual branched channels substantially equal to one another and making pressure losses of the fluid passing through all the branched channels substantially equal to one another such that amounts of the fluid ejected through the individual ejection ports are held uniform with high accuracy (Patent Document 3).

[0007] Patent Document 4 discloses a liquid application apparatus which applies a liquid to an objective region. The apparatus includes a trap having an opening from which the liquid linearly appears, a feeder to feed the liquid to the trap, and an operation unit to position the trap on the objective region and bring the linearly appeared liquid at the trap into contact with the objective region, thereby linearly applying the liquid to the objective region. The apparatus is capable of linearly applying the liquid in a uniform thickness to the objective region.

List of Prior-Art Documents

Patent Documents

[0008]

Patent Document 1: JP 2002-370057 A
Patent Document 2: JP H08-224503 A
Patent Document 3: JP 4,037,861
Patent Document 4: US 2011/061589 A1

Summary of the Invention

Problems to be Solved by the Invention

[0009] Recently, a demand for higher evenness in thickness of a coated film has increased with increasing needs for device components and materials having higher functions and smaller thicknesses in the field of displays and so on. With the slit nozzle disclosed in Patent Document 1, however, if an application gap between a nozzle tip and the coating target varies due to the influences of, e.g., flatness of the coating target and parallelism of a moving means, the coating amount also varies due to those influences, and the thickness of the coated film becomes not uniform, whereby the desired shape of the coated film is not obtained in some cases. Furthermore, because the slit nozzle includes only one elongate gap, pressure for pushing out the liquid material is not uniformly exerted on the slit nozzle, thus causing a problem that the slit nozzle may deform from a weak portion or may break in the worst case. In particular, when coating a liquid material having high viscosity, the above-mentioned problem is more frequently caused because comparatively high pressure is exerted. If the above-described deformation of the slit nozzle occurs, the coating amount would be changed as a matter of course, and a coated film having a uniform thickness could not be obtained.

[0010] Aiming to solve the above-mentioned problem with the slit nozzle, it is conceivable to employ such a comb-shaped nozzle as disclosed in Patent Document 2. However, the comb-shaped nozzle disclosed in Patent Document 2 is not satisfactory as a means for obtaining a painted film having a uniform thickness for the reason that the paint is jetted out in the form of an irregular thin film, and that smoothing of the painted film is based on fluidity of the paint after the coating. Furthermore, Patent Document 2 includes no suggestions with respect to the problem of the pressure loss, which may arise with the provision of the fine holes.

[0011] Additionally, the technique disclosed in Patent Document 3 is adapted for forming a multiplicity of parallel lines, for example, by applying the phosphor paste into a recess of a substrate surface, and it does not include a nozzle for coating a film.

[0012] In consideration of the above-described situations in the art, an object of the present invention is to provide a film-coating technique which can make uniform amounts of inflows through all of flow channels communicating with an ejection port, which can minimize the influence of an application gap, and which can coat a film with higher precision than in the past.

Means for Solving the Problems

[0013] According to a first aspect of the present invention, there is provided a film-coating nozzle comprising branching blocks having a branched channel structure, a tip member having an ejection port formed to be wide in a longitudinal direction, and a tube section including a plurality of tubules having tubule inflow openings that communicate with the branched channel structure, and tubule outflow openings that communicate with the ejection port of the tip member, wherein the branching blocks include multiple stages of branching portions each of which provides a chamber to branch a flow channel communicating with an inflow opening, the flow channels branched by the branching portions in the same stage having equal lengths up to outflow openings thereof, the tip member has a groove that constitutes the ejection port, and a length S of an end surface of the ejection port in a transverse direction is longer than an internal diameter D of the tubule outflow openings, the tubule outflow openings being disposed at substantially equal intervals in an innermost surface of the groove, and the branching blocks and/or the tip member comprises a plurality of modules capable of being assembled and disassembled, and combination of the modules is variable.

[0014] According to a second aspect of the present invention, in the first aspect of the present invention, a length W of the end surface of the ejection port in the longitudinal direction is longer than a distance between the tubule outflow openings that are disposed at opposite ends of the innermost surface of the groove.

[0015] According to a third aspect of the present invention, in the first or second aspect of the present invention, a length of the groove in the transverse direction is gradually increased from the innermost surface of the groove toward the end surface of the ejection port.

[0016] According to a fourth aspect of the present invention, in the third aspect of the present invention, a sectional shape of the groove taken in the transverse direction is trapezoidal, and the tubule outflow openings are positioned on a vertical center line of the sectional shape of the groove.

[0017] According to a fifth aspect of the present invention, in the third aspect of the present invention, a sectional shape of the groove taken in the transverse direction is semi-circular or semi-elliptic, and the tubule outflow openings are positioned on a vertical center line of the sectional shape of the groove.

[0018] According to a sixth aspect of the present invention, in any one of the first to fifth aspects of the present invention, the length S of the end surface of the ejection port in the transverse direction is 1.2 to 2.5 times the internal diameter D of the tubule outflow openings.

[0019] According to an seventh aspect of the present invention, there is provided a coating device comprising the film-coating nozzle according to any one of the first to sixth aspects of the present invention, a tank for storing a liquid material, an ejection valve for controlling supply or stop of the liquid material, which is supplied from the tank, with respect to the nozzle, a work table on which a coating target is placed, and a moving mechanism for moving the nozzle and the coating target placed on the work table relative to each other.

[0020] According to a eighth aspect of the present invention, in the seventh aspect of the present invention, the coating device further comprises an adjustment mechanism including a base member to which the nozzle is fixed, a rotary shaft disposed in a central portion of the base member, a mounting member for rotatably supporting the rotary shaft, and an adjustment screw disposed on the mounting member.

[0021] According a ninth aspect of the present invention, there is provided a coating device comprising the film-coating nozzle according to the first aspect of the present invention, a tank for storing a liquid material, an ejection valve for controlling supply or stop of the liquid material, which is supplied from the tank, with respect to the nozzle, a work table on which a coating target is placed, and a moving mechanism for moving the nozzle and the coating target placed on the work table relative to each other, the coating device further comprising an adjustment mechanism that includes a base member for fixedly holding the branching blocks and/or the tip member in a coupled state, a rotary shaft disposed in a central portion of the base member, a mounting member for rotatably supporting the rotary shaft, and an adjustment screw disposed on the mounting member.

[0022] According to an tenth aspect of the present invention, in any one of the seventh to ninth aspects of the present invention, the tank is provided in plural number, and the coating device further comprises a selector valve for selectively switching over communication with one of the tanks to be used.

[0023] According to a eleventh aspect of the present invention, in any one of the seventh to tenth aspects of the present invention, the coating device further comprises a pump disposed between the ejection valve and the selector valve.

[0024] According to a twelvth aspect of the present invention, in the eleventh aspect of the present invention, the pump is a positive displacement pump.

[0025] According a thirteenth aspect of the present invention, there is provided a coating method of coating a liquid material by employing the film-coating nozzle according to any one of the first to sixth aspects of the present invention, while a coating target and/or the nozzle is moved by a moving mechanism.

[0026] According to a fourteenth aspect of the present invention, in the thirteenth aspect of the present invention, a highly-viscous liquid material is coated in form of a film.

Advantageous Effects of the Invention

[0027] With the present invention, because of including not only the branched channel structure capable of distributing the liquid material in uniform amounts, but also the plural tubules, which are supplied with the liquid material in uniform amounts through the branched channels, and the groove serving to restore pressure, it is possible to minimize the influence of a variation in the application gap, and to coat a film in a more uniform thickness than in the past.

[0028] Furthermore, since a force exerted by supply pressure can be distributed with the provision of the plural tubules, higher pressure can be exerted, and film-coating using a high-viscous liquid material, which has been difficult to realize with the prior art, can be realized.

[0029] Moreover, when individual sections are constituted in the form of modules, a nozzle configuration can be easily changed just by modifying the modules depending on a size change of the coating target. Washing of the individual sections is also facilitated.

Brief Description of the Drawings

[0030]

[Fig. 1] Fig. 1 is a sectional view of an entire structure of a nozzle according to the present invention; Fig. 1(a) is a front view, and Fig. 1(b) is a sectional view taken along an arrow-headed line A-A.

[Fig. 2] Fig. 2 is an enlarged partial sectional view of a tip portion of the nozzle according to the present invention; Fig. 2(a) is a front view, and Fig. 2(b) is a sectional view taken along an arrow-headed line B-B.

[Fig. 3] Fig. 3 is an explanatory view to explain a state under coating; Fig. 3(a) represents the slit nozzle of the prior art, and Fig. 3(b) represents the present invention.

[Fig. 4] Fig. 4 is a sectional view to explain modifications of a shape of a flaring portion of the nozzle according to the present invention; Fig. 4(a) represent the case where the flaring portion flares in a linear form, and Fig. 4(b) represent the case where the flaring portion flares in a curved form.

[Fig. 5] Fig. 5 is an explanatory view to explain an example of a modular structure of the nozzle according to the present invention.

[Fig. 6] Fig. 6 is an explanatory view to explain another example of a modular structure of the nozzle according to the present invention.

[Fig. 7] Fig. 7 is a partial sectional view of an adjustment mechanism capable of being provided in the nozzle according to the present invention; Fig. 7(a) is a front view, and Fig. 7(b) is a partial side sectional view.

[Fig. 8] Fig. 8 is an explanatory view to explain an example of configuration of a coating device provided with the nozzle according to Example 1.

Mode for Carrying out the Invention

[0031] An embodiment of a nozzle according to the present invention will be described below. It is to be noted that in the following, for the sake of convenience in explanation, the inflow side of the nozzle is called the "upper" side, the ejection side is called the "lower" side, a longitudinal direction of branching blocks 3 to 5 and a tip member 12 is called a "direction of longitudinal width", and a transverse direction thereof is called a "direction of depth" in some cases.

[Entire Structure of Nozzle]

[0032] Fig. 1 is a sectional view of an entire structure of a nozzle according to the present invention. Fig. 1(a) is a front view, and Fig. 1(b) is a sectional view taken along a line A-A in Fig. 1(a), looking in a direction denoted by arrow.

[0033] A nozzle 1 of the present invention includes a branching block 3 in a first stage, a branching block 4 in a second stage, and a branching block 5 in a third stage. The nozzle 1 has one nozzle inlet 2 and twelve tubules 14 each having an ejection opening. In an embodiment illustrated in Fig. 1, the nozzle 1 is structured such that a liquid material 43 flowing into the nozzle 1 through the one nozzle inlet 2 is branched in each of the three stages of branching portions (branching chambers), and are ejected after flowing into a groove 15 through the total twelve tubules 14, which are disposed side by side on a straight line. The number of stages of branching blocks is just required to be two or more, and it may be four or five, for example. In each of the branching blocks, the branching chamber constituting the branching portion is provided, and the plural tubules 14 are communicated with the branching chambers. Therefore, the number of the tubules 14 is set to be at least four, preferably six or more, and more preferably eight or more.

[0034] Flow of the liquid material having entered the nozzle 1 is now described. First, the liquid material 43 having entered through the one nozzle inlet 2 is branched into two even flows 9, having a substantially equal length, in a branching portion (branching chamber) 6 that is provided in the branching block 3 in the first stage. Then, the liquid materials 43 branched in the first stage are each further branched into two even flows 10, having a substantially equal length, in each of two branching portions 7 that are provided in the branching block 4 in the second stage. Then, the liquid materials 43 branched in the second stage are each further branched into three even flows 11, having a substantially equal length, in each of four branching portions 8 that are provided in the branching block 5 in the third stage. Thereafter, the branched liquid materials flow into the tubules 14, which are grouped in units of three and which are communicated with the four branching portions 8 that are provided in the branching block 5 in the third stage, and then flow out to the groove 15, and ejected. Herein, the branched flows have the same length in all branching portions provided in the same branching block.

[0035] With such an arrangement, since all the branched flows in the branching portions provided in the same branching block undergo equal channel resistance, etc., pressure losses also become equal to one another. Therefore, amounts of the liquid material ejected through all the tubules 14 linearly disposed in the direction of longitudinal width, i.e., amounts of the liquid material flowing into the groove 15 from all the tubules 14, can be made substantially equal to one another. Such a point is important in coating a film having a uniform thickness.

[Tip Portion]

[0036] Fig. 2 is an enlarged partial sectional view of a tip portion of the nozzle according to the present invention. Specifically, Fig. 2(a) is a front view, and Fig. 2(b) is a sectional view taken along a line B-B in Fig. 2(a), looking in a direction denoted by arrow.

[0037] A nozzle tip member 12 in the present invention includes a tube section 13 including the plural tubules 14, and an elongate groove 15 communicating with the tube section 13 to merge the branched liquid materials 43 together.

[0038] Respective inflow openings 16 of the tubules 14 constituting the tube section 13 communicate with the branching portions 8 provided in the branching block 5 in the third stage of a branched channel structure, which is made up of the branching blocks 3 to 5. On the other hand, respective ends of the tubules 14 at their outflow openings 17 are fitted to the tip member 12 having the groove 15, and are fixed to the tip member 12 by employing, e.g., a brazing alloy, a solder, or an adhesive. In the case of ejecting the liquid material 43 that is incompatible with the adhesive or the like used for fixing, the tubule ends may be fixed through "close fitting" without using the adhesive or the like. End surfaces of tubules 14 defining the outflow openings 17 are positioned in flush with an innermost surface 19 of the groove 15. The tubules 14 are arranged in plural number at substantially equal intervals on a straight line in the longitudinal direction, thereby constituting the tube section 13. The tubules 14 are preferably arranged at predetermined intervals from the viewpoint of providing a spreading effect in the direction of longitudinal width. However, if the tubules 14 are too far spaced from each other, a film could not be formed. Thus, the tubules 14 are arranged such that the distance between centerlines of the adjacent tubules 14, each having an internal diameter D, is about 4 to 12 times the internal diameter D.

[0039] The internal diameter (internal diameter of the ejection port) of each tubule 14 in the present invention is, for example, ϕ 0.3 to 1.0 mm, and the thickness of a coated film is, for example, 20 to 500 μm.

[0040] As illustrated in Figs. 1 and 2, the groove 15 has a rectangular shape that is elongate in the longitudinal direction, and it defines a rectangular parallelepiped space that is surrounded by the innermost surface 19 with which the tube section 13 communicates, and by inner walls 22 and 23. The groove 15 constitutes a spreading portion that acts to spread a space defined by the outflow opening of each tubule 14. On the other hand, outer lateral surfaces of the tip member 12 extending in the longitudinal direction have inclined surfaces 21, and the tip member 12 is formed into a tapered shape by the two inclined surfaces 21 and 21. A tip end surface 18 is formed as a horizontal surface between each inclined surface 21 and the groove 15. Furthermore, inner surfaces of the tip member 12 extending in the transverse direction are formed by the inner walls 23, which are relatively thick and which specify a length W of the groove 15 in the direction of longitudinal width. It is, however, to be noted that the length W of the groove 15 in the direction of longitudinal width is set so as to provide a rather broad space occupying most of the tip member 12, and the walls of the tip member 12 are not so thick as to form a narrow slit nozzle.

[0041] The length W of the groove 15 in the direction of longitudinal width (i.e., in the longitudinal direction) is preferably set to be longer than the distance between the tubules 14 positioned at both ends in the direction of longitudinal width. This aims to enable pressure to restore with the arrangement of providing spreading spaces in the direction of longitudinal width at both the longitudinal ends of the groove 15 as well. The inner walls 23 specifying the length W of the groove 15 in the direction of longitudinal width may be each formed to have an inclined surface or a stepwise or curved surface (see later description related to the inner walls 22 specifying a length S of the groove 15 in the transverse direction).

[0042] In the present invention, the groove 15 is formed in a way to provide a spreading space not only in the direction of longitudinal width, but also in the direction of depth. More specifically, the groove 15 is formed such that a length S of the groove in the transverse direction is greater than the internal diameter D of the tubule (i.e., D < S) (see Fig. 2(b)). With such an arrangement, the liquid material 43 delivered from the branching portion 8 to flow out through the tubule 14 is caused to temporarily spread in the groove 15 before being ejected toward a coating target 29, whereby pressure lost in the tubule 14 is restored to some extent. The above-described arrangement eliminates the influence of an application gap G, i.e., a distance between the tip of the nozzle 1 and the coating target 29. A sectional shape of the groove 15, taken in the transverse direction, is preferably line-symmetrical with respect to the centerline of the tubule 14 having the internal diameter D such that the liquid material spreads uniformly in an entire space of the groove 15.

[0043] Although the length S of the groove 15 in the transverse direction and the internal diameter D of the tubule are changed as appropriate depending on physical property values of the liquid material 43 used, the desired coating shape, and so on, the length S of the groove 15 in the transverse direction is, for example, preferably about 1.2 to about 2.5 times and more preferably about 1.5 to about 2.0 times the internal diameter D of the tubule. When the inflow opening 16 and the outflow opening 17 of the tubule 14 have different internal diameters from each other, the internal diameter of the outflow opening 17 is taken as a reference.

[0044] In the present invention, the tubule 14 is thinnest among all the flow channels including the branching portions (6, 7 and 8), and flow resistance is maximum in the tubule 14. However, because the plural tubules 14 are arrayed in the longitudinal direction of the tip member 12, forces exerted by supply pressure is distributed. Stated another way, even in the case of a liquid material (e.g., a highly-viscous liquid material) requiring exertion of such high pressure as causing, e.g., deformation of the prior-art slit nozzle in which the liquid material is ejected through one slit, the nozzle 1 of the present invention is able to eject the liquid material without causing, e.g., deformation.

[0045] While the nozzle of the present invention can be used to coat the liquid material having viscosity of 300 to 500000 mPa·s, for example, it is particularly preferable to coat the liquid material having high viscosity. Here, the term "high viscosity" implies a viscosity of 50000 mPa·s or more and preferably 100000 mPa·s or more.

[0046] Fig. 3 is an explanatory view to explain a state under coating. In the drawing, reference symbol 24 denotes a moving direction of the nozzle 1.

[0047] Fig. 3(a) represents the case of the prior-art slit nozzle. The liquid material 43 to be ejected is delivered from a pool 25 to pass through a slit (δ), and is directly ejected to the coating target 29. On the other hand, Fig. 3(b) represents the case of the present invention. The liquid material 43 to be ejected is delivered from the branching portion to pass through the tubule 14 (α), and is ejected to the coating target 29 after having spread in the groove 15 (γ).

[0048] In any case, when the liquid material is applied for coating, there is a gap G (hereinafter referred to as an "application gap G") between the tip end of the nozzle 1 and the coating target 29. The application gap G may vary due to the influences of, e.g., flatness of the coating target 29 and parallelism of a moving mechanism 31. If the application gap G increases or decreases, the liquid material 43 sandwiched between the tip surface of the nozzle 1 and the surface of the coating target 29 is pulled or pushed. Correspondingly, pressure in the inside (β, ε) of the liquid material falls or rises.

[0049] In general, when a flow passes through a narrow channel, a flow speed increases and pressure reduces. Conversely, when a flow passes through a wide channel, a flow speed reduces and pressure increases. In the prior-art slit nozzle, because the flow suddenly comes out from the inside of the narrow slit (δ) to the outside (ε), the pressure in the inside (ε) of the liquid material sandwiched between the nozzle and the coating target increases. Stated in another way, a pressure difference between the inside of the slit (δ) and the inside (ε) of the liquid material sandwiched between the nozzle and the coating target increases, thus resulting in a state where the liquid material is harder to flow out. If a pressure variation in the inside (ε) of the liquid material caused by the variation of the application gap G additionally occurs in the above-mentioned state, the coating operation is affected even by a slight pressure variation because the pressure in the slit (δ) is low. As a result, the coating amount is not stabilized, and the film thickness becomes not uniform.

[0050] On the other hand, in the nozzle of the present invention, before the liquid material flows out from the inside (α) of the tubule 14 to the outside (β) of the nozzle 1, the flow of the liquid material is caused to slightly spread in the groove 15 (γ), thus allowing the pressure to restore to some extent. Thereafter, the liquid material flows out to the outside (β). Accordingly, the pressure in the inside (β) of the liquid material sandwiched between the nozzle and the coating target increases, but the increase of the pressure is not so abrupt. Stated in another way, although a pressure difference between the inside (α) of the tubule and the inside (β) of the liquid material, which is sandwiched between the nozzle and the coating target, increases, a pressure difference between the groove 15 (γ) and the inside (β) of the liquid material reduces, thus resulting in a state where the liquid material is easier to flow out. Even if a pressure variation in the inside (β) of the liquid material caused by the variation of the application gap G additionally occurs in the above-mentioned state, the coating operation is not affected by a slight pressure variation because the pressure in the groove 15 (γ) is not so low. As a result, the coating amount is stabilized, and the film thickness becomes uniform.

[0051] By employing the nozzle of the present invention in which the groove 15 acts as the spreading portion, therefore, the coating amount is stabilized and the film thickness becomes uniform even if the application gap varies due to the influences of, e.g., flatness of the coating target and parallelism of the moving mechanism.

[Modifications of Groove Shape]

[0052] In the embodiment of Fig. 2, the groove 15 is formed such that the length S of the groove in the transverse direction is greater than the internal diameter D of the tubule (i.e., D < S). However, the length S of the groove in the transverse direction may be increased finally at a most-downstream end surface 20 that defines an ejection port. Fig. 4 illustrates modifications in that case.

[0053] Fig. 4(a) illustrates the groove 15 having a trapezoidal shape in section taken in the transverse direction. Although an angle formed by each of inner walls 22a and 22b having flat surfaces changes depending on the length S of the groove in the transverse direction and the internal diameter D of the tubule, it is, for example, preferably 90 degrees or less and more preferably 60 degrees or less.

[0054] Fig. 4(b) illustrates the groove15 having a semi-circular or semi-elliptic shape in section taken in the transverse direction.

[0055] Although the inner walls 22a and 22b are just needed to have such shapes as gradually increasing the distance between them in the transverse direction, the inner walls 22a and 22b are preferably formed as smooth (flat or curved) surfaces.

[0056] Furthermore, in any case of Figs. 4(a) and 4(b), the inner walls 22a and 22b are preferably formed in shapes not causing contraction of area midway a portion ranging from the outflow opening 17 of the tubule to the end surface of the groove. This is because such shapes are easier to obtain with working and do not make flows in the groove 15 complicated.

[0057] By forming the ejection port in the shape described above, in comparison with the shape spreading perpendicularly as described above with reference to Fig. 2, the flow of the liquid material is allowed to more gently spread, whereby the pressure can be restored while the pressure loss can be held smaller.

[Modular Structure]

[0058] The nozzle 1 of the present invention can be constituted in a modular structure depending on varieties of the branching portions (6, 7 and 8). Figs. 5 and 6 are each an explanatory view to explain an example of the modular structure of the nozzle according to the present invention.

[0059] Fig. 5 illustrates an example of the modular structure in which one or more branching portions (6, 7 and 8) having equal lengths of the branched flows (9, 10 and 11) per stage are formed as one-piece integral branching blocks (3, 4 and 5), respectively. In other words, the branching blocks (3, 4 and 5) constitute modules for each branching stage. The modules (3, 4 and 5) are coupled to each other using fastening members (not illustrated). The fastening members are, e.g., screws or bolts. Instead of directly coupling the modules to each other, each module may be fixed to, e.g., a plate-like member serving as a base. On that occasion, positioning pins (not illustrated) are preferably disposed to avoid the flow channels from displacing in mutual connection when the modules are coupled or fixed, thus allowing the modules to be properly positioned with ease. As a matter of course, a sealing member (not illustrated) is disposed at a flow-channel connecting portion of each module in order to prevent leakage of the liquid material.

[0060] Fig. 6 illustrates another example of the modular structure in which the branching portions (6, 7 and 8) are each constituted as one integral module. Thus, the modular structure of Fig. 6 can also be said as a modular structure per minimum unit. The tip member 12 is divided into modules corresponding to the divided modules 5 in the lowermost stage. As in the case of Fig. 5, the modules are coupled to each other using fastening members (not illustrated), or are each fixed to a plate-like member serving as a base. In addition, a positioning pin, a sealing member, etc. are further disposed in a similar manner to that in the above example. In the case of Fig. 6, the modules constituting the opposite ends of the tip member 12 are different in shape of the groove 15 from the other modules. This is because the inner walls 23 specifying the longitudinal width of the groove 15 have to be provided in those modules constituting the opposite ends of the tip member 12. In Fig. 6, in other modules than those constituting the tip member 12 (particularly, in the modules 8 in the third stage), the thicknesses of sidewalls of the modules constituting opposite ends of the stage are different from those of sidewalls of the other modules. Such a difference in the thicknesses of the sidewalls is intended to make respective widths of the stages equal to each other when the stages are directly coupled to each other. When the modules are fixed to a plate-like member serving as a base, the modules can be of course formed in the same shape for each stage (see, e.g., Fig. 7(a)).

[0061] By forming the nozzle in the modular structure as described above, when the size of the coating target is changed, it is possible to easily change the nozzle configuration just by changing combination of the modules, and to facilitate cleaning of the nozzle.

[Adjustment Mechanism]

[0062] Because inclinations of the nozzle about an axis in the up and down direction and about an axis perpendicular to an axis in the direction of longitudinal width greatly affect evenness of the film thickness, an adjustment mechanism is preferably provided when the nozzle 1 of the present invention is installed in a coating device. Fig. 7 is a partial sectional view of the adjustment mechanism capable of being attached to the nozzle 1 of the present invention. Specifically, Fig. 7(a) is a front view, and Fig. 7(b) is a partial side sectional view.

[0063] In the adjustment mechanism 35 according to the present invention, a rotary shaft 37 is disposed substantially in a central portion of a nozzle structure 44 including the modules (6, 7 and 8) that are fixed to a base plate 36, and the rotary shaft 37 is inserted into a bearing 38 that is fixed to a mounting plate 39. Here, the base plate 36 and the mounting plate 39 are not fixed to each other such that the base plate 36 and the nozzle structure 44, fixed to the base plate 36, are freely rotatable. Therefore, the nozzle structure 44 is rotatable as a whole about the axis in the up and down direction and about the axis perpendicular to the axis in the direction of longitudinal width (i.e., to an axis perpendicular to the drawing sheet of Fig. 7(a)) (as denoted by reference symbol 41). Two adjustment screws 40 are attached to the mounting plate 39 with one screw disposed at each of the right and left sides. By moving each of the screws forward and backward (as denoted by reference symbol 42), an amount through which an upper surface of the base plate 36 is pushed down is adjusted to rotate the nozzle structure 44 through a minute angle, thereby adjusting the inclination of the nozzle 1. Employing, as the adjustment screw, one provided with a scale like a micrometer head is advantageous in enabling an adjustment amount to be confirmed and recorded, and in facilitating the adjustment operation.

[0064] With the provision of the adjustment mechanism described above, it is possible to avoid the film thickness from becoming not uniform due to the inclination of the nozzle 1, and to form a coating film in a uniform shape with high precision.

[0065] The above-described nozzle of the present invention can be applied to various types of coating devices for coating a film on a workpiece, such as a coating device including an XYZ driving mechanism to move the nozzle and the workpiece relative to each other, a gantry type device in which a frame including the nozzle provided thereon is moved relative to a fixed workpiece, and a coating device for applying a liquid material from the nozzle, which is fixedly positioned, to be coated on a continuously conveyed workpiece.

[0066] Details of the present invention will be described below in connection with Example, but the present invention is in no way restricted by the following Example.

[Example]

[Coating Device]

[0067] A coating device according to Example is to coat an adhesive or a filler for use in optical bonding in which a protective glass and a liquid crystal display are directly bonded to each other to improve viewability. Fig. 8 is an explanatory view to explain an example of configuration of the coating device according to Example.

[0068] The coating device 26 according to Example includes a tank 27 for storing the liquid material 43, an ejection valve 28 for controlling whether the liquid material 43 supplied from the tank 27 is supplied to the nozzle 1 of the present invention or stopped, the nozzle 1 of the present invention, a work table 30 on which the coating target 29 is placed, and a moving mechanism 31 for moving the nozzle 1 of the present invention and the coating target 29 placed on the work table 30 relative to each other.

[0069] The tank 27 is a pressure vessel that supplies the liquid material 43 upon receiving a compressed gas supplied thereto. The liquid material 43 stored in this Example has viscosity of 1500 to 100000 mPa·s, for example. In this Example, plural (two) tanks are prepared to be alternately used such that the operation may be continued without stopping the device each time the liquid material 43 is replenished. While, in this Example, a selector valve 33 is provided for selection of one of the tanks 27 to be used, a single tank 27 may be prepared instead.

[0070] Furthermore, in this Example, a pump 34 is disposed between the selector valve 33 and the ejection valve 28 such that the liquid material 43 is supplied without supplying the compressed gas to the tank 27, or while supplying the compressed gas thereto. The pump 34 used here is preferably, for example, a positive displacement pump such as a syringe pump, a diaphragm pump, a vane pump, or a gear pump. By employing the positive displacement pump, the liquid material 43 can be supplied in a fixed amount, and the amount of the ejected liquid material can be controlled with high precision.

[0071] The ejection valve 28 is to control whether the liquid material 43 supplied from the tank 27 is supplied to the nozzle 1 of the present invention or stopped. The amount of the ejected liquid material is controlled by controlling an open time of the ejection valve 28.

[0072] The nozzle 1 used here is the nozzle that is described in the above embodiment and that is illustrated in Figs. 1 and 2. The number of stages for branching the flow channels, the number of the branching portions, the number of the tubules 14, and the length of the groove 15 in the direction of longitudinal width can be changed as appropriate depending on the size of the coating target 29 and the desired coating shape. The internal diameter of the tubule 14 is, for example, ϕ 0.6 mm.

[0073] The work table 30 is used for placing and fixing the coating target 29 onto it. The coating target 29 is firmly fixed in place with attraction through vacuuming or with abutment using a positioning pin such that the coating target 29 is not displaced when the work table 30 is relatively moved.

[0074] The moving mechanism 31 is to move the nozzle 1 and the coating target 29 placed on the work table 30 relative to each other in any of directions denoted by reference symbol 32. The moving mechanism 31 may be any of the type moving only the nozzle 1, the type moving only the work table 30, and the type moving both the nozzle 1 and the work table 30 individually. In this Example, an XYZ robot is employed as the moving mechanism 31.

[0075] As a result of conducting a coating test by employing the above-described coating device of this Example and by setting a condition of the film thickness to be 100 μm or less, precision of $\pm$ 5 % was obtained with respect to the desired film thickness. Thus, it was confirmed that a film can be coated in a uniform thickness by employing the coating device 26 of this Example.

Industrial Applicability

[0076] The present invention can be applied to the technique for uniformly coating the liquid material on the surface of the coating target over a wide range. More specifically, the present invention can be applied to, for example, the cases of coating a resist liquid, etc. in manufacturing of electric and electronic products, coating a phosphor paste, etc. in manufacturing of display devices, coating a super view resin (SVR) to bond a protective cover, etc. used in a flat display panel, coating an encapsulation material to encapsulate an entire surface of an organic EL panel, and coating heat-radiating grease.

List of Reference Symbols

[0077] 1: nozzle 2: nozzle inlet 3: branching block (module) in first stage 4: branching block (module) in second stage 5: branching block (module) in third stage 6: branching portion (module) in first stage 7: branching portion (module) in second stage 8: branching portion (module) in third stage 9: branched flow in first stage 10: branched flow in second stage 11: branched flow in third stage 12: tip member 13: tube section 14: tubule 15: groove 16: inflow opening of tubule 17: outflow opening of tubule 18: tip end surface 19: innermost surface (surface with which the tube section communicates) 20: end surface of ejection port 21: inclined surface 22: inner wall (transverse direction) 23: inner wall (longitudinal direction) 24: nozzle moving direction 25: pool 26: coating device 27: tank 28: ejection valve 29: coating target 30: work table 31: moving mechanism 32: moving direction 33: selector valve 34: pump 35: adjustment mechanism 36: base plate (base member) 37: rotary shaft 38: bearing 39: mounting plate (mounting member) 40: adjustment screw 41: rotating direction 42: forward and backward moving direction 43: liquid material 44: nozzle structure S: length of groove in transverse direction D: internal diameter of tubule G: application gap α: inside of tubule β: inside of liquid material sandwiched between nozzle of present invention and coating target γ: inside of groove δ: inside of slit ε: inside of liquid material sandwiched between slit nozzle of prior art and coating target

Claims

1. A film-coating nozzle (1) comprising

   branching blocks (3, 4, 5) having a branched channel structure, a nozzle tip (12) and
   a tube section (13) including a plurality of tubules (14) having tubule inflow openings (16) that communicate with the branched channel structure, and tubule outflow openings (17) that communicate with the ejection port of the tip member (12),
   wherein the branching blocks (3, 4, 5) include multiple stages of branching portions (8) each of which provides a chamber to branch a flow channel communicating with an inflow opening, the flow channels branched by the branching portions (8) in the same stage having equal lengths up to outflow openings thereof,
   characterized by the tip member (12) having an ejection port formed to be wide in a longitudinal direction,
   wherein the tip member (12) has a groove (15) that constitutes the ejection port opened downward, and a length S of an end surface of the ejection port in a transverse direction is longer than an internal diameter D of the tubule outflow openings (17), the tubule outflow openings (17) being disposed at substantially equal intervals in an innermost surface (19) of the groove (15), and
   wherein the branching blocks (3, 4, 5) and/or the tip member (12) comprises a plurality of modules capable of being assembled and disassembled, and combination of the modules is variable.

2. The film-coating nozzle (1) according to claim 1,

wherein a length W of the end surface of the ejection port in the longitudinal direction is longer than a distance between the tubule outflow openings (17) that are disposed at opposite ends of the innermost surface (19) of the groove (15).

3. The film-coating nozzle (1) according to claim 1 or 2, wherein a length of the groove (15) in the transverse direction is gradually increased from the innermost surface (19) of the groove (15) toward the end surface (20) of the ejection port.

4. The film-coating nozzle (1) according to claim 3, wherein a sectional shape of the groove (15) taken in the transverse direction is trapezoidal, and the tubule outflow openings (17) are positioned on a vertical center line of the sectional shape of the groove (15).

5. The film-coating nozzle (1) according to claim 3, wherein a sectional shape of the groove (15) taken in the transverse direction is semi-circular or semi-elliptic, and the tubule outflow openings (17) are positioned on a vertical center line of the sectional shape of the groove (15).

6. The film-coating nozzle (1) according to any one of claims 1 to 5, wherein the length S of the end surface of the ejection port in the transverse direction is 1.2 to 2.5 times the internal diameter D of the tubule outflow openings (17).

7. A coating device (26) comprising:

the film-coating nozzle (1) according to any one of claims 1 to 6;
a tank (27) for storing a liquid material (43);
an ejection valve (28) for controlling supply or stop of the liquid material (43), which is supplied from the tank (27), with respect to the nozzle;
a work table (30) on which a coating target (29) is placed, and
a moving mechanism (31) for moving the nozzle (1) and the coating target (29) placed on the work table (30) relative to each other.

8. The coating device (26) according to claim 7, further comprising an adjustment mechanism (35) that includes:

a base member (36) to which the nozzle is fixed;
a rotary shaft (37) disposed in a central portion of the base member (36);
a mounting member (39) for rotatably supporting the rotary shaft (37); and
an adjustment screw (40) disposed on the mounting member (39).

9. A coating device (26) comprising:

the film-coating nozzle (1) according to claim 1;
a tank (27) for storing a liquid material (43);
an ejection valve (28) for controlling supply or stop of the liquid material (43), which is supplied from the tank (27), with respect to the nozzle;
a work table (30) on which a coating target (29) is placed; and
a moving mechanism (31) for moving the nozzle and the coating target (29) placed on the work table (30) relative to each other,
the coating device (26) further comprising an adjustment mechanism (35) that includes:

a base member (36) for fixedly holding the branching blocks (3, 4, 5) and/or the tip member (12) in a coupled state;
a rotary shaft (37) disposed in a central portion of the base member (36);
a mounting member (39) for rotatably supporting the rotary shaft (37); and
an adjustment screw (40) disposed on the mounting member (39).

10. The coating device (26) according to any one of claims 7 to 9, wherein the tank (27) is provided in plural number, and
the coating device (26) further comprises a selector valve (33) for selectively switching over communication with one of the tanks (27) to be used.

11. The coating device (26) according to any one of claims 7 to 10, further comprising a pump (34) disposed between the ejection valve (28) and the selector valve (34).

12. The coating device (26) according to claim 11, wherein the pump (34) is a positive displacement pump (34).

13. A coating method of coating a liquid material (43) by employing the film-coating nozzle (1) according to any one of claims 1 to 6, while a coating target (29) and/or the nozzle is moved by a moving mechanism (31).

14. The coating method according to claim 13, wherein a highly-viscous liquid material (43) is coated in form of a film.

Patentansprüche

1. Filmbeschichtungsdüse (1), die Folgendes aufweist

Abzweigblöcke (3, 4, 5) mit einer verzweigten Kanalstruktur,

eine Düsenspitze (12) und
einen Rohrabschnitt (13), der eine Vielzahl von Röhren (14) mit Röhreneinlassöffnungen (16), die mit der verzweigten Kanalstruktur in Verbindung stehen, und Röhrenauslassöffnungen (17), die mit der Auswurföffnung des Spitzenelements (12) in Verbindung stehen, aufweist,
wobei die Abzweigblöcke (3, 4, 5) mehrere Stufen von Abzweigabschnitten (8) aufweisen, von denen jeder eine Kammer zum Abzweigen eines Strömungskanals bereitstellt, der mit einer Einströmöffnung in Verbindung steht, wobei die Strömungskanäle, die durch die Abzweigabschnitte (8) in der gleichen Stufe verzweigt sind, gleiche Längen bis hin zu deren Ausströmöffnungen aufweisen,
gekennzeichnet durch
wobei das Spitzenelement (12) eine Auswurföffnung aufweist, die so ausgebildet ist, dass sie in Längsrichtung breit ist,
wobei das Spitzenelement (12) eine Nut (15) aufweist, die die nach unten geöffnete Auswurföffnung bildet, und eine Länge S einer Endfläche der Auswurföffnung in Querrichtung länger ist als ein Innendurchmesser D der Röhrenauslassöffnungen (17), wobei die Röhrenauslassöffnungen (17) im Wesentlichen in gleichen Abständen in einer innersten Oberfläche (19) der Nut (15) angeordnet sind, und
wobei die Abzweigblöcke (3, 4, 5) und/oder das Spitzenelement (12) eine Vielzahl von Modulen aufweisen, die montiert und demontiert werden können, und die Kombination der Module variabel ist.

2. Filmbeschichtungsdüse (1) nach Anspruch 1, wobei eine Länge W der Endfläche der Auswurföffnung in Längsrichtung länger ist als ein Abstand zwischen den Röhrenauslassöffnungen (17), die an entgegengesetzten Enden der innersten Oberfläche (19) der Nut (15) angeordnet sind.

3. Filmbeschichtungsdüse (1) nach Anspruch 1 oder 2, wobei eine Länge der Nut (15) in Querrichtung allmählich von der innersten Fläche (19) der Nut (15) in Richtung der Endfläche (20) der Auswurföffnung vergrößert wird.

4. Filmbeschichtungsdüse (1) nach Anspruch 3, wobei eine in Querrichtung genommene Querschnittsform der Nut (15) trapezförmig ist und die Röhrenauslassöffnungen (17) auf einer vertikalen Mittellinie der Querschnittsform der Nut (15) positioniert sind.

5. Filmbeschichtungsdüse (1) nach Anspruch 3, wobei eine in Querrichtung genommene Querschnittsform der Nut (15) halbkreisförmig oder halbelliptisch ist und die Röhrenauslassöffnungen (17) auf einer vertikalen Mittellinie der Querschnittsform der Nut (15) positioniert sind.

6. Filmbeschichtungsdüse (1) nach einem der Ansprüche 1 bis 5, wobei die Länge S der Endfläche der Auswurföffnung in Querrichtung das 1,2- bis 2,5-fache des Innendurchmessers D der Röhrenauslassöffnungen (17) beträgt.

7. Beschichtungsvorrichtung (26), die Folgendes aufweist:

die Filmbeschichtungsdüse (1) nach einem der Ansprüche 1 bis 6;
einen Tank (27) zum Speichern eines flüssigen Materials (43);
ein Ausstoßventil (28) zum Steuern der Zufuhr oder des Stopps des flüssigen Materials (43), das aus dem Tank (27) zugeführt wird, in Bezug auf die Düse;
einen Arbeitstisch (30), auf dem ein Beschichtungsziel (29) platziert ist, und
einen Bewegungsmechanismus (31) zum Bewegen der Düse (1) und des auf dem Arbeitstisch (30) platzierten Beschichtungsziels (29) relativ zueinander.

8. Die Beschichtungsvorrichtung (26) nach Anspruch 7, ferner mit einem Einstellmechanismus (35), der Folgendes aufweist:

ein Basiselement (36), an dem die Düse befestigt ist;
eine Drehachse (37), die in einem zentralen Abschnitt des Basiselements (36) angeordnet ist;
ein Befestigungselement (39) zum drehbaren Halten der Drehachse (37); und
eine Einstellschraube (40), die an dem Befestigungselement (39) angeordnet ist.

9. Beschichtungsvorrichtung (26), die Folgendes aufweist:

die Filmbeschichtungsdüse (1) nach Anspruch 1;
einen Tank (27) zum Speichern eines flüssigen Materials (43);
ein Ausstoßventil (28) zum Steuern der Zufuhr oder des Stopps des flüssigen Materials (43), das aus dem Tank (27) zugeführt wird, in Bezug auf die Düse;
einen Arbeitstisch (30), auf dem ein Beschichtungsziel (29) platziert ist; und
einen Bewegungsmechanismus (31) zum Bewegen der Düse und des auf dem Arbeitstisch (30) platzierten Beschichtungsziels (29) relativ zueinander,
die Beschichtungsvorrichtung (26) ferner einen

Einstellmechanismus (35) aufweist, der Folgendes beinhaltet:

ein Basiselement (36) zum festen Halten der Abzweigblöcke (3, 4, 5) und/oder des Spitzenelements (12) in einem gekoppelten Zustand;
eine Drehachse (37), die in einem zentralen Abschnitt des Basiselements (36) angeordnet ist;
ein Befestigungselement (39) zum drehbaren Halten der Drehachse (37); und
eine Einstellschraube (40), die an dem Befestigungselement (39) angeordnet ist.

10. Die Beschichtungsvorrichtung (26) nach einem der Ansprüche 7 bis 9, wobei der Tank (27) in einer Vielzahl vorgesehen ist, und
die Beschichtungsvorrichtung (26) ferner ein Auswahlventil (33) zum wahlweisen Umschalten der Verbindung mit einem der zu verwendenden Tanks (27) aufweist.

11. Beschichtungsvorrichtung (26) nach einem der Ansprüche 7 bis 10, ferner mit einer Pumpe (34), die zwischen dem Ausstoßventil (28) und dem Auswahlventil (34) angeordnet ist.

12. Beschichtungsvorrichtung (26) nach Anspruch 11, wobei die Pumpe (34) eine Verdrängungspumpe (34) ist.

13. Beschichtungsverfahren zum Beschichten eines flüssigen Materials (43) unter Verwendung der Filmbeschichtungsdüse (1) nach einem der Ansprüche 1 bis 6, wobei ein Beschichtungsziel (29) und/oder die Düse durch einen Bewegungsmechanismus (31) bewegt wird.

14. Beschichtungsverfahren nach Anspruch 13, wobei ein hochviskoses flüssiges Material (43) in Form eines Films beschichtet wird.

Revendications

1. Buse de pelliculage (1) comprenant
des blocs de ramification (3, 4, 5) présentant une structure de canaux ramifiés,
un embout de buse (12) et
une section tube (13) incluant une pluralité de tubules (14) présentant des ouvertures d'admission de tubule (16) qui communiquent avec la structure de canaux ramifiés, et des ouvertures d'évacuation de tubule (17) qui communiquent avec l'orifice d'éjection de l'élément formant embout (12),
dans laquelle les blocs de ramification (3, 4, 5) incluent plusieurs étages de parties de ramification (8) chacun desquels fournit une chambre pour brancher un canal d'écoulement communiquant avec une ouverture d'admission, les canaux d'écoulement ramifiés par les parties de ramification (8) du même étage ayant des longueurs égales jusqu'à leurs ouvertures d'évacuation,
caractérisée en ce que l'élément formant embout (12) présente un orifice d'éjection formé de manière à être large dans une direction longitudinale,
dans laquelle l'élément formant embout (12) présente une rainure (15) qui constitue l'orifice d'éjection ouverte vers le bas, et une longueur S d'une surface d'extrémité de l'orifice d'éjection dans une direction transversale est supérieure à un diamètre interne D des ouvertures d'évacuation de tubule (17), les ouvertures d'évacuation de tubule (17) étant disposées à intervalle sensiblement égal dans une surface interne (19) de la rainure (15), et
dans laquelle les blocs de ramification (3, 4, 5) et/ou l'élément formant embout (12) comprennent une pluralité de modules pouvant être assemblés et désassemblés, et une combinaison des modules est variable.

2. Buse de pelliculage (1) selon la revendication 1, dans laquelle une longueur W de la surface d'extrémité de l'orifice d'éjection dans la direction longitudinale est supérieure à une distance entre les ouvertures d'évacuation de tubule (17) qui sont disposées aux extrémités opposées de la surface interne (19) de la rainure (15).

3. Buse de pelliculage (1) selon les revendications 1 ou 2, dans laquelle une longueur de la rainure (15) dans la direction transversale est progressivement augmentée à partir de la surface interne (19) de la rainure (15) vers la surface d'extrémité (20) de l'orifice d'éjection.

4. Buse de pelliculage (1) selon la revendication 3, dans laquelle une forme en coupe de la rainure (15) prise dans la direction transversale est trapézoïdale, et les ouvertures d'évacuation de tubule (17) sont positionnées sur un axe médian vertical de la forme en coupe de la rainure (15).

5. Buse de pelliculage (1) selon la revendication 3, dans laquelle une forme en coupe de la rainure (15) prise dans la direction transversale est semi-circulaire ou semi-elliptique, et les ouvertures d'évacuation de tubule (17) sont positionnées sur un axe médian vertical de la forme en coupe de la rainure (15).

6. Buse de pelliculage (1) selon l'une quelconque des revendications 1 à 5, dans laquelle la longueur S de la surface d'extrémité de l'orifice d'éjection dans la direction transversale est 1,2 à 2,5 fois supérieure au diamètre interne D des ouvertures d'évacuation de tubule (17).

7. Dispositif de revêtement (26) comprenant :

la buse de pelliculage (1) selon l'une quelconque des revendications 1 à 6 ;
un réservoir (27) pour stocker un matériau liquide (43) ;
une soupape d'éjection (28) pour commander la fourniture ou l'arrêt du matériau liquide (43), qui est fourni depuis le réservoir (27), par rapport à la buse ;
une table de travail (30) sur laquelle est placée une cible de revêtement (29), et
un mécanisme de déplacement (31) pour déplacer la buse (1) et la cible de revêtement (29) placée sur la table de travail (30) l'une par rapport à l'autre.

8. Dispositif de revêtement (26) selon la revendication 7, comprenant en outre un mécanisme de réglage (35) qui inclut :

un élément formant socle (36) auquel la buse est fixée ;
un arbre rotatif (37) disposé dans une partie centrale de l'élément formant socle (36) ;
un élément de fixation (39) pour soutenir en rotation l'arbre rotatif (37) ; et
une vis de réglage (40) disposée sur l'élément de fixation (39).

9. Dispositif de revêtement (26) comprenant :

la buse de pelliculage (1) selon la revendication 1 ;
un réservoir (27) pour stocker un matériau liquide (43) ;
une soupape d'éjection (28) pour commander la fourniture ou l'arrêt du matériau liquide (43), qui est fourni depuis le réservoir (27), par rapport à la buse ;
une table de travail (30) sur laquelle est placée une cible de revêtement (29) ; et
un mécanisme de déplacement (31) pour déplacer la buse et la cible de revêtement (29) placée sur la table de travail (30) l'une par rapport à l'autre,
le dispositif de revêtement (26) comprenant en outre un mécanisme de réglage (35) qui inclut :

un élément formant socle (36) pour maintenir de façon fixe les blocs de ramification (3, 4, 5) et/ou l'élément formant embout (12) dans un état couplé ;
un arbre rotatif (37) disposé dans une partie centrale de l'élément formant socle (36) ;
un élément de fixation (39) pour soutenir en rotation l'arbre rotatif (37) ; et
une vis de réglage (40) disposée sur l'élément de fixation (39).

10. Dispositif de revêtement (26) selon l'une quelconque des revendications 7 à 9, dans lequel le réservoir (27) est prévu en pluralité, et
le dispositif de revêtement (26) comprend en outre une soupape de sélection (33) pour commuter sélectivement la communication avec l'un des réservoirs (27) à utiliser.

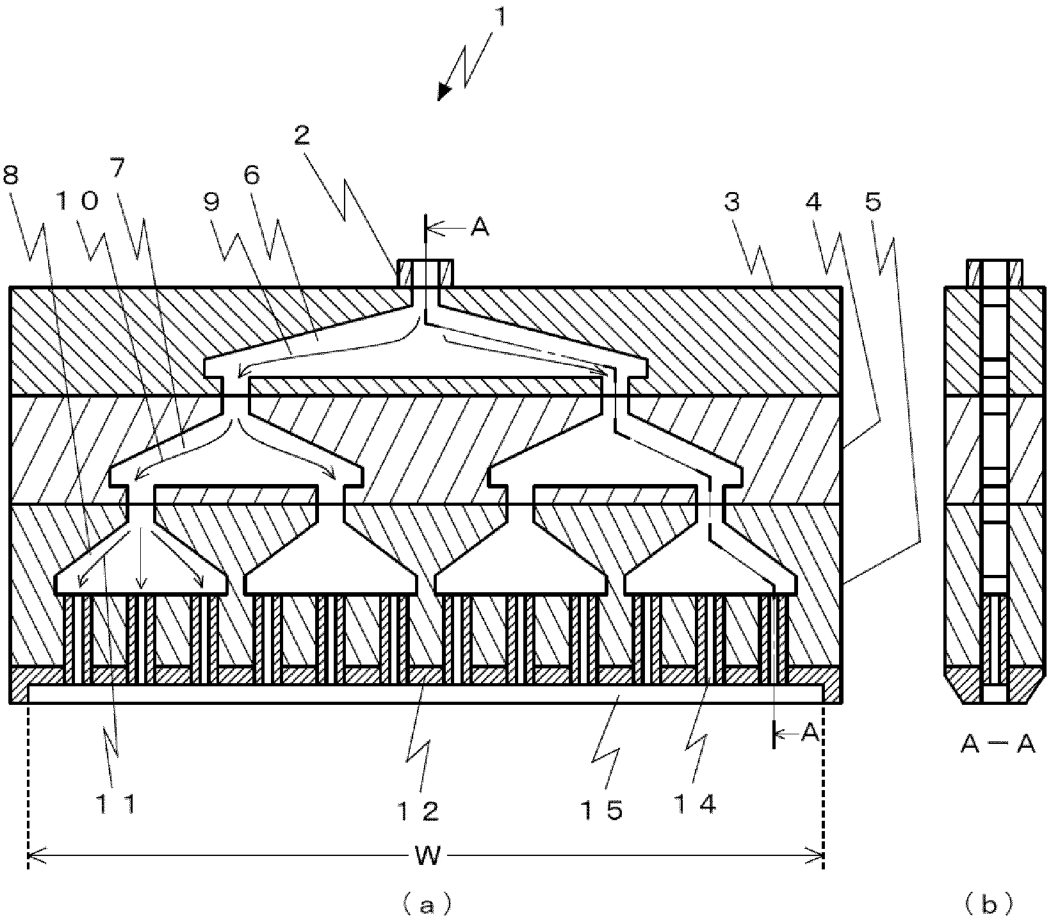
11. Dispositif de revêtement (26) selon l'une quelconque des revendications 7 à 10, comprenant en outre une pompe (34) disposée entre la soupape d'éjection (28) et la soupape de sélection (34).

12. Dispositif de revêtement (26) selon la revendication 11, dans lequel la pompe (34) est une pompe volumétrique (34).

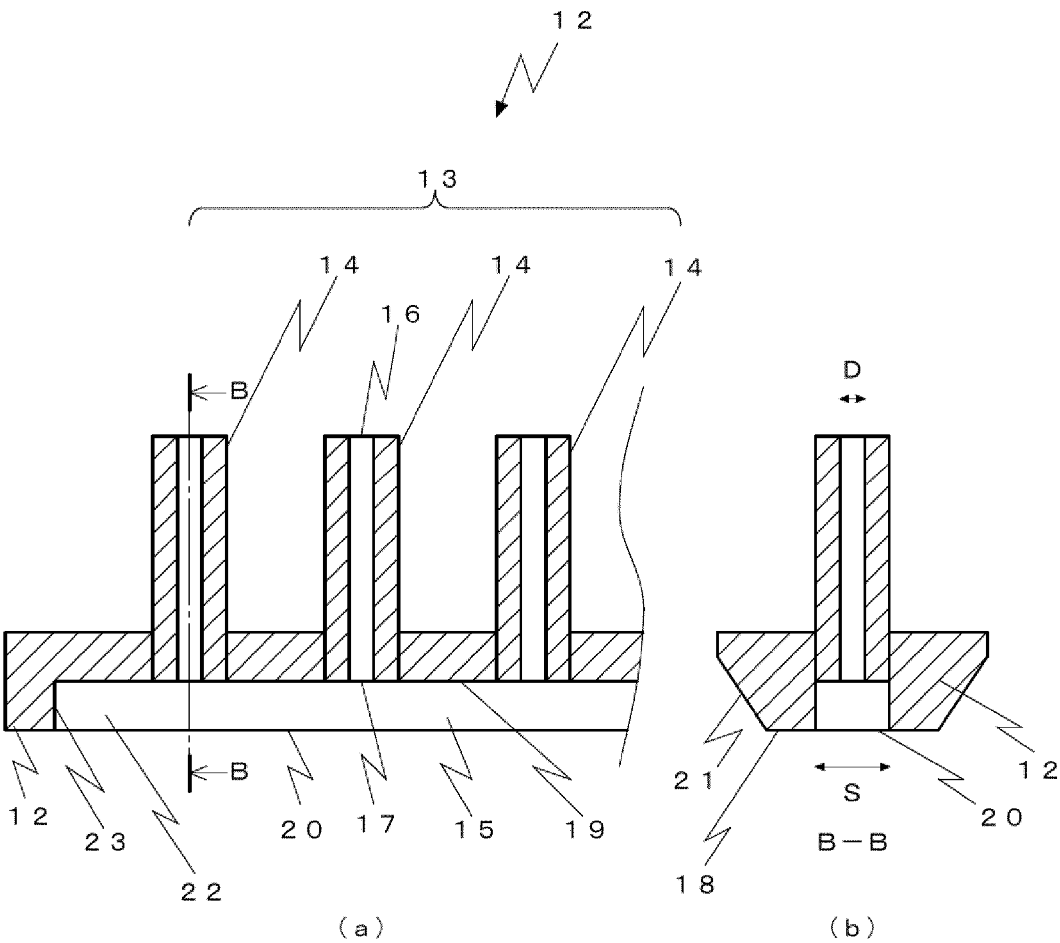
13. Procédé de revêtement consistant à appliquer un matériau liquide (43) en employant la buse de pelliculage (1) selon l'une quelconque des revendications 1 à 6, pendant qu'une cible de revêtement (29) et/ou la buse est déplacée par un mécanisme de déplacement (31).

14. Procédé de revêtement selon la revendication 13, dans lequel un matériau liquide hautement visqueux (43) est appliqué sous la forme d'une pellicule.

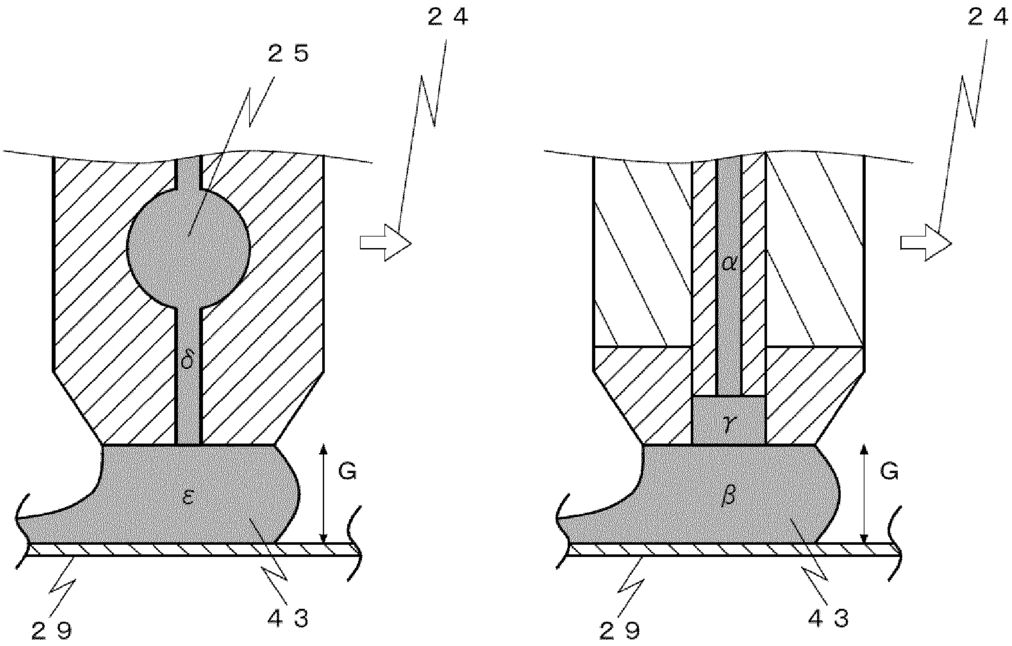
[Fig.1]



[Fig.2]

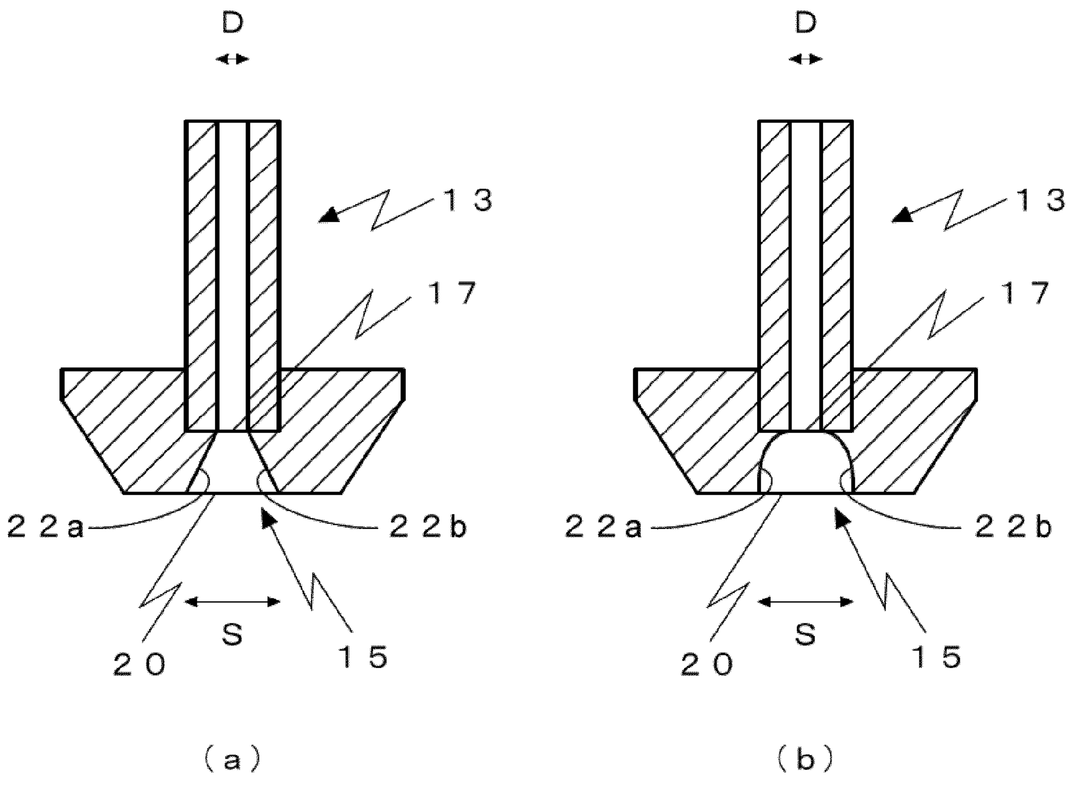


[Fig.3]

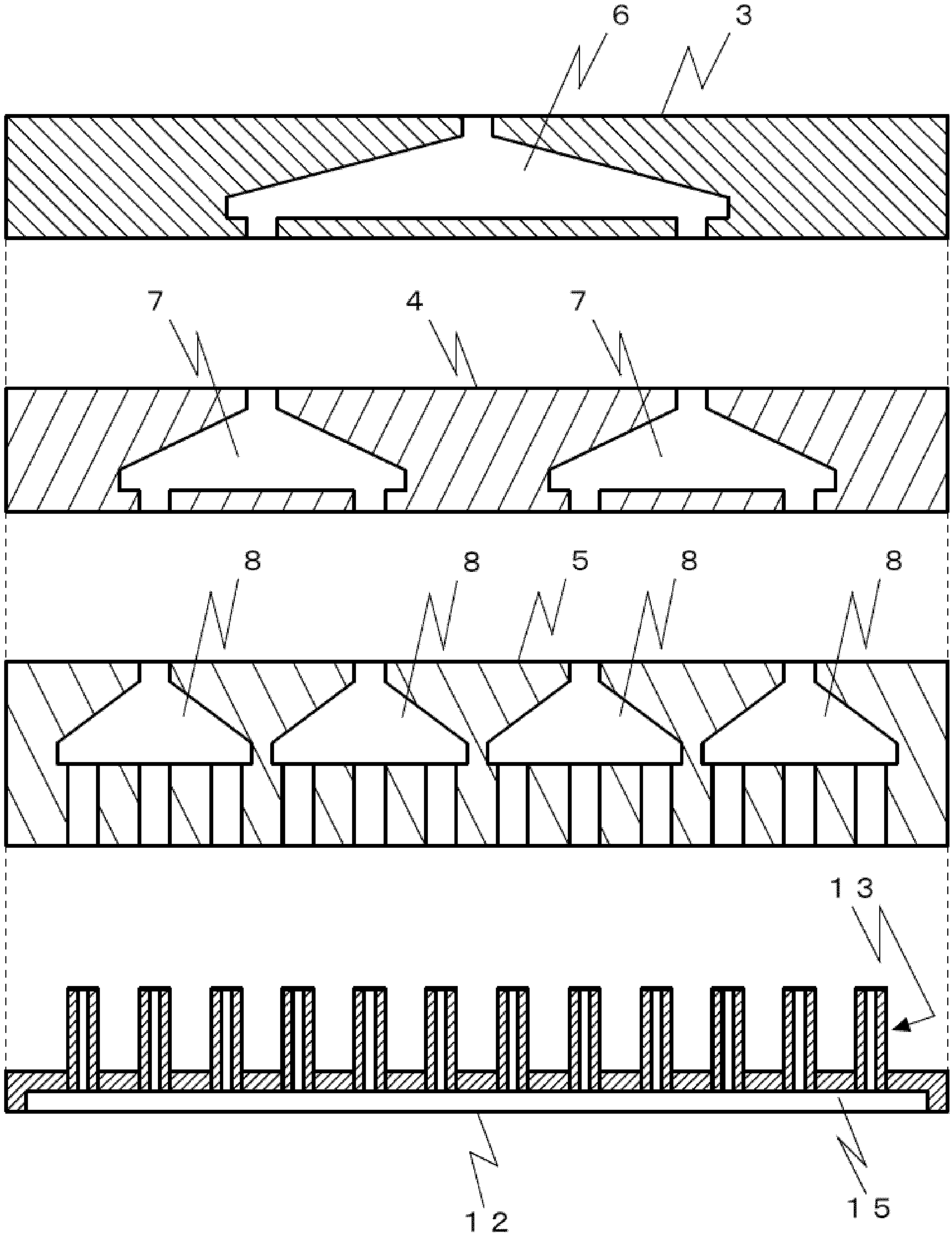


(a) (b)

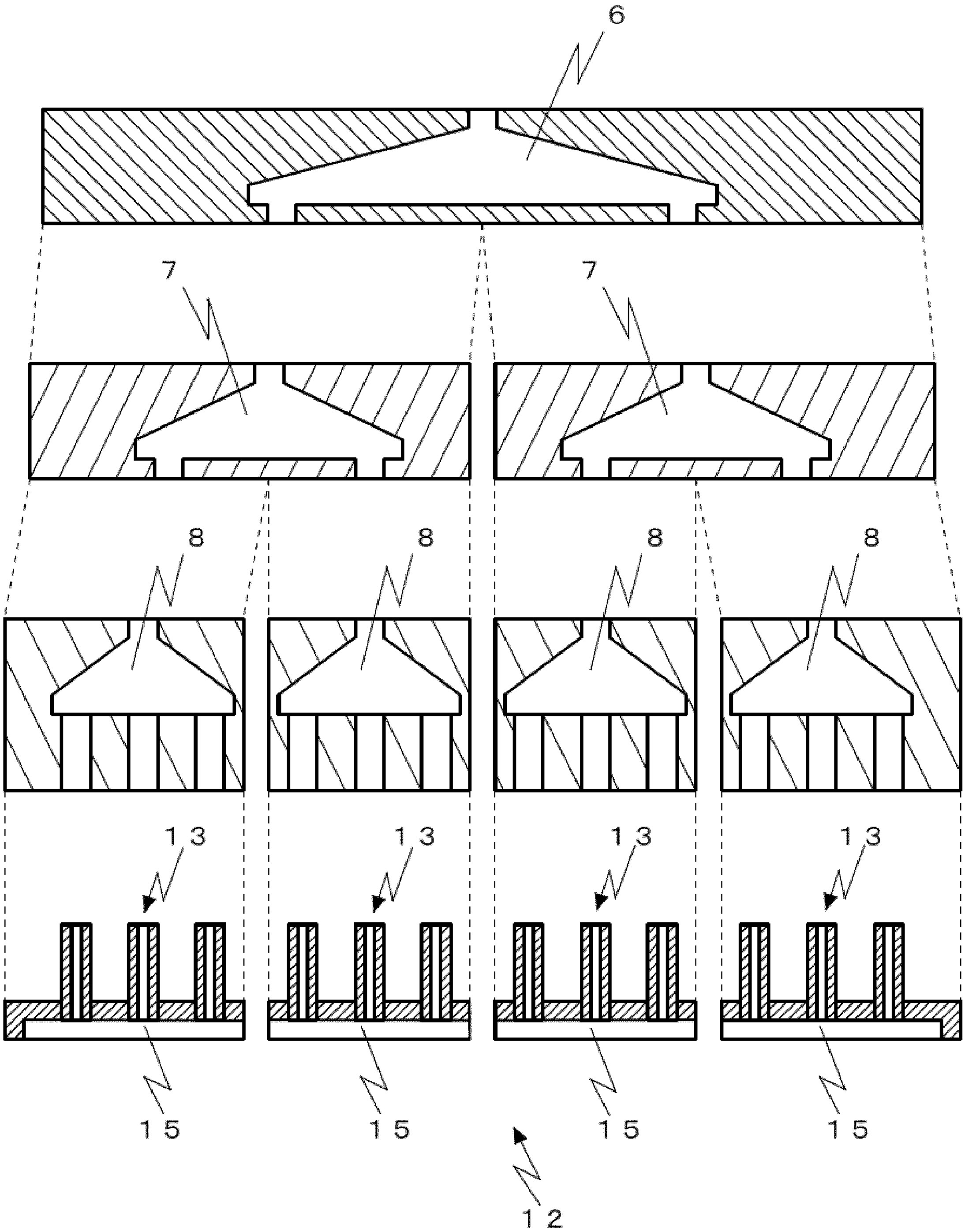
[Fig.4]



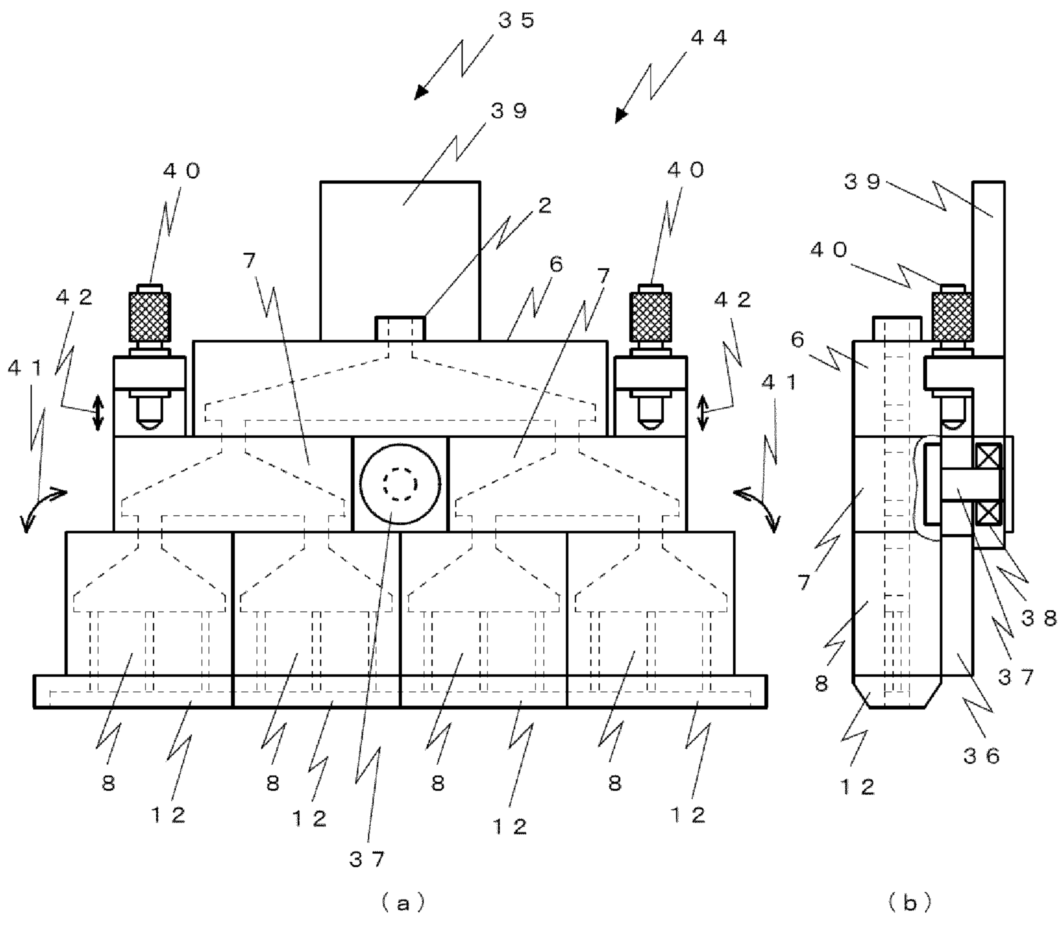
[Fig.5]



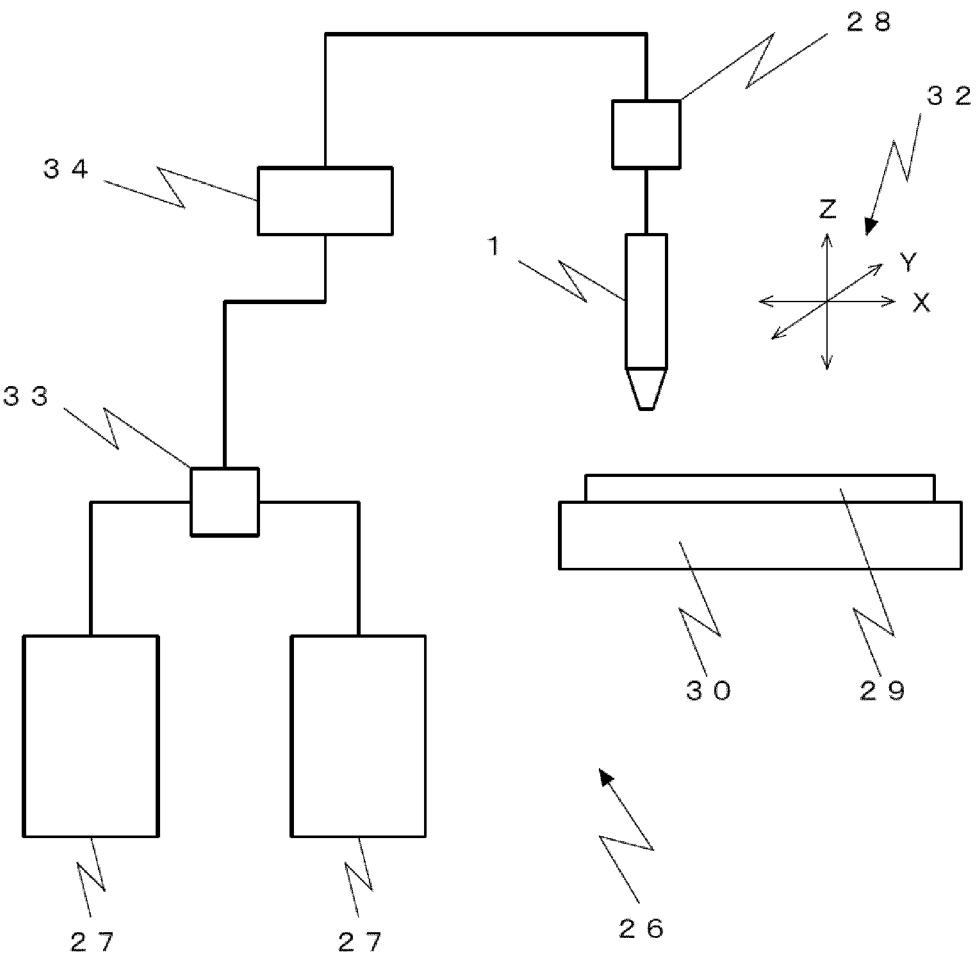
[Fig.6]



[Fig.7]


35
44
39
40
2
7
6
7
40
42
41
42
41
8
12
8
12
37
8
12
8
12
(a)
39
40
6
7
8
12
38
37
36
(b)

[Fig.8]



REFERENCES CITED IN THE DESCRIPTION

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- US 2011061589 A1 **[0008]**