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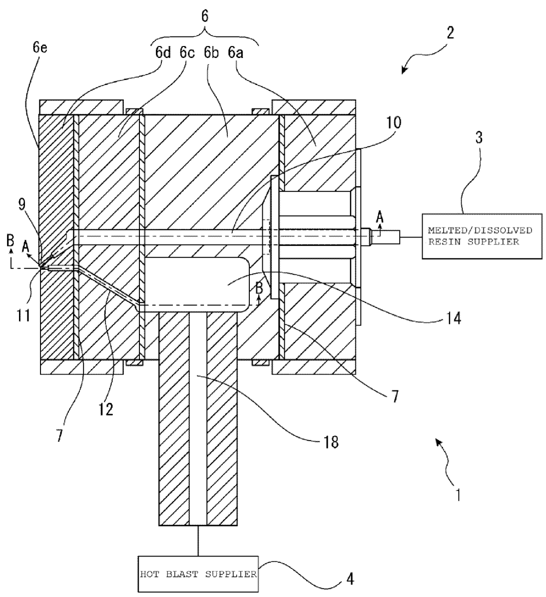
(54) DISCHARGE NOZZLE FOR NANO FIBER MANUFACTURING DEVICE AND NANO FIBER MANUFACTURING DEVICE PROVIDED WITH DISCHARGE NOZZLE

(57) A problem to be solved by the present invention is to provide a discharge nozzle for nanofiber production apparatuses that when producing nanofibers, allows for an easy change to a specification of fibers to be produced, such as the diameter, and thus an improvement in apparatus variety or workability and a nanofiber production apparatus including the discharge nozzle. A discharge nozzle 2 mounted on a nanofiber production apparatus 1 includes a division-type nozzle unit 6 that is provided with a molten/dissolved resin outlet 9 from which a molten or dissolved resin is discharged, a molten/dissolved resin flow path 10 through which the molten or dissolved resin is sent to the molten/dissolved resin outlet 9, a hot blast outlet 11 from which a hot blast is discharged, and a hot blast flow path 12 through which the hot blast is sent to the hot blast outlet 11. The division-type nozzle unit 6 can be divided into first to fourth nozzle units 6a to 6d.

Fig. 3



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Description

Technical Field

[0001] The present invention relates to a discharge nozzle for nanofiber production apparatuses that produce fine fibers and a nanofiber production apparatus including the discharge nozzle.

Background Art

[0002] Nanofibers are being used in various fields thanks to the properties thereof. In recent years, it has been requested to produce nanofibers in which fibers having different diameters and different lengths corresponding to the application are complicatedly intertwined, such as nonwoven fabrics formed of ultrafine fibers. Fine-fiber production technologies are disclosed in, for example, Patent Literatures 1 and 2. Ultrafine-fiber production apparatuses disclosed in Patent Literatures 1 and 2 include substantially the same spinnerets for melt blowing. These ultrafine-fiber production apparatuses include one or more liquid nozzles that are able to discharge a heated molten resin (Patent Literature 1) or a polymer solution obtained by dissolving a raw-material polymer in a solvent (Patent Literature 2) and one or more hot blast nozzles that draw the molten resin or polymer solution discharged from the liquid nozzles into fibers by blowing a hot blast onto the molten resin or polymer solution. Patent Literatures 1 and 2 disclose that the ultrafine-fiber production apparatuses stably spin the molten resin into fine fibers using a small amount of hot blast gas.

Citation List

Patent Literature

[0003]

Patent Literature 1: Japanese Patent No. 5946569
Patent Literature 2: Japanese Patent No. 5946565

Summary of Invention

Technical Problem

[0004] However, in the case of the ultrafine-fiber production apparatuses described in Patent Literatures 1 and 2, for example, when producing fibers having different diameters, it is difficult to appropriately change the diameter or inclination of the liquid nozzles or hot blast nozzles so as to correspond to the different diameters. The only method to change such conventional liquid nozzles or hot blast nozzles is to replace the entire spinneret.

[0005] The present invention has been made in view of the above problem, and an object thereof is to provide a discharge nozzle for nanofiber production apparatuses that allows for an easy change to a specification of nanofibers to be produced, such as the diameter, and thus an improvement in apparatus variety or workability and a nanofiber production apparatus including the discharge nozzle.

Solution to Problem

[0006] A discharge nozzle mounted on a nanofiber production apparatus according to the present invention is a discharge nozzle mounted on a nanofiber production apparatus that draws a molten or dissolved resin discharged from a molten/dissolved resin outlet into fine fibers by discharging the molten/dissolved resin such that the molten or dissolved resin is guided by a hot blast discharged from a hot blast outlet. The discharge nozzle includes a division-type nozzle unit that is provided with a molten/dissolved resin outlet and a hot blast outlet and can be divided into multiple units.

[0007] In the discharge nozzle mounted on the nanofiber production apparatus according to the present invention, the division-type nozzle unit can be divided such that at least one of the molten/dissolved resin flow path and the hot blast flow path is divided into multiple flow paths.

[0008] In the discharge nozzle mounted on the nanofiber production apparatus according to the present invention, a division joint of the division-type nozzle unit is an airtight sealing plate, such as a packing structure, that is formed of a highly heat-resistant, pressure-resistant, and chemical-resistant metal or special material corresponding to the temperature of a hot blast to be used or the properties of the molten or dissolved resin.

[0009] In the discharge nozzle mounted on the nanofiber production apparatus according to the present invention, the division-type nozzle unit includes a first nozzle unit serving as a molten/dissolved resin inflow unit, a second nozzle unit serving as a hot blast inflow unit, a third nozzle unit serving as a resin/hot blast introduction unit, and a fourth nozzle unit serving as a discharge unit.

[0010] A discharge nozzle mounted on a nanofiber production apparatus according to the present invention is a discharge nozzle mounted on a nanofiber production apparatus that draws a molten or dissolved resin discharged from a molten/dissolved resin outlet into fine fibers by discharging the molten/dissolved resin such that the molten or dissolved resin is guided by a hot blast discharged from a hot blast outlet. The discharge nozzle includes a division-type nozzle unit that can be divided into multiple units. The hot blast outlet is formed as a single rectangular slit-shaped hot blast outlet on a front wall surface of the division-type nozzle unit. The molten/dissolved resin outlet includes multiple aligned molten/dissolved resin outlets formed on the front wall surface of the division-type nozzle unit and disposed along a length direction of the hot blast outlet.

[0011] A nanofiber production apparatus according to the present invention is a nanofiber production apparatus that draws a molten or dissolved resin discharged from a molten/dissolved resin outlet into fine fibers by discharging the molten/dissolved resin such that the molten or dissolved resin is guided by a hot blast discharged from a hot blast outlet. The nanofiber production apparatus includes a discharge nozzle including a division-type nozzle unit that can be divided into multiple units. The hot blast outlet is formed as a single rectangular slit-shaped hot blast outlet on a front wall surface of the division-type nozzle unit. The molten/dissolved resin outlet includes multiple aligned molten/dissolved resin outlets formed on the front wall surface of the division-type nozzle unit and disposed along a length direction of the hot blast outlet.

Advantageous Effects of Invention

[0012] According to the present invention, the discharge nozzle can be divided into multiple units. Thus, when producing nanofibers having the desired diameter, some of the divided nozzle units provided with the molten/dissolved resin outlet and hot blast outlet can be easily replaced with units provided with a molten/dissolved resin outlet and a hot blast outlet corresponding to the desired specification, such as the fiber diameter. This allows for an increase in replacement workability and a reduction in the working time, allowing for providing low-cost fine fibers and nonwoven fabrics or the like formed of such fibers.

[0013] When producing a nonwoven fabric, a hot blast is blown from the hot blast outlet formed as a single slit, and the molten or dissolved resin is simultaneously discharged from the aligned multiple molten/dissolved resin outlets. This allows for optimization of a blow of the molten or dissolved resin discharged from the molten/dissolved resin outlets onto the hot blast, allowing for suppression of unevenness in the quality of fibers to be formed and thus acquisition of high-quality fibers.

[0014] The divided nozzle units can be easily integrated using fixing means, such as bolts. This allows for a reduction in the time required for troublesome assembly/disassembly work and thus a reduction in the cost of fibers to be produced.

Brief Description of the Drawings

[0015]

FIG. 1 is a perspective view showing a division-type nozzle mounted on a nanofiber production apparatus as an embodiment of the present invention.

FIG. 2 is an enlarged front view of the division-type nozzle in FIG. 1 and is an enlarged view of a portion shown by an alternate long and short dashed line in FIG. 1.

FIG. 3 is a longitudinal sectional view of the division-type nozzle in FIG. 1.

FIG. 4 is a longitudinal perspective view of a division-type nozzle mounted on a nanofiber production apparatus as another embodiment of the present invention.

FIG. 5 is a sectional view along a hot blast flow path formed in the division-type nozzle mounted on the nanofiber production apparatus as the embodiment of the present invention and shows an example of a sectional view taken along line A-A in FIGS. 3 and 4.

FIG. 6 is a sectional view along a solution flow path formed in the division-type nozzle mounted on the nanofiber production apparatus as the embodiment of the present invention and shows an example of a sectional view taken along line B-B in FIGS. 3 and 4.

FIG. 7 is a longitudinal sectional view of main components of a fourth nozzle unit included in the division-type nozzle mounted on the nanofiber production apparatus as the embodiment of the present invention.

FIG. 8 is a schematic view showing the position relationship between molten/dissolved resin outlets and a hot blast outlet formed in the division-type nozzle mounted on the nanofiber production apparatus as the embodiment of the present invention.

FIG. 9 is a sectional view showing a modification of a spinneret included in the division-type nozzle mounted on the nanofiber production apparatus as the embodiment of the present invention.

Description of Embodiments

[0016] Now, an embodiment of the present invention will be described with reference to FIGS. 1 to 9. However, the present invention is not limited to an implementation aspect described in the embodiment. Addition, deletion, or design change of elements with respect to the embodiment made by those skilled in the art as necessary and appropriate combinations of the features of the embodiment are also included in the present invention without departing from the spirit and scope of the present invention. In the present specification, the term "front" refers to the left side in FIGS. 3 and 4.

[0017] Referring now to FIGS. 1 to 9, the configuration of a division-type discharge nozzle 2 mounted on a nanofiber production apparatus 1 according to the present embodiment will be described. The nanofiber production apparatus 1 draws a molten or dissolved resin discharged from a molten/dissolved resin outlet 9 into fine fibers by discharging the molten or dissolved resin such that the molten or dissolved resin is guided by a hot blast discharged from a hot blast outlet 11. The nanofiber production apparatus 1 having the discharge nozzle 2 of the present embodiment mounted thereon draws the discharged molten resin or solvent-dissolved resin (referred to as the "molten or dissolved resin" in the present invention) into long fibers having ultrasmall diameters by blowing a hot blast onto the molten or dissolved resin. A molten/dissolved resin supplier 3 (not shown in detail) that introduces the heated, molten resin or the resin dissolved in the solvent into the discharge nozzle 2 and a hot blast supplier 4 (not shown in detail) that introduces a hot blast into the discharge nozzle 2 are connected to the discharge nozzle 2 mounted on the nanofiber production apparatus 1 and configured to discharge the molten or dissolved resin.

[0018] The discharge nozzle 2 includes a division-type nozzle unit 6. The division-type nozzle unit 6 can be divided into first to fourth nozzle units 6a to 6d. The first to fourth nozzle units 6a to 6d are arranged sequentially from the right to the left in FIGS. 3 and 4. Sealing plates 7 for maintaining air tightness are disposed as division joints, which are portions adjacent to the first to fourth nozzle units 6a to 6d. That is, the sealing plates 7 are sandwiched between the first nozzle unit 6a and second nozzle unit 6b, between the second nozzle unit 6b and the third nozzle unit 6c, and between the third nozzle unit 6c and fourth nozzle unit. The sealing plates 7 are formed of a highly heat-resistant, pressure-resistant, and chemical-resistant metal or special material corresponding to the temperature of a hot blast to be used or the properties of the molten or dissolved resin. The divided four first to fourth nozzle units 6a to 6d as a whole are penetrated by fixing means 8, such as bolts, and thus are integrated. The division-type nozzle unit 6 can be divided (can be cut in the up-down direction into nozzle units arranged in the left-right direction in FIGS. 3 and 4) such that a molten/dissolved resin flow path 10 and a hot blast flow path 12 are each divided into multiple flow paths. The division-type nozzle unit 6 may be dividable such that only one of the molten/dissolved resin flow path 10 and hot blast flow path 12 is divided. The number of divisions of the division-type nozzle unit 6 of the present embodiment is four. The number of divisions of the division-type nozzle unit 6 is determined in accordance with the implementation aspect. For example, the division-type nozzle unit 6 is divided d into a number of units corresponding to ease of formation of the molten/dissolved resin flow path 10 and hot blast flow path 12 or corresponding to the number of the functions of the division-type nozzle unit 6. In the present embodiment, the multiple nozzle units are jointed together using the shown fixing means 8, such as bolts. Alternatively, rather than penetrating the nozzle units, fixing means (not shown) may be disposed on the peripheries of the nozzle units in accordance with the configuration of the nozzle units and the implementation aspect thereof.

[0019] Depending on ease of formation of the internal molten/dissolved resin flow path 10 or hot blast flow path 12, the discharge nozzle 2 may be divided, for example, in the up-down direction (may be cut in the left-right direction so that nozzle units are arranged in the up-down direction in FIGS. 3 and 4) (not shown in detail). In such a configuration, for example, the nozzle units adjacent to each other in the up-down direction may be integrally fastened using (band-type) heaters for the nozzle units provided with fastening means (not shown), as well as bolts.

[0020] In the present embodiment, the division-type nozzle unit 6 includes the first nozzle unit 6a serving as a molten or dissolved resin inflow unit, the second nozzle unit 6b serving as a hot blast inflow unit, the third nozzle unit 6c serving as a resin/hot blast introduction unit, and the fourth nozzle unit 6d serving as a discharge unit. The first to fourth nozzle units 6a to 6d are provided with the molten/dissolved resin flow path 10 (molten/dissolved resin flow paths 10a to 10d). Thus, the molten or dissolved resin supplied from the molten/dissolved resin supplier 3 is sent to the molten/dissolved resin outlet 9 located on the downstream side of the fourth nozzle unit (discharge unit) 6d through the molten/dissolved resin flow path 10. The molten/dissolved resin outlet 9 is disposed so as to communicate with the downstream end of the molten/dissolved resin flow path 10.

[0021] The molten/dissolved resin flow path 10 is formed continuously over the first to fourth nozzle units 6a to 6d. The molten/dissolved resin outlet 9 of the fourth nozzle unit 6d is in the shape of a circle having an extremely small discharge-side diameter. The diameter of the molten/dissolved resin outlet 9 is determined in accordance with the specification of the shape (e.g., diameter) of ultrafine fibers to be produced. As shown in FIG. 2, the molten/dissolved resin outlet 9 includes multiple (12 in the shown embodiment) outlets 9-1 to 9-12 (hereafter referred to as the "molten/dissolved resin outlets 9-1 to 9-12") aligned along the length direction of a slit-shaped hot blast outlet 11 (to be discussed later). The molten/dissolved resin outlets 9-1 to 9-12 are horizontally aligned with each other on an inclined surface 22 disposed on the front wall surface 6e of the division-type nozzle unit 6 (FIG. 1). The inclined surface 22 will be described later.

[0022] As shown in FIG. 5, the molten/dissolved resin flow path 10 is formed as the single flow path 10a in the first nozzle unit 6a located on the most upstream side of the division-type nozzle unit 6. The flow path 10a is divided into the multiple (four in the embodiment) flow paths 10b and flow paths 10c in the second nozzle unit 6b and third nozzle unit 6c. The flow paths 10c are again merged into the single flow path 10d in the fourth nozzle unit 6d, which is then divided into multiple (12 in the embodiment) flow paths (molten/dissolved resin outlets 9-1 to 9-12) therein. The molten/dissolved resin outlet 9 (molten/dissolved resin outlets 9-1 to 9-12) formed in the fourth nozzle unit 6d is open in the direction of the normal to the inclined surface 22.

[0023] As shown in FIGS. 3, 4, and 6, the hot blast flow path 12 is formed in the second to fourth nozzle units 6b to 6d. The hot blast flow path 12 sends a hot blast supplied from the hot blast supplier 4 to the hot blast outlet 11 located on the downstream side of the fourth nozzle unit 6d. The hot blast flow path 12 may guide a hot blast from an air storage 14 having a large volume to the single horizontally rectangular, slit-shaped hot blast outlet 11 obliquely upward (FIG. 3), or guide a hot blast from the air storage 14 to the slit-shaped hot blast outlet 11 horizontally (FIG. 4).

[0024] The hot blast flow path 12 is formed continuously over the second to fourth nozzle units 6b to 6d. The hot blast supplier 4 supplies a hot blast to the second nozzle unit 6b through a hot blast inlet 18. To suppress a sudden pressure variation in the hot blast flow path 12, the second nozzle unit 6b includes the air storage 14 having a predetermined large volume.

[0025] As shown in FIG. 6, the third nozzle unit 6c is provided with horizontal multiple (11 in the present embodiment) partitions 15 for rectifying a hot blast sent through the air storage 14 of the second nozzle unit 6b. Thus, the hot blast flow path 12 is divided into 12 flow paths (hot blast flow paths 12-1 to 12-12) in the third nozzle unit 6c. As a result, the sent hot blast is relatively equally divided to multiple hot blasts in the third nozzle unit 6c. In the embodiment shown in FIG. 9, the hot blast flow path is represented by a reference numeral 12c and is divided into 12 flow paths (hot blast flow paths 12-1 to 12-12).

[0026] As shown in FIG. 6, the hot blast flow path 12 of the fourth nozzle unit 6d is not provided with any partition or the like but rather provided with a single rectangular-parallelepiped hot blast path space 12d that communicates with the divided hot blast flow paths 12 (12-1 to 12-12) in the third nozzle unit 6c. The hot blast path space 12d forms the horizontally rectangular, slit-shaped hot blast outlet 11 on the front surface of the apparatus. The hot blast path space 12d is formed from the upstream end to the downstream end (the hot blast outlet 11 on the front wall surface of the apparatus) of the fourth nozzle unit 6d. The hot blast outlet 11 is disposed so as to communicate with the downstream end of the hot blast flow path 12.

[0027] As seen above, the hot blast flow path 12 is provided with the many partitions 15 for rectifying a hot blast and the single hot blast path space 12d for merging the hot blasts rectified by the partitions 15. That is, the single horizontally rectangular, slit-shaped hot blast outlet is provided with respect to the multiple resin outlets rather than providing one hot blast outlet with respect to one resin outlet. Thus, a uniform hot blast discharge flow is formed with respect to the resin discharged from the multiple resin outlets, allowing for production of uniform nanofibers over the entire length of the horizontally rectangular slit.

[0028] While, in the embodiment shown in FIG. 6, the fourth nozzle unit 6d is provided with the single horizontally rectangular, slit-shaped hot blast outlet 11 (the outlet of the single hot blast path space 12d) and the third nozzle unit 6c is provided with the multiple partitions 15, a modification as shown in FIG. 9 may be employed. In the modification in FIG. 9, partitions 15 are disposed so as to extend from a third nozzle unit 6c approximately to the middle portion of a fourth nozzle unit 6d. In this configuration, a single horizontally rectangular hot blast path space 12d is formed from the middle portion to the downstream end (a slit-shaped hot blast outlet 11 on the wall surface) of the fourth nozzle unit 6d and is open to a lower vertical surface 20 on the front side of the apparatus.

[0029] The relationship between the molten/dissolved resin outlet 9 and hot blast outlet 11 will be described. As shown in FIG. 7, the front wall surface 6e of the fourth nozzle unit 6d has the lower vertical surface 20 and an upper vertical surface 21 that are parallel with each other. The upper vertical surface 21 is disposed in a more front position than the lower vertical surface 20 (is displaced from the lower vertical surface 20 forward). The lower vertical surface 20 and upper vertical surface 21 are connected through the inclined surface 22. The inclined surface 22 is inclined with respect to the lower vertical surface 20 and upper vertical surface 21.

[0030] The lower vertical surface 20 is provided with the single rectangular slit-shaped hot blast outlet 11. The inclined surface 22 is provided with the molten/dissolved resin outlets 9-1 to 9-12 (12 outlets in the present embodiment) oriented in the direction of the normal to the inclined surface 22. Accordingly, by adjusting the inclination angle of the inclined surface 22, the direction (angle) of discharge of the molten or dissolved resin with respect to the discharged hot blast is changed. That is, if multiple nozzle units having inclined surfaces 22 having different inclination angles are prepared, a nozzle unit having an inclination angle (the angle at which the molten or dissolved resin and a hot blast intersect each other) corresponding to a desired specification, such as the fiber diameter, can be selected. Instead of a nozzle unit having a different inclined angle, a nozzle unit having molten/dissolved resin outlets 9-1 to 9-12 having a different diameter, a nozzle unit having a different number of molten/dissolved resin outlets, or a nozzle unit having a hot blast outlet 11 having a different configuration (the shape, the number of partitions 15, etc.) may be selected.

[0031] As shown in FIGS. 7 and 8, the molten/dissolved resin outlet 9 and hot blast outlet 11 are disposed in extremely close positions. The circular molten/dissolved resin outlet 9 is formed in a direction perpendicular to the inclined surface 22 (in the direction of the normal). According to this configuration, when forming the molten/dissolved resin outlet 9 (molten/dissolved resin outlets 9-1 to 9-12), a drill is applied to the inclined surface 22 so as to be perpendicular thereto and thus does not slip away. As a result, the small-diameter circular molten/dissolved resin outlet 9 can be accurately formed even using a drill or the like.

[0032] FIG. 8 is a schematic view showing the position relationship between the molten/dissolved resin outlet and the hot blast outlet formed in the division-type nozzle mounted on the nanofiber production apparatus according to the embodiment of the present invention.

[0033] The fourth nozzle unit (discharge unit) 6d of the discharge nozzle 2 of the present embodiment shown in FIG. 8 is provided with the 12 molten/dissolved resin outlets 9-1 to 9-12 from which the molten or dissolved resin is discharged and the single slit-shaped hot blast outlet 11 from which a hot blast is discharged. The third nozzle unit (resin/hot blast introduction unit) 6c is provided with the 11 partitions 15. Thus, in the present embodiment, the molten/dissolved resin outlets 9 (molten/dissolved resin outlets 9-1 to 9-12) and the hot blast flow paths 12 (12-1 to 12-12) match each other in number and correspond to each other one-to-one in the discharge direction (the left-right direction in FIG. 8). Instead of this configuration, for example, the third nozzle unit (resin/hot blast introduction unit) 6c may be provided with 12 partitions 15, and the fourth nozzle unit 6d may be provided with 13 hot blast flow paths 12 (12-1 to 12-13). The molten/dissolved resin outlets 9 (molten/dissolved resin outlets 9-1 to 9-12) and the hot blast flow paths 12 (12-1 to 12-13) need not necessarily match each other in number. For example, 12 molten/dissolved resin outlets 9 and 13 hot blast flow paths 12 of the third nozzle unit 6c may be displaced from each other in a direction perpendicular to the discharge direction (in the up-down direction in FIG. 8).

[0034] As seen above, by mounting the discharge nozzle 2 of the present embodiment on the nanofiber production apparatus 1, the nanofiber production apparatus 1 is allowed to draw the molten or dissolved resin discharged from the multiple molten/dissolved resin outlets 9-1 to 9-12 into fibers by discharging the molten or dissolved resin onto a hot blast discharged from the single slit-shaped hot blast outlet 11. The discharge nozzle 2 of the present embodiment includes the division-type nozzle unit 6 that is provided with the molten/dissolved resin outlet 9 from which the molten or dissolved resin is discharged, the molten/dissolved resin flow path 10 through which the molten or dissolved resin is sent to the molten/dissolved resin outlet 9 (molten/dissolved resin outlets 9-1 to 9-12), the hot blast outlet 11 from which a hot blast is discharged, and the hot blast flow path 12 through which a hot blast is sent to the hot blast outlet 11.

[0035] The nanofiber production apparatus 1 of the present embodiment includes the molten/dissolved resin supplier 3 that introduces the molten or dissolved resin into the molten/dissolved resin flow path 10 disposed in the division-type nozzle unit 6 and the hot blast supplier 4 that introduces a hot blast into the hot blast flow path 12 disposed in the division-type nozzle unit 6. The division-type nozzle unit 6 can be divided into first to fourth nozzle units 6a to 6d.

[0036] More specifically, the division-type nozzle unit 6 is divided such that the molten/dissolved resin flow path 10 and hot blast flow path 12 are each divided into multiple flow paths. Thus, if multiple different nozzle units that can be applied to different fiber specifications are prepared, some of the nozzle units can be easily replaced in accordance with the target fiber specification. For example, when changing a specification of fibers to be produced, the fourth nozzle unit 6d provided with the molten/dissolved resin outlet 9 and hot blast outlet 11 can be easily replaced with a fourth nozzle unit 6d provided with a molten/dissolved resin outlet 9 and a hot blast outlet 11 corresponding to the changed fiber specification. This allows for an increase in the workability and a reduction in the working time when producing the desired nanofibers, allowing for efficiently providing low-cost fine fibers and nonwoven fabrics or the like formed of such fibers.

[0037] The discharge nozzle 2 of the present embodiment is provided with the multiple molten/dissolved resin outlets 9-1 to 9-12, and discharges a resin from the outlets and blows a hot blast through the hot blast outlet 11 formed as a single horizontally rectangular slit. This allows for making uniform the amount of hot blast blown onto the molten or dissolved resin discharged from the molten/dissolved resin outlets 9-1 to 9-12, allowing for suppression of unevenness in the quality of fibers to be formed and thus acquisition of high-quality fibers.

[0038] The divided first to fourth nozzle units 6a to 6d can be easily integrated using the fixing means 8, such as bolts. This allows for a reduction in the time required for troublesome assembly/disassembly work and thus a reduction in the cost of fibers to be produced.

[0039] While the embodiment of the present invention has been described, the present invention is not limited thereto. Various modifications can be made to the embodiment without departing from the spirit and scope of the present invention. While, in the above embodiment, the four divided first to fourth nozzle units 6a to 6d are each provided with the molten/dissolved resin flow path 10 and hot blast flow path 12, the portions in which the molten/dissolved resin flow path 10 and hot blast flow path 12 are formed may be further dividable. Of course, the number of divided nozzle units may be reduced.

Reference Signs List

[0040]

1	nanofiber production apparatus
2	discharge nozzle
3	molten/dissolved resin supplier
4	hot blast supplier
5	(band-type) heater for nozzle unit
6	division-type nozzle unit
6a	first nozzle unit (molten/dissolved resin inflow unit)
6b	second nozzle unit (hot blast inflow unit)
6c	third nozzle unit (resin/hot blast introduction unit)
6d	fourth nozzle unit (discharge unit)
6e	front wall surface
7	sealing plate
8	fixing means
9	molten/dissolved resin outlet
9-1 to 9-12	molten/dissolved resin outlet
10	molten/dissolved resin flow path
11	slit-shaped hot blast outlet
12	hot blast flow path (12a to 12d)
14	air storage
15	partition

18	hot blast inlet
20	lower vertical surface
21	upper vertical surface
22	inclined surface

Claims

1. A discharge nozzle mounted on a nanofiber production apparatus that draws a molten or dissolved resin discharged from a molten/dissolved resin outlet into fine fibers by discharging the molten/dissolved resin such that the molten or dissolved resin is guided by a hot blast discharged from a hot blast outlet, the discharge nozzle comprising
a division-type nozzle unit that is provided with a molten/dissolved resin outlet and a hot blast outlet and can be divided into a plurality of units.

2. The discharge nozzle mounted on the nanofiber production apparatus according to Claim 1, wherein the division-type nozzle unit can be divided such that at least one of the molten/dissolved resin flow path and the hot blast flow path is divided into a plurality of flow paths.

3. The discharge nozzle mounted on the nanofiber production apparatus according to Claim 1 or 2, wherein a division joint of the division-type nozzle unit is an airtight sealing plate.

4. The discharge nozzle mounted on the nanofiber production apparatus according to Claim 1, wherein the division-type nozzle unit comprises a first nozzle unit serving as a molten/dissolved resin inflow unit, a second nozzle unit serving as a hot blast inflow unit, a third nozzle unit serving as a resin/hot blast introduction unit, and a fourth nozzle unit serving as a discharge unit.

5. A discharge nozzle mounted on a nanofiber production apparatus that draws a molten or dissolved resin discharged from a molten/dissolved resin outlet into fine fibers by discharging the molten/dissolved resin such that the molten or dissolved resin is guided by a hot blast discharged from a hot blast outlet, the discharge nozzle comprising
a division-type nozzle unit that can be divided into a plurality of units, wherein
the hot blast outlet is formed as a single rectangular slit-shaped hot blast outlet on a front wall surface of the division-type nozzle unit, and
the molten/dissolved resin outlet comprises a plurality of aligned molten/dissolved resin outlets formed on the front wall surface of the division-type nozzle unit and disposed along a length direction of the hot blast outlet.

6. A nanofiber production apparatus that draws a molten or dissolved resin discharged from a molten/dissolved resin outlet into fine fibers by discharging the molten/dissolved resin such that the molten or dissolved resin is guided by a hot blast discharged from a hot blast outlet, the nanofiber production apparatus comprising
a discharge nozzle comprising a division-type nozzle unit that can be divided into a plurality of units, wherein
the hot blast outlet is formed as a single rectangular slit-shaped hot blast outlet on a front wall surface of the division-type nozzle unit, and
the molten/dissolved resin outlet comprises a plurality of aligned molten/dissolved resin outlets formed on the front wall surface of the division-type nozzle unit and disposed along a length direction of the hot blast outlet.

Fig. 1

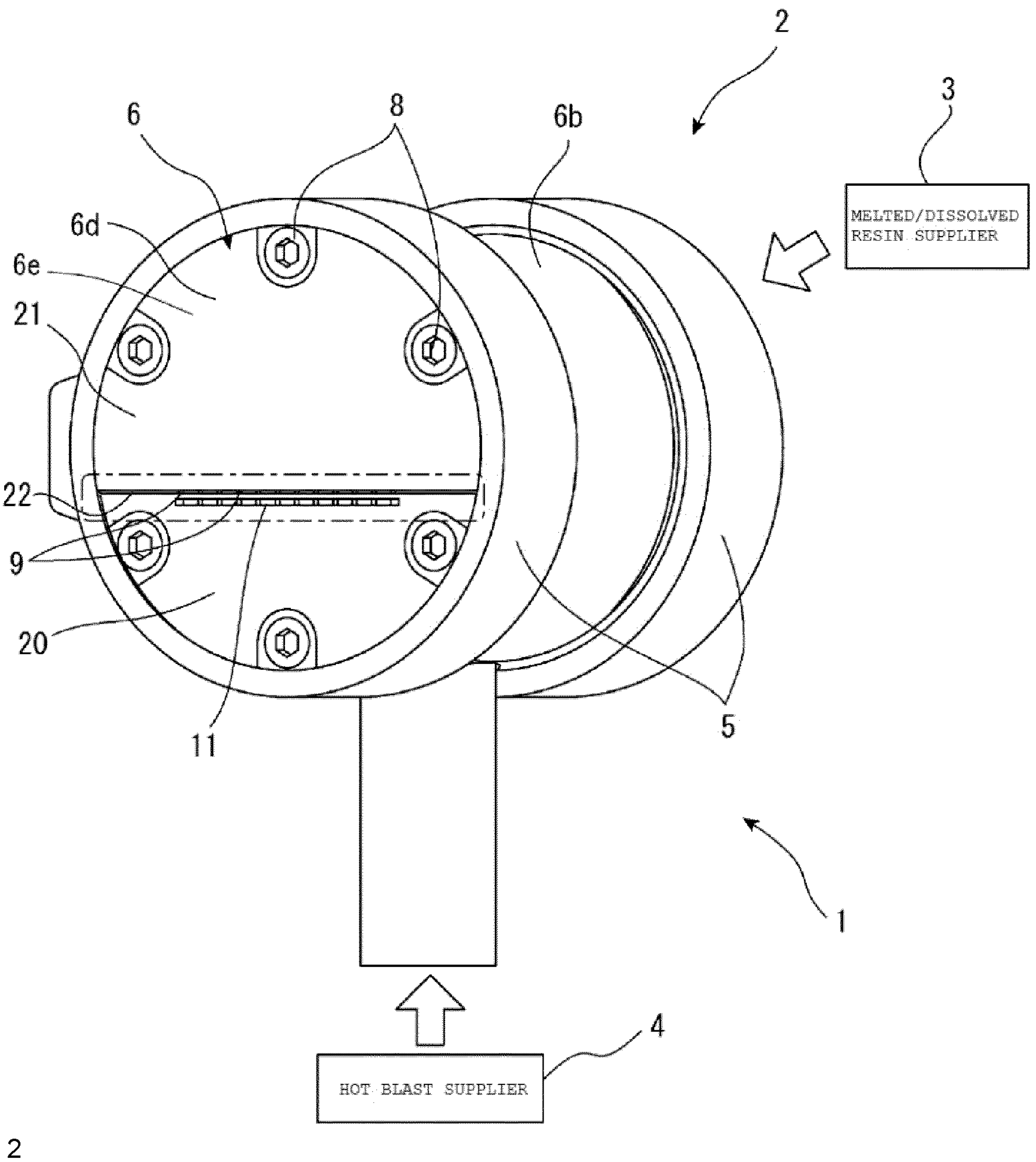
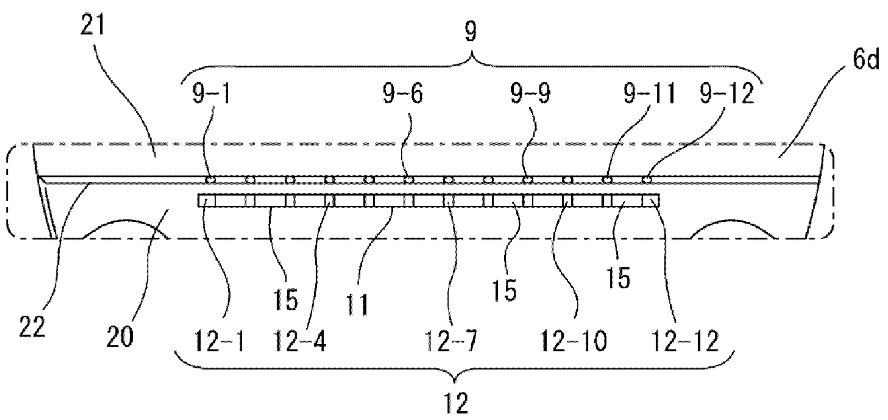

2
3
MELTED/DISSOLVED
RESIN SUPPLIER
6
8
6b
6d
6e
21
22
9
20
11
5
1
4
HOT BLAST SUPPLIER

Fig. 2


21
9
6d
9-1
9-6
9-9
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12-10
12-12
12

Fig. 3

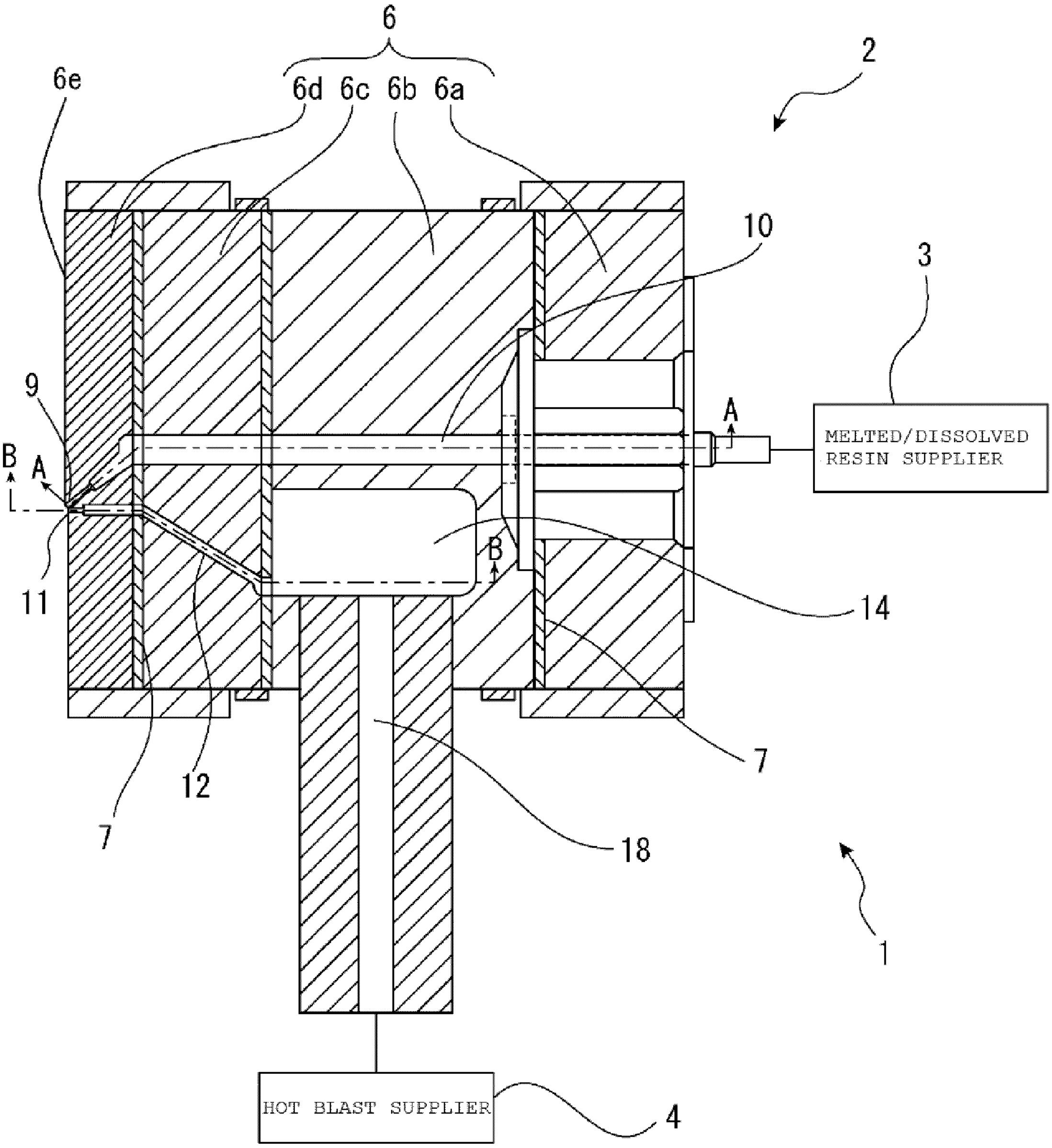

6
6e
6d
6c
6b
6a
2
10
3
A
MELTED/DISSOLVED
RESIN SUPPLIER
9
B
A
11
14
B
7
12
7
18
1
HOT BLAST SUPPLIER
4

Fig. 4

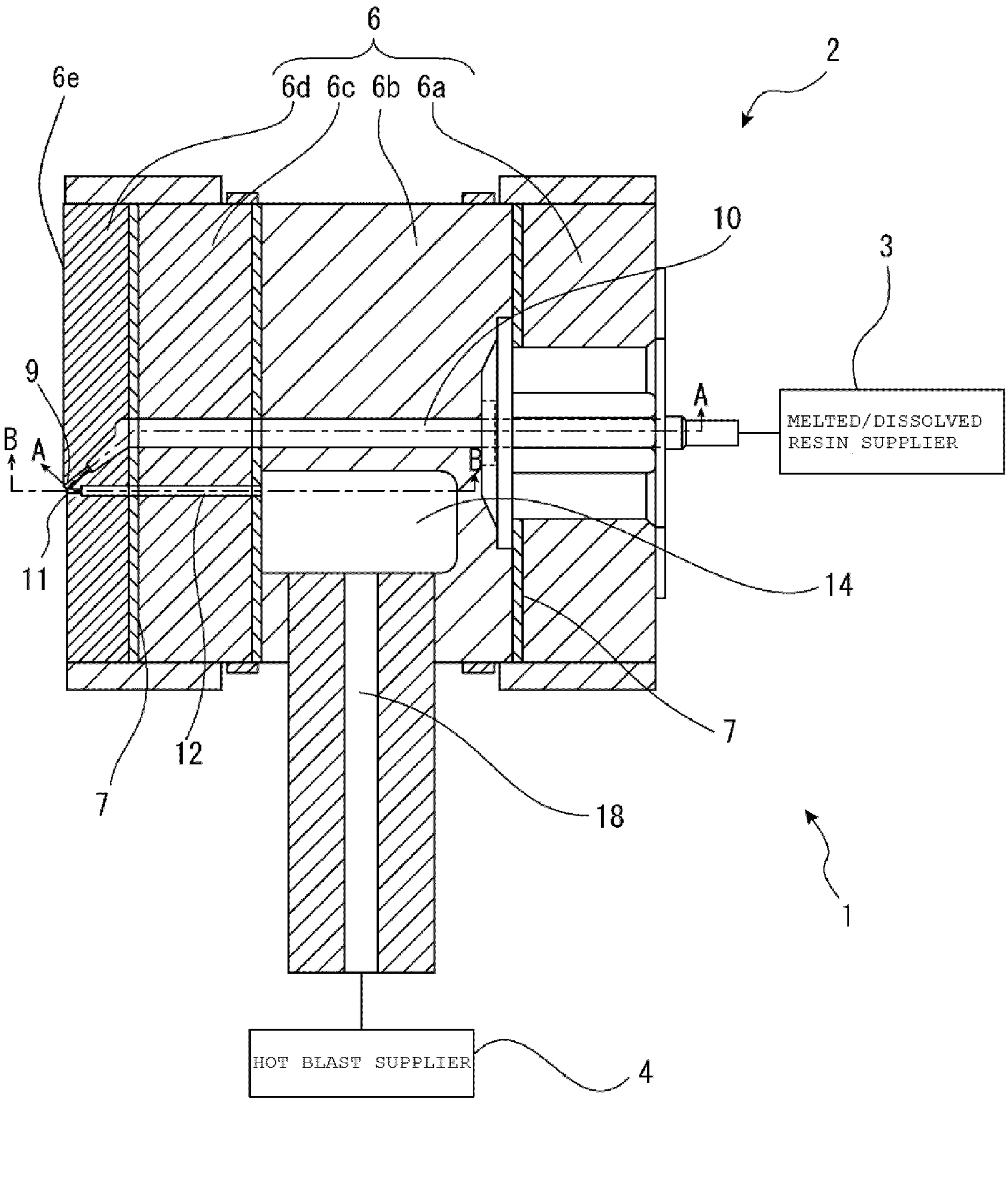

6
2
6e
6d 6c 6b 6a
10
3
9
A
B
A
MELTED/DISSOLVED
RESIN SUPPLIER
B
11
14
12
7
7
18
1
HOT BLAST SUPPLIER
4

Fig. 5

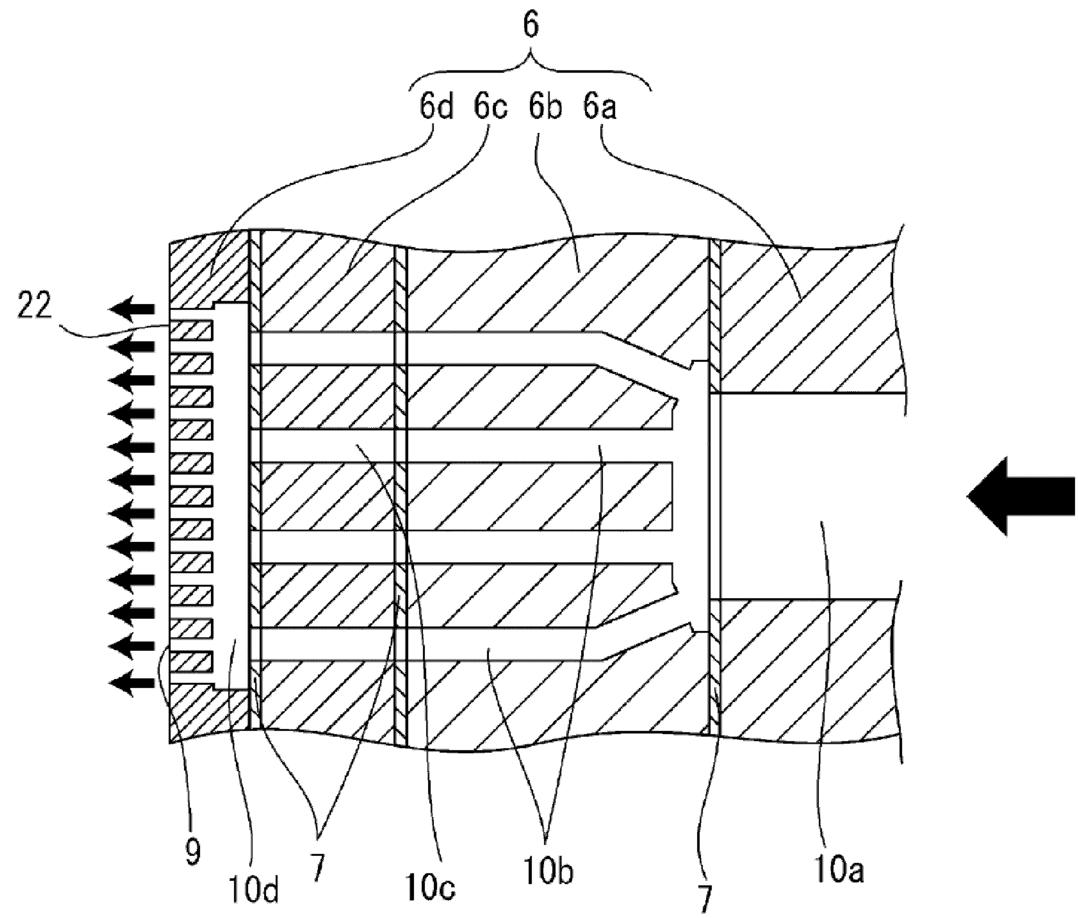


Fig. 6

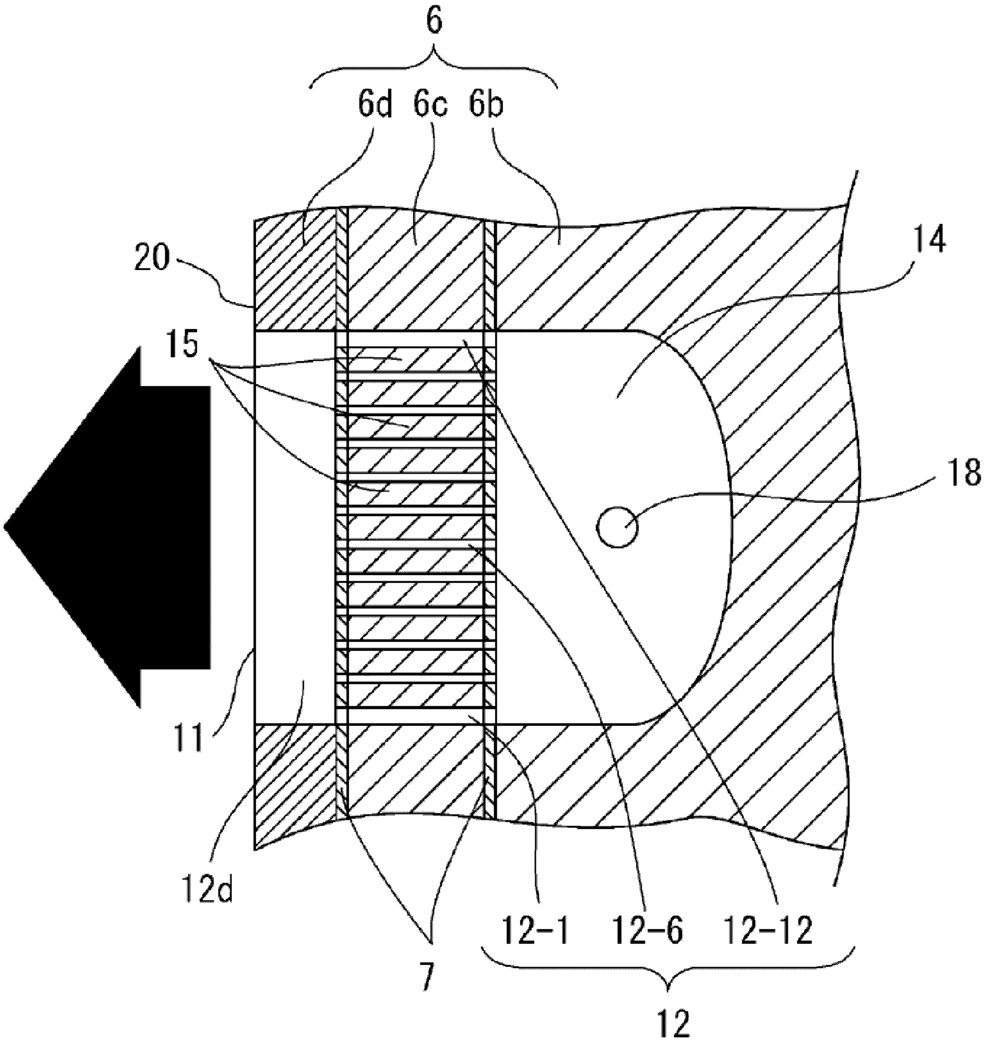


Fig. 7

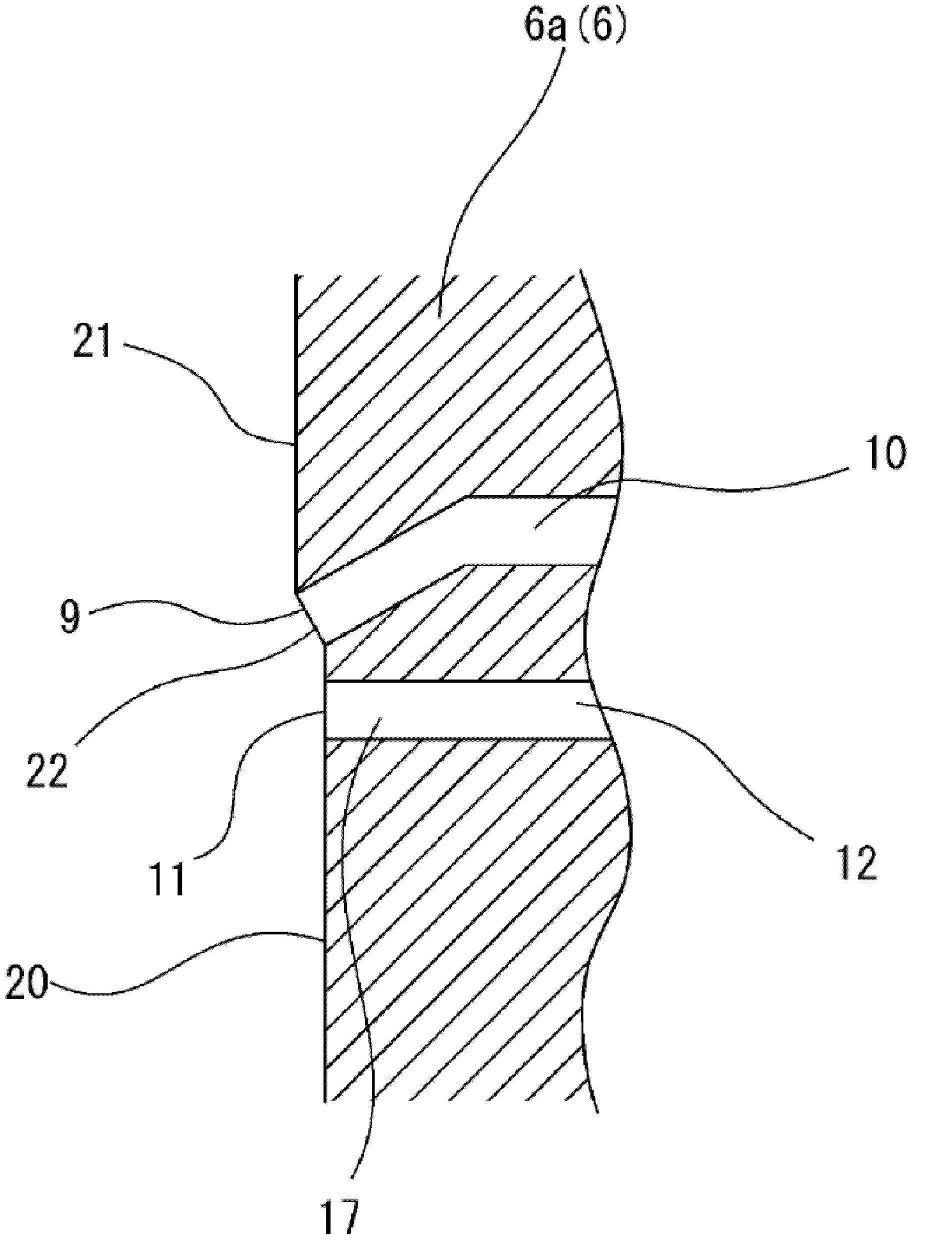


Fig. 8

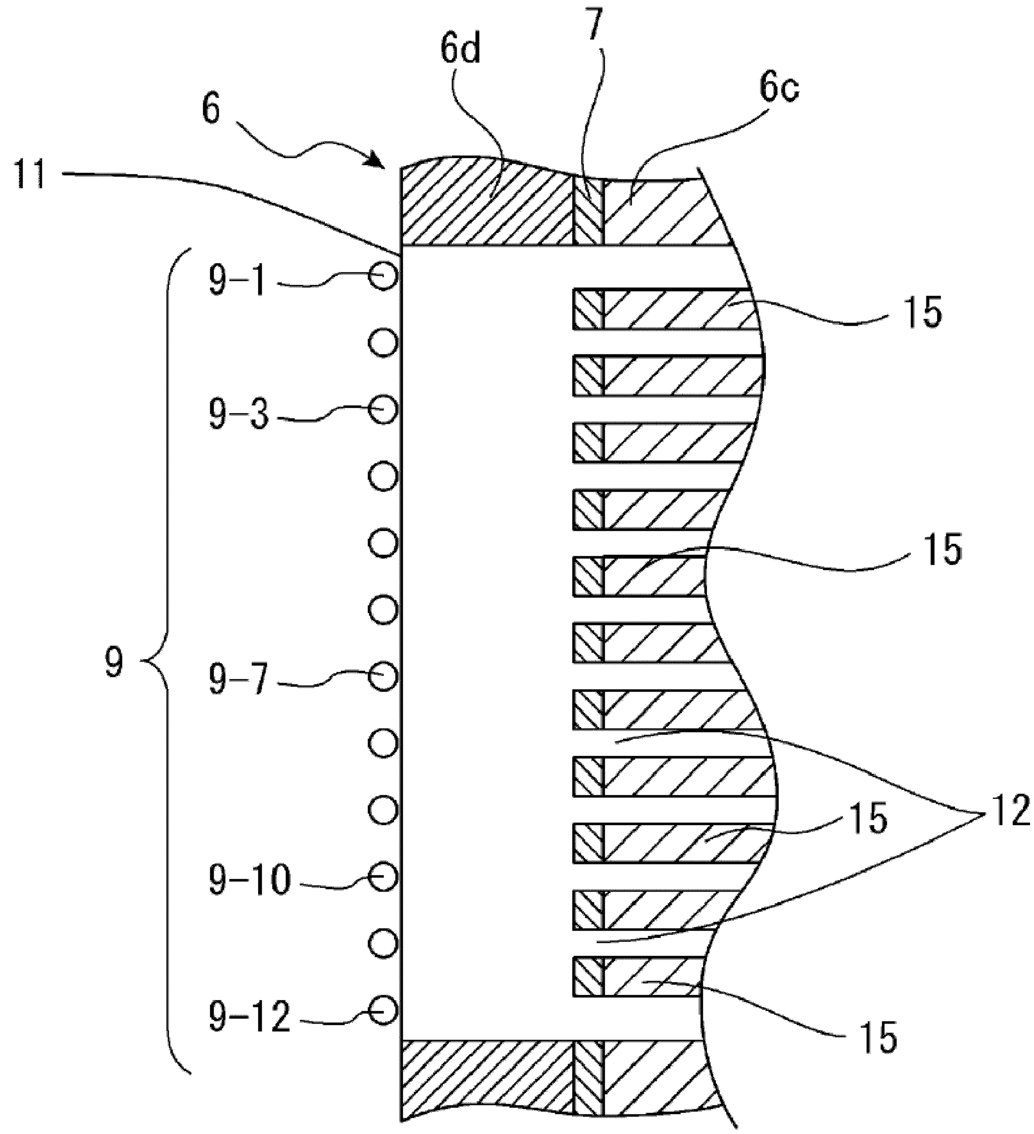
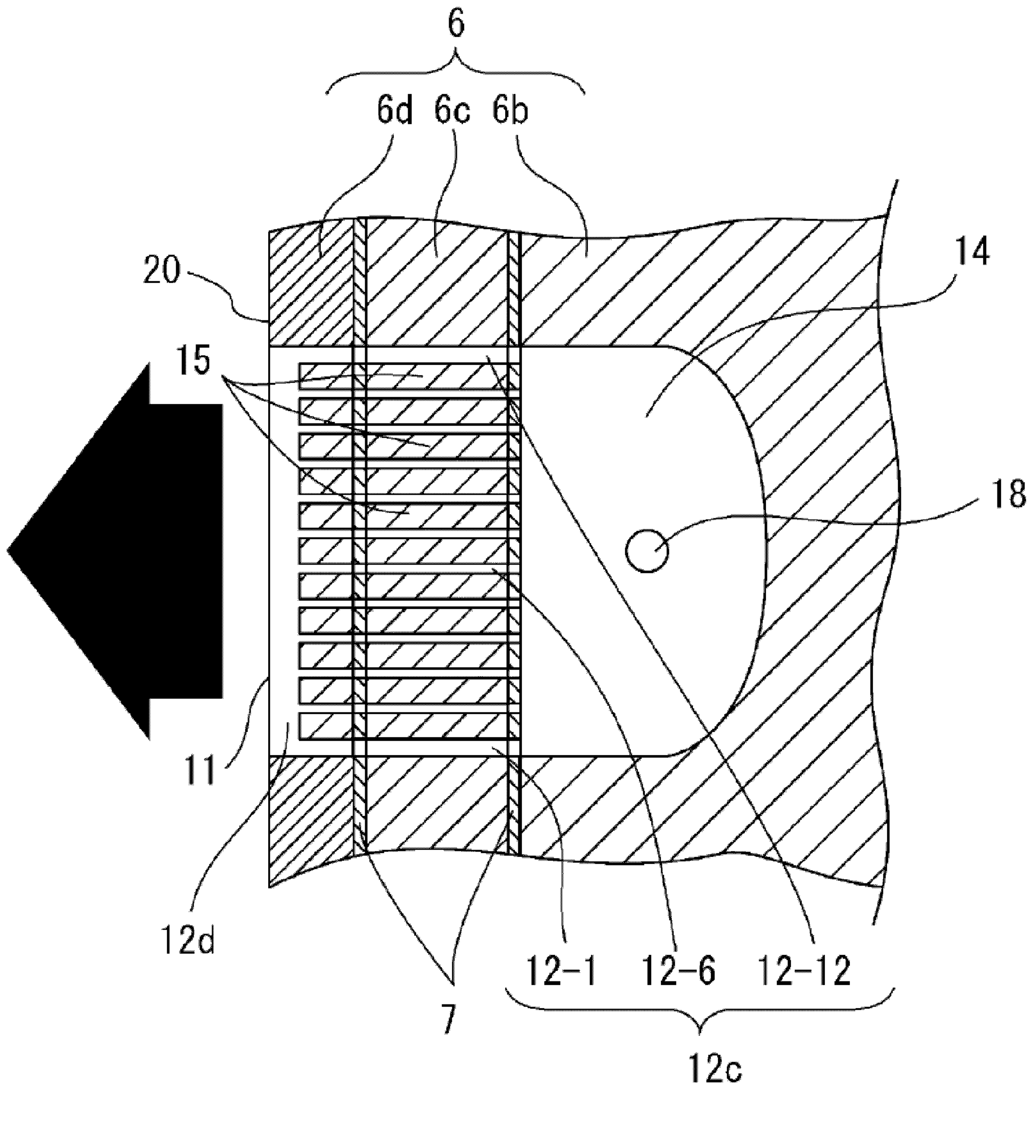


Fig. 9



INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2018/023457

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. D01D4/02(2006.01)i, D01D5/04(2006.01)i, D01D5/08(2006.01)i

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)

Int.Cl. D01D1/00-13/02

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	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

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.
X Y A	WO 2017/014109 A1 (KASEN NOZURU SEISAKUSHO KK) 26 January 2017, paragraphs [0008], [0009], fig. 2 & JP 2017-25433 A & JP 6063012 B1	1, 2, 5, 6 3 4

☒ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:
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- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "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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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search 08.08.2018	Date of mailing of the international search report 21.08.2018
Name and mailing address of the ISA/ Japan Patent Office 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/JP2018/023457

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2-269806 A (ACCURATE PRODUCTS CO.) 05 November 1990, page 4, lower left column, line 5 to page 7, upper left column, line 12, drawings & EP 388036 A2, page 3, line 20 to page 5, line 10, drawings & US 4986743 A & DE 69007659 T & CA 2010860 A & KR 10-0148376 B & CA 2010860 A1	1, 2 3 4-6
Y A	JP 1-282308 A (BAYER AG) 14 November 1989, claims, example 4, fig. 3 & US 5075161 A, claims, example 4, fig. 3 & EP 339240 A2 & DE 3810596 A1	3 1, 2, 4-6
P, X P, A	JP 2017-145529 A (NIPPON NOZZLE CO., LTD.) 24 August 2017, paragraphs [0020]-[0031], fig. 1-5 (Family: none)	1-3, 5, 6 4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 5946569 B **[0003]**
- JP 5946565 B **[0003]**