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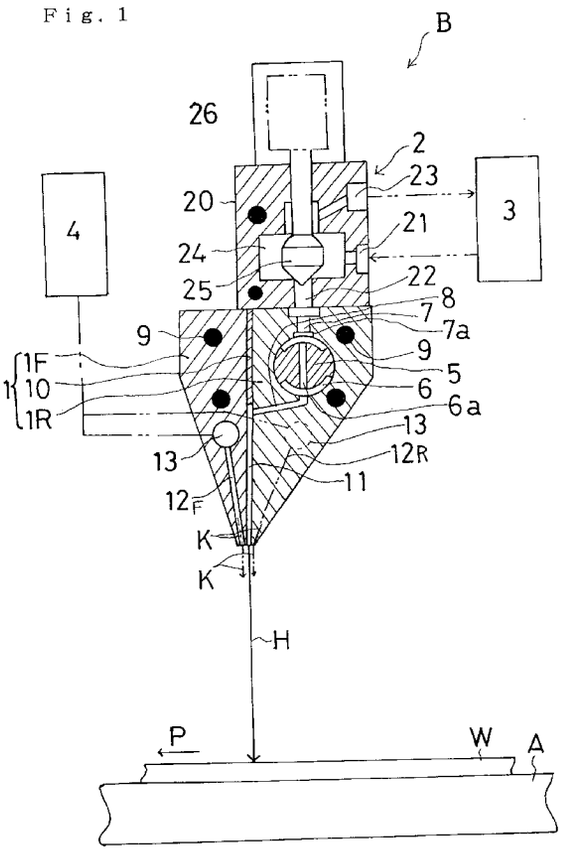
(54) Method of applying curtain-like spray and application nozzle device in curtain-like spray application apparatus

(57) A method of applying curtain-shaped spray characterized in that a curtain-shaped pressurized air flow which jets from the bottom opening of an air jetting hole is formed by jetting pressurized air from the air jetting hole which is formed in groove-shape and in the direction crossing the conveying direction of an application line and said curtain-shaped pressurized air flow is made to act on application agents beat from an application nozzle hole group when it jets from the bottom surface of a nozzle unit.

Fig. 1



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Description

BACKGROUND OF THE INVENITION

Field of the invention:

This invention relates to the method of applying spray of liquid agent (application agent), such as adhesive agent, paint, coating agent for forming film or the like, which is atomized by making pressurized air act thereon, to a material for application and also a nozzle device for spray application in the cases of woodworking (manufacturing of composite wood by gluing, application of a brightener to the wood surface and coloring, pattern forming, etc. on wood surface), processing of nonwoven fabric goods (manufacturing of thrown-away diapers by adhering nonwoven fabrics), processing of household furniture (application of a brightener to the surface of furniture and coloring, pattern forming, etc. on the surface of furniture) and food processing (coloring of food surface, application of a surface brightener, etc.).

More particularly, this invention relates to the method of applying spray uniformly in wider width of application by widening the range of spray application to a material for application and also a spray application nozzle device.

Description of the prior art:

As the method of applying spray, it has been known to apply coating agent, which is put in atomized condition by making pressurized air act thereon, to the surface of a material for application. According to this known method, for the purpose of widening the application area the spraying range of application agent is widened conically, as shown in Fig. 7. This conical range of spraying application agent involves such disadvantage that an application thickness of the application surface is partially thicker in doughnut-shape, namely, uneven application thickness. In addition, if many application nozzle units are arranged in a file for the purpose of enlarging the application width, the peripheral edge parts R of spraying range of application nozzle units overlap each other, as shown in Fig. 8, and accordingly the application surface of more uneven application thickness is involved.

In order to solve the problem of the above-mentioned known technique, the present applicant filed previously a patent application in Japan for "Apparatus for applying hot-melt adhesives (Japanese Patent Application No.163308/1992 filed on May 11, 1992).

According to the prior invention mentioned above, as shown in Fig. 5 and Fig. 6, an application nozzle hole group 11P comprising many application nozzle holes and air jetting hole groups 12P, each comprising many air jetting holes (pressurized air holes), are arranged adjacent to each other in the direction crossing the direction of conveying a material for application W, and by jetting pressurized air flow K from the air jetting hole groups 12P adjacent to a row of hot-melt adhesive beat h jetted from many application nozzle holes 11p, many hot-melt; adhesive beats h are extended by the pressurized air flow K into a slender fiber-shape. Because of that hot-melt adhesives of slender fiber-shape are adjacent to each other and that pressurized air flows of curtain-shape K are formed on the front side of conveyance and on the rear side of conveyance, condition of applying spray of curtain-shape is formed.

In other words, the air jetting holes (pressurized air holes) are formed adjacent to the application nozzle hole, on the front side of conveyance and on the rear side of conveyance, and the pressurized air flow of curtain-shape from the pressurized air hole is made to act on the hot-melt adhesives beat jetted from the application nozzle group.

In the case of the above prior invention, as shown in Fig. 5 and Fig. 6 a space exists between many application nozzle holes 11P and many air jetting holes (pressurized air holes) 12P. This prior invention covers the apparatus for applying hot-melt adhesives by which hot-melt adhesives are applied by spraying after being made in curtain-shape by effect of pressurized air.

Therefore, since hot-melt adhesives are applied in the state of fiber-shaped adhesive heat to the application surface, even if pressure of pressurized air from the air jetting hole (pressurized air hole) is raised, springing back of adhesives will not occur because adhesives reach the application surface in the condition of fiber-shaped adhesives beat. However, if general application agents, instead of hot-melt adhesives, are used in the prior invention they are applied in atomized state instead of fiber-like state.

Therefore, if pressure of pressurized air from the air jetting hole (pressurized air hole) is raised, landing pressure at which application agent in atomized condition reaches the application surface is large and consequently springing back of application agent is involved.

In view of the above, it is an object of the present invention that in spray application of general application agents in atomized state, the application width can be enlarged arbitrarily and pressure of pressurized air is kept low.

Object of the present invention:

The first invention provides the method of applying curtain-shaped spray which is characterized in that for atomizing application agents by making pressurized air from the air jetting hole act on application agent beat from the application nozzle holes arranged in the direction of crossing the conveying direction of application line, pressurized air is jetted from the air jetting holes which are formed in the direction crossing the conveying direction the application line A and in the shape of groove so that it is formed into curtain-like pressurized

air flow which acts on application agent beat from the application nozzle hole group.

The second invention provides an application nozzle device characterized in that in the curtain-like spray application apparatus wherein an application nozzle hole group comprising many application nozzle holes arranged in the direction crossing the conveying direction of application line is formed and spray application is made into curtain-like shape by making pressurized air from the air jetting hole act on application agent beat from the application nozzle hole group, the air jetting hole is made in groove-shape so that its bottom opening is a slit of small width, pressurized air flow from the air jetting hole is made into curtain-like pressurized air flow in the direction crossing the conveying direction of application line A, and the bottom opening of the application nozzle hole group at the nozzle unit of the application nozzle device is arranged adjacent to the bottom opening of the air jetting hole.

The third invention provides an application nozzle device in the curtain-like spray application apparatus as mentioned in the invention, wherein the bottom opening of the air jetting hole is extended toward the outside of the extreme bottom opening of the application nozzle hole group in the direction of application width so that both ends of the bottom openings of the air jetting holes are located a little sideways (outwardly) from the extreme side ends of the bottom openings of the application nozzle hole group.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a vertical section, showing an outline of the application nozzle device of the present invention.

Fig. 2 is a cross section of the nozzle unit.

Fig. 3 is a bottom view of the nozzle unit.

Fig. 4 is a perspective view of the shim plate having comb-like grooves g for forming the application nozzle hole group.

Fig. 5 is a vertical section of the main part of the nozzle unit of the invention of the prior application.

Fig. 6 is an explanation drawing, explaining the application action by the nozzle unit in Fig. 5.

Fig. 7 is an explanation drawing of the general spray application.

Fig. 8 is an explanation drawing of the application surface at the time application width is enlarged in the known hot-melt adhesives melt blow spray application.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

A description is made below about the present invention on the basis of embodiments shown in the drawings.

The adhesives applying nozzle apparatus B is arranged opposite to the upper surface of a material for application W being conveyed in the conveying direction P by an application line A. The adhesives applying nozzle apparatus B is composed of a nozzle unit 1 arranged above the application line A, with an application nozzle hole group 11 located in the direction crossing the direction P of conveying the material for application W (in the embodiment, the direction crossing the direction P), and an application agent (adhesive agent, paint, brightener, etc.) supply controlling valve 2 which is integral with the nozzle unit 1. The nozzle unit 1 has an application nozzle hole group 11, comprising many application nozzle holes 11a, and an air jetting hole 12.

In the embodiment, two air jetting holes 12F and 12R are arranged on both sides of the application nozzle hole group 11. Both of the air jetting hole12F and air jetting hole 12R are connected to a pressurized air source 4 through the medium of a pressurized air hole 13. A single air jetting hole 12, instead of two air jetting holes 12F and 12R, may be arranged on either one side of the application nozzle hole group 11. Heaters 9 are provided inside the nozzle unit 1 and inside the application agent supply controlling valve 2 for keeping application agent being supplied within the limits of specified temperatures. In the case where application agent is hot-melt adhesive agent, it is required to heat the nozzle unit 1 by the heater to keep hot-melt adhesives passing through the application nozzle hole 11 within the limits of specified temperatures but a heater may be omitted in the case of general application agents (adhesives, paints, brighteners, etc.) for which heating is not required.

Referring to Fig. 5, the application nozzle hole group 11 is arranged in a line in the direction crossing at right angles the direction P of conveying the material for application W and the air jetting holes 12F and 12R are arranged in front and in rear of the application nozzle hole group 11. The air jetting hole 12 is made in groove-shape and its bottom opening (m) is a slit of small width (refer to Fig. 3). A bottom opening (n) of the application nozzle group 11 and the bottom opening (m) of the air jetting hole at the bottom surface of the nozzle unit 1 are adjacent to each other (refer to Fig. 3), whereas in the prior invention space exists between the bottom opening (n) of the application nozzle hole group 11 and the bottom opening (m) of the air jetting hole 12.

An explanation is made below about the formation of the application nozzle holes group 11 and the air jetting hole 12.

The application nozzle hole group 11 can be formed by making many small holes but in the embodiment, as shown in Fig. 4 it is formed by a shim plate 10 having comb-like grooves g. In Fig. 1, the shim plate 10 is interposed between the first block 1F and the second block 1R and in Fig. 2, it is interposed between a pair of application nozzle blocks 10F and 10R.

In the embodiment shown in Fig. 1, the air jetting holes 12F and 12R are formed by making grooves of flat plate-shape in the first block 1F and the second block 1R but in Fig. 2, these holes are formed by making space

between the inner lower part of the first block 1F and the outer lower part of the application nozzle block 10F and by making space between the inner lower part of the second block 1R and the outer lower part of the application nozzle block 10R.

In the embodiment shown in Fig. 1 and Fig. 2, an application nozzle hole 11a is formed by space g made between comb-like pieces 10A of the shim plate 10. By making the space g square in shape (viewed in section of the shim plate 10), the bottom opening (n) of the application nozzle hole group 11 at the bottom surface of the nozzle block 1 is made square in shape. Consequently, as shown in Fig. 3, the bottom opening (n) of the application nozzle hole group 11 and the bottom opening (m) of the air jetting hole 12 are adjacent to each other, in linear contact with two sides of the first block 1F and the second block 1R. Numeral 13a (in Fig. 2) denotes a horizontal hole which connects the air jetting hole 12 to the pressurized air hole 13.

Referring to Fig.3, in embodying the third invention of the present application the bottom opening (m) of the air jetting hole is extended to the outside of the bottom opening (n) of the application nozzle hole group in the direction of application width so that both end portions of the bottom opening(m) of the air jetting hole are slightly protruding from the extreme side ends of the bottom opening (n) of the application nozzle hole group.

Referring to Fig. 1, while the material for application W is placed on the application line and is conveyed in the direction P, application agent beat H is sprayed onto the material W being conveyed so as to apply application agent beat H to the desired portion of the material W. This is done also by the known application apparatus.

The adhesives supply controlling valve 2 is provided with a valve housing 20 having an application agent inlet 21, a supply hole 22 and a return hole 23. A valve chest 24 is arranged in the valve housing 20 and by operating a vertically movable valve body 25 (in the valve chest 24) up and down by means of a valve body operating mechanism 26 which is worked by operation air or by an electromagnetic valve, supply and non-supply of application agent to the nozzle unit 1 and return of application agent to the application adhesive supply source 3 through the return hole 23 at stoppage of application are effected and thus circulation of hot-melt adhesive agent at stoppage of application is effected and degradation of application agent due to stagnating is prevented.

The supply hole 22 and the application nozzle hole group 11 are connected to each other through the medium of a supply hole 7 in vertical direction, a lateral hole 7a at a lower end of the supply hole 7, a rotary mask valve 5 and a lateral hole 8. The rotary mask valve 5 has a through hole 6a and an application mask surface 6 and by selecting the speed of revolution of the rotary mask valve 5 and the shape of the application mask surface 6, the application nozzle hole group 11 to which application agent is supplied can be arranged in the selective state for the selective range of application to the material W.

In Fig. 2, numeral 19 denotes a belt for uniting the first block IF, the application nozzle block 10f, the application nozzle block 10R and, the second block 1R in a body. Numerals 27, 28 and 29 denote a bolt, a fitting plate and an 0-ring respectively.

Instead of setting the application range by the application mask surface 6 of the rotary mask valve 5 in the embodiment shown in Fig. 1, in the embodiment shown in Fig. 2 the application range in the direction of width of material W is changeable by replacement with a shim plate having different position of existence of the comb-like grooves g.

The application range in the direction of width of the material W can also be changed as desired by selecting the mask window of the mask plate disclosed in the prior invention (Patent Application No 63308/1992 "Hot-melt adhesives application apparatus").

An upper end of the air jetting hole 12 opens to the pressurized air hole 13 in lateral direction and is connected to the pressurized air source 4 through the medium of the pressurized air hole 13. Thus, application agent H is supplied selectively to the application nozzle hole group 11 and pressurized air is jetted from the pressurized air hole 13.

In the invention of the present application, by making the air jetting hole 12 in groove-shape and by making the bottom opening of the air jetting hole 12 in slit-shape of small width, flow of pressurized air from the air jetting hole 12 is made in curtain-shape in the direction crossing the conveying direction of the application line A and thus curtain-shaped pressurized air flow K is formed.

The application agent beat H jetted from each application nozzle hole 11a of the application nozzle hole group 11 is atomized by effect of pressurized air from the air jetting hole 13 and falls onto the application surface of the material W as it is spreading in conical shape (spray application) but since curtain-like pressurized air flows K are formed as they are sandwiching the application agent beat H therebetween, spreading of the application agent beat H toward the front and rear of conveyance is prevented. Consequently, spray application range of the application agent beat H is made in waterfall-like shape or curtain-like shape in the direction crossing at right angles the material W and thus nearly uniform application width is obtained in the direction crossing at right angles the material W.

Since the air jetting hole 12 and the application nozzle hole group 11 are adjacent to each other, pressurized air from the air jetting hole 12 acts effectively on the adhesive agent beat H from the application nozzle hole group 11 and therefore pressure of pressurized air to be supplied to the air jetting hole 12 can be set lower than in the case of the prior invention.

The air jetting hole 12 is disposed in front of and in rear of the application nozzle hole group 11 but it may

be disposed only at one side of the application nozzle hole group 11 for the same purpose.

In the embodiment, section of the application nozzle hole 11a is made in square-shape with each side of 1mm and space between the pressurized air holes 12 is made 1mm.

In the case where a larger application width is desired, the application width can be changed as desired by arranging nozzle units 1 in a file, in the direction crossing at right angles the conveying direction of the material W.

In the third invention of the present application, referring to Fig. 3 the bottom opening (m) of the air jetting hole slightly protrudes from the extreme side ends of the bottom opening (n) of the application nozzle hole group 11. Therefore, pressurized air flow K exists sidewise in application width direction from the side end, in application width direction, of curtain-shape application agent beat H jetted from the application nozzle hole group 11 and consequently the application agent beat H at side end in application width direction flows down in perpendicular direction by guidance of adjacent flow of pressurized air K which flows down perpendicularly and sideways dispersion of application agent beat H in application width direction is prevented.

Effect of the invention:

According to the invention of the present application, by making the air jetting hole 12 in groove-shape and by making the bottom opening of the air jetting hole 12 in slit-shape of small width, flow of pressurized air from the air jetting hole 12 is formed in curtain-like shape in the direction crossing the conveying direction of the application line and the flow of pressurized air of curtain-shape K is made to act on the application agent beat H jetted from each application nozzle hole 11a of the application nozzle hole group 11. Therefore, the application agent beat H which falls on the application surface of the material W as it is atomized and spreading conically is prevented from expanding in the conveying direction of the material W by curtain-like pressurized air flows K formed adjacent thereto. Thus, uniform application width is obtained in the direction crossing at right angles the material W. Consequently, spray application range of the application agent beat H is formed in waterfall-like shape or curtain-like shape in the direction crossing at right angles the material W. Thus, uniform application width is obtained in the direction crossing at right angles the material W.

Since the air jetting hole 12 and the application nozzle hole group 11 are adjacent to each other, pressurized air from the air jetting hole 12 act effectively on the application agent beat H from the application nozzle hole group 11 and accordingly pressure of pressurized air to be supplied to the air jetting hole 12 can be set lower than in the case of the prior invention, namely, pressure of the application-agent which reached the application surface of the material W is lower and accordingly dispersion of the application agent due to springing back of application agent on the application surface of the material W is almost reduced to zero. This ensures economical application work and maintains good working environment.

The bottom opening (m) of the air jetting hole 12 and the bottom opening (n) of the application nozzle hole 11a are connected adjacently to each other, but entry of the application agent by capillary phenomenon into the air jetting hole 12 at the time of stoppage of supply of pressurized air from the air jetting hole 12 can be prevented by making the air jetting hole 12 in groove-shape (instead of small holes group in the case of the prior invention). Thus, entry of application agent into the air jetting hole 12 at the time of stoppage of supply of pressurized air (at the time of stoppage of application operation) is prevented and maintenance work is made easier

In the third invention of the present application, the bottom opening of the air jetting hole is extended toward the outer side of the bottom opening of the application nozzle hole group and in the direction of application width, namely, the bottom opening of the air jetting hole exists sideways from the extreme side end of the bottom opening of the application nozzle hole group and the flow of pressurized air K exists sideways in application width direction from the side end in application width direction of curtain-like application agent beat H. Consequently, application agent beat H at side end in application width direction flows down in perpendicular direction by guidance of pressurized air flow K and dispersing of it sideways in application width direction is prevented.

Plural application nozzle devices are arranged in lengthwise direction or in zigzag fashion for arbitrary selection of application width. Under this arrangement, if application agent beat H disperses sideways in application width direction, application width at side end of each application nozzle device will become larger but the third invention of the present application solves this problem and application surface of uniform application thickness can be obtained even if plural application nozzle devices are arranged in continuance.

Claims

1. A curtain-shaped spray application method characterized in that for atomizing application agents by making pressurized air from an air jetting hole act on application agents beat from an application nozzle hole group which is formed by arranging many application nozzle holes in the direction crossing the conveying direction of an application line, pressurized air is jetted from an air jetting hole formed in groove-shape and in the direction crossing the conveying direction of the application line and the pressurized air which acts on the application agents beat from the application nozzle hole group is made

into curtain-shaped pressurized air flow for acting on the application agents beat from the application nozzle hole group when it jets from the bottom surface of a nozzle unit.

2. An application nozzle device characterized in that in a curtain-shaped spray application apparatus which is provided with an application nozzle hole group comprising many application nozzle holes arranged in the direction crossing the conveying direction of an application line and which forms a curtain-shaped spray application by making pressurized air from an air jetting hole act on application agents beat from the application nozzle hole group, the air jetting, hole is made in groove-shape, the bottom opening of said air jetting hole is made in a slit of small width, flow of pressurized air from the air jetting hole is made into curtain-shaped pressurized air flow in the direction crossing the conveying direction of the application line, and the bottom opening of the application nozzle hole group and the bottom surface of the air jetting hole, at the bottom surface of a nozzle unit of the application nozzle device, are arranged adjacent to each other.

3. The application nozzle device as defined in Claim 2, wherein the bottom opening of the application nozzle hole group at the bottom surface of the nozzle unit of the application nozzle device is made in square-shape, the application nozzle hole group is formed by interposing a shim plate having comb-like grooves between a pair of application nozzle units and the bottom opening of the application nozzle hole group is made adjacent, in linear contact state, to the bottom opening of the air jetting hole.

4. The application nozzle device as defined in Claim 2, wherein air jetting holes are formed in front of and in rear of the application nozzle hole group in relation to the conveying direction of the application line, and the bottom opening of each application nozzle hole group is made adjacent to the bottom opening of the air jetting hole on the frontward side of the conveying direction and the bottom opening of the air jetting hole on the rearward side of the conveying direction.

5. An application nozzle device in the curtain-shaped spray application apparatus characterized in that in the curtain-shaped spray application apparatus which effects curtain-shaped spray application by forming an application nozzle hole group having many application nozzle holes arranged in the direction crossing the conveying direction of an application line and by making pressurized air from an air jetting hole act on application agents beat from the application nozzle hole group, the air jetting hole is made in groove-shape and the bottom opening of the air jetting hole is made in slit of small width, flow of pressurized air from the air jetting hole is made into curtain-shaped flow of pressurized air in the direction crossing the conveying direction of an application line, the bottom opening of the application nozzle hole group and the bottom opening of the air jetting hole at the nozzle unit of the application nozzle device are made adjacent to each other, and the bottom opening of the air jetting hole is extended toward the outside of the bottom opening of the application nozzle hole group so that both ends of the bottom opening of the air jetting hole are located slightly sideways from extreme side ends of the bottom opening of the application nozzle hole group.

Fig. 1

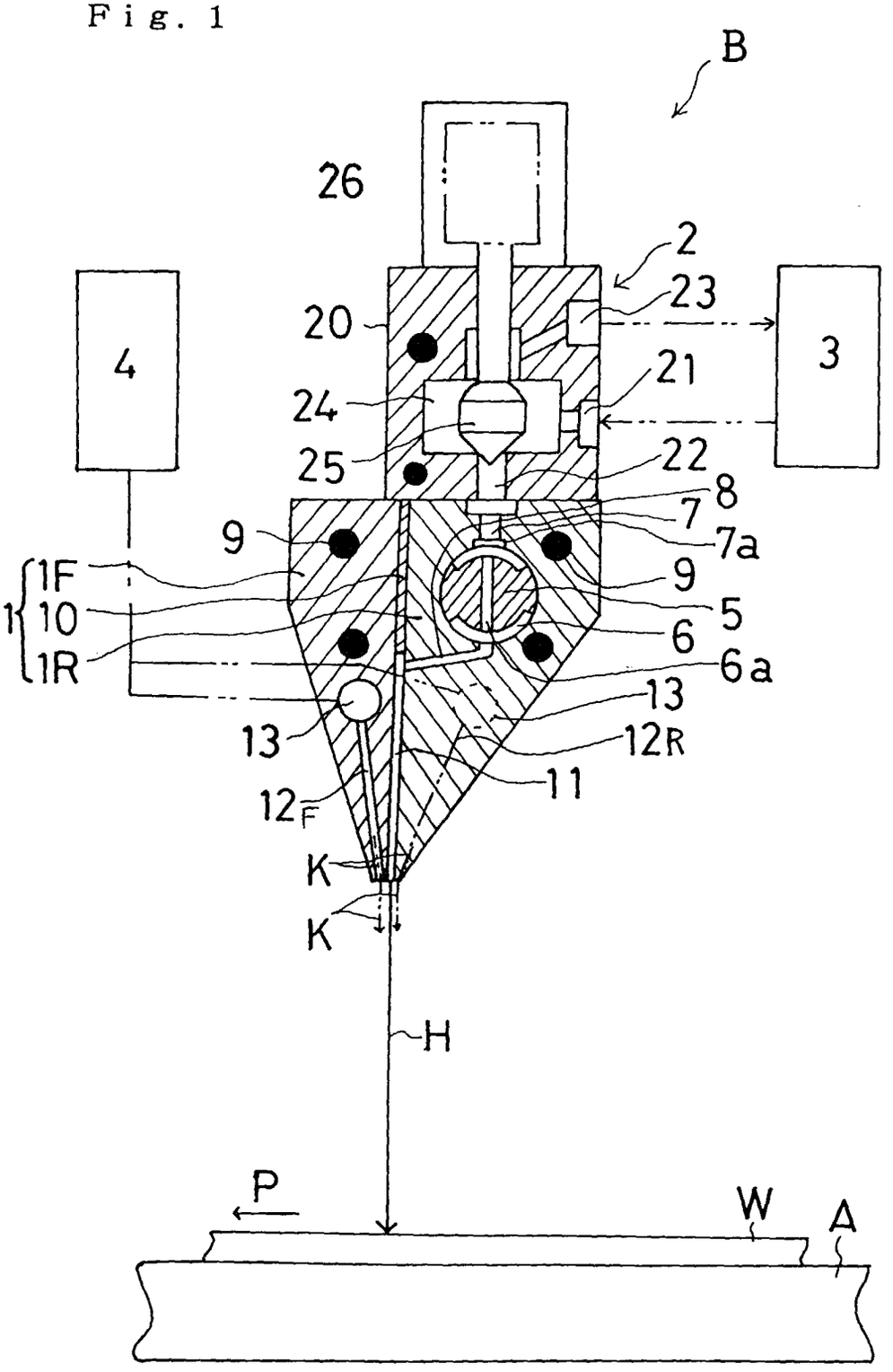
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Fig. 2

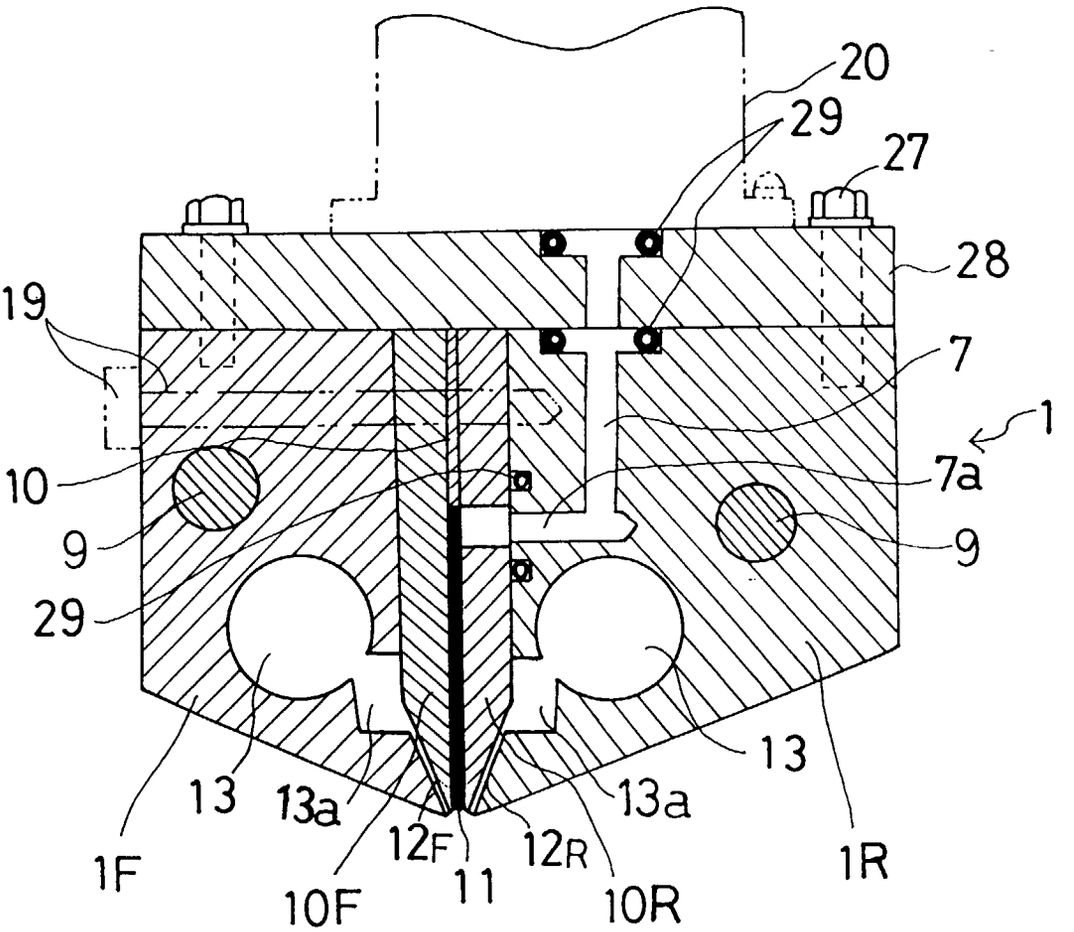

Fig. 3

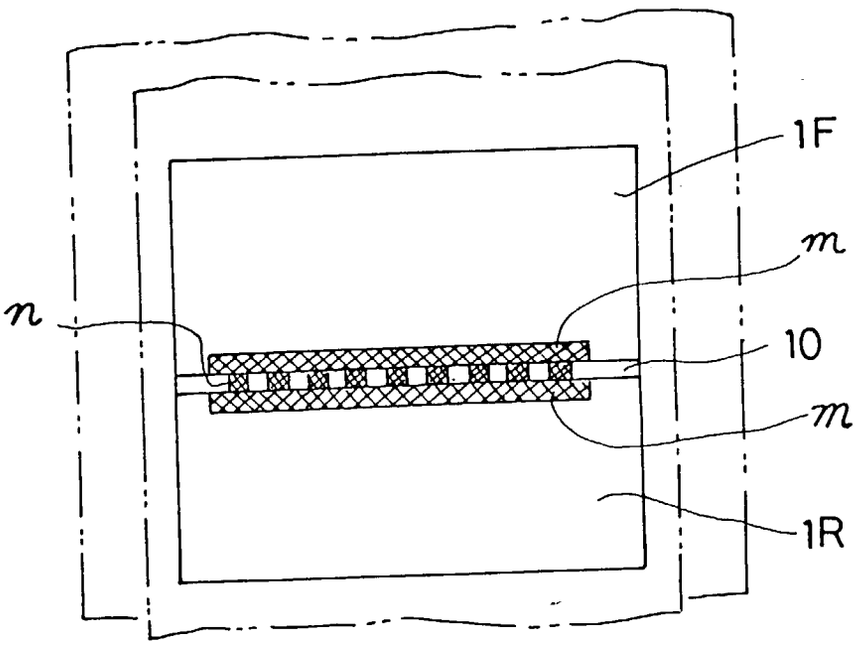

Fig. 4

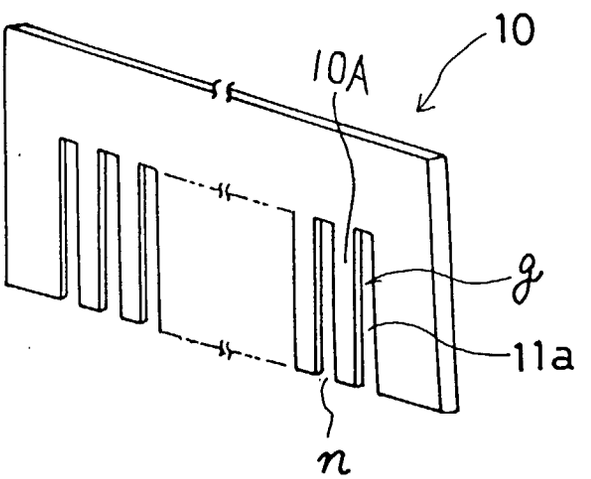

Fig. 5

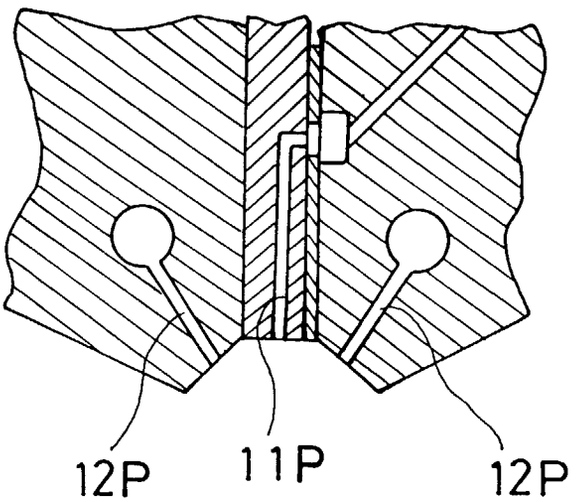

Fig. 6

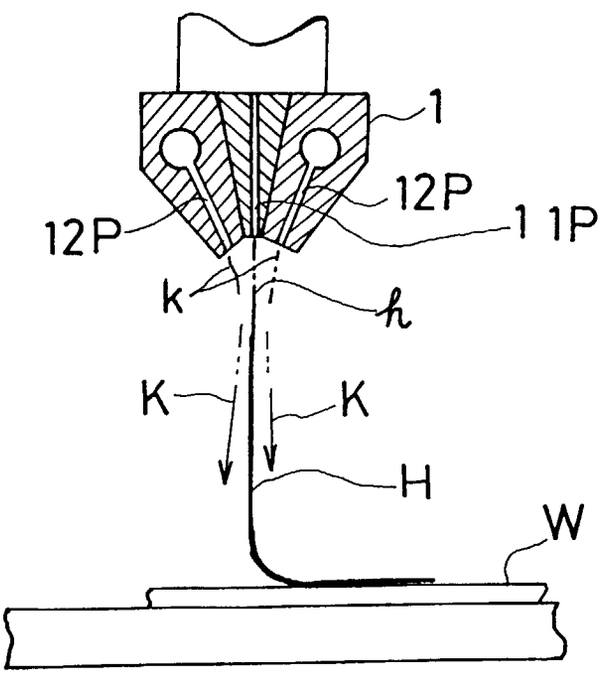

Fig. 7

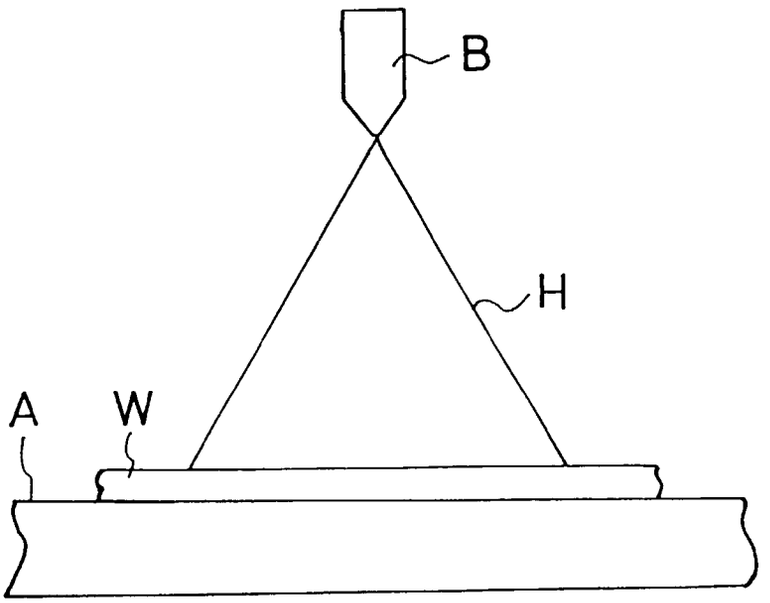

Fig. 8