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(54) **Pneumatic spinning device and spinning machine**

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention mainly relates to a pneumatic spinning device. More particularly, the present invention relates to a shape of a space in which whirling airflow is generated in the pneumatic spinning device.

2. Description of the Related Art

[0002] Conventionally, there is known a spinning machine provided with a pneumatic spinning device which applies twists to fibers by utilizing whirling airflow to generate a spun yarn.

[0003] The above spinning machine is disclosed, for example, in Japanese Unexamined Patent Publication No. 2003-193337. A spinning section provided in the spinning device disclosed in this prior art is provided with a nozzle block in which an air injection hole is formed.

[0004] FIG. 7 illustrates a schematic cross-sectional view of a structure near the nozzle block described in this prior art. As illustrated in FIG. 7, a plurality of air injection holes 105 and a passage hole 101 are formed in a nozzle block 100 disclosed in this prior art. The passage hole 101 includes a columnar space section 102, a first circular truncated cone shaped space section 103 connected to the columnar space section 102, and a second circular truncated cone shaped space section 104 connected to the first circular truncated cone shaped space section 103. The columnar space section 102 is a space in which negative pressure is generated to generate suction flow in a fiber guide hole 106 to suck fibers. In the following description, the columnar space section 102 is referred to as a suction decompression chamber. Since the second circular truncated cone shaped space portion 104 is a space for whirling reversal fibers, it is referred to as a whirling chamber in the following description.

[0005] The above prior art document describes that a suction airflow can be generated near a fiber guide hole of a needle holder by an effect of air injected from an air injection hole, and a fiber bundle can be sucked into the fiber guide hole. If the suction airflow flows smoothly, the fiber bundle can be smoothly sucked. The flow of the suction airflow is conceptually illustrated in FIG. 7 by thick arrows.

[0006] If the whirling airflow generated in the whirling chamber 104 in FIG. 7 flows into the suction decompression chamber 102, there is a problem that the flow of the suction airflow is obstructed, and the fiber bundle cannot be sucked by the fiber guide hole 106. In this regard, in the structure described in the above prior art document, as illustrated in FIG. 7, a diameter of the whirling chamber 104 is formed larger than a diameter of the suction decompression chamber 102, and a step is formed between the suction decompression chamber 102 and the whirling chamber 104. Since this step section serves as a throttling section, the whirling airflow in the whirling chamber 104 is unlikely to flow into the suction decompression chamber 102. Accordingly, since the flow of the suction airflow is not obstructed, it is considered that the fiber bundle can be sucked into the fiber guide hole 106.

[0007] On the other hand, when the step is provided between the suction decompression chamber 102 and the whirling chamber 104 such as the structure described in the above prior art document, the whirling chamber 104 has an angular section (an angle section 107 in FIG. 7) at the suction decompression chamber 102 side (the fiber guide hole 106 side). The present inventor has found out that in the structure described in the above prior art document (refer to FIG. 7), the flow of the suction airflow whirls in the angle section 107, and a behavior of fibers that are whirled in the whirling chamber 104 may be disordered. If the behavior of the fibers is disordered as described above, the winding fiber (the reversal fiber) may be irregularly wound around a core fiber, or free ends (rear end sections mentioned in the above prior art document) of the winding fiber may be entangled with each other. As a result, quality of the produced yarn becomes unstable.

[0008] On the other hand, recently, there is a demand for improvement in spinning speed, and in order to respond to this demand, there has been a problem that a whirling speed of the fiber in the whirling chamber 104 should be improved. A general spinning speed of the conventional pneumatic spinning device is from about 250 m/min to 400 m/min. As means for solving the above problem, consideration can be made to increase the whirling speed of the fiber by making the diameter of the whirling chamber 104 small and making a radius of whirling of the whirling airflow small.

[0009] However, by making the diameter of the whirling chamber 104 smaller, a region (near the angle section 107) in which the turbulence of the suction airflow is generated comes close to a region (around the spindle 108) in which the winding fiber whirls, and an influence which the turbulence of the suction airflow applies to the whirling fiber is further increased. Accordingly, in the structure in FIG. 7, since the diameter of the whirling chamber could not be made small while maintaining the yarn quality, the above-mentioned problem as to improve the whirling speed of the whirling airflow could not be solved. In other words, in the conventional pneumatic spinning device, the spinning speed could be improved.

[0010] As a countermeasure for preventing the turbulence of the suction airflow from affecting the whirling of the winding fiber, consideration can be made to form the whirling chamber 104 sufficiently large in a diametrical direction. With such a structure, since the region (near the angle section 107) in which the turbulence of the suction airflow is generated can be kept away from the region (around the spindle 108) in which the winding fiber whirls, the influence which the turbulence of the suction airflow applies to the whirling of the winding fiber can be made

small.

[0011] However, if the diameter of the whirling chamber 104 is made large, the radius of whirling of the whirling airflow becomes larger. As a result, the whirling speed of the winding fiber becomes slow, and the spinning speed cannot be improved. Taking an installation space of the pneumatic spinning device into consideration, it is difficult to form the whirling chamber 104 having a sufficient size to an extent that the turbulence of the suction airflow can be excluded. If the diameter of the whirling chamber 104 is made too large, an amount of the air supplied to the whirling chamber 104 needs to be increased for maintaining the whirling flow in the whirling chamber 104, and energy efficiency declines.

[0012] WO 03/014443 A1 and EP 1 284 312 A2 disclose devices for producing a spun yarn, in which whirling chambers have inner side walls formed in a convex shape.

[0013] DE 42 02 963 A1 discloses a spinning device, in which a whirling chamber comprises an inner side wall having a concave shape, wherein a fiber supply channel is provided laterally with respect to an opening of a housing, into which a member through which a fiber outlet is formed is inserted.

SUMMARY OF THE INVENTION

[0014] An object of the present invention is to provide a pneumatic spinning machine which can prevent a turbulence of an airflow in a whirling chamber, and can produce yarn having stable quality.

[0015] This object is achieved by a pneumatic spinning device according to claim 1.

[0016] According to a first aspect of the present invention, there is provided a pneumatic spinning device for producing spun yarn by whirling fibers of a fiber bundle by a whirling airflow, wherein the pneumatic spinning device includes a nozzle block, a fiber guide section and a spindle. The nozzle block is arranged to form a whirling fiber. At least one air injection nozzle is formed in the nozzle block. The air injection nozzle injects compressed air from a nozzle opening opening into the whirling chamber to generate the whirling airflow in the whirling chamber. The fiber guide section includes a fiber guide hole connected to the whirling chamber. The spindle is inserted into a passage hole formed in the nozzle block from a side of the passage hole opposite to the fiber guide section. A fiber passage is formed in the spindle to pass through the fiber that has been whirled in the whirling chamber. In a cross-section cut through a plane passing through an axial line of the spindle, at least a portion of a cross-sectional contour of an inner wall surface of the nozzle block forming the whirling chamber located near the fiber guide section is formed in a concave curve.

[0017] Accordingly, since the whirling chamber can be formed such that an angular section does not exist in the wall surface located near the fiber guide section, turbulence of the airflow can be prevented from being generated in the whirling chamber, and the airflow can smoothly flow. As a result, since the winding fiber can be prevented from irregularly winding around the core fiber, and free ends of the winding fiber can be prevented from entangling with one another, quality of the produced yarn can be stabilized. Since the turbulence of the airflow can be prevented as described above, adverse effect on the behavior of the winding fiber is small even if the diameter of the whirling chamber is made small. Therefore, according to the above structure, a whirling speed of the fiber can be improved by making the whirling chamber small, and high-speed spinning can be achieved while maintaining the yarn quality.

[0018] In the above pneumatic spinning device, among the inner wall surface of the nozzle block forming the whirling chamber, the portion of which the cross-sectional contour is the curve is formed as an arc. Therefore, the turbulence of the whirling airflow can be satisfactorily suppressed in the whirling chamber of the pneumatic spinning device.

[0019] In the above pneumatic spinning device, at least a portion of an opening contour of the nozzle opening is preferably formed on the circular cross-sectional contour portion among the inner wall surface of the nozzle block forming the whirling chamber. By forming at least a portion of the nozzle opening on the wall surface having a curved cross-sectional contour, an oval peripheral length of the opening contour of the nozzle can be made long. Accordingly, the compressed air can be injected from the nozzle opening so as to spread into the whirling chamber, and the whirling airflow can be applied to the fiber in a wider range. As a result, the fiber can be efficiently whirled within the whirling chamber by a strong force.

[0020] In the above pneumatic spinning device, the entire opening contour of the nozzle opening is preferably formed on the curved cross-sectional contour portion among the inner wall surface of the nozzle block forming the whirling chamber. In other words, when the wall surface of the whirling chamber is angular as in the conventional pneumatic spinning device, if the nozzle opening is formed over the angular section, a slight displacement of the forming position greatly changes the shape of the nozzle opening, thereby changing the airflow as well. Therefore, when the nozzle opening is formed on the angular wall surface, the quality of the produced yarn tends to be affected by machining precision. However, when the entire nozzle opening is formed on the wall surface having the curved cross-sectional contour, as described above, an outlet shape of the injection nozzle is not changed so much even if the position where the nozzle opening is formed is shifted to some extent. In other words, with the above structure, the quality of the produced yarn can be maintained regardless of the machining precision.

[0021] The above pneumatic spinning device further includes a depressurized suction chamber section in which a depressurized suction chamber is formed. The depressurized suction chamber and the whirling cham-

ber are substantially columnar or substantially cylindrical. A radius of the depressurized suction chamber is smaller than a radius of the whirling chamber. A difference between the radius of the whirling chamber and the radius of the depressurized suction chamber is at most diameter of the air injection nozzle.

[0022] In other words, in the conventional pneumatic spinning device, since the air turbulence is generated in the whirling chamber, the compressed air injected from the nozzle opening inflates in the whirling chamber, and the compressed air tends to flow from the whirling chamber to the depressurized suction chamber. In order to prevent this, in the conventional pneumatic spinning device, the difference between the radius of the whirling chamber and the radius of the depressurized suction chamber was required to be made large to some extent, and as a result, the size of the pneumatic spinning device was enlarged. However, according to the structure of the present invention, since the air smoothly flows in the whirling chamber, the compressed air injected from the nozzle opening is hardly inflated in the whirling chamber. As a result, the compressed air is less likely to flow towards the depressurized suction chamber. Accordingly, the difference between the radius of the whirling chamber and the radius of the depressurized suction chamber is not required to be made large to some extent as in the conventional pneumatic spinning device. For example, as described above, the difference between the radius of the whirling chamber and the radius of the depressurized suction chamber can be made at most the diameter of the air injection nozzle. Since the whirling chamber can be made small as described above, the pneumatic spinning device can be downsized.

[0023] According to a second aspect of the present invention, there is provided a spinning machine including the above pneumatic spinning device, and a winding device adapted to wind spun yarn produced by the pneumatic spinning device into a package. Accordingly, the package can be formed at high speed with stable quality.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

FIG. 1 is a front view illustrating an entire structure of a spinning machine according to an embodiment of the present invention;

FIG. 2 is a cross-sectional view of the spinning machine;

FIG. 3 is a schematic cross-sectional view of a pneumatic spinning device;

FIG. 4 is a cross-sectional view of a nozzle block;

FIG. 5 is a cross-sectional view illustrating a state during spinning;

FIG. 6 is a schematic cross-sectional view of a pneumatic spinning device according to another embodiment; and

FIG. 7 is a cross-sectional view illustrating a structure of a conventional pneumatic spinning device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0025] Next, a first embodiment will be described with reference to the accompanying drawings. A spinning machine 1 illustrated in FIG. 1 includes a plurality of spinning units 2 which are arranged in line. The spinning machine 1 includes a yarn splicing cart 3, a blower box 4 and a motor box 5. The yarn splicing cart 3 can travel in a direction in which the spinning units 2 are arranged.

[0026] As illustrated in FIG. 1, each of the spinning units 2 mainly includes a draft device 7, a pneumatic spinning device 9, a yarn feeding device 11 and a winding device 12. The draft device 7 is provided in an upper portion of a frame 6 of the spinning machine 1. The pneumatic spinning device 9 spins a fiber bundle 8 fed from the draft device 7 to produce spun yarn 10. The spun yarn 10 fed from the pneumatic spinning device 9 is fed by the yarn feeding device 11, and is thereafter wound by a winding device 12 to form a package 45. In FIG. 1, the winding device 12 is illustrated so as to form a cheese winding package, but may be structured so as to form a cone winding package. In the following description, "upstream" or "downstream" respectively means upstream or downstream in a feeding direction of the fiber bundle 8 (or the spun yarn 10).

[0027] The draft device 7 drafts a sliver 13 to form the fiber bundle 8. As illustrated in FIG. 2, the draft device 7 includes four rollers, which are a back roller 14, a third roller 15, a middle roller 17 provided with an apron belt 16, and a front roller 18.

[0028] A draft motor 31 made of an electric motor is installed at an appropriate position in the frame 6. The back roller 14 and the third roller 15 are connected to the draft motor 31 via a belt. Driving and stopping operations of the draft motor 31 are controlled by a unit controller provided in the spinning unit 2. In the spinning machine 1 according to the present embodiment, electric motors for driving the middle roller 17 and the front roller 18 are also provided in the frame 6, however, an illustration thereof will be omitted.

[0029] The pneumatic spinning device 9 is structured by two divided blocks, that is, a first block 91 and a second block 92. The second block 92 is provided downstream of the first block 91.

[0030] The yarn feeding device 11 includes a delivery roller 39 which is supported by the frame 6 of the spinning machine 1, and a nip roller 40 which is arranged so as to make contact with the delivery roller 39. With this structure, the spun yarn 10 fed from the pneumatic spinning device 9 can be fed to the winding device 12 by nipping the spun yarn 10 between the delivery roller 39 and the nip roller 40 and rotating the delivery roller 39 by an electric motor (not illustrated).

[0031] The yarn splicing cart 3 includes a splicer (a yarn splicing device) 43, a suction pipe 44 and a suction

mouth 46, as illustrated in FIGS. 1 and 2. As illustrated in FIG. 1, the yarn splicing cart 3 is provided so as to travel on a rail 41 provided on the frame 6 of the spinning machine 1 main body. If a yarn cut or a yarn breakage is generated in a certain spinning unit 2, the yarn splicing cart 3 travels to the spinning unit 2 and stops. The suction pipe 44 sucks and catches a yarn end fed out from the pneumatic spinning device 9 and guides the yarn end to the splicer 43 while rotating in a vertical direction around an axis. The suction mouth 46 sucks and catches a yarn end from the package 45 rotatably supported by the winding device 12 and guides the yarn end to the splicer 43 while rotating in a vertical direction around an axis. The splicer 43 carries out yarn splicing of the guided yarn ends.

[0032] Next, a description will be made in detail on a structure of the pneumatic spinning device 9 with reference to FIG. 3. As illustrated in FIG. 3, the first block 91 includes a nozzle section casing 53, and a nozzle block 34 and a fiber guide section 23 that are held by the nozzle section casing 53. The second block 92 includes a hollow guide shaft (a spindle) 20, and a shaft holding member 59.

[0033] A fiber guide hole 21 is formed in the fiber guide section 23. The fiber bundle 8 drafted by the draft device 7 is introduced to the fiber guide hole 21. The fiber guide section 23 holds a needle 22 which is arranged on a flow path of the fiber bundle 8 introduced from the fiber guide hole 21.

[0034] The nozzle block (a depressurized suction chamber section, a whirling chamber section) 34 is located downstream of the fiber guide section 23. FIG. 4 illustrates a detailed cross-sectional view of the nozzle block 34. FIG. 4 is a cross-sectional view of the nozzle block 34 which is cut along the same plane as FIG. 3 (a plane passing through an axial line of the hollow guide shaft 20). As illustrated in FIG. 4, a passage hole 70 is formed in the nozzle block 34. The passage hole 70 is formed such that a cross-sectional shape cut through a plane orthogonal to a center axial line 90 of the hollow guide shaft 20 (a plane which is orthogonal to a fiber feeding direction) is circular.

[0035] As illustrated in FIG. 3, the hollow guide shaft 20 includes a columnar body 56 which is held by the shaft holding member 59. A tapered leading end section 24 is formed in one end of the columnar body 56. A fiber passage 29 is formed in an axial section of the columnar body 56. A downstream end portion of the fiber passage 29 forms an outlet hole (not illustrated). The fiber bundle 8 or the spun yarn 10 that passed through the fiber passage 29 is fed out from the outlet hole towards an outside of the pneumatic spinning device 9 by the yarn feeding device 11 located downstream of the pneumatic spinning device 9.

[0036] The leading end section 24 of the hollow guide shaft 20 is inserted into the passage hole 70 formed in the nozzle block 34 from a side of the passage hole 70 located opposite to the fiber guide section 23 seen from the nozzle block 34, while bringing an axial line of the leading end section 24 in line with an inner portion of the passage hole 70. A predetermined interval is set between an outer peripheral surface of the leading end section 24 of the hollow guide shaft 20 and an inner wall surface of the nozzle block 34 (a wall surface of the passage hole 70) such that the airflow can pass therethrough.

[0037] A depressurized suction chamber 71, a whirling chamber 72 and a taper chamber 73 are formed in the nozzle block 34 in this order from upstream in the traveling direction of the fiber bundle 8. More precisely, the depressurized suction chamber 71 having a substantially columnar shape, the whirling chamber 72 having a substantially cylindrical shape and the taper chamber 73 having a substantially taper tubular shape are formed by an outer peripheral surface of the leading end section 24 of the hollow guide shaft 20 and an inner wall surface of the nozzle block 34 (a wall surface of the passage hole 70). In this case, the decompressed suction chamber 71 is formed substantially columnar, however, as illustrated in FIG. 3, the leading end section 24 of the hollow guide shaft 20 is actually slightly inserted into the depressurized suction chamber 71 from downstream side of the depressurized suction chamber 71.

[0038] As illustrated in FIG. 3, the depressurized suction chamber 71 and the fiber guide hole 21 of the fiber guide section 23 are connected to each other. The whirling chamber 72 and the depressurized suction chamber 71 are connected to each other. Therefore, it can be said that the whirling chamber 72 is connected to the fiber guide hole 21 via the decompressed suction chamber 71. The taper chamber 73 and the whirling chamber 72 are connected to each other.

[0039] Meanwhile, a supply air accumulating chamber 61 is formed around the nozzle block 34. A compressed air supplying pipe 65 connected to a compressed air source (not illustrated) is connected to the nozzle section casing 53. Accordingly, the compressed air can be supplied to the supply air accumulating chamber 61 from the compressed air source.

[0040] At least one air injection nozzle 27 connecting the whirling chamber 72 and the supply air accumulating chamber 61 is formed in the nozzle block 34. Although four air injection nozzles 27 are formed in the present embodiment, the number of the air injection nozzles 27 to be formed is not limited thereto. The air injection nozzle 27 is formed as an elongated round hole which is pierced through the nozzle block 34. The compressed air supplied to the supply air accumulating chamber 61 is injected into the whirling chamber 72 via the air injection nozzle 27. Accordingly, a whirling airflow that whirls in one direction around the axial line of the hollow guide shaft 20 is generated in the whirling chamber 72.

[0041] In order to generate such an whirling airflow in the whirling chamber 72, a longitudinal direction of the air injection nozzle 27 is directed substantially to a tangential direction of the whirling chamber 72 in plan view. FIG. 3 illustrates as if the longitudinal direction of the air

injection nozzle 27 exists in the same plane as the center axial line of the whirling chamber 72. However, FIG. 3 has been simply (conceptually) illustrated for facilitating understanding of the drawing. The air injection nozzle 27 is actually formed in the tangential direction of the whirling chamber 72 as described above. Therefore, a cross-sectional view more accurately illustrating the air injection nozzle 27 is illustrated in FIG. 4.

[0042] As illustrated in FIGS. 3 and 4, the longitudinal direction of the air injection nozzle 27 is slightly inclined towards the downstream side. Accordingly, the compressed air injected from the air injection nozzle 27 can be flown towards the downstream side.

[0043] With the above structure, the compressed air injected from the air injection nozzle 27 flows towards the downstream in the traveling direction of the fiber bundle 8 while whirling in the whirling chamber 72. That is, a spiral whirling airflow flowing towards the downstream can be generated in the whirling chamber 72.

[0044] Air discharge space 55 is formed in the nozzle section casing 53. The air discharge space 55 is connected to the taper chamber 73. A negative pressure source (a suction unit) (not illustrated) which is arranged in the blower box 4 is connected to the air discharge space 55 through a piping 60.

[0045] Next, a description will be made of a state at the time of introducing the fiber bundle 8 to the fiber guide hole 21 in the pneumatic spinning device 9.

[0046] First, under a state in which the fiber bundle 8 is not introduced into the pneumatic spinning device 9 (a state illustrated in FIG. 3), the compressed air is supplied to the supply air accumulating chamber 61 from the compressed air source (not illustrated). The compressed air supplied to the supply air accumulating chamber 61 is injected towards the whirling chamber 72 via the air injection nozzle 27. Accordingly, the whirling airflow generated in the whirling chamber 72 flows spirally downstream in the whirling chamber 72, and thereafter flows into the taper chamber 73. The whirling airflow further flows downstream while weakening its flow rate, and is finally discharged from the air discharge space 55.

[0047] Meanwhile, by the generation of the airflow towards the downstream in the whirling chamber 72, the depressurized suction chamber 71 which is adjacent to the upstream of the whirling chamber 72 is depressurized, and the suction airflow is generated in the fiber guide hole 21. The suction airflow flows from the fiber guide hole 21 into the depressurized suction chamber 71. Thereafter, a part of the suction airflow flows into the fiber passage 29 and flows downstream. The remaining suction airflow flows into the whirling chamber 72 and interflows with the whirling airflow.

[0048] If the fiber bundle 8 is fed from the draft device 7 to the pneumatic spinning device 9 under this state, the fiber bundle 8 is sucked from the fiber guide hole 21, and is guided into the depressurized suction chamber 71. The fiber bundle 8 guided into the depressurized suction chamber 71 is guided downstream through the fiber passage 29 along with the flow of the suction airflow that flows into the fiber passage 29, and is fed outside of the pneumatic spinning device 9 from the outlet hole (not illustrated) .

[0049] An end portion of the fiber bundle 8 or the spun yarn 10 which is fed out of the outlet hole of the pneumatic spinning device 9 is caught by the suction pipe 44 of the yarn splicing cart 3, and is spliced with the yarn end from the package 45 by the splicer 43. Accordingly, the fiber bundle 8 or the spun yarn 10 is continuous from the front roller 18, the fiber guide hole 21, the depressurized suction chamber 71 and the fiber passage 29 to the yarn feeding device 11. Under this state, when a feeding force towards the downstream is applied by the yarn feeding device 11, a tension is applied to the spun yarn 10 and the spun yarn 10 is sequentially pulled out from the pneumatic spinning device 9.

[0050] Next, with reference to FIG. 5, a description will be made of a state in which twists are applied to the fiber bundle 8 to produce the spun yarn 10 in the pneumatic spinning device 9 according to the present embodiment. FIG. 5 conceptually illustrates the airflow within the pneumatic spinning device 9 by thick arrows.

[0051] The fiber bundle 8 is formed of a plurality of fibers. Each of the fibers is introduced into the depressurized suction chamber 71 from the fiber guide hole 21. A downstream end portion of each of the fibers is introduced into the fiber passage 29 along with the flow of the suction airflow flowing from the fiber guide hole 21 towards the fiber passage 29. Accordingly, at least a portion of the fibers introduced into the depressurized suction chamber 71 is continuous between the fiber guide hole 21 and the fiber passage 29. The fibers in this state are referred to as core fibers 8a.

[0052] The core fibers 8a are twisted by being lead by reversal fibers 8b (described below) whirling in the whirling chamber 72. The twists tend to propagate upstream (the front roller 18 side), however, the propagation is prevented by the needle 22. Accordingly, the fiber bundle 8 fed out from the front roller 18 is not twisted by the twist mentioned above. As described above, the needle 22 has a twist propagation preventing function.

[0053] The downstream end portion of each of the fibers introduced into the depressurized suction chamber 71 is twisted into the core fibers 8a which are about to be twisted. However, each of the fibers is not entirely twisted into the core fiber 8a, and the upstream end portion is a free end.

[0054] If the free end (the upstream end portion) of each of the fibers enters into the depressurized suction chamber 71, the free end is separated from the core fibers 8a so as to be opened, and flows toward the whirling chamber 72 (the downstream) by the suction airflow flowing from the depressurized suction chamber 71 into the whirling chamber 72. As described above, the upstream end portion of the fibers is flown towards the downstream, whereby the direction of the upstream end portion is "reversed". The fiber in this state is referred to as the reversal

fiber 8b. The fiber which has been the core fiber 8a may become the reversal fiber 8b if its upstream end portion enters into the depressurized suction chamber 71.

[0055] The free end of the reversal fiber 8b is introduced into the whirling chamber 72, and is affected by the whirling airflow flowing spirally towards the downstream. Accordingly, as illustrated in FIG. 5, the reversal fiber 8b whirls around the leading end section 24 of the hollow guide shaft body 20 while being along the surface of the leading end section 24 of the hollow guide shaft 20. Therefore, the free end of the reversal fiber 8b is swung around the core fiber 8a passing through the fiber passage 29. Accordingly, the reversal fiber 8b is sequentially wound around the periphery of the core fiber 8a so as to form the wound fiber. Since the core fiber 8a is fed downstream through the fiber passage 29, the wound fiber that has been wound around the core fiber 8a is also sequentially pulled into the fiber passage 29.

[0056] Truly twisted spun yarn 10 is produced as described above. The spun yarn 10 advances through the fiber passage 29, and is fed out from the outlet hole (not illustrated) towards the yarn feeding device 11.

[0057] The spun yarn 10 is fed via the yarn feeding device 11 illustrated in FIG. 1 and is wound by the winding device 12, into the package 45. The fiber, which has been cut when being opened and twisted and which has not been twisted into the spun yarn 10, is fed from the whirling chamber 72 via the taper chamber 73 to the air discharge space 55 along with the flow of the airflow, and is discharged via the piping 60 by the suction of the negative pressure source.

[0058] Next, a description will be made in detail of a structure of the nozzle block 34 in the pneumatic spinning device 9 according to the present embodiment.

[0059] First, a description will be made of a shape of a whirling chamber forming surface 82 forming the whirling chamber 72. As illustrated in FIG. 4, among the inner wall surface of the nozzle block 34 (the wall surface of the passage hole 70), a portion forming the depressurized suction chamber 71 is a depressurized suction chamber forming surface 81, and a portion forming the whirling chamber 72 is the whirling chamber forming surface 82. The depressurized suction chamber forming surface 81 is facing the depressurized suction chamber 71. The whirling chamber forming surface 82 is facing the whirling chamber 72.

[0060] In the nozzle block 34 according to the present embodiment, in a cross-sectional view (FIG. 4) cut through a plane passing through the center axial line of the hollow guide shaft 20, a cross-sectional contour of a portion located upstream of the whirling chamber forming surface 82 (near the fiber guide section 23) is formed in a curve, and this portion is a curved section 82a. A cross-sectional contour of a portion located downstream of the whirling chamber forming surface 82 is formed as a linear shape, and this portion is a linear section 82b.

[0061] In the pneumatic spinning device 9 according to the present embodiment, a radius R1 of the depressurized suction chamber forming surface 81 is formed smaller than a radius R2 of the whirling chamber forming surface 82 (strictly speaking, a radius of the linear portion 82b). In other words, the radius of the depressurized suction chamber 71 (the depressurized suction chamber radius R1) is formed smaller than the radius of the whirling chamber 72 (the whirling chamber radius R2). Since the radius of the depressurized suction chamber 71 is smaller than the whirling chamber 72 as described above, the compressed air is prevented from flowing towards the depressurized suction chamber 71 even if the compressed air injected into the whirling chamber 72 inflates. Accordingly, since the suction airflow can smoothly flow towards the downstream, the fiber bundle 8 can be sucked into the fiber guide hole 21 and smoothly guided into the depressurized suction chamber 71.

[0062] As illustrated in FIG. 4, a downstream end portion of the depressurized suction chamber forming surface 81 is connected to an upstream end portion of the linear section 82b of the whirling chamber forming surface 82 by the curved section 82a. In a cross-sectional view (FIG. 4) cut through the plane passing through the center axial line of the hollow guide shaft 20, the cross-sectional contours of the curved section 82a and the linear section 82b are smoothly connected. By forming the cross-sectional contour located near the upstream of the whirling chamber forming surface 82 (near the fiber guide section 23) in the curve as described above, the angular portion does not exist in the whirling chamber 72. Accordingly, when compared with the prior art (FIG. 7) in which the angular portion exists in the whirling chamber, the suction airflow can smoothly flow towards the downstream and the turbulence of the airflow in the whirling chamber 72 can be reduced. Therefore, since the behavior of the reversal fiber 8b in the whirling chamber 72 can be stabilized, the free ends of the reversal fibers 8b can be prevented from being entangled with one another. In this manner, by reducing the turbulence of the airflow in the whirling chamber 72, the compressed air injected into the whirling chamber 72 can be prevented from inflating in the whirling chamber 72.

[0063] In the present embodiment, the cross-sectional contour of the curved section 82a is specifically formed as an arc. By forming the cross-sectional contour of the whirling chamber 72 as the arc, the airflow can smoothly flow in the whirling chamber 72.

[0064] Next, a description will be made of the air injection nozzle 27 in the present embodiment.

[0065] As described above, the air injection nozzle 27 is formed such that a longitudinal direction thereof is directed towards a tangential direction of the whirling chamber 72. Accordingly, an opening contour of the portion in which the air injection nozzle 27 is opened through the whirling chamber forming surface 82 (an opening contour of the nozzle opening 27a) is formed substantially oval as illustrated in FIG. 4. In the present embodiment, a peripheral length of the opening contour of the nozzle opening 27a is referred to as an oval peripheral

length.

[0066] In the pneumatic spinning device 9 according to the present embodiment, the nozzle opening 27a of the air injection nozzle 27 is formed in the curved section 82a of the whirling chamber forming surface 82, as illustrated in FIG. 4. Accordingly, since the oval peripheral length of the nozzle opening can be lengthened, compared with a case in which the nozzle opening 27a is formed in the linear section 82b, the compressed air can be injected so as to spread towards the downstream. Therefore, since the whirling airflow can be acted on the fiber in a wider range, the fiber can be efficiently whirled by a strong force. Since the compressed air can be injected so as to spread towards the downstream, the compressed air is unlikely to flow towards the upstream (the depressurized suction chamber 71 side) even if the compressed air inflates within the whirling chamber 72. Therefore, the suction airflow can be more smoothly flown towards the downstream.

[0067] In the prior art (FIG. 7), since the nozzle opening of the air injection hole 105 is formed over the angular portion (reference numeral 109), there has been a problem in that the opening shape of the nozzle opening is greatly changed only by a slight shift in the position where the nozzle opening is formed. Therefore, the structure of the prior art in FIG. 7 has a drawback that the yarn quality tends to be affected by the machining precision. In this regard, in the present embodiment, the opening contour of the nozzle opening 27a is entirely formed on the curved section 82a of the whirling chamber forming surface 82. In other words, in the present embodiment, the nozzle opening 27a is formed at the position where the wall surface does not have the angular portion. According to the structure of the present embodiment, even if the position where the nozzle opening 27a is formed is slightly shifted, the shape of the opening contour of the nozzle opening 27a is not changed so much. Therefore, the quality of the spun yarn 10 can be maintained regardless of the machining precision of the air injection nozzle 27.

[0068] Meanwhile, the conventional pneumatic spinning device has been designed such that the difference between the outer peripheral radius of the whirling chamber and the outer peripheral radius of the depressurized suction chamber becomes larger than a certain level to prevent the whirling airflow in the whirling chamber from flowing into the depressurized suction chamber. In this case, for example, "certain level" means the diameter of the pierced hole of the air injection nozzle. That is, if the difference between the outer peripheral radius of the whirling chamber and the outer peripheral radius of the depressurized suction chamber becomes at most the diameter of the pierced hole of the air injection nozzle, the compressed air injected from the air injection nozzle "protrudes" from the step between the whirling chamber and the depressurized suction chamber. As a result, it is considered that the compressed air tends to flow towards the depressurized suction chamber when the compressed air inflates.

[0069] However, in the present embodiment, the difference between the radius of the whirling chamber forming surface 82 and the radius of the depressurized suction chamber forming surface 81 (that is, the difference between the whirling chamber radius R2 and the depressurized suction chamber radius R1) is set to be at most the diameter of the pierced hole of the air injection nozzle 27. In other words, since the suction airflow can be flown towards the downstream more smoothly in the pneumatic spinning device 9 according to the present embodiment than the conventional structure, the compressed air injected into the whirling chamber 72 hardly inflates. As a result, the whirling airflow in the whirling chamber 72 hardly flows into the depressurized suction chamber 71. Therefore, the difference between the whirling chamber radius R2 and the depressurized suction chamber radius R1 (R2 - R1) can be made small in comparison with the conventional structure. Accordingly, since the radius R2 of the whirling chamber 72 can be made small in comparison with the conventional structure, the whirling speed of the reversal fiber 8b in the whirling chamber 72 can be improved for realizing high-speed spinning. The high-speed spinning is spinning in which the spinning speed is set from about 500 m/min to 600 m/min, in comparison with the conventional spinning speed from 250 m/min to 400 m/min.

[0070] As described above, the pneumatic spinning device 9 according to the present embodiment includes the nozzle block 34, the fiber guide section 23, and the hollow guide shaft 20. The nozzle block 34 is arranged to form the whirling chamber 72. At least one air injection nozzle 27 is formed in the nozzle block 34. The air injection nozzle 27 injects the compressed air from the nozzle opening 27a opening into the whirling chamber 72 to generate the whirling airflow in the whirling chamber 72. The fiber guide section 23 includes the fiber guide hole 21 which is connected to the whirling chamber 72. The fiber passage 29 is formed in the hollow guide shaft 20 to pass through the fiber that has been whirled in the whirling chamber 72. In the cross-section cut through the plane passing through the axial line of the hollow guide shaft 20, the portion of the cross-sectional contour of the whirling chamber forming surface 82 located near the fiber guide section 23 is formed as the circular curved section 82a.

[0071] Accordingly, since the whirling chamber 72 can be formed such that the angular portion does not exist in the wall surface located near the fiber guide section 23, the turbulence of the airflow can be prevented in the whirling chamber 72, and the airflow can smoothly flow. As a result, since the winding fiber can be prevented from being irregularly wound around the core fiber, or the free ends of the winding fiber can be prevented from being entangled with one another, the quality of the produced yarn can be stabilized. Since the turbulence of the airflow can be prevented as described above, the behavior of the winding fiber is unlikely to be adversely affected even if the diameter of the whirling chamber 72 is made small.

Therefore, according to the above structure, the whirling speed of the fiber can be improved by making the whirling chamber 72 small, and the high-speed spinning can be achieved while maintaining the yarn quality.

[0072] In the pneumatic spinning device 9 according to the present embodiment, in the portion of the curved section 82a in which the cross-sectional contour of the whirling chamber forming surface 82 is the curve, the cross-sectional contour is the arc. Therefore, the turbulence of the whirling airflow in the whirling chamber 72 can be preferably suppressed.

[0073] In the pneumatic spinning device 9 according to the present embodiment, an entire opening contour of the nozzle opening 27a is formed on the portion of the curved section 82a in which the cross-sectional contour is formed as the curve among the whirling chamber forming surface 82. As described above, the oval peripheral length of the opening contour of the nozzle opening 27a can be made long by forming the nozzle opening 27a on the wall surface in which the cross-sectional contour is formed as the curve. Accordingly, the compressed air can be injected from the nozzle opening 27a so as to spread into the whirling chamber 72, and the whirling airflow can be applied to the fiber in a wider range. As a result, the fiber can be efficiently whirled in the whirling chamber 72 by a strong force.

[0074] As described above, when the entire nozzle opening 27a is formed on the wall surface having the curved cross-sectional contour, the outlet shape of the air injection nozzle 27 is not changed so much even if the position where the nozzle opening 27a is formed is slightly shifted. In other words, with the above structure, the quality of the produced spun yarn 10 can be maintained regardless of the machining precision.

[0075] In the pneumatic spinning device 9 according to the present embodiment, the depressurized suction chamber 71 is formed in the nozzle block 34. The depressurized suction chamber 71 and the whirling chamber 72 are formed substantially columnar or substantially cylindrical. The depressurized suction chamber radius R1 is smaller than the whirling chamber radius R2. The difference between the whirling chamber radius R2 and the depressurized suction chamber radius R1 is at most a pierced hole diameter D1 of the pneumatic spinning nozzle 27.

[0076] Accordingly, since the air can smoothly flow in the whirling chamber 72, the compressed air injected from the nozzle opening 27a is unlikely to inflate in the whirling chamber 72. As a result, the compressed air is unlikely to flow towards the depressurized suction chamber 71 from the whirling chamber 72. Accordingly, it is not necessary to enlarge the difference between the radius of the whirling chamber and the radius of the depressurized suction chamber to some extent as in the conventional pneumatic spinning device, and for example, the difference between the radius of the whirling chamber 72 and the radius of the depressurized suction chamber 71 can be made at most the diameter of the air injection nozzle 27. Since the whirling chamber 72 can be made small as described above, the pneumatic spinning device 9 can be downsized.

[0077] Since the spinning machine 1 according to the present embodiment includes the pneumatic spinning device 9, and the winding device 12 which winds the spun yarn 10 produced by the pneumatic spinning device 9 into the package 45, the package 45 can be formed with stable quality and at high speed.

[0078] Next, a description will be made of a second embodiment according to the present invention. In the following description, the same reference numerals are denoted to the structures which are the same or similar to the first embodiment, and descriptions thereof will be omitted.

[0079] FIG. 6 illustrates a structure of a pneumatic spinning device 9 provided in the spinning machine according to the second embodiment. As illustrated in FIG. 6, the pneumatic spinning device 9 according to the present embodiment is structured such that the needle 22 provided in the fiber guide section 23 of the first embodiment is omitted. That is, the needle 22 may be omitted. In the first embodiment, the needle 22 serves as the twist propagation preventing function. If the needle 22 is omitted as in the second embodiment, a downstream end portion of the fiber guide section 23 serves as the twist propagation preventing function.

[0080] The preferred embodiments of the present invention has been described above, however, the above structures can be modified, for examples, as follows.

[0081] The above embodiments are structured such that the leading end section 24 of the hollow guide shaft 20 is slightly inserted into the inner portion of the depressurized suction chamber 71. However, the structure is not limited thereto, and may be made such that the hollow guide shaft 20 is not inserted into the depressurized suction chamber 71.

[0082] In the above embodiments, the whirling chamber 72 is formed substantially cylindrical, however, the present invention is not limited thereto. For example, the whirling chamber may be formed as a substantially tapered tubular shape, such as the prior art in FIG. 7. In this case, since the whirling airflow is required to be generated in the whirling chamber 72, the whirling chamber 72 is preferably structured such that a cross-sectional shape cut through a plane orthogonal to the fiber feeding direction is a circle.

[0083] The shape of the depressurized suction chamber 71 is formed substantially columnar, however, the present invention is not limited thereto. Since the whirling airflow is not always necessary to be generated in the depressurized suction chamber 71, a cross-sectional shape cut through a plane orthogonal to the fiber feeding direction may not be formed as a circle.

[0084] In the curved section 82a of the whirling chamber forming surface 82, the cross-sectional contour along the plane passing through the axial line of the hollow guide shaft 20 may not be formed as the arc, but may be

formed as any shape as long as the cross-sectional contour is a smooth curve. The point is that it suffices if the angular portion does not exist in the fiber guide section 23 side of the whirling chamber 72. However, as described above, the turbulence of the airflow can be particularly satisfactorily suppressed in the whirling chamber 72 by forming the cross-sectional contour of the curved section 82a as the arc.

[0085] In the whirling chamber forming surface 82, an entire cross-sectional contour may be formed in a curve. In other words, the linear section 82b may be omitted.

[0086] When the cross-sectional contour of the curved section 82a is assumed to be substantially a curve, the cross-sectional contour may be formed by fine broken lines. For example, if the cross-sectional contour of the curved section 82a is formed by a broken line which is bent a plurality of times at obtuse angles, the cross-sectional contour may be assumed to be substantially a curve.

[0087] The depressurized suction chamber 71 may be omitted (the whirling chamber 72 may be directly connected to the fiber guide hole 21). However, since the fiber can be smoothly reversed by the presence of the depressurized suction chamber 71, it is preferable that the depressurized suction chamber 71 is not omitted.

[0088] The above embodiments are structured such that the entire opening contour of the nozzle opening 27a of the air injection nozzle 27 is formed on the curved section 82a, however, the present invention is not limited to this structure. For example, only a portion of the opening contour of the nozzle opening 27a may be formed in the curved section 82a, and the remaining portion may be formed in the linear section 82b. The entire opening contour of the nozzle opening 27a may be formed on the linear section 82b. However, as described above, if at least a portion of the opening contour of the nozzle opening 27a is formed on the curved section 82a, the air can be injected while spreading from the nozzle opening 27a, and this structure is preferable.

[0089] In the above embodiments, the nozzle block 34 is structured such as to serve both as the whirling chamber section in which the whirling chamber is formed, and the depressurized suction chamber section. However, the depressurized suction chamber section and the whirling chamber section may be formed as independent members.

[0090] In the above embodiments, the air discharge space 55 is formed in the nozzle section casing 53. However, the air discharge space 55 may be formed in the shaft holding member 59. The air discharge space 55 may be formed by combining the nozzle section casing 53 and the shaft holding member 59.

[0091] In the above embodiments, the description is made of the spinning machine 1 in which the fiber bundle 8 (or the spun yarn 10) is fed from top towards bottom. However, the present invention is not limited thereto, and may be structured, for example, by a spinning machine in which the fiber bundle is fed from bottom to top. In other words, the pneumatic spinning device according to the above embodiments may be provided in such a spinning machine in which a can accommodating the fiber bundle is arranged in a lower portion of a machine main body, and the winding device is arranged in an upper portion of the machine main body.

[0092] The spinning machine 1 may be structured such that a yarn accumulating device is provided between the yarn feeding device 11 and the winding device 12. Briefly describing, the yarn accumulating device is structured such that a prescribed amount of spun yarn 10 can be accumulated on a yarn accumulating roller by temporarily winding the spun yarn 10 around the rotating yarn accumulating roller. A function of the yarn accumulating device is as follows. That is, the winding device 12 cannot wind the spun yarn 10 during a yarn splicing operation of the yarn splicing cart 3. In such cases, if the spun yarn 10 is continuously fed from the pneumatic spinning device 9, the spun yarn 10 which is not wound slackens. Accordingly, the spun yarn 10 can be prevented from slackening by providing the yarn accumulating device between the winding device 12 and the yarn feeding device 11, and accumulating the spun yarn 10 on the yarn accumulating roller during a period in which the winding device 12 cannot wind the yarn.

[0093] The above yarn accumulating device includes the yarn accumulating roller which winds the spun yarn 10 therearound and rotates. The above yarn accumulating device can feed the spun yarn 10 wound around the yarn accumulating roller towards the downstream by rotating the yarn accumulating roller. In other words, the yarn accumulating device includes a function of feeding the spun yarn 10 towards the downstream. Accordingly, the spinning machine 1 provided with the yarn accumulating device as described above may be structured such that the yarn feeding device 11 is omitted and the spun yarn 10 from the pneumatic spinning device 9 is fed towards the downstream by the yarn accumulating device.

[0094] In embodiments of the invention, the curve is a concave curve such that a curved section and a linear section of the whirling chamber are smoothly connected without an edge or angular portion therebetween.

Claims

1. A pneumatic spinning device (9) for producing spun yarn by whirling fibers of fiber bundle by whirling airflow, comprising:

   a nozzle block (34) arranged to form a whirling chamber (72) and through which at least one air injection nozzle (27) is formed to inject compressed air from a nozzle opening (27a) opening into the whirling chamber (72) to generate the whirling airflow in the whirling chamber (72),
   a fiber guide section (23) including a fiber guide hole (21) connected to the whirling chamber

(72); and
a spindle (20) in which a fiber passage (29) is formed to pass through the fiber that has been whirled in the whirling chamber (72), wherein the spindle (20) is inserted into a passage hole (70) formed in the nozzle block (34) from a side of the passage hole (70) opposite to the fiber guide section (23),
characterized in that in a cross-section cut through a plane passing through an axial line of the spindle (20), at least a portion (82a) of a cross-sectional contour of an inner wall surface (82) of the nozzle block (34) forming the whirling chamber (72) located near the fiber guide section (23) is formed in a concave curve.

2. The pneumatic spinning device (9) according to claim 1, wherein among the inner wall surface (82) of the nozzle block (34) forming the whirling chamber (72), the portion (82a) of which the cross-sectional contour is the curve is formed as an arc.

3. The pneumatic spinning device (9) according to claim 1 or claim 2, wherein at least a portion of an opening contour of the nozzle opening (27a) is formed on the curved cross-sectional contour portion (82a) among the inner wall surface (82) of the nozzle block (34) forming the whirling chamber (72).

4. The pneumatic spinning device according to claim 3, wherein the entire opening contour of the nozzle opening (27a) is formed on the curved cross-sectional contour portion (82a) among the inner wall surface (82) of the nozzle block (34) forming the whirling chamber (72).

5. The pneumatic spinning device according to any one of claim 1 through claim 4, further comprising a depressurized suction chamber section (34) in which a depressurized suction chamber (71) is formed between the fiber guide section (23) and the whirling chamber (72),
wherein the depressurized suction chamber (71) and the whirling chamber (72) are cylindrical, wherein the concave curve of the inner wall surface (82) of the nozzle block (34) connects a small diameter portion of the whirling chamber (72) connected to the depressurized suction chamber (71) to a large diameter portion of the whirling chamber (72); and
wherein the radius of the depressurized suction chamber (71) is smaller than the radius of the large diameter portion of the whirling chamber (72), and a difference between the radius of the large diameter portion of the whirling chamber (72) and the radius of the depressurized suction chamber (71) is at most diameter of the air injection nozzle (27).

6. A spinning machine comprising:
the pneumatic spinning device (9) according to any one of claim 1 through claim 5; and
a winding device (12) adapted to wind spun yarn produced by the pneumatic spinning device (9) into a package.

Patentansprüche

1. Ein pneumatisches Spinngerät (9) zum Produzieren eines gesponnenen Garns durch Wirbeln von Fasern eines Faserbündels durch einen Wirbelluftstrom, das folgende Merkmale aufweist:

einen Düsenblock (34), der dazu angeordnet ist, eine Wirbelkammer (72) zu bilden, und durch den hindurch zumindest eine Lufteinblasdüse (27) gebildet ist, um komprimierte Luft von einer Düsenöffnung (27a), die sich in die Wirbelkammer (72) öffnet, einzublasen, um den Wirbelluftstrom in der Wirbelkammer (72) zu erzeugen,
einen Faserführungsbereich (23), der ein Faserführungsloch (21) umfasst, das mit der Wirbelkammer (72) verbunden ist; und
eine Spindel (20), in der ein Faserdurchgang (29) gebildet ist, um die Faser, die in der Wirbelkammer (72) gewirbelt worden ist, hindurchzubewegen, wobei die Spindel (20) in ein Durchgangsloch (70), das in dem Düsenblock (34) gebildet ist, von einer Seite des Durchgangslochs (70) eingefügt ist, die dem Faserführungsbereich (23) gegenüberliegt,
dadurch gekennzeichnet, dass in einem Querschnitt durch eine Ebene, die durch eine Axiallinie der Spindel (20) verläuft, zumindest ein Abschnitt (82a) einer Querschnittskontur einer Innenwandoberfläche (82) des Düsenblocks (34), die die Wirbelkammer (72) bildet, die sich in der Nähe des Faserführungsbereichs (23) befindet, in einer konkaven Krümmung gebildet ist.

2. Das pneumatische Spinngerät (9) gemäß Anspruch 1, bei dem bei der Innenwandoberfläche (82) des Düsenblocks (34), die die Wirbelkammer (72) bildet, der Abschnitt (82a), dessen Querschnittskontur die Krümmung ist, als ein Bogen gebildet ist.

3. Das pneumatische Spinngerät (9) gemäß Anspruch 1 oder 2, bei dem zumindest ein Abschnitt einer Öffnungskontur der Düsenöffnung (27a) auf dem gekrümmten Querschnittskonturabschnitt (82a) der Innenwandoberfläche (82) des Düsenblocks (34), die die Wirbelkammer (72) bildet, gebildet ist.

4. Das pneumatische Spinngerät gemäß Anspruch 3, bei dem die gesamte Öffnungskontur der Düsenöffnung (27a) auf dem gekrümmten Querschnittskon-

turabschnitt (82a) der Innenwandoberfläche (82) des Düsenblocks (34), die die Wirbelkammer (72) bildet, gebildet ist.

5. Das pneumatische Spinngerät gemäß einem der Ansprüche 1 bis 4, das ferner einen drucklosen Ansaugkammerbereich (34) aufweist, in dem eine drucklose Ansaugkammer (71) zwischen dem Faserführungsbereich (23) und der Wirbelkammer (72) gebildet ist,
wobei die drucklose Ansaugkammer (71) und die Wirbelkammer (72) zylindrisch sind, wobei die konkave Krümmung der Innenwandoberfläche (82) des Düsenblocks (34) einen Abschnitt der Wirbelkammer (72) mit kleinem Durchmesser, der mit der drucklosen Ansaugkammer (71) verbunden ist, mit einem Abschnitt der Wirbelkammer (72) mit großem Durchmesser verbindet; und
wobei der Radius der drucklosen Ansaugkammer (71) kleiner ist als der Radius des Abschnitts der Wirbelkammer (72) mit großem Durchmesser und eine Differenz zwischen dem Radius des Abschnitts der Wirbelkammer (72) mit großem Durchmesser und dem Radius der drucklosen Ansaugkammer (71) maximal ein Durchmesser der Lufteinblasdüse (27) ist.

6. Eine Spinnmaschine, die folgende Merkmale aufweist:

das pneumatische Spinngerät (9) gemäß einem der Ansprüche 1 bis 5; und
ein Wicklungsgerät (12), das dazu angepasst ist, ein durch das pneumatische Spinngerät (9) produziertes gesponnenes Garn in einen Garnkörper zu wickeln.

Revendications

1. Dispositif de filage pneumatique (9) pour produire du fil filé en faisant tourillonner les fibres du faisceau de fibres par un flux d'air tourbillonnant, comprenant:

un bloc de buses (34) disposé de manière à former une chambre de tourbillonnement (72) et à travers lequel au moins une buse d'injection d'air (27) est formée de manière à injecter de l'air comprimé par une ouverture de buse (27a) débouchant dans la chambre de tourbillonnement (72) pour générer le flux d'air tourbillonnant dans la chambre de tourbillonnement (72),
un segment de guidage de fibre (23) comportant un trou de guidage de fibre (21) connecté à la chambre de tourbillonnement (72); et
une broche (20) dans laquelle est formé un passage de fibre (29) de manière à passer à travers la fibre qui a été tourbillonnée dans la chambre de tourbillonnement (72), où la broche (20) est introduite dans un trou de passage (70) formé dans le bloc de buses (34) depuis un côté du trou de passage (70) opposé au segment de guidage de fibres (23),
caractérisé par le fait que, en vue en coupe transversale dans un plan passant par une ligne axiale de la broche (20), au moins une partie (82a) d'un contour en coupe transversale d'une surface de paroi intérieure (82) du bloc de buses (34) formant la chambre de tourbillonnement (72) située près du segment de guidage de fibres (23) est formée selon une courbe concave.

2. Dispositif de filage pneumatique (9) selon la revendication 1,
dans lequel, de la surface de paroi intérieure (82) du bloc de buses (34) formant la chambre de tourbillonnement (72), la partie (82a) dont le contour en coupe transversale est la courbe est formée en forme d'arc.

3. Dispositif de filage pneumatique (9) selon la revendication 1 ou la revendication 2, dans lequel au moins une partie d'un contour de l'ouverture de buse (27a) est formée sur la partie de contour en coupe courbée (82a) de la surface de paroi intérieure (82) du bloc de buses (34) formant la chambre de tourbillonnement (72).

4. Dispositif de filage pneumatique selon la revendication 3, dans lequel tout le contour de l'ouverture de buse (27a) est formé sur la partie de contour en coupe courbée (82a) de la surface de paroi intérieure (82) du bloc de buses (34) formant la chambre de tourbillonnement (72).

5. Dispositif de filage pneumatique selon l'une quelconque de la revendication 1 à la revendication 4, comprenant par ailleurs un segment de chambre d'aspiration dépressurisé (34) dans lequel une chambre d'aspiration dépressurisée (71) est formée entre le segment de guidage de fibres (23) et la chambre de tourbillonnement (72),
dans lequel la chambre d'aspiration dépressurisée (71) et la chambre de tourbillonnement (72) sont cylindriques, dans lequel la courbe concave de la surface de paroi intérieure (82) du bloc de buses (34) connecte une partie de petit diamètre de la chambre de tourbillonnement (72) connectée à la chambre d'aspiration dépressurisée (71) à une partie de grand diamètre de la chambre de tourbillonnement (72); et dans lequel le rayon de la chambre d'aspiration dépressurisée (71) est plus petit que le rayon de la partie de grand diamètre de la chambre de tourbillonnement (72), et une différence entre le rayon de la partie de grand diamètre de la chambre de tourbillonnement (72) et le rayon de la chambre d'aspiration dépressurisée (71) est de tout au plus le diamètre

de la buse d'injection d'air (27).

6. Machine à filer comprenant:

le dispositif de filage pneumatique (9) selon l'une quelconque de la revendication 1 à la revendication 5; et
un dispositif de bobinage (12) adapté pour bobiner le fil filé produit par le dispositif de filage pneumatique (9) pour former un paquet.

FIG. 1

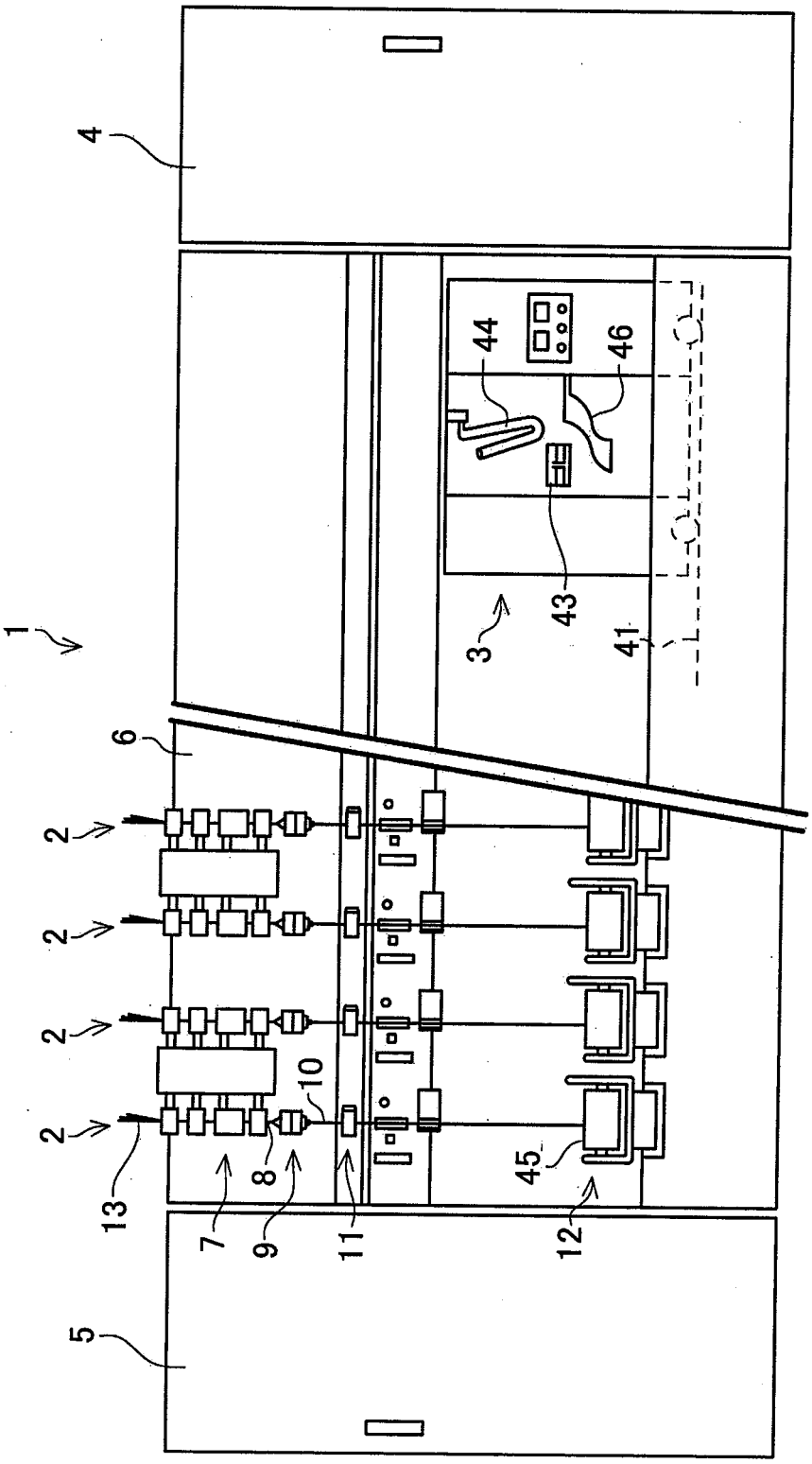


FIG. 2

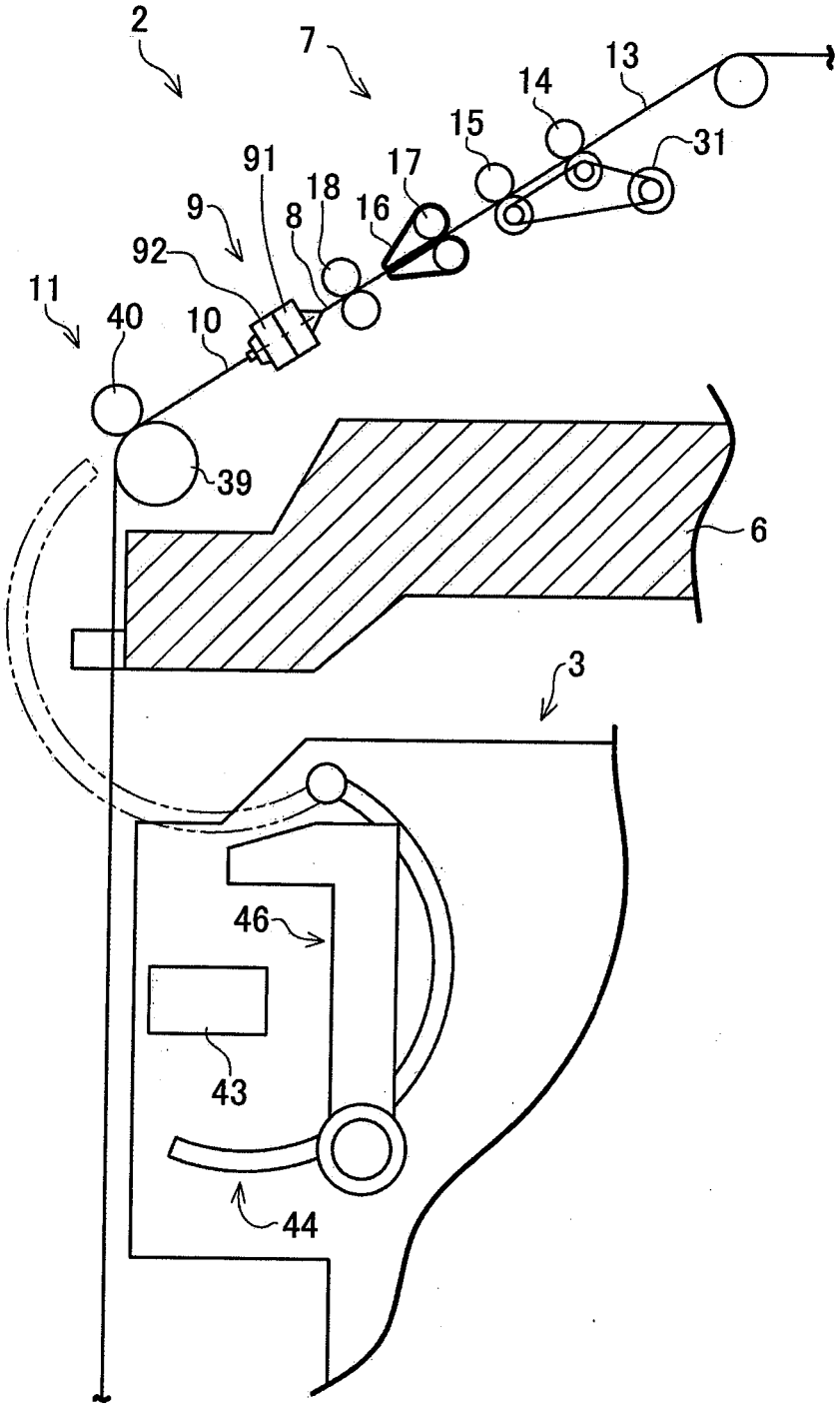


FIG. 3

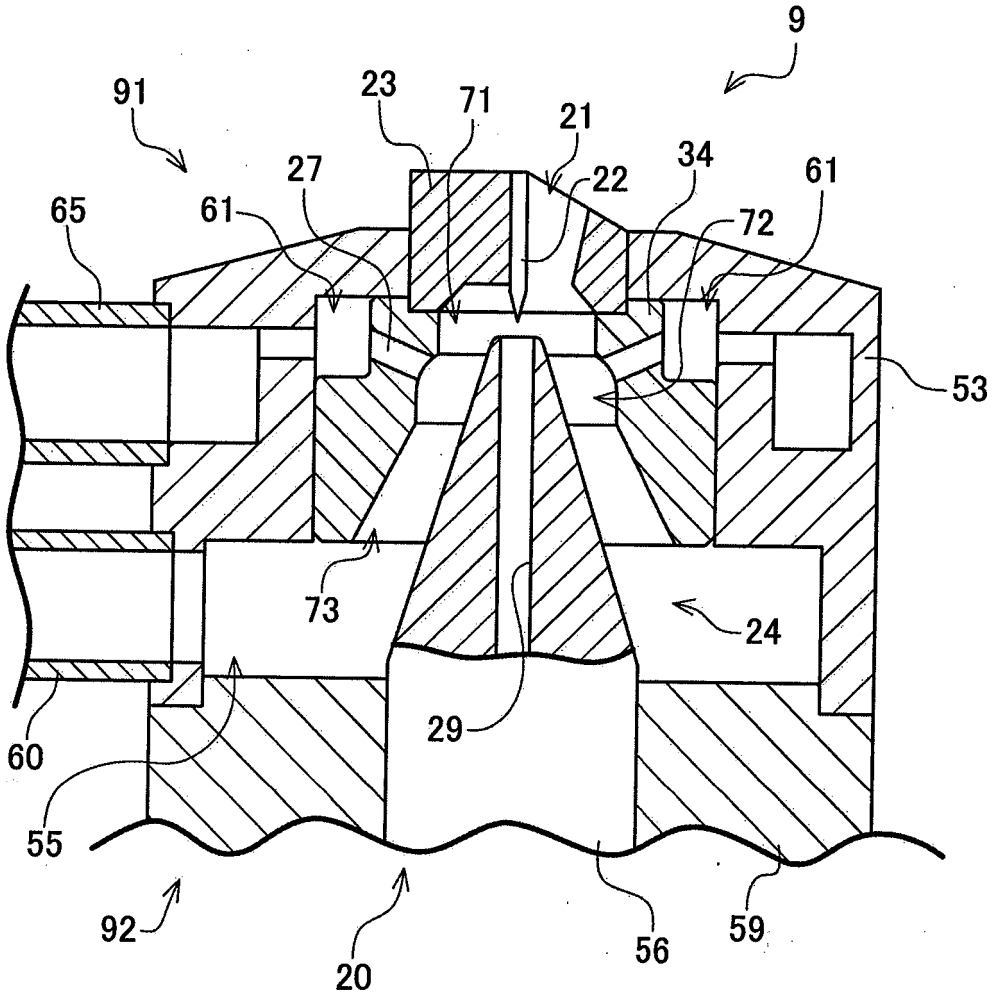


FIG. 4

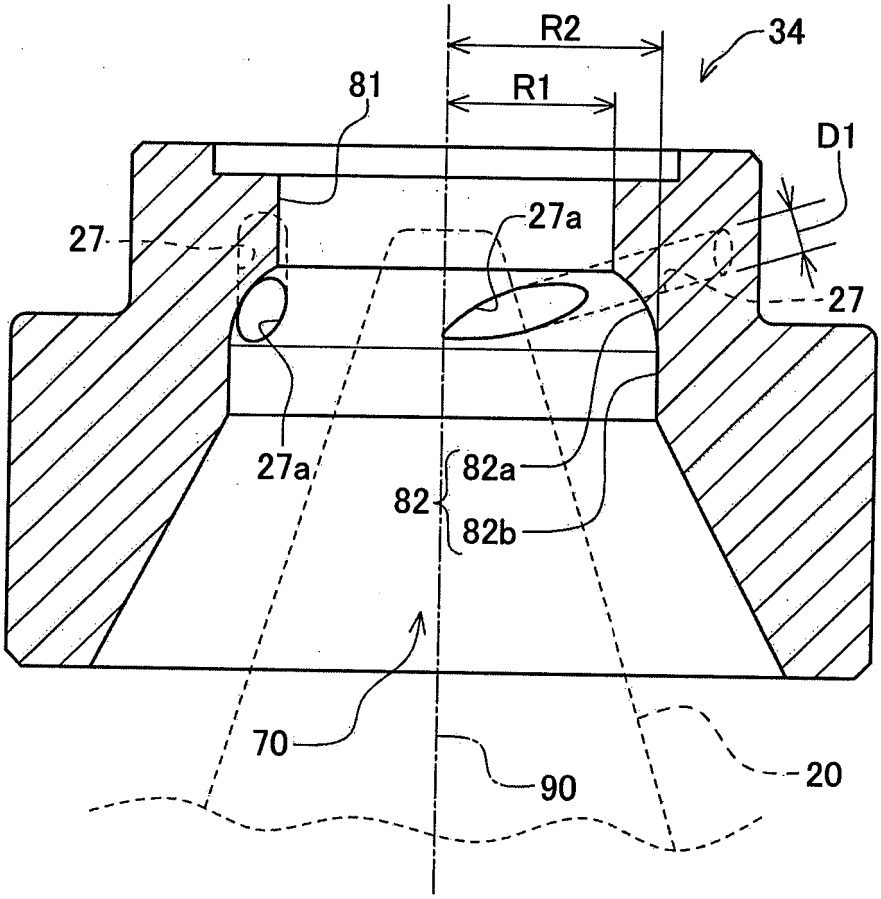


FIG. 5

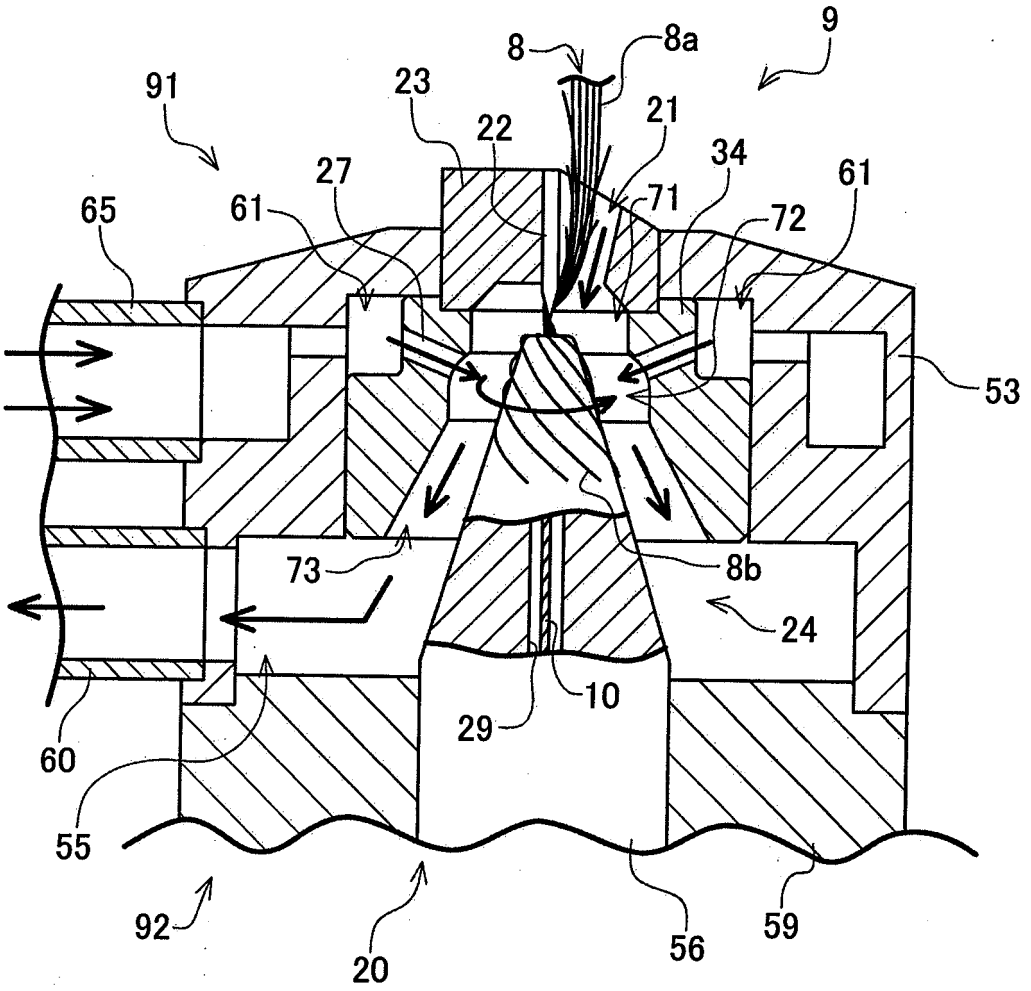

9
8
8a
91
23
22
21
34
61
27
71
72
65
61
53
73
8b
24
10
29
60
55
92
20
56
59

FIG. 6

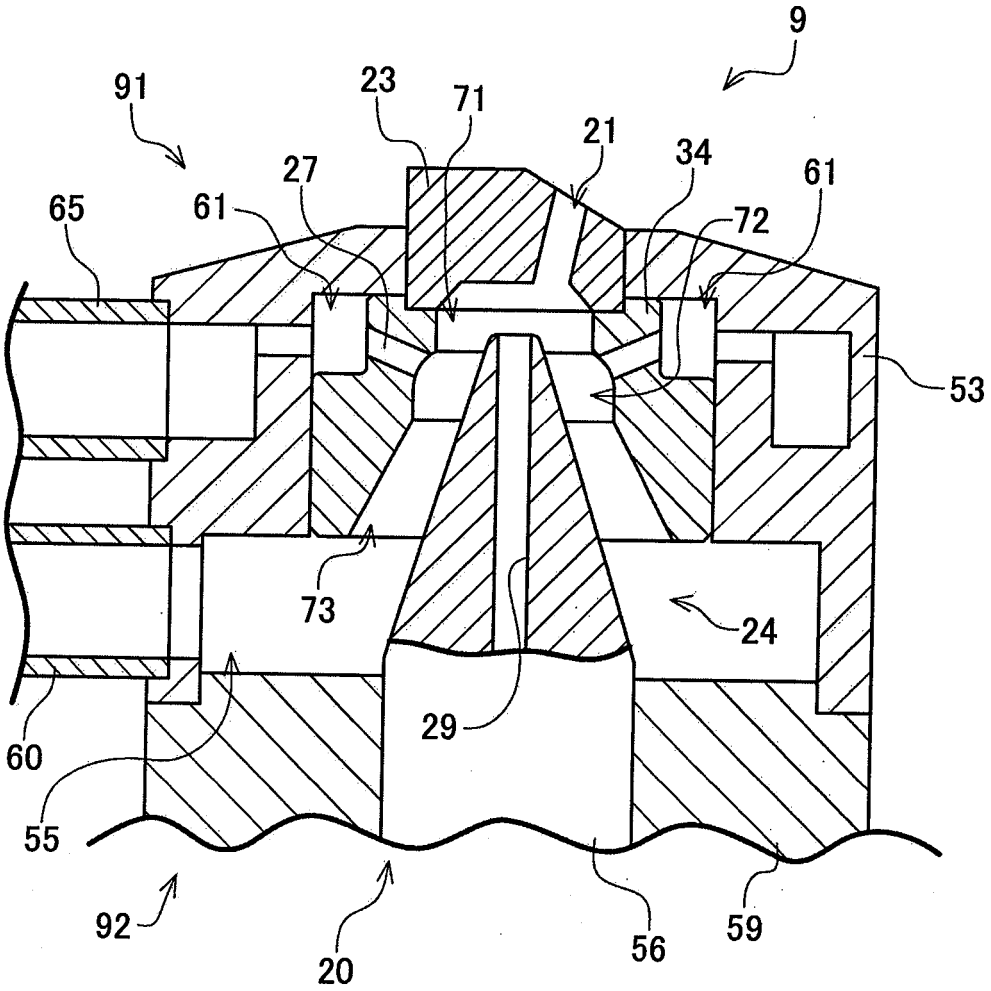
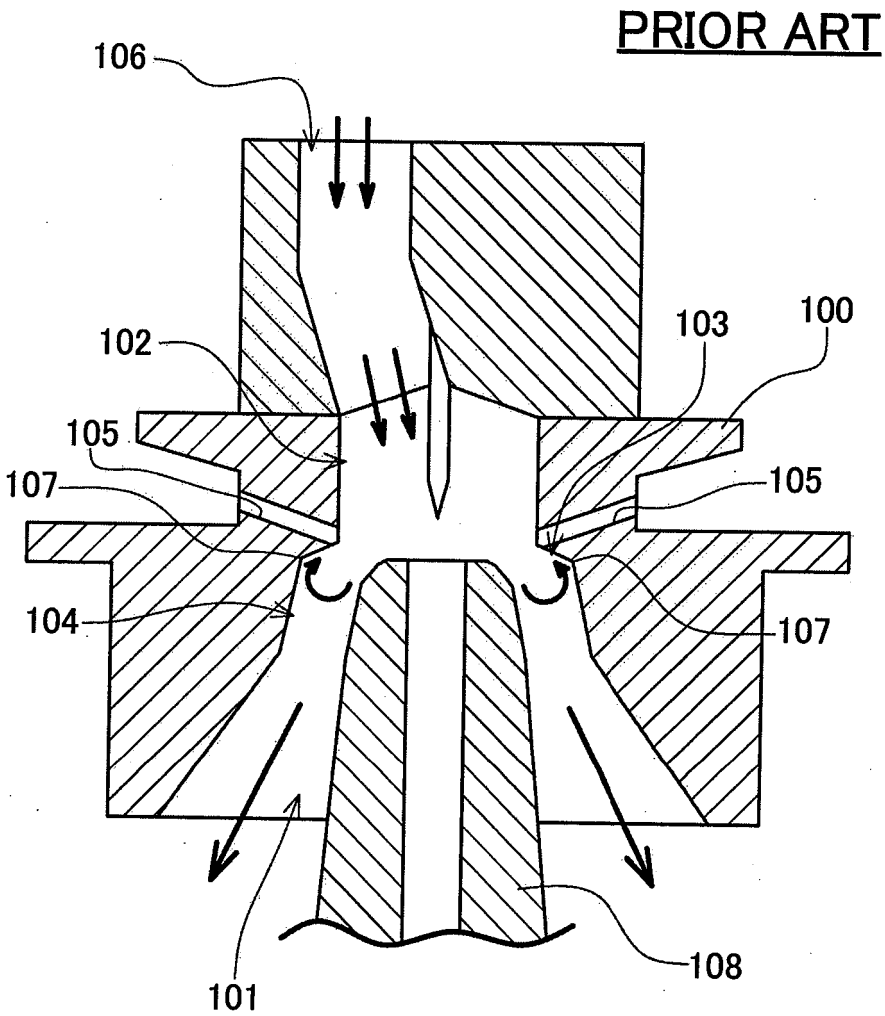


FIG. 7



REFERENCES CITED IN THE DESCRIPTION

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