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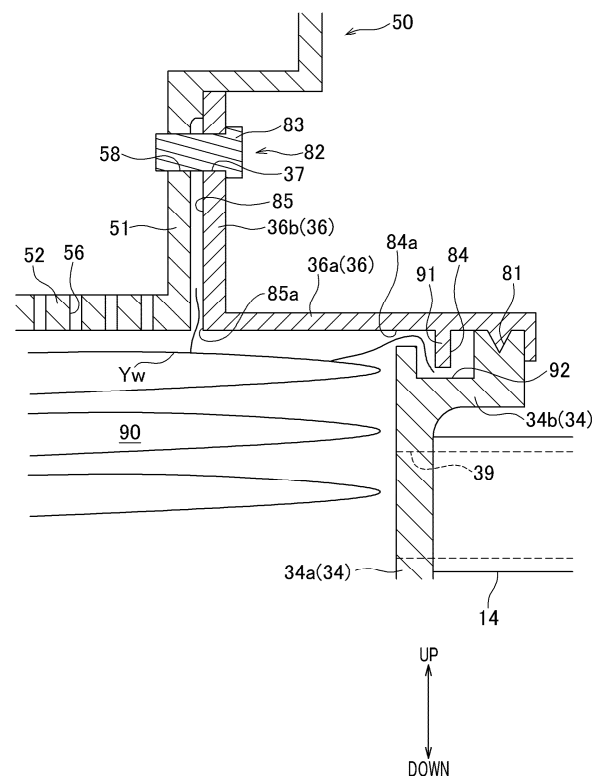
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(54) **YARN CYCLONE SEPARATOR**

(57) A yarn waste collection cyclone separator configured to suppress clogging of yarn wastes in an internal space is provided. A cyclone separator 30 includes: a first member and a second member (a side wall member 34 and a top panel member 36, and a top panel member 36 and an insertion member 51) defining an internal space 90 where a yarn waste Yw is separated from air; and joints (a first joint 81 and a second joint 82) where the first member and the second member are joined to each other. Between the internal space 90 and the joint, gap portions (the first gap portion 84 and the second gap portion 85) are formed to allow a yarn waste Yw to enter and leave the gap portion.

FIG.5



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn waste collection cyclone separator provided in a yarn waste collection device configured to collect yarn wastes.

[0002] Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2024-52577) discloses a yarn waste collection device (fiber waste recovery device of Patent Literature 1) that is configured to collect yarn wastes generated during, for example, yarn threading to a textile machine such as a false-twist texturing machine. The yarn waste collection device has a yarn waste transfer pipe equipped with multiple suction parts through which yarn wastes are sucked, a yarn waste collector configured to collect the yarn wastes, and a cyclone separator provided between the yarn waste transfer pipe and the yarn waste collector to separate the yarn wastes from air. The yarn wastes sucked in together with the air from the suction parts are transferred through the inside of the yarn waste transfer pipe to the cyclone separator. Then, the yarn wastes and the air are separated by the cyclone separator, the air is discharged into the outside space (hereinafter, external space) of the cyclone separator, and the yarn wastes are discharged into the yarn waste collector.

SUMMARY OF THE INVENTION

[0003] The above-described cyclone separator defines an internal space that separates yarn wastes from air by multiple members (e.g., a side wall member and a top panel member covering an upper portion of the side wall member). The members are joined to each other at predetermined positions. However, a slight gap is unintentionally formed at a joint between the joined members. There is a risk that a yarn waste transferred from a yarn waste transfer pipe to the internal space of the cyclone separator may get caught in this gap. As a result, because yarn wastes accumulate in the internal space of the cyclone separator, clogging of the yarn wastes occurs and the yarn wastes cannot be properly collected.

[0004] An object of the present invention is therefore to provide a yarn waste collection cyclone separator configured to suppress clogging of yarn wastes in the internal space.

[0005] A yarn waste collection cyclone separator of the present invention is provided in a yarn waste collection device configured to collect a yarn waste, separates the yarn waste from air, discharges the yarn waste downward, and discharges the air upward, and the yarn waste collection cyclone separator includes: a first member and a second member which define at least part of an internal space where the yarn waste is separated from the air; and at least one joint where the first member and the second member are joined to each other, between the internal space and the at least one joint, at least one gap portion

being formed to allow the yarn waste to enter and leave the gap portion.

[0006] According to this configuration of the present invention, between the internal space and the joint, a gap portion is formed to allow a yarn waste to enter and leave the gap portion. Due to this, the yarn waste that has entered the gap portion from the internal space cannot reach the joint without passing through the gap portion. Moreover, after entering the gap portion, the yarn waste can leave the gap portion and return to the internal space. It is therefore possible to effectively suppress the yarn waste from reaching the joint. On this account, it is possible to suppress the yarn waste from being caught at the joint, and to suppress the yarn waste from clogging in the internal space of the yarn waste collection cyclone separator.

[0007] The yarn waste collection cyclone separator of the present invention is preferably arranged such that the at least one gap portion is shaped to prevent the yarn waste from reaching the at least one joint.

[0008] According to this configuration of the present invention, it is possible to further enhance the possibility that the yarn waste having entered the gap portion is returned to the internal space without reaching the joint. On this account, it is possible to effectively avoid the yarn waste from being caught at the joint, and to further suppress the yarn waste from clogging in the internal space of the yarn waste collection cyclone separator.

[0009] The yarn waste collection cyclone separator of the present invention is preferably arranged such that the at least one gap portion has a labyrinth structure in which a passage from an entrance of the at least one gap portion on the internal space side to the at least one joint is bent midway.

[0010] According to the configuration of the present invention, the yarn waste that has entered the first gap portion cannot reach the joint through the labyrinth structure without changing its traveling direction midway. In this way, as the traveling of the yarn waste is obstructed by the labyrinth structure, it is possible to further effectively suppress the yarn waste from reaching the joint.

[0011] The yarn waste collection cyclone separator of the present invention is preferably arranged such that the passage is bent plural times in the labyrinth structure.

[0012] According to the configuration of the present invention, the yarn waste that has entered the gap portion cannot reach the joint through the labyrinth structure without changing its traveling direction plural times. It is therefore possible to further reliably suppress the yarn waste from reaching the joint.

[0013] The yarn waste collection cyclone separator of the present invention is preferably arranged such that the first member is a side wall member which includes a cylindrical part extending in an up-down direction and a diameter enlarging part enlarged in a radial direction as compared to the cylindrical part at an upper part of the cylindrical part, the second member is a top panel member that covers an upper portion of the side wall member,

the at least one joint includes a first joint where the diameter enlarging part of the side wall member is joined to the top panel member, the at least one gap portion includes a first gap portion formed between the internal space and the first joint, and the first gap portion has the labyrinth structure.

[0014] According to the configuration of the present invention, because the labyrinth structure in which the passage is bent midway is formed in the first gap portion, it is possible to shorten the linear distance of the first gap portion from the internal space to the first joint. As a result, the radial outward expansion of the diameter enlarging part of the side wall member and of the top panel member can be suppressed, with the result that an increase in the size of the yarn waste collection cyclone separator is suppressed.

[0015] The yarn waste collection cyclone separator of the present invention is preferably arranged such that, in the cylindrical part, a communication hole is formed to communicate with the inside of a yarn waste transfer pipe which is provided in the yarn waste collection device to supply the yarn waste to the internal space, and the first joint is provided on the outer side in the radial direction of the inner surface of the cylindrical part, below the top panel member, and above the communication hole.

[0016] In the yarn waste collection cyclone separator of the configuration of the present invention, most of the air supplied to the internal space through the yarn waste transfer pipe flows along the inner circumferential surface of the cylindrical part. According to the configuration of the present invention, the first joint is provided on the outer side in the radial direction of the inner surface of the cylindrical part, below the top panel member, and above the communication hole. For this reason, the first joint does not obstruct the flow of air in the internal space. Due to this, it is possible to sufficiently ensure the separation of the yarn waste from the air by the yarn waste collection cyclone separator.

[0017] Preferably, the yarn waste collection cyclone separator of the present invention further includes: a side wall member which includes a cylindrical part extending in an up-down direction; and a top panel member which includes a top panel part covering an upper portion of the side wall member and a protruding part protruding upward from the top panel part, the first member being the top panel member, the second member being an air discharge section that is provided above the top panel member and including an air discharge port through which the air inside the internal space is discharged to the outside, the at least one joint including a second joint where the protruding part and the air discharge section are joined to each other, and the at least one gap portion including a second gap portion formed between the internal space and the second joint.

[0018] In the yarn waste collection cyclone separator of the configuration of the present invention, most of the air supplied to the internal space flows along the inner circumferential surface of the cylindrical part. According

to the configuration of the present invention, the second joint is a joint where the protruding part of the top panel member and the air discharge section are joined to each other. The second joint is therefore provided above the side wall member. For this reason, the second joint does not obstruct the flow of air in the internal space. Due to this, it is possible to sufficiently ensure the separation of the yarn waste from the air by the yarn waste collection cyclone separator.

[0019] The yarn waste collection cyclone separator of the present invention is preferably arranged such that the at least one gap portion is arranged to linearly extend from an entrance of the at least one gap portion on the internal space side toward the at least one joint.

[0020] According to the configuration of the present invention, because the gap portion is linear in shape, it is relatively easy to design components for forming the gap portion.

[0021] Preferably, the yarn waste collection cyclone separator of the present invention further includes: a side wall member which includes a cylindrical part extending in an up-down direction; and a top panel member covering an upper portion of the side wall member, at least one of the first member or the second member being the top panel member, and the at least one gap portion extending in a direction intersecting with the radial direction of the cylindrical part.

[0022] In general, in the yarn waste collection cyclone separator, a yarn waste moves along the inner circumference of the cylindrical part, and does not easily move in a direction intersecting with the radial direction of the cylindrical part. According to the configuration of the present invention, the gap portion extends in a direction that intersects with the cylindrical part. For this reason, the entrance of the yarn waste is structurally difficult. This makes it relatively easy to design the components while suppressing the yarn waste from reaching the joint through the gap portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a side view showing the outline of a false-twist texturing machine of an embodiment.

FIG. 2 is a schematic representation of a yarn waste collection device of the embodiment.

FIG. 3 is a perspective view of a cyclone separator.

FIG. 4 is a sectional view of the cyclone separator.

FIG. 5 is a partial sectional view in which joints and their surroundings of the cyclone separator are enlarged.

FIG. 6 relates to a modification and is a partial sectional view in which joints and their surroundings of a cyclone separator are enlarged.

FIG. 7 relates to another modification and is a partial sectional view in which joints and their surroundings of a cyclone separator are enlarged.

FIG. 8 relates to still another modification and is a partial sectional view in which joints and their surroundings of a cyclone separator are enlarged.

FIG. 9 is a top view of a first gap portion of still another modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] The following will describe a preferred embodiment of the present invention with reference to figures. In the following description, a yarn waste collection device 1 equipped with a yarn waste collection cyclone separator 30 according to the present invention will be described with the assumption that the device 1 is installed in a false-twist texturing machine 101. Hereafter, the yarn waste collection cyclone separator 30 will simply be referred to as cyclone separator 30.

(Overall Structure of False-Twist Texturing Machine)

[0025] To begin with, the following describes the false-twist texturing machine 101. Hereinafter, the up-down direction, the front-rear direction, and the left-right direction in the false-twist texturing machine 101 are those shown in FIG. 1, for convenience of explanation. The up-down direction is the vertical direction in which the gravity acts. The above-described directions will be consistently used in the following descriptions.

[0026] The false-twist texturing machine 101 is, for example, configured as a textile machine that produces processed yarns that are rich in elasticity by false-twisting yarns Y made of thermoplastic synthetic fibers such as polyester or polyamide to impart crimp. The false-twist texturing machine 101 includes a main frame 102, a yarn supply creel 104, first feed rollers 108, shifter guides 109, first heaters 110, coolers 111, a false-twisting device 106, second feed rollers 112, interlace nozzles 113, a second heater 114, third feed rollers 115, oiling rollers 116, and winding devices 107.

[0027] In the yarn path from the yarn supply creel 104 to the winding devices 107, the following members are provided in this order from the upstream in a yarn running direction: the first feed rollers 108; the shifter guides 109; the first heaters 110; the coolers 111; the false-twisting device 106; the second feed rollers 112; the interlace nozzles 113; the second heater 114; the third feed rollers 115; and the oiling rollers 116. Each component will be detailed below.

[0028] The main frame 102 is provided to extend in the up-down direction. The yarn supply creel 104 is provided to oppose the main frame 102 over a working space 103, so as to hold multiple yarn supply packages 105. The working space 103 is a space where an operator performs operations such as yarn threading to each device.

[0029] The first feed rollers 108 are rollers that feed the yarns Y from the upstream side to the downstream side in the yarn running direction. To be more specific, the first

feed rollers 108 are rollers for feeding the yarns Y supplied from the yarn supply creel 104 to the first heaters 110. The first feed rollers 108 are provided above the working space 103. The first feed rollers 108 are aligned in the front-rear direction.

[0030] The shifter guides 109 are provided between the first feed rollers 108 and the first heaters 110 in the yarn running direction. The shifter guides 109 are used to cause the yarns Y to pass through the first heaters 110 and the coolers 111 when threading the yarns Y to the false-twist texturing machine 101. In addition to this, the shifter guides 109 prevent twisting, which is applied to the yarns Y by the false-twisting device 106, from being propagated to the upstream side of the shifter guides 109 in the yarn running direction. The shifter guides 109 are aligned in the front-rear direction.

[0031] The first heaters 110 are configured to heat the yarns Y fed from the first feed rollers 108. The first heaters 110 are provided above the working space 103 and further above the first feed rollers 108. The first heaters 110 are aligned in the front-rear direction.

[0032] The coolers 111 are configured to cool the yarns Y heated by the first heaters 110. The coolers 111 are provided on the main frame 102 side of the first heaters 110 that are above the working space 103. The first heaters 110 and the coolers 111 are disposed above the working space 103 to extend obliquely upward away from the main frame 102. The coolers 111 are aligned in the front-rear direction.

[0033] The false-twisting device 106 is provided above of the main frame 102. The false-twisting device 106 is configured to false-twist the yarns Y supplied from the yarn supply creel 104. The false-twisting device 106 is, for example, a friction disc twister.

[0034] The second feed rollers 112 are rollers that feed the yarns Y from the upstream side to the downstream side in the yarn running direction. Specifically, the second feed rollers 112 are rollers that send the yarns Y twisted by the false-twisting device 106 to the interlace nozzles 113 and the second heaters 114. The second feed rollers 112 are provided above the main frame 102. The second feed rollers 112 are aligned in the front-rear direction. The yarn feeding speed of the second feed rollers 112 is higher than the yarn feeding speed of the first feed rollers 108. The yarns Y are therefore drawn between the first feed rollers 108 and the second feed rollers 112.

[0035] The interlace nozzles 113 are devices configured to interlace the yarns Y by injecting air thereto. The interlace nozzles 113 are provided above the main frame 102 and are provided below the second feed rollers 112. The interlace nozzles 113 are aligned in the front-rear direction.

[0036] The second heaters 114 are configured to heat the yarns Y interlaced by the interlace nozzles 113. The second heaters 114 are provided on the main frame 102 and behind the winding devices 107 when viewed from the working space 103. The second heaters 114 extend in the up-down direction.

[0037] The third feed rollers 115 are rollers that feed the yarns Y from the upstream side to the downstream side in the yarn running direction. Specifically, the third feed rollers 115 are rollers that feed the yarns Y heated by the second heaters 114 to the winding devices 107 via the oiling rollers 116. The third feed rollers 115 are provided below the second heaters 114. The third feed rollers 115 are aligned in the front-rear direction. The yarn feeding speed of the third feed rollers 115 is lower than the yarn feeding speed of the second feed rollers 112. The yarns Y are therefore relaxed between the second feed rollers 112 and the third feed rollers 115.

[0038] The oiling rollers 116 are rollers for applying oil to the yarns Y. Each oiling roller 116 is, for example, a driven roller that does not actively rotate. The oiling rollers 116 are aligned in the front-rear direction.

[0039] The winding devices 107 are configured to form packages 117 by winding the yarns Y, which have been false-twisted by the false-twisting device 106, onto unillustrated bobbins. The winding devices 107 are provided in the main frame 102. The winding devices 107 are provided to form four stages in the up-down direction. In each stage, the winding devices 107 are aligned in the front-rear direction.

[0040] As the devices are laid out in this way, the yarn path from the yarn supply creel 104 to the winding devices 107 is formed to surround the working space 103.

[0041] In the false-twist texturing machine 101 structured as described above, the yarns Y supplied from the yarn supply creel 104 are fed through the above-described devices and are then wound by the winding devices 107 to form the packages 117. The following will describe the details.

[0042] The yarns Y supplied from the yarn supply creel 104 are drawn between the first feed rollers 108 and the second feed rollers 112. The drawn yarns Y are twisted by the false-twisting device 106 and sent out. The twist formed by the false-twisting device 106 propagates to the shifter guides 109. The yarns Y having been twisted and drawn are heated by the first heaters 110 and cooled by the coolers 111, with the result that the twist is set. The yarns Y, whose twist has been thermally set, are unwound after passing through the false-twisting device 106 before reaching the second feed rollers 112.

[0043] On the yarns Y having been drawn and false-twisted in this way, interlacing portions are properly formed at the interlace nozzles 113 and hence the yarns Y are bundled. Subsequently, the yarns Y are thermally treated by the second heaters 114 while being relaxed between the second feed rollers 112 and the third feed rollers 115. Thereafter, the yarns Y are wound onto bobbins (not illustrated) by the winding devices 107 through the oiling rollers 116, with the result that packages 117 are formed. A fully wound package 117 is removed from the winding device 107 by the operator. A new bobbin is then attached to the winding device 107 by the operator, and the winding operation onto the bobbin is resumed. The replacement of the package 117 is performed in this way.

[0044] The yarn waste collection device 1 of the present embodiment is installed and used in the above-described false-twist texturing machine 101. The following describes the yarn waste collection device 1 of the present embodiment.

(Yarn Waste Collection Device)

[0045] The following describes the yarn waste collection device 1 with reference to FIG. 2. FIG. 2 is a schematic representation of the yarn waste collection device 1 of the present embodiment. The yarn waste collection device 1 is configured to collect a yarn waste generated during, for example, yarn threading to the false-twist texturing machine 101. Hereafter, the yarn waste collected by the yarn waste collection device 1 is referred to as a yarn waste Yw (see FIG. 3). FIG. 3 shows a yarn waste that is relatively long (e.g., yarn waste that is 900m in length). The yarn waste Yw of the present embodiment, however, encompasses a yarn waste that is relatively short in length and a yarn waste aggregate in which two or more yarn wastes are entangled with each other, and so forth. As shown in FIG. 2, the yarn waste collection device 1 includes yarn waste transfer pipes 11 (in the present embodiment, four yarn waste transfer pipes 11a to 11d), one yarn waste collector 13, and cyclone separators 30 (in the present embodiment, four cyclone separators 30a to 30d). One yarn waste collector 13 is provided for plural yarn waste transfer pipes 11. The cyclone separators 30 are provided to one-to-one correspond to the respective yarn waste transfer pipes 11.

(Yarn Waste Transfer Pipe)

[0046] The following will detail each yarn waste transfer pipe 11 with reference to FIG. 2. As shown in FIG. 2, the yarn waste transfer pipe 11 includes a main body pipe 14 and multiple suction parts 15 that suck in yarn wastes Yw. The main body pipe 14 is a hollow cylindrical pipe. A yarn waste Yw sucked in from a suction part 15 is transferred through the main body pipe 14. In the present embodiment, four yarn waste transfer pipes 11 are provided as described above.

[0047] The main body pipe 14 of each of the four yarn waste transfer pipes 11a to 11d is provided to extend in the front-rear direction at a position corresponding to each of the first to fourth stages of the winding devices 107 (see FIG. 1 and FIG. 2). To be more specific, the main body pipe 14 of the yarn waste transfer pipe 11a is provided to extend in the front-rear direction at a position corresponding to the first stage, i.e., the lowest stage of the winding devices 107. The main body pipe 14 of the yarn waste transfer pipe 11b is provided to extend in the front-rear direction at a position corresponding to the second lowest stage of the winding devices 107. The main body pipe 14 of the yarn waste transfer pipe 11c is provided to extend in the front-rear direction at a position corresponding to the third lowest stage of the winding

devices 107. The main body pipe 14 of the yarn waste transfer pipe 11d is provided to extend in the front-rear direction at a position corresponding to the fourth stage, i.e., the highest stage of the winding devices 107. The position of the main body pipe 14 corresponding to the winding devices 107 is, for example, slightly to the right of and below the winding devices 107 aligned in the front-rear direction. The position of the main body pipe 14, however, is not limited to such a position.

[0048] Each main body pipe 14 has an end portion on one side in the front-rear direction (i.e., a rear end portion shown in FIG. 2) which is closed, and an end portion on the other side (a front end portion shown in FIG. 2) which is connected to the cyclone separator 30.

[0049] As shown in FIG. 2, the suction parts 15 are aligned along the front-rear direction which is the longitudinal direction of the main body pipe 14. The suction parts 15 are positioned to correspond to the respective winding devices 107 aligned in the front-rear direction. As shown in FIG. 2, the suction parts 15 are connected to the main body pipe 14 via the suction pipes 16. Each suction part 15 is configured to suck in a yarn waste Yw by means of compressed air ejected from an unillustrated nozzle provided in the suction pipe 16. The yarn waste Yw sucked in together with the air from the suction part 15 is fed to the main body pipe 14 through the suction pipe 16.

(Yarn Waste Collector)

[0050] The yarn waste collector 13 is a container used for collecting the yarn waste Yw transferred from the yarn waste transfer pipe 11. The yarn waste collector 13 is connected to a yarn waste discharge part 34d (described later) of each of the four cyclone separators 30a to 30d. As shown in FIG. 2, in the present embodiment, one yarn waste collector 13 is provided for four yarn waste transfer pipes 11a to 11d. The disclosure, however, is not limited to this arrangement. For example, one yarn waste collector 13 may be provided for one yarn waste transfer pipe 11.

(Cyclone Separator)

[0051] The following will describe the cyclone separator 30 with reference to FIG. 2 to FIG. 5. FIG. 3 is a perspective view of the cyclone separator 30. FIG. 4 is a sectional view of the cyclone separator 30. FIG. 5 is a partial sectional view in which joints (described later) and their surroundings of the cyclone separator 30 are enlarged.

[0052] The cyclone separator 30 has a function of separating air from the yarn waste Yw fed through the inside of the main body pipe 14 of the yarn waste transfer pipe 11 and discharging the yarn waste Yw to the yarn waste collector 13. In the present embodiment, four cyclone separators 30 are provided. As shown in FIG. 2, the four cyclone separators 30a to 30d are provided

between the respective four yarn waste transfer pipes 11a to 11d and the yarn waste collector 13.

[0053] As shown in FIG. 3 and FIG. 4, the cyclone separator 30 includes a separation section 32 that separates a yarn waste Yw from air and an air discharge section 50 that discharges air to the outside of the cyclone separator 30.

(Separation Section)

[0054] To begin with, the separation section 32 will be described. The separation section 32 is configured to separate air from a yarn waste Yw sent from the yarn waste transfer pipe 11. As shown in FIG. 4, the separation section 32 includes a side wall member 34 and a top panel member 36 covering an upper portion of the side wall member 34. The side wall member 34 and the top panel member 36 are, for example, made of resin. The side wall member 34 includes a cylindrical part 34a, a diameter enlarging part 34b which is above the cylindrical part 34a and has a diameter enlarged outward in the radial direction of the cylindrical part 34a, a tapered part 34c which is connected to a lower end portion of the cylindrical part 34a and is tapered toward the leading end of the cylinder, and a cylindrical yarn waste discharge part 34d which is connected to a lower end portion of the tapered part 34c.

[0055] The cylindrical part 34a has an axis extending in a direction substantially identical with the up-down direction, for example. The cylindrical part 34a extends in the up-down direction, is cylindrical in shape, and is open at an upper end portion and a lower end portion. The cylindrical part 34a communicates with the main body pipe 14 of the yarn waste transfer pipe 11. To be more specific, as shown in FIG. 5, a communication hole 39 is formed at a position slightly below the upper end of the cylindrical part 34a. The communication hole 39 connects the inside of the main body pipe 14 of the yarn waste transfer pipe 11 with the inside of the cylindrical part 34a. As shown in FIG. 3, an end portion on the other side of the main body pipe 14 (the front end portion shown in FIG. 2) communicates with the cylindrical part 34a along the circumferential direction of the inner circumferential wall 35 of the cylindrical part 34a.

[0056] The diameter enlarging part 34b is a part where the diameter is radially enlarged as compared to the cylindrical part 34a at an upper end portion of the cylindrical part 34a. The diameter enlarging part 34b is a part joined to the top panel member 36. A first joint 81 where the diameter enlarging part 34b and the top panel member 36 are joined to each other will be described later. It is noted that the diameter enlarging part 34b is not shown in FIG. 3.

[0057] An upper end portion of the tapered part 34c is connected to the cylindrical part 34a. A lower end portion of the tapered part 34c is connected to the later-described yarn waste discharge part 34d. The size of the inner diameter of the upper end portion of the tapered part

34c is substantially identical with the size of the inner diameter of the cylindrical part 34a. The inner diameter of the lower end portion of the tapered part 34c is smaller than the inner diameter of the upper end portion. The tapered part 34c has a hollow circular frustum shape that tapers from the upper end portion toward the lower end portion. The upper end portion and the lower end portion of the tapered part 34c are open. The tapered part 34c and the cylindrical part 34a are integrally formed. In other words, the tapered part 34c and the cylindrical part 34a do not have a joint where these parts are joined to each other.

[0058] The yarn waste discharge part 34d is a part from which a yarn waste Yw is discharged to the yarn waste collector 13. The yarn waste discharge part 34d has an axis that extends in a direction substantially identical with the up-down direction, is cylindrical in shape, and is open at an upper end portion and a lower end portion. The upper end portion of the yarn waste discharge part 34d is connected to the lower end portion of the tapered part 34c. The lower end portion of the yarn waste discharge part 34d is connected to the yarn waste collector 13. The size of the inner diameter of the yarn waste discharge part 34d is substantially identical with the size of the inner diameter of the lower end portion of the tapered part 34c. In the present embodiment, the parts (the cylindrical part 34a, the diameter enlarging part 34b, the tapered part 34c, and the yarn waste discharge part 34d) of the side wall member 34 are integrally formed.

[0059] As shown in FIG. 3 and FIG. 4, the top panel member 36 includes a disc-shaped top panel part 36a covering an upper portion of the side wall member 34 and a protruding part 36b which protrudes upward from around the center of the top panel part 36a. When viewed in the up-down direction, the top panel part 36a is donut-shaped such that a hole is formed at the center of the disc-shaped top panel part 36a. The diameter (outer diameter) of the top panel part 36a is larger than the inner diameter of the cylindrical part 34a. The top panel part 36a is joined to the diameter enlarging part 34b. A first joint 81 where the diameter enlarging part 34b and a top panel part 36a are joined to each other will be described later. The protruding part 36b is a part that protrudes upward from around the center of the top panel part 36a. As shown in FIG. 3 and FIG. 4, the protruding part 36b has a circular opening portion 38 that is coaxial with the cylindrical part 34a. That is to say, the protruding part 36b is cylindrical in shape and is coaxial with the cylindrical part 34a. The opening portion 38 formed in the protruding part 36b is arranged to allow a later-described insertion member 51 of the air discharge section 50 to be inserted. At an upper portion of the protruding part 36b, a through hole 37 is formed to allow a later-described bolt 83 to penetrate the same (see FIG. 5).

(Air Discharge Section)

[0060] The following describes the air discharge sec-

tion 50. The air discharge section 50 discharges air separated from a yarn waste Yw in the separation section 32 to the outside of the cyclone separator 30. The air discharge section 50 is provided above the separation section 32. As shown in FIG. 3 and FIG. 4, the air discharge section 50 includes the insertion member 51, a yarn waste cover 52, and a discharge sound suppressor 53.

[0061] The insertion member 51 is arranged to be insertable into and removable from the opening portion 38 formed in the protruding part 36b of the top panel member 36 of the separation section 32. The insertion member 51 is cylindrical in shape and is coaxial with the cylindrical part 34a of the separation section 32. As shown in FIG. 4, inside the insertion member 51, an air discharge port 55 is formed. The outer diameter of the insertion member 51 is slightly smaller in size than the inner diameter of the opening portion 38. At an upper portion of the insertion member 51, a through hole 58 is formed to allow a later-described bolt 83 to penetrate the same (see FIG. 5). The protruding part 36b of the top panel member 36 and the insertion member 51 are joined to each other. A second joint 82 where the insertion member 51 and the protruding part 36b are joined to each other will be described later.

[0062] The yarn waste cover 52 is a member configured to suppress the discharge of a yarn waste Yw from the air discharge section 50 to the outside of the cyclone separator 30. As shown in FIG. 4, the yarn waste cover 52 is formed to cover the air discharge port 55 at a lower end portion of the insertion member 51. The yarn waste cover 52 is a porous circular plate member whose thickness direction is parallel to the up-down direction. The holes 56 formed in the yarn waste cover 52 penetrate the yarn waste cover 52 in the up-down direction. The air separated from the yarn waste Yw in the separation section 32 can pass through the holes 56. On the other hand, part of the yarn waste cover 52 where the holes 56 are not formed suppresses the yarn waste Yw from being discharged to the outside. In the present embodiment, the insertion member 51 and the yarn waste cover 52 are integrally formed. Alternatively, the insertion member 51 and the yarn waste cover 52 may be independent members. In the present embodiment, the bottom surface of the yarn waste cover 52 is on the same plane as the bottom surface of the top panel member 36. It is noted that the yarn waste cover 52 is not shown in FIG. 3.

[0063] The discharge sound suppressor 53 is configured to suppress the discharge sound generated when air is discharged to the outside of the cyclone separator 30. As shown in FIG. 4, the discharge sound suppressor 53 is connected to an upper end portion of the insertion member 51. The discharge sound suppressor 53 is cylindrical in shape and is coaxial with the insertion member 51. The inner diameter of the discharge sound suppressor 53 is larger in size than the inner diameter of the insertion member 51. On the discharge sound suppressor 53, frill members 57 are formed to protrude inward in

the radial direction and obliquely upward from the inner wall. Although the detailed principle of suppression of discharge sound by the discharge sound suppressor 53 is not explained here, the presence of the above-described frill members 57 suppresses discharge sound generated by the air passing through the discharge sound suppressor 53. It is noted that the frill members 57 are not shown in FIG. 3.

[0064] In the above-described cyclone separator 30, as shown in FIG. 4, the side wall member 34 and the top panel member 36 of the separation section 32 and the insertion member 51 of the air discharge section 50 define an internal space 90 where a yarn waste Yw is separated from air.

[0065] In the cyclone separator 30 configured as described above, a yarn waste Yw and air are separated as follows. To begin with, a yarn waste Yw is fed with air from the main body pipe 14 to the cylindrical part 34a of the separation section 32. The yarn waste Yw fed to the cylindrical part 34a is transferred downward while rotating in the circumferential direction along the inner circumferential wall 35 of the cylindrical part 34a due to the centrifugal force, i.e., due to the centrifugal separation. The yarn waste Yw having moved downward inside the cylindrical part 34a is further transferred along the inner wall 45 of the tapered part 34c toward the yarn waste discharge part 34d. The yarn waste Yw is then discharged from the yarn waste discharge part 34d to the yarn waste collector 13. During the process in which the yarn waste Yw moves along the inner circumferential wall 35 of the cylindrical part 34a and the inner circumferential wall 35 of the tapered part 34c, air is separated from the yarn waste Yw and discharged to the outside from the air discharge section 50. In this way, the yarn waste Yw and air are separated in the cyclone separator 30. The cyclone separator 30 does not completely separate the yarn waste Yw from the air, and the yarn waste Yw heading toward the yarn waste discharge part 34d contains air. For this reason, from the yarn waste discharge part 34d, not only the yarn waste Yw but also the air which was not discharged from the air discharge section 50 are discharged together.

[0066] As described above, in the cyclone separator 30 of the present embodiment, the internal space 90 is defined by the side wall member 34, the top panel member 36, and the insertion member 51. The side wall member 34 and the top panel member 36 are joined to each other, and the top panel member 36 and the insertion member 51 are joined to each other. The following specifically describes this arrangement with reference to FIG. 5. FIG. 5 is a partial sectional view in which two joints and their surroundings of the cyclone separator 30 are enlarged. An upper portion of the diameter enlarging part 34b of the side wall member 34 and a lower portion of the top panel part 36a of the top panel member 36 are joined to each other by ultrasonic welding. For example, the lower portion of the top panel part 36a and the upper portion of the diameter enlarging part 34b are joined to

each other over the entire circumference. Hereafter, the joint between the side wall member 34 and the top panel member 36 will be referred to as a first joint 81. As shown in FIG. 5, the first joint 81 is provided on the outer side in the radial direction of the inner circumferential wall 35 (inner surface of the present invention) of the cylindrical part 34a, below the top panel member 36, and above the communication hole 39. The protruding part 36b of the top panel member 36 and the insertion member 51 are joined by a bolt 83. Specifically, the protruding part 36b and the insertion member 51 are joined to each other in such a way that the bolt 83 is inserted to penetrate the through hole 37 and the through hole 58 in a state in which the insertion member 51 is inserted into the opening portion 38 of the protruding part 36b and the through hole 37 of the protruding part 36b and the through hole 58 of the insertion member 51 are aligned. Hereafter, the joint between the top panel member 36 and the insertion member 51 will be referred to as a second joint 82. In the present embodiment, a combination of the side wall member 34 and the top panel member 36 is equivalent to a combination of a first member and a second member in the present invention. Likewise, a combination of the top panel member 36 and the insertion member 51 is equivalent to a combination of a first member and a second member of the present invention.

[0067] However, a slight gap is unintentionally formed at each of the first joint 81 and the second joint 82 described above. There is a risk that a yarn waste Yw transferred from the yarn waste transfer pipe 11 to the internal space 90 of the cyclone separator 30 may get caught in this gap. As a result, yarn wastes Yw accumulate in the internal space 90 of the cyclone separator 30, causing clogging of the yarn wastes Yw, and consequently, the yarn wastes Yw cannot be properly collected. Therefore, the present embodiment employs an arrangement for suppressing yarn wastes Yw from clogging in the internal space 90. The following will describe the details.

(First Gap Portion)

[0068] As shown in FIG. 5, in the cyclone separator 30 of the present embodiment, a first gap portion 84 through which a yarn waste Yw can enter and leave is formed between the internal space 90 and the first joint 81. The first gap portion 84 is a space that communicates with the internal space 90 and is surrounded by a lower portion of the top panel part 36a of the top panel member 36, an upper portion of the diameter enlarging part 34b of the side wall member 34, and the first joint 81. The width of the first gap portion 84 is, for example, preferably within the range of 0.5 to 3.0 mm when viewed in a direction (e.g., the front-rear direction) orthogonal to the up-down direction. The width of the first gap portion 84 indicates a gap between the top panel part 36a and the diameter enlarging part 34b.

[0069] The first gap portion 84 is shaped to prevent a yarn waste Yw from reaching the first joint 81. To be more

specific, as shown in FIG. 5, the first gap portion 84 has a labyrinth structure in which a passage from an entrance 84a of the first gap portion 84 on the internal space 90 side to the first joint 81 is bent midway. As shown in FIG. 5, in the labyrinth structure of the present embodiment, the passage in the first gap portion 84 is bent three times. In other words, a protrusion 91 is formed to protrude downward at a lower portion of the top panel part 36a defining the first gap portion 84, whereas a recess 92 corresponding to the protrusion 91 is formed at an upper portion of the diameter enlarging part 34b defining the first gap portion 84. The protrusion 91 is formed over the entire circumference of the lower portion of the top panel part 36a. The recess 92 is formed over the entire circumference of the upper portion of the diameter enlarging part 34b. By forming the protrusion 91 and the recess 92, the labyrinth structure in which the passage from the entrance 84a to the first joint 81 is bent three times is formed in the first gap portion 84.

(Second Gap Portion)

[0070] As shown in FIG. 5, in the cyclone separator 30 of the present embodiment, a second gap portion 85 through which a yarn waste Yw can enter and leave is formed between the internal space 90 and the second joint 82. The second gap portion 85 is a space that communicates with the internal space 90 and is surrounded by the inner circumferential surface of the protruding part 36b of the top panel member 36 and the outer circumferential surface of the insertion member 51. The width of the second gap portion 85 is, for example, preferably within the range of 0.5 to 3.0 mm when viewed in a direction (e.g., the front-rear direction) orthogonal to the up-down direction. The width of the second gap portion 85 indicates a gap between the protruding part 36b and the insertion member 51.

[0071] The second gap portion 85 is shaped to prevent a yarn waste Yw from reaching the second joint 82. To be more specific, as shown in FIG. 5, the second gap portion 85 linearly extends from an entrance 85a of the second gap portion 85 on the internal space 90 side toward the second joint 82. In the present embodiment, the second gap portion 85 extends in the up-down direction which is orthogonal to the radial direction of the cylindrical part 34a of the side wall member 34. The length in the up-down direction of the second gap portion 85 is preferably 20 to 40 mm. This makes it possible to suppress increase in height of the cyclone separator 30 while suppressing the yarn waste Yw from reaching the second joint 82.

(Effects)

[0072] The cyclone separator 30 of the present embodiment includes: a first member and a second member defining at least part of the internal space 90 where a yarn waste Yw is separated from air (the combination of the side wall member 34 and the top panel member 36 and

the combination of the top panel member 36 and the insertion member 51 are equivalent to the first member and the second member of the present invention); and joints (the first joint 81 and the second joint 82) where the first member and the second member are joined to each other. Between the internal space 90 and the joint, gap portions (the first gap portion 84 and the second gap portion 85) are formed to allow a yarn waste Yw to enter and leave the gap portion. Hereinafter, the first joint 81 and the second joint 82 may be simply referred to as joints. Hereinafter, furthermore, the first gap portion 84 and the second gap portion 85 may be simply referred to as gap portions. According to the present embodiment, the yarn waste Yw that has entered a gap portion from the internal space 90 cannot reach the joint without passing through the gap portion. Moreover, after entering the gap portion, the yarn waste Yw can leave the gap portion and return to the internal space 90. It is therefore possible to effectively suppress the yarn waste Yw from reaching the joint. On this account, it is possible to suppress the yarn waste Yw from being caught at the joint, and to suppress the yarn waste Yw from clogging in the internal space 90 of the cyclone separator 30.

[0073] In the cyclone separator 30 of the present embodiment, the gap portion is shaped to prevent the yarn waste Yw from reaching the joint. According to the present embodiment, it is possible to further enhance the possibility that the yarn waste Yw having entered the gap portion is returned to the internal space 90 without reaching the joint. On this account, it is possible to effectively avoid the yarn waste Yw from being caught at the joint, and to further suppress the yarn waste Yw from clogging in the internal space 90 of the cyclone separator 30.

[0074] In the cyclone separator 30 of the present embodiment, the first gap portion 84 has a labyrinth structure in which a passage from an entrance 84a of the first gap portion 84 on the internal space 90 side to the first joint 81 is bent midway. According to the present embodiment, the yarn waste Yw that has entered the first gap portion 84 cannot reach the first joint 81 through the labyrinth structure without changing its traveling direction midway. In this way, as the traveling of the yarn waste Yw is obstructed by the labyrinth structure, it is possible to further effectively suppress the yarn waste Yw from reaching the first joint 81.

[0075] Furthermore, in the cyclone separator 30 of the present embodiment, the above-described labyrinth structure is arranged such that the passage of the first gap portion 84 is bent plural times (three times in the present embodiment). According to the present embodiment, the yarn waste Yw that has entered the first gap portion 84 cannot reach the first joint 81 through the labyrinth structure without changing its traveling direction plural times. It is therefore possible to further reliably suppress the yarn waste Yw from reaching the first joint 81.

[0076] In the cyclone separator 30 of the present embodiment, the first member is the side wall member 34

which includes the cylindrical part 34a extending in the up-down direction and the diameter enlarging part 34b which is radially enlarged as compared to the cylindrical part 34a at an upper part of the cylindrical part 34a. The second member is the top panel member 36 that covers an upper part of the side wall member 34. The joints include the first joint 81 where the diameter enlarging part 34b of the side wall member 34 is joined with the top panel member 36. The gap portions include the first gap portion 84 formed between the internal space 90 and the first joint 81. The first gap portion 84 has the labyrinth structure. According to the present embodiment, because the labyrinth structure in which the passage is bent midway is formed in the first gap portion 84, it is possible to shorten the linear distance of the first gap portion 84 from the internal space 90 to the first joint 81. As a result, the radial outward expansion of the diameter enlarging part 34b of the side wall member 34 and of the top panel member 36 can be suppressed, with the result that an increase in the size of the cyclone separator 30 is suppressed. Furthermore, the above-described configuration produces the following effects. Traditionally, because a yarn waste Yw in the internal space 90 moves along the inner circumferential surface of the cylindrical part 34a, the yarn waste Yw tends to be caught at the first joint 81. Because the first gap portion 84 having the labyrinth structure is provided between the internal space 90 and the first joint 81, it is possible to effectively suppress the yarn waste Yw from being caught at the first joint 81.

[0077] In the cyclone separator 30 of the present embodiment, in the cylindrical part 34a, the communication hole 39 is formed to communicate with the inside of the main body pipe 14 of the yarn waste transfer pipe 11. The first joint 81 is provided on the outer side in the radial direction of the inner circumferential wall 35 of the cylindrical part 34a, below the top panel member 36, and above the communication hole 39. In the cyclone separator 30 of the present embodiment, most of the air supplied to the internal space 90 through the yarn waste transfer pipe 11 flows along the inner circumferential surface of the cylindrical part 34a. According to the present embodiment, the first joint 81 is provided on the outer side in the radial direction of the inner circumferential wall 35 of the cylindrical part 34a, below the top panel member 36, and above the communication hole 39. For this reason, the first joint 81 does not obstruct the flow of air in the internal space 90. Due to this, it is possible to sufficiently ensure the separation of the yarn waste Yw from the air by the cyclone separator 30.

[0078] In the cyclone separator 30 of the present embodiment, the first member is the top panel member 36 having the top panel part 36a covering the upper portion of the side wall member 34 and the protruding part 36b protruding upward from the top panel part 36a. The second member is the air discharge section 50 that is provided above the top panel member 36 and includes the air discharge port 55 through which the air inside the internal space 90 is discharged to the outside. The joints

include the second joint 82 where the protruding part 36b and the air discharge section 50 (to be more strict, the insertion member 51 of the air discharge section 50) are joined to each other. The gap portions include the second gap portion 85 formed between the internal space 90 and the second joint 82. In the cyclone separator 30 of the present embodiment, most of the air supplied to the internal space 90 flows along the inner circumferential surface of the cylindrical part 34a. According to the present embodiment, the second joint 82 is a joint where the protruding part 36b of the top panel member 36 and the air discharge section 50 are joined to each other. The second joint 82 is therefore provided above the side wall member 34. For this reason, the second joint 82 does not obstruct the flow of air in the internal space 90. As a result, the cyclone separator 30 can sufficiently ensure the separation of the yarn waste Yw from the air.

[0079] In the cyclone separator 30 of the present embodiment, the second gap portion 85 is arranged to linearly extend from the entrance 85a of the second gap portion 85 on the internal space 90 side toward the second joint 82. According to the present embodiment, because the second gap portion 85 is linear in shape, it is relatively easy to design components for forming the second gap portion 85.

[0080] Furthermore, the cyclone separator 30 of the present embodiment includes the side wall member 34 having the cylindrical part 34a and the top panel member 36 covering the upper portion of the side wall member 34. At least one of the first member or the second member is the top panel member 36. The second gap portion 85 extends in a direction intersecting with the radial direction of the cylindrical part 34a. In general, in the cyclone separator 30, a yarn waste Yw moves along the inner circumference of the cylindrical part 34a, and does not easily move in a direction intersecting with the radial direction of the cylindrical part 34a. According to the present embodiment, the second gap portion 85 extends in a direction that intersects with the cylindrical part 34a. For this reason, the entrance of the yarn waste Yw is structurally difficult. This makes it relatively easy to design the components while suppressing the yarn waste Yw from reaching the second joint 82 through the second gap portion 85.

(Modifications)

[0081] The following will describe modifications of the above-described embodiment. The members identical with those in the embodiment above will be denoted by the same reference symbols and the explanations thereof are not repeated.

(1) In the embodiment above, as shown in FIG. 5, the second gap portion 85 is formed to linearly extend between the internal space 90 and the second joint 82 where the protruding part 36b of the top panel member 36 is joined with the insertion member 51.

The second gap portion 85, however, may not be arranged in this way. A modification is specifically described below with reference to FIG. 6. FIG. 6 is a partial sectional view in which joints and their surroundings of a cyclone separator 30 of the modification are enlarged.

[0082] As shown in FIG. 6, an inner extending portion 93 is formed at a lower portion of a protruding part 136b of a top panel member 136 to extend in the radial direction toward the inside of the cylindrical part 34a. The inner extending portion 93 is bent upward partway. The top panel part 136a of the top panel member 136 is similar in shape to the top panel part 36a of the top panel member 36 of the embodiment described above. In the insertion member 151, a downward recess 94 is formed to correspond to the upward bend of the inner extending portion 93. The inner extending portion 93 is formed over the entire circumference of the protruding part 36b in plan view. The recess 94 is formed over the entire circumference of the insertion member 151 in plan view. A protruding part 136b of the top panel member 136 and the insertion member 151 are joined by a bolt 83. Specifically, the protruding part 136b and the insertion member 151 are joined to each other in such a way that the bolt 83 is inserted to penetrate a through hole 137 and a through hole 158 in a state in which (as shown in FIG. 6) the insertion member 151 is inserted into an opening (not illustrated) formed in the protruding part 136b and the through hole 137 of the protruding part 136b and the through hole 158 of the insertion member 151 are aligned. Hereafter, the joint between the top panel member 136 and the insertion member 151 will be referred to as a second joint 182.

[0083] As shown in FIG. 6, between the internal space 90 and the second joint 182, a second gap portion 185 is formed to allow a yarn waste Yw to enter and leave the gap portion. The second gap portion 185 has a labyrinth structure in which a passage from an entrance 185a of the second gap portion 185 on the internal space 90 side to the second joint 182 is bent midway. As shown in FIG. 6, in the labyrinth structure, the passage in the second gap portion 185 is bent four times. To put it differently, by forming the above-described inner extending portion 93 and the recess 94, the labyrinth structure in which the passage from the entrance 185a to the second joint 182 is bent four times is formed in the second gap portion 185. According to the configuration above, the yarn waste Yw that has entered the second gap portion 185 cannot reach the second joint 182 through the labyrinth structure without changing its traveling direction plural times. It is therefore possible to further reliably suppress the yarn waste Yw from reaching the second joint 182.

[0084] (2) In the embodiment above, the first gap portion 84 has a labyrinth structure and the second gap portion 85 extends linearly. The first gap portion 84 and the second gap portion 85, however, may not be arranged in this way. The first gap portion 84 may be variously

shaped as long as a yarn waste Yw is prevented from reaching the first joint 81. To be more specific, the first gap portion 84 may be curved in shape, for example. The first gap portion 84 may be differently shaped. The first gap portions related to the two modifications (first gap portion 184 and first gap portion 284) are shown in FIG. 7 and FIG. 8. Each of FIG. 7 and FIG. 8 is a partial sectional view in which joints and their surroundings of a cyclone separator 30 of each modification are enlarged. For example, as shown in FIG. 7, the first gap portion 184 may be arranged to narrow in width from an entrance 184a on the internal space 90 side toward a first joint 81. To be more specific, when viewed in a direction orthogonal to the up-down direction, a stepped structure is formed in an upper portion of a diameter enlarging part 134b defining the first gap portion 184. In this stepped structure, the higher the step, the more it is positioned toward the first joint 81. The stepped structure may be formed in the bottom surface of a top panel part 36a defining the first gap portion 184. Alternatively, for example, as shown in FIG. 8, a first gap portion 284 may have a space into which a yarn waste Yw strays. To be more specific, when viewed in a direction orthogonal to the up-down direction, two protrusions 191 protruding upward are formed in an upper portion of a diameter enlarging part 234b defining the first gap portion 284. As the two protrusions 191 are provided, a recessed space is formed at an upper portion of the diameter enlarging part 234b that defines the first gap portion 284. The recessed space is a space into which a yarn waste Yw strays. While the number of the protrusions 191 is two in this arrangement, the number may be three or more. On the bottom surface of the top panel part 36a defining the first gap portion 284, a protrusion may be formed to protrude downward. Similarly, the second gap portion 85 may be variously shaped as long as a yarn waste Yw is prevented from reaching the second joint 82. To be more specific, it is possible to employ an arrangement similar to the arrangement of each modification of the first gap portion 84.

[0085] (3) In the embodiment above, in the labyrinth structure of the first gap portion 84, the passage from the entrance 84a to the first joint 81 is bent three times. However, the disclosure is not limited to this arrangement. For example, the number of bends in the passage of the first gap portion 84 may be two or less, or four or more. It is noted that the number of bends in the passage of the first gap portion 84 is preferably as small as possible from the perspective of the ease of processing the components, whereas the number of bends in the passage of the first gap portion 84 is preferably as large as possible from the perspective of the suppression of a yarn waste Yw from reaching the first joint 81. Considering the balance between the ease of processing the components and the suppression of a yarn waste Yw from reaching the first joint 81, the number of bends of the passage in the first gap portion 84 is preferably three.

[0086] (4) In the embodiment above, the first gap portion 84 has the labyrinth structure in which the passage

from the entrance 85a to the first joint 81 is bent. Alternatively, the first gap portion 84 may linearly extend from the entrance 85a to the first joint 81. In this case, the length of the first gap portion 84 is preferably 20 to 40 mm.

[0087] (5) In the embodiment above, the second gap portion 85 extends linearly in the up-down direction. Alternatively, the second gap portion 85 may linearly extend in a direction different from the up-down direction. For example, the second gap portion 85 may linearly extend in a direction oblique to the up-down direction. The second gap portion 85 may extend along a curved line.

[0088] (6) In the embodiment above, the tapered part 34c and the yarn waste discharge part 34d are integrally formed in the side wall member 34 of the separation section 32. In this regard, the tapered part 34c and the yarn waste discharge part 34d may not be integrally formed. In this case, the gap portion of the present invention is provided between (i) the joint between the tapered part 34c and the yarn waste discharge part 34d of the side wall member 34 and (ii) the internal space 90.

[0089] (7) According to the present embodiment, the first joint 81 is provided on the outer side of the inner circumferential wall 35 of the cylindrical part 34a in the radial direction, below the top panel member 36, and above the communication hole 39 (see FIG. 5). The disclosure, however, is not limited to this arrangement. The first joint 81 may be provided on the inside of the inner circumferential wall 35 of the cylindrical part 34a in the radial direction, for example. Alternatively, the first joint 81 may be provided below the communication hole 39, for example. For example, the first joint 81 may be provided on the outer side of the inner circumferential wall 35 of the cylindrical part 34a in the radial direction and in the vicinity of a lower end portion of the cylindrical part 34a. By providing the first joint 81 in the vicinity of the lower end portion of the cylindrical part 34a, the distance between the communication hole 39 connected to the main body pipe 14 and the first joint 81 is long. This would make it easy for a yarn waste Yw supplied from the main body pipe 14 to the internal space 90 of the cyclone separator 30 to flow together with air flowing along the inner circumferential wall 35 of the cylindrical part 34a. As a result, the action of the yarn waste Yw stabilizes, making it less likely for the yarn waste Yw to become tangled.

[0090] (8) In the embodiment above, the labyrinth structure provided at the first gap portion 84 is formed over the entire circumference of the lower portion of the top panel part 36a and the upper portion of the diameter enlarging part 34b. In other words, the protrusion 91 is formed over the entire circumference of the lower portion of the top panel part 36a, and the recess 92 is formed over the entire circumference of the upper portion of the diameter enlarging part 34b. The disclosure, however, is not limited to this arrangement. A first gap portion 384 according to a modification is shown in FIG. 9. FIG. 9 is a top view of the first gap portion 384. As shown in FIG. 9, a

first gap portion 384 is formed between the internal space 90 and a first joint 381 (hatched in FIG. 9). The first gap portion 384 is a space that communicates with the internal space 90 and is surrounded by a lower portion of a top panel part (not illustrated) of the top panel member 36, an upper portion of a diameter enlarging part (not illustrated) of the side wall member 34, and the first joint 381. The first gap portion 384 has a labyrinth structure shown in FIG. 9.

[0091] To be more specific, on the lower portion of the top panel part (not illustrated) defining the first gap portion 384, protrusions 391 are formed to protrude downward (see dotted lines in FIG. 9). On the upper portion of the diameter enlarging part (not illustrated) defining the first gap portion 384, protrusions 392 and 393 are formed to protrude upward (see solid lines in FIG. 9). As shown in FIG. 9, the protrusions 391 are formed on the lower portion of the top panel part at intervals in the circumferential direction. As shown in FIG. 9, the protrusions 392 are formed on the upper portion of the diameter enlarging part at intervals in the circumferential direction. Likewise, the protrusions 393 are formed at intervals in the circumferential direction on the upper portion of the diameter enlarging part. In the radial direction, the protrusions 392, 391, and 393 are provided in this order from the inside. In this regard, preferably, as shown in FIG. 9, the protrusions 391 and the protrusions 392 are positionally deviated in the circumferential direction. Furthermore, preferably, as shown in FIG. 9, the protrusions 391 and the protrusions 393 are positionally deviated in the circumferential direction. In particular, in order to form the labyrinth structure at any position in the circumferential direction in a cross section of the first gap portion 384 viewed in the horizontal direction, the protrusions 391, the protrusion 392, and the protrusions 393 are preferably different from each other in position in the circumferential direction.

[0092] (9) In the embodiment above, the four cyclone separators 30a to 30d are connected to the four yarn waste transfer pipes 11a to 11d, respectively. Alternatively, one cyclone separator 30 may be connected to four yarn waste transfer pipes 11a to 11d.

[0093] (10) In the embodiment above, the yarn waste collection device 1 equipped with a cyclone separator 30 is installed in the false-twist texturing machine 101. The disclosure, however, is not limited to this arrangement. For example, the yarn waste collection device 1 equipped with a cyclone separator 30 may be installed in a textile machine such as a spun yarn take-up machine.

Claims

1. A yarn waste collection cyclone separator (30) which is provided in a yarn waste collection device (1) configured to collect a yarn waste (Yw), which separates the yarn waste (Yw) from air, which discharges the yarn waste (Yw) downward, and which discharges the air upward, the yarn waste collection

cyclone separator (30) comprising:

- a first member and a second member which define at least part of an internal space (90) where the yarn waste (Yw) is separated from the air; and
 at least one joint (81, 82) where the first member and the second member are joined to each other,
 between the internal space (90) and the at least one joint (81, 82), at least one gap portion (84, 85) being formed to allow the yarn waste (Yw) to enter and leave the gap portion (84, 85).
2. The yarn waste collection cyclone separator (30) according to claim 1, wherein, the at least one gap portion (84, 85) is shaped to prevent the yarn waste (Yw) from reaching the at least one joint (81, 82).
3. The yarn waste collection cyclone separator (30) according to claim 1 or 2, wherein, the at least one gap portion (84) has a labyrinth structure in which a passage from an entrance (84a) of the at least one gap portion (84) on the internal space (90) side to the at least one joint (81) is bent midway.
4. The yarn waste collection cyclone separator (30) according to claim 3, wherein, the passage is bent plural times in the labyrinth structure.
5. The yarn waste collection cyclone separator (30) according to claim 3 or 4, wherein,
- the first member is a side wall member (34) which includes a cylindrical part (34a) extending in an up-down direction and a diameter enlarging part (34b) enlarged in a radial direction as compared to the cylindrical part (34a) at an upper part of the cylindrical part (34a),
 the second member is a top panel member (36) that covers an upper portion of the side wall member (34),
 the at least one joint includes a first joint (81) where the diameter enlarging part (34b) of the side wall member (34) is joined to the top panel member (36),
 the at least one gap portion includes a first gap portion (84) formed between the internal space (90) and the first joint (81), and
 the first gap portion (84) has the labyrinth structure.
6. The yarn waste collection cyclone separator (30) according to claim 5, wherein,
- in the cylindrical part (34a), a communication hole (39) is formed to communicate with the inside of a yarn waste transfer pipe (11) which

is provided in the yarn waste collection device (1) to supply the yarn waste (Yw) to the internal space (90), and
 the first joint (84) is provided on the outer side in the radial direction of the inner surface of the cylindrical part (34a), below the top panel member (36), and above the communication hole (39).

7. The yarn waste collection cyclone separator (30) according to claim 1 or 2, further comprising:
- a side wall member (34) which includes a cylindrical part (34a) extending in an up-down direction; and a top panel member (36) which includes a top panel part (36a) covering an upper portion of the side wall member (34) and a protruding part (36b) protruding upward from the top panel part (36a),
 the first member being the top panel member (36),
 the second member being an air discharge section (50) that is provided above the top panel member (36) and including an air discharge port (55) through which the air inside the internal space (90) is discharged to the outside,
 the at least one joint including a second joint (82) where the protruding part (36b) and the air discharge section (50) are joined to each other, and
 the at least one gap portion including a second gap portion (85) formed between the internal space (90) and the second joint (82).
8. The yarn waste collection cyclone separator (30) according to claim 1 or 2, wherein, the at least one gap portion (85) is arranged to linearly extend from an entrance (85a) of the at least one gap portion (85) on the internal space (90) side toward the at least one joint (82).
9. The yarn waste collection cyclone separator (30) according to claim 8, further comprising:
- a side wall member (34) which includes a cylindrical part (34a) extending in an up-down direction; and a top panel member (36) covering an upper portion of the side wall member (34),
 at least one of the first member or the second member being the top panel member (36), and
 the at least one gap portion (85) extending in a direction intersecting with the radial direction of the cylindrical part (36).

FIG.1

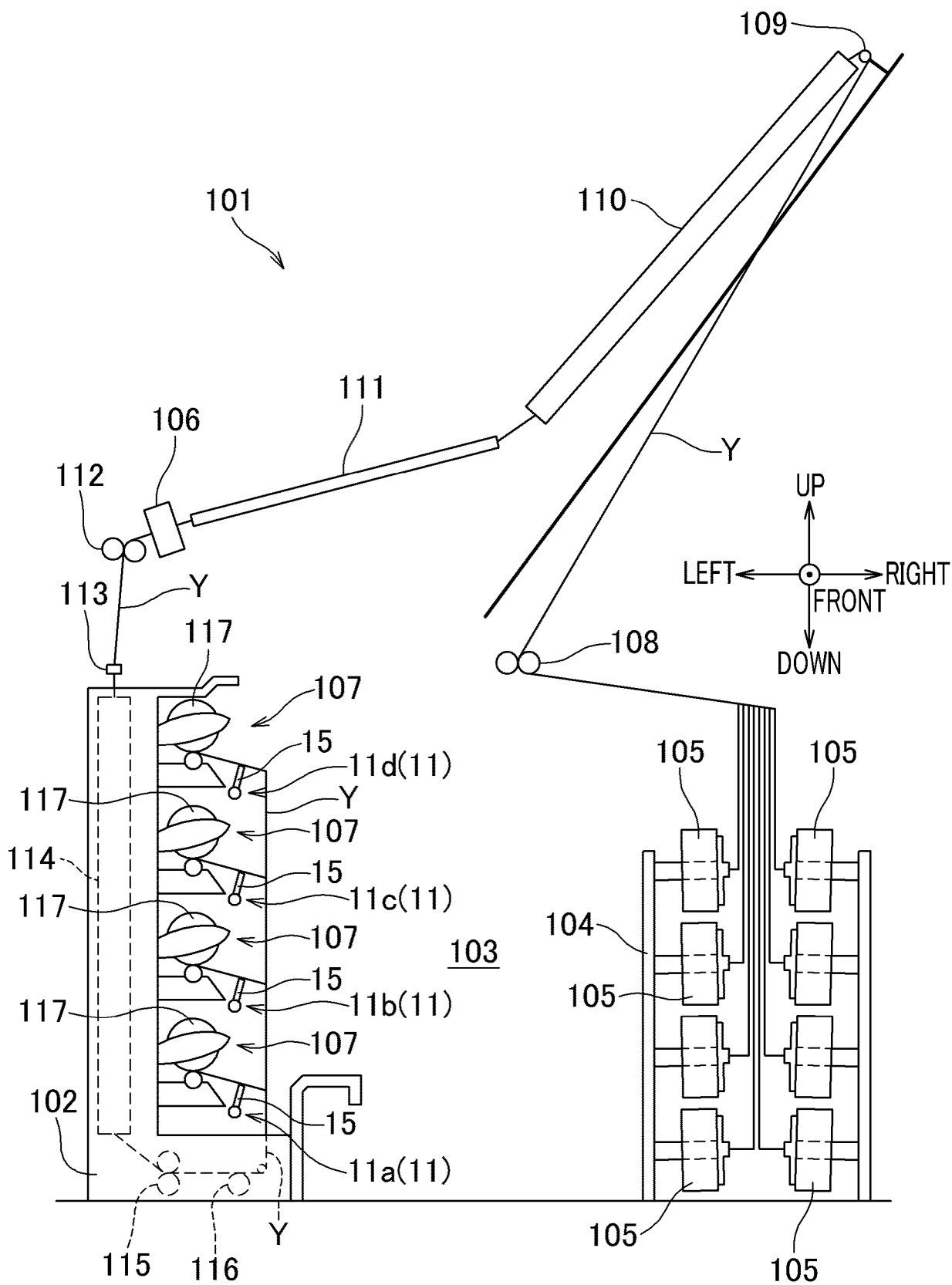


FIG.2

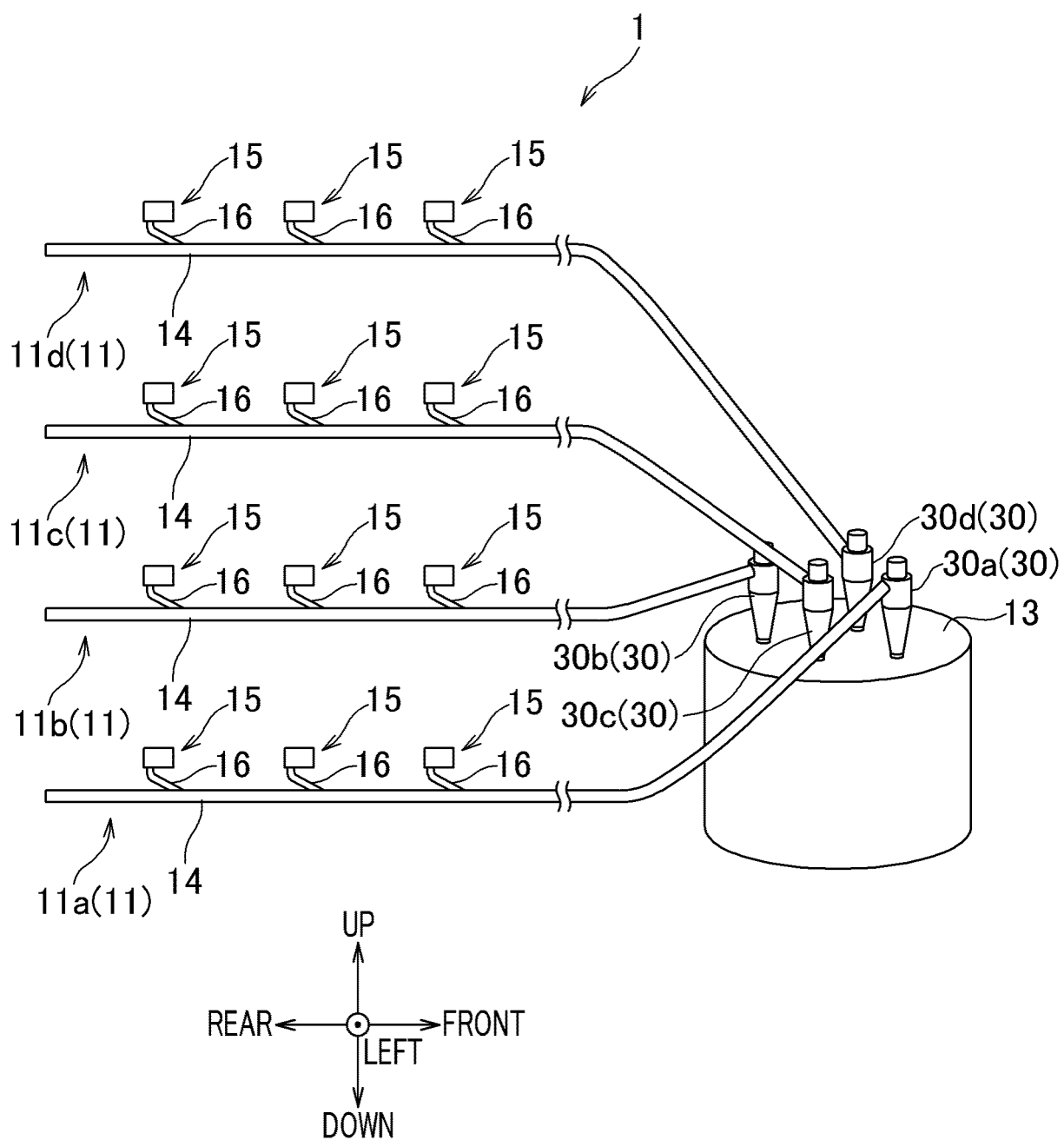


FIG.3

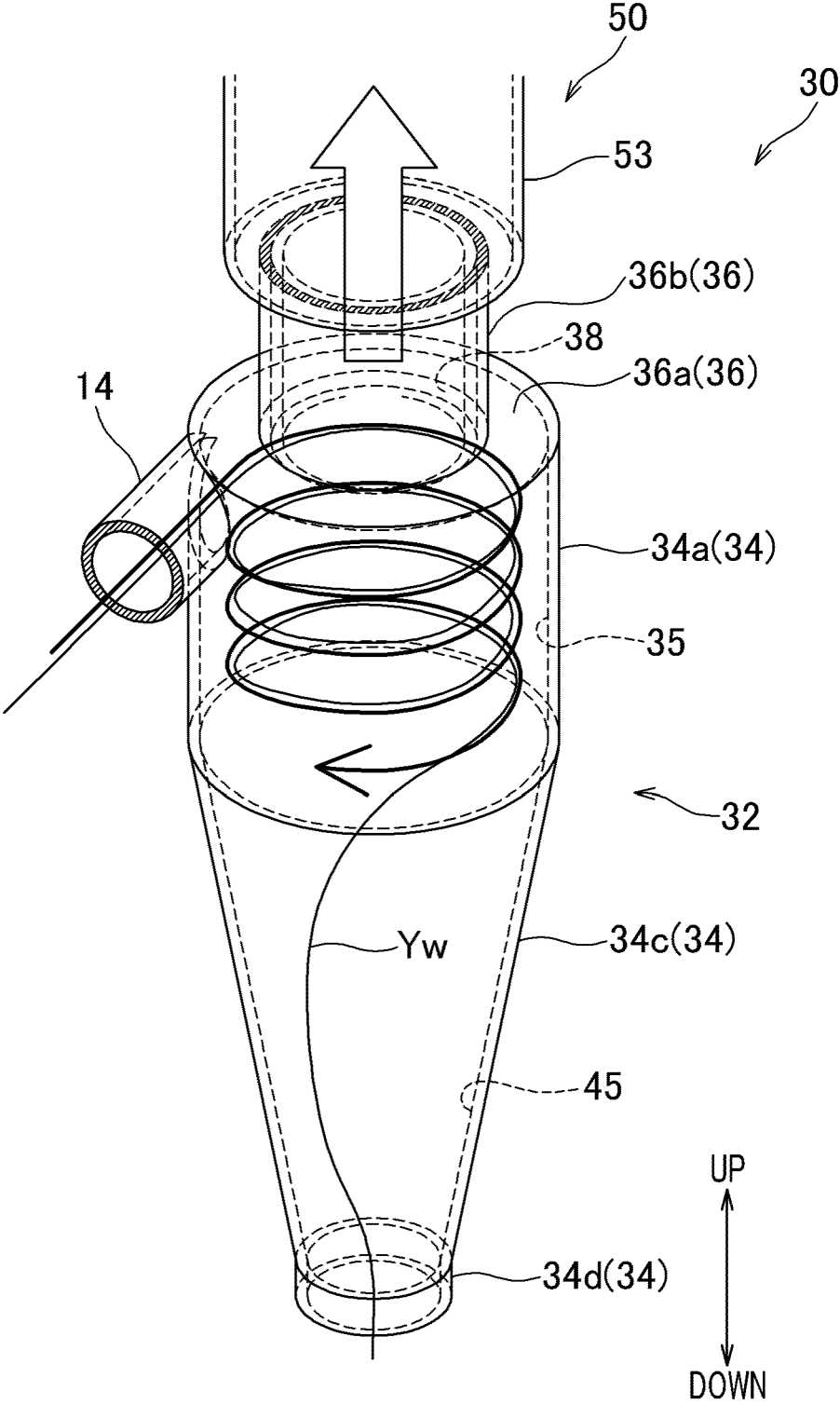


FIG.4

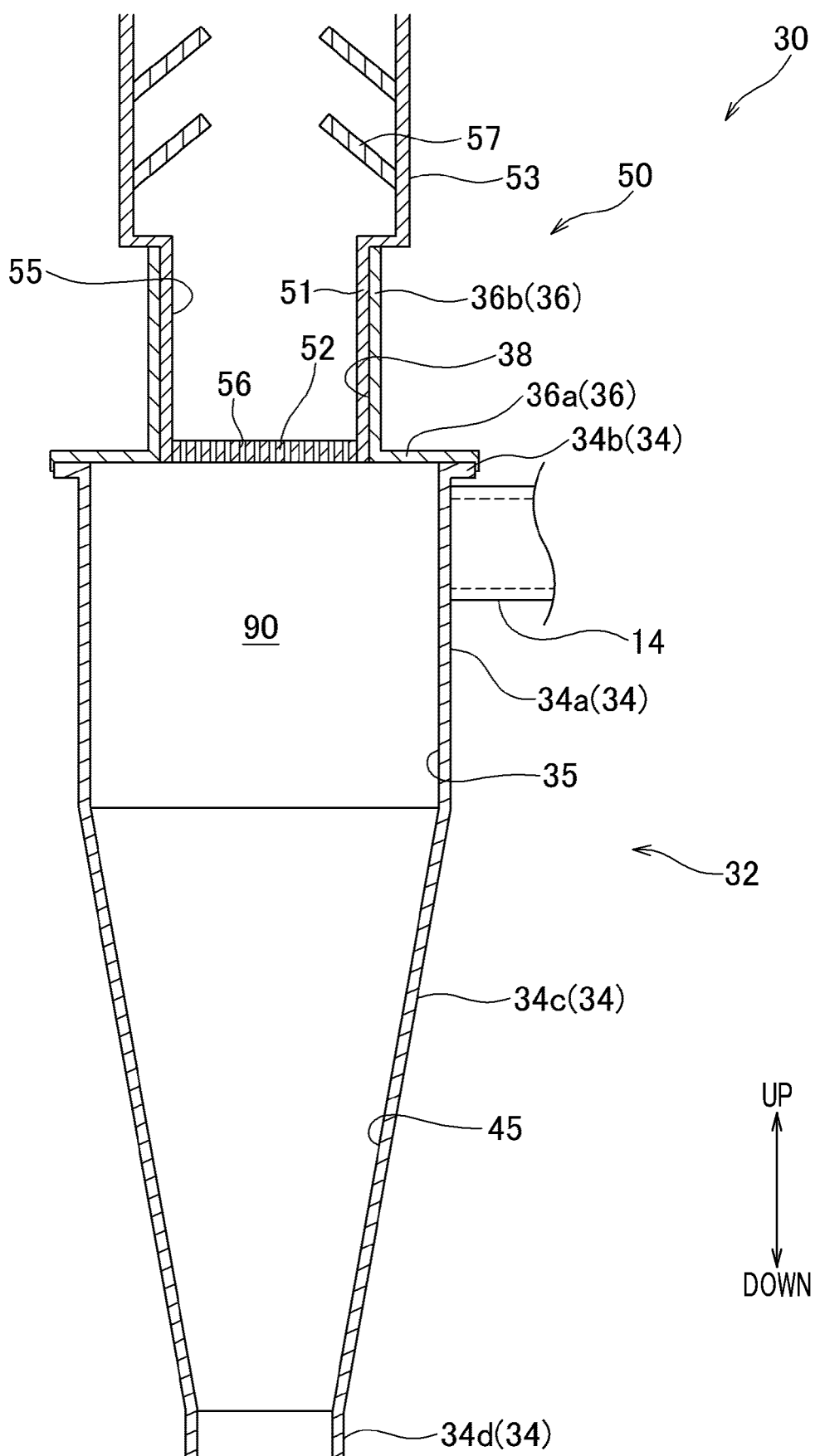


FIG.5

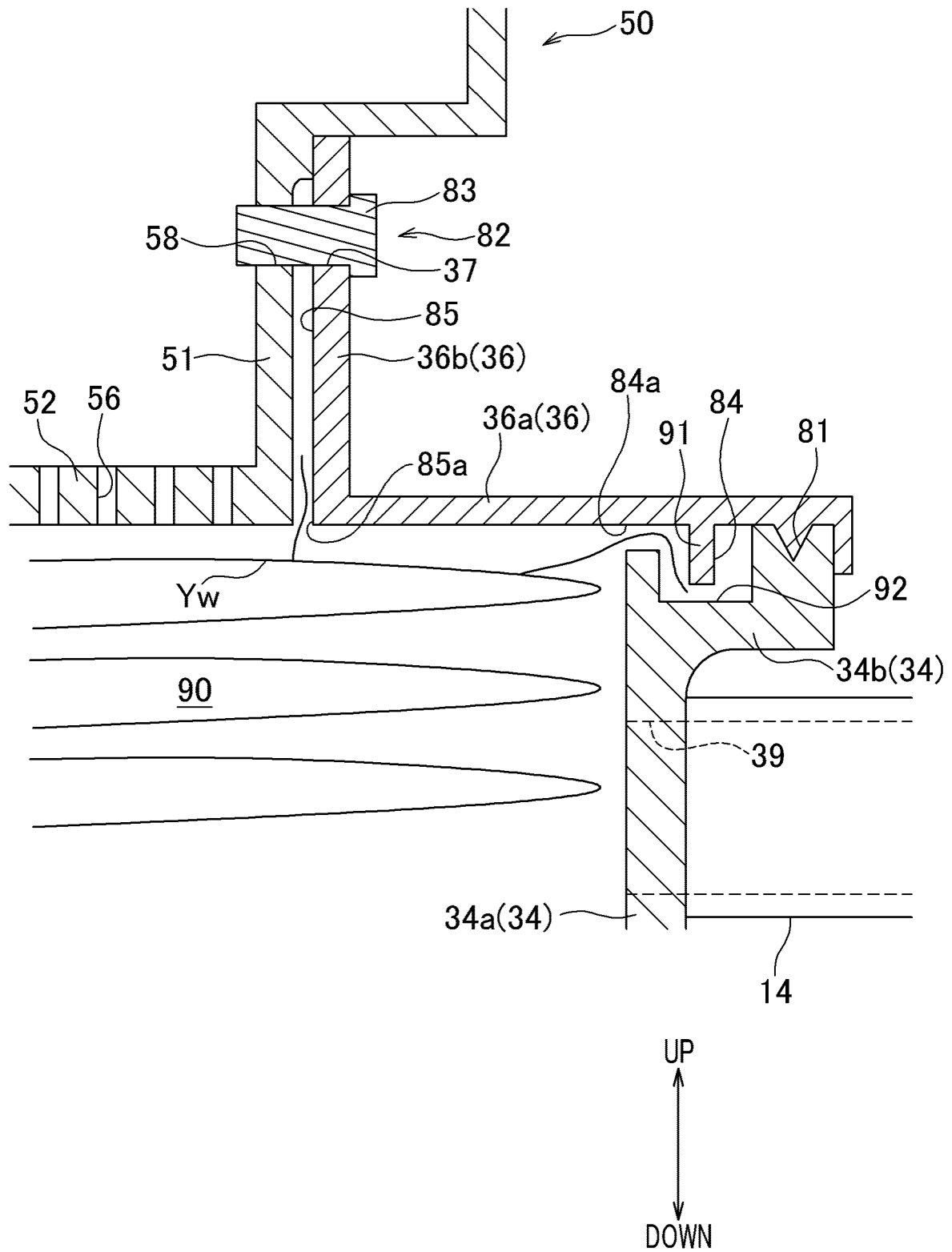


FIG.6

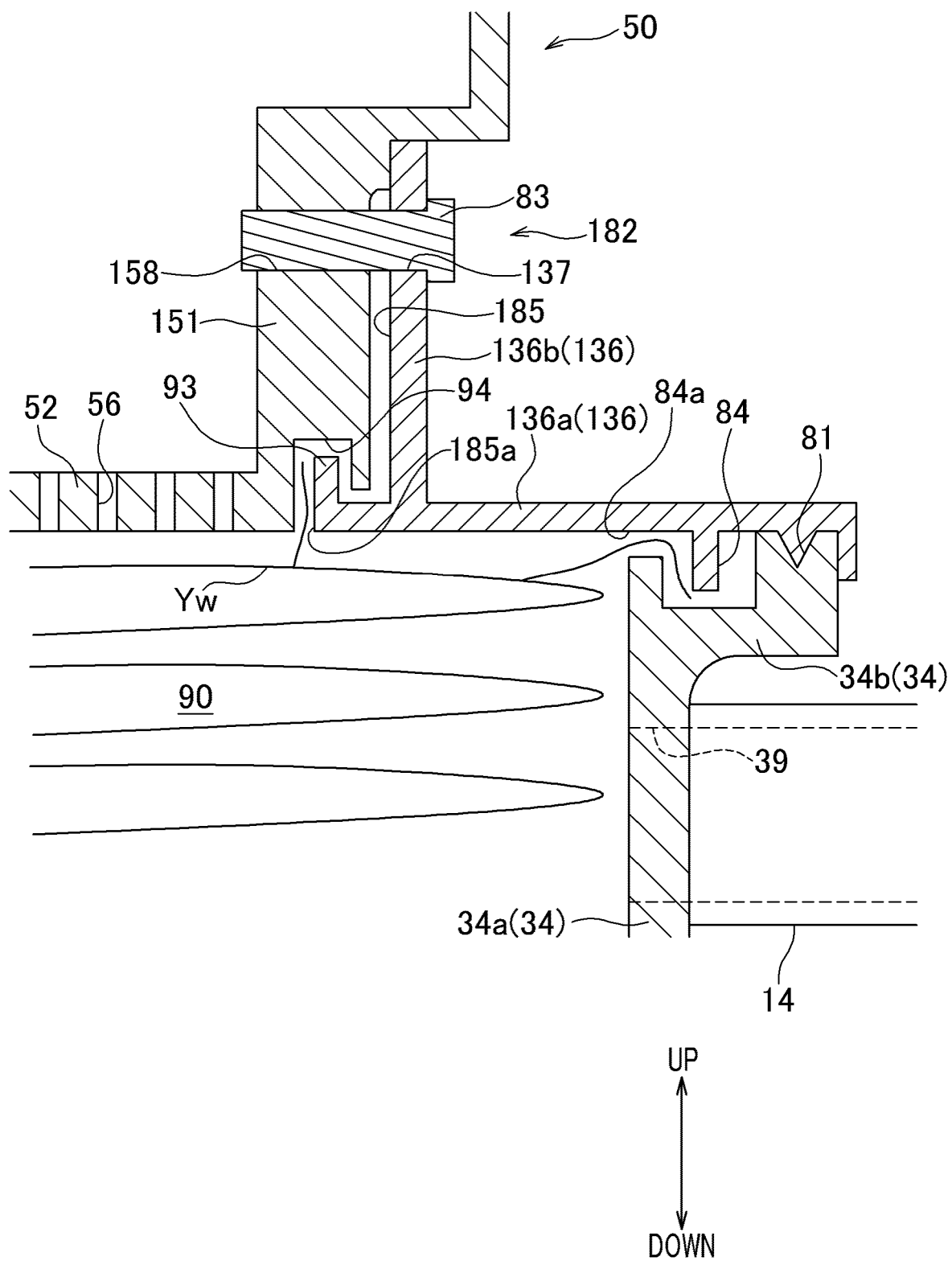


FIG.7

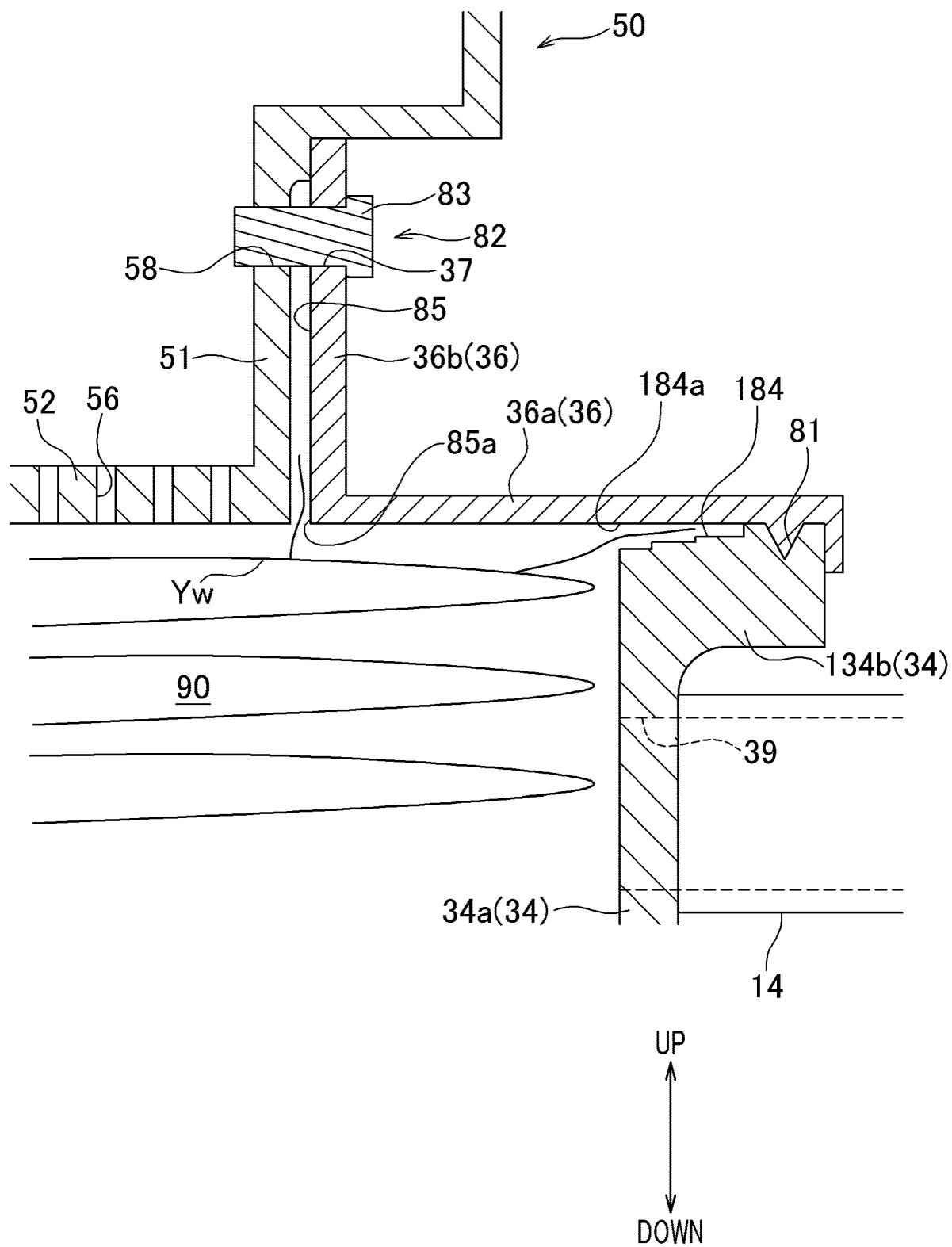


FIG.8

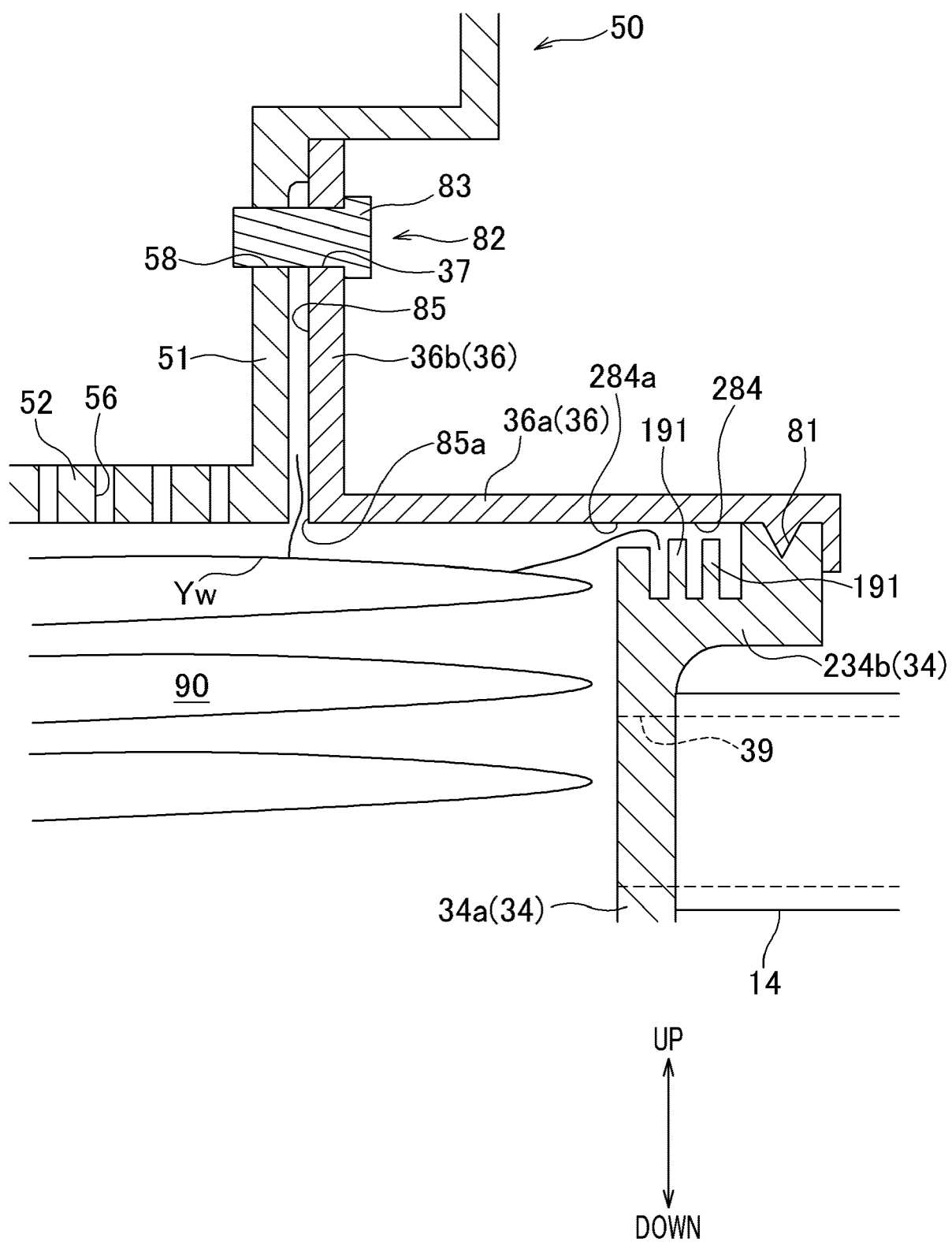
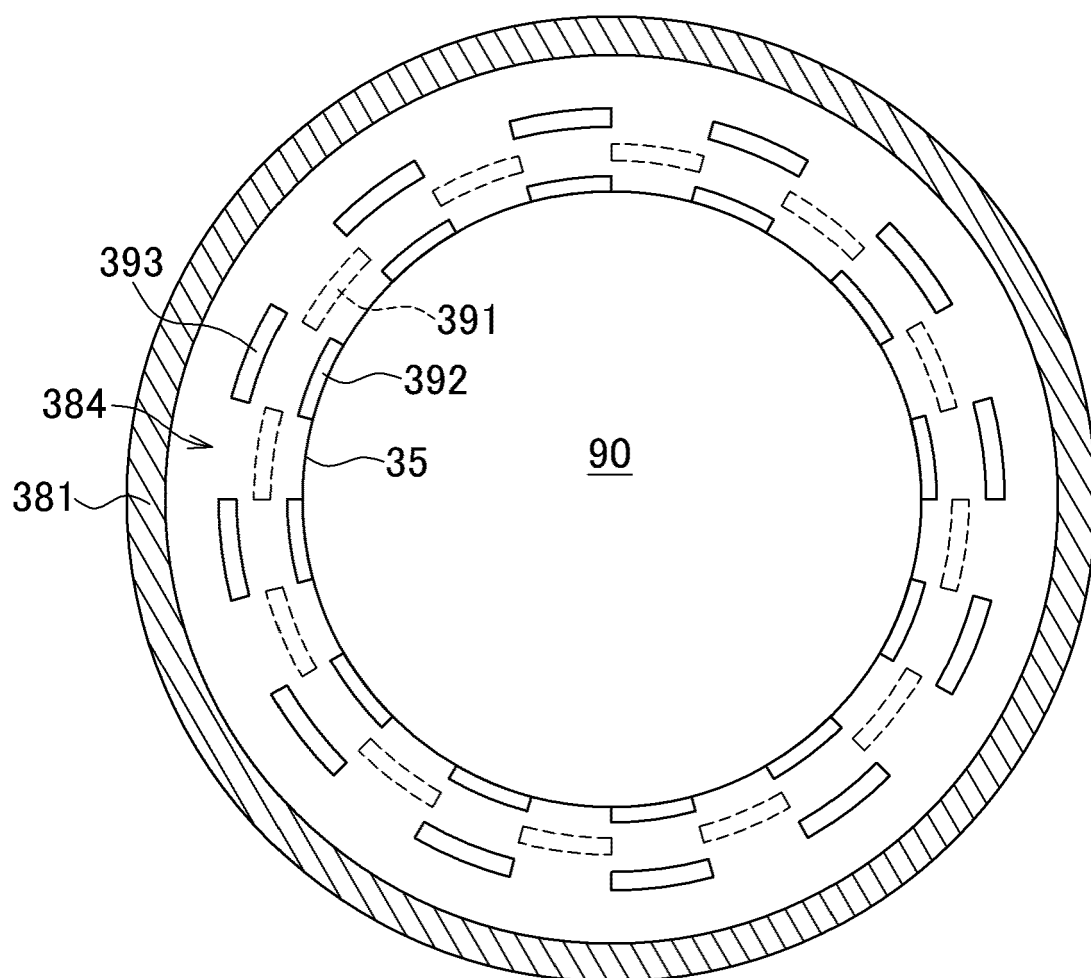


FIG.9





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