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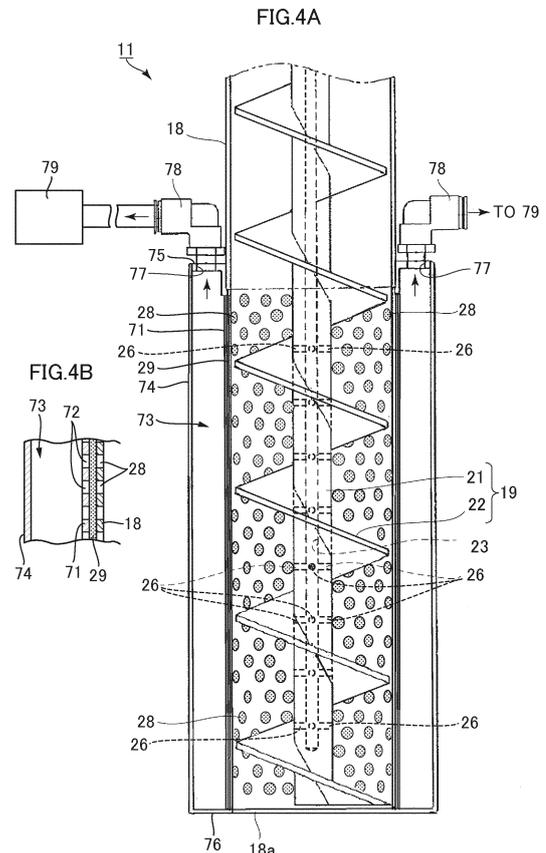
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(54) **DEVICE FOR SUPPLYING GRANULAR MATERIAL**

(57) A powder or granular material feeding apparatus (11) includes: a guide cylinder (18) having a plurality of gas suction holes (28) that guides gas in an interior thereof to an outside formed therethrough and configured to guide a powder or granular material; a filter (29) provided on a portion of the guide cylinder where the gas suction holes are formed to allow the gas in the interior of the guide cylinder to flow to the outside via the gas suction holes and prevent from leaking to the outside; a nitrogen gas feeding apparatus (27) configured to feed inert gas; an auger (19) including a revolving shaft (21) positioned in the guide cylinder and configured to rotate, and a blade (22) provided on the revolving shaft and configured to transport the powder or granular material by being rotated by the rotation of the revolving shaft in the guide cylinder, the revolving shaft including a nitrogen feed channel (23) configured to guide the inert gas supplied by the nitrogen gas feeding apparatus and a gas feed port (26) configured to allow the inert gas guided by the nitrogen feed channel to eject therefrom to cause the powder or granular material to contain the inert gas; and an air-gas suction device (79) configured to suck the gas in the guiding cylinder to the outside of the guide cylinder.



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Description**Technical Field**

[0001] The present invention relates to a powder or granular material feeding apparatus configured to feed powder or granular materials.

Background Art

[0002] In the related art, there is a powder or granular material feeding apparatus configured to supply powder or granular materials in the forms of powder, granules, and the like into a storage bag. In this case, the powder or granular materials are stored in the storage bag with air and sealed in many cases. However, there are the powder or granular materials which may be oxidized, altered, or solidified by air after long term storage in a sealed storage bag depending on types of the powder or granular materials. Examples of such powder or granular materials include flour, non-fat dry milk powder, toner containing a magnetic material for copying machines, and the like.

[0003] Therefore, there is a powder or granular material feeding apparatus configured to deaeration (degassing) and store the powder or granular material in a storage bag (Patent Literature 1).

[Cited List]

[Patent Literature]

[0004] PTL1: JP-A-2011-84311

Summary of the Invention

[Technical Problem]

[0005] However, the powder or granular material feeding apparatus of the related art has a limitation in enhancing a deaeration ratio, and has a limitation in elongating a quality guarantee period of the powder or granular materials.

[0006] Accordingly, the present invention intends to provide a powder or granular material feeding apparatus configured to perform deaeration between the powder or granular materials, eject an inert gas from the inside of the powder or granular materials toward the outside, and cause the powder or granular materials to contain the inert gas.

[Solution to Problem]

[0007] A powder or granular material feeding apparatus including: a guide cylinder having a plurality of through holes that guides gas in an interior thereof to an outside formed therethrough and configured to guide a powder or granular material; a filter provided on a portion of the

guide cylinder where the through holes are formed to allow the gas in the interior of the guide cylinder to flow to the outside via the through holes and prevent the powder or granular material in the guide cylinder from leaking from the through holes to the outside; a gas feed unit configured to feed inert gas; an auger including a revolving shaft positioned in the guide cylinder and configured to rotate, and a blade provided on the revolving shaft and configured to transport the powder or granular material by being rotated by the rotation of the revolving shaft in the guide cylinder, the revolving shaft including a gas guide channel configured to guide the inert gas supplied by the gas feed portion and a gas feed port configured to allow the inert gas guided by the gas guide channel to eject therefrom to cause the powder or granular material to contain the inert gas; and a suction device configured to suck the gas in the guiding cylinder to the outside of the guide cylinder via the through holes and the filter.

[0008] Accordingly, the powder or granular material feeding apparatus of the present invention causes the powder or granular material to contain the inert gas from the gas feed port of the gas guide channel outward from the inside of the powder or granular material while transporting the powder or granular material by the auger in the guide cylinder, and sucks the gas in the interior of the guide cylinder by the suction device via the through holes and the filter to the outside, so that the inert gas may be filled within the powder or granular material to prevent oxidization and solidification of the powder or granular material and maintain the quality of the powder or granular material constant for a long term.

[0009] Preferably, the revolving shaft includes a plurality of the gas feed ports along the revolving shaft in the axial direction, and the guide cylinder includes a plurality of the through holes along the axial direction so as to oppose the plurality of the gas feed ports.

[0010] Accordingly, the powder or granular material feeding apparatus may achieve the deaeration of the powder or granular material and filling of the inert gas simultaneously and efficiently.

[0011] Preferably, the revolving shaft includes the plurality of the gas feed ports over the entire length of the revolving shaft in the axial direction; and the guide cylinder includes the plurality of the through holes formed over the entire length of the guide cylinder.

[0012] Accordingly, the deaeration of the powder or granular material and filling of the inert gas may be achieved simultaneously and efficiently even though the speed of transportation of the powder or granular material is increased.

[0013] Preferably, the guide cylinder includes: a gas non-leak portion where the through holes are not formed and opposing the gas feed ports; an upper sucking portion having the plurality of the through holes formed there-through and formed upstream of the gas non-leak portion in the axial direction; and a lower sucking portion having the plurality of the through holes formed therethrough and formed downstream of the gas non-leak portion in

the axial direction.

[0014] Accordingly, the powder or granular material feeding apparatus expels gas contained in the powder or granular material by the upper sucking unit while transporting the powder or granular material by the auger in the guide cylinder, cause the powder or granular material to contain the inert gas from the gas feed port in the gas non-leak portion, and sucks the residual air contained in the powder or granular material and the inert gas by the lower sucking unit. Therefore, oxidization and solidification of the powder or granular material are prevented and the quality of the powder or granular material may be maintained constant for a long term.

[0015] Preferably, the guide cylinder includes a gas ejection port configured to eject the inert gas at a distal end thereof.

[0016] Accordingly, for example, the air in the storage bag to which the powder or granular material is to be supplied is reduced and, instead, the storage bag may be filled with the inert gas, so that the powder or granular material is prevented from containing air when being stored in the storage bag, and hence the quality guarantee period of the powder or granular materials may be elongated.

[0017] Preferably, the inert gas is nitrogen gas.

[0018] Accordingly, oxidation of the powder or granular material can be prevented by nitrogen gas and the quality guarantee period of the powder or granular materials may be elongated.

[0019] Also, the powder or granular material is, for example, grain powder.

[0020] Accordingly, even though the powder or granular material is the grain powder which is liable to be solidified easily, solidification of the grain powder is prevented and the quality guarantee period of the grain powder may be elongated.

[0021] Alternatively, the powder or granular material is, for example, toner for image formation.

[0022] Accordingly, even though the powder or granular material is toner for image formation, which is liable to be oxidized easily, oxidization is prevented and the quality guarantee period of the toner for image formation may be elongated.

Brief Description of Drawings

[0023]

[Fig. 1] Fig. 1 is a schematic drawing partly in cross section, illustrating an appearance of a powder or granular material feeding apparatus of a first embodiment of the present invention.

[Fig. 2] Fig. 2 illustrates a cross section viewed in a direction indicated by an arrow A-A in Fig. 1.

[Fig. 3] Fig. 3 illustrates a cross section viewed in a direction indicated by an arrow B-B in Fig. 1.

[Figs. 4A and 4B] Figs. 4A and 4B illustrate a cross section viewed in a direction indicated by an arrow

C-C in Fig. 2 and Fig. 3, in which Fig. 4A is a general view and Fig. 4B is a cross-sectional view of a portion of a negative pressure chamber.

[Fig. 5] Fig. 5 illustrates a cross section viewed in a direction indicated by an arrow D-D in Fig. 2 and Fig. 3.

[Fig. 6] Fig. 6 illustrates a cross section viewed in a direction indicated by an arrow E-E in Fig. 2 and Fig. 3.

[Fig. 7] Fig. 7 is a state drawing of the powder or granular material feeding apparatus before feeding the powder or granular material into a storage bag, and illustrates a cross section viewed in a direction indicated by an arrow D-D in Fig. 2 and Fig. 3.

[Fig. 8] Fig. 8 is a state drawing of the powder or granular material feeding apparatus while feeding the powder or granular material into a storage bag, and illustrates a cross section viewed in a direction indicated by an arrow C-C in Fig. 2 and Fig. 3.

[Fig. 9] Fig. 9 is a state drawing of the powder or granular material feeding apparatus immediately after termination of feeding the powder or granular material into a storage bag, and illustrates a cross section viewed in a direction indicated by an arrow E-E in Fig. 2 and Fig. 3.

[Fig. 10] Fig. 10 is a schematic drawing partly in cross section, illustrating an appearance of a powder or granular material feeding apparatus of a second embodiment of the present invention.

[Fig. 11] Fig. 11 illustrates a cross section viewed in a direction indicated by an arrow F-F in Fig. 10.

[Fig. 12] Fig. 12 illustrates a cross section viewed in a direction indicated by an arrow J-J in Fig. 10.

[Figs. 13A and 13B] Fig. 13A and 13B illustrate a cross section viewed in a direction indicated by an arrow K-K in Fig. 11 and Fig. 12, in which Fig. 13A is a general view and Fig. 13B is a cross-sectional view of a portion of a negative pressure chamber.

[Figs. 14A and 14B] Fig. 14A and 14B illustrate a cross section viewed in a direction indicated by an arrow L-L in Fig. 11 and Fig. 12, in which Fig. 14A is a general view and Fig. 14B is a cross-sectional view of a portion of the negative pressure chamber.

[Fig. 15] Fig. 15 illustrates a cross section viewed in a direction indicated by an arrow M-M in Fig. 11 and Fig. 12.

[Fig. 16] Fig. 16 illustrates a cross section viewed in a direction indicated by an arrow N-N in Fig. 11 and Fig. 12.

Description of Embodiments

[0024] Hereinafter, a powder or granular material feeding apparatus of a first embodiment of the present invention will be described with reference to Fig. 1 to Fig. 9, and a powder or granular material feeding apparatus of a second embodiment of the present invention will be described with reference to Fig. 10 to Fig. 16.

(Powder or Granular Material Feeding Apparatus of First Embodiment)

[0025] Configuration of a powder or granular material feeding apparatus of the first embodiment will be described.

[0026] As illustrated in Fig. 1, a powder or granular material feeding apparatus 11 is an apparatus configured to feed or fill a powder or granular material into a storage bag S. Examples of the powder or granular material include grain powders such as flour, non-fat dry milk powder, image forming toner containing a magnetic material for copying machines, and the like.

[0027] The powder or granular material feeding apparatus 11 is provided so as to extend upright on a fixing member 12. The fixing member 12 having a support post 13 with extending upright thereon, and the support post 13 is provided with an elevating shaft 14 so as to be movable upward and downward. The elevating shaft 14 is configured to move upward and downward the support post 13 by an elevating mechanism, which is not illustrated, when a handle 15 is rotated.

[0028] The elevating shaft 14 includes a hopper 17, and a cylindrical guide cylinder 18 provided via a bracket 16. The hopper 17 stores the powder or granular material therein. A motor, which is not illustrated, configured to rotate an auger (also known as a screw) 19 and a cover 20 in which the motor is stored therein are provided on an upper end portion of the elevating shaft 14.

[0029] As illustrated in Figs. 4A and 4B, the auger 19 includes a revolving shaft 21 positioned in the guide cylinder 18 and configured to rotate, and a blade 22 provided on the revolving shaft 21 and configured to rotate in the guide cylinder 18 by the rotation of the revolving shaft 21 to convey the powder or granular material. The blade 22 is formed into a circular shape when viewed from an end portion of the revolving shaft 21 as illustrated in Fig. 2. The revolving shaft 21 is rotatably supported by the hopper 17 and the cover 20. The revolving shaft 21 penetrates through the cover 20 and the hopper 17, and extends to a position near a powder or granular material discharge port 18a of the guide cylinder 18.

[0030] A nitrogen feed channel (a gas guide channel) 23 configured to guide nitrogen gas (inert gas) N₂ supplied by a nitrogen gas feeding apparatus (a gas feed unit) 27 is formed along an axial center of the revolving shaft 21 from an upper end to a substantially lower end of the revolving shaft 21. The nitrogen feed channel 23 includes a plurality of nitrogen ejection ports (gas feed ports) 26 formed radially outward from the nitrogen feed channel 23 as illustrated in Fig. 3, and along an axial direction of the revolving shaft 21 as illustrated in Figs. 4A. The nitrogen ejection ports 26 are configured to allow nitrogen gas guided by the nitrogen feed channel 23 to be ejected out to cause the powder or granular material to contain the nitrogen gas. As illustrated in Fig. 1, the head portion of the revolving shaft 21 is connected to the nitrogen gas feeding apparatus 27 configured to feed the

nitrogen gas via a rotatable elbow 25 and a nitrogen feed pipe 24.

[0031] In Figs. 4A and 4B, the guide cylinder 18 is formed into a cylindrical shape, and is configured to guide the powder or granular material that the auger 19 conveys from the hopper 17 to the storage bag S. The guide cylinder 18 is formed with a plurality of air-gas suction holes (through holes) 28 configured to guide gas in the interior to the outside. A plurality of the air-gas suction holes 28 are formed from a portion lower than the hopper 17 to a distal end (lower end in Fig. 4A) of a position near the powder or granular material discharge port 18a of the guide cylinder 18. The gas includes air contained in the powder or granular material and the nitrogen gas ejected from the nitrogen ejection ports 26.

[0032] A portion of the guide cylinder 18 including the air-gas suction holes 28 formed therethrough is provided with a filter 29 formed into a cylindrical shape on the outer periphery thereof. The filter 29 is configured to allow the gas in the guide cylinder 18 to flow outward through the air-gas suction holes 28, and prevents the powder or granular material in the guide cylinder 18 from leaking out from the air-gas suction holes 28.

[0033] A portion of the guide cylinder 18 including the air-gas suction holes 28 formed therethrough is lower in strength. The outer peripheral portion of the cylindrical filter 29 needs to be protected. Therefore, a reinforcing cylinder 71 configured to reinforce the guide cylinder 18 and protects the outer periphery of the filter 29 is provided on the outside of the filter 29 so as to interpose the filter 29 between the guide cylinder 18 and the reinforcing cylinder 71. The reinforcing cylinder 71 has a length enough for cover the filter 29. The reinforcing cylinder 71 is also provided with a plurality of air-gas suction holes 72 so as to oppose the air-gas suction holes 28 formed in the guide cylinder 18. The air-gas suction holes 72 are also configured to guide the gas in the interior of the guide cylinder 18 to the outside.

[0034] The reinforcing cylinder 71 includes a negative pressure chamber 73 formed on the outer periphery thereof. The negative pressure chamber 73 includes an outer peripheral cylinder 74, an upper lid 75, and a lower lid 76. The outer peripheral cylinder 74 is separated from the reinforcing cylinder 71, is mounted on the guide cylinder 18 at an upper portion thereof with a ring-shaped upper lid 75, and mounted at a lower portion thereof to the powder or granular material discharge port 18a of the guide cylinder 18 by a ring-shaped lower lid 76. The negative pressure chamber 73 is formed in an area wider than an area in which the air-gas suction holes 28 and 72 are formed. Fig. 4B is a drawing illustrating a positional relationship among the guide cylinder 18, the filter 29, the reinforcing cylinder 71, and the outer peripheral cylinder 74. The reinforcing cylinder 71 is not necessarily essential as long as the guide cylinder 18 is reinforced by the outer peripheral cylinder 74.

[0035] A gas passing hole 77 formed in the upper lid 75 of the negative pressure chamber 73 is provided with

a negative pressure elbows 78 configured to connect the negative pressure chamber 73 and an air-gas suction device (a suction device) 79. The four negative pressure elbows 78 are provided at intervals of 90° as illustrated in Fig. 2 and Fig. 3.

[0036] In Fig. 5 and Fig. 6, the nitrogen feed pipes 51 and the nitrogen feed pipes 61 penetrate through the negative pressure chamber 73 formed on the outer periphery of the guide cylinder 18. The nitrogen feed pipes 51 for a bottom part is configured to be used when feeding nitrogen gas to the bottom of the storage bag S, while nitrogen feed pipes 61 for an upper part configured to be used when supplying nitrogen gas to the upper part of the storage bag S.

[0037] The nitrogen feed pipes 51 for the bottom part is formed into a straight shape and is supported by the upper lid 75 and the lower lid 76.

[0038] The nitrogen feed pipes 61 for the upper part are each formed into an L-shape with a distal end portion thereof directed outward, and are supported by the upper lid 75 and the outer peripheral cylinder 74. The nitrogen feed pipes 51 for the bottom part are connected to the nitrogen gas feeding apparatus 27 by the elbows 52 provided on upper portions of the nitrogen feed pipes 51 for the bottom part. The nitrogen feed pipes 61 for the upper part are also connected to the nitrogen gas feeding apparatus 27 via the elbows 62 provided on upper portions of the nitrogen feed pipes 61 for the upper part and nitrogen feed pipes, which are not illustrated. As illustrated in Fig. 3, a pair of the nitrogen feed pipes 51 for the bottom part and a pair of the nitrogen feed pipes 61 for the upper part are arranged alternately at a 90° interval. Therefore, in Fig. 2, eight elbows 52, 78, 62, 78, 52, 78, 62, 78 are provided at regular intervals in the circumferential direction on the upper lid 75 of the negative pressure chamber 73.

[0039] An action of the powder or granular material feeding apparatus 11 of the first embodiment will be described.

[0040] In Fig. 7, the powder or granular material feeding apparatus 11 and the storage bag S are configured to be moved upward and downward with respect to each other, and when at least one of those is moved upward and downward, the powder or granular material discharge port 18a of the guide cylinder 18 enters the storage bag S that stores the powder or granular material therein. Then, a motor for rotating the auger 19, which is not illustrated, the nitrogen gas feeding apparatus 27 and the air-gas suction device 79 start activating.

[0041] The nitrogen gas feeding apparatus 27 ejects nitrogen gas from the nitrogen ejection ports 26 into the guide cylinder 18 through the nitrogen feed pipe 24, the elbow 25, and the nitrogen feed channel 23. Also, the air-gas suction device 79 sucks air in the guide cylinder by bringing the interior of the negative pressure chamber 73 into a low pressure (negative pressure) with respect to the atmospheric pressure through the negative pressure elbows 78.

[0042] Subsequently, the auger 19 is rotated by the motor, which is not illustrated, and conveys the powder or granular material from the hopper 17 to the powder or granular material discharge port 18a in the guide cylinder 18 by the blade 22. During this operation, the nitrogen gas feeding apparatus 27 ejects the nitrogen gas from the nitrogen ejection ports 26 so that the powder or granular material contains the nitrogen gas. In this case, the nitrogen ejection ports 26 are formed in the revolving shaft 21 of the auger 19, and hence the nitrogen gas is ejected outward from the center of the powder or granular material conveyed in the guide cylinder 18.

[0043] The negative pressure chamber 73 is kept at a negative pressure, and hence sucks the powder or granular material. However the powder or granular material is prevented from being sucked by the filter 29. Therefore, the negative pressure chamber 73 sucks the air contained in the powder or granular material via the air-gas suction holes 28, the filter 29, and the air-gas suction holes 72. At this time, the air-gas suction device 79 sucks the powder or granular material from the periphery of the guide cylinder 18, and hence the nitrogen gas ejected from the nitrogen ejection ports 26 to the center of the powder or granular material may be sucked to a portion near the inner periphery of the guide cylinder 18, whereby the nitrogen gas may be delivered over the entire powder or granular material. At this time, the nitrogen gas is taken out with the air to some extent. The amount of the nitrogen gas to be ejected from the nitrogen ejection ports 26 is larger than the amount of the air contained in the powder or granular material. Therefore, the nitrogen gas is delivered to the entire powder or granular material by pushing the air out from the powder or granular material.

[0044] The reason why the air-gas suction device 79 sucks the nitrogen gas to some extent together with the air contained in the powder or granular material is just for aiding the nitrogen gas to be delivered over the entire powder or granular material, and not for sucking out the nitrogen gas entirely to remove the same. The filter 29 used here is configured not to be clogged easily by the powder or granular material.

[0045] As described above, the powder or granular material feeding apparatus 11 causes the powder or granular material to contain the inert gas from the nitrogen ejection ports 26 of the gas guide channel 23 outward from the inside of the powder or granular material while conveying the powder or granular material in the guide cylinder by the auger 19, and sucks the gas in the interior of the guide cylinder by the air-gas suction device 79 via the air-gas suction holes 28 and the filter 29 to the outside, so that the nitrogen gas may be filled within the powder or granular material to prevent oxidization, solidification, and the like of the powder or granular material and maintain the quality of the powder or granular material constant for a long term.

[0046] In addition, the revolving shaft 21 of the auger 19 includes a plurality of the nitrogen ejection ports 26 along the axial direction of the revolving shaft 21, and

the guide cylinder 18 includes a plurality of the air-gas suction holes 28 along the axial direction so as to face the plurality of the nitrogen ejection ports 26. Therefore, the powder or granular material feeding apparatus 11 may perform the deaeration of the powder or granular material and filling of nitrogen gas simultaneously and efficiently.

[0047] Furthermore, the revolving shaft 21 of the auger 19 includes the plurality of the nitrogen ejection ports 26 over the entire length of the revolving shaft 21 in the axial direction, and the guide cylinder 18 includes the plurality of the air-gas suction holes 28 over the entire length of the guide cylinder 18. Therefore, the powder or granular material feeding apparatus 11 may perform the deaeration of the powder or granular material and filling of nitrogen gas simultaneously and efficiently even though the speed of conveyance of the powder or granular material is increased.

[0048] In Fig. 7, at least one of the powder or granular material feeding apparatus 11 and the storage bag S is moved upward and downward, and the powder or granular material discharge port 18a of the guide cylinder 18 enters the storage bag S that stores the powder or granular material therein. Then, the nitrogen gas ejects from a gas ejection port 51a of the nitrogen feed pipes 51 for the bottom part into the interior of the storage bag S. The powder or granular material having the nitrogen gas distributed over the entire part thereof is supplied from the powder or granular material discharge port 18a of the guide cylinder 18 into the storage bag S filled with the nitrogen gas.

[0049] Subsequently, as illustrated in Fig. 8, as a powder or granular material P is supplied to the storage bag S, at least one of the powder or granular material feeding apparatus 11 and the storage bag S is moved upward and downward, and the powder or granular material discharge port 18a of the guide cylinder 18 moves in the direction leaving the storage bag S. During this period, the ejection of the nitrogen gas N_2 from the gas ejection port 51a is stopped. However, the ejection may be continued.

[0050] As illustrated in Fig. 9, when the storage bag is substantially filled with the powder or granular material P, the nitrogen gas N_2 is ejected from the gas ejection port 61a positioned at a portion where the powder or granular material discharge port 18a of the guide cylinder 18 is formed. A gas ejection port 61a is a lower end portion of the nitrogen feed pipes 61 for the upper part, and is bent into an L-shape in the direction away from the guide cylinder 18. The gas ejection port 61a is bent into the L-shape for the reason of preventing nitrogen gas to be fed from the nitrogen gas feeding apparatus 27 through the nitrogen supply elbows 62 for the upper part and the nitrogen feed pipes 61 for the upper part from hitting against the powder or granular material and hence causes the powder or granular material to be stirred up.

[0051] Finally, the upper portion of the storage bag S is closed by a sealing device, which is not illustrated, so

that the storage bag S is sealed.

[0052] In this manner, the interior of the storage bag is in a state of being reduced in air and, instead, filled with the inert gas in the storage bag. Therefore, the powder or granular material feeding apparatus 11 is configured to feed the powder or granular material, having nitrogen gas distributed over the entire part thereof, to the storage bag that is filled with nitrogen gas while performing deaeration so that the storage bag can be closed with nitrogen gas filled in an upper portion thereof.

[0053] Therefore, since the powder or granular material feeding apparatus 11 is configured to reduce the air in the storage bag and, instead, fill the storage bag with the inert gas, the powder or granular material may be filled with nitrogen gas, alteration, solidification, oxidation, and the like of the powder or granular material packed into a bag are prevented, and the quality of the powder or granular material may be maintained constantly for a long term.

[0054] In the description given above, the nitrogen gas is ejected from two of the nitrogen feed pipes 51 for the bottom part into the storage bag S. However, a configuration in which one of the nitrogen feed pipes 51 for the bottom part is connected to the air-gas suction device 79, and nitrogen gas is fed to the storage bag from the other nitrogen feed pipe 51 for the bottom part after or while air in the storage bag is sucked by the corresponding nitrogen feed pipe 51 for the bottom part is also applicable.

[0055] Alternatively, a configuration in which at least one of the nitrogen feed pipes 51 for the bottom part is configured to be selectively connectable to the nitrogen gas feeding apparatus or the air-gas suction device 79, the air in the storage bag is sucked by the air-gas suction device at first, and then nitrogen gas is supplied to the storage bag by using the nitrogen gas feeding apparatus is also applicable. In this case, if only one of the nitrogen feed pipes 51 for the bottom part is configured to be selectively connectable with the nitrogen gas feeding apparatus 27 or the air-gas suction device 79, the other nitrogen feed pipe for the bottom part feeds nitrogen by the nitrogen gas feeding apparatus 27. (Powder or Granular Material Feeding Apparatus of Second Embodiment)

[0056] In Fig. 10 to Fig. 16, a powder or granular material feeding apparatus 111 of a second embodiment is also an apparatus configured to feed or fill the powder or granular material into a storage bag K. The powder or granular material feeding apparatus 111 of the second embodiment has the structure with some part being the same as that of the powder or granular material feeding apparatus 11 of the first embodiment. Therefore, parts different from the powder or granular material feeding apparatus 11 of the first embodiment will be mainly described, and the same parts will be denoted by the same reference numerals with those descriptions being omitted.

[0057] As illustrated in Fig. 10, a guide cylinder 118 is formed into a cylindrical shape, and is configured to guide

the powder or granular material, being conveyed by an auger 119 from the hopper 17 to the storage bag S. The auger 119 includes a revolving shaft 121 positioned in the guide cylinder 118 to rotate, and a blade 122 provided on the revolving shaft 121 to convey the powder or granular material by rotated by the rotation of the revolving shaft 121 in the guide cylinder 118. The revolving shaft 121 is rotatably supported by the hopper 17 and the cover 20. The revolving shaft 121 penetrates through the cover 20 and the hopper 17, and extends to a position near a powder or granular material discharge port 118a of the guide cylinder 118.

[0058] A nitrogen feed channel (a gas guide channel) 123 configured to guide nitrogen gas (inert gas) supplied by a nitrogen gas feeding apparatus (a gas feed unit) 27 is formed along an axial center of the revolving shaft 121 from an upper end to near a lower end of the revolving shaft 121. The nitrogen feed channel 123 includes nitrogen ejection ports (gas supply ports) 126 formed radially outward from the nitrogen feed channel 123 as illustrated in Fig. 12. Nitrogen ejection ports 126 are configured to allow nitrogen gas, being guided by the nitrogen feed channel 123, to be ejected out to cause the powder or granular material to contain the nitrogen gas. As illustrated in Fig. 10, the head portion of the revolving shaft 121 is connected to the nitrogen gas feeding apparatus (the feed unit) 27 configured to feed the nitrogen gas via a rotatable elbow 25 and a nitrogen feed pipe 24.

[0059] In Fig. 13, a non-hole portion 118b on which no through hole is formed is provided on the guide cylinder 118 at a midsection of the guide cylinder 118 in the axial direction so as to oppose the nitrogen ejection port 126 in the nitrogen supply channel 123. The non-hole portion 118b corresponds to a cylindrical non-leak cylinder portion (a gas non-leak portion) 131. The non-leak cylinder portion 131 is formed so as to avoid the formation of the gap to prevent nitrogen gas from leaking outward. A protecting cylinder 139 configured to protect respective pipes, which will be described later, disposed along an outer periphery of the non-leak cylinder portion 131 on the outer periphery of the non-leak cylinder portion 131. A plurality of the nitrogen ejection ports 126 may be formed in the region of the non-leak cylinder portion 131 also along the axial direction of the revolving shaft 121.

[0060] In Fig. 13, the guide cylinder 118 includes a deaeration portion (an upper sucking portion) 132 on an upstream side of the non-leak cylinder portion 131 in the axial direction (direction of convey of the powder or granular material) for performing deaeration of the powder or granular material conveyed by the auger 119. The deaeration portion 132 includes an upper porous portion 118c of the guide cylinder 118 provided with a plurality of deaeration holes (through holes) 135 formed therethrough, a cylindrical filter 133 provided on an outer periphery of the upper porous portion 118c, and a cylindrical upper outer peripheral cylinder 134 provided on the guide cylinder 118 so as to separate from the filter and cover the filter 133. The upper outer peripheral cylinder 134 is

provided on the guide cylinder 118 by a ring-shaped upper lid 175 and a bottom lid 180. The deaeration holes 135 are configured to guide the air contained in the powder or granular material in the interior of the guide cylinder 118 to the outside. The filter 133 is configured to allow air contained in the powder or granular material in the guide cylinder to flow outward through the deaeration holes 135, and prevents the powder or granular material in the guide cylinder from leaking out from the deaeration holes 135.

[0061] The upper outer peripheral cylinder 134 forms an upper negative pressure chamber 136 for expelling the air in the interior of the guide cylinder 118 by a ring-shaped upper lid 175 provided on an upper end thereof, and a ring-shaped bottom lid 180 provided at a lower end thereof. The upper porous portion 118c having the deaeration holes 135 formed through the guide cylinder 118 is lower in strength. Therefore, the upper outer peripheral cylinder 134 also serves to reinforce the guide cylinder 118. Fig. 13B is a drawing illustrating a positional relationship of the guide cylinder 118, the filter 133, and the upper outer peripheral cylinder 134. When the guide cylinder 118 is hardly reinforced by the upper outer peripheral cylinder 134, a reinforcing cylinder having a plurality of holes formed therethrough in the same manner as the reinforcing cylinder 71 illustrated in Figs. 4A and 4B of the first embodiment may be provided on an outer periphery of the filter 133.

[0062] An air through hole 138 formed in the upper lid 175 of the upper negative pressure chamber 136 is provided with a deaeration elbows 137 configured to connect the upper negative pressure chamber 136 and an air-gas suction device 79. The two deaeration elbows 137 are provided at intervals of 180° as illustrated in Fig. 11 and Fig. 12.

[0063] In Fig. 14, the guide cylinder 118 includes a nitrogen sucking portion (a lower sucking portion) 140 configured to suck residual air remaining in the powder or granular material and nitrogen gas filled in the powder or granular material in the non-leak cylinder portion 131 without being sucked by the deaeration portion 132 on the downstream side of the non-leak cylinder portion 131 in the direction of convey of the powder or granular material. The nitrogen sucking portion 140 includes a lower porous portion 118d of the guide cylinder 118 provided with a plurality of nitrogen sucking holes (through hole) 145 formed therethrough, a cylindrical filter 143 provided on an outer periphery of the lower porous portion 118d, and a cylindrical lower outer peripheral cylinder 144 provided on the guide cylinder 118 so as to separate from the filter and cover the filter 143. The lower outer peripheral cylinder 144 is provided on the guide cylinder 118 by a ring-shaped head lid 185 and a lower lid 176. The nitrogen suction hole 145 is configured to guide the residual air and nitrogen gas contained in the powder or granular material in the guide cylinder 118 to the outside. The filter 143 allows the residual air and the nitrogen gas from flowing to the outside via the nitrogen suction hole

145, and to prevent the powder or granular material in the guide cylinder from leaking from the nitrogen suction hole 145 to the outside.

[0064] The lower outer peripheral cylinder 144 forms an lower negative pressure chamber 146 for expelling the residual air and the nitrogen gas in the interior of the guide cylinder 118 by the ring-shaped head lid 185 provided on an upper end thereof, and the ring-shaped lower lid 176 provided at a lower end thereof. The lower porous portion 118d of the guide cylinder 118 in which the nitrogen suction holes 145 are formed is lower in strength. Therefore, the lower outer peripheral cylinder 144 also serves to reinforce the guide cylinder 118. Fig. 14B is a drawing illustrating a positional relationship of the guide cylinder 118, the filter 143, and the lower outer peripheral cylinder 144. When the guide cylinder 118 can hardly be reinforced by the lower outer peripheral cylinder 144, a reinforcing cylinder having a plurality of holes formed therethrough, which is the same as the reinforcing cylinder 71 illustrated in Figs. 4A and 4B of the first embodiment may be provided on an outer periphery of the filter 133.

[0065] The air through hole 148 formed in the head lid 185 of the lower negative pressure chamber 146 is provided with a lower end of the nitrogen suction pipe 141 that connects the lower negative pressure chamber 146 and the air-gas suction device 79. An upper end of the nitrogen suction pipe 141 penetrates through the upper lid 175, and is connected to the air-gas suction device 79 via a nitrogen suction elbow 142. The two deaeration elbows 137 are provided at intervals of 180° as illustrated in Fig. 11 and Fig. 12.

[0066] As illustrated in Fig. 15 and Fig. 16, the powder or granular material feeding apparatus 111 of the second embodiment is also provided with a pair of the nitrogen feed pipes 51 for the bottom part, and a pair of the nitrogen feed pipes 61 for the upper part in the same manner as the powder or granular material feeding apparatus of the first embodiment. The description of this part will be omitted.

[0067] In Fig. 11, the upper lid 175 is provided with eight elbows 52, 137, 62, 142, 52, 137, 62, 142 at regular intervals in the circular direction.

[0068] The upper outer peripheral cylinder 134, the protecting cylinder 139, and the lower outer peripheral cylinder 144 described thus far may be one integrated cylindrical member.

[0069] An action of the second powder or granular material feeding apparatus 111 will be described.

[0070] In the same manner as illustrated in Fig. 7, the powder or granular material feeding apparatus 111 and the storage bag K are configured to be movable with respect to each other, and when at least one of those is moved upward and downward, a powder or granular material discharge port 118a of the guide cylinder 118 enters the storage bag K that stores the powder or granular material therein. Then, a motor, which is not illustrated, for rotating the auger, the nitrogen gas feeding apparatus

27 and the air-gas suction device 79 start activating.

[0071] Then, nitrogen gas N₂ is ejected from a gas ejection ports 51a positioned at positions where the powder or granular material discharge port 118a of the guide cylinder 118 is formed. The gas ejection ports 51a are located at lower ends of the nitrogen feed pipes 51 for the bottom part, and eject nitrogen gas that is fed from the nitrogen gas feeding apparatus through the nitrogen feed elbows 52 and the nitrogen feed pipes 51 for the bottom part.

[0072] When nitrogen gas is ejected from the gas ejection port 51a, air accumulated in the storage bag K is replaced by nitrogen gas. When the motor, which is not illustrated, rotates and hence the auger 119 rotates, the powder or granular material is transported in the guide cylinder 118 by the blade 122 of the auger 119.

[0073] In the interior of the upper negative pressure chamber 136 of the deaeration portion 132 is kept at a low pressure (negative pressure) with respect to the atmospheric pressure by an activation of the air-gas suction device 79. In this state, in Fig. 13, air contained in the powder or granular material that reaches the deaeration portion 132 passes through the deaeration holes 135 and the filter 133 to be sucked into the upper negative pressure chamber 136, and further passes through the air through hole 138 and the deaeration elbow 137 to be sucked by the air-gas suction device 79. Consequently, deaeration (degassing) of air are contained in the powder or granular material passing through the deaeration portion 132. The filter 133 used here is configured not to be clogged easily by the powder or granular material.

[0074] Nitrogen gas supplied by the nitrogen gas feeding apparatus 27 is ejected from a nitrogen ejection ports 126 into the non-leak cylinder portion 131 through a nitrogen feed pipe 24 (Fig. 10), the elbow 25 and the nitrogen feed channel 123 (Fig. 14). Therefore, nitrogen gas is distributed over the entire powder or granular material reaching the interior of the non-leak cylinder portion 131. In addition, deaeration of the powder or granular material is performed in the non-leak cylinder portion 131 and is rather in the negative pressure state. Therefore, the nitrogen gas is easily distributed over the entire part of the powder or granular material. Since the nitrogen gas is ejected radially from the nitrogen ejection ports 126 of the revolving shaft 121 at a center of the powder or granular material, the nitrogen gas is distributed over the entire part of the powder or granular material. Furthermore, since the non-leak cylinder portion 131 is formed so as not have a gap, the nitrogen gas is congested (filled) into the powder or granular material so as to be pushed into the powder or granular material.

[0075] Although the nitrogen ejection ports 126 are positioned at a center of the non-leak cylinder portion 131 in the axial direction (the direction of convey of the powder or granular material), a plurality of the nitrogen ejection ports 126 may be formed in the thrust direction of the revolving shaft 121. However, if the nitrogen ejection ports 126 are formed at positions too much closer to the

deaeration portion 132 and the nitrogen sucking portion 140, since the nitrogen gas is sucked and discharged from the deaeration portion 132 and the nitrogen sucking portion 140, the nitrogen gas cannot be used efficiently. Accordingly, it is preferable to form the nitrogen ejection ports 126 at positions where the nitrogen gas is distributed to the powder or granular material, being located in the interior of the non-leak cylinder portion 131, by utilizing suction force of nitrogen gas that is sucked by the deaeration portion 132 and the nitrogen sucking portion 140.

[0076] In Fig. 14, the powder or granular material filled with the nitrogen gas in the non-leak cylinder portion 131 is fed to the nitrogen sucking portion 140. Nitrogen gas is sucked from the powder or granular material fed to the nitrogen sucking portion 140 by the air-gas suction device 79 so that the nitrogen gas filled in the non-leak cylinder portion 131 is reliably delivered to the entire part of the powder or granular material. The nitrogen gas passes through the nitrogen suction hole 145 and the filter 143 to be sucked into the lower negative pressure chamber 146, and then passes through the nitrogen suction pipe 141 and the nitrogen suction elbow 142 to be sucked by the air-gas suction device 79. At this time, air remaining in the powder or granular material is also sucked.

[0077] The nitrogen sucking portion 140 is not provided for sucking the nitrogen gas contained in the powder or granular material, but for causing the nitrogen gas to be distributed over the entire part of the powder or granular material by sucking the filled nitrogen gas from the center of the powder or granular material in the non-leak cylinder portion 131 from the outer periphery of the powder or granular material (the inner periphery of the guide cylinder 118). Therefore, the powder or granular material passing through the nitrogen sucking portion 140 has the nitrogen gas distributed over the entire part thereof. The filter 143 used here is configured not to be clogged easily by the powder or granular material.

[0078] The powder or granular material having the nitrogen gas distributed over the entire part thereof is fed to the storage bag K filled with nitrogen gas from the powder or granular material discharge port 118a of the guide cylinder 118.

[0079] In the same manner as the configuration illustrated in Fig. 8 of the first embodiment, as the powder or granular material P is supplied to the storage bag, at least one of the powder or granular material feeding apparatus 111 and the storage bag K is moved upward and downward, and the powder or granular material discharge port 118a of the guide cylinder 118 moves in the direction leaving the storage bag K. During this period, the ejection of the nitrogen gas N₂ from the gas ejection port 51a is stopped.

[0080] Subsequently, in the same manner as the configuration illustrated in Fig. 9 of the first embodiment, when the storage bag is substantially filled with the powder or granular material P, nitrogen gas N₂ is ejected from the gas ejection port 61a positioned at a position

where the powder or granular material discharge port 118a of the guide cylinder 118 is formed. The gas ejection port 61a is bent into an L-shape. Therefore, a probability that the nitrogen gas hits against the powder or granular material and causes the same to be stirred up is reduced.

[0081] Finally, the upper portion of the storage bag K is closed by a sealing device, which is not illustrated, so that the storage bag K is sealed.

[0082] In this manner, the powder or granular material feeding apparatus 111 is configured to expel the air contained in the powder or granular material, fill the powder or granular material with nitrogen gas and distribute the nitrogen gas over the entire part of the powder or granular material, then feed the powder or granular material into the storage bag filled with the nitrogen gas, fill the upper part of the storage bag with nitrogen gas, and then close the storage bag.

[0083] Therefore, the powder or granular material feeding apparatus 111 is capable of filling the powder or granular material with an inert gas to prevent alteration and solidification of the powder or granular material, and maintaining the quality of the powder or granular material packed into a bag constant for a long term.

[0084] It is also applicable to configure the powder or granular material feeding apparatus 111 of the second embodiment in the same manner as the powder or granular material feeding apparatus 11 of the first embodiment such that air in the storage bag is sucked by at least one of the two nitrogen feed pipes 51 for the bottom part.

[0085] The powder or granular material feeding apparatus 111 of the second embodiment described thus far is configured to expel air in the powder or granular material by the deaeration portion 132 while transporting the powder or granular material in the guide cylinder by the auger 119, causes the powder or granular material from the nitrogen ejection ports 126 to contain nitrogen gas in the non-leak cylinder portion 131, and suck residual air and nitrogen gas contained in the powder or granular material by the deaeration portion 132. Therefore, the powder or granular material is filled with the inert gas and hence a quality guarantee period of the powder or granular materials may be elongated.

[Industrial Applicability]

[0086] The powder or granular material feeding apparatus of the present invention is capable of feeding the powder or granular material and, specifically, is optimum to be used for feeding powder or granular materials which are subjected to oxidation, alteration, and solidification such as flour, non-fat dry milk powder, and toner containing magnetic material for copying machines.

Reference Signs List

[0087] P: powder or granular material, S: storage bag, N₂: nitrogen gas (inert gas), 11: powder or granular material feeding apparatus, 17: hopper, 18: guide cylinder,

18a: powder or granular material discharge port, 19: auger, 21: revolving shaft, 22: blade, 23: nitrogen feed channel (gas guide channel), 26: nitrogen ejection ports (gas feed port), 27: nitrogen gas feeding apparatus (gas feeding unit), 28: air-gas suction holes (through holes), 29: filter, 79: air-gas suction device (suction device), 51a: gas ejection port, 61a: gas ejection port, 111: powder or granular material feeding apparatus, 118: guide cylinder, 118a: powder or granular material discharge port, 119: auger, 121: revolving shaft, 122: blade, 123: nitrogen feed channel (gas guide channel), 126: nitrogen ejection port (gas feed port), 131: non-leak cylinder portion (gas non-leak portion), 132: deaeration portion (upper sucking portion), 133: filter, 135: deaeration holes (through hole), 140: nitrogen sucking portion (lower sucking portion), 143: filter, 145: nitrogen suction holes (through holes)

Claims

1. A powder or granular material feeding apparatus comprising:

a guide cylinder for guiding a powder or granular material, having a plurality of through holes formed thereon through which gas in an interior thereof is guided to an outside;

a filter provided on a portion of the guide cylinder where the through holes are formed to allow the gas in the interior of the guide cylinder to flow to the outside via the through holes while prevent the powder or granular material in the guide cylinder from leaking from the through holes to the outside;

a gas feed unit configured to feed inert gas;

an auger including a revolving shaft positioned in the guide cylinder and configured to rotate, and a blade provided on the revolving shaft and configured to transport the powder or granular material by being rotated by the rotation of the revolving shaft in the guide cylinder, the revolving shaft including a gas guide channel configured to guide the inert gas supplied by the gas feed portion and gas feed ports configured to allow the inert gas guided by the gas guide channel to eject therefrom to cause the powder or granular material to contain the inert gas; and a suction device configured to suck the gas in the guide cylinder to the outside of the guide cylinder via the through holes and the filter.

2. The powder or granular material feeding apparatus according to Claim 1, wherein the revolving shaft includes a plurality of the gas feed ports along the revolving shaft in the axial direction, and the guide cylinder includes a plurality of the through holes along the axial direction so as to oppose the plurality of the gas feed ports.

3. The powder or granular material feeding apparatus according to Claim 2, wherein the revolving shaft includes the plurality of the gas feed ports over the entire length of the revolving shaft in the axial direction; and the guide cylinder includes the plurality of the through holes formed over the entire length of the guide cylinder.

4. The powder or granular material feeding apparatus according to Claim 1 or 2, wherein the guide cylinder includes:

a gas non-leak portion where the through holes are not formed and opposing the gas feed ports; an upper sucking portion having the plurality of the through holes formed therethrough and formed upstream of the gas non-leak portion in the axial direction; and

a lower sucking portion having the plurality of the through holes formed therethrough and formed downstream of the gas non-leak portion in the axial direction.

5. The powder or granular material feeding apparatus according to any one of Claims 1 to 4, wherein the guide cylinder includes a gas ejection port configured to eject the inert gas at a distal end thereof.

6. The powder or granular material feeding apparatus according to any one of Claims 1 to 5, wherein the inert gas is nitrogen gas.

7. The powder or granular material feeding apparatus according to any one of Claims 1 to 5, wherein the powder or granular material is grain powder.

8. The powder or granular material feeding apparatus according to any one of Claims 1 to 5, wherein the powder or granular material is toner for image formation.

FIG.2

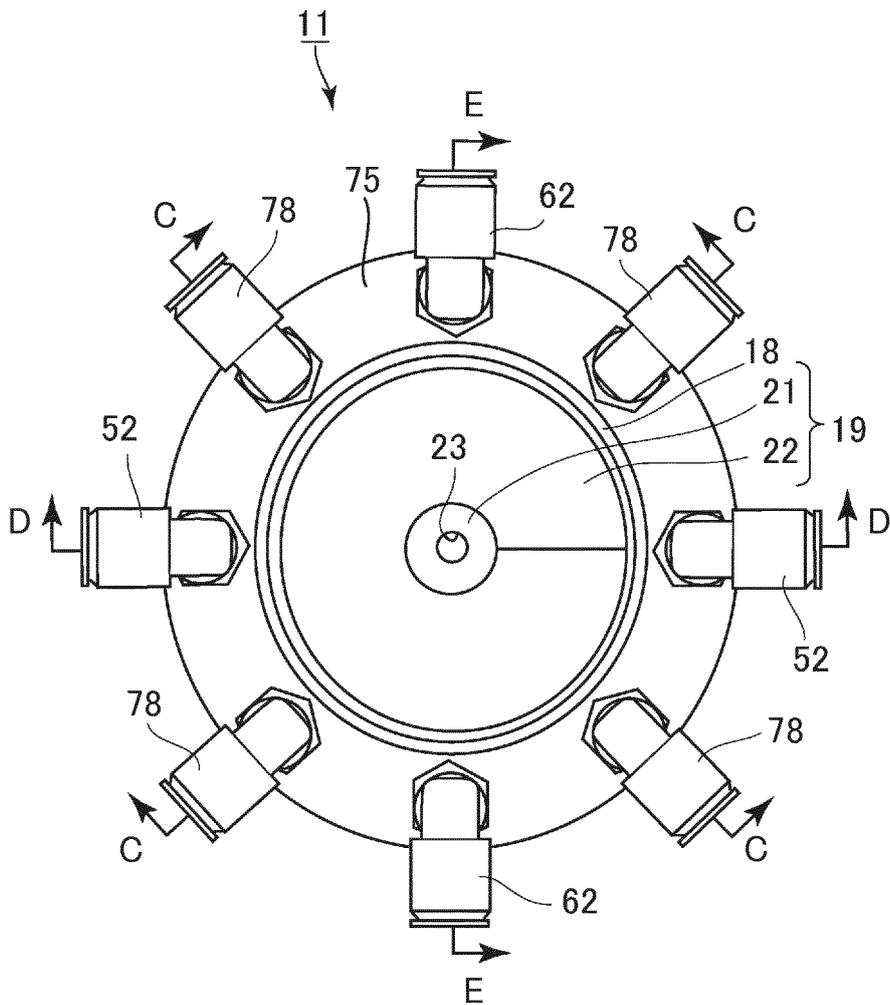


FIG.3

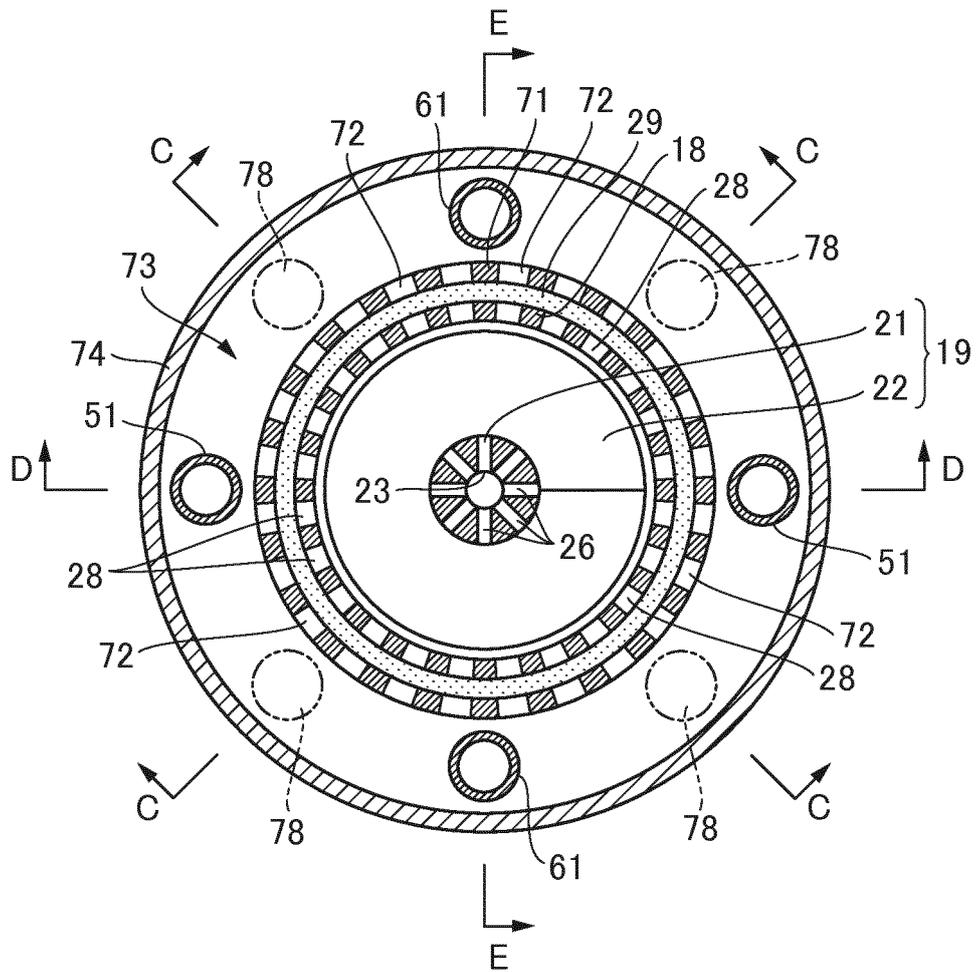


FIG.4A

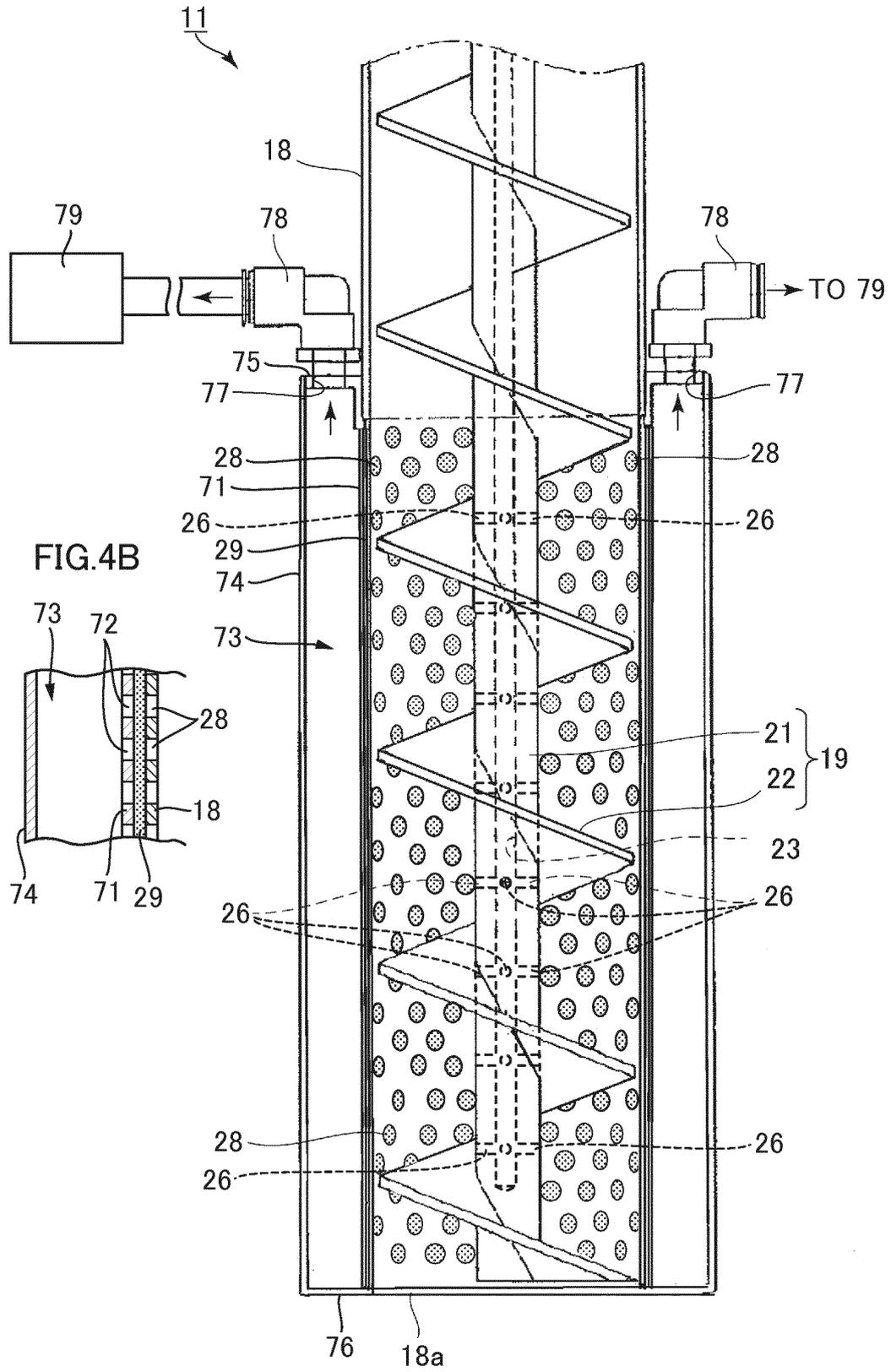


FIG.4B

FIG.6

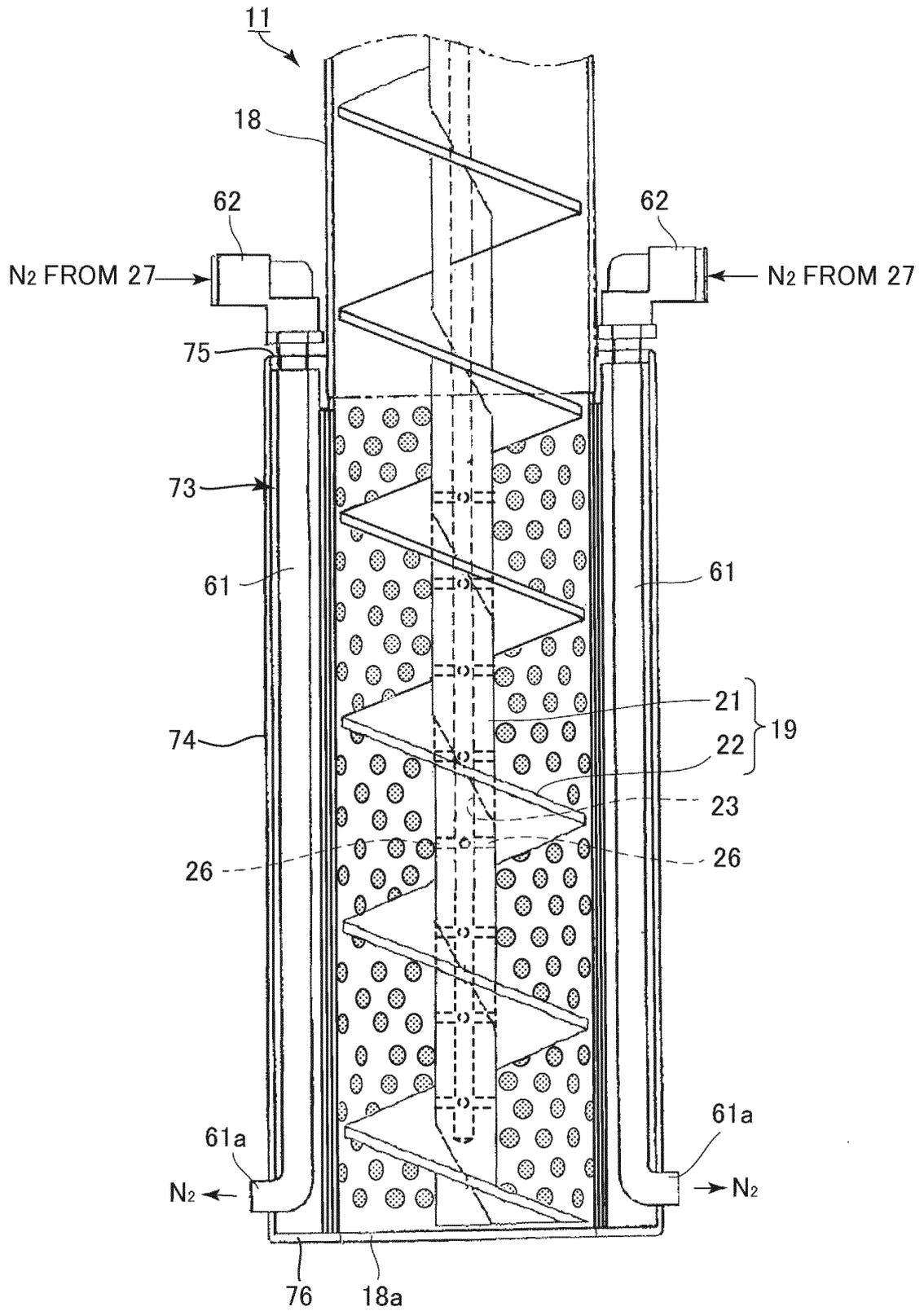


FIG.8

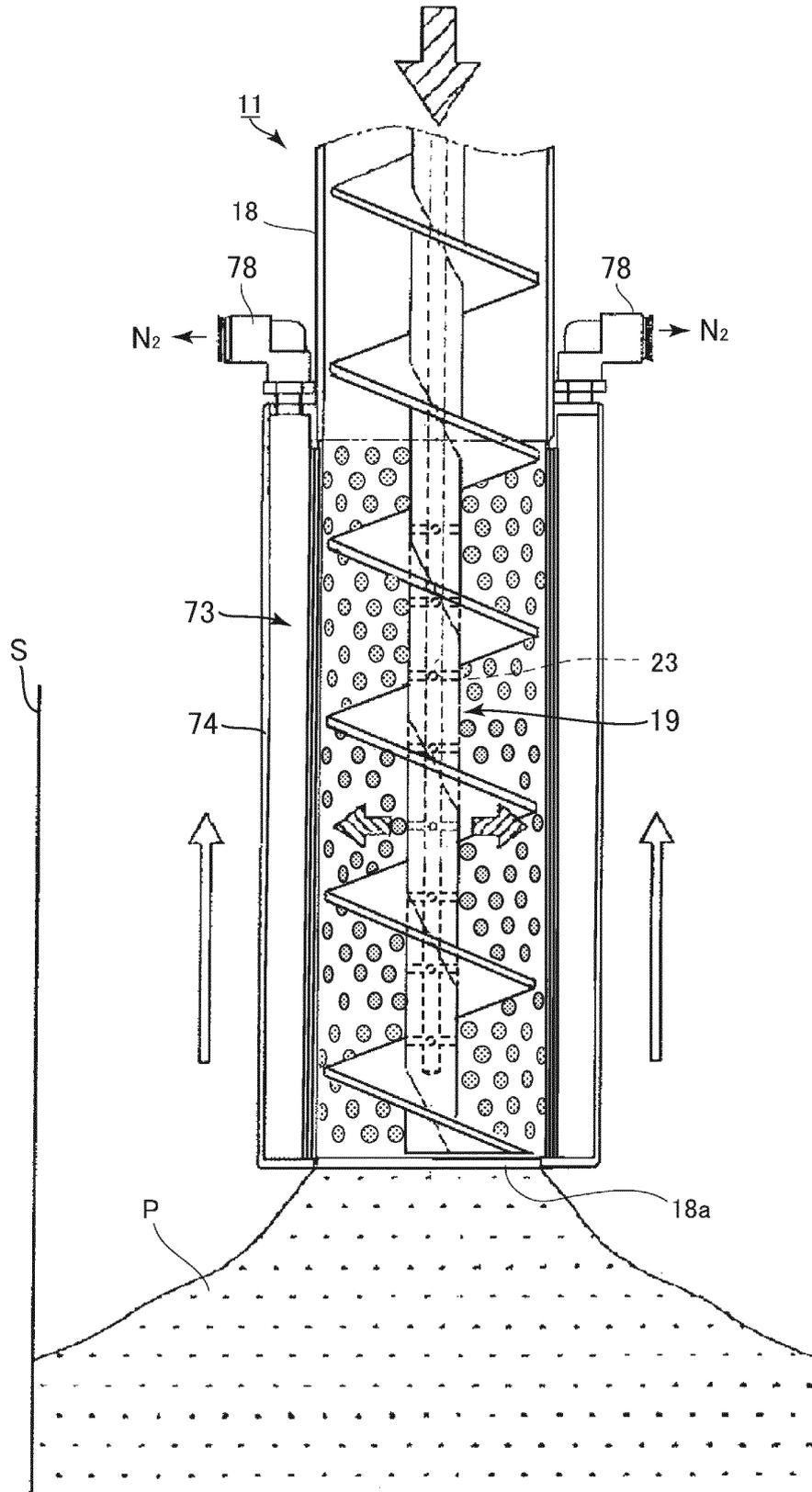


FIG.9

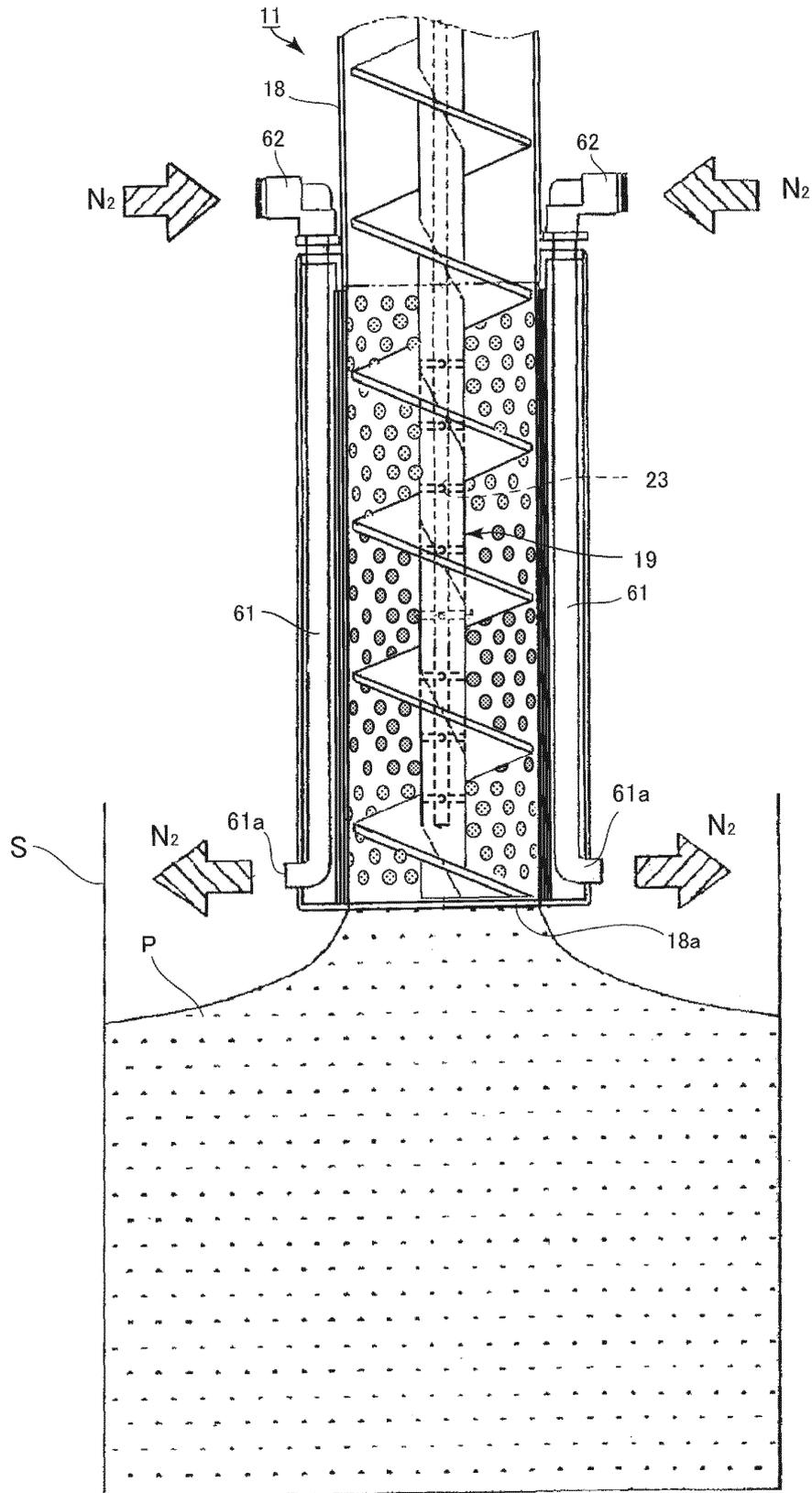


FIG.10

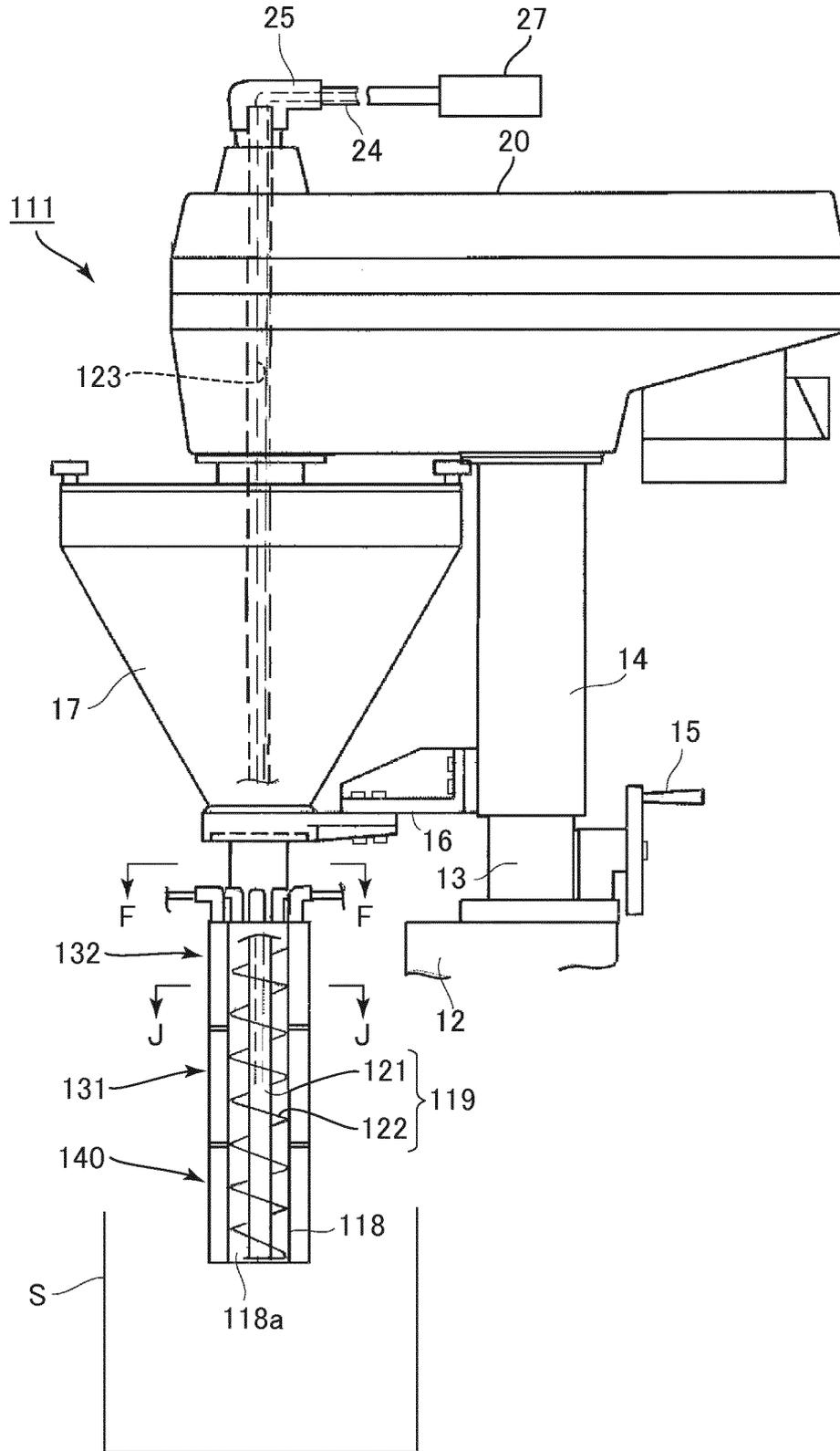


FIG.11

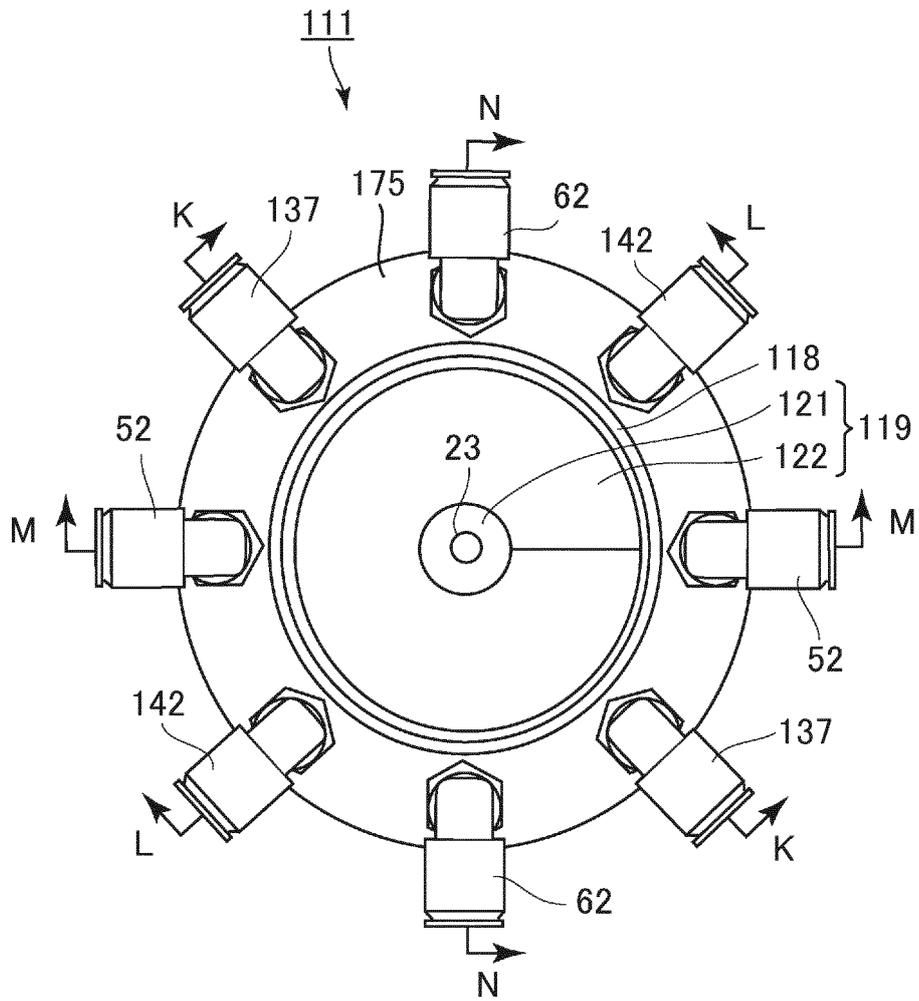


FIG.12

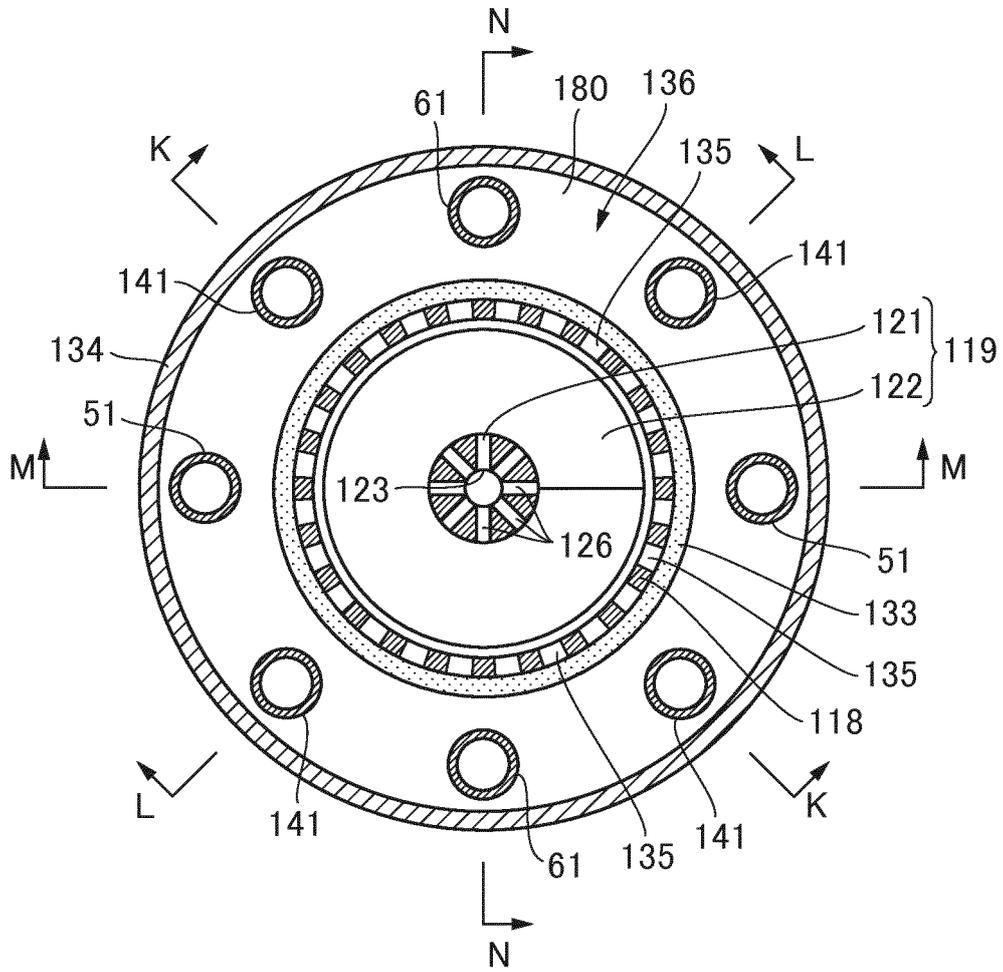


FIG.14A

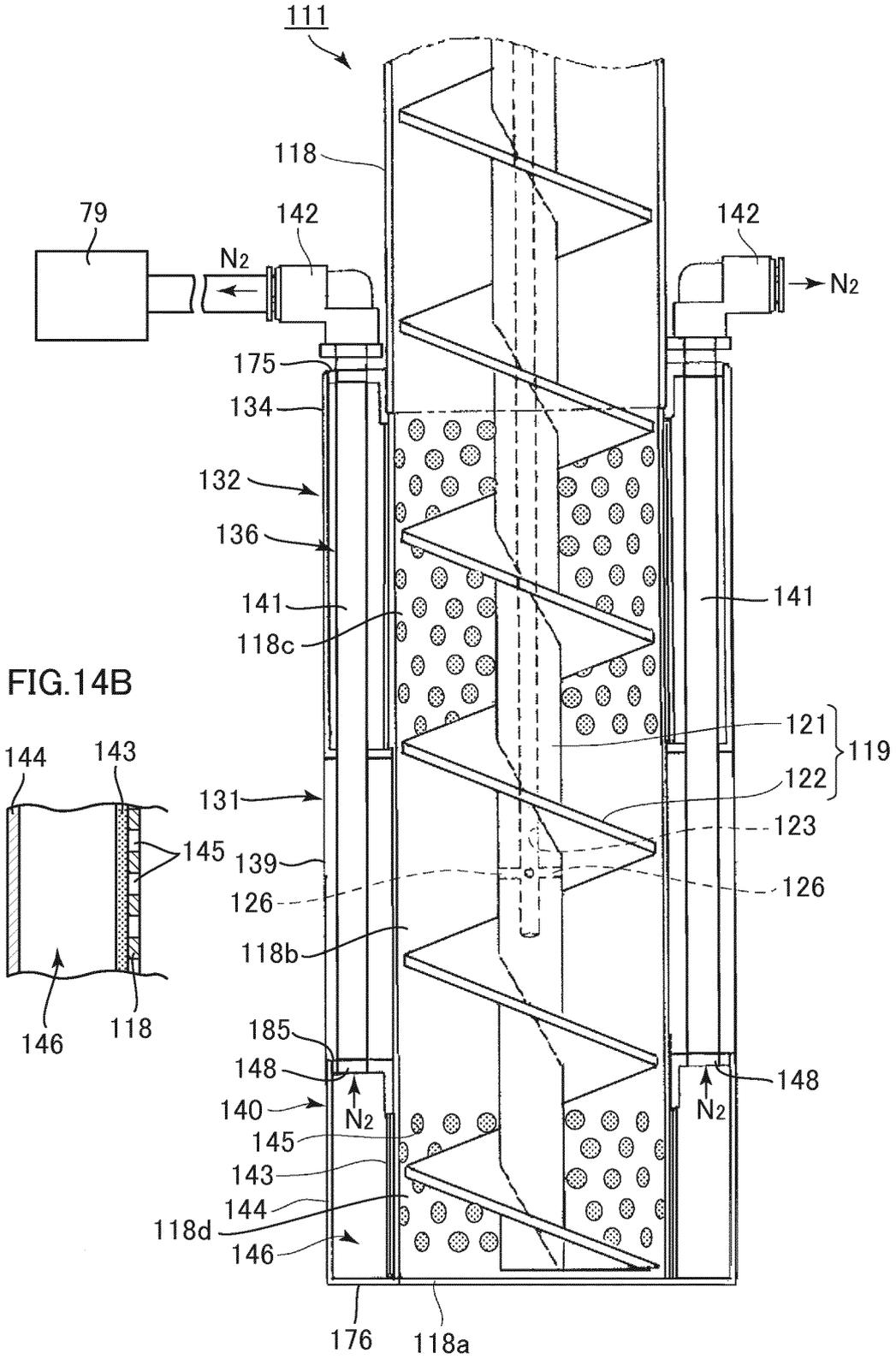


FIG.15

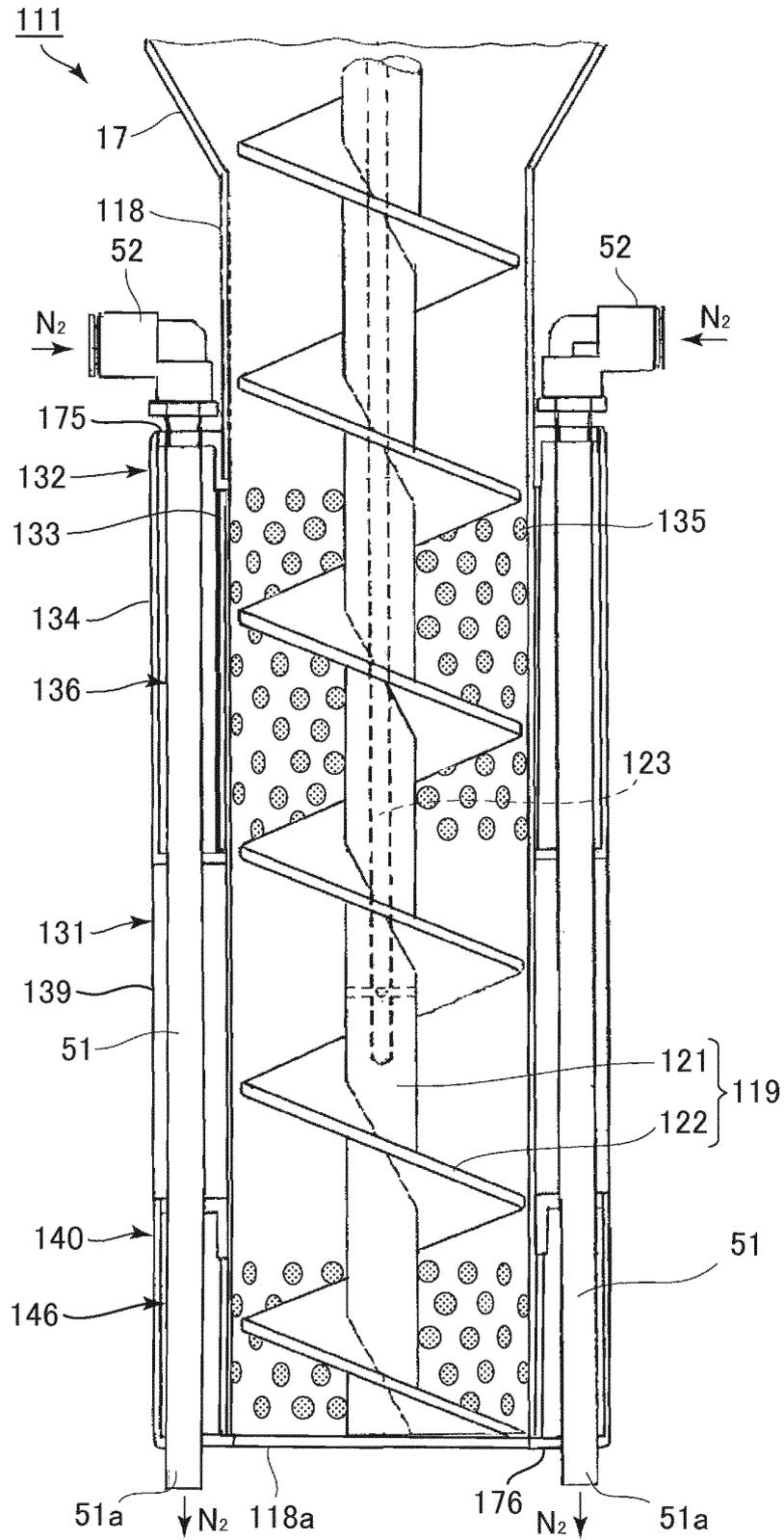
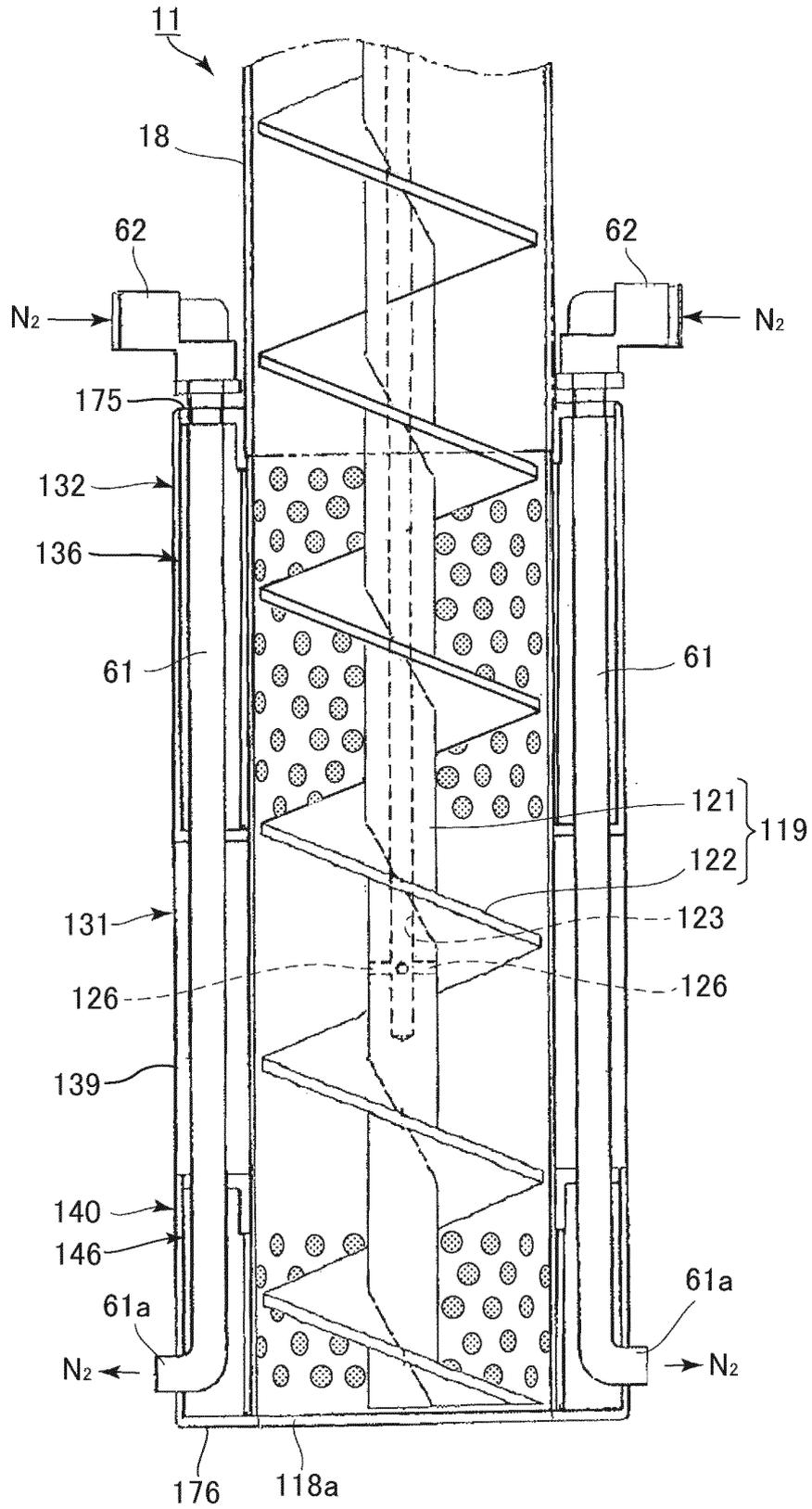


FIG.16



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/075686

5	A. CLASSIFICATION OF SUBJECT MATTER B65G65/46(2006.01)i, B65B31/04(2006.01)i, B65B37/10(2006.01)i, B65B39/04(2006.01)i	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B65G65/46, B65B31/04, B65B37/10, B65B39/04	
15	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012 Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012	
20	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)	
	C. DOCUMENTS CONSIDERED TO BE RELEVANT	
	Category*	Citation of document, with indication, where appropriate, of the relevant passages
25	Y A	JP 2006-341449 A (Mitsubishi Engineering-Plastics Corp.), 21 December 2006 (21.12.2006), paragraphs [0001], [0012] to [0014], [0016] to [0024], [0029]; fig. 1 (Family: none)
30	Y	JP 58-42507 A (Ishikawajima-Harima Heavy Industries Co., Ltd.), 12 March 1983 (12.03.1983), page 2, lower left column, line 6 to lower right column, line 1; drawings (Family: none)
35		
40	<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.	
45	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
50	Date of the actual completion of the international search 01 November, 2012 (01.11.12)	Date of mailing of the international search report 13 November, 2012 (13.11.12)
55	Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
	Facsimile No.	Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/075686

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 9-110135 A (Takeda Chemical Industries, Ltd., Unimetal Co., Ltd.), 28 April 1997 (28.04.1997), paragraph [0024]; fig. 1, 2 & US 5868234 A	1-3, 5-8
Y	JP 2011-73715 A (Ohki Co., Ltd., Tsubakimoto Kogyo Co., Ltd., Fabrica Toyama Corp.), 14 April 2011 (14.04.2011), paragraphs [0014], [0020], [0022]; fig. 6B (Family: none)	5-8
Y	JP 2007-290735 A (Orihiro Engineering Co., Ltd.), 08 November 2007 (08.11.2007), paragraphs [0029], [0030], [0035]; fig. 5, 6 (Family: none)	5-8
Y	JP 10-95405 A (Koichi TOSAKA), 14 April 1998 (14.04.1998), paragraph [0001] (Family: none)	7
Y	JP 5-127527 A (Fujitsu Ltd.), 25 May 1993 (25.05.1993), paragraph [0011] (Family: none)	8

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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