(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 166 134 B2

(12) NEW EUROPEAN PATENT SPECIFICATION
After opposition procedure

(45) Date of publication and mention of the opposition decision:
**04.10.2017 Bulletin 2017/40**

(45) Mention of the grant of the patent:
**23.04.2014 Bulletin 2014/17**

(21) Application number: **09010690.7**

(22) Date of filing: **19.08.2009**

(51) Int Cl.:
***D01H 11/00*** *(2006.01)* ***D01H 5/66*** *(2006.01)*

# (54) Duct for textile machine and textile machine equipped with the same

Kanal für Textilmaschine und mit diesem Kanal ausgestattete Textilmaschine

Conduit pour machine textile et machine textile équipée de celui-ci

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR**

(30) Priority: **19.09.2008 JP 2008241862**

(43) Date of publication of application:
**24.03.2010 Bulletin 2010/12**

(73) Proprietor: **Murata Machinery, Ltd.**
**Minami-ku**
**Kyoto-shi**
**Kyoto 601-8326 (JP)**

(72) Inventors:
- **Nakagawa, Takashi**
  **Kyoto-shi**
  **Kyoto 612-8686 (JP)**
- **Takahashi, Akira**
  **Kyoto-shi**
  **Kyoto 612-8686 (JP)**
- **Hidaka, Ichiro**
  **Kyoto-shi**
  **Kyoto 612-8686 (JP)**
- **Inoue, Takuya**
  **Kyoto-shi**
  **Kyoto 612-8686 (JP)**
- **Mori, Hideki**
  **Kyoto-shi**
  **Kyoto 612-8686 (JP)**

(74) Representative: **Zimmermann, Tankred Klaus et al**
**Schoppe, Zimmermann, Stöckeler**
**Zinkler, Schenk & Partner mbB**
**Patentanwälte**
**Radlkoferstrasse 2**
**81373 München (DE)**

(56) References cited:
**DE-A1- 4 229 552**
**DE-A1- 19 836 065**
**GB-A- 959 969**

EP 2 166 134 B2

## Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

2. Description of the Related Art

**[0001]** The present invention relates to automatic winders having a duct, and more specifically, to removing yarn waste in the duct.

**[0002]** A conventionally known duct for textile machine has a configuration of being connected to a negative pressure source such as a blower box and supplying a suction force to each part of the textile machine. This type of duct is disclosed in Japanese Unexamined Publication No. 9-53766 and Japanese Examined Utility Model Publication No. 49-10328.

**[0003]** A duct for spinning machine disclosed in Japanese Unexamined Patent Publication No. 9-53766 is configured by configuring pieces obtained by dividing a tubular duct into plurals at a plane intersecting both ends thereof and to a shape the configuring pieces of at least the same shape can be stacked in great numbers. With such a configuration, Japanese Unexamined Patent Publication No. 9-53766 enables each configuring piece to be easily stacked in packaging so that a more efficient packaging can be carried out. A duct disclosed in Japanese Examined Utility Model Publication No. 49-10328 conveys waste material into a casing having a curved inner side surface without settling by generating eddying flow of air and contamination.

**[0004]** DE 42 29 552 A1 discloses a textile machine suction device comprising a negative pressure line connected to a separator chamber by a tube. Yarn waste is collected within the separator chamber.

SUMMARY OF THE INVENTION

**[0005]** In a textile machine such as an automatic winder, yarn waste produced through splicing task and the like is sent into a duct from a winding unit, and then discharged to the outside through the duct. However, in the duct having a polygonal cross-sectional shape as disclosed in Japanese Unexamined Patent Publication No. 9-53766, a flow of air stagnates at the bottom or the corner of the duct, and the yarn waste sometimes remains in the duct.

**[0006]** In this regard, an ability to convey waste material in the duct by generating eddying flow is enhanced in Japanese Examined Utility Model Publication No. 49-10328. However, the duct in which the inner side surface is formed to a curved shape needs to be manufactured through complicating steps of processing a sheet metal to a curved surface and welding the spliced points. In the case of a duct formed to a cylindrical shape, a piping and the like for supplying the suction force to each part of the winding unit or the like needs to be attached to the curved surface, and thus the winding unit and the duct cannot be easily connected.

**[0007]** The present invention was made in view of the above circumstances. According to the present invention, an automatic winder having a duct that can effectively remove the yarn waste in the duct and that can be easily manufactured is provided.

**[0008]** The problems to be solved by the present invention are as described above, and the invention provides for an automatic winder according to claim 1 or 2.

**[0009]** According to one aspect of the present invention, the following configuration is provided for a duct in an automatic winder for suctioning and removing yarn waste by a negative pressure source arranged at an end. In other words, the duct is formed such that a cross-sectional shape cut at a plane perpendicular to a suctioning direction by the negative pressure source is a hexagon or a pentagon. A cyclone flow is generated in the duct.

**[0010]** With this configuration, even the yarn waste that tends to remain in the blower duct can be effectively removed by the cyclone flow. Therefore, the suction force of the negative pressure source necessary for removing the yarn waste can be reduced, thereby achieving energy conservation. As the blower duct is configured such that the cross-sectional shape is a polygon, the duct can be easily manufactured by combining or bending plate-shaped members that are easy to process.

**[0011]** The duct in the automatic winder is configured as below. In other words, the duct includes a duct wall surface formed to a planar shape so as to become one surface that configures the cross-sectional shape. The duct wall surface is formed with a first air inflow hole for supplying suction force to each part of the textile machine. An inner wall facing the air inflow hole is formed inclined with respect to the duct wall surface.

**[0012]** With this configuration, the air flowed in from the air inflow hole is guided in the constant direction by the inclined inner wall, so that the cyclone flow can be efficiently generated in the duct. Therefore, the cyclone flow can be generated with a simple configuration of forming the air inflow hole. Furthermore, since the duct wall surface with the air inflow hole is formed to a planar shape, the structure of the connecting portion of the suction path configured in the textile machine and the air inflow hole can be simplified.

**[0013]** In the duct for the automatic winder, the cross-sectional shape is a hexagon or a pentagon.

**[0014]** With this configuration, as the number of vertices becomes greater, the cross-sectional shape of the duct becomes a shape close to a circle. Therefore, the cyclone flow can be easily generated in the duct, and the yarn waste in the duct can be effectively removed.

**[0015]** In the duct for textile machine, an inscribed circle of maximum diameter that inscribes the cross-sectional shape preferably comes into contact with all sides configuring the cross-sectional shape.

**[0016]** With this configuration, the flow of the cyclone flow is not inhibited by the shape of the duct, and the ability to remove the yarn waste can be enhanced.

**[0017]** According to the present invention, the automatic winder includes the duct and a blower box serving as the negative pressure source connected to the duct.

**[0018]** With this configuration, there is provided an automatic winder capable of reducing the capacity of the blower box and effectively suppressing the yarn waste from remaining in the duct.

**[0019]** Other features, elements, processes, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the present invention with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

**[0020]**

Fig. 1 is a perspective view illustrating one part of an automatic winder according to one embodiment of the present invention;

Fig. 2 is a perspective view illustrating a state of a blower duct of the present embodiment;

Fig. 3 is a front view illustrating a state of the blower duct of the present embodiment;

Fig. 4 is a cross-sectional view in which the blower duct of the present embodiment is cut along a plane perpendicular to a suctioning direction of a blower box;

Fig. 5 is a front cross-sectional view of the blower duct schematically illustrating the state of air-flow in the blower duct;

Fig. 6 is a cross-sectional view in which a blower duct of a variant is cut along a plane perpendicular to the suctioning direction of the blower box;

Fig. 7 is a schematic view illustrating an internal average flow rate distribution in the blower duct (hexagonal cross-section) of the present embodiment;

Fig. 8 is a schematic view illustrating an internal average flow rate distribution in the blower duct (pentagon cross-section) of the variant;

Fig. 9 is a schematic view illustrating an internal average flow rate distribution in the conventional blower duct (rectangular cross-section); and

Fig. 10 is a schematic view illustrating an average flow rate distribution in the blower duct configured to a cylindrical shape.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

**[0021]** Hereinafter, the preferred to embodiments of the present invention will be described with reference to the drawings.

Fig. 1 is a perspective view illustrating one part of an automatic winder 10 according to one embodiment of the present invention.

**[0022]** As illustrated in Fig. 1, the automatic winder 10 serving as a textile machine includes an automatic winder frame 12, a plurality of winding units 11, a blower duct 20, and a package conveyor 75.

**[0023]** Although not illustrated in the figure, the automatic winder 10 also includes a blower box (negative pressure source) arranged at one end in a direction the winding units 11 are lined, a frame control device, an automatic doffing device, and the like. The blower box generates the suction force at each winding unit 11. The frame control device is provided to control each part of the winding unit 11. The automatic doffing device automatically replaces the package in a fully wound state formed in each winding unit 11 with an empty winding bobbin 70. The package in the fully wound state taken up from the winding unit 11 by the automatic doffing device is conveyed to an appropriate location by the package conveyor 75.

**[0024]** The automatic winder frame 12 is formed to a framework shape so as to support the winding unit 11, the blower duct 20, the package conveyor 75, the automatic doffing device, and the like. The winding unit 11 forms a package of a predetermined shape with a predetermined length by winding the yarn unwound from a yarn feeding bobbin to the winding bobbin 70 while traversing, and is lined in the automatic winder frame 12.

**[0025]** The blower duct 20 supplies the suction force of the blower box to each winding unit 11 in a distributed manner, and has one end in the longitudinal direction connected to the blower box. The blower duct 20 is installed in the automatic winder frame 12 so as to face the side at the rear surface side of the winding unit 11. The winding unit 11 is thereby supported by the blower duct 20 from the rear surface side. A first air inflow hole 31, a second air inflow hole 32, and a third air inflow hole 33 are formed at an outer wall on a front surface side of the blower duct 20. The suction force of the blower box is supplied to each part of the winding unit 11 through such air inflow holes. The details of the blower duct 20 will be described in detail below.

**[0026]** The details of the winding unit 11 will now be described. The winding unit 11 includes, for the main configuration, a magazine supply device 61, a yarn feeding bobbin holder 62, an unwinding assisting device 63, a tension exerting device 64, a splicer device 65, a yarn defect detecting device 66, and a winding drum 69.

**[0027]** As illustrated in Fig. 1, the magazine supply device 61 is supported by a supporting frame diagonally extending upward of a front surface from the lower part of the winding unit 11. In the magazine supply device 61, the yarn feeding bobbin can be set in an inclined orientation to each accommodation hole (not illustrated) of a magazine pocket arranged at a distal end portion of the supporting frame. The magazine pocket can be intermittently rotating-feed driven by a motor (not illustrated), where the yarn feeding bobbin is supplied to the yarn feeding bobbin holder 62 by the intermittent drive and a control valve (not illustrated) of the magazine pocket.

**[0028]** The magazine supply device 61 includes a suction unit arranged at a central part of the upper part of the magazine pocket, where the yarn end of the yarn feeding bobbin set in the accommodation hole is suctioned by the suction unit. The suction unit is connected to the third air inflow hole 33 by way of a hose.

**[0029]** The yarn feeding bobbin holder 62 is provided to set the yarn feeding bobbin at an unwinding position, and includes a movement means for moving the yarn feeding bobbin received from the magazine pocket to the unwinding position. The yarn feeding bobbin supplied from the magazine supply device 61 is thereby set at an appropriate position of the winding unit 11.

**[0030]** The unwinding assisting device 63 exerts an appropriate tension to a balloon formed at the upper part of the yarn feeding bobbin. The unwinding assisting device 63 exerts an appropriate tension to the balloon by lowering a regulation member covered on a core tube of the yarn feeding bobbin in conjunction with the unwinding of the yarn from the yarn feeding bobbin.

**[0031]** The tension exerting device 64 enhances the quality of the package by exerting a predetermined tension on the traveling yarn. The tension exerting device 64 may be a gate type or a disc type.

**[0032]** The splicer device 65 splices a lower yarn on the yarn feeding bobbin side and an upper yarn on the package side at the time of yarn cutting performed when the yarn defect detecting device 66 detects yarn defect or at the time of yarn breakage during unwinding from the yarn feeding bobbin.

**[0033]** The yarn defect detecting device 66 includes a sensor for detecting a yarn thickness, and detects the yarn defect by monitoring a yarn thickness signal from the sensor. A cutter (not illustrated), which immediately cuts the yarn when the yarn defect is detected, is arranged near the yarn defect detecting device 66.

**[0034]** A lower yarn guiding pipe 67 for capturing the lower yarn on the yarn feeding bobbin side and guiding the same to the splicer device 65, and an upper yarn guiding pipe 68 for capturing the upper yarn on the package side and guiding the same to the splicer device 65 are arranged on the lower side and the upper side of the splicer device 65. The lower yarn guiding pipe 67 and the upper yarn guiding pipe 68 are rotatably attached with respect to the main body of the winding unit 11.

**[0035]** A suction port 71 is formed at the distal end of the lower yarn guiding pipe 67, and a suction mouth 72 is attached to the distal end of the upper yarn guiding pipe 68. The upper yarn guiding pipe 68 is connected to the first air inflow hole 31 of the blower duct 20, so that the suction flow can be generated at the suction mouth 72 at the distal end. The suction mouth 72 is formed to an elongated shape such that the suction unit encompasses the width of the package to capture the yarn end on the surface of the package. The lower yarn guiding pipe 67 is connected to the second air inflow hole 32 of the blower duct 20, so that the suction flow can be generated at the suction port 71. The winding unit 11 is arranged with a shutter device (not illustrated), so that whether or not to act the suction force on the suction port 71 of the lower yarn guiding pipe 67 and the suction mouth 72 of the upper yarn guiding pipe 68 can be switched by the shutter device.

**[0036]** With such a configuration, the lower yarn guiding pipe 67 suctions and captures the lower yarn at the capturing position, and thereafter rotates upward to guide the lower yarn to the splicer device 65 during splicing. The upper yarn guiding pipe 68 rotates to the capturing position on the upper side, suctions and captures the upper yarn present on the surface of the package, and then rotates downward to guide the upper yarn to the splicer device 65. In the splicer device 65, the splicing task of the upper yarn and the lower yarn is carried out, and the extra yarn is appropriately cut. The cut yarn is suctioned as yarn waste by the lower yarn guiding pipe 67 and the upper yarn guiding pipe 68, and sent into the blower duct 20 through the first air inflow hole 31 and the second air inflow hole 32.

**[0037]** The winding drum 69 rotatably drives the package (winding bobbin 70), and is connected to a drive motor (not illustrated). A traverse groove is formed on the peripheral surface of the winding drum 69, where the yarn is wound up by the package while being traversed by the traverse groove.

**[0038]** The blower duct 20 will now be described with reference to Figs. 2, 3, 4, and 5. Fig. 2 is a perspective view illustrating a state of the blower duct 20 of the present embodiment. Fig. 3 is a front view of the blower duct 20. Fig. 4 is a cross-sectional view in which the blower duct 20 is cut along a plane perpendicular to a suctioning direction of the blower box. Fig. 5 is a front cross-sectional view of the blower duct 20 schematically illustrating the state of air flow in the blower duct 20.

**[0039]** As illustrated in Fig. 2, the blower duct 20 is formed to a tubular shape in which the cross-sectional shape cut along a plane perpendicular to the suctioning direction of the blower box is a hexagonal shape. Specifically, the cross-sectional shape has a hexagonal shape as if one of two sets of opposing corners of the rectangle is cut off. The blower duct 20 is manufactured by performing bend processing on the sheet metals and combining such sheet metals. As previously described, the blower box is connected to the end of the blower duct 20, and the blower box acts the suction force to the inside of the blower duct 20.

**[0040]** As illustrated in Figs. 2 and 3, an air inflow hole is formed at the wall surface on the front surface side of the blower duct 20. The air inflow hole and the wall surface where the air inflow hole is formed will be described below. As illustrated in Fig. 3, the first air inflow hole 31 is formed at a first wall surface 35 positioned on the upper side in front view, and the second air inflow hole 32 and the third air inflow hole 33 are formed at a second wall surface 36 positioned on the lower side in front view. As illustrated in Fig. 4, the first wall surface 35 is formed to a planar shape, and is arranged in a direction substantially perpendicular to the ground plane of the automatic winder 10. The first wall surface 35 is configured such that one end is connected to the upper surface of the blower duct 20 and the other end is connected to the second wall surface 36. The second wall surface 36 is formed to a planar shape, and is configured to incline from the connecting portion with the first wall surface 35 so as to approach the rear surface side in the downward direction to be connected to the lower surface of the blower duct 20.

**[0041]** The first air inflow hole 31 is arranged at the uppermost side of the air inflow holes, and is formed as a through-hole at the first wall surface 35. The first air inflow hole 31 is attached with a piping for supplying the suction force to the suction mouth 72 of the upper yarn guiding pipe 68, so that the suction flow generates at the suction mouth 72 through the piping. The diameter of the first air inflow hole 31 of the present embodiment is formed larger than the diameters of the second air inflow hole 32 and the third air inflow hole 33. Thus, the inflow amount of air that flows in from the first air inflow hole 31 into the blower duct 20 is also large compared to the inflow amount that flows in from other air inflow holes.

**[0042]** The second air inflow hole 32 is at the position on the lower side of the first air inflow hole 31, and is formed as a through-hole at the upper part of the second wall surface 36. The second air inflow hole 32 is attached with a piping for supplying the suction force to the suction port 71 of the lower yarn guiding pipe 67, so that the suction flow generates at the suction port 71 through the piping.

**[0043]** The third air inflow hole 33 is arranged at the lowermost side of the air inflow holes, and is formed as a through-hole at the second wall surface 36. The third air inflow hole 33 is arranged on the left side of the second air inflow hole 32 in front view. The third air inflow hole 33 is attached with a hose for supplying the suction force to the suction unit of the magazine supply device 61, so that the suction force acts on the suction unit through the hose. The suction unit connected to the magazine supply device 61 is constantly in a suctioning state, and thus the air suctioned from the suction unit continuously flows into the duct from the third air inflow hole 33.

**[0044]** The first wall surface 35 and the second wall surface 36 formed with air inflow holes are made of plane sheet metal. Therefore, a fixing tool for attaching the piping and the hose for supplying the suction force to each part (suction mouth 72, suction port 71, and magazine supply device 61) of the winding unit 11 can be easily installed on a plane portion. In order to appropriately supply the suction force of the blower box to the winding unit 11 side, a gap needs to be prevented from being formed at the connecting portion of the blower duct 20 and the piping or the like. In this regard, the attachment surface of the fixing tool is formed to a planar shape in the present embodiment, as described above, and thus the attachment structure for attaching the piping can be easily configured and the attachment task can be easily carried out compared to the cylindrical blower duct of the related art in which the attachment surface is formed with a curved surface.

**[0045]** As illustrated in Fig. 4, an opposing surface wall 38 to which the first air inflow hole 31 faces in the blower duct 20 is formed to an inclined shape so as to approach the rear surface side in the downward direction. The first wall surface 35 is configured to be substantially perpendicular to the installation surface of the automatic winder 10, as described above, and thus the opposing surface wall 38 is inclined with respect to the first wall surface 35. Therefore, the air flowed into the blower duct 20 from the first air inflow hole 31 formed at the first wall surface 35 is guided in the downward direction along the inclination of the opposing surface wall 38. As the air flowed in from the first air inflow hole 31 is guided in a constant direction, an air current generates in the blower duct 20 as if drawing a circle.

**[0046]** The blower duct 20 of the present embodiment is configured such that the inner side surfaces (inner walls) of all the sheet metals configuring the inner wall of the blower duct 20 come into contact with an inscribed circle 50 of maximum diameter illustrated with a chain line of Fig. 4. Therefore, the air flowed in from the first air inflow hole 31 can smoothly flow without being subjected to a large interference by the inner wall of the blower duct 20.

**[0047]** With such a configuration, the suction force of the blower box is supplied to each winding unit 11 through the blower duct 20. In the winding unit 11, the shutter on the winding unit 11 side is opened to act the suction force on the upper yarn guiding pipe 68 and the lower yarn guiding pipe 67 when the splicing task is carried out. The unnecessary yarn waste produced by the splicing task is suctioned from the suction mouth 72 of the upper yarn guiding pipe 68 and the suction port 71 of the lower yarn guiding pipe 67, and suctioned into the blower duct 20 from the first air inflow hole 31 and the second air inflow hole 32. The air continuously flows in from the third air inflow hole 33. As the inflow amount of air of the first air inflow hole 31 is large in the present embodiment, the air that flows in from the second air inflow hole 32 and the third air inflow hole 33 joins with the flow of air generated by the air that flows in from the first air inflow hole 31.

**[0048]** As illustrated with an outlined arrow of Fig. 5, a force of being pulled toward the blower box side is acted by the suction force from the blower box in the blower duct 20. The suction force of the blower box and the flow of air guided in the constant direction by the opposing surface wall 38 cooperate to generate a cyclone flow that rotates in a spiral shape in the blower duct 20. The yarn waste delivered into the duct from the first air inflow hole 31, the second air inflow hole 32, and the third air inflow hole 33 gets involved in the cyclone flow and is delivered in the suctioning direction without remaining at the bottom of the blower duct 20. The yarn waste delivered to the blower box by the cyclone flow is collected in a dust box (not illustrated).

**[0049]** A variant of the blower duct 20 formed with a pentagonal cross-section will now be described with reference to Fig. 6. The variant has a configuration similar to the above-described configuration other than that the cross-sectional shape of a blower duct 90 is a pentagon shape, and thus same reference numerals may be denoted in the figure for portions similar to the above-described embodiment, and the description thereof will not be given.

**[0050]** As illustrated in Fig. 6, the blower duct 90 of the variant is formed to a tubular shape by performing appropriate processing on the sheet metal such that the cross-sectional shape becomes a pentagon shape. The blower box is connected to the end of the blower duct 90, and the suction flow toward the blower box is generated in the blower duct 90.

**[0051]** A front wall 95 on the front surface side is substantially perpendicular to the ground plane of the automatic winder 10. The front wall 95 is formed with a first air inflow hole 91, a second air inflow hole 92, and a third air inflow hole 93 as through-holes in order from the top. The diameter of the first air inflow hole 91 is formed to be larger than the second air inflow hole 92 and the third air inflow hole 93, and the inflow amount of air that flows in from the first air inflow hole 91 is also the largest.

**[0052]** An opposing surface wall 98 facing the first air inflow hole 91 is formed to an inclined shape so as to approach the rear surface side in the downward direction. The air flowed in from the first air inflow hole 91 is guided by an inclined surface of the opposing surface wall 98, so that the flow of air flow in a constant direction generates in the blower duct 90 as if drawing a circle. The flow of the air flow and the suction flow generated by the blower box generate the cyclone flow. Since the inner walls of all the sheet metals configuring the cross-sectional shape of the blower duct 90 are formed to come into contact with the inscribed circle 50 of maximum diameter in the blower duct 90, the flow of the generated cyclone flow will not be inhibited.

**[0053]** The flow of air that flows in from the second air inflow hole 92 and the third air inflow hole 93 joins the cyclone flow, and the yarn waste flowed in from the second air inflow hole 92 and the third air inflow hole 93 is also delivered by the cyclone flow. Thus, even in the blower duct 90 having a pentagonal cross-section, the cyclone flow can be generated at the interior, and the yarn waste that tends to remain in the blower duct 90 can be effectively removed.

**[0054]** The simulation results of the air current in four types of blower ducts having different cross-sectional shapes will now be described with reference to Figs. 7 to 10. Figs. 7 to 10 schematically illustrate, in plan view, the average flow rate distribution (contour distribution) at the position of 10 mm from the bottom surface of the blower duct. The blower box is connected to one end (end on lower side in the figure) of the blower duct illustrated in Figs. 7 to 10, and the suction force is generated in the direction toward the blower box. The air from the lower yarn guiding pipe 67, the upper yarn guiding pipe 68, and the magazine supply device 61 flow into the blower duct through the air inflow holes.

**[0055]** Fig. 7 is a simulation result for the blower duct 20 (hexagonal cross-section) illustrated in Fig. 4 and the like. Fig. 8 is a simulation result for the blower duct 90 (pentagonal cross-section) illustrated in Fig. 6. In the present simulation experiment, the experiment was conducted for the conventional blower duct having a rectangular cross-section and the blower duct having a circular cross-section. The case of rectangular cross-section is illustrated in Fig. 9, and the case of circular cross-section is illustrated in Fig. 10. The simulation results illustrated in Figs. 7 to 10 all show the average flow rate distribution at the height 10 mm above the inner bottom surface of the blower duct (in the case of circular cross-section, height 10 mm above from the lowermost end of the inner surface). The average flow rate distribution is the contour distribution showing the portion where the absolute value of the speed at the relevant location is equal for every 1 m/s. Large disturbance in the distribution diagram indicates that the turbulence of the air flow in the duct is large, and small disturbance in the distribution diagram indicates that the turbulence of the air flow in the duct is small.

**[0056]** As illustrated in Figs. 7 to 10, the turbulence of the air flow occurs in all four types of blower ducts due to the lowering of the suction force that occurs since the pressure loss becomes large as the distance from the blower box becomes greater, and the inflow air that flows in from the air inflow holes. However, in the blower duct having a hexagonal cross-section illustrated in Fig. 7, the turbulence of the air flow is small compared to other blower ducts with different cross-sectional shapes. In the cylindrical blower duct illustrated in Fig. 10, the influence of the inflow air from the air inflow holes is large since the cross-sectional area is small compared to the blower ducts of other shapes, and thus the turbulence of the air flow is assumed to be strong.

**[0057]** As previously described, the blower duct having a hexagonal or pentagonal cross-section as in the above-described embodiments and the variant can efficiently generate the cyclone flow at the interior, and thus a loss speed in the suctioning direction is small and a delivery ability of the yarn waste is high compared to the conventional blower duct. From the experimental results, the loss speed is small and the turbulence of the air flow is small in the blower duct having a hexagonal cross-section, in particular, and thus such a blower duct is suitable in the simulation results in terms of effectively removing the yarn waste.

**[0058]** As described above, the blower duct 20 of the present embodiment is configured as below. The blower duct 20 is formed such that the cross-sectional shape cut at the plane perpendicular to the suctioning direction by the blower box (negative pressure source) is a polygon. In addition, the blower duct 20 is configured to generate the cyclone flow in the blower duct 20.

**[0059]** With this configuration, even the yarn waste that tends to remain in the blower duct 20 can be effectively removed by the cyclone flow. The suction force of the negative pressure source necessary for removing the yarn waste thus can be reduced, thereby achieving energy conservation. As the blower duct is configured such that the cross-sectional shape is a polygon, the blower duct 20 can be easily manufactured by combining or bending sheet plates (plate-shaped member) that are easy to process.

**[0060]** The blower duct 20 of the present embodiment is configured as below. The blower duct 20 includes the first wall surface 35 formed to a planar shape so as to become one surface that configures the cross-sectional shape. The first wall surface 35 is formed with the first air inflow hole 31 for supplying the suction force to each winding unit 11 of the automatic winder 10. The opposing surface wall 38 facing the first air inflow hole 31 is formed inclined with respect to the first wall surface 35.

**[0061]** With this configuration, the air flowed in from the first air inflow hole 31 is guided in the constant direction by the inclined opposing surface wall 38, whereby the cyclone flow can be efficiently generated in the blower duct 20. Therefore, the cyclone flow can be generated with a simple configuration of forming the first air inflow hole 31. Furthermore, since the first wall surface 35 with the first air inflow hole 31 is formed to a planar shape, the structure of the connecting portion of the suction path for supplying the suction force to the winding unit 11 configured in the automatic winder 10 and the first air inflow hole 31 can be simplified. In the present embodiment and the variant, the diameter of the first air inflow hole 31 is formed the largest of the diameters of the air inflow holes, and thus the inflow amount of air is also large. Therefore, the flow of air introduced from the first air inflow hole 31 becomes dominant when the shutter device is opened, whereby the cyclone flow can be effectively generated.

**[0062]** The blower duct 20 of the present embodiment is configured such that the cross-sectional shape is a hexagon.

**[0063]** With this configuration, the cross-sectional shape of the blower duct 20 becomes close to a circle as the number of vertices becomes greater. Therefore, the cyclone flow can be easily generated in the blower duct 20, and the yarn waste in the blower duct 20 can be effectively removed.

**[0064]** In the blower duct 20 of the present embodiment, the inscribed circle 50 of maximum diameter that inscribes the cross-sectional shape comes into contact with all sides configuring the cross-sectional shape.

**[0065]** With this configuration, the flow of the cyclone flow is not inhibited by the shape of the blower duct 20, whereby the ability to remove the yarn waste can be enhanced.

**[0066]** The automatic winder (textile machine) 10 of the present embodiment includes the blower duct 20, and the blower box serving as the negative pressure source connected to the blower duct 20.

**[0067]** With this configuration, the capacity of the blower box can be reduced, and the yarn waste can be effectively suppressed from remaining in the blower duct 20.

**[0068]** The preferred embodiment of the present invention has been described above, however, the above-described configuration may be further changed as below.

**[0069]** The configuration of the air inflow hole formed in the blower duct of the above-described embodiment can be appropriately changed. In the blower duct formed to have a hexagonal cross-sectional shape, the second air inflow hole and the third air inflow hole may be formed at the first wall surface 35 on the upper side in addition to the first air inflow hole 31. In this manner, the number of arrangements and the arrangement area of the air inflow hole for supplying the suction force to each winding unit 11 can be changed according to the situation.

**[0070]** In the above-described embodiment, all the sheet metals configuring the inner wall of the blower duct 20 come into contact with the inscribed circle 50 of maximum diameter. However, in place of such a configuration, the blower duct may have a configuration including an inner wall that does not come into contact with the inscribed circle of maximum diameter.

**[0071]** In the above-described embodiment, the cyclone flow generates when the air that flows in from the first air inflow hole 31 is guided by the opposing surface wall 38, but the configuration for generating the cyclone flow may be appropriately changed. For example, a groove, a guide plate, and the like for generating the cyclone flow may be formed at the inner side surface of the blower duct. Furthermore, the configuration is not limited to the configuration of generating the cyclone flow in the blower duct as in the above-described embodiment. As long as the air that flows in from the air inflow hole into the blower duct is guided in the constant direction by the inclined opposing surface wall, the configuration of the blower duct can be appropriately changed. With such a configuration as well, the yarn waste that tends to remain near the air inflow hole in the blower duct can be efficiently removed.

**[0072]** While the present invention has been described with respect to preferred embodiments thereof, it will be apparent to those skilled in the art that the disclosed invention may be modified in numerous ways and may assume many embodiments other than those specifically set out and described above. Accordingly, it is intended by the appended claims to cover all modifications of the present invention that fall within the scope of the present invention.

## Claims

1. An automatic winder comprising a duct (20) for suctioning and removing yarn waste by a negative pressure source arranged at an end and a blower box serving as the negative pressure source connected to the duct (20); wherein
   the duct is formed so that a cross-sectional shape

cut at a plane perpendicular to a suctioning direction by the negative pressure source is a hexagon;
a cyclone flow is generated in the duct (20);
the duct (20) comprises a duct wall surface (35) formed to a planar shape and arranged in a direction perpendicular to a ground plane of the automatic winder to become one surface that configures the cross-sectional shape;
the duct wall surface (35) is formed with a first air inflow hole for supplying suction force to each part of the automatic winder;
an inner wall (38) facing the first air inflow hole (31) is formed inclined with respect to the duct wall surface (35) so as to approach the rear surface side in the downward direction;
the duct wall surface (35) is a first duct wall surface positioned on an upper side in front view of the automatic winder, wherein one end of the first duct wall surface (35) is connected to an upper surface of the blower duct (20) and the other end of the first duct wall surface (35) is connected to a second duct wall surface (36) positioned on a lower side in front view of the automatic winder, wherein the second duct wall surface (36) is formed to a planar shape and is configured to incline from the connecting portion with the first duct wall surface (35) so as to approach the rear surface side in the downward direction to be connected to a lower surface of the blower duct (20);
a second air inflow hole (32) and a third air inflow hole (33) are formed at the first duct wall surface (35) or at the second duct wall surface (36), wherein the second air inflow hole (32) is at a position on a lower side of the first air inflow hole (31), wherein the third air inflow hole (33) is the lowermost of the air inflow holes and is arranged on a left side of the second air inflow hole in the front view of the automatic winder; and
a diameter of the first inflow hole (31) is formed larger than diameters of the second air inflow hole (32) and the third air inflow hole (33).

2. An automatic winder comprising a duct (90) for suctioning and removing yarn waste by a negative pressure source arranged at an end and a blower box serving as the negative pressure source connected to the duct (20); wherein
the duct is formed so that a cross-sectional shape cut at a plane perpendicular to a suctioning direction by the negative pressure source is a pentagon;
a cyclone flow is generated in the duct (20);
the duct (90) comprises a duct wall surface (95) formed to a planar shape and arranged in a direction perpendicular to a ground plane of the automatic winder to become one surface that configures the cross-sectional shape;
the duct wall surface (95) is formed with a first air inflow hole for supplying suction force to each part of the automatic winder;
an inner wall (98) facing the first air inflow hole (91) is formed inclined with respect to the duct wall surface (95) so as to approach the rear surface side in the downward direction;
the duct wall surface (95) is a front wall formed with a first air inflow hole (91), a second air inflow hole (92) and a third inflow hole (93) in order from the top; and
a diameter of the first inflow hole (91) is formed larger than diameters of the second air inflow hole (92) and the third air inflow hole (93).

3. The automatic winder according to any one of claims 1 to 2, wherein an inscribed circle of a maximum diameter that inscribes the cross-sectional shape comes into contact with all sides configuring the cross-sectional shape.

## Patentansprüche

1. Eine automatische Wickelvorrichtung, die ein Rohr (20) zum Absaugen und Entfernen von Garnabfall durch eine Unterdruckquelle, die an einem Ende angeordnet ist, und einen Gebläsekasten aufweist, der als die Unterdruckquelle dient, der mit dem Rohr (20) verbunden ist; wobei
das Rohr gebildet ist, so dass eine Querschnittform, geschnitten auf einer Ebene senkrecht zu einer Ansaugrichtung durch die Unterdruckquelle ein Hexagon ist;
ein Zyklonfluss in dem Rohr (20) erzeugt wird;
das Rohr (20) eine Rohrwandoberfläche (35) aufweist, die in eine planare Form gebildet ist und in einer Richtung senkrecht zu einer Grundebene der automatischen Wickelvorrichtung angeordnet ist, um eine Oberfläche zu werden, die die Querschnittform ausbildet;
die Rohrwandoberfläche (35) mit einem ersten Lufteinlassloch gebildet ist zum Liefern einer Ansaugkraft zu jedem Teil der automatischen Wickelvorrichtung;
eine Innenwand (38), die dem ersten Lufteinlassloch (31) zugewandt ist, geneigt im Hinblick auf die Rohrwandoberfläche (35) gebildet ist, um sich der Rückoberflächenseite in der Abwärtsrichtung zu nähern;
die Rohrwandoberfläche (35) eine erste Rohrwandoberfläche ist, die in der Vorderansicht der automatischen Wickelvorrichtung an einer Oberseite positioniert ist, wobei ein Ende der ersten Rohrwandoberfläche (35) mit einer oberen Oberfläche des Gebläserohrs (20) verbunden ist und das andere Ende der ersten Rohrwandoberfläche (35) mit einer zweiten Rohrwandoberfläche (36) verbunden ist, die in der Vorderansicht der automatischen Wickelvorrichtung an einer unteren Seite positioniert ist, wobei die zweite Rohrwandoberfläche (36) in eine planare Form gebildet ist und ausgebildet ist, um sich von

dem Verbindungsabschnitt mit der ersten Rohrwandoberfläche (35) zu neigen, um sich der Rückoberflächenseite in der Abwärtsrichtung zu nähern, um mit einer unteren Oberfläche des Gebläserohrs (20) verbunden zu sein;
ein zweites Lufteinlassloch (32) und ein drittes Lufteinlassloch (33) an der ersten Rohrwandoberfläche (35) oder an der zweiten Rohrwandoberfläche (36) gebildet sind, wobei das zweite Lufteinlassloch (32) an einer Position auf einer unteren Seite des ersten Lufteinlasslochs (31) liegt, wobei das dritte Lufteinlassloch (33) das unterste der Lufteinlasslöcher ist und in der Vorderansicht der automatischen Wickelvorrichtung auf einer linken Seite des zweiten Lufteinlasslochs angeordnet ist; und
ein Durchmesser des ersten Lufteinlasslochs (31) größer gebildet ist als Durchmesser des zweiten Lufteinlasslochs (32) und des dritten Lufteinlasslochs (33).

2. Eine automatische Wickelvorrichtung, die ein Rohr (90) zum Absaugen und Entfernen von Garnabfall durch eine Unterdruckquelle, die an einem Ende angeordnet ist, und einen Gebläsekasten aufweist, der als die Unterdruckquelle dient, der mit dem Rohr (20) verbunden ist; wobei
das Rohr gebildet ist, so dass eine Querschnittform, geschnitten auf einer Ebene senkrecht zu einer Ansaugrichtung durch die Unterdruckquelle ein Pentagon ist;
ein Zyklonfluss in dem Rohr (20) erzeugt wird;
das Rohr (90) eine Rohrwandoberfläche (95) aufweist, die in eine planare Form gebildet ist und in einer Richtung senkrecht zu einer Grundebene der automatischen Wickelvorrichtung angeordnet ist, um eine Oberfläche zu werden, die die Querschnittform ausbildet;
die Rohrwandoberfläche (95) mit einem ersten Lufteinlassloch gebildet ist zum Liefern einer Ansaugkraft zu jedem Teil der automatischen Wickelvorrichtung;
eine Innenwand (98), die dem ersten Lufteinlassloch (91) zugewandt ist, geneigt im Hinblick auf die Rohrwandoberfläche (95) gebildet ist, um sich der Rückoberflächenseite in der Abwärtsrichtung zu näheren;
die Rohrwandoberfläche (95) eine Vorderwand ist, die mit einem ersten Lufteinlassloch (91), einem zweiten Lufteinlassloch (92) und einem dritten Einlassloch (93) gebildet ist, in der Reihenfolge von oben; und
ein Durchmesser des ersten Lufteinlasslochs (91) größer gebildet ist als Durchmesser des zweiten Lufteinlasslochs (92) und des dritten Lufteinlasslochs (93).

3. Die automatische Wickelvorrichtung gemäß einem der Ansprüche 1 bis 2, bei der ein eingeschriebener Kreis eines Maximaldurchmessers, der die Querschnittform einschreibt, in Kontakt mit allen Seiten kommt, die die Querschnittform ausbilden.

## Revendications

1. Bobineur automatique comprenant un conduit (20) pour aspirer et enlever les déchets de fils par une source de dépression disposée à une extrémité et une boîte de soufflage qui sert de source de dépression raccordée au conduit (20); dans lequel
le conduit est formé de sorte qu'une forme de section découpée dans un plan perpendiculaire à une direction d'aspiration par la source de dépression soit un hexagone;
un écoulement tourbillonnaire est généré dans le conduit (20);
le conduit (20) comprend une surface de paroi de conduit (35) formée de forme plane et disposée dans une direction perpendiculaire à un plan de sol du bobineur automatique pour devenir une surface qui configure la forme de section;
la surface de paroi de conduit (35) est formée avec un premier trou d'entrée d'air, pour fournir une force d'aspiration à chaque partie du bobineur automatique;
une paroi intérieure (38) faisant face au premier trou d'entrée d'air (31) est formée inclinée par rapport à la surface de paroi de conduit (35) de manière à se rapprocher du côté de la surface arrière dans la direction vers le bas;
la surface de paroi de conduit (35) est une première surface de paroi de conduit positionnée d'un côté supérieur, en vue de face, du bobineur automatique, où une extrémité de la première surface de paroi de conduit (35) est connectée à une surface supérieure du conduit de souffleur (20) et l'autre extrémité de la première surface de paroi de conduit (35) est connectée à une deuxième surface de paroi de conduit (36) positionnée d'un côté inférieur, en vue de face, du bobineur automatique, où la deuxième surface de paroi de conduit (36) est formée de forme plane et est configurée de manière à s'incliner depuis la partie de connexion avec la première surface de paroi de conduit (35) de manière à se rapprocher du côté de la surface arrière dans la direction vers le bas pour être connectée à une surface inférieure du conduit de souffleur (20);
un deuxième trou d'entrée d'air (32) et un troisième trou d'entrée d'air (33) sont formés dans la première surface de paroi de conduit (35) ou dans la deuxième surface de paroi de conduit (36), où le deuxième trou d'entrée d'air (32) se trouve en une position d'un côté inférieur du premier trou d'entrée d'air (31), où le troisième trou d'entrée d'air (33) est le plus bas des trous d'entrée d'air et est disposé d'un côté gauche du deuxième trou d'entrée d'air dans la vue de face du bobineur automatique; et

un diamètre du premier trou d'entrée (31) est formé plus grand que les diamètres du deuxième trou d'entrée d'air (32) et du troisième trou d'entrée d'air (33).

**2.** Bobineur automatique comprenant un conduit (90) pour aspirer et enlever les déchets de fils par une source de dépression disposée à une extrémité et une boîte de soufflage qui sert de source de dépression raccordée au conduit (20); dans lequel
le conduit est formé de sorte qu'une forme de section découpée dans un plan perpendiculaire à une direction d'aspiration par la source de dépression soit un pentagone;
un écoulement tourbillonnaire est généré dans le conduit (20);
le conduit (90) comprend une surface de paroi de conduit (95) formée de forme plane et disposée dans une direction perpendiculaire à un plan de sol du bobineur automatique pour devenir une surface qui configure la forme de section;
la surface de paroi de conduit (95) est formée avec un premier trou d'entrée d'air, pour fournir une force d'aspiration à chaque partie du bobineur automatique;
une paroi intérieure (98) faisant face au premier trou d'entrée d'air (91) est formée inclinée par rapport à la surface de paroi de conduit (95) de manière à se rapprocher du côté de la surface arrière dans la direction vers le bas;
la surface de paroi de conduit (95) est une paroi avant formée avec un premier trou d'entrée d'air (91), un deuxième trou d'entrée d'air (92) et un troisième trou d'entrée d'air (93) dans l'ordre depuis le haut; et
un diamètre du premier trou d'entrée (91) est formé plus grand que les diamètres du deuxième trou d'entrée d'air (92) et du troisième trou d'entrée d'air (93).

**3.** Bobineur automatique selon l'une quelconque des revendications 1 à 2, dans lequel un cercle inscrit d'un diamètre maximum qui inscrit la forme de section entre en contact avec tous les côtés configurant la forme de section.

Fig.1

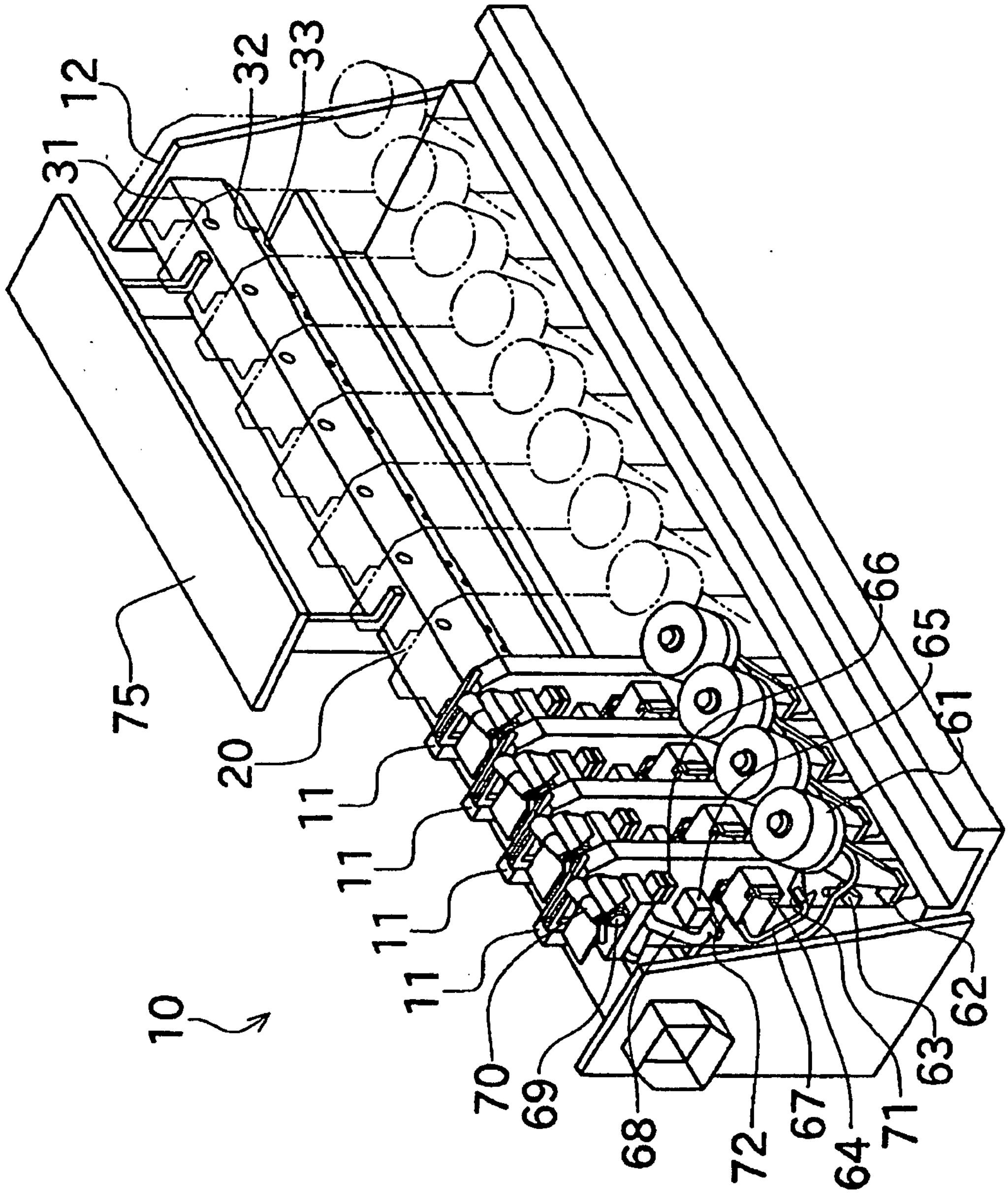


Fig.2

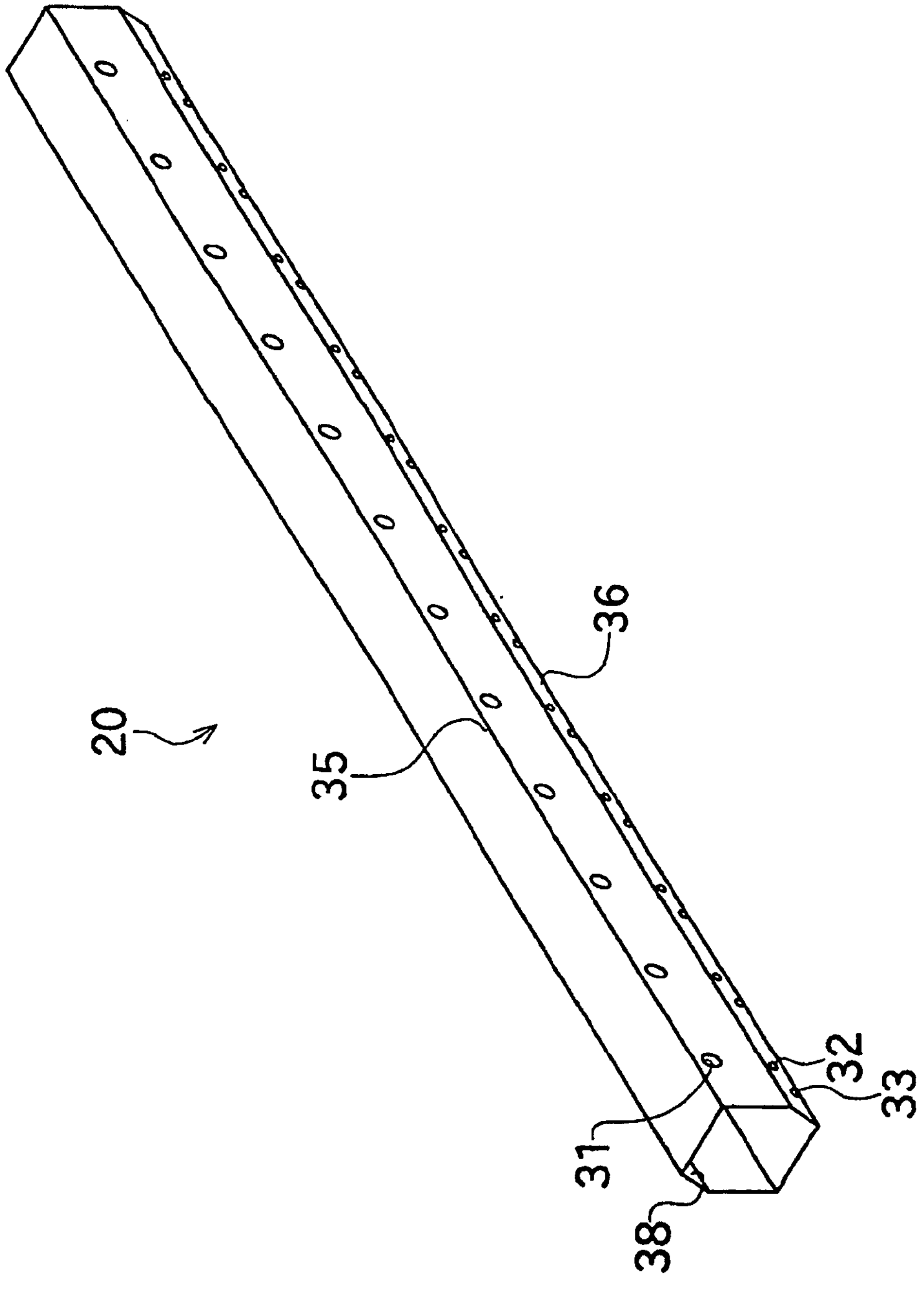


Fig.3

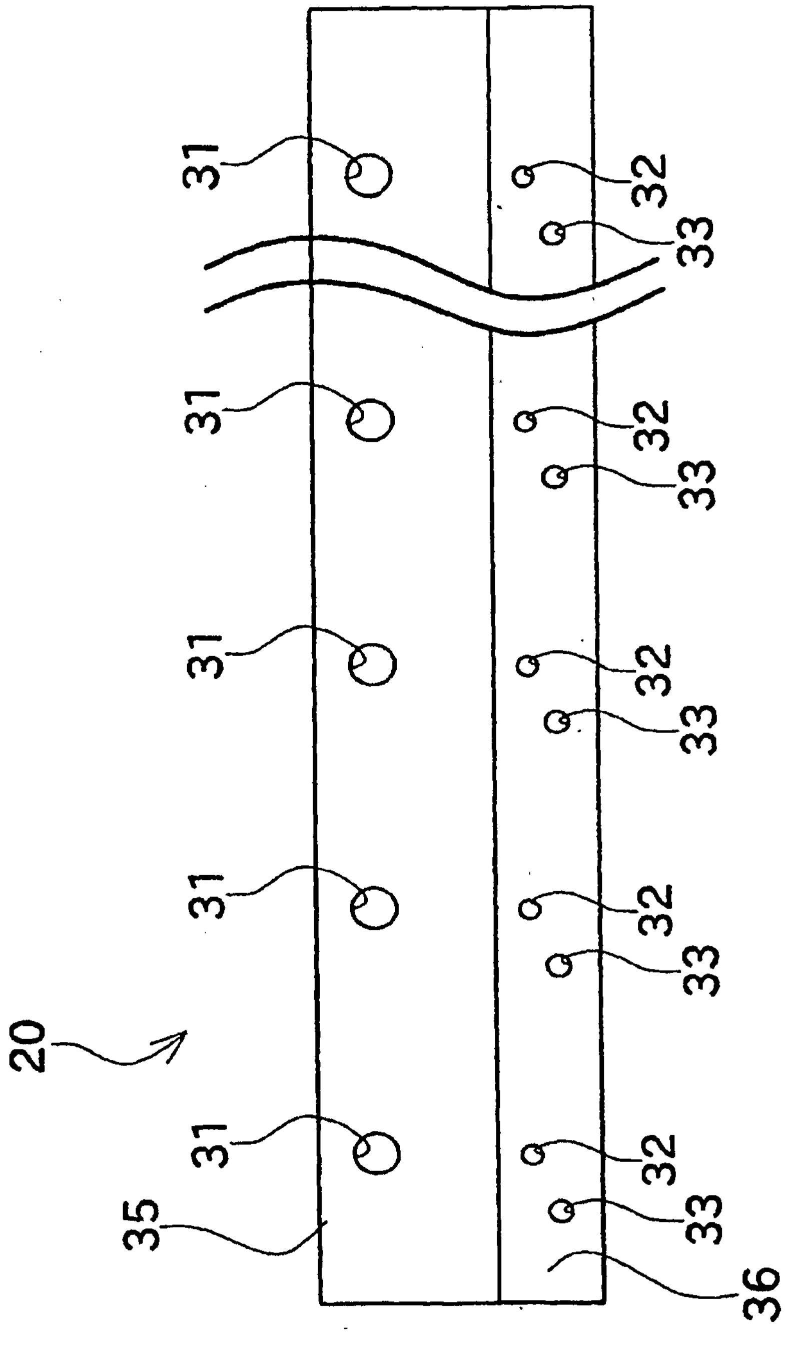


Fig.4

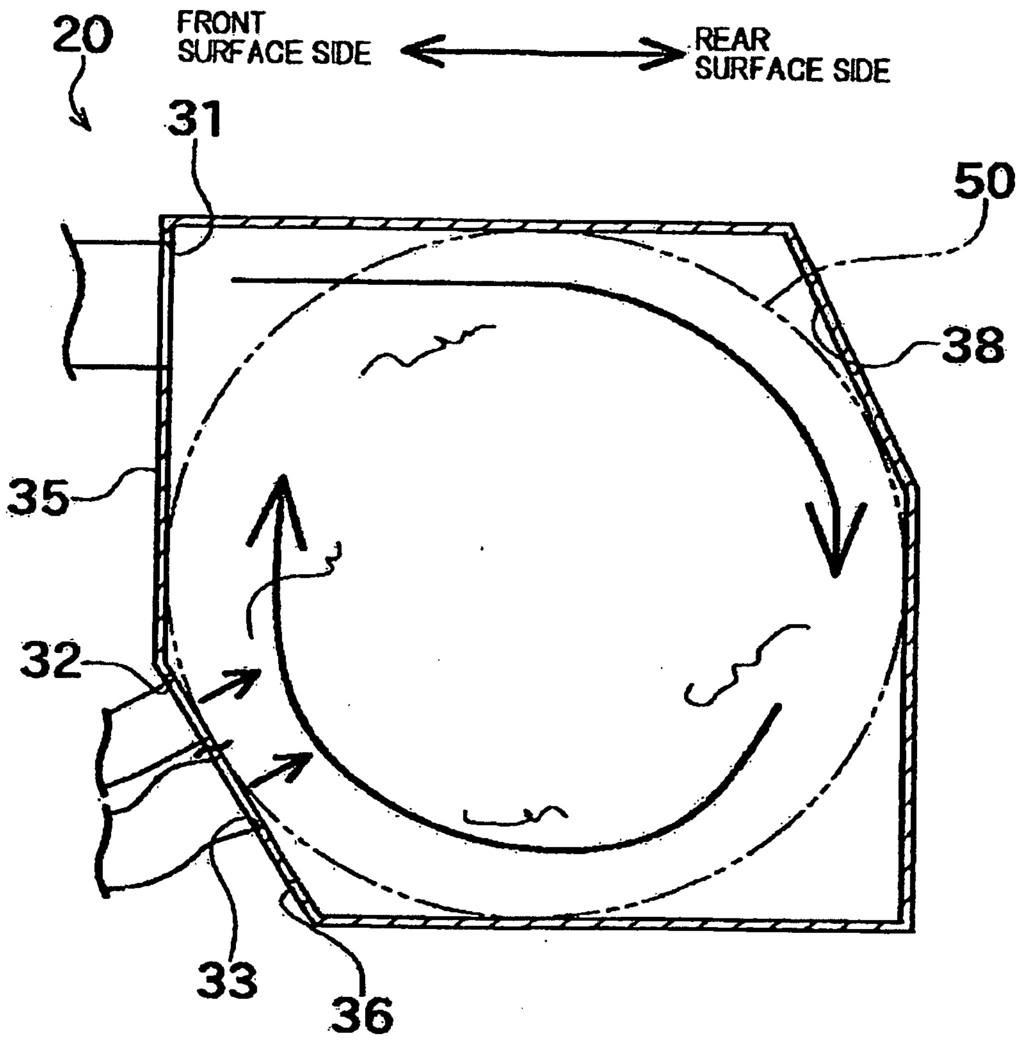


Fig.5

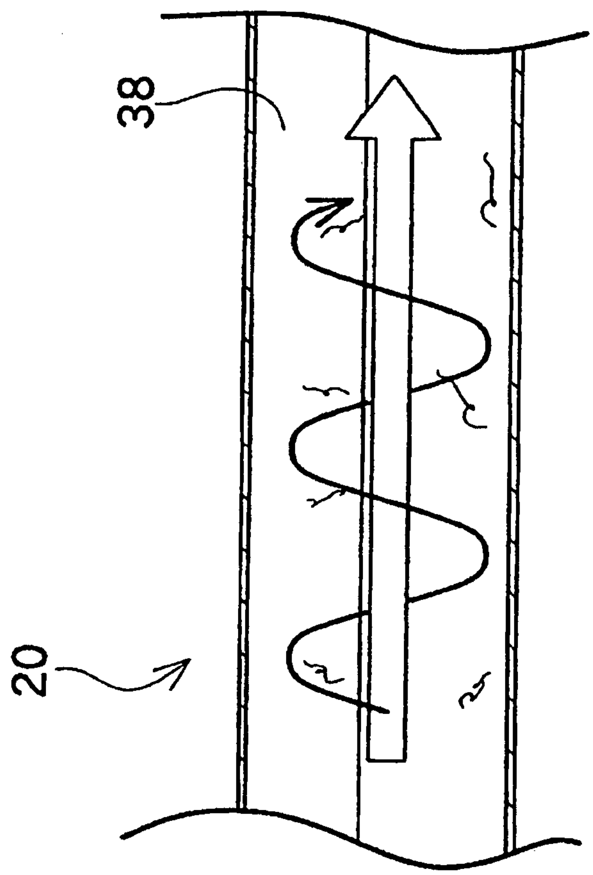


Fig.6

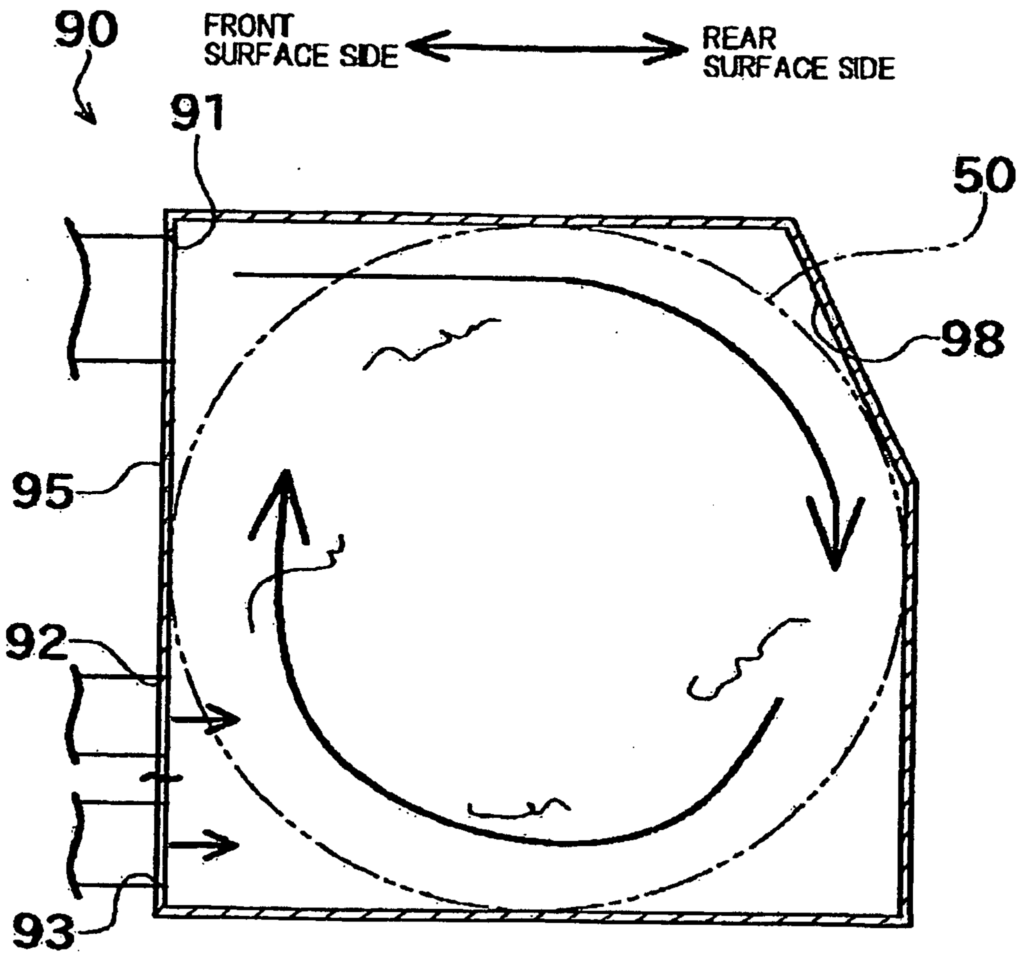


Fig.7

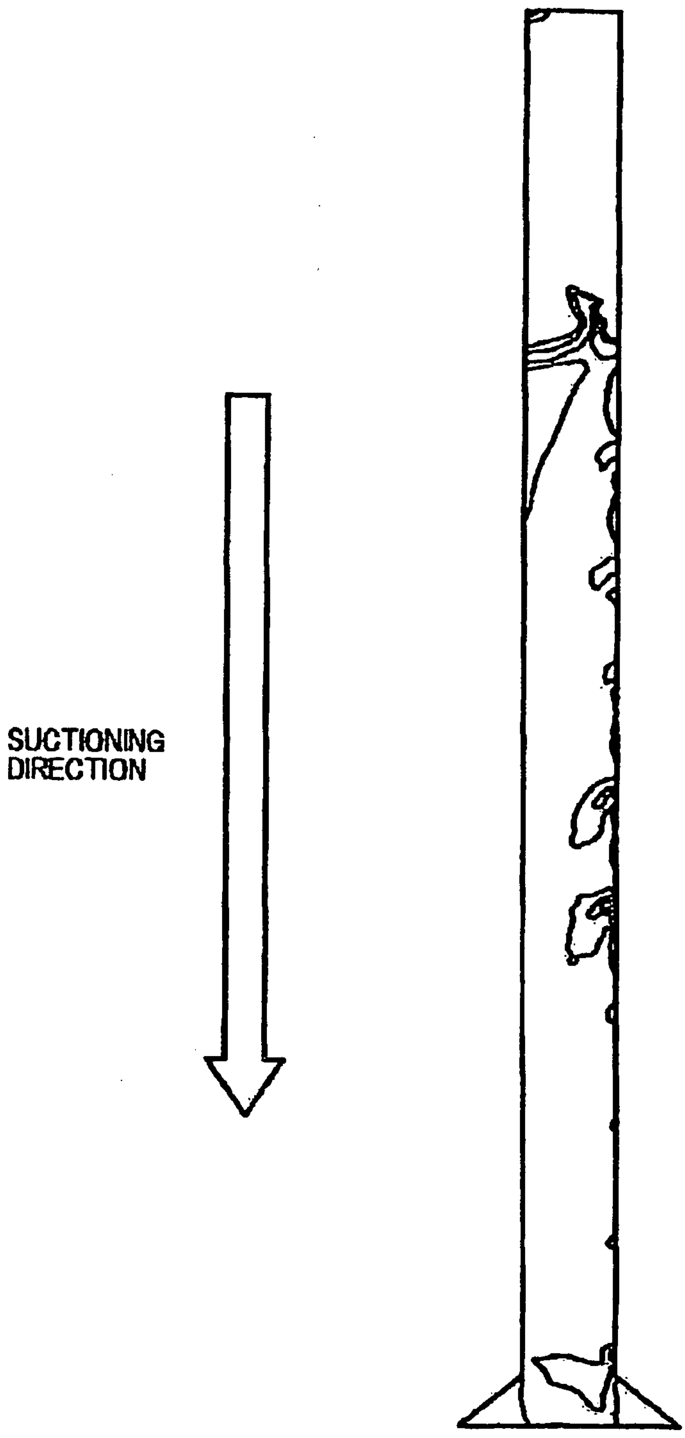


Fig.8

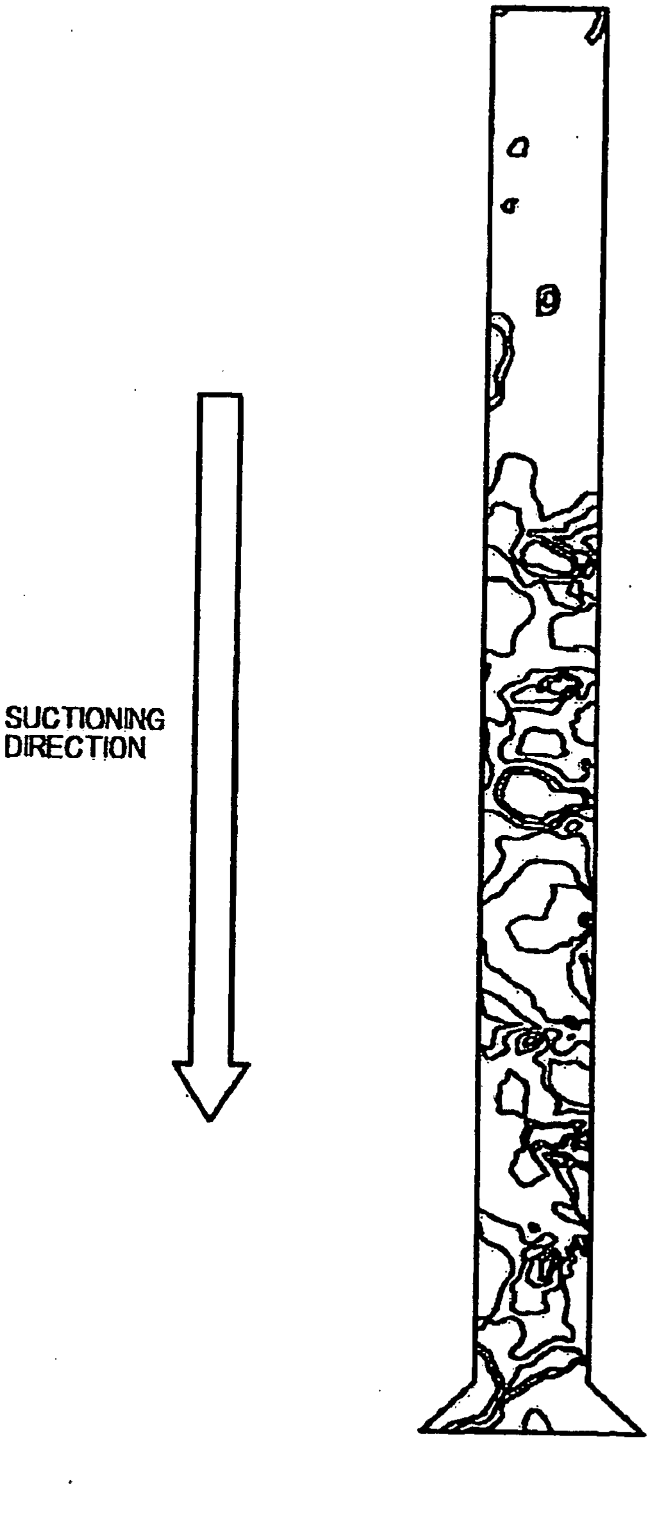


Fig.9

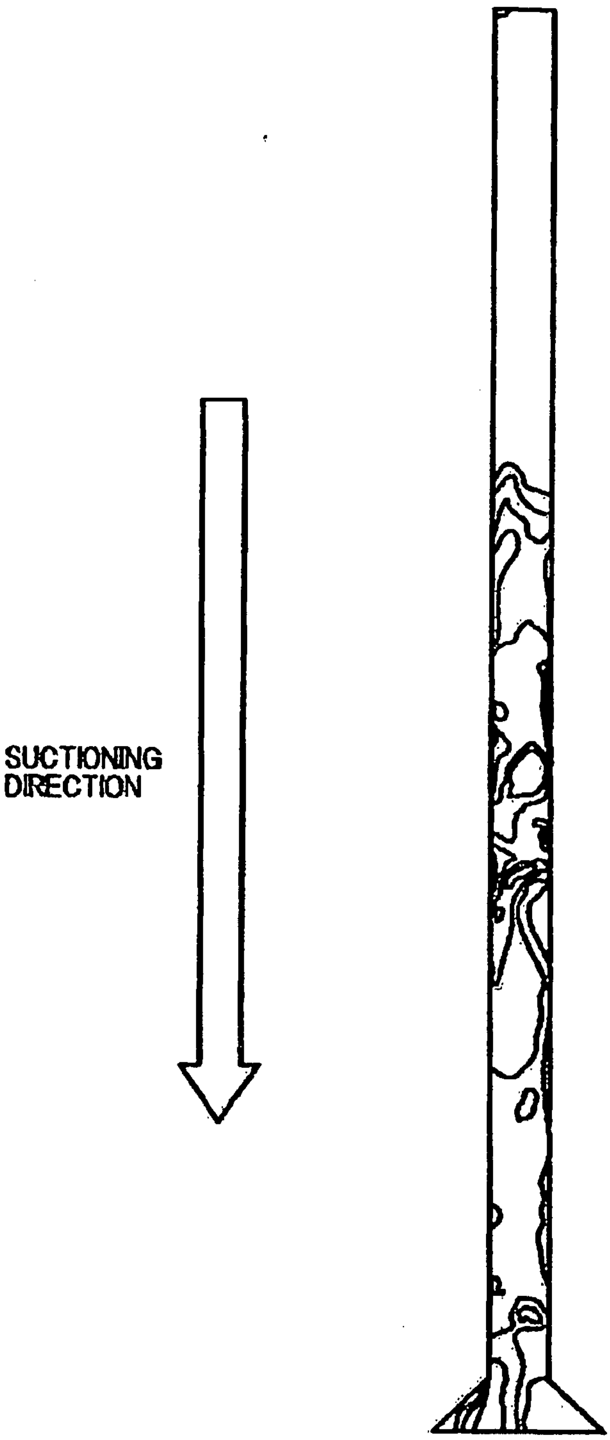
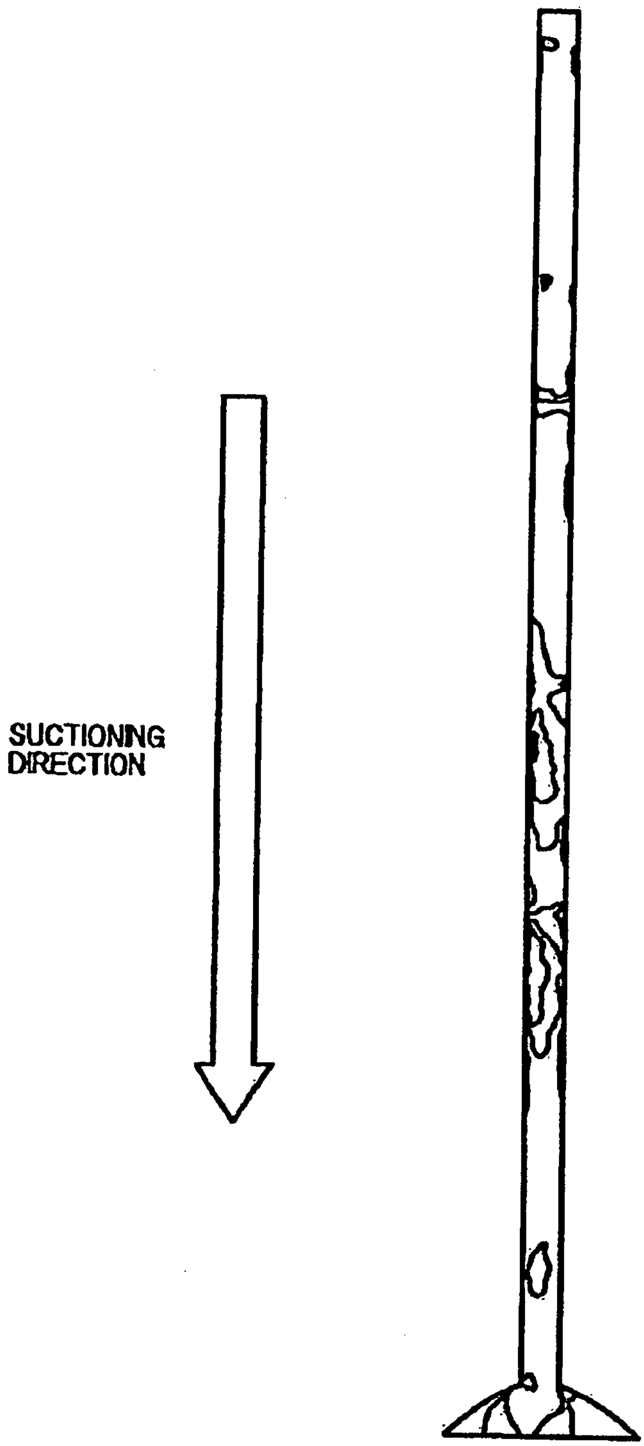


Fig. 10



## REFERENCES CITED IN THE DESCRIPTION

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

### Patent documents cited in the description


- JP 9053766 A **[0002] [0003] [0005]**
- JP 49010328 A **[0002] [0003] [0006]**
- DE 4229552 A1 **[0004]**