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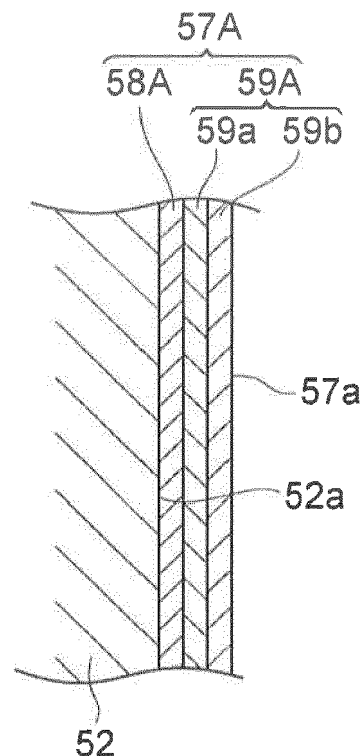
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(54) **YARN STORAGE ROLLER, YARN STORAGE DEVICE, AND YARN WINDING MACHINE**

(57) A yarn storage roller (51) includes a roller main body (52) made of aluminum or aluminum alloy, and a coating layer (57A) formed on the roller main body (52), wherein a Vickers hardness (Hv) of the coating layer (57A) is greater than or equal to 550.

FIG. 4A



EP 2 927 173 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn storage roller, a yarn storage device, and a yarn winding machine.

2. Description of the Related Art

[0002] The yarn winding machine is provided with a yarn storage roller adapted to store a yarn and the like. The yarn is wound around an outer circumferential surface of the yarn storage roller by rotating the yarn storage roller. The yarn storage roller temporarily stores the yarn, and hence functions as a buffer between a spinning device and a winding device.

[0003] As described in Japanese Unexamined Patent Publication No. 2013-063839 and Japanese Unexamined Patent Publication No. 2010-174421, when the yarn breaks at downstream of the yarn storage roller, the yarn remains on the yarn storage roller. In this case, the yarn storage roller is reversely rotated to suck and remove the remaining yarn with a suction device arranged at a base of the yarn storage roller. As described in Japanese Unexamined Patent Publication No. 2013-159467, there is known a yarn storage roller made of a resin material which is a non-metallic material. In such a yarn storage roller, a base layer having nickel or copper as a main component is formed on the resin, and a plated layer having chromium as a main component is formed thereon.

[0004] The inventors of the present invention have considered using a roller main body made of aluminum or aluminum alloy for a roller main body of the yarn storage roller. If the roller main body is made of aluminum or aluminum alloy, a torque for rotating the yarn storage roller can be suppressed low. On the other hand, a predetermined hardness is required on the surface of the yarn storage roller. This is because if the hardness of the surface is low, flaws and the like are easily formed on the surface, and the yarn on the yarn storage roller may get caught at the flaws and the like.

BRIEF SUMMARY OF THE INVENTION

[0005] It is an object of the present invention to provide a yarn storage roller in which a hardness of a surface is increased even if the roller main body made of aluminum or aluminum alloy is used, as well as a yarn storage device and a yarn winding machine including such a yarn storage roller.

[0006] A yarn storage roller of the present invention is a yarn storage roller arranged in a yarn winding machine and having a surface around which a yarn is wound, the yarn winding machine including a yarn supplying device adapted to supply a yarn, and a winding device adapted

to wind the yarn supplied from the yarn supplying device into a package; the yarn storage roller including a roller main body containing aluminum or aluminum alloy; and a coating layer formed on the roller main body, wherein a Vickers hardness (Hv) of the coating layer is greater than or equal to 550. The Vickers hardness (Hv) is smaller than or equal to 7000. In other words, the roller main body is made of aluminum or aluminum alloy. The roller main body is not limited to being made of aluminum having a purity of 100% or aluminum alloy. The Vickers hardness (Hv) is a numerical value obtained through a test method defined in JIS Z 2244, 7725 (Japanese Industrial Standards corresponding to ISO 6507-1 to 4). The load used for measuring the Vickers hardness was 0.01 kgf. The Vickers hardness was measured by a Micro Vickers Hardness Tester.

[0007] Since aluminum and aluminum alloy are light weight, the torque when rotating the yarn storage roller can be suppressed low. The Vickers hardness (Hv) of the coating layer formed on the roller main body is greater than or equal to 550, whereby the hardness of the surface is increased, and flaws and the like are less likely to be formed on the surface.

[0008] The Vickers hardness (Hv) of the coating layer is greater than or equal to 700. In this case, the hardness of the surface is further increased. The Vickers hardness (Hv) is preferably smaller than or equal to 1500 or smaller than or equal to 1200.

[0009] The coating layer includes an intermediate layer arranged on the roller main body, and a surface layer arranged on the intermediate layer and made of a material different from that of the intermediate layer. In this case, the coating layer has a two-layer structure, so that the hardness of the surface is increased.

[0010] For example, the intermediate layer is made of non-electrolytic nickel, and the surface layer is formed by hard chromium plating. With the arrangement of the intermediate layer made of non-electrolytic nickel, the surface layer formed by the hard chromium plating can be easily formed. Since the hardness of the hard chromium plating is high, the hardness of the surface is increased.

[0011] For example, the intermediate layer is formed by copper plating. Since copper is soft, even if impurities and the like exist or irregularities are formed on the surface of the roller main body, the impurities and/ or the irregularities can be covered and hidden by the copper plating. As a result, the intermediate layer can be made uniform, and furthermore, the surface of the surface layer can be made uniform.

[0012] The surface layer includes a non-electrolytic nickel layer and a hard chromium plated layer formed on the non-electrolytic nickel layer. The surface layer includes the non-electrolytic nickel layer, so that the hard chromium plated layer can be easily formed thereon. The surface of the surface layer can be made uniform by forming the intermediate layer by the copper plating, and furthermore, the hardness of the surface can be increased

by arranging the hard chromium plated layer in the surface layer.

[0013] For example, the surface layer is formed by the nickel chromium plating. In this case, the surface of the surface layer can be made uniform by forming the intermediate layer by the copper plating, and furthermore, the hardness of the surface is increased by forming the surface layer by the nickel chromium plating.

[0014] The surface of the coating layer is a mirror surface. When detecting whether or not the yarn exists on the yarn storage roller by a reflective sensor, reflection efficiency of the light is improved since the surface of the coating layer is a mirror surface. Detection accuracy of the reflective sensor is thus enhanced. Furthermore, output in the reflective sensor can be reduced.

[0015] For example, the coating layer is formed by thermal processing. In this case, the hardness of the coating layer is increased by performing the thermal processing.

[0016] The thickness of the coating layer is smaller than 25 μm . If an impurity and the like exist on the surface of the roller main body, a crater is likely to be formed at a periphery of the impurity when the coating layer is formed on the surface. The diameter of the crater can be reduced by making the coating layer formed on the surface of the roller main body thin, i.e., smaller than 25 μm .

[0017] A yarn storage device of the present invention includes a reflective sensor adapted to detect a yarn on the coating layer. According to such a yarn storage device, the coating layer is arranged so that the reflection efficiency of the light at the surface of the yarn storage roller is improved. The detection accuracy of the reflective sensor is thus enhanced. Furthermore, the output in the reflective sensor can be reduced.

[0018] The yarn storage device of the present invention further includes a yarn hooking member arranged to be relatively rotatable with respect to the yarn storage roller, and adapted to rotate at a speed same as or different from that of the yarn storage roller with the yarn hooked to the yarn hooking member. Since the yarn storage device includes the yarn hooking member, a travelling speed (entrance speed) of the yarn entering the yarn storage roller is constant, whereas a travelling speed (exit speed) of the yarn exiting from the yarn storage roller and a position (unwinding position) where the yarn exits change. As a result, the yarn slides in a circumferential direction of the yarn storage roller on the surface of the yarn storage roller, and the yarn storage roller is in an easily wearable state. However, since the hardness of the surface of the yarn storage roller is increased, flaws and the like are less likely to be formed on the surface of the yarn storage roller.

[0019] A yarn winding machine of the present invention includes a draft device adapted to draft a fiber bundle; a spinning device adapted to spin the fiber bundle drafted by the draft device to spin a yarn; the yarn storage roller adapted to store the yarn spun by the spinning device; and the winding device adapted to wind the yarn stored on the yarn storage roller into a package. According to

such a yarn winding machine, since the hardness of the surface of the yarn storage roller is increased, flaws and the like are less likely to be formed on the surface of the yarn storage roller. Therefore, the yarn is prevented from getting caught at the surface of the yarn storage roller. Furthermore, since the roller main body contains aluminum or aluminum alloy, the torque when rotating the yarn storage roller can be reduced.

[0020] According to the present invention, the hardness of the surface of the yarn storage roller is increased even if the roller main body made of aluminum or aluminum alloy is used, and flaws and the like are less likely to be formed on the surface.

15 BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a front view of a spinning machine according to one embodiment of the present invention;

FIG. 2 is a side view of a spinning unit of the spinning machine of FIG. 1;

FIG. 3 is a perspective view illustrating a yarn storage roller in FIG. 2;

FIG. 4A is a cross-sectional view illustrating a coating layer of the yarn storage roller of the first embodiment;

FIG. 4B is a cross-sectional view illustrating a coating layer of a yarn storage layer of a second embodiment;

FIG. 5 is a cross-sectional view illustrating a coating layer of a yarn storage roller of a third embodiment;

FIG. 6A is a cross-sectional view describing a case where an impurity exist on the roller main body; and

FIG. 6B is a cross-sectional view describing a crater formed when the impurity exist on the roller main body.

40 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0022] Embodiments of the present invention will be hereinafter described with reference to the drawings. The same reference numerals are denoted on the same components in the description of the drawings, and the redundant description will be omitted.

[0023] As illustrated in FIG. 1, a spinning machine (yarn winding machine) 1 includes a plurality of spinning units 2, a yarn joining cart 3, a blower box 4, and a motor box 5. The plurality of spinning units 2 are arranged in a line, and each spinning unit 2 produces a yarn Y and winds the yarn Y into a package P. The yarn joining cart 3 performs a yarn joining operation in the spinning unit 2 in which the yarn Y is cut. The blower box 4 accommodates a blower and the like for generating a suction airflow, a whirling airflow, or the like at each section of the spinning unit 2. The motor box 5 accommodates a motor and the like for supplying power to each section of the

spinning unit 2.

[0024] In the following description, upstream in a travelling direction of a sliver S, a fiber bundle F, and the yarn Y is simply referred to as "upstream in the travelling direction", and downstream in the travelling direction is simply referred to as "downstream in the travelling direction". A side where a travelling path of the yarn Y is located with respect to the yarn joining cart 3 is simply referred to as "front side", and the opposite side is simply referred to as "back side".

[0025] As illustrated in FIGS. 1 and 2, each spinning unit 2 includes a draft device 6, a pneumatic spinning device (spinning device, yarn supplying device) 7, a yarn monitoring device 8, a tension sensor 9, a yarn storage device 50, a waxing device 11, and a winding device 12 in this order from the upstream in the travelling direction. These devices are directly or indirectly supported by a machine frame 13 such that the upstream in the travelling direction is the upper side in a machine height direction (i.e., downstream in the travelling direction is the lower side in the machine height direction).

[0026] The draft device 6 drafts the sliver S including a natural fiber such as cotton or the like, a synthetic fiber, or another fiber to produce the fiber bundle F. The draft device 6 includes a back roller pair 61, a third roller pair 62, a middle roller pair 64 provided with an apron belt 63 on each roller, and a front roller pair 65 in this order from the upstream in the travelling direction. Each roller pair 61, 62, 64, 65 feeds the sliver S supplied from a can (not illustrated) from the upstream towards the downstream in the travelling direction while drafting the sliver S.

[0027] The pneumatic spinning device 7 applies twists to the fiber bundle F drafted by the draft device 6 with the whirling airflow to spin the yarn (spun yarn) Y. More specifically (although not illustrated), the pneumatic spinning device 7 includes a spinning chamber, a fiber guiding section, a whirling airflow generating nozzle, and a hollow guide shaft body. The fiber guiding section is adapted to guide the fiber bundle F supplied from the draft device 6 located upstream in the travelling direction to the spinning chamber. The whirling airflow generating nozzle is arranged at a periphery of a path through which the fiber bundle F travels, and is adapted to generate the whirling airflow in the spinning chamber. This whirling airflow causes a fiber end of the fiber bundle F guided into the spinning chamber to be reversed and to whirl. The hollow guide shaft body is adapted to guide the spun yarn Y from the spinning chamber to outside the pneumatic spinning device 7.

[0028] The yarn monitoring device 8 monitors information of the travelling yarn Y between the pneumatic spinning device 7 and the yarn storage device 50, and detects presence or absence of a yarn defect based on the monitored information. When the yarn defect is detected, the yarn monitoring device 8 transmits a yarn defect detection signal to a unit controller 10. The yarn monitoring device 8 detects, for example, thickness abnormality of the yarn Y and/or foreign substances contained in the

yarn Y as the yarn defect. The tension sensor 9 is adapted to measure tension of the travelling yarn Y between the pneumatic spinning device 7 and the yarn storage device 50, and transmit a tension measurement signal to the unit controller 10. The waxing device 11 is adapted to apply wax on the travelling yarn Y between the yarn storage device 50 and the winding device 12. The unit controller 10 is provided for each spinning unit 2, and is adapted to control an operation of the spinning unit 2. The unit controller 10 may be arranged for each group of the plurality of spinning units 2.

[0029] The yarn storage device 50 is adapted to store the travelling yarn Y between the pneumatic spinning device 7 and the winding device 12. The yarn storage device 50 has a function of stably pulling out the yarn Y from the pneumatic spinning device 7, a function of preventing the yarn Y from slackening by retaining the yarn Y fed from the pneumatic spinning device 7 during the yarn joining operation by the yarn joining cart 3 or the like, and a function of preventing fluctuation in the tension of the yarn Y from the winding device 12 from being transmitted towards the pneumatic spinning device 7 by adjusting the tension of the yarn Y from the winding device 12. If the spinning unit 2 includes a delivery roller and a nip roller, the delivery roller and the nip roller have the function of pulling out the yarn Y from the pneumatic spinning device 7.

[0030] The winding device 12 is adapted to wind the yarn Y spun by the pneumatic spinning device 7 to form the package P. The winding device 12 includes a cradle arm 21, a winding drum 22, and a traverse device 23. The cradle arm 21 is swingably supported by a supporting shaft 24, and brings a surface of a rotatably supported bobbin B or a surface of the rotatably supported package P (i.e., the bobbin B around which the yarn Y is wound) into contact with the surface of the winding drum 22 at an appropriate pressure. The winding drum 22 is driven by an electric motor (not illustrated) provided in each spinning unit 2 to rotate the bobbin B or the package P masking contact with the winding drum 22. The traverse device 23 is driven by a shaft 25 shared among the plurality of spinning units 2, and traverses the yarn Y over a prescribed width with respect to the rotating bobbin B or the rotating package P.

[0031] The yarn joining cart 3 travels to the spinning unit 2 in which the yarn Y is disconnected to perform the yarn joining operation in the relevant spinning unit 2. The yarn joining cart 3 includes a splicer 26, a suction pipe 27, and a suction mouth 28. The suction pipe 27 is swingably supported by a supporting shaft 31, is adapted to suck and catch the yarn end of the yarn Y from the pneumatic spinning device 7 to guide the yarn end to the splicer 26. The suction mouth 28 is swingably supported by a supporting shaft 32, and is adapted to suck and catch the yarn end of the yarn Y from the winding device 12 to guide the yarn end to the splicer 26. The splicer 26 joins the guided yarn ends.

[0032] Next, the configuration of the yarn storage de-

vice 50 will be described. As illustrated in FIGS. 2 and 3, the yarn storage device 50 includes a yarn storage roller 51, a yarn hooking member 54, an electric motor 55, and a stored, yarn amount sensor (reflective sensor) 56.

[0033] The yarn storage roller 51 is fixed to a drive shaft of the electric motor 55 to be rotated by the electric motor 55. The yarn storage roller 51 includes a yarn storage section 51a. The yarn storage section 51a is a substantially cylindrical portion around which the yarn Y is wound, and is slightly tapered towards the distal end (downstream). A recess 51b having a shape depressed with respect to the yarn storage section 51a is formed at a central portion of the yarn storage section 51a. For example, when an operator cuts the yarn Y wound around the yarn storage roller 51 with a tool such as a pair of scissors, a cutter, or the like, the distal end of the tool is placed in the recess 51b.

[0034] The yarn hooking member 54 is arranged at a downstream end of the yarn storage roller 51. The yarn hooking member 54 is configured to be able to hook (guide) the yarn Y. The yarn hooking member 54 is arranged to be relatively rotatable with the yarn storage roller 51. When the yarn hooking member 54 is rotated together with the yarn storage roller 51 with the yarn Y hooked to the yarn hooking member, the yarn Y is wound around the surface of the yarn storage roller 51. Specifically, the yarn Y is hooked to the yarn hooking member 54 at the start (including restart) of storing of the yarn Y on the yarn storage roller 51. When the yarn hooking member 54 is integrally rotated with the yarn storage roller 51 at the same speed with the yarn Y hooked to the yarn hooking member 54, the yarn Y is wound around the surface of the yarn storage roller 5:1.

[0035] In addition to the introducing function of winding the yarn Y around the yarn storage roller 51 at the start of storing of the yarn Y as described above, the yarn hooking member 54 also has an unwinding tension applying function of applying an appropriate (stable) tension on the yarn Y unwound (pulled out) from the yarn storage roller 51. Specifically, for example, when the load with respect to the yarn hooking member 54 is smaller than or equal to a predetermined value (when the yarn Y unwound while being hooked to the yarn hooking member 54 is about to slacken), the yarn hooking member 54 rotates (integrally rotates) integrally with the yarn storage roller 51 so that the yarn Y is wound around the surface of the yarn storage roller 51. When the load with respect to the yarn hooking member 54 exceeds a predetermined value, the yarn hooking member 54 rotates (relatively rotates) at a speed different from that of the yarn storage roller 51 so that the yarn Y is unwound from the yarn storage roller 51. In other words, the yarn Y is unwound from the yarn storage roller 51 when the tension of the yarn Y located downstream of the yarn storage roller 51 is increased, and the unwinding of the yarn Y is stopped when the tension of the yarn Y located downstream of the yarn storage roller 51 is reduced. The yarn hooking member 54 thus can apply an appropriate tension on the

yarn Y unwound from the yarn storage roller 51. The yarn hooking member 54 can absorb the fluctuation in the tension of the yarn Y between the yarn storage roller 51 (yarn storage device 50) and the winding device 12.

[0036] The yarn Y is continuously wound around the yarn storage roller 51 at a constant speed (entrance speed) from the yarn supplying side, which is the upstream, and the yarn Y is pulled out at the speed (exit speed) same as or substantially the same as the winding speed of the winding device 12 while applying tension by the yarn hooking member 54 from the winding side, which is the downstream. The entrance speed is set to coincide with the rotation speed of the yarn storage roller 51, and to be the speed same as the spinning speed or the speed slightly faster than the spinning speed. The exit speed changes by the influence of the winding speed of the winding device 12 and the influence of the rotation speed of the yarn hooking member 54. The position (unwinding position) where the yarn Y comes out from the yarn storage roller 51 also changes. If the exit speed is greater than the entrance speed, the stored amount of the yarn wound around the yarn storage roller 51 is reduced. On the contrary, if the exit speed is smaller than the entrance speed, the stored amount of the yarn wound around the yarn storage roller 51 is increased. The direction of the yarn Y unwound from the yarn storage roller 51 is not the circumferential direction of the yarn storage roller 51, but is the direction along the axial direction.

[0037] The yarn storage roller 51 and the yarn hooking member 54 may be rotatably driven by one common motor, or may be independently rotatably driven by different motors. A rotational axis of the yarn storage roller 51 and a rotational axis of the yarn hooking member 54 have the same axis line. If the motors of the yarn hooking member 54 and the yarn storage roller 51 are common, the yarn hooking member 54 is configured to generate a resistance torque against the relative rotation of the yarn storage roller 51 by a predetermined relative rotation resistance means. According to such a resistance torque, the yarn hooking member 54 can rotate integrally with the yarn storage roller 51 following the rotation of the yarn storage roller 51. When a force greater than the resistance torque is applied to the yarn hooking member 54, the yarn hooking member 54 can relatively rotate with respect to the yarn storage roller 51. That is, if the tension of the yarn Y located downstream of the yarn storage device 50 is greater than the resistance torque, the yarn hooking member 54 relatively rotates with respect to the yarn storage roller 51. The tension applied on the yarn Y unwound from the yarn storage roller 51 can be determined by the magnitude of the resistance torque. The relative rotation resistance means is, for example, a magnetic means, an electromagnetic means by an electromagnet, or a mechanical means by a frictional force.

[0038] The stored yarn amount sensor 56 is a light reflective sensor adapted to detect presence or absence of the yarn Y on the yarn storage roller 51 in a non-contacting manner, and is arranged on the back of the yarn

storage roller 51 so as to face the yarn storage roller 51. When the stored amount of the yarn Y wound around the yarn storage roller 51 reaches a lower limit amount, the stored yarn amount sensor 56 transmits a stored-amount lower limit detection signal to the unit controller 10.

[0039] As illustrated in FIG. 4A, the yarn storage roller 51 of the first embodiment includes a roller main body 52, and a coating layer 57A formed on a surface 52a of the roller main body 52. The roller main body 52 is made of aluminum. The roller main body 52 is formed by die cast molding, for example.

[0040] The coating layer 57A includes an intermediate layer 58A arranged on the surface 52a of the roller main body 52, and a surface layer 59A arranged on the intermediate layer 58A. The surface layer 59A is made of a material different from that of the intermediate layer 58A. More specifically, the intermediate layer 58A is formed by the copper plating. The surface layer 59A includes a non-electrolytic nickel layer 59a formed on the intermediate layer 58A, and a hard chromium plated layer 59b formed on the non-electrolytic nickel layer 59a.

[0041] The thickness of the coating layer 57A having such a three-layer structure is smaller than 15 μm . For example, the thickness of the intermediate layer 58A is smaller than 5 μm , the thickness of the non-electrolytic nickel layer 59a is smaller than 5 μm , and the thickness of the hard chromium plated layer 59b is smaller than 5 μm . The thickness of the coating layer 57A may be smaller than 25 μm .

[0042] In describing the method for forming the coating layer 57A, the surface 52a of the roller main body 52 is subjected to a mirror surface processing prior to forming the coating layer 57A. Each layer constituting the coating layer 57A can be formed through a known method. Since the surface 52a of the roller main body 52 is subjected to the mirror surface processing, a surface 57a of the formed coating layer 57A becomes a mirror surface.

[0043] In the yarn storage roller 51 of the first embodiment, the Vickers hardness (Hv) of the coating layer 57A is greater than or equal to 550. The Vickers hardness (Hv) of the coating layer 57A can be adjusted by adjusting the thickness of the surface layer 59A, and the like. The Vickers hardness (Hv) of the coating layer 57A may be greater than or equal to 700, or may be greater than or equal to 800. The Vickers hardness (Hv) of the coating layer 57A may be greater than or equal to 1000. The Vickers hardness (Hv) is smaller than or equal to 7000. Rationally (realistically), the Vickers hardness (Hv) is preferably smaller than or equal to 1500.

[0044] Since the roller main body 52 of the yarn storage roller 51 is made of aluminum and the aluminum is light weight, the torque of the electric motor 55 when rotating the yarn storage roller 51 can be reduced. The Vickers hardness (Hv) of the coating layer 57A formed on the roller main body 52 is greater than or equal to 550, whereby the hardness of the surface 57a is increased, and flaws and the like are less likely to be formed on the surface 57a.

[0045] For example, even when the yarn Y wound around the yarn storage section 51a is cut with a tool such as a pair of scissors, a cutter, or the like, flaws are less likely to be formed on the surface 57a of the coating layer 57A by the tool. The Vickers hardness (Hv) of the tool such as the pair of scissors, the cutter, or the like is, for example, about 500 or smaller than 500. The Vickers hardness (Hv) of the coating layer 57A is greater than the Vickers hardness (Hv) of the tool. The damage of the surface 57a is prevented because the distal end of the tool enters into the recess 51b, for example.

[0046] If the Vickers hardness (Hv) of the coating layer 57A is greater than or equal to 700, the hardness of the surface 57a becomes higher. For example, even if a cutting tool (cutter or the like) having a Vickers hardness (Hv) of about 550 is used, flaws are less likely to be formed on the surface 57a of the coating layer 57A.

[0047] The hardness of the surface 57a is increased by forming the coating layer 57A with a plurality of layers including the intermediate layer 58A and the surface layer 59A.

[0048] The intermediate layer 58A is formed by the copper plating. Since copper is soft, even if impurities and the like exist or irregularities are formed on the surface 52a of the roller main body 52, the impurities and/or irregularities can be covered and hidden by the copper plating. As a result, the intermediate layer 58A can be made uniform, and furthermore, the surface of the surface layer 59A can be made uniform.

[0049] The surface layer 59A includes the non-electrolytic nickel layer 59a, so that the hard chromium plated layer 59b can be easily formed thereon. The surface of the surface layer 59A can be made uniform by forming the intermediate layer 58A by the copper plating, and furthermore, the hardness of the surface 57a can be increased by arranging the hard chromium plated layer 59b in the surface layer 59A. In the surface layer 59A, it is also effective to arrange another intermediate layer between the non-electrolytic nickel layer 59a and the hard chromium plated layer 59b.

[0050] When detecting whether or not the yarn Y exists on the yarn storage roller 51 by the stored yarn amount sensor 56, the reflection efficiency of the light is improved since the surface of the coating layer 57A is a mirror surface. The detection accuracy of the stored yarn amount sensor 56 is thus enhanced. The output in the stored yarn amount sensor 56 can be reduced. With the arrangement of the hard chromium plated layer 59b, the surface 57a of the coating layer 57A becomes a whitish color. The reflection efficiency of the light at the surface 57a is improved by the whitish color of the surface 57a.

[0051] As described above, the roller main body 52 made of aluminum is formed by die cast molding. As illustrated in FIG. 6A, a fine impurity X may exist on the surface (outer circumferential surface) 52a of the roller main body 52. When forming a coating layer 157 on the surface 52a, a crater 100 is likely to be formed at the periphery of the impurity X, as illustrated in FIG. 6B. Con-

ventionally, the coating layer 157 is required to be formed thick to increase the strength of the coating layer 157. In particular, if the roller main body 52 is made of aluminum, the coating layer 157 is required to be formed greater than or equal to a prescribed thickness.

[0052] If the coating layer 157 is formed thick in a state where the crater 100 is formed, the diameter R of the crater 100 becomes large, as illustrated in FIG. 6B. For example, if the thickness of the coating layer 157 is 25 μm , the diameter of the crater is between 1 mm and 2 mm. If the diameter R of the crater 100 is large, for example, the yarn Y on the yarn storage roller 51 may get caught at the surface.

[0053] In the yarn storage roller 51 of the present embodiment, the coating layer 57A formed on the surface 52a of the roller main body 52 is formed thin, i.e., smaller than 25 μm , so that the diameter of the crater can be made small even if the crater is formed.

[0054] The thermal processing need not be performed when forming the coating layer 57A, and hence the shape of the roller main body 52 can be maintained.

[0055] According to the spinning machine 1 of the present embodiment, the hardness of the yarn storage roller 51 is increased so that flaws and the like are less likely to be formed on the surface (yarn storage section 51a or the like) of the yarn storage roller 51. Therefore, the yarn Y is prevented from getting caught at the surface of the yarn storage roller 51. Since the roller main body 52 is made of aluminum, the torque of the electric motor 55 when rotating the yarn storage roller 51 can be reduced.

[0056] Next, a second embodiment will be described. As illustrated in FIG. 4B, the yarn storage roller 51 of the second embodiment includes the roller main body 52, and a coating layer 57B formed on the surface 52a of the roller main body 52. The roller main body 52 is made of aluminum. The roller main body 52 is formed by die cast molding, for example.

[0057] The coating layer 57B includes an intermediate layer 58B arranged on the surface 52a of the roller main body 52, and a surface layer 59B arranged on the intermediate layer 58B. The surface layer 59B is made of a material different from that of the intermediate layer 58B. More specifically, the intermediate layer 58B is formed by the non-electrolytic nickel plating. The surface layer 59B is formed by the hard chromium plating.

[0058] The thickness of the coating layer 57B having such a two-layer structure is, for example, about 10 μm . For example, the thickness of the intermediate layer 58B is about 5 μm , and the thickness of the surface layer 59B is about 5 μm . The thickness of the coating layer 57B may be smaller than 25 μm .

[0059] In the yarn storage roller 51 of the second embodiment, the Vickers hardness (Hv) of the intermediate layer 58B is 500. The Vickers hardness (Hv) of the surface layer 59B is 1000. The Vickers hardness (Hv) of the coating layer 57B is, for example, 1000. The Vickers hardness (Hv) of the coating layer 57B can be adjusted

by adjusting the thickness of the surface layer 59A, and the like. The Vickers hardness (Hv) of the coating layer 57B may be greater than or equal to 550, may be greater than or equal to 700, or may be greater than or equal to 800. The Vickers hardness (Hv) is smaller than or equal to 7000. Rationally (realistically), the Vickers hardness (Hv) is preferably smaller than or equal to 1500.

[0060] Even when such a coating layer 57B is arranged, the effects similar to those of the coating layer 57A described above can be obtained. For example, flaws and the like are less likely to be formed since the hardness of the surface 57a is increased. The detection accuracy of the stored yarn amount sensor 56 is enhanced since the surface 57a is a mirror surface.

[0061] With the arrangement of the intermediate layer 58B made of the non-electrolytic nickel, the surface layer 59B formed by the hard chromium plating can be easily formed. The hardness of the surface 57a is increased since the hardness of the hard chromium plating is high. The coating layer 57B does not use copper, and thus the yarn storage roller 51 having high hardness can be manufactured relatively inexpensively.

[0062] Next, a third embodiment will be described. As illustrated in FIG. 5, the yarn storage roller 51 of the third embodiment includes the roller main body 52, and a coating layer 57C formed on the surface 52a of the roller main body 52. The roller main body 52 is made of aluminum. The roller main body 52 is formed by die cast molding, for example.

[0063] The coating layer 57C is formed by thermal processing. The coating layer 57C is made of a non-electrolytic nickel layer, for example. The thickness of the coating layer 57C is, for example, 25 μm . The thickness of the coating layer 57C may be smaller than 20 μm , or may be smaller than 15 μm .

[0064] In the coating layer 57C performed with the thermal processing, a non-electrolytic nickel (Ni-P) coated layer is precipitated as an amorphous (noncrystalline) alloy of nickel and phosphorous. The coated layer is crystallized by the baking process to increase the hardness. In other words, the hardness is increased by crystallizing the coated layer of nickel and phosphorous.

[0065] In the yarn storage roller 51 of the third embodiment, the Vickers hardness (Hv) of the coating layer 57C is greater than or equal to 550. The Vickers hardness (Hv) of the coating layer 57C can be adjusted by adjusting the thickness of the coating layer 57C and/or the temperature, time, or the like of the thermal processing. The Vickers hardness (Hv) of the coating layer 57C may be greater than or equal to 700, or may be greater than or equal to 800. The Vickers hardness (Hv) of the coating layer 57C may be greater than or equal to 1000. The Vickers hardness (Hv) is smaller than or equal to 7000. Rationally (realistically), the Vickers hardness (Hv) is preferably smaller than or equal to 1200.

[0066] The embodiments of the present invention have been described above, but the present invention is not limited to the embodiments described above.

[0067] For example, in the coating layer 57B having the two-layer structure illustrated in FIG. 4B, the intermediate layer 58B may be formed by the copper plating, and the surface layer 59B may be formed by the nickel chromium plating. In this case as well, the Vickers hardness (Hv) of the coating layer may be set to the same extent as the embodiments described above. The surface of the surface layer 59B can be made uniform by forming the intermediate layer 58B by the copper plating, and furthermore, the hardness of the surface is increased by forming the surface layer 59B by the nickel chromium plating.

[0068] The roller main body 52 is not limited to being made of aluminum, and may be made of aluminum alloy. In other words, the roller main body 52 may contain aluminum alloy.

[0069] The yarn storage roller 51 or the yarn storage device 50 may be arranged in an automatic winder (yarn winding machine). The automatic winder includes the yarn supplying device adapted to supply the yarn wound around the yarn supplying bobbin, and the winding device adapted to wind the yarn supplied from the yarn supplying device into the package. In other words, the yarn storage roller or the yarn storage device of the present invention is arranged in the yarn winding machine including the yarn supplying device adapted to supply the yarn, and the winding device adapted to wind the yarn supplied from the yarn supplying device into the package. If the yarn winding machine is the spinning machine, the spinning device corresponds to the yarn supplying device. The yarn storage roller or the yarn storage device is arranged between the yarn supplying device and the winding device. The yarn supplied from the yarn supplying device is temporarily stored by being wound around the surface of the yarn storage roller, and the yarn unwound from the yarn storage roller is wound into the package by the winding device.

Claims

1. A yarn storage roller (51) arranged in a yarn winding machine (1) and having a surface around which a yarn (Y) is wound, the yarn winding machine (1) including a yarn supplying device (7) adapted to supply a yarn, and a winding device (12) adapted to wind the yarn (Y) supplied from the yarn supplying device (7) into a package (P), the yarn storage roller (51) comprising:

a roller main body (52) containing aluminum or aluminum alloy; and
a coating layer (57A; 57B; 57C) formed on the roller main body (52),
wherein a Vickers hardness (Hv) of the coating layer (57A; 57B; 57C) is greater than or equal to 550.

2. The yarn storage roller (51) according to claim 1,

wherein the Vickers hardness (Hv) of the coating layer (57A; 57B; 57C) is greater than or equal to 700.

3. The yarn storage roller (51) according to claim 1 or 2, wherein
the coating layer (57A; 57B) includes
an intermediate layer (58A; 58B) arranged on the roller main body (52), and
a surface layer (59A; 59B) arranged on the intermediate layer (58A; 58B) and made of a material different from that of the intermediate layer (58A; 58B).

4. The yarn storage roller (51) according to claim 3, wherein
the intermediate layer (58B) is made of non-electrolytic nickel, and
the surface layer (59B) is formed by hard chromium plating.

5. The yarn storage roller (51) according to claim 3, wherein the intermediate layer (58A; 58B) is a formed by copper plating.

6. The yarn storage roller (51) according to claim 5, wherein the surface layer (59A) includes a non-electrolytic nickel layer (59a), and a hard chromium plated layer (59b) formed on the non-electrolytic nickel layer (59a).

7. The yarn storage roller (51) according to claim 5, wherein the surface layer (59B) is formed by nickel chromium plating.

8. The yarn storage roller (51) according to any one of claims 1 to 7, wherein a surface of the coating layer (57A; 57B; 57C) is a mirror surface.

9. The yarn storage roller (51) according to claim 1 or 2, wherein the coating layer (57A; 57B; 57C) is formed by thermal processing.

10. The yarn storage roller (51) according to any one of claims 1 to 9, wherein a thickness of the coating layer (57A; 57B; 57C) is smaller than 25 μm .

11. A yarn storage device (50) comprising:

the yarn storage roller (51) according to any one of claims 1 to 10; and
a reflective sensor (56) adapted to detect a yarn (Y) on the coating layer (57A; 57B; 57C) of the yarn storage roller (51).

12. The yarn storage device (50) according to claim 11, further comprising:

a yarn hooking member (54) arranged to be relatively rotatable with respect to the yarn storage

roller (51), and adapted to rotate at a speed same as or different from that of the yarn storage roller (51) with the yarn (Y) hooked to the yarn hooking member (54).

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13. A yarn storage device (50) comprising:

the yarn storage roller (51) according to any one of claims 1 to 10; and
a yarn hooking member (54) arranged to be relatively rotatable with respect to the yarn storage roller (51), and adapted to rotate at a speed same as or different from that of the yarn storage roller (51) with the yarn (Y) hooked to the yarn hooking member (54).

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14. A yarn winding machine (1) comprising:

a draft device (6) adapted to draft a fiber bundle (F);
a spinning device (7) adapted to spin the fiber bundle (F) drafted by the draft device (6) to spin a yarn (Y);
the yarn storage roller (51) according to any one of claims 1 to 10 adapted to store the yarn (Y) spun by the spinning device (7); and
the winding device (12) adapted to wind the yarn (Y) stored on the yarn storage roller (51) into a package (P).

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FIG. 1

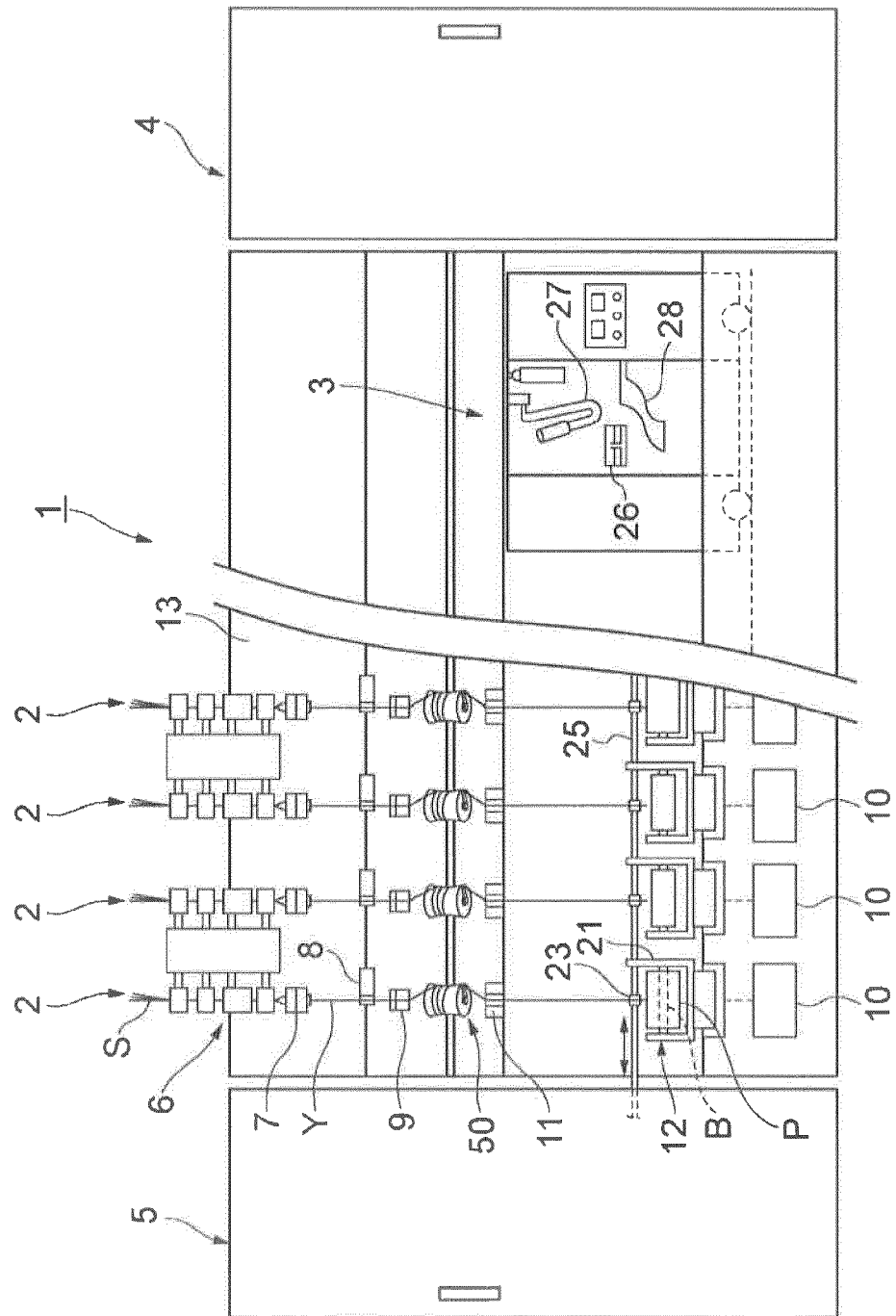


FIG. 2

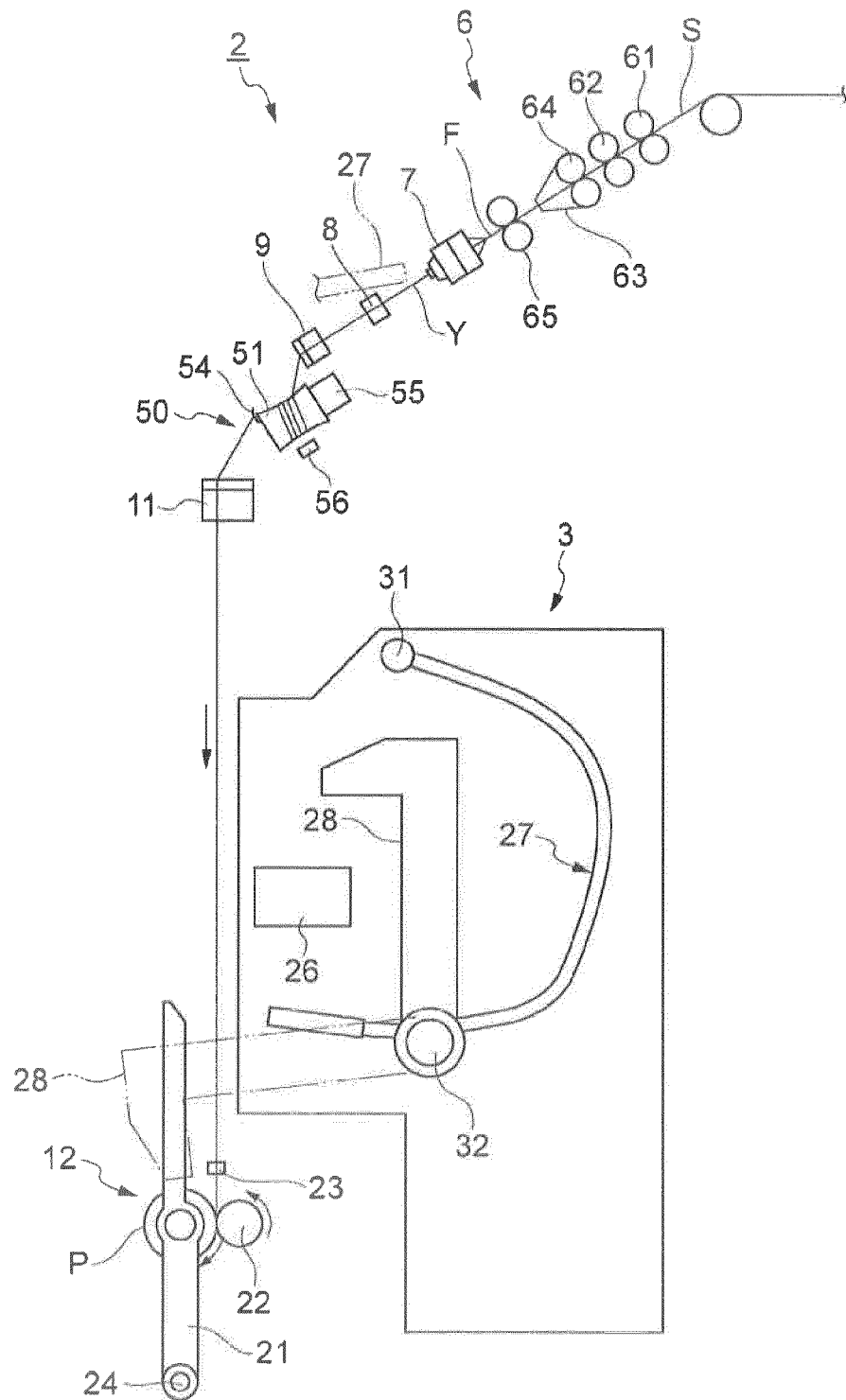


FIG. 3

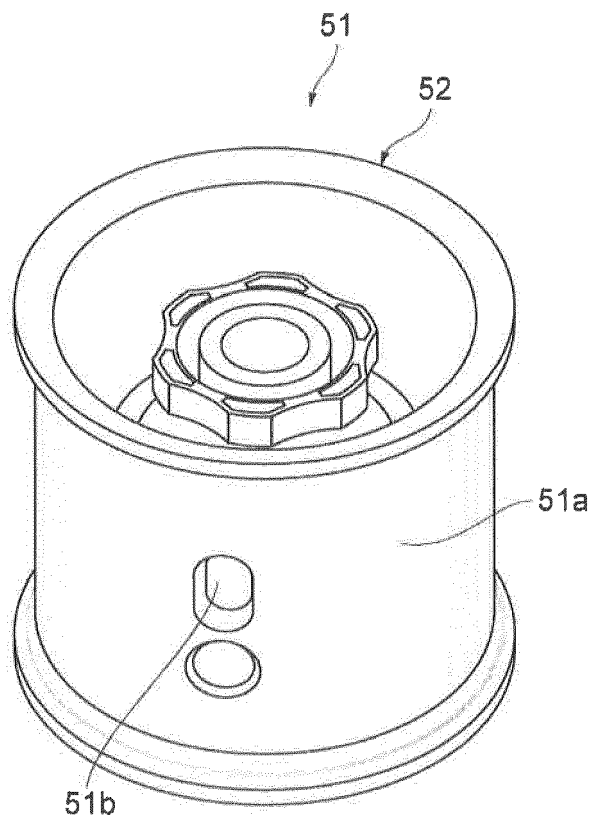


FIG. 4A

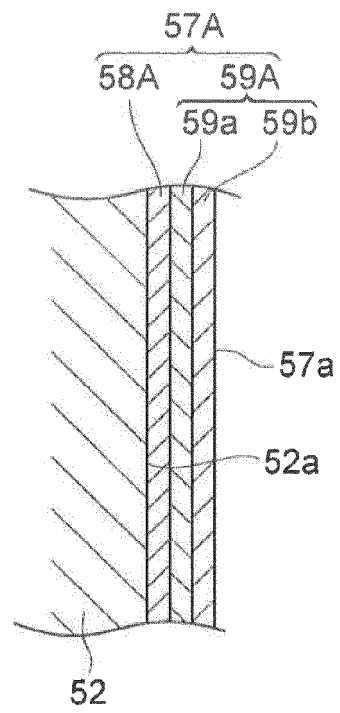


FIG. 4B

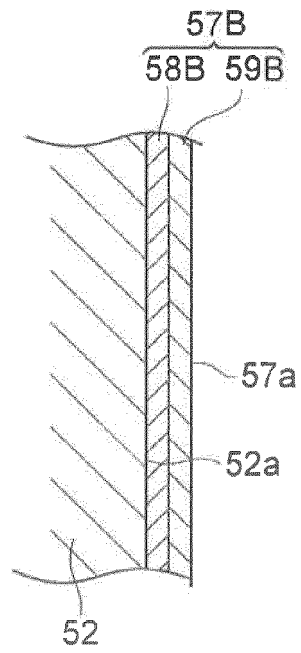


FIG. 5

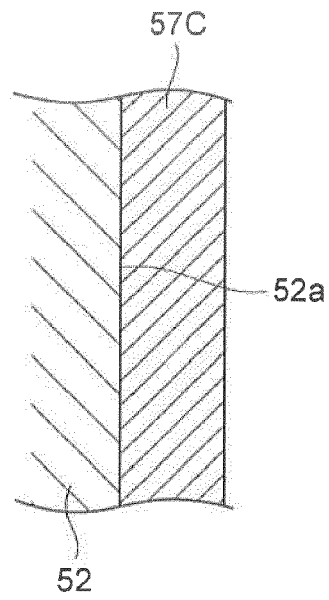


FIG. 6A

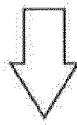
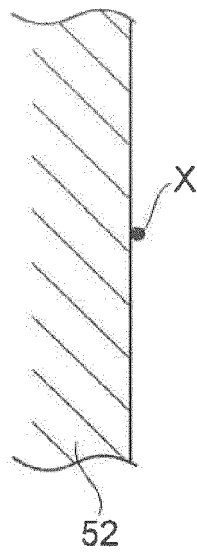
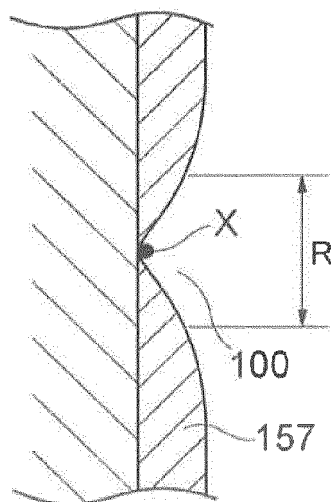


FIG. 6B





EUROPEAN SEARCH REPORT

 Application Number
 EP 15 16 1653

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 2 354 069 A2 (MURATA MACHINERY LTD [JP]) 10 August 2011 (2011-08-10) * paragraphs [0017] - [0019], [0028], [0032]; figures *	1-14	INV. B65H51/22 D01H13/10
Y	US 4 358 922 A (FELDSTEIN NATHAN) 16 November 1982 (1982-11-16) * column 1, lines 19-23 * * column 1, line 62 - column 2, line 18 * * column 2, lines 30-37, 61-63 * * column 3, lines 1-3, 29-45 *	1,2,8,9, 11-14	
Y,D	JP 2013 159467 A (MURATA MACHINERY LTD) 19 August 2013 (2013-08-19) * figures * & EP 2 626 323 A2 (MURATA MACHINERY LTD [JP]) 14 August 2013 (2013-08-14) * paragraph [0056] *	3-7	
Y	GB 1 037 629 A (BRITISH NYLON SPINNERS LTD) 27 July 1966 (1966-07-27) * page 1, lines 21-30 * * page 2, lines 15-17, 30-32 *	10	TECHNICAL FIELDS SEARCHED (IPC)
A	DE 10 2010 035584 A1 (OERLIKON TEXTILE GMBH & CO KG [DE]) 24 March 2011 (2011-03-24) * paragraphs [0001], [0002], [0007], [0048]; figures *	1,2, 11-14	B65H D01H C23C
A	GB 1 401 401 A (RUETI TE STRAKE BV) 16 July 1975 (1975-07-16) * page 2, lines 102-105 *	1	
A	GB 1 097 028 A (SHIMADZU CORP) 29 December 1967 (1967-12-29) * page 1, lines 44-48; claim 1 *	1	
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		31 July 2015	Lemmen, René
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 16 1653

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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31-07-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2354069 A2	10-08-2011	CN 102139820 A	03-08-2011
		CN 104590944 A	06-05-2015
		EP 2354069 A2	10-08-2011
		JP 2011157196 A	18-08-2011
US 4358922 A	16-11-1982	NONE	
JP 2013159467 A	19-08-2013	CN 103241594 A	14-08-2013
		EP 2626323 A2	14-08-2013
		JP 2013159467 A	19-08-2013
GB 1037629 A	27-07-1966	DE 1270912 B	20-06-1968
		GB 1037629 A	27-07-1966
DE 102010035584 A1	24-03-2011	NONE	
GB 1401401 A	16-07-1975	AR 204698 A1	27-02-1976
		AU 5754473 A	09-01-1975
		BE 801711 A2	15-10-1973
		CA 977654 A1	11-11-1975
		CH 562345 A5	30-05-1975
		DE 2333107 A1	17-01-1974
		FR 2190962 A1	01-02-1974
		GB 1401401 A	16-07-1975
		IT 990831 B	10-07-1975
		JP S4955962 A	30-05-1974
		JP S5611779 B2	17-03-1981
		NL 7209278 A	02-01-1974
GB 1097028 A	29-12-1967	DE 1560602 B	06-05-1970
		GB 1097028 A	29-12-1967
		US 3356308 A	05-12-1967

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2013063839 A [0003]
- JP 2010174421 A [0003]
- JP 2013159467 A [0003]