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

(11) EP 2 626 323 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
14.08.2013 Bulletin 2013/33

(51) Int Cl.:
B65H 51/22 *(2006.01)*

(21) Application number: **13150070.4**

(22) Date of filing: **02.01.2013**

(84) Designated Contracting States:
AL 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 RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **07.02.2012 JP 2012024295**

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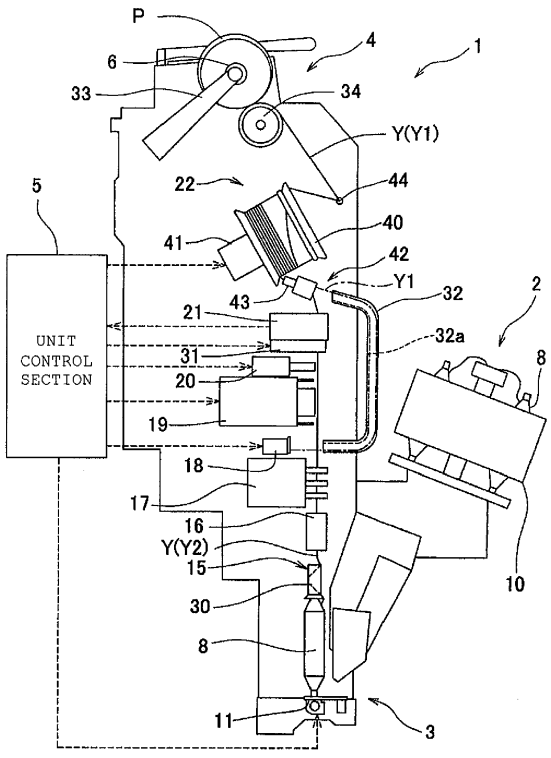
(54) Yarn accumulating device and yarn winding device provided with the same

(57) The invention aims to reduce a weight of a yarn accumulating roller and realize a quick rotational control of the yarn accumulating roller. A winding unit (1) includes a yarn supplying section (3), a package winding section (4), and a yarn accumulating device (22) arranged between the yarn supplying section (3) and the package winding section (4). The yarn accumulating device (22) includes a cylindrical yarn accumulating roller (40) around which a yarn (y) is wound by being rotated. The yarn accumulating roller (40) is formed of a resin material which is a non-metal material.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn accumulating device adapted to accumulate a yarn, and a yarn winding device provided with the yarn accumulating device.

2. Description of the Related Art

[0002] WO 2011/040545 discloses an automatic winder adapted to rewind a yarn unwound from a yarn supplying bobbin while removing a yarn defect such as slub to form a package. The automatic winder of WO 2011/040545 includes various devices such as a yarn joining device, a yarn accumulating device, and the like between the yarn supplying bobbin and a package winding section adapted to wind the yarn. The yarn joining device joins the yarn from the package and the yarn from the yarn supplying bobbin at the time of replacing the yarn supplying bobbin, after performing yarn cutting operation to remove the yarn defect, and after occurrence of an unexpected yarn breakage. The yarn accumulating device includes a rotating yarn accumulating roller (rotating accumulating drum), and temporarily accumulates the yarn that is not yet wound into a package by winding the yarn around the yarn accumulating roller.

[0003] In the above automatic winder, during the winding of the yarn by the package winding section, the yarn accumulating roller of the yarn accumulating device arranged between the yarn supplying bobbin and the package winding section winds the yarn unwound from the yarn supplying bobbin, and unwinds the yarn wound around the yarn accumulating roller towards the package winding section. The yarn accumulating roller rotates with a prescribed amount of yarn wound therearound. The rotation of the yarn accumulating roller is stopped when performing yarn joining operation by the yarn joining device. At the time of the yarn joining operation, although the yarn is not supplied from the yarn supplying bobbin, since a prescribed amount of yarn is accumulated in the yarn accumulating roller, the yarn of the yarn accumulating roller is unwound and wound by the package winding section. In this manner, the winding of the yarn by the package winding section is continuously carried out without being stopped even at the time of the yarn joining operation.

[0004] The yarn accumulating device of WO 2011/040545 adopts a method of accumulating the yarn by winding the yarn around the rotating yarn accumulating roller. If the winding speed of the package winding section is large, the yarn accumulated in the yarn accumulating device quickly runs out during the yarn joining operation, and hence the yarn accumulating amount of the yarn accumulating device is desirably large. However, the amount of yarn that can be accumulated in the yarn accumulating device is proportional to the size (outer diameter and length) of the yarn accumulating roller. That is, the yarn accumulating roller needs to be large in order to increase the yarn accumulating amount, which consequently increases the inertia moment of the yarn accumulating roller. In this case, it becomes difficult to quickly control the rotation of the roller, for example, the yarn accumulating roller cannot be promptly stopped when starting the yarn joining operation. Alternatively, a large motor can be adopted to rotationally drive the yarn accumulating roller, but this greatly increases the cost and is also disadvantageous in terms of energy consumption.

BRIEF SUMMARY OF THE INVENTION

[0005] An object of the present invention is to reduce a weight of the yarn accumulating roller and realize a quick rotational control of the yarn accumulating roller.

[0006] A yarn accumulating device according to a first aspect of the invention relates to a yarn accumulating device for accumulating a yarn, and the yarn accumulating device includes a cylindrical yarn accumulating roller around which the yarn is wound by being rotated, the yarn accumulating roller being formed of a non-metal material having a smaller specific weight than that of iron.

[0007] According to the present invention, since the cylindrical yarn accumulating roller is formed of a non-metal material having a smaller specific weight than that of iron, the weight of the yarn accumulating roller can be reduced compared to when being formed of a metal material. Therefore, a prompt rotational control of the yarn accumulating roller can be carried out without enlarging the motor.

[0008] In accordance with a second aspect of the invention, in the yarn accumulating device, the non-metal material is a resin material. According to the present invention, the weight of the yarn accumulating roller can be further reduced.

[0009] In accordance with a third aspect of the invention, in the yarn accumulating device, the yarn accumulating roller is formed of a fiber reinforced resin in which reinforced fiber is contained in the resin material. According to the present invention, high strength can be ensured in addition to the reduction in weight of the yarn accumulating roller.

[0010] In accordance with a fourth aspect of the invention, in the yarn accumulating device, at least a portion, around which the yarn is wound, of an outer surface of the yarn accumulating roller is covered with a protective layer. According to the present invention, since the portion around which the yarn is wound of the yarn accumulating roller is covered with the protective layer, deformation, scratches, abrasion, or the like caused by the winding of the yarn are suppressed from occurring at the outer surface of the yarn accumulating roller made of resin material, thus improving durability.

[0011] In accordance with a fifth aspect of the invention, in the yarn accumulating device, the yarn accumulating roller is formed of the resin material, and a metal plated layer is applied as the protective layer on the entire outer surface of the yarn accumulating roller. According to the present invention, the entire surface of the yarn accumulating roller is protected with the plated layer serving as the protective layer. In the case of plating, it is generally easier to form the plated layer on the entire surface rather than forming the plated layer only on one part of the base material.

[0012] In accordance with a sixth aspect of the invention, in the yarn accumulating device, the yarn accumulating roller is formed of ABS resin, the plated layer is a layer having chromium as a main component, and a base layer having nickel or copper as a main component is formed between the yarn accumulating roller and the plated layer.

[0013] The ABS resin (copolymeric synthetic resin of Acrylonitrile, Butadiene, and Styrene) has high moldability and is suited for molding of the yarn accumulating roller. The chromium plating has high corrosion resistance and excels in hardness of the roller surface and the improvement of the abrasion resistance. However, it is difficult to form the chromium plating through electrolytic plating on the surface of the ABS resin, which is an insulating material. However, in the present invention, the chromium plating can be formed with electrolytic plating since the base layer having nickel or copper as the main component that can be formed with non-electrolytic plating or the like exists on the surface of the ABS resin.

[0014] In accordance with a seventh aspect of the invention, in the yarn accumulating device, the yarn accumulating roller is formed of ceramics. According to the present invention, the weight of the yarn accumulating roller can be reduced since the yarn accumulating roller is formed of ceramics which is lighter in weight than the metal material.

[0015] In accordance with an eighth aspect of the invention, in the yarn accumulating device, a metal coupling member for coupling a rotation shaft of a drive motor, which is adapted to rotate the yarn accumulating roller, and the yarn accumulating roller is attached to the yarn accumulating roller. According to the present invention, since the yarn accumulating roller made of a non-metal material and the drive motor are coupled with the metal coupling member having high strength, breakage is less likely to occur at the coupling portion with the motor when the torque of the drive motor is applied.

[0016] A yarn winding device according to a ninth aspect of the invention includes a yarn supplying section; a winding section adapted to wind a yarn supplied from the yarn supplying section; the yarn accumulating device arranged between the yarn supplying section and the winding section and adapted to accumulate the yarn that is not yet wound around the winding section; and a yarn defect removing device, which is arranged between the yarn supplying section and the yarn accumulating device, and adapted to detect and remove a defect of the travelling yarn.

[0017] According to the present invention, the yarn accumulating device is arranged between the yarn supplying section and the yarn defect removing device. Thus, even in a state in which the yarn is not supplied from the yarn supplying section to the winding section at the time of removing the yarn defect, the winding section winds the yarn accumulated in the yarn accumulating device, and hence the winding operation of the winding section can be continuously carried out.

[0018] In accordance with a tenth aspect of the invention, in the yarn winding device, the yarn defect removing device includes a yarn defect detecting device adapted to detect the defect of the travelling yarn, a yarn cutting section adapted to cut the yarn when the yarn defect is detected by the yarn defect detecting device, and a yarn joining device adapted to join a yarn end from the yarn accumulating device and a yarn end from the yarn supplying section while removing the yarn defect after the yarn is cut by the yarn cutting section.

[0019] In the present invention, when the yarn defect is detected by the yarn defect detecting device, the yarn is first cut by the yarn cutting section. Thereafter, the yarn joining device joins the yarn end from the yarn accumulating device and the yarn end from the yarn supplying section. Then, the yarn joining device removes the yarn defect upon joining the yarn ends. During such series of operations, the yarn is not supplied from the yarn supplying section, but the winding section winds the yarn unwound from the yarn accumulating roller of the yarn accumulating device, so that the winding operation can be continued.

[0020] In accordance with an eleventh aspect of the invention, the yarn winding device further includes: a control section adapted to control a winding operation of the winding section and a yarn accumulating operation of the yarn accumulating roller of the yarn accumulating device; and a yarn amount detecting section adapted to detect an amount of yarn accumulated in the yarn accumulating device; wherein the control section stops rotation of the yarn accumulating roller and controls the winding operation of the winding section according to a detection result of the yarn amount detecting section when the yarn is cut by the yarn cutting section.

[0021] In the present invention, when a state in which the amount of yarn of the yarn accumulating device is small is detected by the yarn amount detecting section, the winding operation of the winding section is stopped or the winding speed is reduced to prevent the yarn accumulated in the yarn accumulating device from running out.

In the following, the present invention is illustrated with more detail with regard to an embodiment disclosed in the enclosed drawings.

Figure 1 is a side view of a winding unit of an automatic winder according to the present invention;

figure 2 is a side view of a yarn accumulating device according to the invention;

figure 3 is a cross sectional view in a plain including an axis center of the yarn accumulating roller according to the invention;

figure 4 is an enlarged cross-sectional view of an outer peripheral portion of the yarn accumulating roller of figure 3; and

figure 5 is a flow chart showing the control of the package winding operation including the yarn joining operation performed by the unit control section according to the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0022] An embodiment of the present invention will be described below. The present embodiment is an example in which the present invention is applied to an automatic winder including a plurality of winding units (yarn winding devices), adapted to wind a yarn unwound from a yarn supplying bobbin to form a winding package. The automatic winder has a configuration in which the plurality of winding units, each forming one package, is arranged in a line in one direction. FIG. 1 is a side view of one winding unit of the automatic winder.

[0023] As illustrated in FIG. 1, each winding unit 1 includes a bobbin supplying device 2, a yarn supplying section 3, a package winding section 4, and a unit control section 5 for controlling each section of the winding unit 1. With the yarn supplying bobbin 8 supplied from the bobbin supplying device 2 being held by the yarn supplying section 3, the winding unit 1 winds a spun yarn Y unwound from the yarn supplying bobbin 8 around a winding tube 6 while traversing the spun yarn Y by the package winding section 4 to form a package P of a predetermined shape.

[0024] The bobbin supplying device 2 includes a rotary magazine 10 capable of holding an extra supply of yarn supplying bobbins 8. When the magazine 10 is intermittently rotated, one yarn supplying bobbin 8 is dropped diagonally so that the yarn supplying bobbin 8 is supplied to the yarn supplying section 3.

[0025] The yarn supplying section 3 holds the yarn supplying bobbin 8 in a replaceable manner. Specifically, the yarn supplying bobbin 8 supplied from the bobbin supplying device 2 is held in a substantially upright state by a bobbin holding tool (not illustrated) inserted to a lower end of the yarn supplying bobbin 8. When the yarn of the yarn supplying bobbin 8 is all unwound and the yarn supplying bobbin 8 becomes empty, the yarn supplying section 3 can flip up the yarn supplying bobbin 8 by a springboard 11 to discharge the yarn supplying bobbin 8 outside the yarn supplying section 3.

[0026] On a yarn travelling path between the yarn supplying section 3 and the package winding section 4, an unwinding assisting device 15, a lower yarn blow-up device 16, a tension applying device 17, an upper yarn catching device 18, a yarn joining device 19, a yarn trap 20, a clearer 21, and a yarn accumulating device 22 are arranged in this order from the yarn supplying section 3.

[0027] The unwinding assisting device 15 lowers a tube body 30, which covers an upper end of the yarn supplying bobbin 8, with advancement in the unwinding of the yarn Y to regulate bulging (balloon) of the yarn Y during the unwinding and stabilize the unwinding tension.

[0028] The lower yarn blow-up device 16 is connected to a compressed air source (not illustrated), and is configured to generate an upward airflow at the time of the yarn joining operation to blow up a lower yarn Y2 from the yarn supplying bobbin 8 towards the yarn joining device 19.

[0029] The tension applying device 17 is adapted to apply a predetermined tension on the travelling yarn Y. The tension device 17 may be, for example, a gate-type which includes fixed comb teeth and movable comb teeth movably arranged with respect to the fixed comb teeth.

[0030] The upper yarn catching device 18 is connected to a negative pressure source (not illustrated), and is adapted to generate a suction airflow during the yarn joining operation to suck and catch an upper yarn Y1 from the yarn accumulating device 22 guided by a guide member 32, to be described later.

[0031] The yarn trap 20 is connected to the negative pressure source (not illustrated), and catches the lower yarn Y2 blown up by the lower yarn blow-up device 16 at the time of the yarn joining operation.

[0032] The yarn joining device 19 joins the lower yarn Y2 from the yarn supplying bobbin 8 and the upper yarn Y1 from the winding side (yarn accumulating device 22) at the time of replacing the yarn supplying bobbin 8, after yarn cut carried out when the clearer 21, described later, detects a yarn defect, or after yarn breakage during the unwinding of the yarn from the yarn supplying bobbin 8. The yarn joining device 19 may be the yarn joining device 19 (air splicer) including an untwisting nozzle adapted to untwist the yarn end of the upper yarn Y1 and the yarn end of the lower yarn Y2, and a twisting nozzle adapted to apply a whirling airflow on the untwisted yarn ends to twist the yarn ends together.

[0033] The clearer 21 (yarn defect detecting device) is arranged on the yarn travelling path between the yarn supplying section 3 and the yarn accumulating device 22, and detects a yarn defect such as slub of the yarn Y travelling through the yarn travelling path. The clearer 21 is provided with a cutter 31 (yarn cutting section) adapted to cut the yarn when the clearer 21 detects the yarn defect.

[0034] The substantially tubular guide member 32 is arranged on the side of the yarn joining device 19 between the upper yarn catching device 18 and the yarn accumulating device 22 so as to circumvent a linear yarn travelling path during the normal winding. Furthermore,

a slit 32a is formed over the entire length of the guide member 32 in a side wall (left side in the figure) of the guide member 32.

[0035] At the time of the yarn joining operation, the upper yarn Y1 from the yarn accumulating device 22 is pulled out by an upper yarn pull-out device 42 of the yarn accumulating device 22, to be described later, and fed to the guide member 32, and the yarn end of the upper yarn Y1 is passed through the guide member 32 to be caught by the upper yarn catching device 18. Furthermore, when the yarn is pulled by the upper yarn catching device 18, the yarn is pulled out to the outside of the guide member 32 from the slit 32a and guided to the yarn joining device 19. The lower yarn Y2 from the yarn supplying bobbin 8 is blown upward by the lower yarn blow-up device 16. Moreover, the blown-up yarn is caught and pulled by the yarn trap 20 to be guided to the yarn joining device 19. After the upper yarn Y1 and the lower yarn Y2 are set in the yarn joining device 19 in this manner, the yarn joining device 19 joins the upper yarn Y1 and the lower yarn Y2.

[0036] Although not illustrated, the yarn joining device 19 includes a cutter adapted to cut the ends of the guided upper yarn Y1 and the lower yarn Y2. The yarn defect in the upper yarn Y1 is removed at the time of the cutting operation performed by the cutter in the yarn joining operation when the yarn defect is detected. After the cutting operation, the yarn ends of the upper yarn Y1 and the lower yarn Y2 are joined.

[0037] In the present embodiment, a device group such as the lower yarn blow-up device 16, the upper yarn catching device 18, the yarn joining device 19, the yarn trap 20, the clearer 21, and the cutter 31 corresponds to a "yarn defect removing device" in the invention of the present application, which detects and removes the yarn defect from the travelling yarn Y.

[0038] The yarn accumulating device 22 is arranged between the yarn joining device 19 and the package winding section 4. The yarn accumulating device 22 temporarily accumulates the yarn Y that is not yet wound by the package winding section 4. The details on the structure of the yarn accumulating device 22 will be described later.

[0039] The package winding section 4 (winding section) includes a cradle 33 which has a pair of cradle arms for rotatably and detachably supporting the winding tube 6, and a traverse drum 34 which can make contact with the surface of the winding tube 6 supported by the cradle 33 or the surface of a package P formed on the winding tube 6. The package winding section 4 is configured such that, by rotating the traverse drum 34 by a drum driving motor (not illustrated) with the traverse drum 34 making contact with the winding tube 6 (or the surface of the package P), the winding tube 6 is rotated (accompanying rotation) accompanying the rotation of the traverse drum 34 while traversing the yarn unwound from the yarn accumulating device 22, to thereby form the package P on the outer periphery of the winding tube 6.

[0040] In the present embodiment, since the yarn accumulating device 22 adapted to accumulate the yarn Y is arranged between the yarn supplying section 3 and the package winding section 4, the package winding section 4 can wind the yarn accumulated in the yarn accumulating device 22 and the winding of the package P can be continued even if the unwinding of the yarn from the yarn supplying bobbin 8 is interrupted for some reason (e.g., during the yarn joining operation by the yarn joining device 19).

[0041] The unit control section 5 (control section) is configured by a CPU (Central Processing Unit) which is an arithmetic processing unit, a ROM (Read-Only Memory) which stores programs executed by the CPU and data used in the program, a RAM (Random Access Memory) which temporarily stores the data during the execution of the program, and an input/output interface for inputting and outputting data from and to outside. The unit control section 5 controls the operation of each device of the above-described winding unit 1 based on a command sent from a machine control device (not illustrated), which performs the overall control of the automatic winder.

[0042] Next, the yarn accumulating device 22 will be described in detail. FIG. 2 is a side view of the yarn accumulating device 22. As illustrated in FIG. 1 and FIG. 2, the yarn accumulating device 22 includes a cylindrical yarn accumulating roller 40 around which the yarn is wound by rotating, a roller driving motor 41 which rotatably drives the yarn accumulating roller 40, and an upper yarn pull-out device 42 which pulls out the yarn end of the yarn wound around the yarn accumulating roller 40 at the time of the yarn joining operation.

[0043] As will be specifically described later, the yarn accumulating roller 40 is formed of a resin material R. As illustrated in FIG. 2, the yarn accumulating roller 40 is rotatably supported on the machine of the winding unit 1 with an axis C1 which is slightly tilted with respect to a horizontal direction, as a center. Tapered portions 40a, 40b, whose diameter becomes larger towards the end, are formed at both axial ends of the yarn accumulating roller 40, respectively. The portion between the two tapered portions 40a, 40b is a cylindrical portion 40c having a constant diameter, and the yarn Y is wound around the cylindrical portion 40c. The yarn Y wound around the cylindrical portion 40c is prevented from falling off by the two tapered portions 40a, 40b at both ends.

[0044] FIG. 3 is a cross-sectional view in a plane including an axis center of the yarn accumulating roller 40. A wall portion 40d is formed inside the cylindrical yarn accumulating roller 40, and a metal coupling member 48 is attached to the wall portion 40d. A rotation shaft 41a of the roller driving motor 41 is coupled to the coupling member 48. The roller driving motor 41 is a position controllable motor such as a DC brushless motor, a stepping motor, a servo motor, and the like, and can rotatably drive the yarn accumulating roller 40 in both directions. Since the yarn accumulating roller 40 formed of the resin ma-

terial R and the rotation shaft 41a of the roller driving motor 41 are coupled by the metal coupling member 48 having high strength, the portion coupled with the roller driving motor 41 is less likely to break when the torque of the roller driving motor 41 is applied.

[0045] A guide tube 43 which constitutes one part of the upper yarn pull-out device 42, to be described later, is arranged in proximity to the tapered portion 40a on the basal end side of the yarn accumulating roller 40. One end of the guide tube 43 is arranged close to the surface of the yarn accumulating roller 40. At the time of the normal winding, the yarn from the yarn supplying bobbin 8 is guided to the tapered portion 40a on the basal end side of the yarn accumulating roller 40 through the guide tube 43.

[0046] When the yarn accumulating roller 40 is rotated in one direction, the yarn Y guided to the tapered portion 40a on the basal end side of the yarn accumulating roller 40 by the guide tube 43 is sequentially wound while pushing up the previous yarn layer from the basal end side (left side in the figure) of the cylindrical portion 40c. As a result, the yarn that is already wound around the yarn accumulating roller 40 is pushed by the newly wound yarn, and is sequentially fed towards the distal end side. The yarn Y is thus spirally aligned and orderly wound from the basal end side on the outer peripheral surface of the cylindrical portion 40c of the yarn accumulating roller 40.

[0047] Meanwhile, the yarn Y wound around the yarn accumulating roller 40 is pulled out from the tapered portion 40b on the distal end side (right side in the figure) of the yarn accumulating roller 40, and is fed downstream (towards the package winding section 4). At the tapered portion 40b on the distal end side, the yarn on the yarn accumulating roller 40 is pulled out towards the downstream through a pull-out guide 44, which is positioned on an extended line of the center axis C1 of the yarn accumulating roller 40.

[0048] A rubber annular member 45 such as a rubber band, an o ring, or the like is attached to the distal end of the cylindrical portion 40c of the yarn accumulating roller 40 (boundary portion with the distal end side taperedportion 40b). The yarn wound around the yarn accumulating roller 40 is passed between the yarn accumulating roller 40 and the annular member 45 to be unwound, whereby an appropriate tension is applied on the unwinding yarn. The annular member 45 is prevented from falling off from the yarn accumulating roller 40 by the tapered portion 40b on the distal end side of the yarn accumulating roller 40.

[0049] As described above, in the present embodiment, the yarn accumulating roller 40 is formed of the resin material R which is a non-metal material. As the resin material R for forming the yarn accumulating roller 40, if it is a thermoplastic resin, ABS resin (specific weight: 1.0) (copolymeric synthetic resin of Acrylonitrile (specific weight: 0.6), Butadiene (specific weight: 1.0), and Styrene (specific weight 1.0)) or a polycarbonate (specific weight: 1.2), which excels in moldability may be suitably used. If it is a thermosetting resin, phenol resin (specific weight: 1.25 to 1.5), unsaturated polyester resin (specific weight: 1.1 to 1.46), epoxy resin (specific weight: 1.1 to 1.2), and the like may be suitably used. Including the above examples, the resin material R has a significantly low specific weight compared to the iron-based metal material such as stainless steel (specific weight: 7.7), and thus the weight of the yarn accumulating roller 40 can be greatly reduced compared to the case where the yarn accumulating roller 40 is formed of a metal material.

[0050] Furthermore, the yarn accumulating roller 40 may be formed of a fiber reinforced resin (FRP) in which reinforced fiber is contained in the thermosetting resin. For example, a glass fiber reinforced resin (GFRP) in which glass fiber is contained in the above-described phenol resin and the like, a carbon fiber reinforced resin (CFRP) which contains carbon fiber, and the like may be used. By forming the yarn accumulating roller 40 from a fiber reinforced resin, high strength can be ensured in addition to further reduction in weight of the yarn accumulating roller 40. Moreover, a vibration damping effect can be obtained by the reinforced fiber.

[0051] The yarn accumulating roller 40 can be molded through a general molding method using a die. With the thermoplastic resin, the yarn accumulating roller 40 can be easily molded by injection molding. With the thermosetting resin, the yarn accumulating roller 40 can be molded by transfer molding, compression molding, or injection molding. If the thermosetting resin such as the phenol resin is used, the shrink produced at the time of molding by the die is reduced. Since the phenol resin has a low thermal contraction rate, the accuracy of the surface of the die becomes the accuracy of the resin surface as is, and thus the yarn accumulating roller 40 having a very small surface roughness can be molded.

[0052] In the present embodiment, as illustrated in FIG. 3, the metal coupling member 48 for coupling the yarn accumulating roller 40 with the roller driving motor 41 is attached to the yarn accumulating roller 40. In such a case, the yarn accumulating roller 40 is preferably molded by insert molding. That is, the metal coupling member 48 is attached in advance to the interior of the die for molding the yarn accumulating roller 40, and the resin material R is then injected into the die to integrally form the yarn accumulating roller 40 and the coupling member 48. In this case, the positional accuracy of the coupling member 48 and the yarn accumulating roller 40 to be molded with the die becomes higher by setting the die with the coupling member 48 as a reference.

[0053] Since the resin material R generally has low hardness compared to the metal material, scratches and deformation may occur on the outer surface of the yarn accumulating roller 40 formed of the resin material R depending on the wound yarn Y. Furthermore, abrasion may occur when the wound yarn Y is rubbed against the outer surface of the yarn accumulating roller 40. Thus,

the outer surface of the yarn accumulating roller 40 may be covered with a protective layer H. Accordingly, the deformation, scratches, abrasion, or the like caused by the winding of the yarn are suppressed from occurring on the outer surface of the yarn accumulating roller 40 formed of the resin material R, whereby the durability is improved.

[0054] The material of the protective layer H is not particularly limited, but the material excelling in corrosion resistance and abrasion resistance is preferably used. Examples of the material include hard chrome plating, DLC (Diamond-like Carbon), and the like. The covering method may include plating (wet plating), deposition (PVD, CVD, or the like), painting, thermal spraying, and the like. A thin metal film manufactured in a different step may be laminated to the surface of the yarn accumulating roller 40.

[0055] From the viewpoint of preventing scratches and the like caused by the wound yarn Y, the protective layer H is preferably arranged at least on the tapered portions 40a, 40b and the cylindrical portion 40c, on which the yarn Y is wound, of the outer surface of the yarn accumulating roller 40. However, from the viewpoint of protecting the entire yarn accumulating roller 40, the outer surface of the yarn accumulating roller 40 may be entirely covered with the protective layer H. In particular, in the case of plating, the protective layer H can be easily formed over the entire surface of the yarn accumulating roller 40. Furthermore, in the case of plating, it is generally easier to form the plated layer entirely rather than forming the plated layer only on one part of the base material.

[0056] A case of forming the protective layer H by plating will be described by way of example. FIG. 4 is an enlarged cross-sectional view of an outer peripheral portion of the yarn accumulating roller 40 of FIG. 3. First, the outer surface of the yarn accumulating roller 40 formed of the resin material R is etched to form irregularities on the outer surface, and then a catalyst having high reducing ability such as Pd and Sn is added. Then, the yarn accumulating roller 40 added with the catalyst is immersed in a chemical plating solution to carry out non-electrolytic plating, thereby forming a base layer 61, which has nickel or copper as the main component, on the outer surface of the yarn accumulating roller 40. The electrolytic plating thus can be carried out by forming the base layer 61 having conductivity on the outer surface of the yarn accumulating roller 40. Then, a metal plated layer 60 having chromium as the main component is formed as the protective layer H on the base layer 61 by the electrolytic plating. In the above configuration, the term "main component" refers to a component having the highest weight ratio among the components of each layer.

[0057] It should be noted that, regardless of the presence or absence of coating by the protective layer H described above, the physical processing such as blast processing, buffing, and the like may be performed on the outer surface of the yarn accumulating roller 40, as necessary.

[0058] Returning to FIG. 2, an upper limit sensor 46 for detecting that the amount of yarn Y on the yarn accumulating roller 40 is greater than or equal to a predetermined upper limit amount, and a lower limit sensor 47 for detecting that the amount of yarn Y is smaller than a predetermined lower limit amount are arranged in proximity of the outer peripheral surface of the cylindrical portion 40c of the yarn accumulating roller 40. The detection results of the upper limit sensor 46 and the lower limit sensor 47 are sent to the unit control section 5. Based on the detection results of the sensors 46, 47, the unit control section 5 controls the roller driving motor 41 such that the yarn accumulating amount (winding amount) of the yarn accumulating roller 40 is within a range between the upper limit amount and the lower limit amount. Each of the upper limit sensor 46 and the lower limit sensor 47 corresponds to a "yarn amount detecting section" in the invention of the present application.

[0059] The upper yarn pull-out device 42 is a device for pulling out the yarn end of the yarn from the yarn accumulating device 22 (upper yarn Y1) to perform the yarn joining operation by the yarn joining device 19 at the time of replacement of the yarn supplying bobbin 8, after the cutting of the yarn, or after the yarn breakage when the yarn defect is detected. The upper yarn pull-out device 42 includes the guide tube 43 mentioned above. A yarn passage 50 and a nozzle 51 connected to the yarn passage 50 are formed inside the guide tube 43. One end of the guide tube 43 faces the tapered portion 40a on the basal end side of the yarn accumulating roller 40, and the above-described guide member 32 is arranged at the other end of the guide tube 43 with its opening at the upper end facing the guide tube 43. The nozzle 51 is connected to a compressed air source 52, and an electromagnetic valve 53 that opens and closes by the signal from the unit control section 5 is arranged between the nozzle 51 and the compressed air source 52.

[0060] At the time of the normal winding, the yarn Y unwound from the yarn supplying bobbin 8 is passed through the yarn passage 50 of the guide tube 43 and guided to the surface of the yarn accumulating roller 40. At the time of the yarn joining operation, the electromagnetic valve 53 is switched from close to open, and the compressed air is supplied from the nozzle 51 into the yarn passage 50, so that the airflow directed from the yarn accumulating roller 40 towards the guide member 32 is generated in the yarn passage 50. Under this state, when the yarn accumulating roller 40 is rotated in a direction opposite to the rotation at the time of normal winding, the yarn Y on the yarn accumulating roller 40 is unwound from the basal end side, and the yarn end thereof is pulled into the guide tube 43 by the airflow and further fed from the guide tube 43 to the guide member 32. The yarn end of the upper yarn Y1 fed to the guide member 32 in this manner is guided to and caught by the above-described upper yarn catching device 18, whereby the upper yarn Y1 is fed to the yarn joining device 19.

[0061] Next, the control of the package winding operation including the yarn joining operation performed by the unit control section 5 will be described with reference to a flowchart of FIG. 5. In the following, in particular, a series of operations performed when a yarn defect is detected during the package winding will be described.

[0062] When a yarn defect of the travelling yarn Y is detected (S10) by the clearer 21 while the package P is being wound, the yarn Y is cut with the cutter 31 (S11). The rotation of the yarn accumulating roller 40 is stopped (S12). However, the traverse drum 34 of the package winding section is not stopped. In other words, the package winding section 4 unwinds and winds the yarn Y wound around the yarn accumulating roller 40.

[0063] Then, the yarn joining device 19 performs the yarn joining operation (S13). With respect to the lower yarn Y2 from the yarn supplying bobbin 8, the yarn end blown up by the lower yarn blow-up device 16 illustrated in FIG. 1 is caught by the yarn trap 20 so that the lower yarn Y2 is guided to the yarn joining device 19. The upper yarn Y1 is pulled out by the upper yarn pull-out device 42 illustrated in FIG. 1 and FIG. 2, and the upper yarn Y1 fed to the guide member 32 is caught by the upper yarn catching device 18 so that the upper yarn Y1 is guided to the yarn joining device 19. The yarn joining device 19 joins the guided lower yarn Y2 and the upper yarn Y1. Then, the yarn joining device 19 removes the yarn defect contained in the upper yarn Y1 upon joining the lower yarn Y2 and the upper yarn Y1.

[0064] Since the yarn Y wound around the yarn accumulating roller 40 is unwound during the yarn joining operation, the amount of yarn accumulated in the yarn accumulating roller 40 is reduced. When the lower limit sensor 47 (see FIG. 2) of the yarn accumulating device 22 detects that the amount of yarn accumulated in the yarn accumulating roller 40 is less than a predetermined lower limit value (S14: Yes) before the yarn joining operation is finished, the winding speed of the package winding section 4 (rotation speed of the traverse drum 34) is reduced to prevent the yarn Y of the yarn accumulating roller 40 from running out (S15). Alternatively, the winding operation of the package winding section 4 may be temporarily stopped.

[0065] After the yarn joining operation by the yarn joining device 19 is finished (S16: Yes), the yarn accumulating roller 40 is re-accelerated to resume the unwinding of the yarn Y from the yarn supplying bobbin 8 (S17). If the winding speed of the package winding section 4 is reduced or the winding is stopped previously, the winding speed is increased to a predetermined speed.

[0066] The yarn accumulating device 22 is arranged between the yarn supplying section 3 and the package winding section 4. Thus, even in a state in which the yarn Y is not supplied from the yarn supplying section 3 to the package winding section 4 at the time of removing the yarn defect, the package winding section 4 winds the yarn accumulated in the yarn accumulating device 22 to continuously perform the winding operation of the package winding section 4. When a state in which the amount of yarn of the yarn accumulating device 22 is small is detected by the lower limit sensor 47, the winding operation of the package winding section 4 may be stopped or the winding speed may be reduced to prevent the yarn Y accumulated in the yarn accumulating device 22 from running out.

[0067] In the present embodiment described above, the yarn accumulating roller 40 of the yarn accumulating device 22 is formed of a non-metal material, and the yarn accumulating roller 40 has light weight. In particular, further reduction in weight of the yarn accumulating roller 40 can be realized by forming the yarn accumulating roller 40 with the resin material R. Therefore, the quick rotational control of the yarn accumulating roller 40 can be achieved without enlarging the roller driving motor 41.

[0068] Specifically, at the time of the yarn joining operation by the yarn joining device 19, the yarn accumulating roller 40 can be promptly stopped. Furthermore, after the yarn joining operation is finished, the yarn accumulating roller 40 can be promptly re-accelerated. In the case where the amount of yarn accumulated in the yarn accumulating roller 40 is required to be increased or decreased during the package winding, the rotation speed of the yarn accumulating roller 40 is to be changed. Such changing of the rotation speed can also be promptly performed.

[0069] In the above embodiment, an example in which the yarn accumulating roller 40 is formed of the resin material R has been described, but the yarn accumulating roller 40 may be formed of other non-metal materials. For example, the yarn accumulating roller 40 may be formed of ceramics. Ceramics also has a smaller specific weight compared to that of the metal material, and thus the weight of the yarn accumulating roller 40 can be reduced. If the yarn accumulating roller 40 is formed of ceramics, the hardness of the outer surface of the yarn accumulating roller 40 becomes high. Thus, the durability becomes sufficiently high even if the protective layer H is not provided. However, since the ceramics has low toughness, the protective layer H formed of rubber or resin may be formed on the surface of the yarn accumulating roller 40 made of ceramics for the purpose of preventing cracks.

[0070] In addition, the carbon fiber reinforced carbon composite material (CC material) may be used. Generally, the CC material is produced by alternately repeating a step of covering a core material of the carbon fiber with carbon resin such as phenol resin, and a step of firing the same in vacuum at a temperature from 1000°C to 2000°C to carbonize the resin. The specific weight of the general CC material is 1.3 to 1.7.

[0071] The above embodiment is an example in which the present invention is applied to the automatic winder for rewinding the yarn of the yarn supplying bobbin while removing the yarn defect to form a package, but the target of application of the present invention is not limited to the automatic winder. In other words, the present invention

can be applied to the yarn winding device other than the automatic winder as long as it is useful to install the yarn accumulating device adapted to accumulate the yarn in the middle of the yarn path from the yarn supplying section to the winding section. For example, in a spinning device adapted to spin and wind the yarn, the present invention can be applied to an accumulating roller adapted to temporarily wind and accumulate the yarn between the spinning section and the winding section.

Claims

1. A yarn accumulating device (22) for accumulating a yarn, the device (22) **characterized by** comprising:

a cylindrical yarn accumulating roller (40) around which the yarn is wound by being rotated, the yarn accumulating roller (40) being formed of a non-metal material having a smaller specific weight than that of iron.

2. The yarn accumulating device (22) according to claim 1, **characterized in that** the non-metal material is a resin material (R).

3. The yarn accumulating device (22) according to claim 2, **characterized in that** the yarn accumulating roller (40) is formed of a fiber reinforced resin in which reinforced fiber is contained in the resin material (R).

4. The yarn accumulating device (22) according to claim 2 or 3, **characterized in that** at least a portion, around which the yarn is wound, of an outer surface of the yarn accumulating roller (40) is covered with a protective layer (H).

5. The yarn accumulating device (22) according to claim 4, **characterized in that**
the yarn accumulating roller (40) is formed of the resin material (R), and
a metal plated layer (60) is applied as the protective layer (H) on the entire outer surface of the yarn accumulating roller (40).

6. The yarn accumulating device (22) according to claim 5, **characterized in that**
the yarn accumulating roller (40) is formed of ABS resin,
the plated layer (60) is a layer having chromium as a main component, and
a base layer (61) having nickel or copper as a main component is formed between the yarn accumulating roller (40) and the plated layer (60).

7. The yarn accumulating device (22) according to claim 1, **characterized in that** the yarn accumulating roller (40) is formed of ceramics.

8. The yarn accumulating device (22) according to any of claims 1 to 7, **characterized in that**
a metal coupling member (48) for coupling a rotation shaft (41a) of a drive motor (41), which is adapted to rotate the yarn accumulating roller (40), with the yarn accumulating roller (40) is attached to the yarn accumulating roller (40).

9. A yarn winding device (1) comprising:

a yarn supplying section (3);
a winding section (4) adapted to wind a yarn supplied from the yarn supplying section (3); **characterized in that**
the yarn accumulating device (22) according to any of claims 1 to 8 is arranged between the yarn supplying section (3) and the winding section (4) and adapted to accumulate the yarn (y) that is not yet wound around the winding section (4); and that
a yarn defect removing device is arranged between the yarn supplying section (3) and the yarn accumulating device (22), and is adapted to detect and remove a defect of the travelling yarn (y).

10. The yarn winding device (1) according to claim 9, **characterized in that**
the yarn defect removing device includes
a yarn defect detecting device (21) adapted to detect the defect of the travelling yarn (y),
a yarn cutting section (31) adapted to cut the yarn (y) when the yarn defect is detected by the yarn defect detecting device (21), and
a yarn joining device (19) adapted to join a yarn end (y1) from the yarn accumulating device (22) and a yarn end (y2) from the yarn supplying section (3) while removing the yarn defect after the yarn (y) is cut by the yarn cutting section (31).

11. The yarn winding device (1) according to claim 10, **characterized by** further comprising:

a control section (5) adapted to control a winding operation of the winding section (4) and a yarn accumulating operation of the yarn accumulating roller (40) of the yarn accumulating device (22); and
a yarn amount detecting section (46, 47) adapted to detect an amount of yarn (y) accumulated in the yarn accumulating device (22), wherein
the control section (5) stops rotation of the yarn accumulating roller (40) and controls the winding operation of the winding section (4) according to a detection result of the yarn amount detecting section (46, 47) when the yarn (y) is cut by the yarn cutting section (31).

FIG. 1

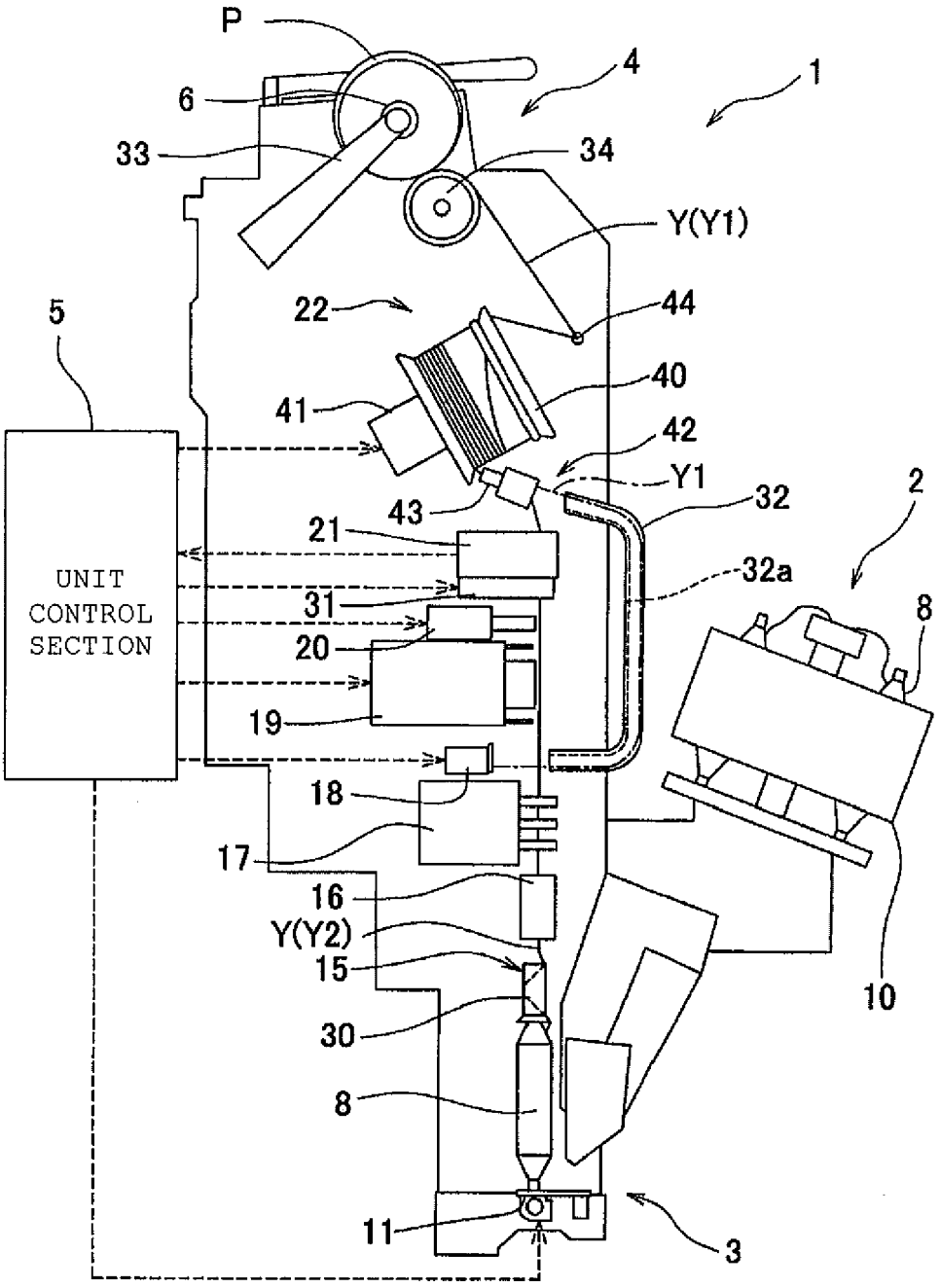

P
6
33
4
1
34
Y(Y1)
5
22
44
40
41
42
Y1
43
32
2
21
32a
UNIT
CONTROL
SECTION
31
8
20
19
18
17
16
Y(Y2)
15
10
30
8
11
3

FIG. 2

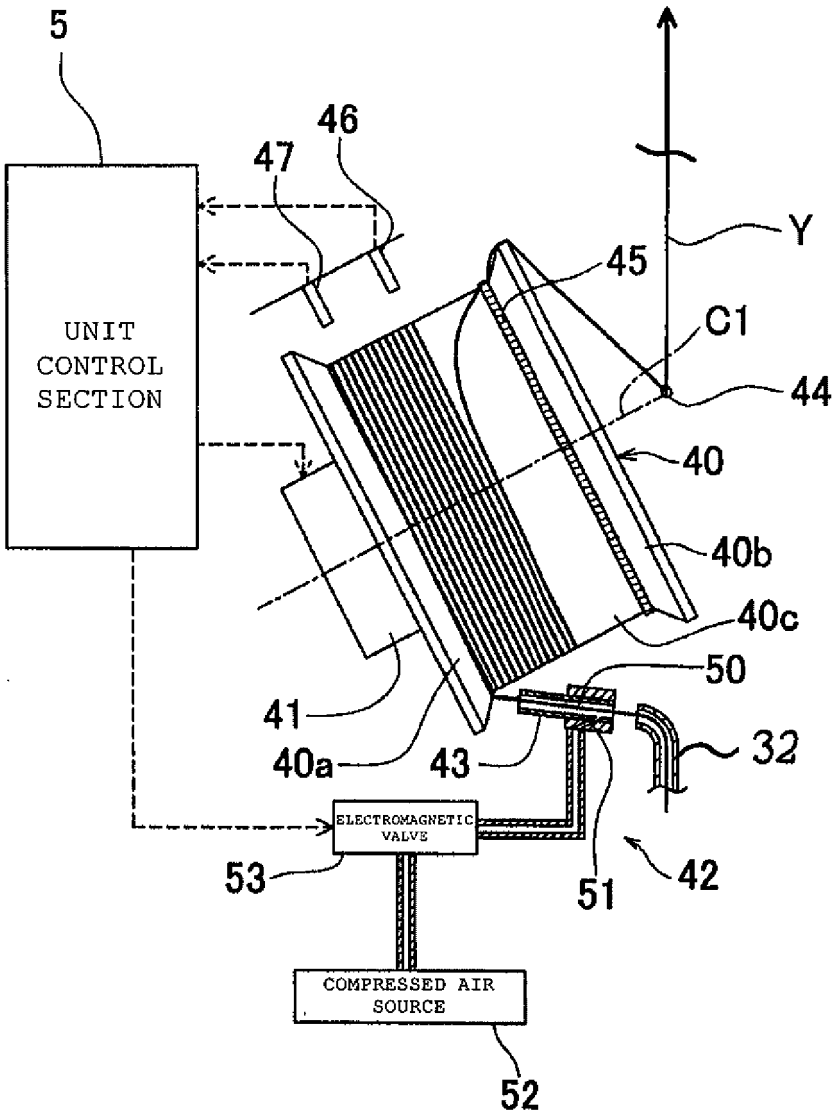

5
46
47
Y
45
C1
UNIT CONTROL SECTION
44
40
40b
40c
50
41
40a
43
32
ELECTROMAGNETIC VALVE
53
51
42
COMPRESSED AIR SOURCE
52

FIG. 3

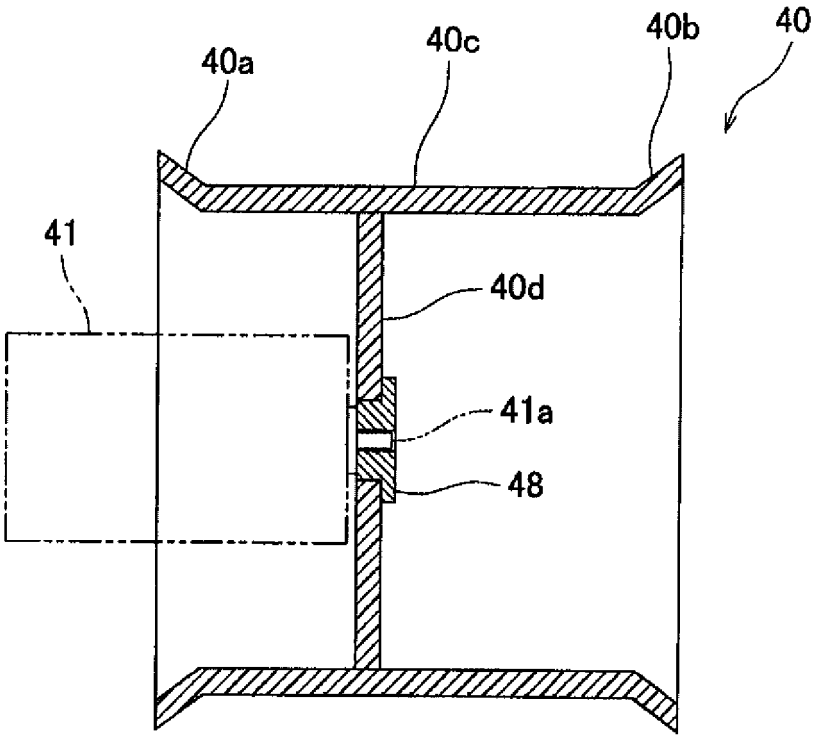


FIG. 4

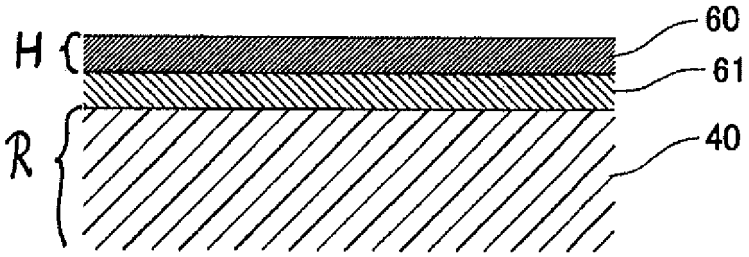
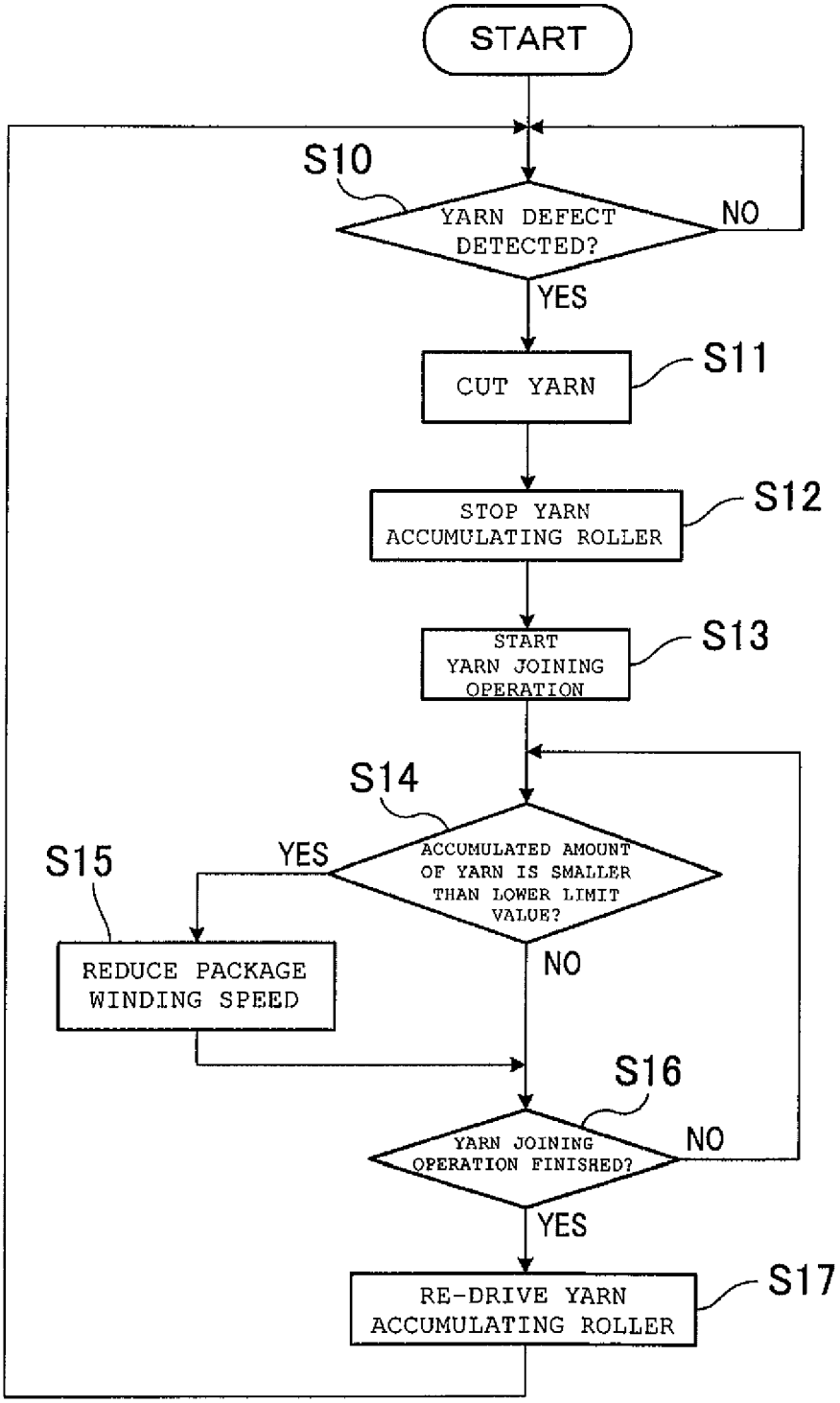


FIG. 5


START
S10
YARN DEFECT DETECTED?
NO
YES
CUT YARN
S11
STOP YARN ACCUMULATING ROLLER
S12
START YARN JOINING OPERATION
S13
S14
ACCUMULATED AMOUNT OF YARN IS SMALLER THAN LOWER LIMIT VALUE?
YES
S15
REDUCE PACKAGE WINDING SPEED
NO
S16
YARN JOINING OPERATION FINISHED?
NO
YES
RE-DRIVE YARN ACCUMULATING ROLLER
S17

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2011040545 A **[0002] [0004]**